Ecosystem Services: Theory, Methods, and Practice
AGR 4932/6932
SWS 4932/6932

Instructor:

Dr. Chang Zhao
Assistant Professor
Agronomy Department
McCarty Hall D, Rm G052A
University of Florida – Gainesville
Email: changzhao@ufl.edu

Office phone number: 352-294-0994

Office hours: Thursdays 10 am – 12 pm or by appt at McCarty Hall D, Rm G052A or on Zoom: https://ufl.zoom.us/my/chang.zhao.meeting.room

Course credits: 3

Teaching Format and Course Communications:

- Exclusively online.
- Pre-recorded lectures, supplementary readings, weekly chat sessions, discussion boards, assignments, and exams.
- Canvas eLearning Login: http://elearning.ufl.edu/
- Contact instructor through Canvas messaging system or email.
  - Allow 24 hours for a response during the week.
  - Questions posted over the weekend may not receive a response until Monday.

Pre-Requisites: None

Since this is a transdisciplinary course, there is no pre-requisite course. Students with fundamental knowledge in one or more of the following disciplines are encouraged to attend:

- Agricultural and life sciences, including agronomy, soil and water sciences, natural resources and environment, forest, fisheries, and geomatics sciences, wildlife ecology and conservation, food and resource economics, etc.

- Geography, urban and regional planning, sustainability, economics, social sciences and related disciplines.

Required Textbook: None

- Required readings are available on Canvas.
- Recommended textbook can be obtained from UF Library as a free ebook:
  - Potschin, M., Haines-Young, R., Fish, R., & Turner, R. K. (Eds.). (2016). Routledge handbook of ecosystem services. Routledge.
  - For UF students, full text of the book is available with unlimited user access through https://guides.uflib.ufl.edu/ebooks/

Required Technology & How to Obtain the Technology

Technology requirements include:

- Speakers, microphone or a headset for participating in live chat sessions.
- i-tree software: i-Tree delivers current, peer-reviewed tree benefits estimation science from the USDA Forest Service to all types of users with free tools and support. For more information: https://www.itreetools.org/
- InVEST software: InVEST® is a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfill human life. For more information: https://naturalcapitalproject.stanford.edu/software/invest
- ArcGIS Pro: ArcGIS Pro is the premier desktop geographic information system (GIS) application that allows users to explore, analyze, and visualize data, create 2D maps and 3D scenes, and share their work. Students can install and use ArcGIS Pro free of charge on UF-owned or personally owned computers if it is for class purposes only. For more information about download and installation instruction, check the link from UF GeoPlan Center: https://www.geoplan.ufl.edu/software/arcgis-pro/
- Zoom: Zoom is an easy-to-use video conferencing service available to all UF students, faculty, and staff that allows for meetings of up to 300 participants. For more information: https://ufl.zoom.us/

Required Technology & Digital Information Literacy Skills

Technical skills required:

- Using the Canvas learning management system
- Using UFL email with attachments
- Creating and submitting files in commonly used word processing program formats, including Microsoft Excel, Word and PowerPoint
- Downloading and installing software, including i-Tree, the InVEST model, and ArcGIS Pro

- Using Zoom for live chat sessions

Digital information literacy skills include:

- Using online libraries and databases to locate and gather appropriate information
- Using computer networks to locate and store files or data
- Using online search tools for specific academic purposes, including the ability to use search criteria, keywords, and filters
- Analyzing digital information for credibility, currency, and bias (e.g., disinformation, misinformation)
- Properly citing information sources
- Preparing a presentation of research findings

Course Description:

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services, such as the supply of food and forage; regulating services, which involve climate regulation, air and water purification, carbon sequestration, and pollination; supporting services that are fundamental to the functioning of all other ecosystem services, such as soil formation, nutrient cycling, and primary production; and cultural services through spiritual enrichment, recreation, and aesthetic experiences.

In this course we will examine ecosystem services from an interdisciplinary perspective centering on the conceptual background, indicators, and various quantitative and qualitative approaches for ecosystem services assessments, including biophysical, socio-economic, model-, expert-, and citizen science-based methods. We will also review initiatives and applications that integrate ecosystem services assessments into policy and decision-making in various domains, such as natural capital accounting, biological conservation and land use planning.

Course Learning Objectives:

After successfully completing the course, students will be able to:

- Identify the definition and common classifications of ecosystem services.
- Contrast different ecosystem services terminologies and interpret the ecosystem services cascade framework.
- Illustrate ecological structure and functions, and socio-ecological processes that underpin the delivery of different types of ecosystem services.
- Identify ecological indicators used to measure ecosystem services.

- Examine and compare the different methods of quantifying, mapping and valuing ecosystem services.
- List and discuss major intergovernmental and governmental programs and initiatives that mainstream ecosystem services into policy instruments.
- Identify existing data, variables and indicators and develop an analysis for ecosystem services assessments.

Topic Outline:

Week	Module	Topics
8/22-8/23	0. Orientation	i. Course introduction ii. Vetting online sources
8/22-8/28	1. Concept of Ecosystem Services	i. Definition of ecosystem services (ES) ii. Key findings of the millennium ecosystem assessment (MEA)
8/29-9/4	2. Ecosystem Services Terminologies and Classifications	i. ES terminologies: supply, demand, flow ii. The ES cascade framework iii. Common terminologies and classifications of ES iv. Related concepts: ecosystems, biomes, land use and land cover, biodiversity.
9/5-9/11	3. Supporting Services	i. Primary productivity ii. Nutrient cycling iii. Soil formation
9/12-9/18	4. Regulating Services	i. Carbon storage and sequestration ii. Micro-climate regulation iii. Pollination services
9/19-9/25	5. Provisioning and Cultural Services	i. Food, fiber, timber and fuel production ii. Nonmaterial benefits that arise from the interaction between people and ecosystems

9/26-10/2	6. Integrating Ecosystem Services in Management	i. Daily's framework from measurements to decision-making ii. Case study: the i-Tree canopy tool
10/3-10/9	Exam 1	i. Covers materials in modules 1-6
10/10-10/16	7. Quantifying and Mapping Ecosystem Services	i. Ecological production functions (EPFs) ii. A tiered approach for quantifying and mapping ES iii. Emerging data and technologies for measuring ES
10/17-10/23	8. Valuing Ecosystem Services	i. Rationale for economic valuation of ES ii. Fundamentals of economic value iii. Opportunity costs iv. **Project outline due on Saturday October 26th**
10/24-10/30	9. Monetary Valuation of Ecosystem Services	i. Direct market valuation ii. Revealed preference methods iii. Stated preference methods iv. Value transfer
10/31-11/6	10. Non-Monetary Valuation of Ecosystem Services	i. Pitfalls of monetary valuation ii. Cultural, shared and social values iii. Non-monetary valuation
11/7-11/13	11. Decision-making analysis (DMA)	i. Trade-offs in ES ii. Cost-benefit analysis iii. Multi-criteria analysis
11/14-11/20	12. Paying for Ecosystem Services	i. Market-based instruments (MBIs) ii. Payments for ecosystem service (PES) iii. Key factors that influence the effectiveness of MBIs
11/22-12/4	13. Revisiting the concept and methods of ecosystem service	i. Critique and weaknesses of ES methods ii. Environmental justice and ES iii. Study exercise questions for Exam 2 iv. **Final project paper due on Saturday December 7th**

12/9-12/13	Exam 2 (during finals week)	i.	Covers materials in modules 7-12 and the last week of the semester

Disclaimer:

Because ecosystem services is a dynamic contemporary field of study specific topics may be added or shifted within the above schedule. Please note, the grading structure will not differ from what is outlined below.

Grading Structure:

Graduate Students*

Assessment Type	Percent of Final Grade
Exams (2 total)	28
Assignments & On-line Discussions	35
Project Paper	25
Chat Participation	12

*Compared to undergraduate students, graduate students have different requirements for their projects and additional questions in assignments and exams to receive graduate level credits for this class.

Undergraduate Students

Assessment Type	Percent of Final Grade
Exams (2 total)	28
Assignments & On-line Discussions	35
Project Paper	25
Chat Participation	12

Rubrics will be provided with graded activities. See Canvas assignments for individual rubrics.

Grading Scale:

Percent	Grade	Grade Points
100 – 90.0	A	4.00

89.9 – 87	B+	3.67
86.9 – 80	B	3.00
79.9 – 77.0	C+	2.33
76.9 – 70.0	C	2.00
69.9 – 67.0	D+	1.33
66.9 – 60.0	D	1.00
59.9 – 0	E	0.00

Current UF grading policy for assigning grade point averages can be found here: https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/

Project paper

Each student will conduct an independent study and submit a project paper (800-1200 words). When preparing the project papers, students are required to submit an outline (30% of the grade for the project) due on **Saturday October 26th**. The project paper is due on **Saturday December 7th**. More details about the requirements, rubrics, and tips will be provided on Canvas.

Undergraduate students will each pick a regulating/cultural ecosystem service as the focus of their projects. The paper will cover topics including how the provision of this ecosystem service differs by ecosystems and land use and land cover, how it can be quantified, mapped, and valued.

Graduate students are expected to develop a draft suitable for future publication at the UF/IFAS Electronic Data Information System. The topic can be anything related to ecosystem services, such as highlighting certain ecosystem services in Florida agroecosystems, identifying the approaches in quantifying and valuing ecosystem services, and outlining the benefits of incorporating ecosystem services in decision making. Graduate students are strongly encouraged to contact the instructor to discuss potential research topics.

Chat Sessions

Chat sessions will be scheduled weekly, and all students are expected to participate. Chat sessions will be held outside of the Canvas course framework using Zoom. Students will need access to a computer with audio and a web camera (optional) to take this course. The first chat session will take place on **Wednesday August 28th 8-9 pm**. Other chat sessions will be scheduled after course registration to best accommodate everyone's schedule.

Additional sessions per week may be added to accommodate conflicting schedules based on instructor discretion. If you are unable to attend a chat session, chat sessions may be replaced with watching the recordings and answering make-up assignments on Canvas at the instructors' discretion.

Class Demeanor or Netiquette: All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats.

Privacy Disclaimer: Our chat sessions are audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance and Late Policy:

Requirements for class attendance (module participation) and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

Late assignments and projects will be accepted for 3 days after the submission date and will lose 10% of the grade per day that they are late. After 3 days (including Saturdays and Sundays) the assignment will no longer be accepted, and the student will receive a zero for that assignment.

Course Evaluation Process

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at: https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens and can complete evaluations through the email they receive from GatorEvals,

in their Canvas course menu under GatorEvals, or via the [GatorEvals site](). Summaries of course evaluation results are available to students at [GatorEvals Public Data]().

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

UF Policies

University Policy on Accommodating Students with Disabilities: Students with disabilities requesting accommodations should first register with the Disability Resource Center (352- 392-8565, http://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter, which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Academic Honesty

University of Florida students are bound by the Honor Pledge. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Student Honor Code." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see [Student Conduct Code Process]().

Policy on the Use of Generative Artificial Intelligence Tools: You may use AI programs e.g. ChatGPT to help generate ideas and brainstorm. However, you should note that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. Beware that use may also stifle your own independent thinking and creativity. You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material. Submitting work containing any content generated by artificial intelligence (AI) when not explicitly cited or not directed to do so by the instructor will be considered an act of academic dishonesty.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or guest lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Getting Help, Technical difficulties: For issues with technical difficulties for Canvas, please contact the UF Help Desk.

http://helpdesk.ufl.edu

(352) 392-HELP (4357)

Walk-in: HUB 132

Note, any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from the Help Desk when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

Campus Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

Health and Wellness

- U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or https://umatter.ufl.edu/ to refer or report a concern and a team member will reach out to the student in distress.
- Counseling and Wellness Center: Visit https://counseling.ufl.edu/ or call 352-392-1575 for information on crisis services as well as non-crisis services.
- Student Health Care Center: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit https://shcc.ufl.edu/
- University Police Department: Visit https://police.ufl.edu/ or call 352-392-1111 (or 9-1-1 for emergencies).
- UF Health Shands Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; visit https://ufhealth.org/locations/uf-health-shands-emergency-room-trauma-center
- GatorWell Health Promotion Services: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit https://gatorwell.ufsa.ufl.edu/ or call 352-273-4450.

Privacy and Accessibility Policies

For information about the privacy policies of the tools used in this course, see the links below:

- Instructure (Canvas)
  - [Instructure Privacy Policy](#)
  - [Instructure Accessibility](#)
- Microsoft
  - [Microsoft Privacy Policy](#)
  - [Microsoft Accessibility](#)
- Sonic Foundry (Mediasite Streaming Video Player)
  - [Sonic Foundry Privacy Policy](#)
  - [Mediasite Accessibility](#) [(PDF)](#)
- I-Tree
  - [i-Tree USDA Privacy Policy](#)
  - [i-Tree USDA Accessibility](#)
- InVEST
  - [Stanford Online Privacy Policy](#)
  - [Stanford Digital Accessibility](#)
  -
- ArcGIS Pro
  - [ESRI Privacy Policy](#)
  - [ESRI Accessibility](#)
- Zoom
  - [Zoom Privacy Policy](#)
  - [Zoom Accessibility](#)

Academic Resources

- E-learning technical support: Contact the UF Computing Help Desk at 352-392-4357 https://it.ufl.edu/helpdesk/ or via e-mail at helpdesk@ufl.edu.
- *[Career Connections Center](#)*: Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.
- *[Library Support](#)*: Various ways to receive assistance with respect to using the libraries or finding resources.
- *[Teaching Center](#)*: 1317 Turlington Hall, 352-392-2010. General study skills and tutoring.
- *[Writing Studio](#)*: 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.
- Student Concern: [Report Student Concerns or Conduct](#)

Student Complaints:

- Residential Course: https://www.sfa.ufl.edu/written-student-complaints/

- Online Course: https://pfs.tnt.aa.ufl.edu/state-authorization-status/#student-complaint