2025 Syllabus

ESM 325 Environmental Risk Assessment Lab

Instructor: Dr. Yangdong Pan

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Lab: 12:00-3:50 PM, Tuesday, Thursday or Friday

Overall objectives

Introduce the US EPA's Ecological Risk Assessment Framework using concepts and methods ranging from laboratory ecotoxicology to watershed characterization and field-based bioassessment. Students will be expected to apply the framework, critique the relevant literature, and complete an environmental risk assessment group project.

Software/Apps

- **R**, an open source statistical computing software (freely available from https://cran.r-project.org/)
- **RStudio**, an open source text editor for R (freely available from http://www.rstudio.com/)
- **QGIS**, an open source software for GIS (freely available from https://qgis.org/en/site/forusers/download.html)
- **MS Office,** PSU has an agreement with Microsoft for MS Office and as a PSU student, you can get free software including PowerPoint, Excel, and Word for your personal computer <https://www.pdx.edu/oit/microsoft-office>.

Approach

This class emphasizes team-work and student-based learning. The learning that takes place in this class is largely accomplished through student-led inquiry and research, which places more responsibility on the student to guide learning and intellectual development. Therefore, the learning you achieve in this class is largely a product of your participation in all aspects of the course.

Grading

- Lab 1 Report (30%)
- Lab 2 Report (35%)
- Group Project (30%)
    - Annotated Bibliography (5%)

- Proposal (10%)
- Presentation (15%)

- Lab participation (5%)

Group project: The class will be divided into project groups of 3 members, which will work together on formulating a common research question and hypothesis, designing and collecting data, analyzing the data and interpreting the results, writing a scientific paper (as part of ESM 322 requirement), and then presenting their results to the class (as part of ESM 325 requirement).

Several benchmark products will be due throughout the term to help you formulate your study design prior to field work. These include an annotated bibliography of relevant research papers on your topic of interest, a proposal, and a final oral presentation after data has been collected and analyzed. Your TAs will offer more guidance on these deliverables in the weeks prior to their due date.

Group participation includes attendance and group research. Full active participation is demonstrated by asking questions about the material, assisting other students, and contributing to group research. Group research contributions will be assessed by group members at the end of the term. If you have a legitimate reason for missing a lab, please contact the TA **prior** to the lab period.

Late lab reports: Unlike the group project, all lab reports will be written individually. Assignments are due at the beginning of lab via Canvas. Late assignments will be accepted but will suffer a 10% per day grade reduction, unless you have a legitimate reason and you arrange it with the TA **prior** to the due date.

Grading scale (percent scores and grade break points for letter grades):

A 94 – 100; A- 90 – 93;

B+ 87 – 89; B 83 – 86; B- 80 – 82;

C+ 77 – 79; C 73 – 76; C- 70 – 72; D <70

Grade Updates: Students are responsible for tracking and managing their grades. Current standings are available upon request and will be provided in weeks 6 and 8.

Incompletes: Please check PSU's policy for receiving an incomplete grade
https://www.pdx.edu/registration/incomplete-grades

Statement on Academic Honesty

Plagiarism of any form will not be tolerated in this class and will result in failing grades for the assignment and course participation, and a referral to the Office of the Dean of Student Life. For more information, please see the Portland State University's Bulletin and how to avoid plagiarism.

PSU Student Resources

• **PSU's latest COVID-19 virus responses** <https://www.pdx.edu/coronavirus-response> • **Student resources during COVID-19** < https://www.pdx.edu/clas/covid-19-resources-for students>

• Title IX reporting
• Disability accommodations and the Disability Resource Center
• Dean of student life
• Religious accommodations policy
• Library
• Writing Center
• Food assistance
• General PSU Policies (e.g., Student Conduct and Responsibility Policy) • Student Resources and Centers (e.g., campus public safety, veterans resource center, etc.) • Sanctuary campus information and resources
• DACA resources

Tentative Lab Outline

Week Topic Due

Module One. Lab-based ecological risk assessment: effects of glyphosate on zooplankton

1 Course introduction and lab organization

- Lab course introduction
- Form groups (3 students per group)
- Introduction of R and RStudio (worksheet 1)

In this lab, we will overview the lab course. For both ESM 322 (Lecture) and 325 (Lab), students will work together as a group throughout the entire term on multiple assignments (for ESM 322), lab reports (for ESM 325), and an independent research project (for both ESM 322 and 325). Therefore, it is very important to choose 'right' group mates for each group. We will give you time during this lab to discuss your research interests, form a research group with three members, and come up a cool group name.

In the 2nd part of the lab, we will introduce you R and RStudio which will be used for visualizing data and performing statistical analysis. We don't assume that you have any prior experience with both R and RStudio and we will provide you a worksheet for you to get familiar and comfortable with R and RStudio.

2 Ecotoxicology assays with *Daphnia pulex* adults

- Set up an ecotoxicity experiment
- Analysis of ecotoxicity data using RStudio
- Lab report on ecotoxicity test

In this lab, we will first set up an acute ecotoxicity experiment to test the effect of glyphosate on *Daphnia pulex*.

In the 2nd part of the lab, we will analyze and interpret the ecotoxicity experimental data generated by previous students using several statistical methods. Specifically, we will estimate two endpoints: No Observed Effective Concentration (NOEC) and Lowest Observed Effective Concentration (LOEC) using Analysis of Variance (ANOVA) and multiple comparison test (Tukey HSD test). We will test the assumptions for ANOVA first; If the assumptions are violated, we will attempt for remediation using log transformation; If the remediation doesn't help, we will use rank-based non-parametric tests instead.

In addition, we will use a logistic regression to model the does-response curve between glyphosate and Daphnia's mortality and estimate another important endpoint: Lethal Concentration at which 50% test organisms are killed (LC_{50}). Both analytical methods will be explained in detail in the lecture course. In the lab, we will analyze the data to estimate these above-mentioned endpoints following a step-by-step worksheet 2 using R. This is an important exercise because many our current water quality standards are based on these endpoints and we commonly use these endpoints to assess ecological risk.

Module Two. Ecosystem-level ecological risk assessment: effects of urbanization on stream ecosystems

3 Watershed land use analysis **Lab 1 Report due**

In this lab, we will use QGIS, an open source GIS software to analyze land cover and land use in two watersheds with contrasting land use. Johnson Creek watershed is characterized by extensive urbanization while Eagle Creek watershed remains largely natural. We will first watch two introduction videos, one on the QGIS software, the 2nd is a land cover tutorial. We will then use QGIS to analyze land use in the two watersheds following worksheet 3. The exercise will help us understand how land use in a watershed is characterized, which is very critical when we design a study to assess the impacts of urbanization in watersheds on stream ecosystems in the next. As a first step, we need to establish a gradient of watersheds with a different extent of urban land use and meanwhile by minimizing possible confounding factors of other types of land use such as agricultural land use. In other words, we want to select many watersheds with different extent of urban land use but with a similar amount of low agricultural land use. Learning how to use an open source GIS tool will be very beneficial.

4 Field trip to Johnson Creek (An urban stream) **Annotated Bibliography due**

Urban land-use in a watershed can have adverse effects on aquatic ecosystems. For example, increases in impervious surface areas in urban watersheds can alter stream hydrology by increasing the frequency and magnitude of peak flows. Ecological integrity of streams measured by macroinvertebrate and fish indices decrease when impervious surface areas increase. The main objective of this and next lab is to compare two streams with contrasting land-use patterns in their watersheds. Johnson Creek is an urban stream with most of its watershed in the Portland metropolitan area and Eagle Creek is a rural stream located in the foothills of Mt Hood. The QGIS lab should provide you a watershed view of each stream and during each of the field trips, we will measure water quality, assess physical habitat conditions, collect macroinvertebrates and calculate an

EPT index based on macroinvertebrates in these two streams.

5 Field trip to Eagle Creek (A natural stream)

Module Three. Applications (group-based research)

6 Group project proposal defense **Proposal due**

In the last twenty years, we had three open labs for student-led group research projects. Students can check out equipment and use the lab for analyzing samples and finally students present their research to the entire class. Each group is required to formulate their own research question, design a field study, collect and analyze data, and finally present their findings. This lab will kick-off the group research project. Each group will present their research proposal with the research question or hypothesis, background information including the relevant literature, study design, and expected results using PowerPoint slides. After the presentation, each group will be required to answer questions from their peers, GTA, and instructor and then revise their research plan accordingly.

7 Group research (open lab) **Lab 2 Report due**

8 Group research (open lab)

9 Group research (open lab)

10 Group research presentations

We will use two lecture class periods for group research presentations so that everyone can share and learn research experiences and findings from each other.

11 Peer evaluation on each group member's contribution to the group project.