Institutional Effectiveness
2020-2021

Program: Environmental Sciences Ph.D.

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

Contact: Dr. Steve Sharp

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.

A departmentally developed curriculum map can be found in Appendix 1 that shows the connections between courses and student learning outcomes.

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 2019 covered the reporting period of January-December 2018. 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. Increasing the number of concentrations will increase the number of students whose background and interests are closely aligned with agriculture and earth sciences, those who have a strong interdisciplinary research focus, as well as those 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 2020, the Executive Committee discussed the strengths and weaknesses of the current EVS interdisciplinary core curriculum. It was decided that the EVS Curriculum Committee, which also include student representatives, would study the matter more carefully and bring recommendations back to the Executive Committee in Spring 2021. Tentative recommendations from this group have involved a 3-course core curriculum instead of the current 4-course core, with one of the three courses being an interdisciplinary seminar-based course in environmental sciences. These efforts are targeted to produce more consistent and effective understanding of the interdisciplinary aspects of the degree program.

In Spring 2021, the Executive Committee discussed at length several potential changes to the core course curriculum but could not come to a consensus as to which direction to go. The matter was referred back to SOES leadership for further refinement in order to present a proposal in 2021-2022.

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

During the 2020-2021 year, students were recognized for the quality of their work.

- Best Student Poster Award ($1,000), 72nd Annual Southeastern Association of Fish and Wildlife Agencies Annual Conference, “Prebreeding migration strategies of mallards wintering in the Mississippi Alluvial Valley”
- Best Student Presentation Award, Natural Resources Conservation Service/Nature Conservancy Flash Conference, “The Effects of Hydrology and Habitat on Nutrient Retention in Restored Floodplain Wetlands”
- Best Student/Young Professional Speed Talk Presentation, SEPARC
- Best PhD Student Poster, Department of Biology, TTU 2021 Research and Creative Inquiry Day, “The relation of microbial biomass carbon with denitrification and nutrient retention in restored floodplain wetlands”
- Best PhD Student Poster, Department of Chemistry, TTU 2021 Research and Creative Inquiry Day, “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 Agriculture Concentration has six, surpassing the number in Chemistry and Integrated Research which have four each, as well as Geosciences which adds one student to the list, for a total of 25 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.

Two EVS students, one in the Integrated Research Concentration and the other in the Biology Concentration, successfully completed their comprehensive exams during the 2020-2021 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 many conferences were 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 2020 were down in most areas as compared to recent years. This undoubtedly was due in large part to the COVID-19 pandemic. Conferences were cancelled, field research was hampered, and some students were in a quandary as to how to move forward. Interestingly, the one area in which there was a substantial increase was poster presentations (n = 25). The majority of these (n = 14), however, were from two students. One EVS-Biology student presented eight posters and another one submitted six. The number of manuscripts published in 2020 (n = 12) was more in line with 2016, 2017 and 2018 (Tables 1 and 2). The twelve manuscripts published in 2020 appeared in a range of journals (Table 3). EVS students were first authors in seven of the twelve 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 (2020) and previous six calendar-year reporting periods. EVS enrollment ranged from 14 to 17 students during 2014–2017 and then climbed to 20 students in 2018, 24 in 2019, and 25 in 2020.

	Student annual report period						
Type of scholarly activity	2014	2015	2016	2017	2018	2019	2020
Conference attendances	13	15	25	22	32	32	18
Poster presentations	8	14	17	14	15	15	25
Oral presentations	8	8	9	26	19	16	13
Manuscripts submitted	6	12	10	13	14	27	8
Manuscripts published	6	8	12	14	10	16	12

Table 2. EVS student activities during the reporting period of January-December 2020 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
Biology Concentration						
2018	18	9	9		11	9
2019	23	8	15		24	12
2020	9	18	12		5	11
Chemistry Concentration						
2018	9	6	5		1	1
2019	5	5	0		2	0
2020	2	2	0		0	0
Geosciences Concentration						
2019	0	0	0		0	0
2020	0	0	0		0	0
Integrated Research Concentration						
2018	5	0	5		2	0
2019	2	2	1		1	1
2020	5	3	1		3	1
Total						
2018	31	15	19		14	10
2019	32	15	16		27	16
2020	**18**	**25**	**13**		**8**	**12**

Table 3. Twelve journal publications from 2020 co-authored by EVS Ph.D. students (names shown in bold text).

Manuscripts Published

1) **Blake-Bradshaw, A.G.,** Lancaster, J.D., O'Connell, J.R., Eichholz, M.W., Matthews, J.W., and Hagy, H.M. 2020. Suitability of wetlands for migrating and breeding waterbirds in Illinois. *Wetlands* 40, 1993 – 2010. https://doi.org/10.1007/s13157-020-01276-7
2) Geographic distribution *Agkistrodon contortrix* (Eastern Copperhead) Herpetological Review H. B. Plylar., **Godwin, C. D.**
3) Geographic distribution *Chrysemys picta* (Painted Turtle) Herpetological Review. **C. D. Godwin,** Plylar H. B.
4) Geographic distribution *Nerodia erythrogaster* (Plain-bellied Watersnake) Herpetological Review. **C.D. Godwin,** Moore. A. J.
5) Geographic distribution *Storeria occipitomaculata* (Red-bellied Snake) Herpetological Review. **C. D. Godwin,** Plylar H. B.
6) Geographic distribution *Thamnophis sirtalis* (Common Gartersnake) Herpetological Review. **C.D. Godwin**, Moore. A. J.
7) 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*.
8) Kluber, L.A., **S.A. Allen,** J.N. Hendershot, P.J. Hanson, and C.W. Schadt. 2020. Constraints on microbial communities, decomposition and methane production in deep peat deposits. *PLoS ONE*, 15(2): e0223744
9) **Masto, N. M.**, A. G. Bradshaw, C. J. Highway, D. Combs, and B. Cohen. 2020. Mallards (*Anas platyrhynchos*) spatial ecology project: an update for Tennessee Wildlife Resources Agency and partners. 35 pp. (pdfs upon request)
10) **Masto, N. M.**, B. A. Bauer, R. M. Kaminski, R.C. Leland*, C. S. Sharpe*, P. D. Gerard. E. Wiggers. 2020. Rake sampling to estimate biomass of submersed aquatic vegetation in coastal wetlands. *Wetlands* https://doi.org/10.1007/s13157-020-01296-3
11) McKay, T., **M. P. Bowombe-Toko**, L. A. Starkus, F. H. Arthur, and J. F. Campbell. 2019. Monitoring of *Tribolium castaneum* (Coleoptera: Tenebrionidae) in Rice Mills using Pheromone-baited Traps. *Journal of Economic Entomology*, 112 (3):1454-1462. DOI: https://doi.org/10.1093/jee/toy422. 3
12) Schwarz, M., Byrd, B.D., Marayati, B.F., **Blum, P.W.,** Wells, M.B., Greene, A.D., Taylor, M. and Wasserberg, G. (2020), Horizontal distribution affects the vertical distribution of native and invasive container-inhabiting *Aedes* mosquitoes within an urban landscape. Journal of Vector Ecology, 45: 16-24. https://doi.org/10.1111/jvec.12369

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 a Spring 2021 EVS Executive Committee meeting, a matrix of options for revising the EVS PhD core course requirements was discussed at great length. Different academic units expresses 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 will be developing this fall a singular specific proposal that will, as much as possible, address all of the concerns expressed about the current core as well as the concerns expressed about the various options presented. 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 2021-2022 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 is slated to be implemented in the 2021-2022 academic year. 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 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.

Appendices

1. Curriculum Map