

Institutional Effectiveness
2021-2022

Program: Environmental Sciences Ph.D.

College and Department: College of Interdisciplinary Studies – School of Environmental Studies

Contact: Dr. Tammy Boles

Mission: The Environmental Sciences (EVS) doctoral program's mission is to advance the knowledge and promote the leadership necessary to understanding natural environments by incorporating perspectives from social sciences, humanities, and environmental sciences in the program's teaching and research in the fields of natural resources and the environment.

Concentrations: There are five concentrations available within the EVS Ph.D. program:

(1) Agriculture; (2) Biology; (3) Chemistry; (4) Geosciences; and (5) Integrated Research.

The Agriculture, Geosciences, and Integrated Research concentrations were officially added in Spring 2018.

Program Goals:

- PG 1: Environmental Sciences students will receive detailed interdisciplinary training and experience to enable them to address complex environmental problems with greater effectiveness.
- PG 2: EVS student research projects will be peer-reviewed and widely recognized for their innovation and relevance to environmental concerns.
- PG 3: Add new concentrations to the Environmental Sciences PhD program.

Student Learning Outcomes

- SLO 1: Students will demonstrate understanding of the interdisciplinary nature of environmental sciences such that they are aware of a wide range of environmental concerns beyond the boundaries of any single, specific discipline.
- SLO 2: Students will improve oral and written communication skills by giving technical presentations at symposia, conferences, and similar venues where abstracts are peer-reviewed for acceptance.
- SLO 3: Students will improve written communication skills by submitting manuscripts to peer-reviewed publications such as scholarly journals, conference proceedings, books, or similar outlets.

Assessment Methods:

1. *Comprehensive Exams - Outcome 1.1:* The EVS faculty will monitor student understanding of the interdisciplinary nature of environmental science by the administration of oral and written comprehensive exams. The comprehensive exam is interdisciplinary and is comprised of questions

written by each member of the graduate advisory committee. The results of these exams are kept on file by the EVS Director.

The timing of the comprehensive exams represents an ideal opportunity for assessment because the student has just completed all or nearly all of his/her coursework. The exams are provided in two different formats (written and oral) that allow better insight into the student's interdisciplinary knowledge and proficiency. The student's graduate advisory committee discusses the results and provides paper copies of the exams to the Director, who monitors the results to maintain integrity and consistency.

2. *Student Annual Reports - Outcomes 2.1 and 2.2:* In December of each year, the program Director requests annual reports from each student that cover the previous 12-month period. Reports are due by the end of January. For example, student reports received in January 2022 covered the reporting period of January-December 2021. Students are provided with a template to follow when preparing reports. The Director and academic staff members review each report and tally the total number of presentations and publications generated by students during the reporting period.

EVS students are required to submit an annual report to allow direct assessment of student productivity and development of written and communication skills in terms of presentations and publications. The report template also requires additional details regarding the nature of the presentation or publication. For example, the presentation might be at an international conference rather than a state meeting, or the publication might be in a high-impact journal as opposed to a regional journal. These details can be used to generate a more refined analysis of the TTU EVS program's impact on the wider discipline of environmental sciences. Annual reports have the added benefit of student professional development because their CVs are current and updated with each successive year's accomplishments.

3. *Annual count of number of concentrations - Program Goal 3:* Once per year (at the end of the state fiscal year in June) the SOES Director will tally the number of available concentrations and track them longitudinally through time.

The EVS Ph.D. program historically only had two concentrations available for students, Biology or Chemistry. Future growth in enrollment and interdisciplinary development was limited; therefore, the EVS Executive Committee voted on September 15, 2017, to approve three additional concentrations: Agriculture; Geosciences; and Integrated Research. Furthermore, in the upcoming 5-year period, we will be discussing the addition of a Low-Residency option for the EVS Ph.D. program. Establishing a Low-Residency option will increase the number of students whose who live and work at a distance.

Results:

PG 1: Environmental Sciences students will receive detailed interdisciplinary training and experience to enable them to address complex environmental problems with greater effectiveness.

Students continue to receive quality instruction and support from faculty in a variety of disciplines, included but not limited to biology, chemistry, geosciences, agriculture and social policy.

In Fall 2021, the Executive Committee discussed the strengths and weaknesses of the current EVS interdisciplinary core curriculum. The EVS Curriculum Committee, which also includes student

representatives, discussed adding two new core courses, making the core flexible. The committee decided that standards for the core and a rubric for the comprehensive exams need to be developed. In addition, the committee decided that the logistics of the core course offerings need to be studied in order to allow students to know when courses will be offered and to be able to take the core courses early in their program of study.

In Spring 2022, the Executive Committee discussed at length two proposed courses to be added to the core, but could not reach a consensus. The committee decided requested that the EVS Curriculum Committee study the current and proposed core courses and submit suggested curriculum changes to the Executive Committee meeting in Fall 2022.

PG 2: EVS student research projects will be peer-reviewed and widely recognized for their innovation and relevance to environmental concerns.

During the 2021-2022 year, students were recognized for the quality of their work.

- Best oral presentation in the Ecology & Environmental Science category of the 131st Meeting of the Tennessee Academy of Science, “Documenting Effective Pollinator Species and Metabarcoding Environmental DNA to Examine Pollinator Communities Across the Range of *Physaria globosa* (Brassicaceae)”
- Best Doctoral Student Presentation Award (Biology Department) at the Tennessee Tech University 16th Annual Research and Creative Inquiry Day, April 2021, “The relation of microbial biomass carbon with denitrification and nutrient retention in restored floodplain wetlands”
- Best Doctoral Student Presentation Award (Chemistry Department) at the Tennessee Tech University 16th Annual Research and Creative Inquiry Day, April 2021, “A study on the spectrophotometric analysis of Hg(II) using dithizone under conditions pertinent to Hg(II) reduction in aquatic systems”

PG 3: Add new concentrations to the Environmental Sciences PhD program.

The addition of the new concentrations (Agriculture, Geosciences and Integrated Research) have expanded the reach of the EVS program. While the Biology Concentration still has the highest number of students at ten, the Integrated Research Concentration has seven, the Agriculture Concentration has four, the Chemistry Concentration has three, and the Geosciences Concentration has two, for a total of 26 EVS students. There is a possibility of adding one or more concentrations in the future, pending future deliberations of the EVS Executive Committee. Recent committee discussions have included the possibility of adding a low-residency option to the program.

SLO 1: Students will demonstrate understanding of the interdisciplinary nature of environmental sciences such that they are aware of a wide range of environmental concerns beyond the boundaries of any single, specific discipline.

Five EVS students, two in the Agriculture Concentration, two in the Biology Concentration, and the other in the Geosciences Concentration, successfully completed their comprehensive exams during the 2021-2022 reporting period. Student performance and interdisciplinary proficiency on both written and oral aspects were approved by the EVS faculty graduate advisory committees.

The School of Environmental Studies recently created Microsoft Teams groups for each student's dissertation committee to facilitate interdisciplinary collaborations and collegiality among committee members. The Teams group is a location where the comprehensive exam questions, answers, and grades can be uploaded for easy access and viewing in a secure fashion.

SLO 2: Students will improve oral and written communication skills by giving technical presentations at symposia, conferences, and similar venues where abstracts are peer-reviewed for acceptance.

The School of Environmental Studies provides supplemental support for student travel to meetings for the purposes of making presentations. Although some conferences were still cancelled or switched to virtual, SOES continued to provide conference support for students as needed. The School will continue to place a priority on supporting student travel to scientific conferences.

SLO 3: Students will improve written communication skills by submitting manuscripts to peer-reviewed publications such as scholarly journals, conference proceedings, books, or similar outlets.

Student written and oral measures of productivity in 2021 were up in many areas as compared to 2020. Although some conferences were cancelled and others were virtual, conference attendance was almost back to pre-COVID levels. Although the number of poster presentations decreased ($n = 15$), there was a concomitant increase in the number of oral presentations ($n = 22$). The number of manuscripts submitted in 2021 ($n = 15$) was similar to the number of manuscripts submitted in the 2015 – 2019 reporting years (Tables 1 and 2). The number of manuscripts published in 2021 ($n = 8$) was down slightly from previous years, but that may be due to the pandemic negatively impacting student research. The eight manuscripts published in 2021 appeared in a range of journals (Table 3). EVS students were first authors in six of the eight publications.

In 2016, the EVS 7900 Scientific Writing and Grantsmanship elective course was changed to allow students the option of developing a journal manuscript. Previously, students were required to submit a grant proposal. In recent years, many EVS 7900 students have elected to prepare a journal manuscript and worked one-on-one with the instructors during editing sessions. The EVS Curriculum Committee is also tentatively recommending that EVS 7900 be one of the three required courses in the newly revamped core curriculum. If approved, then nearly every student in the program would be exposed to a writing course, which is expected to have a widespread effect on quantity and quality of manuscripts from students in the EVS program.

The EVS Executive Committee created a new policy to require doctoral students to submit a portion of their dissertation for peer review before they can defend their dissertation. The new policy was approved by GSEC and became effective in August 2017. This new policy should further increase student proficiency in scientific writing and publication skills.

Table 1. Scholarly activity related to oral and written communication skills shown by EVS Ph.D. students in the current (2021) and previous six calendar-year reporting periods. EVS enrollment has steadily increased since 2015, with the enrollment at 26 in 2021.

Type of scholarly activity	Student annual report period						
	2015	2016	2017	2018	2019	2020	2021
Conference attendances	15	25	22	32	32	18	27
Poster presentations	14	17	14	15	15	25	15
Oral presentations	8	9	26	19	16	13	22
Manuscripts submitted	12	10	13	14	27	8	15
Manuscripts published	8	12	14	10	16	12	10

Table 2. EVS student activities during the reporting period of January-December 2021 in the Agriculture, Biology, Chemistry, Geosciences, and Integrated Research concentrations.

Year	Conference Attendances	Technical Presentations		Manuscripts	
		Poster	Oral	Submitted	Published
Agriculture Concentration					
2018	0	0	0	0	0
2019	2	0	0	0	1
2020	2	2	0	0	0
2021	2	0	2	0	0
Biology Concentration					
2018	18	9	9	11	9
2019	23	8	15	24	12
2020	9	18	12	5	11
2021	13	7	17	6	6
Chemistry Concentration					
2018	9	6	5	1	1
2019	5	5	0	2	0
2020	2	2	0	0	0
2021	3	2	1	0	0
Geosciences Concentration					
2019	0	0	0	0	0
2020	0	0	0	0	0
2021	2	0	1	1	0
Integrated Research Concentration					
2018	5	0	5	2	0
2019	2	2	1	1	1
2020	5	3	1	3	1
2021	7	6	1	8	2
Total					
2018	31	15	19	14	10
2019	32	15	16	27	16
2020	18	25	13	8	12
2021	27	15	22	15	8

Table 3. Eight journal publications from 2021 co-authored by EVS Ph.D. students (names shown in bold text).

Manuscripts Published

- 1) Kawai, T., **Grubb B.**, and Grandjean F. (2021). Conservation of the Japanese endangered Japanese Crayfish, *Cambaroides japonicus* (De Haan, 1841) (Decapoda; Cambaroididae). Chapter

17. In: Recent Advances in Freshwater Crustacean Biodiversity and Conservation. (Eds: T. Kawai & D. C. Rogers). CRC Press, Boca Raton
- 2) Walker, D., Murray, C., **Godwin, C.**, and Romer, A. Understanding the impact of snake fungal disease on species of greatest conservation need in Tennessee. Technical Report for Tennessee Wildlife Resource Agency Geographic distribution *Chrysemys picta* (Painted Turtle) Herpetological Review. **C. D. Godwin,** Plylar H. B.
 - 3) **Godwin, C. D.**, Walker, D. M., Romer, A. S., Grajal-Puche, A., Grisnik, M., Goessling, J. M., Perkin, J. S., and Murray, C. M. Testing the Febrile Response of Snakes Inoculated with *Ophidiomyces ophiodiicola*, The Causative Agent of Snake Fungal Disease. Journal of Thermal Biology 100 (2021) 103065.
 - 4) **Godwin, C. D.**, and Romer, A, S. Snake Fungal Disease (Ophidiomycosis) in Southeastern Snake Populations. SEPARC DTT Information Sheet 21.
 - 5) **Godwin, C. D.**, Doody, J. S., and Crother, B. I. The Impact of ATVs on Survival of Softshell Turtle (*Apalone* spp.) Nests. Journal of Herpetology 55(2): 201-207 Highway, C. J., A. G. Blake-Bradshaw, and **N. M. Masto**. Putting duck folks' folklore to the test: Research to examine local beliefs of duck movements in West Tennessee. *Tennessee Wildlife Magazine Fall Edition*.
 - 6) **Masto, N. M.**, A. G. Bradshaw, C. J. Highway, D. Combs, and B. Cohen. 2021. Mallard (*Anas platyrhynchos*) spatial ecology project: an update for Tennessee Wildlife Resources Agency and partners. 27 pp
 - 7) **Rawal, S.**, Buer, S. H., Sanders, J. R., & Arce, P. E. (2022). Photocatalytic degradation of acetaminophen in water via ultraviolet light and titanium dioxide thin films part II: chemical and kinetic aspects, *International Journal of Chemical Reactor Engineering*, 20(1), 113-127.
 - 8) **Rawal, S.** and Buer, S. H. (2021). Photocatalytic Degradation of Acetaminophen in Water Via Ultraviolet Radiation and Titanium Dioxide Thin Films. *Proceedings of Student Research and Creative Inquiry Day*, 5.

Modifications for Improvement

PG 1: Environmental Sciences students will receive detailed interdisciplinary training and experience to enable them to address complex environmental problems with greater effectiveness.

In both Fall 2021 and Spring 2022 EVS Executive Committee meetings, a matrix of options for revising the EVS PhD core course requirements was discussed at great length. Different academic units expressed different concerns about the current core courses. Faculty also expressed a variety of concerns about the various core course options presented. In the end there was a lack of consensus on the best way to modify the core course requirements to meet the needs of the students. The committee was reminded that the EVS PhD program is an interdisciplinary program in environmental science that warrants training in a range of academic disciplines, not solely in the concentration area.

SOES leadership and the EVS Curriculum Committee will be working to develop a proposed core that addresses all of the needs and concerns of the faculty and students. One of the goals of the proposal will be to better standardize the core courses and the comprehensive exams, thus facilitating the refinement of a rubric for comprehensive exams, better tracking of learning objectives, and more focused and appropriate improvement measures. This will allow the school to better track progress in student understanding of the complexity and interdisciplinary nature of environmental problems.

PG 2: EVS student research projects will be peer-reviewed and widely recognized for their innovation and relevance to environmental concerns.

Students will continue to be encouraged (and financially supported) to participate in oral and poster presentations in appropriate professional conferences.

PG 3: Add new concentrations to the Environmental Sciences PhD program.

The number of existing EVS concentrations was successfully increased from two to five during the last monitoring period. The EVS Executive Committee has set a future goal of having a total of six concentrations. Discussions began in 2020-2021 and will continue in 2022-2023 to determine how to move forward with adding one or more new concentrations to support the growth and health of the EVS program. The committee will also continue to address the possible addition of a low-residency option to make the program available to those students living some distance away from Cookeville. The recent development or conversion of more courses to an online format (due to the Covid-19 pandemic) should also support rapid implementation of a low-residency option should the Executive Committee decide to approve such an initiative.

SLO 1: Students will demonstrate understanding of the interdisciplinary nature of environmental sciences such that they are aware of a wide range of environmental concerns beyond the boundaries of any single, specific discipline.

The existing assessment approach for the comprehensive exams was recognized as too imprecise to enable any depth of insight into the level of student understanding of the interdisciplinary nature of environmental sciences. The historical approach was simply to list the number of students that passed (or failed) and provide a qualitative description of the exams. Therefore, a more quantitative rubric was drafted by the EVS Curriculum Committee in 2017-2018 to provide a refined, commonly used tool for assessing student interdisciplinary performance on their exams. The EVS Curriculum Committee suggested minor changes to the rubric prior to its presentation to the EVS Executive Committee. The rubric was approved by the executive committee, but the addition of the three new concentrations in Spring 2018 necessitated further revisions to the rubric. The rubric was slated to be implemented in the 2021-2022 academic year, but the EVS Executive Committee members have not finalized the rubric. Additionally, in order to track specific students' interdisciplinary knowledge, the EVS Executive Committee will consider the possibility of creating a test bank of interdisciplinary learning questions that could be used during the comprehensive exams.

SLO 2: Students will improve oral and written communication skills by giving technical presentations at symposia, conferences, and similar venues where abstracts are peer-reviewed for acceptance.

SLO 3: Students will improve written communication skills by submitting manuscripts to peer-reviewed publications such as scholarly journals, conference proceedings, books, or similar outlets.

SOES will develop qualitative and quantitative measures of written communication skills to track progress. These could include such things as student perception of growth in written communication after taking the EVS 7900 Scientific Writing and Grantsmanship course. It could also include pre- and

post-test measures of writing skills that could be included within the course. Additionally, the school will begin tracking the ratio of manuscripts submitted to manuscripts published.