

# Wildlife and Fisheries Science

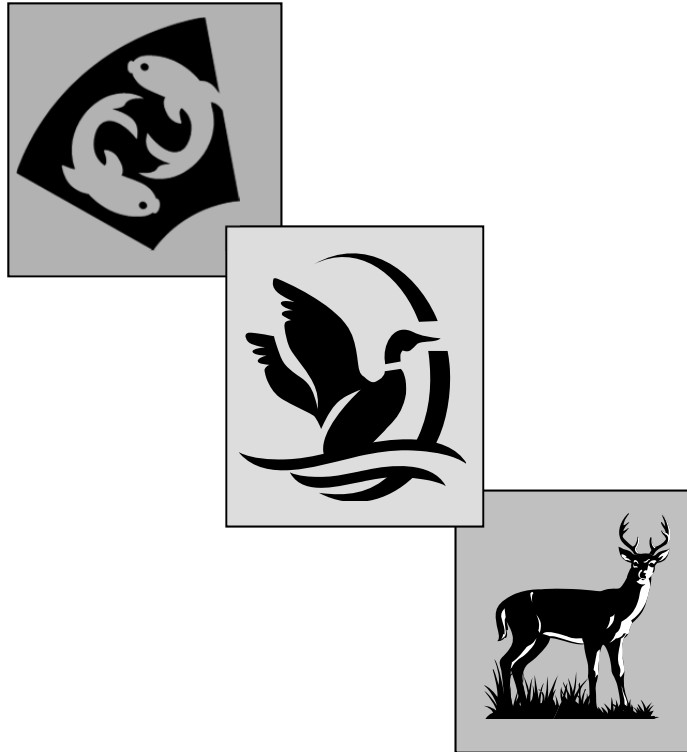
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## 2017-18 Student Handbook

Ecosystem Science and Management

College of Agricultural Sciences

The Pennsylvania State University



<http://ecosystems.psu.edu/>

September 2017

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## **Ecosystem Science and Management Department**

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The Ecosystem Science and Management Department is an academic unit in the College of Agricultural Sciences at Penn State. Our mission is to provide educational opportunities and science-based information to protect, manage, and use natural resources for sustained benefits. This is accomplished through educational, research, and outreach programs in forestry, wildlife and fisheries, soils, water, and related areas.

The Ecosystem Science and Management Department offers two associate in science (A.S.) degree programs: Forest Technology (at Penn State Mont Alto) and Wildlife Technology (at Penn State DuBois); and two bachelor of science (B.S.) degree programs: Forest Ecosystem Management and Wildlife and Fisheries Science. A minor in each of these two areas is also offered as is a minor in Environmental Soil Science. In addition, we offer graduate programs at both the master's and doctoral levels. We are committed to quality teaching.

Information about our academic programs, scholarships, student activities and professional societies, faculty, and facilities is available on our website: <http://ecosystems.psu.edu>.

Follow us on Facebook ([facebook.com/PSUecosystems](https://www.facebook.com/PSUecosystems)) and Twitter ([twitter.com/PSUecosystems](https://twitter.com/PSUecosystems)).

## **Undergraduate Programs Office**

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The Ecosystem Science and Management Undergraduate Programs Office is housed in 113 Forest Resources Building at Penn State University Park; phone (814) 865-4237. Ms. Ellen Manno is the undergraduate program coordinator, Ms. Dana Grove is the staff assistant, and Dr. Paola Ferreri is our department's representative on the College of Agricultural Sciences Instruction and Curricular Affairs committee.

Each student in the Ecosystem Science and Management Department is assigned an academic adviser. For students at the University Park campus, advising assignments are made by the Ecosystem Science and Management Undergraduate Programs Office.

Any student enrolled in or thinking about enrolling in a major in the Ecosystem Science and Management Department, regardless of campus location, is encouraged to contact the Ecosystem Science and Management Undergraduate Programs Office.

Undergraduate Programs Office  
Ecosystem Science and Management  
The Pennsylvania State University  
113 Forest Resources Building  
University Park, PA 16802-4301  
*phone* (814) 865-4237  
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## Wildlife and Fisheries Science Undergraduate Program

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### Introduction

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The major in Wildlife and Fisheries Science is designed for students interested primarily in conservation and management of wildlife and fish species and their habitats. The major provides a broad background in quantification, arts and humanities, physical and biological sciences, and natural resource management. Flexibility in course selection permits students to plan their programs in keeping with their specific interests, goals, and plans for the future. Graduates may pursue graduate-level training in the wildlife and fisheries sciences or careers in management, research, or information and education. The curriculum provides a firm base for graduate study and the opportunity to meet standards established by The Wildlife Society, The American Fisheries Society, and the federal Office of Personnel Management for employment in wildlife and fisheries biology.

Wildlife and fisheries scientists find employment as natural resource biologists, habitat managers, fish or wildlife technicians, conservation officers, environmental educators, research scientists, teachers, and administrators. Students seeking a career as a wildlife or fisheries biologist often pursue a master's degree. Graduates with a bachelor's degree are generally competitive for technician-level jobs in fisheries and wildlife with federal, state, and county agencies, environmental interpretation positions, and private sector jobs (e.g., environmental consultants, animal damage control, etc.).

Bachelor of Science graduates generally find jobs with state and federal agencies or with private firms. Federal agencies that employ wildlife and fisheries biologists include the U.S. Fish and Wildlife Service, Forest Service, National Park Service, Geological Survey, Bureau of Land Management, Bureau of Reclamation, Bureau of Indian Affairs, and Environmental Protection Agency. State agencies hire fisheries and wildlife biologists in departments of fish and wildlife, forestry, conservation, and environmental resources. Private firms hire fish and wildlife biologists in the areas of environmental consulting, forest management, animal damage control, and natural resource extraction (e.g., gas, oil, coal, and chemical companies). Nonprofit organizations such as The Nature Conservancy, Audubon Society, Trout Unlimited, Pheasants Forever, Quality Deer Management Association, and Ducks Unlimited also hire biologists and environmental educators.

### Mission

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The mission of the Wildlife and Fisheries Science program is threefold: (1) to provide a challenging and comprehensive curriculum in concepts, principles, and techniques of wildlife and fisheries science and natural resource conservation and management; (2) to educate future wildlife and fisheries professionals; and (3) to increase the awareness of students from all disciplines of the importance of wise stewardship of wildlife, fisheries, and other natural resources.

## Wildlife and Fisheries Science Curriculum Requirements

The bachelor of science (B.S.) degree in Wildlife and Fisheries Science requires completion of 120-122 credits. Students enrolled in the B.S. program in Wildlife and Fisheries Science choose one of two options: (1) Wildlife option – 120 credits, and (2) Fisheries option – 122 credits. This specialization is designed to prepare students to enter professional employment or graduate studies.

### **Courses Required for BOTH Options:**

(Individual course credits are given in parentheses)

Penn State General Education Requirement Designations:

|                                    |                                     |
|------------------------------------|-------------------------------------|
| GWS – Writing/Speaking             | GH – Humanities                     |
| GQ – Quantification                | GS – Social and Behavioral Sciences |
| GHA – Health and Physical Activity | IL – International Cultures         |
| GN – Natural Sciences              | US – United States Cultures         |
| GA – Arts                          |                                     |

### COMMUNICATIONS

- ENGL 15 GWS – Rhetoric and Composition (3)
- ENGL 202C GWS – Effective Writing: Technical Writing (3)
- CAS 100 GWS – Effective Speech (3)
- AEE 440 – Communications Methods and Media (3), CAS 211 - Informative, Technical, and Presentational Speaking (3), ENGL 416 - Science Writing (3), or ENGL 418 - Advanced Technical Writing and Editing (3).

[Note: Also acceptable are AEE 330W – Communication in Ag and Natural Resources Careers, CAS 213 – Persuasive Speaking, CAS 250 – Small Group Communication, and RPTM 325 – Principles of Environmental Interpretation.]

### QUANTIFICATION

- MATH 110 or 140 GQ – Techniques of Calculus I (4) \*
- MATH 111 or 141 GQ – Techniques of Calculus II (2-4)
- STAT 240 – Introduction to Biometry (3), or STAT 301 – Statistical Analysis I (3)  
[Note: Also acceptable are STAT 200 – Elementary Statistics, and STAT 250 – Introduction to Biostatistics.]
- FOR 350 – Forest Resources Biometrics (3), or STAT 460 – Intermediate Applied Statistics

### NATURAL SCIENCES and OTHER PRESCRIBED COURSES

- WFS 209 GN – Wildlife and Fisheries Conservation (3) \*
- WFS 300 – The Vertebrates (2) \*▲
- WFS 301 – Vertebrate Lab (2) \*
- WFS 310 – Wildlife and Fisheries Measurements (3) \*
- WFS 446 – Wildlife and Fisheries Population Dynamics (3)
- BIOL 110 GN – Biology: Basic Concepts and Biodiversity (4)
- BIOL 220W GN – Biology: Populations and Communities (4) \*
- BIOL 133 – Genetics and Evolution of the Human Species, or BIOL 222 – Genetics, or BIOL 230W GN – Biology: Molecules and Cells, or ANSC 322 – Principles of Animal Breeding (3-4)
- BIOL 240W GN – Biology: Function and Development of Organisms (4)

- CHEM 110 GN – Chemical Principles (3)
- CHEM 111 GN – Experimental Chemistry (1)
- CHEM 202 – Organic Chemistry (3)
- PHYS 250 GN – Introductory Physics I (4)\*\*
- SOILS 101 – Introduction to Soils (3)

\*Indicates a course requiring at least a C grade.

\*\*PHYS 250 requires “MATH 22 and MATH 26; or MATH 40; or MATH 41” as prerequisites. Students who have placed into MATH 140 have met the “MATH 22 and MATH 26” prerequisite. Students who have placed into or completed the prerequisites for MATH 110, should take MATH 26 (Trigonometry) before taking PHYS 250.

▲ Effective Fall 2015, WFS 300 is no longer offered. WFS students must select a 400-level course (for two or more credits) that is not otherwise required, with the exception of WFS 495 and WFS 496. A ‘C’ or better grade is required.

#### ARTS (6 credits)

- Selections from the University-approved Arts list [GA] (6)

#### HUMANITIES (6 credits)

- Selections from the University-approved Humanities list [GH] (6)

#### SOCIAL AND BEHAVIORAL SCIENCES (6 credits)

- ECON 104 GS – Introductory Macroeconomic Analysis (3)
- Selection from the University-approved Social and Behavioral Sciences list [GS] (3)

#### HEALTH SCIENCE AND PHYSICAL EDUCATION (3 credits)

- Selection(s) from the University-approved Health Sciences and Physical Education list [GHA](3)

#### ELECTIVES (3-9 credits)

- Selection(s) of choice, excluding remedial courses

#### UNITED STATES CULTURES AND INTERNATIONAL CULTURES (6 credits)

- Must select 3 credits of University-approved United States Cultures (US) and 3 credits of University-approved International Cultures (IL). This requirement can be satisfied in combination with requirements in Arts (GA), Humanities (GH), or Social and Behavioral Sciences (GS).

#### FIRST-YEAR SEMINAR (minimum 1 credit)

- Must select a minimum of 1 credit of First-Year Seminar.

#### WRITING-INTENSIVE COURSE (3 credits)

- Must select 3 credits of writing-intensive (W) course work in your major or college of enrollment. Writing-intensive requirement is satisfied by completion of WFS 463W in the Fisheries option or WFS 447W in the Wildlife option.

Note: Acceptable selections for Arts, Humanities, Social and Behavioral Sciences, United States Cultures, International Cultures, Health Sciences and Physical Education, and First-Year Seminar are listed on the Web at [http://bulletins.psu.edu/bulletins/bluebook/general\\_education.cfm](http://bulletins.psu.edu/bulletins/bluebook/general_education.cfm).

**Also required for BOTH options:**

**NATURAL RESOURCE POLICY, PLANNING, LAW, ADMINISTRATION (PPLA) and HUMAN DIMENSIONS (HD)**

Choose 6 credits from the following list:

- BLAW/REST 425\* – Environmental Law, Property, and Commerce (3)
- EMSC 101 – Resource Wars (3)
- ERM 411\* – Legal Aspects of Resource Management (3)
- FOR 410 – Forest Ecosystem Management (3)
- FOR 450W – Human Dimensions of Natural Resources (3)
- FOR 480 – Policy and Administration (3)
- GEOG 1 – Global Parks and Sustainability (3)
- GEOG 130 – Environment, Power, and Justice (3)
- GEOG 430\* - Human Use of Environment (3)
- GEOG 431 – Geography of Water Resources (3)
- RPTM 120 – Leisure and Human Behavior (3)
- RPTM 320 – Recreation Resource Planning and Management (3)
- RSOC/STS 327 – Society and Natural Resources (3)
- SOC/STS 47 – Wilderness, Technology, and Society
- SOILS 71 – Environmental Sustainability (3)
- SOILS 422 – Natural Resources Conservation and Community Sustainability (3)
- STS/PLSC 135 – The Politics of the Ecological Crisis (3)
- STS 201 – Climate Change, Energy, and Biodiversity (3)
- WFS 461 – Animal Welfare (3)
- WFS 497 – Natural History Collections and Techniques (3)

*\* denotes course has prerequisites not included in the WFS program*

## ADDITIONAL COURSES REQUIRED FOR THE FISHERIES OPTION

- WFS 410 – General Fishery Science (3); Fall
- WFS 452 – Ichthyology (2); Fall
- WFS 453 – Ichthyology Lab (2); Fall
- WFS 463W – Fishery Management (3); Spring
- Fisheries and Aquatic Science Selection (*choose 3 credits from the following list*):
  - WFS 422 – Ecology of Fishes (3); Fall, odd years
  - FOR 470 – Watershed Management (3); Spring
  - WFS/ERM 435 – Limnology (3); Fall
  - ENT 425 – Freshwater Entomology (3); Fall, even years
- Physical Science Selection (*choose 3 credits from the following list*):
  - GEOC 303 – Introduction to Environmental Geology (3); Fall and Spring
  - GEOC 340\* – Geomorphology (3); Fall
  - GEOC 412\* – Water Resources Geochemistry (3); Fall
  - GEOC 440 – Marine Geology (3); Spring
  - GEOC 452\* – Introduction to Hydrogeology (3); Fall
  - GEOG 160 – Mapping Our Changing World (3); Fall and Spring
  - GEOG 363\* – Geographic Information Systems (3); Fall and Spring
- Physiology Selection (*choose 3-4 credits from the following list*):
  - BIOL 141 and 142 – Physiology and Lab (4); BIOL 141, Fall and Spring; BIOL 142, Fall
  - BIOL 446 – Physiological Ecology (3); Spring, even years
  - ANSC 201 – Animal Science (4); Fall and Spring
- Wildlife Selection (*choose 3 credits from the following list*):
  - WFS 407 – Ornithology (3); Spring
  - WFS 408 – Mammalogy (3); Spring
  - WFS 447W – Wildlife Management (3); Fall
  - WFS 460 – Wildlife Behavior (3); Fall
  - WFS 462 – Amphibians and Reptiles (3); Fall

\* denotes course has prerequisites not included in the WFS program



## ADDITIONAL COURSES REQUIRED FOR THE WILDLIFE OPTION

- FOR 203 – Field Dendrology (3)
- WFS 407 – Ornithology (3)
- WFS 408 – Mammalogy (3)
- WFS 447W – Wildlife Management (3)
- WFS 406 – Ornithology Lab (2), or WFS 409 – Mammalogy Lab (2)
- Fisheries Selection (*Choose 2 – 3 credits from the following list*):
  - WFS 410 – General Fishery Science (3); Fall
  - WFS 422 – Ecology of Fishes (3); Fall, even years
  - WFS 452 – Ichthyology (2); Fall
  - WFS 453 – Ichthyology Lab (2); Fall
  - WFS 463 – Fishery Management (3); Spring
- Botany Selection (*choose 3 credits from the following list*):
  - \*BIOL 127 – Introduction to Plant Biology (3)
  - BIOL 414 – Taxonomy of Seed Plants (3)
  - BIOL 441 – Plant Physiology (3)
  - FOR 303 – Herbaceous Forest Plant Identification and Ecology (3); Spring
  - FOR 308 – Forest Ecology (3); Fall
  - FOR 403 – Invasive Forest Plants: Identification, Ecology, and Management (3); Spring
  - HORT 101 – Horticultural Science (3); Fall and Spring
  - HORT 138 – Ornamental Plants - shrubs (3); Fall
  - HORT 445 – Plant Ecology (3); Fall

\*Students who have passed BIOL 240W may not schedule this course.

## Recommended Academic Plans for Wildlife and Fisheries Science

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*(These notes apply to the plans on pages 9 – 12.)*

- **Bold** type indicates courses requiring a quality grade of C or better.
- *Italics* indicate courses that satisfy both major and General Education requirements.
- ***Bold Italics*** indicates courses requiring a quality grade of C or better and that satisfy both major and General Education requirements.
- GWS, GHA, GQ, GN, GA, GH, and GS are codes used to identify General Education requirements.
- US and IL are codes used to designate courses that satisfy United States/International Cultures requirements.
- W is the code used to designate courses that satisfy Writing Across the Curriculum requirements.

### **Program Notes:**

All course “selections” are listed elsewhere in this handbook, which is also available on our website (<http://ecosystems.psu.edu/>) under the “Student Resources” tab. Many classes are offered only once per year – in the fall or in the spring.

### **Academic Advising Notes:**

US and IL cultures may be “double-counted” with Electives or General Education course selections.

STAT 200 and STAT 250 are acceptable alternatives to STAT 240 or 301.

PHYS 250 requires “MATH 22 and MATH 26; or MATH 40; or MATH 41” as prerequisites. Students who have placed into MATH 140 have met the “MATH 22 and MATH 26” prerequisite. Students who have placed into or completed the prerequisites for MATH 110, should take MATH 26 (Trigonometry) before taking PHYS 250.

Students should monitor their academic progress by checking their degree audits on LionPATH. Questions about degree audits should be directed to academic advisers or to the Undergraduate Programs Office.

### **Course Scheduling Tips:**

All Wildlife and Fisheries Science students should change their campus location to University Park by the start of their junior year (fifth semester).

When a required course has both a lecture and practicum portion, such as PHYS 250L and PHYS 250R, students are required to take both portions.

Acceptable selections for Arts, Humanities, Social and Behavioral Sciences, United States and International Cultures, Health Sciences and Physical Education, and First-Year Seminar are listed on the Web at [http://bulletins.psu.edu/bulletins/bluebook/general\\_education.cfm](http://bulletins.psu.edu/bulletins/bluebook/general_education.cfm).

Please contact Ellen Manno with any scheduling questions ([exr2@psu.edu](mailto:exr2@psu.edu) or 814-863-0362).

Recommended Academic Plan for Wildlife and Fisheries Science –  
 Fisheries option starting at University Park, Effective Summer 2008

| Semester 1 (fall)   | Credits | Semester 2 (spring)                                  | Credits |
|---|---------|--|---------|
| <a href="#">BIOL 110</a> (GN)   | 4       | <a href="#">BIOL 220W</a> (GN) <sup>▲</sup>          | 4       |
| <a href="#">MATH 110</a> or <a href="#">140</a> (GQ)  | 4       | <a href="#">MATH 111</a> or <a href="#">141</a> (GQ) | 2-4     |
| <a href="#">ENGL 15</a> or <a href="#">30</a> (GWS)   | 3       | <a href="#">CHEM 110</a> (GN)                        | 3       |
| Humanities (GH)   | 3       | <a href="#">CHEM 111</a> (GN)                        | 1       |
| <a href="#">First-Year Seminar</a>  | 1-3     | <a href="#">Arts</a> (GA)                            | 3       |
|   |         | Social and Behavioral Science (GS)                   | 3       |
| Total Credits:  | 15-17   | Total Credits:                                       | 16-18   |
| Semester 3  | Credits | Semester 4   | Credits |
| <a href="#">BIOL 141</a> & <a href="#">142</a> , or <a href="#">BIOL 446</a> , or AN SC 201         | 3-4     | <a href="#">PHYS 250</a>                             | 4       |
| <a href="#">CHEM 202</a>  | 3       | <a href="#">BIOL 240W</a>                            | 4       |
| <a href="#">BIOL 133</a> , <a href="#">222</a> , <a href="#">230W</a> , or <a href="#">ANSC 322</a> | 3-4     | <a href="#">SOILS 101</a>                            | 3       |
| <a href="#">WFS 209</a> (GN)  | 3       | <a href="#">CAS 100</a> (GWS)                        | 3       |
| <a href="#">STAT 240</a> or <a href="#">301</a> (GQ)  | 3       | Humanities (GH)                                      | 3       |
| Total Credits:  | 15-17   | Total Credits:                                       | 17      |
| Semester 5  | Credits | Semester 6   | Credits |
| <a href="#">WFS 300</a>   | 2       | <a href="#">FOR 350</a> or <a href="#">STAT 460</a>  | 3       |
| <a href="#">WFS 301</a>   | 2       | Fisheries and Aquatic Sci. selection                 | 3       |
| <a href="#">WFS 310</a>   | 3       | Wildlife selection                                   | 3       |
| <a href="#">WFS 452</a>   | 2       | <a href="#">ECON 104</a>                             | 3       |
| PPLA/HD selection   | 3       | PPLA/HD selection                                    | 3       |
| Elective  | 0-4     |  |         |
| Total Credits:  | 12-16   | Total Credits:                                       | 15      |
| Semester 7  | Credits | Semester 8   | Credits |
| <a href="#">WFS 410</a>   | 3       | <a href="#">WFS 463W</a>                             | 3       |
| <a href="#">WFS 453</a>   | 2       | <a href="#">WFS 446</a>                              | 3       |
| <a href="#">ENGL 202C</a> (GWS)   | 3       | <a href="#">Arts</a> (GA)                            | 3       |
| <a href="#">AEE 440</a> , <a href="#">CAS 211</a> , <a href="#">ENGL 416</a> or <a href="#">418</a> | 3       | Elective   | 3       |
| <a href="#">Health and Physical Activity</a> (GHA)  | 1.5     | <a href="#">Health and Physical Activity</a> (GHA)   | 1.5     |
| Physical science selection  | 3       |  |         |
| Total Credits:  | 15.5    | Total Credits:                                       | 13.5    |

▲ Effective fall 2018, BIOL 220W will be a fall-only course at University Park.

Recommended Academic Plan for Wildlife and Fisheries Science –  
 Fisheries option starting at Commonwealth Campuses, Effective Summer 2008

| Semester 1 (fall)   | Credits | Semester 2 (spring)                                  | Credits   |
|---|---------|--|-----------|
| <a href="#">BIOL 110</a> (GN)   | 4       | <a href="#">BIOL 220W</a> (GN)                       | 4         |
| <a href="#">MATH 110</a> or <a href="#">140</a> (GQ)  | 4       | <a href="#">MATH 111</a> or <a href="#">141</a> (GQ) | 2-4       |
| <a href="#">ENGL 15</a> or <a href="#">30</a> (GWS)   | 3       | <a href="#">CHEM 110</a> (GN)                        | 3         |
| <a href="#">Arts</a> (GA)   | 3       | <a href="#">CHEM 111</a> (GN)                        | 1         |
| <a href="#">First-Year Seminar</a>  | 1-3     | <a href="#">Health and Physical Activity</a> (GHA)   | 1.5       |
|   |         | <a href="#">Social and Behavioral Sciences</a> (GS)  | 3         |
| Total Credits:  | 15-17   | Total Credits:                                       | 14.5-16.5 |
| Semester 3  | Credits | Semester 4   | Credits   |
| <a href="#">BIOL 141</a> and <a href="#">142</a> , or <a href="#">BIOL 446</a> , or AN SC 201       | 3-4     | <a href="#">PHYS 250</a>                             | 4         |
| <a href="#">CHEM 202</a>  | 3       | <a href="#">BIOL 240W</a>                            | 4         |
| <a href="#">BIOL 133</a> , <a href="#">222</a> , <a href="#">230W</a> , or <a href="#">ANSC 322</a> | 3-4     | <a href="#">ENGL 202C</a> (GWS)                      | 3         |
| <a href="#">CAS 100</a> (GWS)   | 3       | <a href="#">Humanities</a> (GH)                      | 3         |
| <a href="#">STAT 240</a> or <a href="#">301</a> (GQ)  | 3       | <a href="#">ECON 104</a> (GS)                        | 3         |
| Total Credits:  | 15-17   | Total Credits:                                       | 17        |
| Semester 5  | Credits | Semester 6   | Credits   |
| <a href="#">WFS 209</a> (GN)  | 3       | <a href="#">FOR 350</a> or <a href="#">STAT 460</a>  | 3         |
| <a href="#">WFS 300</a>   | 2       | Fisheries and Aquatic Science selection              | 3         |
| <a href="#">WFS 301</a>   | 2       | <a href="#">SOILS 101</a>                            | 3         |
| <a href="#">WFS 310</a>   | 3       | PPLA/HD selection                                    | 3         |
| <a href="#">WFS 452</a>   | 2       | Elective   | 0-4       |
| <a href="#">Humanities</a> (GH)   | 3       |  |           |
| Total Credits:  | 15      | Total Credits:                                       | 12-16     |
| Semester 7  | Credits | Semester 8   | Credits   |
| <a href="#">WFS 410</a>   | 3       | <a href="#">WFS 463W</a>                             | 3         |
| <a href="#">WFS 453</a>   | 2       | <a href="#">WFS 446</a>                              | 3         |
| <a href="#">Arts</a> (GA)   | 3       | Elective   | 3         |
| <a href="#">AEE 440</a> , <a href="#">CAS 211</a> , <a href="#">ENGL 416</a> or <a href="#">418</a> | 3       | PPLA/HD selection                                    | 3         |
| <a href="#">Health and Physical Activity</a> (GHA)  | 1.5     | Physical science selection                           | 3         |
| Wildlife selection  | 3       |  |           |
| Total Credits:  | 15.5    | Total Credits:                                       | 15        |

Recommended Academic Plan for Wildlife and Fisheries Science –  
Wildlife option starting at University Park, Effective Summer 2008

| Semester 1 (fall)   | Credits | Semester 2 (spring)  | Credits   |
|---|---------|--|-----------|
| <a href="#">BIOL 110</a> (GN)   | 4       | <a href="#">BIOL 220W</a> (GN) <sup>▲</sup>                    | 4         |
| <a href="#">MATH 110</a> or <a href="#">140</a> (GQ)  | 4       | <a href="#">MATH 111</a> or <a href="#">141</a> (GQ)           | 2-4       |
| <a href="#">ENGL 15</a> or <a href="#">30</a> (GWS)   | 3       | <a href="#">CHEM 110</a> (GN)                                  | 3         |
| Arts (GA)   | 3       | <a href="#">CHEM 111</a> (GN)                                  | 1         |
| First-Year Seminar  | 1-3     | <a href="#">Social and Behavioral Sciences</a> (GS)            | 3         |
| Total Credits:  | 15-17   | Total Credits:   | 13-15     |
| Semester 3  | Credits | Semester 4   | Credits   |
| <a href="#">FOR 203</a>   | 3       | <a href="#">PHYS 250</a>                                       | 4         |
| <a href="#">CHEM 202</a>  | 3       | <a href="#">BIOL 240W</a>                                      | 4         |
| <a href="#">BIOL 133</a> , <a href="#">222</a> , <a href="#">230W</a> , or <a href="#">ANSC 322</a> | 3-4     | <a href="#">SOILS 101</a>                                      | 3         |
| <a href="#">WFS 209</a> (GN)  | 3       | <a href="#">CAS 100</a> (GWS)                                  | 3         |
| <a href="#">STAT 240</a> or <a href="#">301</a> (GQ)  | 3       | <a href="#">Humanities</a> (GH)                                | 3         |
| Total Credits:  | 15-16   | Total Credits:   | 17        |
| Semester 5  | Credits | Semester 6   | Credits   |
| <a href="#">WFS 300</a>   | 2       | <a href="#">FOR 350</a> or <a href="#">STAT 460</a>            | 3         |
| <a href="#">WFS 301</a>   | 2       | <a href="#">WFS 406</a> or <a href="#">409</a> (one required)  | 2         |
| <a href="#">WFS 310</a>   | 3       | <a href="#">WFS 407</a> or <a href="#">408</a> (both required) | 3         |
| <a href="#">Humanities</a> (GH)   | 3       | <a href="#">ECON 104</a>                                       | 3         |
| PPLA/HD selection   | 3       | PPLA/HD selection  | 3         |
| Elective  | 3       | <a href="#">Health and Physical Activity</a> (GHA)             | 1.5       |
| Total Credits:  | 16      | Total Credits:   | 15.5      |
| Semester 7  | Credits | Semester 8   | Credits   |
| <a href="#">WFS 447W</a>  | 3       | <a href="#">WFS 407</a> or <a href="#">408</a> (both required) | 3         |
| Fisheries selection   | 2-3     | <a href="#">WFS 446</a>  | 3         |
| <a href="#">ENGL 202C</a> (GWS)   | 3       | Arts (GA)  | 3         |
| <a href="#">AEE 440</a> , <a href="#">CAS 211</a> , <a href="#">ENGL 416</a> or <a href="#">418</a> | 3       | Elective   | 1-5       |
| Botany selection  | 3       | <a href="#">Health and Physical Activity</a> (GHA)             | 1.5       |
| Total Credits:  | 14-15   | Total Credits:   | 11.5-15.5 |

▲ Effective fall 2018, BIOL 220W will be a fall-only course at University Park.

Recommended Academic Plan for Wildlife and Fisheries Science –  
Wildlife option starting at Commonwealth Campuses, Effective Summer 2008

| Semester 1 (fall)   | Credits   | Semester 2 (spring)  | Credits   |
|---|-----------|--|-----------|
| <a href="#">BIOL 110</a> (GN)   | 4         | <a href="#">BIOL 220W</a> (GN)                                 | 4         |
| <a href="#">MATH 110</a> or <a href="#">140</a> (GQ)  | 4         | <a href="#">MATH 111</a> or <a href="#">141</a>                | 2-4       |
| <a href="#">ENGL 15</a> or <a href="#">30</a> (GWS)   | 3         | <a href="#">CHEM 110</a> (GN)                                  | 3         |
| <a href="#">First-Year Seminar</a>  | 1-3       | <a href="#">CHEM 111</a> (GN)                                  | 1         |
| <a href="#">Humanities</a> (GH)   | 3         | <a href="#">Arts</a> (GA)                                      | 3         |
|   |           | <a href="#">Social and Behavioral Sciences</a> (GS)            | 3         |
| Total Credits:  | 15-17     | Total Credits:   | 16-18     |
| Semester 3  | Credits   | Semester 4   | Credits   |
| <a href="#">CHEM 202</a>  | 3         | <a href="#">PHYS 250</a>                                       | 4         |
| <a href="#">BIOL 133</a> , <a href="#">222</a> , <a href="#">230W</a> , or <a href="#">ANSC 322</a> | 3-4       | <a href="#">BIOL 240W</a>                                      | 4         |
| <a href="#">CAS 100</a> (GWS)   | 3         | <a href="#">ECON 104</a>                                       | 3         |
| <a href="#">STAT 240</a> or <a href="#">301</a> (GQ)  | 3         | <a href="#">Humanities</a> (GH)                                | 3         |
| <a href="#">Health and Physical Activity</a> (GHA)  | 1.5       | <a href="#">ENGL 202C</a> (GWS)                                | 3         |
| Total Credits:  | 13.5-14.5 | Total Credits:   | 17        |
| Semester 5  | Credits   | Semester 6   | Credits   |
| <a href="#">WFS 209</a> (GN)  | 3         | <a href="#">FOR 350</a> or <a href="#">STAT 460</a>            | 3         |
| <a href="#">WFS 300</a>   | 2         | <a href="#">WFS 406</a> or <a href="#">409</a> (one required)  | 2         |
| <a href="#">WFS 301</a>   | 2         | <a href="#">WFS 407</a> or <a href="#">408</a> (both required) | 3         |
| <a href="#">WFS 310</a>   | 3         | <a href="#">SOILS 101</a>                                      | 3         |
| <a href="#">FOR 203</a>   | 3         | Elective   | 3         |
| PPLA/HD selection   | 3         |  |           |
| Total Credits:  | 16        | Total Credits:   | 14        |
| Semester 7  | Credits   | Semester 8   | Credits   |
| <a href="#">WFS 447W</a>  | 3         | <a href="#">WFS 407</a> or <a href="#">408</a> (both required) | 3         |
| Fisheries selection   | 2-3       | <a href="#">WFS 446</a>  | 3         |
| <a href="#">Arts</a> (GA)   | 3         | PPLA/HD selection  | 3         |
| <a href="#">AEE 440</a> , <a href="#">CAS 211</a> , <a href="#">ENGL 416</a> or <a href="#">418</a> | 3         | Elective   | 1-5       |
| Botany selection  | 3         | <a href="#">Health and Physical Activity</a> (GHA)             | 1.5       |
| Total Credits:  | 14-15     | Total Credits:   | 11.5-15.5 |



| Student                                      |                                 |         |       | <b>Wildlife and Fisheries Science, Wildlife Option</b><br>Effective Summer 2008, 120 Credits Required<br>The Pennsylvania State University<br>College of Agricultural Sciences<br>Department of Ecosystem Science and Management |  |         |       | Adviser  |                  |              |       |   |  |   |  |  |  |  |  |
|--|---------------------------------|---------|-------|--|--|---------|-------|--|------------------|--------------|-------|---|--|---|--|--|--|--|--|
| Student Number                               |                                 |         |       |  |  |         |       | Gen. Ed. Year                                    |                  | Program Year |       |   |  |   |  |  |  |  |  |
| E-mail Address                               |                                 |         |       |  |  |         |       | Date   |                  |              |       |   |  |   |  |  |  |  |  |
| <b>Requirements for the Major</b>            |                                 |         |       |  |  |         |       | <b>General Education (Effective Summer 2005)</b> |                  |              |       |   |  |   |  |  |  |  |  |
| Sem  | Course                          | Credits | Grade | Sem.   | Course   | Credits | Grade | Sem.   | Course           | Credits      | Grade |   |  |   |  |  |  |  |  |
| Prescribed Courses for the Major (45 cr.)    |                                 |         |       | Supporting Courses for the Option (6 cr.)  |  |         |       | Communication (9 cr. GWS)                        |                  |              |       |   |  |   |  |  |  |  |  |
|  | BIOL 110                        | 4       |       | PPLA/HD – select 6 credits from BLAW/REST 425, EMSC 101, ERM 411, FOR 410, 416, 480, 485, GEOG 130, RPTM 120, 320, or WFS 440.   |  |         |       |  | ENGL 15          | 3            |       |   |  |   |  |  |  |  |  |
|  | BIOL 220W*                      | 4       |       | Prescribed Courses for the Option (12 cr.)   |  |         |       |  | CAS 100A, B or C | 3            |       |   |  |   |  |  |  |  |  |
|  | BIOL 240W                       | 4       |       |  |  |         |       | and ENGL 202C GWS                                |                  |              |       |   |  |   |  |  |  |  |  |
|  | CHEM 110                        | 3       |       |  | FOR 203  | 3       |       | Quantification (6 cr.) MATH GQ and STAT GQ       |                  |              |       |   |  |   |  |  |  |  |  |
|  | CHEM 111                        | 1       |       |  | WFS 407  | 3       |       | Natural Sciences (9 cr.) BIOL GN and CHEM GN     |                  |              |       |   |  |   |  |  |  |  |  |
|  | CHEM 202                        | 3       |       |  | WFS 408  | 3       |       | Arts (6 cr. GA)                                  |                  |              |       |   |  |   |  |  |  |  |  |
|  | ECON 104                        | 3       |       |  | WFS 447W   | 3       |       |  |                  | 3            |       |   |  |   |  |  |  |  |  |
|  | ENGL 202C                       | 3       |       | Additional Courses for the Option (7-8 cr.)  |  |         |       |  |                  | 3            |       |   |  |   |  |  |  |  |  |
|  | PHYS 250                        | 4       |       |  |  |         |       |  | WFS 406 or 409   | 2            |       | Humanities (6 cr. GH)                   |  |   |  |  |  |  |  |
|  | SOILS 101                       | 3       |       |  | WFS 410, 422, 452, 453, or 463W                    | 2-3     |       |  |                  | 3            |       |   |  |   |  |  |  |  |  |
|  | WFS 209*                        | 3       |       |  | BIOL 127, 414, 441, FOR 308, HORT 101, 138, or 445 | 3       |       | Social and Behavioral Sciences (6 cr. GS)        |                  |              |       |   |  |   |  |  |  |  |  |
|  | WFS 300*                        | 2       |       | A minimum cumulative GPA of 2.00 is required for graduation.<br><br>*Courses requiring at least a C grade.   |  |         |       |  |                  |              |       |   |  | 3 |  |  |  |  |  |
|  | WFS 301*                        | 2       |       |  |  |         |       |  |                  |              |       | and ECON 104 GS                         |  |   |  |  |  |  |  |
|  | WFS 310*                        | 3       |       |  |  |         |       |  |                  |              |       | United States Cultures (3 cr. US)*      |  |   |  |  |  |  |  |
|  | WFS 446                         | 3       |       |  |  |         |       |  |                  |              |       | International Cultures (3 cr. IL)*      |  |   |  |  |  |  |  |
| Additional Courses for the Major (18-21 cr.) |                                 |         |       |  |  |         |       |  |                  |              |       | AEE 440, CAS 211, ENGL 416, or ENGL 418 |  |   |  | * May count twice with GA, GH, GS, or Elective |  |  |  |
|  |                                 |         |       |  |  |         |       |  |                  |              |       |   |  |   |  | First-Year Seminar (1-3 cr.)                   |  |  |  |
|  | ANSC 322, BIOL 133, 222 or 230W | 3-4     |       | Electives (4-8 cr.)  |  |         |       | Health and Physical Education (3 cr. GHA.)       |                  |              |       |   |  |   |  |  |  |  |  |
|  | FOR 350 or STAT 460             | 3       |       |  |  |         |       | 6/13   |                  |              |       |   |  |   |  |  |  |  |  |
|  | MATH 110 or 140*                | 4       |       |  |  |         |       |  |                  |              |       |   |  |   |  |  |  |  |  |
|  | MATH 111 or 141                 | 2-4     |       |  |  |         |       |  |                  |              |       |   |  |   |  |  |  |  |  |
|  | STAT 240 or 301                 | 3       |       |  |  |         |       |  |                  |              |       |   |  |   |  |  |  |  |  |



## Technology Resources

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Need help with a course assignment that requires technology? Here are two resources:

- <http://techtutors.psu.edu/>

Tech tutors provide personalized training on Access, Photoshop, Excel, ANGEL, PowerPoint, Visio, Word, Acrobat, Indesign, Sites at Penn State, WikiSpaces, Prezi, and more. Tech Tutors offer **face-to-face** help that's hard to beat!

- <http://lynda.psu.edu/>

Free video tutorials on Illustrator, Dreamweaver, Photoshop, Access, Excel, PowerPoint, and more—all free to Penn State faculty, staff, and currently enrolled students.

## Internships, Independent Study, Undergraduate Research and Work Experience

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Practical work or research experience that supplements a student's course work is a valuable asset when seeking employment after graduation. All Wildlife and Fisheries Science students are encouraged to get related experience through either summer jobs or internships. Academic credit can be awarded for Independent Studies (WFS 496), Undergraduate Research (WFS 494), or Internship work experiences (WFS 495); however, it is not required.

A handbook of guidelines for WFS 495 internships is available in the Ecosystem Science and Management Undergraduate Programs Office, 113 Forest Resources Building. These guidelines must be followed before a student registers for internship credits. Students must have a minimum cumulative 2.0 GPA in order to register for internship credits. The Ecosystem Science and Management Internship Handbook is also available online at: [ecosystems.psu.edu/students/handbooks/internship-handbook/view](http://ecosystems.psu.edu/students/handbooks/internship-handbook/view)

The Ecosystem Science and Management Department maintains an employment webpage to assist students in their search for related experience. This page includes job, internship, and graduate assistantship openings, as well as links to natural resources employers. It is important to remember that this is only one resource and that an effective job search may utilize a variety of sources. The Ecosystem Science and Management employment webpage is: [ecosystems.psu.edu/students/employment/openings](http://ecosystems.psu.edu/students/employment/openings).

Details about Undergraduate Research are posted online at [agsci.psu.edu/students/research](http://agsci.psu.edu/students/research).

## Study Abroad

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### School for Field Studies

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Penn State's College of Agricultural Sciences has established a formal affiliation with The School for Field Studies for study abroad in Costa Rica and in Kenya/Tanzania. For more information, please contact Ketja Lingenfelter, Education Abroad Adviser, Office of International Programs. College of Agricultural Sciences, 122 Agricultural Administration Building, Phone: 814-863-4164; e-mail [ketja@psu.edu](mailto:ketja@psu.edu).

### Office of International Programs

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Staff in the College of Agricultural Sciences Office of International Programs are available to help students find the right program and identify financial support. Learn more at [agsci.psu.edu/international](http://agsci.psu.edu/international).

### Office of Global Programs

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The Penn State University Office of Global Programs also offers help in planning an international experience. Penn State has more than 180 summer, semester, and full-year programs in more than 45 countries! More than 60 of these programs are either specially designed, semester-length programs or are reciprocal exchange programs with an international university. The Office of Global Programs also offers numerous other short-term, faculty-led programs. With all these options, it is possible for students in nearly any discipline to study abroad. A listing of these programs may be found at [global.psu.edu](http://global.psu.edu). In addition, Penn State accepts transfer credits from many other programs.

## The Wildlife Society

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The Wildlife Society (TWS) is an international organization committed to addressing national and international issues that affect the current and future status of wildlife in North America and throughout the world. Founded in 1937, the organization's mission is "To inspire, empower, and enable wildlife professionals to sustain wildlife populations and habitats through science-based management and conservation."

TWS supports the development and advancement of wildlife professionals throughout their careers. Certification constitutes recognition by TWS that, to its best knowledge, a member meets the minimum educational, experience, and ethical standards adopted by the society for professional wildlife biologists.

TWS is the only organization to provide the peer-reviewed wildlife biologist certification process that bestows the title of Associate Wildlife Biologist and Certified Wildlife Biologist.

**Associate Wildlife Biologist®** - An individual who has completed rigorous academic standards and is judged able to represent the profession as an ethical practitioner will be designated as an Associate Wildlife Biologist®. The AWB® certification is granted for 10 years and cannot be renewed. An AWB® certified individual can upgrade to Certified Wildlife Biologist® during the 10 year time period once the necessary experience requirements are obtained.

**Certified Wildlife Biologist®** - An individual with the educational background and demonstrated expertise in the art and science of applying the principles of ecology to the conservation and management of wildlife and its habitats, and is judged able to represent the profession as an

ethical practitioner, will be designated as a Certified Wildlife Biologist®. The CWB® certification is valid for 5 years and may be renewed.

For the most current certification information and application forms visit <http://www.wildlife.org> or contact: The Wildlife Society, 5410 Grosvenor Lane, Bethesda, MD 20814-2197; phone (301) 897-9770.

## Educational Requirements for Certification

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Applicants must have completed a course of study in a college or university leading to a bachelor of science, or bachelor of arts, or equivalent, or higher degree, and should have the following, or equivalent, course work listed below. **All courses must be taken for credit and passed.** Each application for certification is individually reviewed. TWS membership is required for valid certification.

Penn State courses understood to meet these requirements are listed; however, it is important to note that courses are not pre-approved and the acceptability of specific courses to TWS can, and does, change.

1. Biological Sciences: Thirty-six (36) semester hours in biological sciences are required and must include courses in the following subcategories (Note: the sum of hours required in subcategories a-e is 33; the remaining 3 hours may be in any of these five subject areas):

- a. Wildlife Management: Courses emphasizing the principles and practices of wildlife management. **Course descriptions are required.** Courses should focus on understanding and manipulating wildlife habitats and population dynamics, in the context of human objectives and influences. Conservation biology courses count if they contain a specific focus on management and decision making (6 hours).

|  |           |
|--|-----------|
| WFS 447W – Wildlife Management                       | 3         |
| WFS 209 – Wildlife and Fisheries Conservation        | 3         |
| WFS 310 – Wildlife and Fisheries Measurements        | 3         |
| WFS 446 – Wildlife and Fisheries Population Dynamics | 3         |
| <i>Total</i>   | <i>12</i> |

- b. Wildlife Biology: Courses in the biology and behavior of birds, mammals, reptiles, or amphibians. **Course descriptions are required.** Courses should focus on the biology of wildlife species and their habitat relationships as the basis for management, and must include at least one course dealing **solely** with the science of mammalogy, ornithology, and/or herpetology (this course must be taken at a college/university and cannot be substituted by another course or experience). Ichthyology, marine biology (except courses focusing on marine mammals or reptiles), microbiology, entomology, or related courses will not count in this category, but will qualify in the Zoology category (6 hours).

|                       |          |
|-----------------------|----------|
| WFS 407 – Ornithology | 3        |
| WFS 408 – Mammalogy   | 3        |
| <i>Total</i>          | <i>6</i> |

- c. Ecology: Courses in general plant or animal ecology (excludes human ecology). **Course descriptions are required** (3 hours).

|   |          |
|---|----------|
| BIOL 220W – Populations and Communities | 4        |
| <i>Total</i>                            | <i>4</i> |

- d. Zoology: Courses in the taxonomy, biology, behavior, physiology, anatomy, and natural history of vertebrates and invertebrates. **Course descriptions are required**. Courses in genetics, nutrition, physiology, disease, and other biology or general zoology courses are accepted. Credits in general genetics and general biology should be split evenly between Zoology and Botany categories. Ichthyology or fisheries biology courses are accepted (9 hours).

|  |           |
|--|-----------|
| ANSC 322, BIOL 133 or 222 <sup>▲</sup> – Genetics/Breeding | 3         |
| WFS 301 – Vertebrate Laboratory                            | 2         |
| WFS 406 or 409 – Ornithology or<br>Mammalogy Laboratory    | 2         |
| BIOL 110 – Basic Concepts and Biodiversity                 | 2         |
| BIOL 240W – Function and Development Organisms             | 2         |
| <i>Total</i>   | <i>11</i> |

[<sup>▲</sup>Note that credits for BIOL 222, a general genetics course, are to be split evenly between Zoology and Botany categories.]

- e. Botany: Courses in general botany, plant anatomy, plant genetics, plant morphology, plant physiology, or plant taxonomy and other botany courses (9 hours). **Course descriptions are required**. Only one of the following courses – dendrology, silvics, or silviculture - is accepted. At least one course must be primarily concerned with plant taxonomy or identification (this course must be taken at a college/university and cannot be substituted by another course or experience). Credits in general genetics and general biology should be split evenly between the Zoology and Botany categories.

|  |           |
|--|-----------|
| FOR 203 – Dendrology                           | 3         |
| Botany Selection                               | 3         |
| BIOL 110 – Basic Concepts and Biodiversity     | 2         |
| BIOL 240W – Function and Development Organisms | 2         |
| <i>Total</i>                                   | <i>10</i> |

2. Physical Sciences: Nine (9) semester hours in physical sciences such as chemistry, physics, geology, or soils, with at least two disciplines represented.

|                                   |           |
|-----------------------------------|-----------|
| CHEM 110 – Chemical Principles    | 3         |
| CHEM 111 – Experimental Chemistry | 1         |
| CHEM 202 – Organic Chemistry      | 3         |
| PHYS 250 – Introductory Physics   | 4         |
| SOILS 101 – Introduction to Soils | 3         |
| <i>Total</i>                      | <i>14</i> |

3. Quantitative Sciences: Nine (9) semester hours in quantitative sciences that must include:

a. Basic Statistics: A course in basic statistics (3 hours). **Course descriptions are required.**

|  |          |
|--|----------|
| STAT 240 – Introduction to Biometry                        | 3        |
| FOR 350 – Forest Ecosystem Monitoring<br>and Data Analysis | 3        |
| <i>Total</i>   | <i>6</i> |

b. Quantitative Sciences: Courses in calculus, biometry, advanced algebra, systems analysis, mathematical modeling, sampling, computer science, or other quantitative science. **Course descriptions are required.** Elementary algebra, introductory algebra, algebra, introductory GIS, and introductory personal computing courses do not count in this category. (6 hours)

|                               |            |
|-------------------------------|------------|
| MATH 110 or 140 – Calculus I  | 4          |
| MATH 111 or 141 – Calculus II | 2-4        |
| <i>Total</i>                  | <i>6-8</i> |

4. Humanities and Social Sciences: Nine (9) semester hours in humanities and social sciences, such as economics, sociology, psychology, political science, government, history, literature, or foreign language.

|  |           |
|--|-----------|
| GS and GH General Education requirements | 12        |
| <i>Total</i>                             | <i>12</i> |

5. Communications: Twelve (12) semester hours in courses designed to improve communication skills such as English composition, technical writing, journalism, public speaking, or use of mass media. **Course descriptions are required.** A maximum of three (3) semester hours each will be allowed for a completed master's thesis and Ph.D. dissertation. Courses in literature interpretation, foreign languages, classes requiring a term paper, class projects, and seminars in non-communication courses will not count toward this category.

|                                    |           |
|------------------------------------|-----------|
| ENGL 15 – Rhetoric and Composition | 3         |
| ENGL 202C – Technical Writing      | 3         |
| CAS 100 – Effective Speech         | 3         |
| Communications selection           | 3         |
| <i>Total</i>                       | <i>12</i> |

6. Policy, Administration, and Law: Six (6) semester hours in courses that demonstrate significant content or focus on natural resource policy and/or administration, wildlife or environmental law, or natural resource/land use planning will apply; as will courses that document contributions to the understanding of social, political and ethical decisions for wildlife or natural resource management. **Course descriptions are required.** Up to three (3)

semester hours in classes dealing with human dimension issues may count in this category depending on course content. Conservation Biology courses that effectively integrate legal and policy aspects of conservation planning will count toward this category. Courses that are tools supporting professional practice, e.g. Landsat, GIS techniques, or more general courses such as environmental science, resource management, law enforcement, criminology, political science, and introductory survey courses in conservation will not apply.

|   |              |   |
|---|--------------|---|
| Policy, Planning, Law, and Administration (PPLA) and Human Dimensions selections (HD) |              | 6 |
|   | <i>Total</i> | 6 |

## The American Fisheries Society

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The American Fisheries Society (AFS) is the world’s leading association of fisheries professionals and it has established certification criteria. The society’s certification program is fully developed and reputable, providing a meaningful credential for those who meet the certification standards. A board of certified fisheries professionals objectively reviews the qualifications of applicants. Practiced across a broad range of professions, certification programs provide standards and guidelines for professional recognition. While certification is not a license to practice for fisheries professionals as is required of physicians, architects, lawyers, or accountants, it does provide an extra measure of professionalism.

Two levels of certification are available:

### Associate Fisheries Professional (FP-A)

- An applicant who satisfies course work and degree (minimum of B.S. or B.A.) requirements but has insufficient or no experience

### Certified Fisheries Professional (FP-C)

- An applicant who satisfies course work and degree requirements and has a specific number of years of qualifying experience and a specific number of professional development quality points (PDQPs)

Only members of AFS are allowed to apply for certification.

For the most current certification information and application forms visit <http://www.fisheries.org> or contact the American Fisheries Society, 5410 Grosvenor Lane, Bethesda, MD 20814; phone (301) 897-8616.

Penn State courses understood to meet these requirements are listed; however, it is important to note that courses are not pre-approved and the acceptability of specific courses to AFS can, and does, change.

A minimum grade of C is required to receive credit.

## Educational Requirements for Certification

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1. Fisheries and Aquatic Sciences: A minimum of four courses, for a total of 12 credits. Of the four courses, at least two must be directly related to fisheries science and at least one must cover principles of fisheries science and management. The Fisheries and Aquatic Sciences category must include four courses related to understanding or manipulating aquatic ecosystems. Courses such as fisheries science, limnology, oceanography, fisheries management, ichthyology, aquaculture or fish culture, taxonomy of aquatic organisms, and aquatic ecology are acceptable. Courses such as vertebrate biology, wildlife management, ornithology, general ecology, etc. do not belong in this category. The course designated as fulfilling the principles of fisheries science/management requirement must include fisheries population dynamics and habitat assessment and management. It must be an upper division course (i.e. junior, senior, or graduate level), must be at least 3 semester hours. All combined fisheries and wildlife courses, count as if they were 100% fisheries.

|                                   |           |
|-----------------------------------|-----------|
| WFS 410 – General Fishery Science | 3         |
| WFS 422 – Ecology of Fishes       | 3         |
| WFS 452 – Ichthyology             | 2         |
| WFS 453 – Ichthyology Lab         | 2         |
| WFS 463W – Fishery Management     | 3         |
| <i>Total</i>                      | <i>13</i> |

2. Other Biological Sciences: That, when added to the preceding courses, total to thirty (30) semester hours.

|   |           |
|---|-----------|
| BIOL 110 – Basic Concepts and Biodiversity  | 4         |
| BIOL 220W – Populations and Communities     | 4         |
| BIOL 240W – Function and Develop. Organisms | 4         |
| BIOL 133 or 222 – Genetics                  | 3         |
| Physiology Selection                        | 3         |
| <i>Total</i>                                | <i>18</i> |

3. Physical Sciences: Fifteen (15) semester hours. Includes chemistry, physics, soils, geology, hydrology, earth science, astronomy, and meteorology.

|                                   |           |
|-----------------------------------|-----------|
| CHEM 110 – Chemical Principles    | 3         |
| CHEM 111 – Experimental Chemistry | 1         |
| CHEM 202 – Organic Chemistry      | 3         |
| PHYS 250 – Introductory Physics   | 4         |
| SOILS 101 – Introduction to Soils | 3         |
| Physical Science Selection        | 3         |
| <i>Total</i>                      | <i>17</i> |

4. Mathematics and Statistics: Six (6) semester hours, including one (1) calculus and one (1) statistics course or two (2) statistics courses.

|                              |   |
|------------------------------|---|
| MATH 110 or 140 – Calculus I | 4 |
|------------------------------|---|

|                                      |              |
|--------------------------------------|--------------|
| MATH 111 or 141 – Calculus II        | 2-4          |
| STAT 240 – Introduction to Biometry  | 3            |
| FOR 350 – Forest Resource Biometrics | 3            |
| <i>Total</i>                         | <i>12-14</i> |

5. Communications: Nine (9) semester hours. The Communications category includes courses such as composition, technical writing, and verbal communication. Literature, foreign language, other humanities courses, and seminars do not count. Communications-intensive courses are defined as courses whose primary subject matter is not communications but which have intensive communications requirements and are officially designated as such by the university. "Officially designated" means that the university has a formal listing of courses as "communications intensive" or a similar title, and that certain criteria have been met by those courses to receive such designation. Officially designated communications-intensive courses, credited in this category, may also be counted in another category. For example, if a fisheries management course is designated as communications intensive, the course may count for full credit in both the Fisheries and Aquatic Science category and the Communications category.

|                                    |           |
|------------------------------------|-----------|
| ENGL 15 – Rhetoric and Composition | 3         |
| ENGL 202C – Technical Writing      | 3         |
| CAS 100 – Effective Speech         | 3         |
| Communications selection           | 3         |
| <i>Total</i>                       | <i>12</i> |

6. Human Dimensions: Six semester hours. Human Dimensions courses deal with social aspects of natural resource science and management. They include courses such as named courses in human dimensions of natural resources and courses in policy, planning, administration, law, ethics, public relations, leadership, conflict resolution, natural resource economics, and others related to natural resource management. Introductory social science courses, such as sociology and psychology, do not qualify. Courses in this group may be doublecounted as fulfilling course requirements in the Fisheries and Aquatic Sciences category but the credit hours must be apportioned between the two categories based on the percentage time devoted to the human dimensions topic.

|  |          |
|--|----------|
| Policy, Planning, Law, and Administration (PPLA)<br>and Human Dimensions selections (HD) | 6        |
| <i>Total</i>   | <i>6</i> |



## Course Descriptions

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AEE 440 COMMUNICATIONS METHODS AND MEDIA (3) Mass media techniques for reporting and promoting extension and related programs, including message preparation, presentation, and strategy development. Prerequisites: 3 credits in communication.

ANSC 201 ANIMAL SCIENCE (4) Scope of animal and poultry science; genetic, physiological, nutritional, and health factors in food production.

ANSC 322 PRINCIPLES OF ANIMAL BREEDING (3) Fundamental principles of genetics as applied to breeding farm animals. Prerequisite: BIOL 110 or BIOL 11 and BIOL 12.

BIOL 110 GN BIOLOGY: BASIC CONCEPTS AND BIODIVERSITY (4) A study of the evolution of the major groups of organisms including the fundamental concepts of biology.

BIOL 127 GN INTRODUCTION TO PLANT BIOLOGY (3) Cellular structure and organization; physiological processes; classification; reproduction and redevelopment; relationship of plant groups. Students who have passed BIOL 240W may not schedule this course.

BIOL 133 GN GENETICS AND EVOLUTION OF THE HUMAN SPECIES (3) Human heredity and evolution, individual and social implications. The course is for non-majors; students who have passed BIOL 222, 230W, BMB 251 or any upper-division biology course may not schedule this course.

BIOL 141 GN INTRODUCTORY PHYSIOLOGY (3) Explanation of the normal structure and function of the animal body, with special emphasis on human body systems. Students who have passed BIOL 472 may not schedule this course.

BIOL 142 PHYSIOLOGY LABORATORY (1) Experiments demonstrating basic physiological principles, with special reference to man. Prerequisite: or concurrent: BIOL 141.

BIOL 220W GN BIOLOGY: POPULATIONS AND COMMUNITIES (4) A study of the structures and functions of organismic interactions from simple populations to complex ecosystems. (BIOL 220W, 230W, and 240W each carry only 1 credit of "writing"; all three courses must be taken to meet the writing requirement.) Prerequisite: BIOL 110.

BIOL 222 GENETICS (3) Variation and heredity in plants and animals, including man; relationships of genetical knowledge to evolution and breeding practices. Prerequisites: 3 credits in biological science.

BIOL 230W GN BIOLOGY: MOLECULES AND CELLS (4) A study of cellular phenomena including molecular genetics and metabolic interactions. (BIOL 220W, 230W, and 240W each carry only 1 credit of "writing"; all three courses must be taken to meet the writing requirement.) Prerequisites: BIOL 110, CHEM 110.

BIOL 240W GN BIOLOGY: FUNCTION AND DEVELOPMENT OF ORGANISMS (4) A study of the development and physiological processes at the organismic level. (BIOL 220W, 230W, and 240W each carry only 1 credit of "writing" all three courses must be taken to meet the writing requirement.) Prerequisites: BIOL 110, CHEM 110.

BIOL 414 TAXONOMY OF SEED PLANTS (3) Basic principles and procedures in the practice of angiosperm systematics. Prerequisites: BIOL 240W.

BIOL 435 ECOLOGY OF LAKES AND STREAMS (3) Physical, chemical, and biological characteristics of freshwater environments, with special emphasis on factors regulating productivity in freshwater ecosystems. Prerequisite: BIOL 220W.

BIOL 441 PLANT PHYSIOLOGY (3) Classical and current concepts in plant constituents, mineral nutrition, water relations, respiration, photosynthesis, photoperiodism, plant hormones, growth, and development. Prerequisite: BIOL 230W, BIOL 240W.

BLAW/RM 425 BUSINESS AND ENVIRONMENTAL REGULATION (3) Examines the interplay between environmental regulation and commercial activities, including property interests. Prerequisite: BLAW 243 or BLAW 341.

CAS 100 GWS EFFECTIVE SPEECH (3) Introduction to speech communication: formal speaking, group discussion, analysis and evaluation of messages. WFS students may take CAS 100A, 100B or 100C.

CED 201 INTRODUCTORY ENVIRONMENTAL AND RESOURCE ECONOMICS (3) Apply principles of economics to analyze environmental protection policies and natural resource use decision. Examine contemporary policy issues. Prerequisite: AGBM 101 or ECON 102.

CED 427W SOCIETY AND NATURAL RESOURCE (3) Analysis of the relationships between societal development and enhancement and natural resources. Prerequisite: RSOC 1 or SOC 1.

CHEM 110 GN CHEMICAL PRINCIPLES (3) Basic concepts and quantitative relations. Students may take only one course for General Education credit from CHEM 110 or CHEM 101. Prerequisite: satisfactory performance on the Math placement tests – i.e., placement beyond the level of MATH 22; or CHEM 101 and MATH 22 or MATH 41.

CHEM 111 GN EXPERIMENTAL CHEMISTRY (1) Introduction to quantitative experimentation in chemistry. Prerequisite or concurrent: CHEM 110 or CHEM 106.

CHEM 202 FUNDAMENTALS OF ORGANIC CHEMISTRY (3) Introduction to organic chemistry, with emphasis on the properties of organic compounds of biochemical importance. Because of duplication of subject matter, students may not receive credit for both CHEM 202 and 210. Prerequisite: CHEM 101 or CHEM 110 or CHEM 106.

ECON 104 GS INTRODUCTORY MACROECONOMIC ANALYSIS AND POLICY (3) National income measurement; aggregate economic models; money and income; policy problems.

EMSC 101 US;IL RESOURCE WARS (3) "Resource Wars" presents an analysis of natural resources and how competition for them shapes national and international cultures and geopolitics.

ENGL 15 GWS RHETORIC AND COMPOSITION (3) Instruction and practice in writing expository prose that shows sensitivity to audience and purpose. Prerequisite: ENGL 004 or satisfactory performance on the English proficiency examination.

ENGL 30 GWS HONORS FRESHMAN COMPOSITION (3) Writing practice for specially qualified and screened students. Students who have passed a special writing test will qualify for this course.

ENGL 202C GWS EFFECTIVE WRITING: TECHNICAL WRITING (3) Writing for students in scientific and technical disciplines. (A student may take only one course for credit from ENGL 202A, 202B, 202C, and 202D. Prerequisite: ENGL 15 or ENGL 30; fourth-semester standing.

ENGL 416. SCIENCE WRITING Prepares scientists and writers to gather, interpret, and present scientific information to the layman with clarity and accuracy. Prerequisite: COMM 260W, ENGL 202C, ENGL 210, ENGL 215, or ENGL 421.

ENGL 418 ADVANCED TECHNICAL WRITING AND EDITING Preparing and editing professional papers for subject specialists and for other interested in careers as writers or editors. Prerequisite: ENGL 202A, ENGL 202B, ENGL 202C, ENGL 202D, or ENGL 215.

ENT 425 FRESHWATER ENTOMOLOGY (3) Collection and identification of insects and other arthropods in freshwater ecosystems; field study of habitats.

ERM 411 LEGAL ASPECTS OF RESOURCE MANAGEMENT (3) Legal systems and lawmaking processes; property rights in land, water, and wildlife resources; jurisdictional problems in planning resource use. Prerequisite: ECON 102 or AGBM 101; and prerequisite or concurrent: ERM 151, CED 152, or EBF 200.

FOR 203 FIELD DENDROLOGY (3) Field identification of native and introduced trees and shrubs.

FOR 303 HERBACEOUS FOREST PLANT IDENTIFICATION AND ECOLOGY (3) Survey of common herbaceous plant taxa occurring within forested habitats in Pennsylvania and eastern North America. Botanical characteristics, ecological interrelations, commercial importance, and field specimen collection methods are covered. Prerequisite: 3 credits in plant or biological sciences.

FOR 308 FOREST ECOLOGY (3) Effect of environment, spacing, and age in trees; forest influences; origin and development of forest communities. Prerequisite or concurrent: FOR 203.

FOR 350 FOREST ECOSYSTEM MONITORING AND DATA ANALYSIS (3) Quantitative approaches for characterization monitoring, and comparison of forest ecosystems. Prerequisite: STAT 200, STAT 240, STAT 250 or equivalent with a C or higher grade.

FOR 403 INVASIVE FOREST PLANTS: IDENTIFICATION, ECOLOGY, AND MANAGEMENT (3). Survey of common nonnative ("exotic") herbs, forbs, shrubs, trees, and vines that invade forested habitats in Pennsylvania and the region. Field identification, life history traits, ecosystem-related challenges and problems, and management options and considerations are reviewed. Prerequisite: 6 credits in plant or biological sciences.

FOR 410 ELEMENTS OF FOREST ECOSYSTEM MANAGEMENT (3) Fundamentals of forest ecosystem management for goods and services. Prerequisite: 3 credits in both ecology and biology.

FOR 450W HUMAN DIMENSIONS OF NATURAL RESOURCES (3) Addresses human needs and desires, from individuals to nations for social, ecological, and economic benefits derived from natural resource decisions. Prerequisite: 6 credits of social and behavioral sciences.

FOR 470 WATERSHED MANAGEMENT (3) Management of wild land watersheds for control of the amount and timing of water yield, water quality, erosion, and sedimentation. Prerequisite: 3 credits in Soils.

FOR 480 POLICY AND ADMINISTRATION (3) Forest resources policy objectives; criteria and goals of society; policy implementation by ownership classes; planning, administration, and evaluation of programs. Prerequisite: 3 credits of social or behavioral science.

GEOG 1 GS;IL GLOBAL PARKS AND SUSTAINABILITY (3) Introduction to U.S. and global protected areas, with a focus on historical and emerging trends in conservation, sustainability, and socio-ecological systems.

GEOG 130 GS ENVIRONMENT, POWER, AND JUSTICE (3) This course explores contemporary themes in human-environment relations through the lens of political ecology.

GEOG 160 GS MAPPING OUR CHANGING WORLD (3) Fundamental concepts of GIS, cartography, remote sensing, and GPS in the context of environmental and social problems.

GEOG 363 GEOGRAPHIC INFORMATION SYSTEMS (3) Principles and use of geographic information; emphasis is on data acquisition and techniques for computer-aided analysis. Prerequisite: GEOG 160.

GEOG 430 HUMAN USE OF ENVIRONMENT (3) The human use of resources and ecosystems and social causes and consequences of environmental degradation in different parts of the world; development of environmental policy and management strategies. Prerequisite: GEOG 10 or GEOG 20, or GEOG 30, or GEOG 040, or GEOG 130 or permission of the program.

GEOG 431 GEOGRAPHY OF WATER RESOURCES (3) Perspectives on water as a resource and hazard for human society; water resource issues in environmental and regional planning. Prerequisite: 6 credits in geography or natural sciences.

GEOG 303 INTRODUCTION TO ENVIRONMENTAL GEOLOGY (3) Origin of earth and earth materials; natural resources, geologic barriers and hazards, and relationships to human use of the environment. (This course includes from one to several field trips for which an additional charge will be made to cover transportation.)

GEOG 340 GEOMORPHOLOGY (3) Physical and chemical processes operating at the earth's surface and their resulting landforms. This course has one or more required field trips for which a fee is charged to the student. Prerequisite: GEOSC 1; fifth-semester standing.

GEOG 412 WATER RESOURCES GEOCHEMISTRY (3) Aqueous geochemistry of silica, alumina, carbonate minerals, and selected metals; organic species in water; isotope geochemistry applied to water. Prerequisite: CHEM 110, CHEM 112.

GEOG 440 MARINE GEOLOGY (3) Chemical and physical processes affecting the topography and sediments of the sea floor. Prerequisite: fourth-semester standing.

GEOG 452 HYDROGEOLOGY (3). Hydrologic cycle: occurrence, movement, quality, and quantity of groundwater; solute transport; quantitative hydrologic methods; role of water in geologic processes. This course has one or more required field trips for which a fee may be charged to the student. Prerequisite: CHEM 112; GEOSC 1, GEOSC 20, GEOSC 71, MATH 140 OR MATH 110.

HORT 101 GN HORTICULTURAL SCIENCE (3) Introduction to horticulture with emphasis on plant domestication, morphology, classification, world food crops, commodities, gardens, propagation, and agrochemicals.

HORT 138 ORNAMENTAL PLANT MATERIALS (3) Identification and description under spring conditions; discussion of cultural and aesthetic aspects of shrubs of value in ornamental plantings.

HORT 445 PLANT ECOLOGY (3) Advanced lectures on plant ecology that stress integration of physiological, population-level, and community-level phenomena, and ecology in agriculture. Prerequisites: BIOL 220W, FOR 308, or HORT 315.

MATH 110 GQ TECHNIQUES OF CALCULUS I (4) Functions, graphs, derivatives, integrals, techniques of differentiation and integration, exponentials, improper integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, and 140B. Prerequisite: MATH 22; MATH 40; MATH 41; or satisfactory performance on the mathematics placement examination.

MATH 111 GQ TECHNIQUES OF CALCULUS II (2) Analytic geometry, partial differentiation, maxima and minima, differential equations. Prerequisite: MATH 110.

MATH 140 GQ CALCULUS WITH ANALYTIC GEOMETRY I (4) Functions, limits; analytic geometry; derivatives, differentials, applications; integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, 140B, and 140H. Prerequisite: MATH 22 and MATH 26 or MATH 26 and satisfactory performance on the mathematics placement examination or MATH 40 or MATH 41 or satisfactory placement on the mathematics placement examination.

MATH 141 GQ CALCULUS WITH ANALYTIC GEOMETRY II (4) Derivatives, integrals, applications; sequences and series; analytic geometry; polar coordinates. Students may take only one course for credit from MATH 141, 141B, and 141H. Prerequisite: MATH 140; MATH 140A; MATH 140B; MATH 140E; MATH 140G; or MATH 140H.

PHYS 250 GN INTRODUCTORY PHYSICS I (4) Selected topics in mechanics, heat, and sound. Prerequisite: MATH 22, MATH 26; or MATH 40; or MATH 41 or satisfactory performance on mathematics proficiency exam. WFS students must take both lecture and practicum.

PLSC 135(STS 135) GS THE POLITICS OF THE ECOLOGICAL CRISIS (3) The political implications of the increasing scarcity of many of the world's resources.

RPTM 120 US/IL LEISURE AND HUMAN BEHAVIOR (3) Leisure from historical and contemporary perspectives, including forces shaping leisure behavior, and relationships among leisure, the environment, and social institutions.

RPTM 320 RECREATION RESOURCE PLANNING AND MANAGEMENT (3) Relationship between leisure behavior and natural environment. Exploration of natural resources that enhance leisure.

SOILS 71 GN;IL ENVIRONMENTAL SUSTAINABILITY (3) An introduction to environmental science exploring sustainable human-environment interactions with examples from environmental soil science.

SOILS 101 INTRODUCTION TO SOILS (3) A study of soil properties and relationships to land use, plant growth, environmental quality, and society.

SOILS 422 NATURAL RESOURCES CONSERVATION AND COMMUNITY SUSTAINABILITY (4) Conservation, land-use, and community (soil, water, air, plants, animals, and humans) impacting quality of life and sense of place. Prerequisite: SOILS 101

STAT 240 GQ INTRODUCTION TO BIOMETRY (3) Statistical analysis, sampling, and experimentation in the agricultural sciences; data collection, descriptive statistics, statistical inference, regression, one factor AOV, probability. Students may take only one course from STAT 200, 220, 240, 250 for credit. Prerequisite: Placement into MATH 21 or higher.

STAT 301 GQ STATISTICAL ANALYSIS I (3) Probability concepts; nature of statistical methods; elementary distribution and sampling theory; fundamental ideas relative to estimation and testing hypotheses. Prerequisite: 3 credits of calculus.

STAT 460 INTERMEDIATE APPLIED STATISTICS (3) Review of hypothesis testing, goodness-of-fit tests, regression, correlation analysis, completely randomized designs, randomized complete block designs, Latin squares. Prerequisite: STAT 200, 240, 250, 301, or 401.

STS 47 WILDERNESS, TECHNOLOGY, AND SOCIETY (3) Impact of developments in science, literature, and art on changing attitudes toward nature; consequences for conservation, preservation, environmental ethics.

STS 201 CLIMATE CHANGE, ENGERGY, AND BIODIVERSITY (3) Studies of global warming, energy options, and biodiversity; their interrelations as sciences and as societal issues.

WFS 209 GN WILDLIFE AND FISHERIES CONSERVATION (3) Survey of current and historical issues in wildlife and fisheries conservation; emphasis on vertebrate biodiversity, habitat management and protection, and populations. Prerequisite: BIOL 110.

WFS 296 INDEPENDENT STUDIES (1-18) Creative projects, including research and design, that are supervised on an individual basis and that fall outside the scope of formal courses.

WFS 300 THE VERTEBRATES (2) Overview of the evolution, systematics, ecology, and behavior of the subphylum vertebrata. Prerequisite: BIOL 110.

WFS 301 VERTEBRATE LABORATORY (2) Overview of the anatomy, identification, collection, and preservation of the vertebrates. Prerequisite: or concurrent: WFS 209, WFS 300.

WFS 310 WILDLIFE AND FISHERIES MEASUREMENTS (3) Introduction to field and laboratory approaches for collecting, analyzing, and communicating data regarding wildlife and fish populations and their habitats. Prerequisite: or concurrent: WFS 209, STAT 240.

WFS 406 ORNITHOLOGY LAB (2) Laboratory and field identification of Pennsylvania birds, avian ecology, and behavior, field survey techniques. Prerequisite: or concurrent: WFS 209, WFS 407.

WFS 407 ORNITHOLOGY (3) Introduction to the biology, ecology, adaptations, and conservation of birds. Prerequisite: BIOL 110, WFS 209.

WFS 408 MAMMALOLOGY (3) Identification, systematics, characteristics, adaptations, ecology, behavior, natural history and conservation, and socio-economic aspects of mammals. Prerequisite: BIOL 110.

WFS 409 MAMMALOLOGY LABORATORY (2) Laboratory and field identification of mammals, ecology and behavior of mammals, field survey techniques. Prerequisite: or concurrent: WFS 209, WFS 408.

WFS 410 GENERAL FISHERY SCIENCE (3) Introduction to the study, management, and uses of fish populations; methods of investigation, culture, and harvest of fishes. Prerequisite: WF S 209 or BIOL 210.

WFS 422 ECOLOGY OF FISHES (3) Role of fishes in aquatic communities and general ecosystems. Environmental factors influencing fish as individuals, populations, and communities. Prerequisite: BIOL 220W or WFS 209.

WFS/FOR 430 CONSERVATION BIOLOGY (3) The application of biological principles to issues in the conservation of biodiversity. Prerequisite: BIOL 220W or FOR 308 or WF S 209.

WFS/ERM 435 LIMNOLOGY (3) Biogeochemistry and natural history of freshwater ecosystems. Prerequisite: BIOL 110, BIOL 220W , CHEM 110.

WFS 440 NATURAL RESOURCES PUBLIC RELATIONS (3) This course prepares students to integrate public relations concepts with principles of natural resources management at the community level. Prerequisite: CAS 100, seventh-semester standing, and 6 credits of WFS, FOR, or RPM.

WFS 446 WILDLIFE AND FISHERIES POPULATION DYNAMICS (3) Concepts and estimation of mammalian, avian, and fish populations; processes of mortality, natality, growth, and regulation. Prerequisite: WFS 209.

WFS 447W WILDLIFE MANAGEMENT (3) Management of renewable wildlife resources by applying ecological concepts, habitat evaluation, and decision-making; writing and editing reports are emphasized. Prerequisite: WFS 209.

WFS/ERM 450 WETLAND CONSERVATION (3) Wetland types, classification, functions and values; hydrology, soils, and plants; introduction to wetland identification and delineation; wetland regulations. Prerequisite: ERM 300 or WFS 209.

WFS 452 ICHTHYOLOGY (2) Study of the structure, taxonomy, systematics, and natural history of freshwater and marine fishes. Prerequisites: BIOL 110, BIOL 240W.

WFS 453 ICHTHYOLOGY LABORATORY (2) Identification of fishes, major fish families, use of keys. Prerequisites: BIOL 110, BIOL 240W. Prerequisite or concurrent: WFS 452.

WFS 454 FIELD ICHTHYOLOGY (2) Introduction to collection and field identification of the fishes of Pennsylvania. Prerequisite: BIOL 110, BIOL 240W.

WFS 460 WILDLIFE BEHAVIOR (3) Scholarly discussion and critique of history, concepts, and application of wildlife behavioral concepts to conservation issues. Prerequisite: at least 6 credits in general wildlife or biology

WFS 461 ANIMAL WELFARE: SCIENCE AND ETHICS (3) Understanding animal welfare and well-being in farmed, wild and captive animals, and the implications for policy legislation and conservation. Prerequisite: BIOL 110 or WFS 209.

WFS 462 AMPHIBIANS AND REPTILES (3) Critique of global evolution and conservation of amphibians and reptiles, focusing on Northeastern U.S. natural history and ecology. Prerequisite: 5<sup>th</sup> semester standing or higher and 6 credits of general biology.

WFS 463W FISHERY MANAGEMENT (3) Management of sport and commercial fisheries, including biological, political, social, and economic factors; regulations and other management techniques. Prerequisite: WFS 209, WFS 300, WFS 301, WFS 310.

WFS 494 UNDERGRADUATE RESEARCH (1-12) Supervised student activities on research projects identified on an individual or small group basis.

WFS 495 WILDLIFE/FISHERIES INTERNSHIP (1-6) Supervised field experience related to the student's major. Prerequisite: approval of proposed assignment by instructor prior to registration.

WFS 496 INDEPENDENT STUDIES (1-18) Creative projects, including research and design, which are supervised on an individual basis and which fall outside the scope of formal courses.

## Ecosystem Science and Management Undergraduate Course Offerings by Semester at University Park

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*These offerings are subject to change as circumstances require*

| Course     | Title (cr.)                      | Fall 2017 | Spring 2018 | Fall 2018 | Spring 2019 | Fall 2019 | Spring 2020 | Fall 2020 | Spring 2021 |
|------------|----------------------------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|-------------|
| FOR 200    | Forest Profession (1)            | X         |             | X         |             | X         |             | X         |             |
| FOR 201    | Global Change and Ecosystems (3) |           |             | X         |             | X         |             | X         |             |
| FOR 203    | Field Dendrology (3)             | X         |             | X         |             | X         |             | X         |             |
| FOR 204    | Dendrology (2)                   |           | X           |           | X           |           | X           |           | X           |
| FOR 228    | Chnsaw in For Mgmt (1)           |           | X           |           | X           |           | X           |           | X           |
| FOR 255    | GPS/GIS Nat Res (3)              | X         | X           | X         | X           | X         | X           | X         | X           |
| FOR 266    | For Res Measurements (4)         |           | X           |           | X           |           | X           |           | X           |
| FOR 303    | Forest Herbs (3)                 |           | X           |           | X           |           | X           |           | X           |
| FOR 308    | Forest Ecology (3)               | X         |             | X         |             | X         |             | X         |             |
| FOR 320    | Forest Fire Mgmt (2)             |           | X           |           | X           |           |             |           | X           |
| FOR 350    | For Monit & Analy (3)            |           | X           |           | X           |           | X           |           | X           |
| FOR 400    | Senior Practicum (2)             |           |             |           |             |           |             |           |             |
| FOR 401    | Urban Forest Mgmt (3)            | X         |             | X         |             | X         |             | X         |             |
| FOR 403    | Invasive Plants (3)              |           | X           |           | X           |           | X           |           | X           |
| FOR 409    | Tree Physiology (2)              |           |             |           | X           |           |             |           | X           |
| FOR 410    | Forest Ecosys Mgmt (3)           |           | X           |           | X           |           | X           |           | X           |
| FOR 418    | Agroforestry (3)                 |           | X           |           |             |           | X           |           |             |
| FOR 421    | Silviculture (3)                 | X         |             | X         |             | X         |             | X         |             |
| FOR 430    | Conservation Biol (3)            | X         |             | X         |             | X         |             | X         |             |
| FOR 439    | Timber Sale Admin (3)            | X         |             | X         |             | X         |             | X         |             |
| FOR 440    | For & Consv Econ (3)             | X         |             | X         |             | X         |             | X         |             |
| FOR 450W   | Hum Dimen Nat Res (3)            |           | X           |           | X           |           | X           |           | X           |
| FOR 455    | Rem Sens & Spa Dat (3)           |           | X           |           | X           |           | X           |           | X           |
| FOR 466W   | For Mgmt & Plan (3)              |           | X           |           | X           |           | X           |           | X           |
| FOR 470    | Watershed Mgmt (3)               |           | X           |           | X           |           | X           |           | X           |
| FOR 471    | Watershed Mgmt Lab (1)           |           | X           |           | X           |           | X           |           | X           |
| FOR 475    | Forest Soils Mgmt (3)            | X         |             | X         |             | X         |             | X         |             |
| FOR 480    | Policy & Adm (3)                 |           | X           |           | X           |           | X           |           | X           |
| FOR 488Y   | Global Forest Cons (3)           |           |             |           | X           |           |             |           | X           |
|            |                                  |           |             |           |             |           |             |           |             |
| SOILS 071  | Env Sustainability (3)           |           | X           |           | X           |           | X           |           | X           |
| SOILS 101  | Intro Soil Science (3)           | X         | X           | X         | X           | X         | X           | X         | X           |
| SOILS 102  | Intro Soil Science Lab (3)       | X         | X           | X         | X           | X         | X           | X         | X           |
| SOILS 401  | Soil Comp/Phy Prop (3)           |           | X           |           | X           |           | X           |           | X           |
| SOILS 402  | Soil Nutr Behav (3)              |           | X           |           | X           |           | X           |           | X           |
| SOILS 403  | Soil Morph Prac (2)              | X         |             | X         |             | X         |             | X         |             |
| SOILS 404  | Urban Soils (3)                  |           | X           |           | X           |           | X           |           | X           |
| SOILS 405  | Hydropedology (3)                | X         |             | X         |             | X         |             | X         |             |
| SOILS 412W | Soil Ecol (3)                    | X         |             | X         |             | X         |             | X         |             |
| SOILS 416  | Soil Gen Class Map (4)           | X         |             | X         |             | X         |             | X         |             |



|           |   |   |   |   |   |   |   |   |   |
|-----------|---|---|---|---|---|---|---|---|---|
| SOILS 418 | Nutr Mgmt Ag Sys (3)                    | X |   | X |   | X |   | X |   |
| SOILS 420 | Soil Remediation (3)                    | X |   | X |   | X |   | X |   |
| SOILS 422 | Natural Res Cons (4)                    |   | X |   | X |   | X |   | X |
| SOILS 450 | Environmental GIS (3)                   | X |   | X |   | X |   | X |   |
| SOILS 489 | Supv Exp Col Tchg (1-3)                 | X | X | X | X | X | X | X | X |
|           |   |   |   |   |   |   |   |   |   |
| WFS 209   | Wild/Fish Conservation (3)              | X | X | X | X | X | X | X | X |
| WFS 300   | The Vertebrates (2)                     |   |   |   |   |   |   |   |   |
| WFS 301   | Vertebrate Laboratory (2)               | X |   | X |   | X |   | X |   |
| WFS 310   | Wildlife and Fisheries Measurements (3) | X |   | X |   | X |   | X |   |
| WFS 406   | Ornithology Lab (2)                     |   | X |   | X |   | X |   | X |
| WFS 407   | Ornithology (3)                         |   | X |   | X |   | X |   | X |
| WFS 408   | Mammalogy (3)                           |   | X |   | X |   | X |   | X |
| WFS 409   | Mammalogy Lab (2)                       |   | X |   | X |   | X |   | X |
| WFS 410   | Fisheries Science (3)                   | X |   | X |   | X |   | X |   |
| WFS 422   | Ecology of Fish (3)                     |   |   | X |   |   |   | X |   |
| WFS 430   | Conservation Biology (3)                |   |   |   |   |   |   |   |   |
| WFS 435   | Limnology (3)                           | X |   | X |   | X |   | X |   |
| WFS 446   | Wildl Fish Pop Dyn (3)                  |   | X |   | X |   | X |   | X |
| WFS 447W  | Wildl Management (3)                    | X |   | X |   | X |   | X |   |
| WFS 450   | Wetland Conservation (3)                | X |   | X |   | X |   | X |   |
| WFS 452   | Ichthyology (2)                         | X |   | X |   | X |   | X |   |
| WFS 453   | Ichthyology Lab (2)                     | X |   | X |   | X |   | X |   |
| WFS 454   | Field Ichthyology (2)                   |   |   | X |   |   |   |   |   |
| WFS 460   | Wildlife Behavior (3)                   | X |   | X |   | X |   | X |   |
| WFS 461   | Animal Welfare: Science and Ethics (3)  | X |   | X |   | X |   | X |   |
| WFS 462   | Amphibians and Reptiles (3)             |   | X |   | X |   | X |   | X |
| WFS 463W  | Fishery Management (3)                  |   | X |   | X |   | X |   | X |

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