

Department of Watershed Sciences

Pre-proposal for USU Department Teaching Excellence Award

Department Profile

The Department of Watershed Sciences (WATS) is focused on providing a hands-on educational experience to produce exceptional, engaged graduates ready to assume their roles in furthering scientific understanding and management of watershed ecosystems. Our faculty enhance our undergraduate and graduate educational programs through a process of shared commitment to maintain excellence. The goal of our teaching, research, and extension programs is to bring science to the management of watershed ecosystems in Utah and the world. Our educational programs help us achieve this goal by educating students on basic concepts of hydrology, geomorphology, fisheries, and ecology. Students learn to integrate these diverse fields of knowledge through an intense and rigorous curricula focused on hands-on learning via field, laboratory, and analytical activities.

The Department of Watershed Sciences was formed in 2002 with the reorganization of the College of Natural Resources. WATS offers BS degrees in Watershed & Earth Systems, and Fisheries & Aquatic Sciences. Our department also supports the BS in Geography by advising students enrolled in the Physical Geography emphasis. Master of Science and PhD degrees in Fisheries Biology, Watershed Sciences, and Aquatic Ecology form the core of our graduate program. This fall we enrolled 58 undergraduate majors and 50 graduate students. These numbers have increased by more than 50% in three years. Our educational program is delivered by 7.6 FTE faculty.

Commitment to Learning Excellence

Our commitment to educational excellence is defined in a four-step process. The process begins with faculty working together to design a coherent curriculum for each undergraduate major and a series of competencies for graduate program. The second step, which involves developing high quality and meaningful experiences in all classes, derives from our faculty's understanding that education in the natural sciences can only be successfully achieved with extensive use of field, laboratory, and data learning exercises. Thirdly, we demand that students become competent in the analysis of environmental data by thoughtful integration of study design, statistical inference, and policy implications. Lastly, we require that undergraduate students complete a capstone course in which a particular environmental problem is defined and students work to produce concrete solutions to the problem.

Our undergraduate curricula were developed during a series of departmental workshop in 2002 when our department and these new degrees were first approved. Working groups developed a set of foundation science requirements for both the Watershed & Earth Systems and the Fisheries & Aquatic Sciences degrees. The groups defined a common departmental core of classes that embody the learning objectives required for students completing one of our undergraduate degrees. These core learning objectives represent the following general skills needed by all Watershed Sciences students:

1. *Gain proficiency in spreadsheet analysis.*
2. *Statistical competence in ANOVA, and regression.*
3. *Competence in GIS using ArcView, AcrGIS.*
4. *Writing competence for science applications.*
5. *Oral communication skills.*
6. *Understanding of biogeochemical cycling of Carbon, Nitrogen, and Phosphorous.*

7. *Analysis of services ecosystems provide.*
8. *Assessment of human impacts on earth systems.*

A set of common core courses was also identified as required by all undergraduate students in the department. These include: WATS Professional Orientation, Fundamentals of Watershed Sciences, Introduction to Geographic Information Sciences, Small Watershed Hydrology, Limnology, Geographic Information Sciences, and a Capstone Course. Additional specific learning objectives and the needed coursework to support these objectives were designed for the Watershed & Earth Systems and the Fisheries & Aquatic Sciences BS degrees.

Field, laboratory, and analytical exercises are infused throughout the curricula for these two degrees. Students in the freshman-level Professional Orientation course sample and measure fish populations in local streams, collect meteorological data from Logan Canyon, visit the Logan sewage treatment plant and a local environmental instrumentation company. Students in the hydrology course learn to sample streams and collect and analyze their own data. The two courses in GIS move students through a process whereby they eventually use remotely sensed images to analyze data to address a specific question in environmental sciences. Additional courses allow students to become engaged in the fieldwork and data analyses.

Seniors in our undergraduate degree programs take one of two capstone courses. In both courses, a current and relevant problem in watershed sciences is defined at the beginning of the course. Students work throughout the semester individually, in small groups and as a class to address different aspects of the defined issue. Recent examples of issues tackled by these courses include: assessing impacts of Logan sewage effluent on the ecosystem health of Cutler Reservoir, examining effects of pollutants on the ecology of the Great Salt Lake, and development of a management plan to bring the Bear River into compliance with US-EPA water quality standards. The work of these capstone courses is supported in part by federal and state environmental agencies. The agencies help us to define the problem and frequently provide financial support to assist with field collections, data analyses, and report writing. These courses typically involve direct interaction between agency personnel and students. We receive additional support from our private partners and friends in local NGOs. Results of these capstone courses are submitted to the relevant agencies and have been published in peer-reviewed literature.

In our graduate degree programs, the faculty advisor and committee define individual coursework and research plans for each student. The students in these programs come from varied backgrounds and have diverse career goals. Our present group of 50 graduate students come from 4 nations and 14 different states. These students are best served by individual guidance by the graduate committee. The faculty have defined a set of minimal competencies that students of each degree need to master.

Specific highlights of our educational program during the past year include:

- Student organization of a poster symposium (last year's symposium was titled "Hot Fish Sex" and held on campus and at the Stokes Nature Center)
- Series of workshops on stream restoration where graduate students and professionals work together in a two-week program delivered by a faculty from three universities (last year offered at the Swaner EcoCenter)
- Overnight field trips to Yellowstone, the Tetons, and the Wind River Range

- Local field trips to Bear River, Logan River, Bear Lake, Provo River, the Great Salt Lake, Bear River Bird Refuge, and other small streams and reservoirs in northern Utah
- Student participation in internships, undergraduate research, and Posters on the Hill
- Capstone experience examining the impacts of sewage effluent on Cutler Marsh
- Capstone experience examining land use impacts on water quality in the Bear River

Assessment

Assessment of undergraduate programs in WATS consists of four measures of student success. Students are surveyed at the end of their senior year to determine how well they felt the degree programs met their needs. Results of these extensive exit questionnaires are reported to the faculty and discussed during the fall retreat. We use the capstone courses to assess the degree to which we have met the learning objectives identified for the undergraduate degree programs. This discussion is part of the fall retreat and helps us to make modifications in our course syllabi and activities. The department head also conducts individual interviews with graduating seniors to assess the quality and value of the degree programs. Nine months after graduation, a placement survey is delivered to graduates to assess the employment results of the most recent class. In addition to student responses, a system of peer teaching evaluation provides the faculty with insights into the strengths and weaknesses of specific courses and the integration of the courses into degree programs. Results of each of these evaluations are used to modify the curriculum, make teaching assignments, and proportion resources to the various courses taught by faculty in the department.

The key to assessment of our educational programs lies in the placement of graduates in key position with natural resource agencies, non-governmental environmental organizations, environmental consulting firms and research positions at other universities. The most recent placement surveys indicated that 48 of 69 recent graduates with BS degrees (70%) are gainfully employed in their chosen field of study. Forty percent of these graduates have gone on to further their education in graduate school, an additional 40% are working for federal or state agencies, and the remaining 20% are working for environmental entities. Of the 57 students who attained MS degrees, 55 are employed within the profession, with 30% entering PhD programs and 51% working for natural resource agencies. During the past 8 years, 13 students have been awarded doctoral degrees. Half of these young professionals are working at Universities with three gaining professorships. The other 6 recent PhDs work for federal research agencies. In sum, over 80% of our recent graduates have entered professional life in some field of watershed sciences. Each fall we invite a number of these recent graduates of our programs to come back to campus to talk about careers with our incoming freshman class. Our graduates are our best recruiting tool and provide relevant career advice to beginning students. Our greatest accomplishments are the impact that these young people are having on the science and management of our natural resources.

In summary, the Department of Watershed Sciences is committed to providing excellent teaching programs that promote superior learning experiences for our undergraduate and graduate students. We welcome the opportunity to describe our programs in more detail and illustrate the successes we have in using our educational mission to transform the science and management of watershed ecosystems.