ESM 325 Environmental Risk Assessment Lab

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Lab: 12:10-3:50 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

● **Zoom,** a video conferencing tool which we will use for remote teaching and learning (freely available from https://www.pdx.edu/oit/zoom-meetings)

● **D2L**, an on-line learning system (https://d2l.pdx.edu/). You need to use your ODIN user name and password to log in. Lab materials such as syllabus, reading assignments, and lab report assignments will be posted in "D2L". Please check it on a regular basis for class materials, news, and last-minute announcements. You are encouraged to use "D2L" to post questions, comments, and suggestions.

● **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.

- **Virtual lab via Zoom video conference**

We will use Zoom for virtual meetings and recordings in this course. Your use of Zoom is governed by the [Acceptable Use Policy](#) and PSU's [Student Code of Conduct](#). A record of all meetings and recordings is kept and stored by PSU, in accordance with the Acceptable Use Policy and FERPA. Individual use and distribution of recording is limited to academic purposes.

Your instructor will schedule Zoom video conference for each lab period (T, Th, or F at 12:10) in D2L and record each session. The recorded session will be posted in D2L in case you miss it due to health or other issues

- **How to join a Zoom meeting in D2L**

Note: Zoom meetings run best via the Zoom App or Google Chrome. If you have not already downloaded the app, you will be prompted to do so upon joining the meeting. It will take a few minutes and thus it is highly recommended that you join the first zoom meeting several minutes before class starts.

1. Login to D2L at d2l.pdx.edu
2. Navigate to the course in which the Zoom meeting is scheduled.
3. Click **People**, then **Zoom Meetings**.
4. Find your meeting from the list of upcoming meetings and click Start or Join.
5. Confirm the browser dialogue to launch Zoom.
6. Select your audio conference options. In most cases, you should choose "Join With Computer Audio," which may be your only option.

For more details on **How to join a Zoom meeting in D2L**, please check this webpage < https://oaiplus.pdx.edu/blog/2019/09/20/getting-started-with-zoom-via-d2l/>

- **Student guide to learning remotely and remote learning kit**

PSU has a variety of tools to help you connect, share information, and complete coursework without meeting physically. For more information, please check these webpages

< https://portlandstate.atlassian.net/servicedesk/customer/portal/2/article/877265100>

<https://pdx.pressbooks.pub/remotelearningkit/front-matter/introduction/>

Grading

● Lab 1 Report (25%)

● Lab 2 Report (25%)

● Lab 3 Report (25%)

● Group Project (25%)

- Annotated Bibliography (5%)
- Proposal (10%)
- Presentation (10%)

Group project: The class will be divided into project groups of 3-5 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 D2L Dropbox. 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.

Department Policy: Incompletes can only be given for verified medical reasons.

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   Ecotoxicology assays with *Daphnia pulex* adults (Watch a video of a demo lab experiment)

An actual ecotoxicological lab was performed and video-recorded by TAs and ESM lab manager so that we will learn how to design an ecotoxicity experiment, set up and run the experiment, and finally collect ecotoxicity data.

Since we will use R/RStudio to perform multiple data analyses during the course, we will get started with RStudio with software installation, data import, data summary, and data visualization. Worksheet 1 will be provided. We will also install QGIS software which will be used for Lab 3.

2   Analysis of Ecotoxicology assays using RStudio

We will analyze and interpret the ecotoxicity experimental data 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 GIF tool will be very beneficial.

4   Macroinvertebrate responses to urbanization

Annotated Bibliography due

In this lab, we will watch two short videos. One is by University of Wisconsin on how to sample stream macroinvertebrates and the 2nd is by an aquatic ecologist Kris Wright from University of Wisconsin at Platteville. He will give a short introduction of stream macroinvertebrates, guides, and their roles in stream bioassessment.

We will use a dataset collected by USGS scientists in Oregon Water Science Center in the Willamette Valley as a part of the National Water-Quality Assessment program (NAWQA). In this study, USGS scientists methodically selected 28 watersheds in the Willamette Valley along an urban gradient using GIS and multiple urban land use indicators such as population density, road density, and % of impervious areas in a watershed. In each stream site, they collected water quality data as well as macroinvertebrates data. We will analyze the effect of watershed urbanization on pollution sensitive macroinvertebrate taxa richness (EPT richness) using a multiple regression model following worksheet 4 and then summarize our findings in the 2nd lab report.

5   Stream insect identification and macroinvertebrate metrics   **Lab report 2 due**

In this lab, we will first watch a video on how to identify major aquatic insect groups in California streams by Joseph Slusark, a taxonomist in Chico Aquatic Bioassessment Lab. He provides a detailed coverage on major groups of freshwater insects in streams. Despite the focus is on California streams, a large portion of the same taxa are also present in Oregon streams.

We will use the same dataset that we used in Lab 4 to generate macroinvertebrate metrics. Each metric describes a different aspect of macroinvertebrate assemblage structure and function and in bioassessment, we are selecting and using a set of the metrics which are sensitive to human disturbance. Macroinvertebrate metrics are generated based on each taxa's traits. In Lab 4, we have learned already about several macroinvertebrate traits such as feeding guilds. Dr. Poff from Colorado State University has published a detailed list of stream macroinvertebrate traits and we will use his work to generate multiple metrics which will be used for developing a multimetric index, a subject for the next lab. Worksheet 5 will be provided.

6   Macroinvertebrate multimetric index development   **Proposal due**

In this lab, we will develop a macroinvertebrate multi-metric index for assessing the impacts of urbanization on stream ecosystems. We will first identify both reference streams which are minimally impacted by urbanization and impacted streams which are extensively impacted by urbanization. Macroinvertebrates are identified and enumerated for their abundance. Based on a set of candidate metrics which we generate in Lab 5, we will visualize the difference of each metric between the reference and impact streams using Box plots and then test their sensitivity using a t test. We will select those sensitive metrics and score each metric based on their distribution. A sum of the sensitive metrics will make up for a multi-metric index and we will use the index to assess stream health. A detailed instruction on each step will be provided in worksheet 6 and the results will be written as the 3rd and last lab report.

Module Three. Applications (group-based research)

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. Under current circumstance, we have to modify the approach but still provide an opportunity for student-led inquiry. We will have two options:

Option 1. Each group can formulate their own research question, design a field study, collect and analyze data, and finally present their findings. This is our traditional approach. In this case, we need to make a few changes. Each student needs to collect the data alone or collect data together in the field but following a strict 'social distance' protocol by the state (e.g., each of you drives to the field site in a separate car, keep at least 6 feet away in the field).

Option 2. Each group selects a stressor of their interests (e.g., heavy metals, pesticides, timber harvest, etc.), collect ecological risk assessment data (e.g., NOEC, LOEC, LC_{50}, EC_{50}) from the published literature or agency reports, compile these data to build a dose-response curve, and then use the dose-response curve to assess ecological risk of a local stream (e.g., Johnson Creek).

We don't need to make our decision on either option right away. We will use the option 2 as a default and if the COVID-19 virus situation gets improved by Week 6 or 7, we may be able to lean towards the field work option. Regardless, in week 7-9, each group should schedule weekly meetings with your section TA to discuss the group research projects, progress, and any challenges.

7	Group research (open lab)	**Lab 3 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.