EAS 509: Ecology: Concepts and Applications Fall 2018

Primary Instructor: Dr. Sheila K. Schueller schuel@umich.edu
Office Hours (4556 Dana): Tuesday 12-2pm, Wednesday 1-3pm

Clinic in the Commons Hours:
Monday & Wednesday 10-11:30am, Tuesday 4:30-6pm, Thursday 6-7:30pm
All Instructors are also available by appointment.

Lecture: Monday/Wednesday 11:30-1, 1040 Dana
Lab: G556 Dana
Lab Coordinator: Isabella Garramone igarr@umich.edu
002 - Monday 2-6 pm: Lexi Brewer albrewer@umich.edu
003 - Tuesday 10-2pm: Lauren Schmitt lschmit@umich.edu
004 - Tuesday 2-6pm: Santiago Bukovsky-Reyes sbukovsk@umich.edu
007 - Wednesday 2-6pm: Dorthea Leisman dleisman@umich.edu
005 - Thursday 10-2pm: Collin Knauss crknauss@umich.edu
006 - Thursday 2-6pm: Harrison Smith harsmi@umich.edu

What to do if you are lost, confused, behind, don't get it, and/or can't find it:
- Read this syllabus!
- Go to the Canvas site. Use Piazza, instead of email, within Canvas to check announcements, ask questions, get updates, etc.
- Go to the Clinic in the Commons or meet with an instructor
- Read suggested pages in the textbook – a copy is on reserve in 1520 Dana.
- Use other resources on Canvas (lecture and lab notes, supplementary biology background, Statistics & Excel help, and more!)
- Ask your peers/ create a peer study group

Syllabus Contents
1. Course Goals: What should you walk out of this course with?
2. What is this course about?
3. What will you need for this course?
4. Grading Breakdown and Rationale
5. Important Course Policies and Expectations
6. Student Support, Resources, & Accommodations
7. Key Advice & Tips for Students: From experience and research
8. Schedule of lectures, readings, assignments, and labs

Course Goals: What should you walk out of this course with? (See **Outcomes Tracker** on course home page for more)
1. A basic understanding of the key parts and processes of ecological systems relevant for evidence-based design, planning, and decision-making in the real, changing, and diverse world.
2. Skills in communication (the ability to use and understand a variety of ecological sources of information), research process and quantitative literacy (field observation, experimental design, data analysis, and interpretation), systems thinking (use of frameworks and logic models), and collaboration (team problem-solving and cooperative learning).
3. Inspiration and preparation to take more natural science courses in SEAS.
Overview of Course Content: What is this course about?
Through interactive lectures, discussions of real-world cases, and inquiry-based guided and independent field labs we will study the basic parts and processes of ecological systems – how organisms respond to their physical environment, interact with each other in populations and communities across the landscape, and affect the movement of energy and nutrients through terrestrial and aquatic ecosystems. This will include topics and questions relevant to global change, such as:

- **Evolutionary Ecology**: What is a species? What is the time scale of evolution? How is genetic variation important in conservation, restoration, agriculture, and public health?
- **Physiological Ecology**: How can organisms tolerate or respond to changes in climate, salinity, or acidity? How can indicator species inform citizen-science site assessments?
- **Population Ecology**: How can hunting-related changes in age distribution affect population growth? How can we estimate maximum sustainable yield to inform fisheries management?
- **Community Ecology**: How do species compete for limited resources? Why are some species invasive? How can restoration ecologists change the direction of a community over time?
- **Landscape Ecology**: What are organisms’ patterns of migration and movement? What are the consequences of connecting or fragmenting habitats in the landscape?
- **Ecosystem Ecology**: What are the fluxes and pools of nutrients in a system and how do they affect productivity? How can salmon feed forests and fertilizing crops lead to fish kills?
- **Assessment of Ecological Systems**: What is the indirect impact of one species on many others? How can I test a possible cause? What are appropriate measures of ecosystem “health”?

Course materials: What will you need for this course?
1. **Your 509 Canvas site** ([https://umich.instructure.com/courses/241974](https://umich.instructure.com/courses/241974)) will have all course info and resources, including assigned readings, assignments, and lecture notes.

2. **Piazza** is an online forum within the 509 Canvas site.
   - Use Piazza instead of email to ask any questions or share resources.
   - Share ideas!
   - Get answers to questions quickly and efficiently from classmates and instructors!
   - You can opt to send messages publically, privately, and/or anonymously.
   - You can change your notification settings to allow you to get every Piazza message in your email or not. When I send once weekly course announcements these will over-ride your settings and go to your email inbox.

3. **Required SIMUTEXT Chapters**: See your first Simutext Assignment details in Canvas for how to purchase and use your Simutext package ($52).

4. **Recommended (not required) Textbook**: Stiling, Peter. 2014. *Ecology: Global Insights and Investigations*. Second Edition. McGraw Hill. [ISBN 9780073532509](https://example.com). Two copies will be on reserve in the SEAS OAP office for you to borrow, or you can buy a used copy (1st edition) available for as little as $10. Recommended page numbers for both editions are provided in the lecture schedule on Canvas. Many students find that the textbook can be very useful to quickly define a term, find an appropriate graph, or be reminded of a particular example.

5. **Appropriate outdoor clothing for field labs**: Dress for being OUTDOORS on lab days. This means solid, comfortable walking shoes (no flip flops or high heels), long pants (no business suits), rain gear, and warm layers. We WILL go out even if it is WET and/or COLD!!!
Grading Breakdown and Rationale (600 pts total)
Percentage point letter grade cut-offs are not pre-set but will be determined at the end of the term to maximize fairness and accuracy – e.g. to adjust for any grading discrepancies among sections.

1. Simutext Assignments (6 x 20pts, drop the lowest = 100 pts): What? Online interactive chapters with questions on particular topics. Why? Opportunity to engage (including using simulations) with some important topics/skills on your own.

2. Research skills assignments (180 pts): What? Exercises related to the research process. Details are provided on Canvas. Why? Practice finding and interpreting primary literature, doing statistical analysis and creating graphs (basic excel skills), drawing conclusions, communicating research in abstracts and presentations, and designing and executing your own research based on your interests and the needs of local managers and planners. These skills are useful for being able to use and interpret scientific sources in your career, as well as work in interdisciplinary teams.
   a. Comparing and Relating Data (35 pts)
   b. Field Notebook (30 pts)
   c. Independent Project (115 pts): Proposal (15 pts), Plan (20 pts), Presentation (65 pts), and Abstract (15 pts)

3. Quizzes and Exams – Graded questions in this course are designed not only as assessment, but to help you learn the material. We are aiming not to weed you out, but for everyone to achieve mastery in basic concepts and at least get exposure to beyond basics. (See Let’s teach for mastery not test scores to understand why it is key that you keep working on understanding, even after you get tests back, so that later you are not building a policy, or designing a landscape, or creating a sustainable product that fails because you lacked mastery in foundational ecology). Though the focus is conceptual understanding, you do have to memorize (own) some facts in order to play with them in your brain and create your own meaningful chunks of information that you can then apply and transfer.
   a. In-class questions (15 x 2 pts each = 30 pts): What? Low-stakes questions on previous material and/or assigned readings in lecture and lab throughout the term. Why? To practice retrieval, which assists in long-term memory retention more than just re-reading, and for you/me to regularly be aware of what you know so we can learn/teach adaptively.
   b. Online quizzes (2 x 30 pts each = 60 pts): What? Cumulative online questions on course material. Why? Same as above, but with more time. You will get feedback on what you got right and your grade will be a combination of your first and second attempts.
   c. Take-home exams (2 x 115 pts each = 230 pts): What? Longer set of questions and problems (including response to specific readings) to be completed over at least a week. You may discuss them with your peers, ask questions, but then complete them on your own. Why? Integrate, apply, and process lecture and lab material, and benefit from collaborative learning.

You come to SEAS with diverse academic backgrounds. For some, the course may feel too fast, for others parts will feel too basic. You may need to either:
   a) Share your knowledge/expertise with others if parts of this are what you already know, and/or
   b) Be a self-directed graduate learner and use supplemental resources as needed. Regularly attending office and clinic hours and reading the text will be necessities for some – and all can benefit from using all the resources you have available to you while you are here!
Important Course Policies and Expectations

- **Attend all lectures** (see student advice below!)

- **Attend all labs**: *An unexcused absence from lab section will result in a 30pt deduction from your grade.* If necessary, and only if you make appropriate arrangements with all relevant instructors IN ADVANCE, you can make-up a lab by attending another section within the same week.

- **Plan on spending at least 3 hours per week* outside of lab and lecture on coursework.**
  
  “About 70% of students agreed with this estimate, but because of varied backgrounds in ecology, some will need to spend more time.

*You are paying a lot to get an education, and that does take a significant time commitment!* According to the Rackham Graduate School, “it is assumed that each hour of class time spent in a lecture or seminar will be accompanied by 2 to 3 hours of time spent in independent preparation (readings, papers, etc.).”

**Prepare for lecture:**
1. **Print or download the lecture outline** from Canvas to review them to “prime your mental pump” before. You can write notes directly on them.
2. **Read the Quick Reads** assigned to each lecture

**After lecture:** View the complete color ppt together with your notes to fill in gaps and check out additional resources. Don’t just reread your notes. Annotate, recreate, re-organize them.

**Prepare for lab:**
1. **Review that week’s lab introduction page on Canvas** (link from course schedule). *Note that these intros are not intended to provide details on exactly what we will do in lab. Labs in general are inquiry-based (how can we figure this out?) instead of cookbook style (first we will ..., then we will ...).*
2. **Read at least 1-2 of the related resources**, learn the key terms, and **write the “big question” and at least two additional questions** for that lab (any related issues/topics that you wonder about) in your field notebook.

*Late Policy for Assignments:* A 5% loss of points per day will be assessed to all assignments handed in after the date and time they are due. Unless there are extenuating circumstances, there are no make-up exams and **assignments will not be accepted more than one week past the due date.**

- **Technology and attention:** While in lecture and lab please do not use a cell phone or laptop or other device in any way that is not directly related to class. Not only is it disrespectful, but your assumed productive multi-tasking is wasting your time!

- **Academic integrity:** The point of group work and discussions are to exchange ideas with others and refine your own, however, you must not hand in someone else’s words or ideas as your own. You are expected to **understand what plagiarism is, both accidental and deliberate**, and to be familiar with the University of Michigan standards on professional academic behavior, as stated here: http://www.rackham.umich.edu/current-students/policies/academic-policies/section10. **Plagiarism is grounds for expulsion from the program and includes copying material from another student or source and/or writing the same thing as your friend on an assignment you turn in separately.** If you are at all unclear about what constitutes plagiarism or cheating, especially with group work, please ask one of the instructors before you hand in work with your name on it!!!

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**Student Support, Resources, & Accommodations**

SEAS students represent a diversity of individual academic and cultural backgrounds, beliefs, and experiences. A diverse, equitable, and inclusive classroom is essential to your professional training. I do not wish to exclude anyone from a positive and productive learning environment. Your 509 instructors use a variety of teaching approaches and examples, and in every activity we expect every member and instructor of this class to show respect for others. Please approach me, another instructor, and/or other resources on campus to voice concerns or suggestions about an event, comment, or course content that affects your own or another student’s comfort or learning experience. Here are some excellent on campus resources to optimize your experience and performance:

- If you think you need an accommodation for a disability, let me know as soon as possible, so that we can work with the [Services for Students with Disabilities (SSD)](SSD) office to help us determine appropriate and helpful academic accommodations. 734-763-3000;

- If English is not your first language and you may find it challenging to either understand or communicate well in this course. Please meet often with instructors and definitely use both the [English Language Institute](English Language Institute), which provides a variety of resources for international students;

- The [Sweetland Center for Writing](Sweetland Center for Writing) is a great place for anyone to receive feedback to improve clear communication in your written work.

- The [UM Library](UM Library) provides a wealth of free primary literature at your fingertips, you just need to make sure you do your searches while logged in or via the library home page, even if you are using Google Scholar to reach the source for free (look for MGet IT links).

- The [Scholar Space](Scholar Space) is an excellent resource for doing anything digital – image manipulation, citation management, web publishing, doc formatting, multimedia creation, text mining, etc.

- [Consulting for Statistics, Computing and Analytics Research (CSCAR)](Consulting for Statistics, Computing and Analytics Research (CSCAR)) provides consulting services and training in data science, statistics, and advanced research computation.

- [Counseling and Psychological Services (CAPS)](Counseling and Psychological Services (CAPS)) provides free and confidential support options for any issue including experiencing stress, mood changes, problems with eating and/or sleeping.

- [CEW+](CEW+) provides immediate, ongoing services and financial support, especially to women and nontraditional students, but also to any students who encounter education and career obstacles based on their non-linear paths to, and experiences within, the University community.

- The [Students with Children](Students with Children) website is dedicated to the needs of student caregivers at the University of Michigan who juggle parenting, other family care, work, and study.

- [Students of Color of Rackham](Students of Color of Rackham) (SCOR) is a network for graduate and professional students dedicated to the social, cultural, and academic well-being of students of color.

- [Spectrum Center](Spectrum Center) works toward enhancing the campus climate and support services for LGBTQ+ students, staff, and faculty at the University through education, advocacy, and community building.

- For additional resources see also the [Diversity, Equity, and Inclusion offices](Diversity, Equity, and Inclusion offices) of the [University of Michigan](University of Michigan) and of SEAS.
Key Advice & Tips from Students for Students
Here is a summary and some examples of how students responded to: **What advice would you give a future student about how to get the most out of this class and/or use their time effectively?**

1. **Prepare for class by printing & reviewing notes and resources:** “Take at least 15-30 mins to prep for each class by reading the articles, journals, textbook, or anything else to give you some insight into the day’s material and to help you generate relevant questions.” “read the lecture notes before class and try to answer the questions by yourself and then check the answer during lecture.”

2. **Attend and take good notes in lecture:** “Definitely attend all lectures to get the most out of this class.” “Go to every lecture, no matter what. If you miss a lecture, visit with a GSI who was in that lecture and go over the slides.” “It's hard to get what you need to understand power point slides from other people's notes.” “Be engaged during lecture, … take rigorous notes.” “One tool that I've found extremely helpful is the application I use to take notes, called Notability. This has allowed me to record lectures and take notes, and then later when I want to review, I can playback the recording.”

3. **Don't procrastinate:** “Start assignments early – if you rush through them, they aren't very valuable.”, “Keep up with the work.” “It is well worth putting the time into the assignments. All of the material is carefully crafted to help the students be successful, so if you put the time in, you will get a lot out of the class.” “Take the time to look over assignments early! Some require much more time than others!” “I wish I had spent more time engaging and reviewing in course material between classes. … It's tempting to take as many courses as you can stand in order to expose yourself to as many appealing classes as possible. There are so many interesting courses! But, is it better to stick to fewer classes and get as much out of them as you can?”

4. **Review as you go:** “review the material periodically and discuss ecological topics with classmates on a regular basis” “I would recommend going over the lectures and writing down a quick sheet of every one with the key concepts and ideas. This really helped me pull together knowledge for the quizzes and exams.” “review with friends every weekend.” “I use a computer software (space repetition software), and enter all the content of the lecture in flash card form by date (i.e. electronic stacks of cards by topic). I use these to review every week, and it is really good for helping to remember those concepts that just won't stick”

5. **Ask questions & converse with your classmates and instructors:** “meeting regularly with instructors for asking questions is the most important thing for this class for students who did not have ecology before.” “Do the assignments in groups - when you can - and argue with your friends.” “Work together with a group of students (5-6 ideally) on take home exams - I learned so much doing this.” “Do the take-homes on your own, in full. THEN, work in a group.” “Go meet with the instructors whenever you have any problems, they are always glad to help. That can make things much easier.”

6. **Use all the available resources:** “Extra readings are helpful in understanding better.” “Check out the additional materials. When I had a chance to look at them they were always really fascinating and further expanded my knowledge of a topic.” “I would recommend reading the textbook after the lecture, and going through the questions at the end of the chapter. This helps in absorbing concepts taught in class, and the textbook is super interesting. Secondly, the student should read everything (including the extra links) in the simutext assignments, as they are very helpful and are extremely fun.”

7. **Enjoy it!!** “Have fun during labs” “Enjoy it, breathe it in” “Don't lose sight of how FUN it is to learn about bugs and stuff, go outside and experience nature!”
More ways to get the most out of this course: 7 Evidence-Based Tips for Better Learning

1. Take notes in class and then re-structure them. You learn more (and improve your grade) if you (a) take notes by hand, not with your laptop during lecture, and (b) take time soon after lecture to not just re-read your notes, but generate something new by actively re-structuring and re-organizing your notes (combining the slides, your notes, memory, and other sources) into a coherent product (Cohen et al. 2013; Generation Effect).

2. Recall what you know from memory: To best assist your long-term memory retention, instead of re-reading your notes or text, try recalling from memory or elaborating/explaining what you know – that is, test yourself and each other! See: Research finds practicing retrieval is best tool for learning and a very useful book by Brown et al. (2014) called Make it Stick (for video on key lessons see https://www.youtube.com/watch?v=lyHAjVJiGfo).

3. You are learning for the long-term when learning feels slow & difficult, not when you can improve your short-term retention through rote repetition. Fumbling, grappling, and unsuccessful attempts to solve a problem are actually good for your learning! You also do not necessarily learn better when the style of teaching fits your preference (Brown et al. 2014; Oakley 2014).

4. Be an active vs. a passive learner: “One must learn by doing the thing, for though you think you know it--you have no certainty until you try. “ (Sophocles, 5th c. B.C.); “Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing pre-packaged assignments, and spitting out answers. They must talk about what they are learning, write about it, relate it to past experiences, and apply it to their daily lives.”(Chickering and Gamson 1987)

5. Collaborate (but do not free ride or be a leech): Teach others, learn in groups, quiz & explain to each other! Students working in teams tend to learn, understand, and remember more, and acquire critical thinking as well as teamwork and communication skills that are key for the workplace (Marzano et al. 2001, Hanson 2006).

6. Organize your thoughts, facts, concepts into mental models, diagrams, hierarchies or structures: Working memory is limited to 9 slots. Chunking or clustering information into structures increases the amount of information that can be held in working memory (Brown et al. 2014). Graphically organized notes and creating nonlinguistic representations increase higher order thinking and have strong positive effects on learning (Marzano et al. 2001, Oakley 2014).

7. Alternate between periods of intently focusing on a task or problem without distraction (try 25 minutes – see the Pomodoro Technique) and then diffuse, relaxed time (Oakley 2014), such as taking a walk or even a nap.

- Hanson, D. 2006. Instructor’s Guide to Process-Oriented Guided Inquiry Learning, Pacific Crest, Lisle, IL.
- Oakley, B. 2014. A Mind for Numbers: How to Excel at Math and Science (Even If You Flunked Algebra). See also the related very popular massive open online course: https://www.coursera.org/learn/learning-how-to-learn
# Course Schedule –

The most up to date version of this schedule is on Canvas with link to all files. Additional readings will be given within assignments and take-home exams. *Recommended textbook reading is in Stiling, Peter. 2014. *Ecology: Global Insights and Investigations. Second Edition. *McGraw Hill. (1st edition page assignments available on Canvas.)*

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<tr>
<th>Date</th>
<th>Lecture topics</th>
<th>Quick Reads &amp; <em>Weekly Assignment DUE</em></th>
<th>Lab</th>
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<tbody>
<tr>
<td>W, 9/5</td>
<td>UNIT 1: Origin, study &amp; state of biodiversity</td>
<td>* Independent Project Timeline - know what’s coming up and start thinking about what interests you</td>
<td>No lab first week</td>
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<td>M, 9/10</td>
<td>2. Experimental Approaches in Ecology: Observations, hypotheses and predictions; If, then logic statement; Treatment, controls, &amp; replicates; Natural, field, lab experiments, models &amp; meta-analysis. [1:14-22]</td>
<td>* Rebuilding the Natural World (Coniff 2014) - How can we improve the effectiveness of restoration investments? * To seed or not to seed: Researchers engage citizen scientists in reducing bird-window collisions. * Science or not? Hallmarks of Science.</td>
<td>1. Insect Patterns</td>
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<td>M, 9/17</td>
<td>4. Biodiversity continued to Biomes: Species Concepts; Environmental variation across terrestrial biomes and aquatic ecosystems [22, 23, 24]</td>
<td>* Widespread ‘gray zone’ of animals transitioning from one species to two * Tree planting can harm ecosystems - Why do they say that?</td>
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<td>W, 9/19</td>
<td>UNIT 2: Physiological Ecology 5. How and why does the physical environment vary? Conditions and resources; Soil; Climate at global, regional, local and micro scale [22:435-444]</td>
<td>* “Urban hot tub” effect in city ponds * Online Quiz 1 - Due Friday 9/21</td>
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| W, 10/3 | UNIT 3: Population Ecology  
8. Demographics: Density, dispersion; Age distribution, sex ratios; Life & fecundity tables; Survivorship & replacement; How might endocrine disrupters or trophy hunting change demographics? [8:159-166; 9] | * Demographic Side Effects of Selective Hunting in Ungulates and Carnivores (Milner et al. 2006): Abstract |                      |
| M, 10/8 | 9. How do populations change over time?: From demographics to dynamics; Exponential & logistic growth; Carrying capacity; Density dependent & independent regulation; inverse regulation & risks of small populations [2: 38-43; 10:194-204] | * Understanding Population Growth Models Assignment (Simutext)                                      | 5. Agroecology        |
| W, 10/10 | 10. Life History Traits: Organisms vary in their reproductive strategies; Trade-offs; r vs. K-selection. [10:204-210] | * Hatchery fish may hurt wild salmon runs  
* Population equations study guide                                                                  |                      |
| M, 10/15 | NO CLASS M/T Fall Study Break                                                                                     | NO LAB – Independent Project Meetings  
* Research Plan                                                  |                      |
Skim to identify relevant concepts  
* Optional: Michigan Fisheries: 200 Years of Changes  
| M, 10/22 | UNIT 4: Community Ecology  
* Got snags? Dead tree habitat | 6. Independent project data collection |
| W, 10/24 | 13. Competition : Interference & exploitation; Removal, density series experiments; Coexistence or exclusion; Rank depends on the environment; Resource partitioning, Character displacement, Adaptive radiation. [11:236-241] | * TAKE-HOME EXAM 1 due in class (Units 1-3)  
* Competitive mechanisms underlying the displacement of native ants by the invasive Argentine ant (Holway 1999) - Abstract |                      |
* Putting loosestrife beetles to work  
* Forest-loving moose learning to thrive on farmland  
* Rapid evolution as an ecological process: Abstract & Table 1 (Thompson 1998) | 7. Wetlands          |
* Experimental species removals impact the architecture of pollination networks. - How might this kind of network analysis apply to human organizations?  
* Guam’s Forests Have an Unlikely Ally: Feral Pigs  
* Isle Royal Assignment (Simutext) - due FRIDAY 11/2 |                      |
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* Great background and terminology review on Direct and Indirect Interactions  
* Salt Marsh trophic cascade studies                                                                 | 8. Greenhouse                  |
| W, 11/7 | UNIT 5: Landscape Ecology  
18-19. Metapopulations and reserve design: Movement among patches; Species-area relationship; Fragmentation; the matrix matters. [21; 8: 167-175] | * Movement of rain forest butterflies restricted by oil palm plantations  
* How should humans arrange themselves to maximize biodiversity? - How does the land sparing vs. land sharing debate relate to the idea of the quality of the matrix?  
* Online Quiz 2                                                                                     | 9. Concept mapping from tick data, Tours of some SEAS research labs, & IP Analysis and Presentation Prep |
| M, 11/12 | UNIT 6: Ecosystem Ecology  
20. Energy Flow and the production and decomposition of biomass: Systems approach; Productivity (NPP); Respiration, efficiencies, energy pyramids, & biomagnification; Net Ecosystem Productivity (NEP); Detritus; Decomposition. [25: 502-514; 26:523-541; 27] NEP concept map handout | *Ecosystem Ecology Assignment (Simutext)                                                                 |                              |
| W, 11/14 | 21. Biogeochemical Cycles in the landscape and watersheds: Decomposition cont. and the C cycle; Nitrogen cycle and alterations; Eutrophication & dead zones [27; 7:148-149] | What do all three of these stories illustrate?  
* Asian dust providing key nutrients for California’s giant sequoias  
* Salmon, Wildlife, and Wine (Mertz & Moyle 2006)  
* Miles of Algae Covering Lake Erie  
Optional background: Transformations of the nitrogen cycle (Galloway et al. 2008) |                              |
| M, 11/19 | 22. Cycles continued: In & out of systems, Green Infrastructure, & other eutrophication solutions: Marine Derived Nutrients; From impervious surface to prairie strips, rain gardens & aquaponics | * What is Green Infrastructure? (HRWC)  
* “Accidental” urban wetlands: ecosystem functions in unexpected places  
* Nutrient Cycling Assignment (Simutext)                                                                 | NO LAB (Thanksgiving recess 5pm, Nov 21) |
| W, 11/21 | No Lecture. On your own (or with friends and family): Play the N-Cycle game (keep track of your moves as instructed) and Watch min 8:10-25:00 min (or more) on Stormwater Management in the context of the Master Raingardners Class by Washtenaw County Water Resources. How do the purposes of raingardens relate to N and C cycles? |                              |                              |
| Date     | Lecture topics                                                                                                                                                                                                 | Quick Reads & Weekly Assignment DUE                                                                                                                                                                                                 | Lab                                                                 |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| M, 11/26| **UNIT 7: Maintaining & measuring changing ecosystems**  
23. Relationship between Biodiversity and ecosystem function & services: How much do we need? Rivet-redundancy hypothesis; Functional diversity; Case Conversation with Drew Lathin (Creating Sustainable Landscapes, LLC): conversion of a suburban yard. [18; 19: 377-392] | * What does biodiversity do for us? [Video](https://example.com)  
* Loss of Dung beetles Puts Ecosystems in Deep Doo-Doo  
* Biodiversity improves stability of algal biofuel systems - A SEAS research project!  
Optional:  
* Biodiversity impacts ecosystem productivity as much as resources, disturbance, or herbivory (Tilman, Reich & Isbell 2012)  
* Urban Nature: How to Foster Biodiversity in World’s Cities  
* Why companies should care about biodiversity (ASU webinar video including reps from Dow and Monsanto) | 10. Greenhouse Part 2  
Practice your IP Presentation with an instructor |
| W, 11/28| 24. Succession: Glaciers, sand dunes; pioneer to climax; Primary vs. secondary; Species interactions and Disturbance; Restoration ecology. [20; 5:112-113]                                                                 | * Social drivers forewarn of marine regime shifts - What natural factors could cause a “regime shift”?  
* Life after prescribed burns  
Optional - to get to know Michigan succession, the place where the idea was born!  
Succession: From Sand Dune to Forest [Video](https://example.com) | 11. Research Symposium  
* IP Presentations & Abstracts due |
| M, 12/3 | 25. Climate Change: Physical and biological consequences of greenhouse gases; Fertilization effect?; Carbon sequestration; Ocean acidification [5:114-121; 26: 530; 27: 556-557]  
* Greenhouse effect video  
* Climate Change Assignment (Simutext) | | 11. Research Symposium  
* IP Presentations & Abstracts due |
| W, 12/5 | 26. Climate Change, cont. Ecological consequences: trophic mismatches; Carbon sequestration; Climate change mitigation and “adaptation”  
| | * Beetles move, Pines Die and Bears Feel It  
* Fighting carbon with fire, Arnhem Land, Australia - How does this case bring together your understanding of TEK, succession, disturbance, and climate change mitigation?  
* Nature Without Biodiversity: Urban Climate Adaptation Has a Blind Spot **Essential reading for all planners** | | |
| M, 12/10 | 27. How do we assess whole ecosystems? Back to causes of biodiversity; Need for new approaches; What is ecological “health,” “integrity,” and other buzzwords? [22:443-463; 23 & 24] | * The portfolio concept in ecology and evolution (Schindler et al. 2015) - What is the main point?  
* Loss of Foundation Species - Panel 1 (Ellison et al. 2005)  
* Conceptual Models for Grassland (Tinker & Hild 2005) - Which figure is most informative to you?  
* Managing the whole landscape: historical, hybrid, and novel ecosystems - Note assessment tool in Fig. 1 and decision-making tool in Fig. 2 | NO LAB  
Revised Abstracts due Dec. 13 |
| Tuesday, 12/18 | | **TAKE-HOME EXAM 2 due** (hand in directly to your GSI or hand in 10:30am-12:30pm in room 1040 Dana on 12/18) | |