Introduction to EcoToxicology

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Course Description:

This course is an introduction to the science of ecotoxicology. Specific foci are the translational and multidisciplinary nature of ecotoxicology and its main application in ecological risk assessment. The course will cover the movement of chemicals in the environment and bioaccumulation into ecological receptors and through food webs (exposure in the ecorisk paradigm). The course will cover effects of chemical exposure across a range of levels of biological organization (suborganismal, individual, populations, and beyond) and the methods utilized to determine these effects (effects in the ecorisk paradigm). This course will then combine these approaches by introducing ecological risk assessment, associated regulations, applications, and case studies. To be successful in the course, students should have an understanding of chemistry and ecology—this course is largely about the convergence of these topics.

Course Philosophy:

While the topics of the course are largely in two large pieces, the course will comingle principles and application. This is intended to encourage engagement as the "why?" of ecotoxicology varies due to the varied reasons one would be concerned about chemicals as stressors to ecosystems.

Teaching philosophy will be based on Methods, Data, and Practice. We will largely chunk material into "why" and "how," (Methods), "who," "what," "where," and "when" (Data), and work in teams to solve real world examples (Practice).

Course Purpose and Learning Outcomes:

The purpose of the course is to hit the high points of the science behind chemical management. There will be details and advanced topics left for higher level courses, but students will engage with principles of exposure, principles of effects, and how those two are integrated to speak to risk of chemicals to ecosystems.

Successful students of the course will be able to:

-Explain basic principles of chemical fate and transport
-Explain basic principles of bioaccumulation and trophic transfer
-Explain acute, chronic, lethal, and sublethal effects of chemical exposure
-Explain the translation of effects or exposure observed in the lab to effects or exposure in the field

-Make quantitative estimates of exposure, effects, and understand how these contribute to an estimate of risk.

Suggested Reading:

Peer reviewed readings will be provided as needed in the course.

Specific textbooks that will be referenced include:

Newman, M.C. (2019). Fundamentals of Ecotoxicology: The Science of Pollution, Fifth Edition (5th ed.). CRC Press. https://doi.org/10.1201/9781351133999

Walker, C.H., Sibly, R.M., Sibly, R.M., & Peakall, D.B. (2012). Principles of Ecotoxicology (4th ed.). CRC Press. https://doi.org/10.1201/b11767

Course Structure:

The course will be a mix of lectures, discussions, and team projects.

Lectures will cover topical material, discussions will be based on topical reading, and team projects will be based on topical case studies.

Student Performance Evaluation:

Students' performance will be evaluated against expectations of participation, demonstrated knowledge, and successful project execution.

Weekly lectures and discussions will require student participation. We will define desired activities such as teach a slide, describe a figure, work a math problem, summarize a paper, etc. in the early stages of the course to match students' appetite for public performance with real-world expectations of engagement with colleagues.

Topical exams will be used periodically to provide checks on course material uptake. Exams will likely take a variety of formats to ensure approachability. Potential formats include 'fill in the blank,' 'complete the equation,' 'multiple choice,' 'make yours look like mine,' 'describe in your own words,' etc.

Project execution will be determined by written assertions of contribution, a written plan for assigning contribution, and appropriate citation in completed material. Accordingly, as in real life, contribute where you are strongest.

Each of these represent 33% of course performance.

{insert legalese sections specific to organization}

Course Schedule:

Week	Topic	Reading	Activity
1	Toxicological Paradigms		Make your own version of Newman Chp 1 Figure 1.14
2	Why are chemicals in the environment?	Newman Chp 2, Walker Chp 2	Read the SDS of your toothpaste
3	What are ecological receptors?	Salice et al. 2018; Leeson et al., 2021	Draw hypothetical site conceptual model
4	Abiotic movement of chemicals	Walker Chp 3	Partitioning examples
5	Biotic movement of chemicals	Newman Chp 4+5	Define your food web
6	Persistence of chemicals	EPISuite User Guide[a]	Run example chemicals through EPISuite
7	Organism uptake of chemicals	Walker Chp 5	Estimate your receptor exposure
8	Lethal endpoints	Newman Chp 9	EC50 estimation
9	Sublethal endpoints	Walker Chp 7+8	EC50 estimation
10	Endpoint translation	Salice et al. 2018; Ankley et al. 2010	HC5 estimation and AOP description
11	In situ observations	Walker Chp 11; Poliserpi et al. 2021	Describe field observed effects or concentrations
12	Population and other considerations	Walker Chp 12, Kohler et al. 2013	Exponential growth example
13	Risk estimation	Newman Chp 13	Estimate HQ

[a]: https://episuite.dev/EpiWebSuite/#/help

Salice CJ, Anderson TA, Anderson RH, Olson AD. 2018. Ecological risk assessment of perfluorooctane sulfonate to aquatic fauna from a bayou adjacent to former fire training areas at a US Air Force installation. Environmental Toxicology and Chemistry. 37(8):2198–2209. doi:10.1002/etc.4162.

Leeson A, Thompson T, Stroo HF, Anderson RH, Speicher J, Mills MA, Willey J, Coyle C, Ghosh R, Lebrón C, et al. 2021. Identifying and Managing Aqueous Film-Forming Foam-Derived Per- and Polyfluoroalkyl Substances in the Environment. Environ Toxicol Chem. 40(1):24–36. doi:10.1002/etc.4894.

Ankley GT, Bennett RS, Erickson RJ, Hoff DJ, Hornung MW, Johnson RD, Mount DR, Nichols JW, Russom CL, Schmieder PK, et al. 2010. Adverse outcome pathways: A conceptual framework to support

ecotoxicology research and risk assessment. Environmental Toxicology and Chemistry. 29(3):730–741. doi:10.1002/etc.34.

Poliserpi MB, Cristos DS, Brodeur JC. 2021. Imidacloprid seed coating poses a risk of acute toxicity to small farmland birds: A weight-of-evidence analysis using data from the grayish baywing Agelaioides badius. Science of The Total Environment. 763:142957. doi:10.1016/j.scitotenv.2020.142957.

Köhler H-R, Triebskorn R. 2013. Wildlife Ecotoxicology of Pesticides: Can We Track Effects to the Population Level and Beyond? Science. 341(6147):759–765. doi:10.1126/science.1237591.