

Ecology and Restoration of Invaded Ecosystems
FOR 6934 (3 credits)
Spring 2022

Course Description

This course begins with an overview of the ecological basis for plant invasions in terrestrial ecosystems, with emphasis on applications for restoration and management of invaded ecosystems. Methods and techniques for prediction, prevention, control, and restoration will be discussed, and plant invasions from Florida and around the U.S. will be used as case studies.

This course will follow on an online discussion format, with recorded lectures and relevant assigned readings from textbooks and primary literature. The course is graduate level and is designed for students with a strong interest and background in ecology and applied plant science and an interest in invasive species ecology and management.

Pre-Requisites

No formal pre-requisites, but coursework in biology, ecology, or other relevant plant science courses is strongly recommended.

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Learning Outcomes

At the end of this course, each student will:

- Be able to critically assess scientific literature and implications of results for practical management.
- Be able to evaluate invasive species documented on a site and identify potential impacts.
- Develop the desired future conditions incorporating available resources, and infestations that impact the current condition.
- Incorporate knowledge of invasion theory and mechanisms to design and prioritize treatments in an annual and/or multi-year adaptive management plan.
- Propose a monitoring scheme to support an adaptive management approach.

Required Text

1. Invasion Ecology 2nd ed. JL Lockwood, MF Hoopes and MP Marchetti. 2013. Blackwell Publishing, 303 p. 978-1444333657

Class Format

The course will consist of one-week modules focused on specific topics related to invasion ecology, management, and restoration. The format will consist primarily of readings and discussion threads. To accommodate students with full-time employment, modules will follow a **Friday-Monday (11 days)** schedule to allow time for adequate discussion over the weekend period as needed. For each module in the first half of the semester, students will be assigned several readings, including chapter(s) from one of the required texts, relevant peer-reviewed journal articles, or other materials. A short (approximately 20 minute) summary lecture to review core lessons from the general topic will be provided by the instructor. The lecture will be posted each **Friday**. Throughout the semester, some additional guest lectures and

video podcasts will be provided as a supplement.

The second half of the semester will take an interrupted case study format, with several relevant, peer-reviewed journal articles to introduce the general topic, plus a short description of that module's section of the case study and relevant questions with a discussion thread.

A discussion thread will also be posted on **Friday**. Eight discussions will be led by the instructors (focusing on the module topic) and seven discussion will be led by a group of students (focusing on a single journal article). These additional readings will build on topics introduced in the lectures and/or present a case study of relevant invasive plant ecology and management. All students are expected to read these articles and participate in the additional discussion. Comments/responses from the students can be posted until **Sunday (10 days)** evening.

NOTE: *Discussion questions are intended to stimulate conversation and debate and encourage you to explore more deeply into the topics covered in the week's readings. In many cases, there will not be a clear "right" or "wrong" answer. In some cases, the questions will be contextual (e.g., "Describe an example of a species that exhibits invasive traits"), other questions will be more conceptual, and some questions may ask to merely express an opinion. Towards the end of the semester the discussion threads will be used to practice developing adaptive management recommendations for an invaded ecosystem.*

Late policy for assignments and attendance: "Attendance" for this course will be based on participation in the discussion forum. Written assignments and projects are due electronically by noon (Eastern time) on the due date and will lose 10% of the grade for each day they are late (weekends count too). In cases of extended illness or emergencies, arrangements to turn in late exams or other written assignments must be made with the instructor prior to the due date. Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

Assignments and Evaluation of Student Learning

Discussion thread participation

Students will be expected to contribute **two** unique comments and/or responses to other students (typically several sentences to about a paragraph in length) which demonstrate thought and/or research into the topic area. A citation relevant to at least one of your comments is required. Note that you are welcome to post and respond more than the minimum.

Rubric:

0 Points: No response

.5 Points: only one comment that demonstrates thought and/or research

.8 Points: 2 comments, no citation or 1 comment with citation

1.0 Points: 2 comments that demonstrate thought and/or research including relevant citation.

Student-led Discussion thread

For the student-led discussions, the discussion leader(s) will be expected to read the article (and supporting literature, as necessary) and lead a discussion on the most important topics covered in it. This will involve providing a brief 1-2 paragraph summary, posing at least 3 questions for the other students, and *facilitating* a productive online dialogue between students. The discussion leader(s) should initiate the discussion no later than Thursday at noon (Eastern).

Rubric for group leaders:

While it is important that all group members contribute to the 1) development of questions, 2) writing of the summary and 3) moderation of the discussion; all members do not have to do all three things equally

but should be significant contributors to at least 2 of the three areas.

Individual score: List individual contribution to each of the three areas: 15 points.

Group score: Group will collectively be scored on the for the overall week: 9 pts

Summary of papers was insightful, succinct yet complete: Y/N

The discussion prompt questions stimulated thoughtful discussion: Y/N

Moderators encouraged cogent responses: Y/N

Management Plan Project

You will develop and present an actionable management plan for restoring and managing a particular property with non-native species invasions. You are encouraged to choose a property that you are familiar with and currently working on, or you can work with the instructors to find a suitable scenario relative to your locale. Your management plan should provide an overview of the non-native species of concern including mechanisms for dispersal into your site and ecosystem impacts, followed by a feasible annual work plan for control of the current invasion, restoration of ecological characteristics (e.g., species composition, structure, soils/hydrology, or other ecological processes) following control, and monitoring and prevention of new invasions. Prioritization of actions should also be discussed.

Two homework assignments during the second half of the semester will build up to the final paper, allowing for instructor input and increased application of knowledge by the student.

You will have the option of presenting your plan to the class through a variety of formats (including but not limited to a written plan including figures, maps and flowcharts; a narrated PowerPoint discussing the plan; or podcast or video of you in the field discussing management options, etc.). We encourage creativity in presenting your plan as well as the use of multi-media.

As part of your grade, you will also be asked to peer review one plan presented by your fellow students. More detailed instructions on this assignment and directions for uploading your materials will be provided in the Assignments tab.

The grading breakdown will be as follows:

15 points	Participation in weekly discussion sessions (1 point each x 15 discussions)
24 points	Presentation of one weekly article and moderation of discussion (Group)
10 points	Quizzes (2 points x 5 quizzes)
20 points	Homework assignments leading to management plan (2 x 10 points each)
23 points	Management plan project
8 points	Peer review of student management plan

Total: 100 points

Grading Scale (<http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html>)

Letter grades will be assigned as follows: A (93-100), A⁻ (90-92), B⁺ (86-89), B (83-85), B⁻ (80-82), C⁺ (76-79), C (73-75), C⁻ (70-72), D⁺ (66-69), D (63-65), D⁻ (60-62), E (<60)

For information on current UF policies for assigning grade points, see

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Schedule of Class Topics and Readings

I. Introduction (Why Invasive Species Are a Problem)

Module 1: Introduction

- A. *Required Text:* Lockwood et al, Chapter 1, An Introduction to Invasion Ecology
- B. *Article:* van Kleunen, Mark, Oliver Bossdorf, and Wayne Dawson. "The ecology and evolution of alien plants." *Annual Review of Ecology, Evolution, and Systematics* 0 (2018).
- C. *Article:* Ricciardi, Anthony, and Rachael Ryan. "The exponential growth of invasive species denialism." *Biological Invasions* 20, no. 3 (2018): 549-553.
- D. *Article:* Sagoff, Mark. "Invasive species denialism: a reply to Ricciardi and Ryan." *Biological Invasions* (2018): 1-7.

Module 2: Critically Evaluating Invasive Species Literature

- A. *Article:* Frazier, Jesse E., Ajay Sharma, Daniel J. Johnson, Michael G. Andreu, and Kimberly K. Bohn. "Group selection silviculture for converting pine plantations to uneven-aged stands." *Forest Ecology and Management* (2020): 118729.

Module 3: Impacts to Individuals, Species and Communities

- A. *Required Text:* Lockwood et al, Chapter 9 through page 233, Ecological Impacts of Invasive Species
- B. *Article:* Liebhold, Andrew M., Eckehard G. Brockerhoff, Susan Kalisz, Martin A. Nuñez, David A. Wardle, and Michael J. Wingfield. "Biological invasions in forest ecosystems." *Biological Invasions* 19, no. 11 (2017): 3437-3458.
- C. Student-led *article:* Tarasi, Dennis D., and Robert K. Peet. "The native-exotic species richness relationship varies with spatial grain of measurement and environmental conditions." *Ecology* 98, no. 12 (2017): 3086-3095.

Module 4: Impacts to Ecological Processes and Economics

- A. *Required Text:* Lockwood et al, finish Chapter 9, Ecological Impacts of Invasive Species
- B. *Article:* Pimentel, David, Rodolfo Zuniga, and Doug Morrison. "Update on the environmental and economic costs associated with alien-invasive species in the United States." *Ecological Economics* 52, no. 3 (2005): 273-288.
- C. Student-led *article:* Januchowski-Hartley, Stephanie R., Vanessa M. Adams, and Virgilio Hermoso. "The need for spatially explicit quantification of benefits in invasive-species management." *Conservation Biology* 32, no. 2 (2018)

II. Invasion Theory (How They Become and Cause These Problems)

Module 5: Dispersion and the Invasion Process

- A. *Required text* Lockwood et al. Chapters 2, Transport Vectors and Pathways; and Chapter 4, Propagules.
- B. *Article:* Harvey, Rebecca G., and Frank J. Mazzotti. "The invasion curve: A tool for understanding invasive species management in south Florida." IFAS Publication Number WEC347. Gainesville, FL: University of Florida. edis.ifas.ufl.edu/uw392(2014).
- C. Student-led *article:* Gordon, Doria R., Deah Lieurance, and S. Luke Flory. "Predicted versus actual invasiveness of climbing vines in Florida." *Biological Invasions* 19, no. 8 (2017): 2375-2384.
- D. *Optional text:* Lockwood et al. Chapter 8, Ecological Processes and the Spread of Non-native Species

Module 6: Disturbances and How They Impact Invasions

- A. *Required Text:* Lockwood et al, Chapter 5, Disturbance; and Chapter 6, Establishment Success: The Influence of Biotic Interactions

- B. *Article*: Xiao, Sa, Ragan M. Callaway, Ryan Graebner, Jose L. Hierro, and Daniel Montesinos. "Modeling the relative importance of ecological factors in exotic invasion: The origin of competitors matters, but disturbance in the non-native range tips the balance." *Ecological Modelling* 335 (2016): 39-47.
- C. Student-led *article*: Pearson, Dean E., Yvette K. Ortega, Diego Villarreal, Ylva Lekberg, Marina C. Cock, Özkan Eren, and José L. Hierro. "The fluctuating resource hypothesis explains invasibility, but not exotic advantage following disturbance." *Ecology* 99, no. 6 (2018): 1296-1305.

III. Management Planning (How to Limit or Remove These Problems)

Module 7: Management Planning- Assessment (What Do You Have?)

- A. *Article*: Gordon, Doria R., S. Luke Flory, Deah Lieurance, Philip E. Hulme, Chris Buddenhagen, Barney Caton, Paul D. Champion et al. "Weed risk assessments are an effective component of invasion risk management." *Invasive Plant Science and Management* 9, no. 1 (2016): 81-83.
- B. *Article*: Lieurance, D. "Protocols for testing the invasiveness of plants in Florida." In *Proceedings of the 2015 Annual Meeting of the International Plant Propagators' Society 1140*, pp. 279-284. 2015.
- C. *Optional text*: Lockwood et al. Chapter 12, Predicting and Preventing Invasion

Module 8: Management Planning- Assessment (Biology and Control)

- A. *Required Text*: Chapter 13, Lockwood et al. Ecological Processes and the Spread of Non-native Species

Module 9: Discussion, HOMEWORK ASSIGNMENT

- A. Student-led *article*: Pecl, Gretta T., Miguel B. Araújo, Johann D. Bell, Julia Blanchard, Timothy C. Bonebrake, I-Ching Chen, Timothy D. Clark et al. "Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being." *Science* 355, no. 6332 (2017).
- B. *Optional article*: Wallingford, Piper D., Toni Lyn Morelli, Jenica M. Allen, Evelyn M. Beaury, Dana M. Blumenthal, Bethany A. Bradley, Jeffrey S. Dukes et al. "Adjusting the lens of invasion biology to focus on the impacts of climate-driven range shifts." *Nature Climate Change* (2020): 1-8.
- C. *Optional article*: Beaury, Evelyn M., Emily J. Fusco, Michelle R. Jackson, Brittany B. Laginhas, Toni Lyn Morelli, Jenica M. Allen, Valerie J. Pasquarella, and Bethany A. Bradley. "Incorporating climate change into invasive species management: insights from managers." *Biological Invasions* 22, no. 2 (2020): 233-252.

Module 10: Management Planning- Desired Future Conditions (What Do You Want?)

- A. *Article*: Messier, Christian, Klaus Puettmann, Robin Chazdon, K. P. Andersson, Virginie A. Angers, L. Brotons, E. Filotas, Rebecca Tittler, Lael Parrott, and Simon A. Levin. "From management to stewardship: viewing forests as complex adaptive systems in an uncertain world." *Conservation Letters* 8, no. 5 (2015): 368-377.
- B. *Optional text*: Lockwood et al. Chapter 14, Global Climate Change and Invasive Species

Module 11: Peer Review, HOMEWORK ASSIGNMENT

- A. Online readings posted on Canvas

Module 12: Management Planning- Building a Treatment Plan (How Do You Get There?)

- A. *Article*: Stone, Deborah, and Michael Andreu. "Direct Application of Invasive Species Prioritization: The Spatial Invasive Infestation and Priority Analysis Model." *Ecological Restoration* 35, no. 3 (2017): 255-265.

- B. Student-led *article*: Baker, Christopher M. "Target the source: optimal spatiotemporal resource allocation for invasive species control." *Conservation Letters* 10, no. 1 (2017): 41-48.
- C. Student-led *article*: Moody, Michael E., and Richard N. Mack. "Controlling the spread of plant invasions: the importance of nascent foci." *Journal of Applied Ecology* (1988): 1009-1021.

Module 13: Management Planning- Finalizing and Implementing Your Management Plan (Adaptive Management)

- A. *Article*: Prior, Kirsten M., Damian C. Adams, Kier D. Klepzig, and Jiri Hulcr. "When does invasive species removal lead to ecological recovery? Implications for management success." *Biological invasions* 20, no. 2 (2018): 267-283.

FINAL PROJECT (See CANVAS for due dates)

RESOURCES TO HELP YOU SUCCEED?

Course Website

The course website can be accessed on Canvas using your myUFL key. The course site will contain readings, announcements, helpful links, and important course information, as well as an online grade book. All assignments should be submitted electronically through Canvas unless otherwise noted by your instructors.

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.

Academic Civility

Meaningful and constructive dialogue is encouraged in this class and requires a degree of mutual respect, willingness to listen, and tolerance of opposing points of view. Respect for individual differences and alternative viewpoints will be maintained in this class. One's words and use of language should be temperate and within acceptable bounds of civility and decency. Friendly persuasion wins friends and influences people. Aggressively arguing your point often does the opposite and stops dialogue.

Academic Honesty

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.*" 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: <https://www.dso.ufl.edu/sccr/process/student-Conducthonor-code/>

Wellness

UF Counseling and Wellness Center offers individual counseling, wellness counseling, couples counseling, problem solving help, CERC crisis services, and other assistance. For more information, visit: <http://www.counseling.ufl.edu/cwc/Default.aspx>

Students with Disabilities Act

The Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

Campus Helping 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.

- *University Counseling & Wellness Center*, 3190 Radio Road, 352-392-1575,

www.counseling.ufl.edu/cwc/

- *U Matter We Care*, www.umatter.ufl.edu/

- *Career Resource Center*, First Floor JWRU, 392-1601, www.crc.ufl.edu/

UF/IFAS Field and Fork Food Pantry

The Pantry (<http://pantry.fieldandfork.ufl.edu>) is a resource on the University of Florida campus committed to eradicate food insecurity. Food insecurity is not having a reliable access to nutritious foods for yourself on a regular basis. If you, or anyone you know is experiencing food insecurity, the Pantry is a resource to visit. They offer non-perishable food, toiletries and fresh vegetables grown at the Field and Fork Gardens to provide a well-balanced diet. Protecting the privacy of its guests and providing food to those in need within our campus community is their priority. Guests do not need any proof of need to use this resource, all that is needed is a Gator 1 ID to prove you are a current Student, Faculty or Staff at the University of Florida.

Student Complaints

Residential Course: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf

Feedback

Student assessment of instruction is an important part of efforts to improve teaching and learning. We encourage your constructive criticism, suggestions, ideas, and other feedback for improving the course. Please refer to contact information on the first page. Additionally, at the end of the semester, students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.