EAS 552 ECOSYSTEM SERVICES
Syllabus, Fall 2019

Time & Location: Tuesdays 9:00AM – 11:00AM, 1024 Dana
Instructor: Dr. Brad Cardinale (bradcard@umich.edu)
Office hours: Tues 11:00AM and by appointment, Room 110G Dana

Course description. This course evaluates the ecological, economic, and programmatic basis for ecosystem services, which represent the sum of all goods and services that natural and managed ecosystems provide to humanity. Sometimes referred to as Earth’s natural capital, or nature’s benefits to humanity, ecosystem services include the direct provisioning of goods like food, wood, and water, indirect services like climate regulation and pest control, and cultural services like recreation, ecotourism, and cultural heritage. Ecosystem services have increasingly been used to justify local, national, and international policies aimed at conservation of ecosystems and their biodiversity. This class will explore the ways in which ecosystem services are measured and related to basic ecological processes, how those services are quantified and valued, and how services are provided by governments and private organizations.

Course goals. The goal of this course is to teach students the tools and techniques that are used to quantify the monetary and non-monetary values of ecosystem services, and to understand the policy and business instruments that use ecosystem services as part of conservation efforts. After completion of this course, students should be prepared for jobs in government agencies (e.g., NOAA, USDA Forest Service), non-governmental organizations (e.g., The Nature Conservancy, World Wildlife Fund), or academic-private ventures (e.g., the Natural Capital Project) that promote the use of ecosystem services in natural resource management.

Course website. All materials for this course, including lectures, readings, and exercises, are available on Canvas at https://umich.instructure.com/courses/320111. Within Canvas, the function Piazza is an online forum where you can share ideas and get answers quickly and efficiently from classmates and instructors. Please use Piazza to ask questions or share resources. You can send messages privately and/or anonymously.

Course materials. This course does not have a required textbook; however, readings associated with each class will be posted on the Canvas website prior to class. Students will need access to a computer with two software programs – the statistics programs R (https://www.r-project.org/) and R-studio (https://www.rstudio.com/), and the spreadsheet program Microsoft Excel. Ideally, students should bring their personal laptops to class. The instructor has a few loaners for those who do not own a laptop. In addition, computer labs are available in SEAS. All exercises for the class are formatted for PC, though Mac’s usually work.

Course prerequisites. This course has been developed for upper-division undergraduates and early-career graduate students who are planning a career in natural resource management. Therefore:
1. Students should have some background in ecology or environmental science (e.g., EAS 509 or equivalent. Note that concurrent enrollment in EAS 509 and EAS 552 is acceptable).

2. Students should have math proficiency equivalent to college-level algebra (calculus is not required). If you are ‘rusty’ in math, several good tutorials are available online at coolmath.com/index.html, www.sosmath.com/, www.khanacademy.org/math.

3. Students should be proficient with the basic use of data spreadsheets like Microsoft Excel. Good tutorials are available at:
   

   **Course grading.** There are 12 quantitative exercises associated with this class. These are designed to build expertise in the methods used to quantify and value ecosystem services. Students are required to complete 10 of the 12 exercises (the two lowest grades will be dropped), each of which is worth 20 points for a total of 200 points for the class. All exercises must be submitted via Canvas prior to the start of class on their due date. The grading scale is A = 90-100%, B = 80-89.9%, C = 70-79.9%, D = 60-69.9%. The instructor reserves the right to curve grades at the end of the course if he deems necessary.

**Course policies and expectations**

1. **Attendance.** Students should plan to attend all classes and be actively engaged. Because SEAS does not have an attendance policy of its own, this course will use the policy adopted by the College of Literature, Sciences, and the Arts https://lsa.umich.edu/advising/policies-procedures/class-attendance.html for all matters related to class attendance and documented absences.

2. **Late work.** Deadlines for exercises will be enforced, with extensions only granted for those who provide documentation of a valid, university approved hardship or extenuating circumstance (see point 1). Late work turned in after the deadline will have grades deducted at 10% per day.

3. **Drop/Add.** Because SEAS does not have a drop/add policy, this course will follow policies adopted by the College of Literature, Sciences, and the Arts available at https://lsa.umich.edu/lsa/academics/lsa-academic-policies/registration-and-enrollment/drop-add.html. Please consult this URL for all matters related to drop/add of this course.

4. **Technology in the classroom.** Please kindly refrain from using cell phones, laptops, or other device in any way that is not directly related to class (e.g., web surfing, text messaging). Not only is it disruptive to the instructor and your student colleagues, it wastes your time!

5. **Academic integrity.** Students are expected to be familiar with the University of Michigan standards on professional academic behavior (http://www.rackham.umich.edu/current-students/policies/academic-policies/section10). Cheating, copying, and plagiarism are all grounds for expulsion from the program.

6. **Student support & accommodations:** All students have the right to a positive learning environment. Please contact the instructor if any resources or support are needed to optimize your academic experience and performance. If you need accommodations for a disability, please let the instructor know as soon as possible, so that he can work with the Services for Students with Disabilities (SSD) office to determine appropriate academic accommodations (734-763-3000; http://ssd.umich.edu).
If English is not your first language, please meet with instructor often to ensure you understand the material. In addition, consider contacting the English Language Institute (https://lsa.umich.edu/eli/), which provides resources for international students, or the Sweetland Center for Writing (http://lsa.umich.edu/sweetland) where you can receive feedback to improve your written work.

Diminished mental health, including significant stress, mood changes, or problems with eating and/or sleeping can interfere with your course experience and optimal academic performance. The Counseling and Psychological Services (http://caps.umich.edu/) office provides free and confidential support and counseling options for students. If there are specific events or needs related to your academic performance that you think the instructor can help with, please talk with him/her.

7. **Inclusive classroom.** SEAS students represent a diversity of individual beliefs, backgrounds, and experiences. In all activities of this class, students should show respect for the differing beliefs, backgrounds, and experiences of others. If you have a concern about an event, comment, or course content that affects your own or another student’s learning experience, please speak with the instructor about it.

### Course schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Class topic</th>
<th>Discussion [reading]*</th>
<th>Exercise (due date)**</th>
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<tbody>
<tr>
<td>09/03</td>
<td>Introduction to ecosystem services</td>
<td>Human values &amp; worldviews [1]</td>
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<tr>
<td>09/10</td>
<td>Historical foundations and frameworks</td>
<td>Conceptual frameworks for ecosystem services [2]</td>
<td>1. Introduction to Excel and R (due 9/17)</td>
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<td>09/17</td>
<td>Ecosystem functions: The ‘supporting’ services</td>
<td>How to avoid bio-perversity [3]</td>
<td>2. Calculating residence &amp; turnover times (due 9/24)</td>
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<tr>
<td>09/24</td>
<td>Ecological production functions</td>
<td>Case study: Biodiversity &amp; C-sequestration [4]</td>
<td>3. Quantifying ecological production functions (due 10/1)</td>
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<tr>
<td>10/01</td>
<td>Provisioning and regulating services</td>
<td>Case study: Biodiversity &amp; C-storage [5]</td>
<td>4. Translating production functions to ecosystem services (due 10/08)</td>
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<tr>
<td>10/08</td>
<td>Cultural and relational services</td>
<td>Case study: Coral reefs and ecotourism [6]</td>
<td>5. Translating ecosystem properties to cultural services (due 10/22)</td>
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<td>10/15</td>
<td>Fall study break: No class</td>
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<td>11/05</td>
<td>Hypothetical market methods of valuation</td>
<td>Case study: TEV of ecosystem restoration [7]</td>
<td>8. Translating services to values using hypothetical markets (due 11/12)</td>
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<td>12/10</td>
<td>The future of ecosystem services</td>
<td>When anthropocentrism goes extreme [12]</td>
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*Readings will help students understand material presented in lecture, and be prepared for discussions and the exercises. **All exercises must be submitted via Canvas prior to the start of class on their due date.
References