# Management and Restoration of Invaded Ecosystems

**FOR 6158 (3 credits)**
**online Spring 2024**

## Course Description

An overview of the ecological basis for plant invasions in terrestrial ecosystems, with primary 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 focuses heavily on applying scientific theory and research to on-the-ground management.

## Format and Audience

This course will follow an online asynchronous 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. **The first half of the semester is designed to have less instructor interaction than the second half of the semester.**

## Pre-Requisites

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

## Instructors


Michael Andreu
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Tracy Muzyczka
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## TA


Elysia Lewis
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## Office Hours

Given that this course is remotely taught the best way to set up a meeting is by emailing me and then we can arrange to set up a Zoom/TEAMS call.

## Group Meetings with the Instructors

Throughout the semester we will schedule meetings with the instructors and all students enrolled in the course. Participation in these meetings is optional. Times will be listed in CANVAS.

**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.
- Evaluate invasive species documented on a site and identify potential impacts.
- Describe the desired future ecosystem conditions incorporating available resources.
- Identify 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

**Course Flow**

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-Sunday (10 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 instructors. The lecture will be posted each Friday. Throughout the semester, some additional guest lectures and video podcasts will be provided as a supplement. **The first half of the semester is designed to have less instructor interaction than the second half of the semester.** However, do not hesitate to reach out to the instructors with any questions or for any needed help with the course materials or structure.

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 discussions will be led by a group of students (focusing on a 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 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 midnight (Eastern time) on the due date and **unexcused late work 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://gradcatalog.ufl.edu/graduate/regulations/.

**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 follow the directions in the relevant Canvas assignment, which are typically to email the article summary and discussion questions to a TA by the Thursday evening before the discussion opens.

*Rubric for group leaders*: While it is important that all group members contribute to the: 1) development of questions, 2) writing of the article summary, 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*: Individual contribution to each of the three areas: 15 points.
*Group score*: Group will collectively be scored for the overall week: 12 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/or are 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. It should include mechanisms for dispersal into your site and ecosystem impacts, 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.

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 of Canvas.

The grading breakdown will be as follows:

- 15 points Participation in weekly discussion sessions (1 point each *x* 15 discussions)
- 27 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)
- 20 points Management plan project.
- 8 points Peer review of student management plan

Total: 100 points

**Grading Scale**
Letter grades will be assigned as follows: A (93-100), $A^-$ (90-92.99), $B^+$ (86-89.99), B (83-85.99), $B^-$ (80- 82.99), $C^+$(76-79.99), C (73-75.99), $C^-$(70-72.99), $D^+$(66-69.99), D (63-65.99), D- (60-62.99), E (<60)

For information on current UF policies for assigning grade points, see https://gradcatalog.ufl.edu/graduate/regulations/

**Schedule of Class Topics and Readings**

## *Introduction (Why Invasive Species Are a Problem)*

**Module 1: Introduction**
*Required Text:* Lockwood et al, Chapter 1, An Introduction to Invasion Ecology
*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).
*Article:* Ricciardi, Anthony, and Rachael Ryan. "The exponential growth of invasive species denialism."
*Biological Invasions* 20, no. 3 (2018): 549-553.
*Article:* Sagoff, Mark. "Invasive species denialism: a reply to Ricciardi and Ryan." *Biological Invasions*
(2018): 1-7.

**Module 2: Critically Evaluating Invasive Species Literature**
*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**
*Required Text:* Lockwood et al, Chapter 9 through page 233, Ecological Impacts of Invasive Species
*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.
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**
*Required Text:* Lockwood et al, finish Chapter 9, Ecological Impacts of Invasive Species
*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.
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)

## *Invasion Theory (How They Become and Cause These Problems)*

**Module 5: Dispersion and the Invasion Process**
*Required text* Lockwood et al. Chapters 2, Transport Vectors and Pathways; and Chapter 4, Propagules.
*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).
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.
*Optional text*: Lockwood et al. Chapter 8, Ecological Processes and the Spread of Non-native Species

**Module 6: Disturbances and How They Impact Invasions**
*Required Text:* Lockwood et al, Chapter 5, Disturbance; and Chapter 6, Establishment Success: The Influence of Biotic Interactions
*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.
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.

## *Management Planning (How to Limit or Remove These Problems)*

**Module 7: Management Planning- Assessment (What Do You Have?)**
*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.
*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.
*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**
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*: 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. A*rticle:* 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** Online readings posted on Canvas
Student-led *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.

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

*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.

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

*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.

*Optional article:* Stone, Deborah, and Michael Andreu. "Fire and Invasive Plant Interactions" University of Florida IFAS Extension FOR 386 (2022) 13 pp. https://doi.org/10.32473/edis-FR457-2022

**Module 14: FINAL PROJECT** (See CANVAS for due dates)

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.

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.

## 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 an online grade book. All assignments should be submitted electronically through Canvas unless otherwise notes 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.

**Online 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 https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at: https://gatorevals.aa.ufl.edu/public-results/.

**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: http://www.dso.ufl.edu/sccr/process/student- conduct-honor-code.

**Services for Students with Disabilities**
The Disability Resource Center 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.

0001 Reid Hall, 352-392-8565, https://disability.ufl.edu/

**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** Counseling Services Groups and Workshops Outreach and Consultation Self-Help Library Wellness Coaching

- U Matter We Care, **www.umatter.ufl.edu/**
- *Career Connections Center,* First Floor JWRU, 392-1601, https://career.ufl.edu/.
- Student Success Initiative, http://studentsuccess.ufl.edu.

**Student Complaints:**
The School of Forestry, Fisheries and Geomatics Sciences cares about your experience and we will make every effort to address course concerns. We request that all online students complete a course satisfaction survey each semester, which is a time for you to voice your thoughts on how your course is being delivered. If you have a more urgent concern, your first point of contact should be the SFFGS Academic Coordinator or the Graduate/Undergraduate Coordinator for the program offering the course.

- Residential Course: https://sccr.dso.ufl.edu/policies/student-honor-code-student- conduct- code/.
- Online Course: https://pfs.tnt.aa.ufl.edu/state-authorization-status/#student-complaint