Road Ecology, ESM 415/515

Instructor: Catherine de Rivera, Ph.D.
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Office Hrs:

Course Overview: This class focuses on environmental impacts of roads and how they can be mitigated. Through lecture, reading, discussion, and projects, students will learn to identify and explain the major environmental issues associated with road system construction, maintenance, and operation. Guest lecturers and projects will bring real-world perspectives to the class, helping students understand current problems and research needs. Students will also acquire library research skills through an individual report and presentation that require a review of primary literature. Scientific reasoning, data collection, and analysis skills and strategies will also be used to complete group projects integrating the ecological effects of the road system into management.

Course Objectives:
By the end of the course students will be able to interpret and synthesize information about the ecological effects of roads to **create** an ecologically based, useful **management document** and, separately, to create an informative, **synthetic paper** of a topic important to our current understanding ecological or evolutionary effects of roads. Students will also **build skills** of **reading** and critiquing pertinent **papers**. Therefore, after taking this course, students should be able to:

- Explain ecological concepts central to understanding effects of pollution, reduced habitat connectivity, and other impacts of roads on organisms.
- Apply ecological knowledge to management or roads
- Find, understand, critique, and discuss relevant literature, and incorporate scientific papers into independent learning.
- Create a useful management tool.

Learning Outcomes: Through the coursework students will be working towards the following abilities and ESM Learning Outcomes.

- Critical thinking;
- Ability to explain interactions among the physical, biological, chemical, and human components of the environment;
- Ability to generate and communicate supported conclusions on environmental problems at hand;
- Experience working collaboratively in a team to develop approaches to address environmental issues;
- Ability to approach problem solving using both science and social science/humanities;
- Ability to identify drivers of environmental problems and potential solutions

Prerequisites: undergraduate environmental science or ecology course

Schedule

Date	Topic	Assignments
T 3/30	Introduction	
R 4/1	Habitat fragmentation & roads, Discuss paper 1	P#1, skim bk 3-16, 39-47
T 4/6	Projects; Roads as a conduit for species	Ch 3; skim P#2; Topics due
R 4/8	Road effects on water quality, William Fletcher, ODOT	Ch 8, P#3 **or** #4
T 4/13	Managing runoff, Ivy Dunlap Portland Green Streets	Ch 7
R 4/15	Library Skills, Greta Siegel, PSU, **Library, rm 160**.	
T 4/20	Martin Lafrenz, PSU air quality,	Ch 11, P#6
R 4/22	Establishing wildlife corridors, Lori Hennings, Metro	Ch 4,5; **Bibliography due**
T 4/27	Work on group projects	
R 4/29	Linda George, PSU	Ch 10, P#5, **Exam** for 410
T 5/4	Construction and use of underpasses: Kerry Rappold, Wilsonville; Leslie Bliss-Ketchum, PSU	Ch 6, P#7; **Annotated due**
R 5/6	Field Trip to Boeckman Road	
T 5/11	Regulatory issues w/ Bridges, Hal Gard, ODOT	Ch 9, **Draft papers due**
R 5/13	Fish passages, Greg Apke, ODFW	
T 5/18	Management of verge weeds. Will Lackey, ODOT	**Peer reviews due**
R 5/20	Field Trip	
T 5/25	Issues & progress, Gail Achterman, Inst Natural Res.	Ch 14, 320-340; **Papers due**
R 5/27	Student presentations	
T 6/1	Student presentations	
R 6/3	Project presentations /Conclusions and review	
M 6/7	10:15-12:05 Comprehensive Exam	**Exam**

Readings:

Text: Forman et al. 2003. Road Ecology: Science and Solutions.

Papers ***(Note: paper readings will change each year but are along the lines of these, used in 2010).***

1. Eigenbrod F, Hecnar SJ, Fahrig L (2009) Quantifying the road-effect zone: Threshold effects of a motorway on anuran populations in Ontario, Canada. Ecology and Society 14
2. Von der Lippe M, Kowarik I (2007) Long-distance dispersal of plants by vehicles as a driver of plant invasions. Conservation Biology 21:986-996
3. Kayhanian M, Singh A, Suverkropp C, Borroum S (2003) Impact of annual average daily traffic on highway runoff pollutant concentrations. Journal of Environmental Engineering 129:975-990
4. Booth DB, Jackson CR (1997) Urbanization of aquatic systems: degradation thresholds, stormwater detection, and the limits of mitigation. Journal of the American Water Resources Association 33:1077-1090
5. Air quality paper TBA
6. Shepard DB, Kuhns AR, Dreslik MJ, Phillips CA (2008) Roads as barriers to animal movement in fragmented landscapes. Animal Conservation 11:288–296
7. van der Ree R, Heinze D, McCarthy M, Mansergh I (2009) Wildlife tunnel enhances population viability. Ecology and Society 14:online

Assignments & Grading

Grading component	Undergraduate %	Graduate %
Participation (questions, discussions on papers)	8	8
Homework	7	7
Lead paper discussion	0	2
Annotated bibliography (bibliography & annotated)	7	7
Group project (methods, participation, product, + presentation)	18	22
Review paper	15	18
Oral presentation on review topic	15	18
Midterm Exam	12	N/A
Comprehensive Exam	18	20

- **Participation**: based on the degree to which you are prepared for and participate in class discussions, ask and answer questions and remain attentive to your peers on a daily basis. Participation will be graded for a total of at least 10 points per day. Attend prepared for class = 7 points, contribute once = 8.5, multiple contributions = 10. Particularly insightful comments and questions can earn more points!

- **Homework**/Paper and chapter discussion prep: For each paper and chapter that we discuss in class, please read carefully and come to class with at least three questions or comments written up per day. These will be turned in after each discussion and will count as your homework.

- **Annotated bibliography**: provide brief critical commentary or explanatory notes for the papers you read in the quarter: the papers you read for the project and ones for your research paper. Should include more papers than the number needed for your topic writeup. A bibliography (list) without the annotations is due prior to the annotated version (but it can already be partially annotated).

- **Group Projects**: Select from one of the inquiry-based group projects listed on pages 5 and 6. Conduct your project with your group outside of class plus in available class time. You will earn points for participation based on your methods write up (5 pts), a self and peer evaluation (15 pts), from a written product from your project (50 pts) and from a brief group presentation to the class (25 pts). Ideally all undergraduates will be in groups with at least one graduate student.

- **Literature-based paper and presentation** on a Road Ecology topic that interests you. Ideally your paper will be related to (in more depth on some aspect of) your group project. Topic ideas include: sustainable design of roadways; best practices for policy and planning for your group project topic; effectiveness of mitigation; roadways and transport of nonindigenous species; compare and contrast rural v. urban effects; effectiveness of different materials; different road planning processes. Graded: Rough draft (7 pts); Provided thoughtful review of peer's draft (8 pts); final draft (85pts)
  - Undergraduate Students: Select a chapter from the text book or a review paper as the starting point for your paper. Use the references therein (or other primary references) to write a review (maximum 5 page, 1.5 space) of key research and ideas on the theme. Include in your review an evaluation of at least 6 primary references that you have read carefully. Prepare and give a 12 min presentation including time (~2 min) for questions.

  - Graduate Students: Select a topic in Road Ecology and write a paper that synthesizes the current state of the research OR write a grant proposal to conduct research on that topic. Your review/proposal should be a maximum of 7 pages (1.5 spaced) and include at least 12 primary

research reference papers. Prepare and give a 20 min presentation for the class including time for questions.

- **Exam(s)**: based on all materials presented in class, including guest and student presentations. Exam is Monday, 7 June, 10:15-12:05. Undergraduates also have a take home midterm exam.

Grading scale: You will earn a letter grade for your work in this course. The scale to translate your numeric grade to a letter grade is as follows: A (90-100): High level integration and conceptual development with factual accuracy, coupled with clear, concise communication; B (80-89): Accurate with significant integration and conceptual development, and clear writing/delivery; C (70-79): Mostly accurate and simply factual, modest concept development and communication D (60-69) & F: Missing or ineffective elements of conceptual development, idea integration, accuracy, or clarity. + x7.0-x9.9; - x0.0-x2.9 (e.g. 82.8 = B-)

Policies

D2L: Links to assignments will be posted on D2L: https://d2l.pdx.edu/ If you don't have an Odin ID go to http://oit.pdx.edu/set-up-odinacct

Services: If you are a student with a documented disability and are registered with the Disability Resource Center, please contact me so that we can arrange whatever academic accommodations you need. If you are a Veteran and have questions about University services or need assistance with your transition from military to campus life, please contact Chris Goodrich, Coordinator of Veterans Services at the Office of Veterans' Services, SMSU room 425.

Late policy: Prepare and deliver work on time. *Late assignments will be penalized: your grade will reduced by 5% for each day late for the first 1-6 days; Late work 7 days or more will be given a zero* (e.g., if due on Monday, must be handed in before start of class the following Monday to be graded). Extension requests must be made at least two days prior to the assignment due date. If you're sick, e-mail me your assignment or upload it to d2l. If you are unable to come to class for your scheduled oral presentation, let me know at least 36 hrs in advance.

***Illness policy*:** If you're contagious, please don't come to class. Work with me to figure out how to compensate for missed class and email me or upload your assignments as they're due (if you didn't ask for and receive an extension).

***Conduct*:** We are to 'realize' the 'highest ethical standards of professional' and student behavior. Check out the Student Code of Conduct, to which you are bound: http://www.pdx.edu/dos/codeofconduct

Also, if you have not already done so, please go through the on-line training for creating a safe, respectful campus: https://d2l.pdx.edu/d2l/home/425907

Plagiarism: Do not plagiarize. There are many forms of plagiarism, including: Copying word for word without quotation marks and proper citation; and Paraphrasing without proper citation
Please consult the Purdue OWL regarding plagiarism and other writing issues:
https://owl.english.purdue.edu/owl/resource/589/01/

Questions and Email: As much as possible, please ask questions during and after class and come to my office hours. If these times do not work for you, send me a message to set up an alternative time. If you do need to send me an email, please follow these general guidelines:

- include an informative subject line (e.g., ESM 221, assignment #1)

- include a salutation (e.g., Dear Dr. de Rivera: or Hello,…)
- include your name
- do not expect an immediate reply. Normal turnaround time for email is 1-2 business days.

General expectations:

- **Participate daily, ask questions, share your ideas!** We have many experts taking time to share their knowledge with you: respect their time, think about their ideas, and take advantage of their expertise.
- Be **prepared** for class
  - Communicate and collaborate with your classmates on group assignments.
  - Read assigned papers and come to class prepared for discussions.
- Correct grammar, clear structure and **scientific reasoning** will all be incorporated into your grades.

For your written work **refrain from citing work from the web**. Follow the information to its source and cite the primary, reviewed literature.

Topics and themes for Projects: ***Note: These topics change yearly as community partners bring different current projects to the class each year. Here are examples from 2010, when the course was taught as 410/510.***

1) **Assess habitat connectivity**. The Oregon Conservation Strategy identifies "Barriers to Fish and Wildlife Passage" as one of the key conservation issues in the state, and many people and organizations are working to provide room for the natural movement of animals across the landscape. Consequently two projects are on this general theme.

a) Students will help collect and analyze tracking data for the study, "The Effectiveness of Vertebrate Passage and Prevention Structures: a Study of Boeckman Road in Wilsonville." Wildlife usage of structures will be monitored using sand to determine how the use frequency, composition, and diversity of animals varies across passage structure type and with varying light conditions. Contact: Leslie Bliss-Ketchum, PSU

b) Students will survey Johnson Creek (where accessible) for barriers to wildlife crossing and assess the strength of the barriers and identify potential mitigations to the barriers. Contact: Lori Hennings, Metro

2) **Map ivy along area roads for ODOT and prioritize areas for removal.** The impacts of invasive species are many and varied and invasive species are often found in disturbed habitats. Roadside areas are typically heavily impacted by non-natives. Here in Portland, roadside trees are being pulled down by ivy. This, of course, affects roadside habitat as well as conditions (amount of erosion along the road and possible tree fall). Mapping of roadside ivy is prerequisite for removal (and, in fact, for grants for removal). ODOT ecologists therefore need students to identify the extent and distribution of ivy along roads. Contact: Mindy Trask.

3) **Evaluate the effectiveness of swales** or retention ponds on water quality. Swales are open channel drainage ways used to filter and channel stormwater runoff. William Fletcher (ODOT) will help identify swales that are safe to access. Take sediment cores (for grain size and contaminant levels) at the entry and exit points to assess changes in concentrations of metals along the length of swales or retention ponds. This will identify accumulation of lead along roadsides, particle size partitioning, and the effectiveness of treatment measures. This effort will assist in assessing BMP effectiveness (pollutant concentrations in treatment facility deposits) and provide context for explaining why ODOT sets

standards and criteria for treatment the way they do. Alternatively, students could sample along a transect from the highway shoulder down an embankment to native soils, or conduct comparative sampling of accumulated material in bare versus vegetated roadside ditches (will coordinate with ODOT Maintenance so they could provide a safe environment to do the sampling).

4) **Evaluate the effect of stormwater outfall on macroinvertebrates**. Students would compare the composition of the macro-invertebrate community upstream versus downstream of a highway stormwater outfall. This could be done in coordination with #3 above and include evaluating how the community changes with distance along the swale. Students would be responsible for sampling and identification as well as evaluating upstream conditions and land uses that might influence species composition or population. Contact: William Fletcher

5) **Roadside plantings** of a variety of species of plants are conducted in part to reduce run-off and air-pollution. Evaluate the effectiveness of several different species of common plants that are found in the same area (freeway adjacent, slope plantings, etc…). Plants can be expected to have varying rates of contaminant uptake rates and contaminant retention (in particular, heavy metals). ODOT is interested in the fate of these heavy metals, whether they are retained in the plant tissues, or released back into the environment once the leaves drop or tissues senesce, so sampling should cover several different plants of varying ages. Samples can be prepared and submitted to the OHSU Metals lab for evaluation. This information and recommendations based on this project will be submitted via William Fletcher to ODOT.

6) Select your own project! Propose a project that focuses on a topic in Road Ecology that will yield a product useful for researchers, managers or the public at large. This project should include an impact statement outlining how your work will be used by any of the above. E.g., producing a guide of Oregon's roadside species, their distributions and descriptions, and contact information for reporting sightings.