

# Aquatic, Watershed, and Earth Resources

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## Undergraduate Advisors:

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**Degrees offered:** Bachelor of Science (BS) in Fisheries and Aquatic Sciences; BS in Watershed and Earth Systems; Master of Science (MS) and Doctor of Philosophy (PhD) in Watershed Science; MS and PhD in Ecology; MS and PhD in Fisheries Biology

**Graduate specializations:** *MS, PhD in Ecology*—Aquatic Ecology; *MS, PhD in Fisheries Biology*—Aquatic Ecology, Conservation Biology, Fisheries Management

## Undergraduate Programs

### Objectives

The Department of Aquatic, Watershed, and Earth Resources (AWER) offers comprehensive educational opportunities for graduate and undergraduate students in hydrology, geomorphology, biogeochemistry, water quality, watershed management, fisheries, aquatic ecology, remote sensing, and geographic modeling. Departmental faculty provide expertise in fisheries, the hydrologic cycle, conservation biology, restoration and management of aquatic and riparian ecosystems, and in the remote sensing and geographic analysis of the earth's landcovers. Graduates of departmental programs become scientists and managers for natural resource agencies, professionals with consulting and nonprofit environmental firms, and teachers and researchers at major universities.

### Requirements

**Departmental Admission Requirements.** Admission requirements for the department are the same as those described for the College of Natural Resources (see pages 115-116).

**Graduation Requirements.** All courses listed as major subject courses must be taken on an *A-B-C-D-F* basis. A grade of *C* or better is required for all AWER courses used to meet the requirements for a major or minor in the department. The grade point average for all courses taught by the College of Natural Resources must be 2.5 or higher.

For information about changes in requirements, course sequence, and scheduling, students should confer with a departmental advisor. The undergraduate program can be readily tailored to individual student needs with the help of a faculty advisor.

**Bachelor of Science in Fisheries and Aquatic Sciences.** Students must meet the course requirements for University Studies, in addition to the following departmental requirements. The first two years of study include courses designed to give the student a sound scientific background, an introduction to the field of natural resources management, and an introduction to aquatic and earth resources. Some of these courses may be used toward the University Studies requirements, as indicated by the University Studies designations listed in parentheses following the course numbers. *Science Foundation* courses (35 credits) include: BIOL 1210, 1220 (BLS); CHEM 1210, 1220 (BPS), 1230, 1240; MATH 1050 (QL), 1100 (QL); NR 2220; PHYX 2110; and STAT 3000 (QI). *Common Departmental Core* courses (19 credits) include: AWER 1020, 3700, 4490, 4500, 4930, 4980; and ENVS 5320. *Fisheries Courses* (19 credits) include: AWER 3100 (DSC/CI), 3110, 4510, 4650, 5200, and 5550. Students must also complete *either* AWER 5330 *or* an approved natural resources capstone experience.

In addition to the preceding courses, students in the Fisheries and Aquatic Sciences major must choose a minimum of 24 elective credits. The majority of these elective credits must come from courses directly related to the degree program. **All elective courses must be approved by the student's faculty advisor before enrollment.** The following recommended courses will partially satisfy this requirement: AWER 3000, 3820 (QI), 4530, 5150, 5640; and FRWS 4880.

**Fisheries Science Minor (18 credits).** This minor is designed for students with a strong background in biology. The department head's approval and a minimum of 18 credits are required. Students must complete the *Fisheries Science Core* (9 credits) which includes: AWER 3100 (DSC/CI), AWER 3700, and NR 2220. They must also complete 9 credits of *Electives*, by selecting three courses from the following: AWER 4500, 4650, 5200, 5550, and FRWS 3810.

**Bachelor of Science in Watershed and Earth Systems.** All Watershed and Earth Systems majors must complete the following *Science Foundation* courses (19 credits): CHEM 1210, GEOL 1150 (BPS), MATH 1210 (QL), STAT 3000 (QI), and PHYX 2210 (QI). They must also complete the *Common Departmental Core* (19 credits): AWER 1020, 3700, 4490, 4500, 4930, 4980; and ENVS 5320. The following *Watershed and Earth Systems* courses (18 credits) are also required: AWER 3820 (QI), 4750, 5150, 5170, and SOIL 3000. Students must also complete *either* AWER 5330 *or* an approved natural resources capstone experience.

In addition to the preceding courses, 40 elective credits must be completed. The majority of these elective credits must come from courses directly related to the degree program. **All elective courses must be approved by the student's faculty advisor before enrollment.** The following lists of recommended courses could be used to satisfy this requirement.

**Watershed Science:** AWER 4510, 4530, 5200, 5640, 5660; CHEM 1220 (BPS); and FRWS 5350.

**Geographic Information Science:** AWER 5250, 5760, 5930; MATH 1220 (QL); PHYX 2220 (QI); and STAT 6810.

**Watershed Science Minor (15-16 credits).** For the Watershed Science minor, students must complete AWER 3700, 4490, 4530, plus two courses selected from the following: AWER 4500, 5150, 5640, 5660.

**Geographic Information Science Minor (18-19 credits).** For this minor, students must complete the following *Watershed and Earth Resources Core Courses* (12 credits): AWER 4930, 5930; CS 1700, 1710. Students must also complete 6-7 credits of *Electives* by selecting two courses from the following: AWER 3900, 5250; FRWS 3750; GEOG 4850.

### **Career Opportunities**

Graduates in Aquatic, Watershed, and Earth Resources occupy an expanding niche in the fields of natural resources and environmental management. Degree holders often work as environmental scientists, hydrologists, fisheries biologists, or specialists in geographic information analysis and remote sensing. With experience and/or advanced degrees, AWER graduates may do natural resource assessment, management planning, and resource impact analysis.

Federal agencies, such as the Forest Service, Fish and Wildlife Service, Geological Survey, Bureau of Land Management, Environmental Protection Agency, National Park Service, Bureau of Reclamation, and National Marine Fisheries Service, hire graduates of AWER academic programs. Graduates also find employment with state natural resource agencies, nongovernmental conservation organizations, and private consulting firms.

### **Financial Assistance**

The main sources of undergraduate financial assistance include University scholarships, grants-in-aid, work-study, and loans. In addition, more than 30 scholarships are offered for eligible students in the College of Natural Resources.

Scholarships are awarded for scholastic and professional achievements at the department, College of Natural Resources, and University level. For more information, contact College of Natural Resources academic advisors. Grants-in-aid and work-study are available from the Financial Aid Office. In addition, departmental faculty often employ undergraduate students to assist in research, extension, and outreach projects. These projects often involve field and laboratory data collection, data management and analysis, and report preparation.

### **Additional Information**

For additional information about the Bachelor of Science requirements, course sequencing, and departmental specialization options and their related coursework, as well as updated information describing current programs and courses offered by the Department of Aquatic, Watershed, and Earth Resources, visit the Aquatic, Watershed, and Earth Resources main office, Natural Resources 210, or visit <http://www.cnr.usu.edu/awer>.

## **Graduate Programs**

### **Admission Requirements**

General admission requirements apply, in addition to the requirements which follow. Although admission to the graduate program is treated on an application-by-application basis, the following are usually required: (1) a bachelor's degree from an accredited college or university; (2) a GPA of 3.2 or better (out of 4.0) for the most recent two years of academic coursework; (3) combined verbal and quantitative GRE scores above the 40th percentile; and (4) a letter of "interest and purpose" detailing the applicant's reasons for seeking an advanced degree. Foreign students should have a TOEFL score of at least 550. The written statement of interest helps match applicants with faculty advisors. A faculty member must agree to serve as the major professor in order for an applicant to be accepted. Prospective students are encouraged to contact faculty members early in the application process to investigate mutual interests, projects, and prospects for financial support.

Previous training in the field is not a prerequisite for admission, although a sound background in the physical and biological sciences is recommended. Successful applicants without the necessary background will be expected to obtain it in the course of their studies for the advanced degree.

### **Degree Programs**

A Master of Science degree in Fisheries Biology or Watershed Science, with emphasis on the management of fisheries or watershed resources directed toward decision-making roles in natural resource agencies, is offered for the applicant with previous agency experience and for the student motivated toward an administrative career. A Doctor of Philosophy degree in Fisheries Biology, Ecology, or Watershed Science is provided for students interested in pursuing a research or academic career.

A thesis or dissertation based on original research performed by the student is required. Written comprehensive examinations are required of all students pursuing the PhD degree. At the discretion of the student's graduate supervisory committee, an additional oral examination may be required.

The minimum requirement for an MS degree is 30 credits, including at least 24 credits in residency and 6 credits of thesis research. The minimum requirement for a PhD degree is 60 approved graduate credits in addition to an MS degree, or 90 approved graduate credits with no MS degree. At least one year (a minimum of 32 credits), including a minimum of two consecutive semesters, of full-time registration must be in residence at USU.

With committee approval, graduate credit may be transferred from accredited graduate schools, provided the minimum residency requirement (including thesis and dissertation credit) at USU is met. Transfer credit, which must not have been used for any other degree, will be shown on official USU transcripts at completion of the degree.

**Master of Natural Resources.** The department also participates in the College of Natural Resources Master of Natural Resources (MNR) degree program. For more information, see page 278.

### ***Specializations***

The MS and PhD degrees in Fisheries Biology and Ecology allow students to specialize in either Fisheries Management or Aquatic Ecology.

### ***Financial Assistance***

General aspects of financial support for graduate students at Utah State University are listed on pages 89-90 in the *Graduate Financial Assistance* section. This includes important information on the University-wide policies and terms of reference for research and teaching assistantships, graduate tuition obligations and benefits, Western Regional Graduate Programs, and competitive University-wide fellowships and scholarships.

### ***Assistantships***

Research assistantships are available through individual faculty members who hold research grants or contracts. Occasionally, teaching assistantships are available through the department. Recipients of teaching assistantships are usually selected from among PhD students.

### ***Western Regional Graduate Programs***

The MS and PhD in Watershed Science are Western Regional Graduate Programs. For more information, see page 89.

## ***Aquatic, Watershed, and Earth Resources Faculty***

#### **Professors**

*Charles P. Hawkins*, stream ecology, conservation biology, and biomonitoring  
*Wayne A. Wurtsbaugh*, limnology, fish ecology, and watershed biogeochemistry

#### **Adjunct Professors**

*Christopher Neale*, remote sensing  
*David G. Tarboton*, geomorphology, hydrology  
*James P. Dobrowolski*, watershed hydrology, management, and restoration

#### **Professors Emeriti**

*John A. Kadlec*, wetland ecology and biogeochemistry  
*John M. Neuhold*, fisheries biology

#### **Associate Professors**

*Todd A. Crawl*, aquatic ecology and conservation biology  
*Robert R. Gillies*, remote sensing and meteorology  
*Chris Luecke*, lake ecology and fisheries  
*John C. Schmidt*, fluvial geomorphology and water policy  
*Helga Van Miegroet*, biogeochemistry, soils, and ecosystem ecology

#### **Research Associate Professor**

*Jeffrey L. Kershner*, USDA Forest Service, national habitat coordinator, stream ecology and fish-habitat relationships

#### **Adjunct Associate Professor**

*Joanna L. Ender-Wada*, cultural anthropology, natural resource policy and sociology

#### **Assistant Professors**

*Paul W. Box*, geographic information systems, spatial analysis, and modeling  
*Phaedra E. Budy*, assistant leader, fisheries, Utah Cooperative Fisheries and Wildlife Research Unit, fisheries management and aquatic ecology  
*Michael N. Gooseff*, hydrology and hyporheic zone ecology  
*Nancy O. Mesner*, water quality, water policy, and modeling  
*Michael A. White*, ecosystem modeling, remote sensing, and global climatology

#### **Research Assistant Professor**

*Mark R. Vinson*, aquatic invertebrate ecology and biomonitoring

#### **Adjunct Assistant Professors**

*Michelle A. Baker*, ecology, hydrology  
*David A. Beauchamp*, food webs, bioenergetics models, predator-prey interactions, visual foraging  
*Nicolaas W. Bouwes, Jr.*, fisheries management, aquatic ecology  
*David G. Chandler*, hydrology  
*Joel L. Pederson*, geomorphology, paleoclimatology, and sedimentology  
*Brett Roper*, USDA Forest Service Aquatic Monitoring Center Program Leader, aquatic ecologist  
*Juergen Symanzik*, computational and graphical statistics  
*J. Christopher Wilson*, director, State of Utah Division of Wildlife Resources Fisheries Experiment Station, fish pathologist/nutritionist

## ***Course Descriptions***

Aquatic, Watershed, and Earth Resources (AWER),  
pages 342-346