Ecological Risk Assessment

EAS 523-01, Tuesday 5:30 – 7:00pm (discussion/questions) + Remote lectures
Fall 2020

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Class Overview & Outcomes

This course allows you to:

- Understand how ecological risk is determined
- Understand the role of multiple stressors in ecosystem impairments
- Learn how to make science-based decisions via weight-of-evidence approaches to better manage, protect and restore waters.
- Develop an appreciation for stakeholder perspectives

This course introduces ecological risk assessment (ERA), describing the basics of how ERAs are most often conducted by governments and environmental consultants. A wide range of assessment approaches exist dealing with chemical-specific criteria development to the remediation of small to mega-sites exceeding $1billion. Case study examples will demonstrate the state-of-the-practice and new approaches that decrease uncertainty associated with the ERA process. The important linkage of ERA issues to decision-making in the risk management process will be emphasized, with real-world, high visibility case studies.

In addition, we will include a Michigan Sustainability Class case study. Our case example will focus on Ann Arbor's 1,4 dioxane groundwater pollution plume caused by Gelman industry. Students will "enter" the immersive case environment as an assignment (readings, watching videos, listening to interviews). The in-class case discussion offers a chance to digest and debate elements of the case. We will consider the environmental, human health, and political complexities of this site, which are common to most contaminated sites.

The course reviews the ERA and hazard assessment processes used to determine 1) whether contaminated sites should be cleaned-up, 2) safe levels for chemicals in the environment, 3) if other non-chemical stressors are a concern, 4) relevant social/environmental justice issues, and, 5) thereby, provide for sound environmental management applications. This approach is primarily used in Developed Countries; but, we will discuss how perceptions and approaches vary in Developing Countries.

The primary objectives of the course are to build competency in assessing stressors in ecosystems and thereby become more effective in dealing with real-world issues commonly encountered. This bridges process, science and practice throughout the ERA process. This should result in the ability to recognize quality ERAs and identify ways to strengthen the linkage between an accurate ERA and management options. The overriding consideration is: **How can you improve and restore ecosystem quality without knowing what is causing**

the majority of its impairment (i.e., hazard or risk)? *Present practice is antiquated, inefficient and thus, misleading as it oversimplifies ecosystem dynamics and focuses on single chemicals, such as PCBs or mercury.*

Students will learn to both recognize a strong ERA vs. one laden with scientific uncertainties, confounding litigation settlements and decision making. We will describe the state-of-the-practice including its limitations, realities and ways to improve ERAs along with remediation efforts in freshwaters and marine near-coastal areas.

Prerequisite requirements

Ecology and freshman chemistry courses are helpful - *but not required*.

Course Logistics and Grading

The course will consist of asynchronous lecture videos (via Canvas) and weekly Zoom discussions (scheduled class time). During the Zoom discussion, the learning objectives from the previous lecture will be addressed by answering questions provided at the end of the video. There will be time for online questions during group discussion; and, students may converse "one-on-one" with Dr. Burton via email or Zoom.

Grading:

1. At the end of each video (3 per lecture topic) there will be one short answer question. So, by the end of the semester there will be 30-40 questions each student will have answered. During the **final scheduled class period** (via Zoom), each student will submit the answers to 6 videos from 2 lectures, randomly selected by Dr. Burton. Answers will be checked for plagiarism. **60 points**
2. Powerpoint and optional video on an environmental risk topic (pre-approved). The presentation should provide an overview of the risk topic (e.g., PFAS chemicals, HABs, Environmental justice and contaminated sites) and then describe how to best design a study to evaluate ecological risk of the topic. Examples will be provided and discussed on Zoom. **30 points**
3. Participation (Zoom discussions, Chat, Email, Canvas) **10 points**
4. **BONUS POINTS**: Up to five half-page summaries of course-related journal papers and/or related UM environmental seminars. 4 points each. **20 points max**

Schedule *(lectures posted one week prior to class)*

Lecture No.	***Topic***	***Other***
1	Class overview. What is risk? U.S. EPA ERA process overview. The MichCon Site	 *Risk Bite 4 videos (see below)*
2	Problem Formulation & Exposure Characterization	
3	ERA in Developing Countries	Dr Eduardo Cervi *ECO Update: Selecting and using reference info*
4	The Ann Arbor dioxane plume: Health risk?	*MSC web site link: Read & view podcast* Risk Bite: How dangerous is 1-4 dioxane
5	ERA at Dow Chemical: Case examples & Management issues	Dr. Steve Brown

6	Effects Characterization	*ECO Updates: Field Studies & Tox testing*
7	Risk Characterization	
9	ERA at U.S. EPA: Case examples & mgmt Issues.	
10	Uncertainties and management issues	
11	**Student presentations**	

Required Reading Highlighted + Useful Information

Risk Bites: 4 short videos: What the heck is dose response? Part 2. Fear of the Unknown; Part 3. Dread; Hazard vs. Risk. https://www.youtube.com/user/riskbites

Dioxane Plume Pollution (Gelman Case Study in "Gala" with the Michigan Sustainability Classes.
https://www.learngala.com/magic_link?key=_30-gdkC0keOiFH4DghzUA
If you do not have a Gala account you can "Sign in with Google" and enter your UM account.

ECO Update: Selecting and using reference information in Superfund Ecological Risk Assessments
https://www.epa.gov/sites/production/files/2015-09/documents/v2no4.pdf

ECO Update: Field studies for ecological risk assessment.
https://www.epa.gov/sites/production/files/2015-09/documents/v2no3.pdf

ECO Update: Using toxicity tests in ecological risk assessment.
https://www.epa.gov/sites/production/files/2015-09/documents/v2no1.pdf

U.S. EPA ECO Update Bulletin Series: https://www.epa.gov/risk/eco-update-bulletin-series

U.S. EPA Ecological Risk Assessment Guidance. 1998
http://www.epa.gov/sites/production/files/2014-11/documents/eco_risk_assessment1998.pdf

U.S. EPA Ecological Risk Assessment Home Page
https://www.epa.gov/risk/ecological-risk-assessment

Great Lakes Areas of Concern
https://www.epa.gov/great-lakes-aocs

U.S. EPA Rapid Bioassessment Protocols for stream fish, benthic macroinvertebrates and periphyton (also includes habitat assessment and physicochemical parameters in Chp 5).
https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1164.pdf

Revised methods for characterizing stream habitat in the national water-quality assessment program. USGS Water-Resources Investigations Report 98-4052.
https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf

Ohio EPA Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI)
https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf

U.S. EPA. 2016. Stressor identification evaluation guidance.
https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=20685

U.S. EPA 2001. Methods for collection, storage and manipulation of sediments for chemical and toxicological analyses: Technical Manual. EPA-823-8-01-002

U.S. EPA, 2012. Equilibrium partitioning benchmarks (ESBs) for the protection of benthic organisms; procedures for the determination of the freely dissolved interstitial water.

U.S. EPA. 2005. Procedures for derivation of equilibrium partitioning sediment benchmarks (ESBS) for the protection of benthic organisms: Metal mixtures (Cadmium, copper, lead, nickel, silver, and zinc). https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1008GZA.TXT

Bately, G and S. Simpson. 2016. Sediment Quality Assessment: A Practical Guide https://books.google.se/books?isbn=1486303854

U.S. EPA. Region V. Ecological Risk Assessment Sediment Quality Benchmarks. https://archive.epa.gov/reg5sfun/ecology/web/html/screeningbench.html

NOAA. Screening Quick Reference Tables (SQuiRT). Summary of water, soil and sediment chemical guidelines. https://repository.library.noaa.gov/view/noaa/9327