

ENVS 427: Environmental and Ecological Monitoring

Winter 2016 Syllabus

I. Summary Information

A. Instructors

- Peg Boulay, Instructor, 541-346-5945, boulay@uoregon.edu
Office: 242 COL; Office Hour: 2:00 – 3:00 p.m. Wed and by appointment
- Lauren Hendricks, GTF, lhendri2@uoregon.edu
Office: 47B COL (ELP Lab); Office Hour: 11:00 a.m. – 12:00 p.m. Fri and by appointment

B. Meeting Times and Locations

Lecture: Wednesday 12:00 – 1:50 p.m.; 142 COL

Lab: Friday 1:00 – 4:50 p.m.; 101 PETR (unless otherwise specified)

C. Required Readings and Materials

Required readings will be from the text, on-line documents, peer-reviewed journal articles, and other materials.

- Text = Elzinga, C. L., D. W. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring Plant and Animal Populations. Blackwell Science, Malden, Massachusetts. The text is available on reserve in the Science Library (4 copies). Excerpts from the text are available on Google Books: http://books.google.com/books?id=fSWchnyyLhEC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false.
- Additional assigned readings (available on-line and/or Canvas) and handouts.
- 4.5" x 7" (or similar size) Rite in the Rain[®] notebook (mandatory; available at UO bookstore). Do not use a smaller notebook (e.g., 3" x 4.5") – it won't be big enough.
- Calculator for in-class exercises and exams.

D. Key Dates

1/13	Wed	Field Observation topic due
1/15	Fri	Homework: Partner/Planning Worksheet Section 1 draft due
1/22	Fri	Homework: Partner/Planning Worksheet completed final due
1/29	Fri	Literature Search due
2/3	Wed	Exam 1
2/5	Fri	Field Observation update due
2/19	Fri	Literature Synthesis due
3/4	Fri	Field Notebook due (at end of class)
3/9	Wed	Monitoring Plan due
3/18	Fri	Exam 2

E. Course Website

We will be using Canvas as a means of communication and coordination. Visit our Canvas site regularly throughout the term for announcements, assignments, handouts, worksheets, pdfs of lecture Powerpoint presentations, and other information.

II. Course Overview and Objectives

Environmental scientists collect, analyze and share information for a variety of reasons. In this course, we will use a broad definition of environmental and ecological monitoring, one that encompasses a variety of activities, including rigorous research and long-term surveillance. Your specific objectives will shape your questions which in turn will drive your project design and methods. In the Environmental Leadership Program's (ELP) "Conservation Science in Action" projects, students collect and use information to assist our community partners with habitat restoration, management planning, species conservation and other needs. This course is designed to prepare you for your spring ELP projects by introducing you to your team, community partners, project background and protocols. However, to be an effective field scientist, you need to know more than one or two methodologies. We will examine the entire process of designing and implementing a monitoring program. We will investigate several local case studies and gain hands-on experience using common techniques to collect, manage, summarize and present data. The ELP projects all use established techniques to address current conservation issues, so these case studies are relevant to our course work regardless of your affiliation with a particular ELP project. In addition, we will practice some fundamental skills that all field-based environmental scientists should know.

Learning Objectives

Through active engagement in the course and course materials, students will:

- Describe how monitoring programs are used to address questions and management issues in population, habitat and ecosystem management; restoration ecology; sustainable agriculture; and other fields.
- Describe the critical role of planning and design within a monitoring program.
- Compare and contrast local case studies to discover common themes of sampling design, sources of bias, data management, and more.
- Critically consider the causes and consequences of coming to the wrong conclusion (e.g., concluding there was a change when there was none or failing to detect a real change).
- Learn how to use common monitoring tools and techniques and understand the circumstances where they are best applied.
- Practice collecting, summarizing and interpreting monitoring data.
- Search for, read, interpret, and summarize scientific literature. Communicate monitoring goals and protocols in the form of a monitoring plan.
- Apply listening, communicating, collaborating and other interpersonal skills essential to working within team settings.

Ecological monitoring is highly quantitative and relies on models for predicting outcomes and statistics for analyzing data. Because I emphasize field methods, we do not have time to adequately address statistical design. Please be aware of that you must thoughtfully consider variation, sample size, power and the assumptions of specific statistical tests **before** you collect any data! We will discuss some sampling design considerations. Students with weak statistics background often find this content challenging but not overly difficult. I encourage you to read Chapters 7 and 8 carefully and ask questions.

III. Class Activities, Evaluation and Grading

*Note: We will post test scores and assignment grades on our Canvas website. If you believe that we made a data entry error or that you deserve more points on an assignment or exam question, submit a brief explanation of the situation **in writing within one week** of the scores being posted.*

A. Logistics and Standards

- **Submitting Assignments.** To save paper, we will use Canvas (for submitting and returning assignments) and the editing function in Word (for feedback). Unless otherwise instructed, submit all assignments via Canvas. Please complete your assignments in Microsoft Word or a compatible word processing program (generally, open access software works fine). Name your file with your first name and assignment title (e.g., Boulay_Synthesis.docx). All assignments are due at the beginning of class on the specified date.
- **Late assignments.** Late assignments will be penalized 5% if turned in late on the due date, then 5% every calendar day, up to one week after the original due date. To submit a late assignment, simply use Canvas. If you need to submit a hard copy (e.g., your Field Notebook), take it to the Environmental Studies office (144 Columbia Hall), ask Taylor or a Student Adviser to record the date/time and sign it, and place it in my mailbox. Except for emergencies, no assignments will be accepted after one week.
- **Determination of course grade.** Grading will be based on points rather than a curve: A = 450 – 500 pts (90–100%), B = 400 – 459 pts (80–89.9%), C = 350 – 399 pts (70–79.9%), D = 300 – 349 pts (60–69.9%), F = \leq 299 pts (< 60%).

B. Summary of class activities and grading.

Activity	Type of Activity	Total Points	Percent of Grade
Participation	Individual	20	4%
Homework: Rough Draft of Worksheet	Individual	20	4%
Homework: Final Worksheet	Team	40	8%
Field Notebook	Individual		
Mid-term update		10	2%
Final Notebook		60	12%
Project: Monitoring Plan			
<i>Literature Search</i>	Individual	30	6%
<i>Literature Synthesis</i>	Individual	60	12%
<i>Final Monitoring Plan and UO Symposium Abstract</i>	Team	100	20%
Exam 1	Individual	80	16%
Exam 2	Individual	80	16%
Total Points		500	100%

1. Participation: class meetings, Friday labs/field trips. Class meetings give us an opportunity to explore concepts in depth, place them in context, relate them to broader ecological principles or policy considerations, and apply them to environmental issues. We will use class time for exercises,

demonstrations, discussion, and problem solving. Your attendance and active participation in class activities will provide you with a greater understanding of the material than can be gained by doing the reading on your own, by talking to someone who attended class, or by reading lecture materials on the class website. The readings will provide you with important background for understanding the material in class, and I will expect that you have done the readings before coming to class.

Factors that contribute to a high participation grade include: being prepared and fully engaged during class activities, sharing your insights on the class material, asking questions when you do not understand a concept, respectfully listening to others' viewpoints, and doing your part to keep exercises and discussions focused and on track.

Poor participation in team assignments will affect both the assignment grade and your class participation grade. Lack of participation in ENV5 427 group assignments will result in a "0" for the assignment.

Lastly, the Friday labs/field trips are an important part of this course and are designed to give you hands-on practice; your attendance is required and will factor into your participation grade. If an illness or unforeseeable emergency forces you to miss a field trip, let me know as soon as possible and we will work out an alternate approach. You are required to make up missed field trips.

Dress for success! ("There is no bad weather, only inappropriate clothing." – anonymous). Unless otherwise indicated, the Wednesday lectures will be indoors. The Friday labs will almost always involve at least some time outside, even on days when we don't have off-campus field trips. Since this is Oregon, we can expect to get cold and/or wet. Please dress appropriately to keep yourself warm and dry. Dress in layers and bring raingear, gloves, hat and appropriate footwear. What else to bring on field trips: your Rite in the Rain[®] field notebook, 2 pencils (not pens), and water bottle. Optional: umbrella, sunglasses, binoculars, magnifying hand lens, snacks, and personal field plant or animal identification guides.

2. Homework: Community Partner Worksheet. This assignment is designed to familiarize you with your ELP Community Partner, project goals and your teammates. It will also allow you to begin planning your project as a team. You will be given an assignment handout with more information. Lack of participation in ENV5 427 group assignments will result in a "0" for the assignment.

Students who are not continuing in ELP spring term (the "Mighty Oaks" team) will examine oak restoration as a case study and will meet with Jason Blazar (Friends of Buford Park and Mt. Pisgah).

3. Field Notebook. The purpose of this assignment is to encourage you to take good notes during field trips and to allow you to create your own personal system of recording field notes. In addition, you will practice field observation skills and hypothesis generation through a weekly exercise. For the Field Notebook assignment, you are required to have a 4.5" x 7" (or similar size) Rite in the Rain[®] notebook. You will be given an assignment handout with more information.

4. Project: Monitoring Plan. Often practitioners must write a monitoring plan or proposal to communicate project goals/methods and/or secure funding. You will write a streamlined plan for your ELP project. This assignment will allow you to hone your synthesis and writing skills as you prepare for your project by becoming familiar with relevant literature, completing critical background reading, thinking carefully about your protocols, becoming familiar with your site(s) and creating content that can be used during spring term. This project will be completed in stages: Literature Search, Literature Synthesis, and Monitoring plan. This assignments include submitting an abstract to the UO Undergraduate Symposium. You will be given assignment handouts with more information. Lack of participation in ENVS 427 group assignments will result in a “0” for the assignment.

Students who are not continuing in ELP spring term (the “Mighty Oaks” team) will choose – as a team – between doing a monitoring plan or scientific poster using class mistletoe data. If you chose the scientific poster option, you will be required to submit an abstract to the UO Undergraduate Symposium. Regardless of your choice, you will complete the Literature Search and Syntheses assignments.

5. Exams. There will be 2 exams. The second exam will only cover material after the first exam; however, you may be asked to relate new information to material presented earlier in the class. The exams will emphasize applying concepts rather than remembering details. Exam questions will be in a variety of formats (short essay, problem-solving, fill-in-the-blank, and other approaches). Mark the exam dates on your calendar NOW. Exams cannot be made up for unexcused absences; if you miss an exam, you will get 0 points. Of course, I will work with you if you are ill or suffer an emergency. Bring a calculator to both exams!

V. Classroom Conduct

This syllabus describes the roles and expectations for each of us during the course. If you have questions or concerns about any of the course requirements, please let me know as soon as possible.

I support the use of computers to take notes. However, please show respect to your instructors and fellow students by not checking email/social media or playing games during class. Such actions can be a distraction to your neighboring students. Also, please turn off your cell phones during class. Do not check email or text via your phone during class.

A few words on cheating, plagiarism and other academic misconduct issues: I expect everyone to strictly adhere to the University Student Conduct Code (available at conduct.uoregon.edu) and University policies regarding academic misconduct. All work submitted for this course must be your own and be written exclusively for this course. Cheaters act unfairly and disrespectfully towards themselves, their classmates, and their instructors. Here are two examples of issues:

- You should not give or receive (or attempt to do so) unauthorized help on individual assignments or examinations without express permission from me. Discussing class concepts with your classmates can give you new insights into the class material, and I encourage you to share ideas. However, you must ensure that the work you turn in for credit is truly your own.
- You must properly acknowledge and document all sources of information (e.g., quotations, paraphrases, ideas). In this course, we will discuss proper methods for evaluating, using and

citing reference material. “Cutting and pasting” from the internet is essentially stealing intellectual property and will not be tolerated.

I will treat any cases of academic dishonesty seriously. If there is any question about whether an act constitutes academic misconduct, it is your obligation to clarify the question with me before carrying out or attempting to carry out the act. Additional information about a common form of academic misconduct, plagiarism, is available at www.libweb.uoregon.edu/guides/plagiarism/students.

VI. Attendance and Special Arrangements

Your attendance is expected and part of your grade. However, please tell me if you are having significant problems that interfere with your ability to attend or do work in this class. Depending on the situation, I am willing to give you an incomplete or to make special arrangements to allow you to complete your work. However, please realize that an “Incomplete” grade in this class may preclude your participation in your spring ELP project. Please ensure that your need is real and unavoidable, that you have done your best to deal with the situation, and that you inform me about it as soon as is practically possible.

Also, the University of Oregon strives to create inclusive learning environments. If there are aspects of the instruction or design of this course that result in disability-related barriers to your participation, please notify me during the first week of class. You may also wish to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

VII. Acknowledgements

I’d like to thank the following people for sharing ideas, insights and materials that have improved this course: Bitty Roy, Katie Lynch, Bruce Newhouse, Pat McDowell, and Nick Kohler. I would also like to thank in advance the guest speakers who will greatly enrich our discussions!

ENVS 427: Environmental and Ecological Monitoring

Winter 2016 Class Schedule

If specific pages aren't given, you are expected to read the entire article, chapter or document. This schedule is subject to adjustments: the assignment dates will not change, but topics covered in each class may shift.

Wk	Date	Topics	Reading	Assignment Due
1	C1 – 1/06	- ELP/course overview - Upcoming assignments - Why monitor?: overview, roles, types	1. Text (Elzinga et al. 2013. Monitoring plant and animal populations): <i>Read pp. 2-7 (part of Ch 1 Introduction to Monitoring).</i> 2. Roni, P., M. Liermann, S. Muhar, and S. Schmutz. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 254-256 (Sections 8.1-8.2 in Ch 8).</i>	
	C2 – 1/08	Field Trip: Howard Buford Recreation Area (Mt. Pisgah) - Silvicultural methods: tree dbh & height; canopy closure; pacing; keeping a field journal - mistletoe data coll.	1. Husch, B., T.W. Beers, J.A. Kershaw, Jr. 2003. Forest Mensuration. <i>Read these pages in Ch 5 Individual Tree Parameters: pp. 81-91 (5-1 Age and most of 5-2 Tree Diameters and Areas); pp. 99 – 110 (5-3 Height); and pp. 113 – 117 (5-5 Crown Parameters).</i> 2. Watch this video: City of Eugene, 2007, https://vimeo.com/43211144 . 3. Field Notebook Assignment Description	(field notes required)
2	C3 - 1/13	- Field notebooks - Planning a monitoring program - Priorities, scale, parameters	1. Text: Ch 2 Monitoring Overview 2. Text: Ch 3 Selecting Among Priorities. <i>Read pp. 25-36.</i> 3. Roni, P., M. Liermann, S. Muhar, and S. Schmutz. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 257-264 (Section 8.3).</i> 4. Greene, E. 2011. Why keep a field notebook? <i>Read pp. 256 – 274 (part of Ch 12 in M. R. Canfield, editor. Field notes on science and nature).</i> Optional: Dangles, O., and J. Casas. 2012. The bee and the turtle: a fable from Yasuní National Park. <i>Frontiers in Ecology and the Environment</i> 10 :446-447.	Due: Field Observation topic
	C4 – 1/15	- ELP community partners and project overview - Group norms - Interpreting maps	1. Community Partner websites (see Homework). 2. Princeton University's Outdoor Action Program's "The OA Guide to Map and Compass" (Ch 6 of <i>The Backpacker's Field Manual</i> by Rick Curtis [1998]). <i>Read the section titled "Maps and Map Reading,"</i> http://www.princeton.edu/~oa/manual/mapcompass.shtml . 3. USGS. 2001. The Universal Transverse Mercator (UTM) Grid, http://pubs.usgs.gov/fs/2001/0077/report.pdf .	Due: 1. Homework - Partner/ Planning Worksheet (section I draft)
3	C5 - 1/20	- Qualitative techniques - Photopoints - General field techniques - Finding, using and citing scientific literature	1. Text: Ch 4 Qualitative Techniques for Monitoring 2. Text: Ch 5 General Field Techniques 3. Text: Pp. 203-204 (part of Ch 11 Selecting Random Samples). 4. Hamilton, R. No date. Photopoint monitoring, http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint_monitoring.pdf . 5. Dean Walton's Search Strategies for Environmental Studies, http://researchguides.uoregon.edu/c.php?g=367264 and UO Libraries Checklist for Evaluating Sources, http://researchguides.uoregon.edu/c.php?g=318981&p=2665186 . Optional: Two recent articles on "predatory journals": http://news.sciencemag.org/education/2015/09/predatory-publishers-earned-75-million-last-year-study-finds and http://www.nature.com/news/backlash-after-frontiers-journals-added-to-list-of-questionable-publishers-1.18639	Please bring your laptop if you have one.

Wk	Date	Topics	Reading	Assignment Due
	C6 – 1/22	- Spatial data: aerial photo interpretation, MAP Library tour, Google Earth - map and compass - GPS (<i>weather allowing</i>)	1. Paine, D. P., and J. D. Kiser. 2012. Aerial photography and image interpretation. A) <i>Read pp. 280-290 in Ch 15 Principles and techniques of aerial image interpretation.</i> B) <i>Pp. 370-376 in Ch 19 Environmental monitoring.</i> 2. “The OA Guide to Map and Compass” cont. <i>Read all pages.</i> http://www.princeton.edu/~oa/manual/mapcompass.shtml 3. Garmin: What is GPS? http://www8.garmin.com/aboutGPS/ Optional: Baillie, M. B., N. L. Salant, and J. C. Schmidt. 2011. Using a historical aerial photograph analysis to inform trout habitat restoration efforts. <i>Earth Surface Processes and Landforms</i> 36 :1693-1702.	Due: Homework - Partner/ Planning Worksheet (final)
4	C7 - 1/27	-“Computer Lab”: Random Samples, Pivot Tables - Riparian restoration overview	1. Text: Ch 11 Selecting Random Samples. <i>Read pp. 196-the top of 201, through “Method 1”.</i> 2. Withrow-Robinson, B., M. Bennett, and G. Ahrens. 2011. A guide to riparian tree and shrub planting in the Willamette Valley: steps to success. EM 9040. Oregon State Extension Service, Corvallis, Oregon. Available from http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/24003/em9040.pdf?sequence=1	<i>Please bring your laptop if you have one.</i>
	C8 – 1/29	Field trip: Whitewater Ranch #1 Guest speaker: Jared Weybright, McKenzie Watershed Council	1. Browse the Whitewater Ranch website http://www.whitewaterranch.com/ , and watch the River Stories video: Three Million Neighbors: Conservation and Organic Farming at Whitewater Ranch. http://www.youtube.com/user/elpriverstories 2. Luna T., R. K. Dumroese and T. D. Landis. 2006. Collecting dormant hardwood cuttings for western riparian restoration projects, http://www.fs.fed.us/t-d/pubs/htmlpubs/htm06242334/index.htm and http://www.fs.fed.us/t-d/pubs/htmlpubs/htm06242334/page01.htm .	Due: Literature Search
5	C9 - 2/3	Exam #1	Study!	Exam #1
	C10 – 2/5	Field Trip: Berggren Watershed Conservation Area (BWCA) #1 - vegetation monitoring - floodplain restoration and monitoring	1. Read about the Berggren Watershed Conservation Area, http://mckenzieriver.org/protected-lands/owned-properties/berggren-watershed-conservation-area/ . 2. 2015 Riparian Restoration plant monitoring protocol. 3. USFS. 2015. Deer Creek habitat enhancement project (pdf of Powerpoint presentation). 4. USFS. No date. Deer Creek Floodplain Enhancement Project Monitoring Plan (3 page handout). 5. (Tentative). 2016 ELP Large Wood Survey protocols. 6. Watch this video: http://vimeo.com/58400710 . 7. Gilkey, H. M., and P. L. Packard. 2001. Winter twigs. <i>Read Introduction (pp. 1-11).</i>	(<i>field notes required</i>) Due: Field Observation update

Wk	Date	Topics	Reading	Assignment Due
6	C11 – 2/10	- Data collection and management - Quality Assurance/ Quality Control (QA/QC) - Scientific writing for different audiences - Climate and Phenology research – Lauren Hendricks	1. Text: Ch 6 Data Collection and Data Management. 2. Water Quality Monitoring Technical Guide Book: Ch 4 Data Quality, pp. 4.1-4.4, http://www.oregon.gov/OWEB/docs/pubs/wq_mon_guide.pdf 3. Pechenik, J. A. 2010. A short guide to writing about biology, seventh edition. <i>Read pp. 2-15 (part of Ch 1 Introduction and General Rules), p. 209 (Writing an abstract).</i> 4. Discover blog entry: http://blogs.discovermagazine.com/notrocketscience/2010/04/07/gut-bacteria-in-japanese-people-borrowed-sushi-digesting-genes-from-ocean-bacteria/ 5. Read the abstract and first 2 paragraphs of the original article (look at the figures, too): http://www.nature.com/nature/journal/v464/n7290/full/nature08937.html .	
	C12 – 2/12	Field Trip: Willow Creek #1 - Overview of HOPS project - Estimating cover	1. Pfeifer-Meister, L. et al. 2013. Pushing the limit: experimental evidence of climate effects on plant range distributions. <i>Ecology</i> 94 :2131-2137. 2. Text: Ch 12 Field Techniques for Measuring Vegetation	(field notes required)
7	C13 – 2/17	- Review Exam #1 - Central tendencies and distributions - Basic principles of sampling	1. Text: Ch 7 Basic Principles of Sampling – <i>read pp. 76 – 89 (only through “How to achieve high statistical power.” We will not cover the content on pp. 89-100).</i>	
	C14 – 2/19	- Field Trip: Whitewater Ranch #2 - Team meeting (brief!)	1. <i>Review (from 1/29):</i> Withrow-Robinson, B., M. Bennett, and G. Ahrens. 2011. Available from http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/24003/em9040.pdf?sequence=1	Due: Literature Synthesis
8	C15 – 2/24	- Sampling design, part I	1. Text: Ch 8 Sampling Design. 2. Roni, P., M. Liermann, S. Muhar, and S. Schmutz. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 264-269, Section 8.3.4, including table 6).</i>	
	C16 – 2/26	Field Trip: BWCA #2 - TFT methods - Stream inventory - Team meeting (brief!)	1. The Freshwater Trust. 2014. Revegetation monitoring protocol for water quality trading projects. <i>Read pp. 1-10.</i> 2. U.S. Forest Service. 2015. Stream Inventory Handbook, Level I & II, version 2.15. <i>Read Ch 3 (pp. 26-68),</i> http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3854765.pdf . 3. (Tentative). 2016 ELP Stream Inventory protocols.	(field notes required)
9	C17 - 3/2	- Sampling design, part II - Monitoring animal populations, part I (overview, fish)	1. Text: Ch 13 Animal Monitoring, <i>Read pp. 237-241.</i> 2. Thurow, R. F. 1994. Underwater methods for study of salmonids in the Intermountain West. <i>Read pp. 1-10,</i> http://www.fs.fed.us/rm/pubs_int/int_gtr307.pdf . 3. McKenzie Watershed Council’s fish anatomy handout.	

Wk	Date	Topics	Reading	Assignment Due
	C18 – 3/4	- Field Trip: Willow Creek #2) - Team meeting - Techniques: more veg monitoring	1. Wolkovich et. Al. 2012. Warming experiments underpredict plant phenological responses to climate change. <i>Nature</i> 465 :494-497. 2. 2016 Climate and Phenology Vegetation Survey Protocol.	(<i>field notes required</i>) Due at end of class: Field Notebook
10	C19 - 3/9	- Monitoring animal populations, part II (pollinators, aquatic invertebrates)	1. Murdoch et al. 1999. Streamkeeper’s field guide. <i>Read pp. 118-138 (part of Ch 6 The Spineless Ones)</i> . 2. Ullmann, K., M. Vaughn, C. Kremen, T. Shih, and M. Shepherd. 2010. California Pollinator Project: Citizen Scientist Pollinator Monitoring Guide. <i>Read pp. 3-19</i> , http://www.xerces.org/wp-content/uploads/2010/06/CA_CSM_guide.pdf . 3. 2016 Climate and Phenology Pollinator Survey Protocol. Optional: 1. Parachnowitsch, A. L., and E. Elle. 2005. Insect visitation to wildflowers in the endangered Garry Oak, <i>Quercus garryana</i> , ecosystem of British Columbia. <i>Canadian Field-Naturalist</i> 119 :245-253. (<i>We’ll use this article for a class exercise</i>). 2. Watch: Native Bumblebees, 2008 (8 min), http://www.opb.org/programs/ofg/segments/view/1684?q=bumblebees . (<i>Relevant to Riparian Restoration team</i>).	Due: Monitoring Plan
	C20 - 3/11	- Field Trip: Alton Baker Park - Aquatic invertebrates - Synthesis and review.	No readings	
11	TBA	Final Exam		Final Exam