

Biology 648 - Invasive Species: Ecology, Evolution and Management
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Instructors:

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Course Description:

This course is designed to provide students with an up-to-date perspective on invasive species. Part one will cover characteristics of invasive species and the ecological and evolutionary processes that occur when non-native species are introduced into new habitats. There will also be a review of past and present pathways that have led to the introduction and spread of invasives. Part two will cover invasive species control and management. Course literature will be a mix of recent peer-reviewed articles, reports and landmark papers.

Grading:

Participation and Discussion: 30% (Based on attendance and contributions to class discussions)

Homework Assignments: 35%

Semester Project and Presentation: 35%

Description of the semester project: Students will be matched to an invasive species (terrestrial, marine, pathogen etc.) that has been targeted as a threat to New England or the U.S. The goal will be to prepare a monograph for this species using the topics covered in class as your guide. Students are expected to develop a report over the semester and to use their research to participate in class discussions. At the end of the semester each student will give a brief presentation summarizing the work and conclusions. The final report will be due on the last day of class. Well done reports may be submitted to state or regional organizations.

BIOL 648 SYLLABUS:

I: Introduction - What is an invasive species?

1/29: Introduction, class administrivia

II: Defining Invasive Species

1/31: Defining Invasives

- [Invasive Plant Pests Definitions and Criteria](#). (2004). NBII Southern Appalachian Information Node.
- [A Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species. Environment Policy and Law Paper No. 40](#) (.pdf file). (2000). IUCN. [Only read Section 1.1 (pp. 1-4)! No need to print out the whole thing!]
- "Biological Invasions and Cryptogenic Species." Carlton, J. T. (1996). **Ecology** 77(6): 1653-1655. [Available via [JSTOR](#), library barcode required if off-campus]
- ["On invading species and invaded ecosystems: the interplay of historical chance and biological necessity."](#) (.pdf) di Castri (1990). In **Biological Invasions in Europe and the Mediterranean Basin**. pp. 3-16.

2/5: The "ideal" invader – Biological characteristics that make a successful invader

- ["Invasive species profiling? Exploring the characteristics of non-native fishes across invasion stages in California."](#) (.pdf file) Marchetti et al. (2004) **Freshwater Biology**. Vol. 49, pp. 646-661.
- **Ecological and physiological characteristics of invading species.** in Ecology of Biological Invasions. Newsome, A. E. and I. R. Noble (1986). Cambridge, Cambridge University Press: 1-20. [Handed out after class]
- ["Behavioural flexibility and invasion success in birds."](#) (.pdf file) Sol et al. (2002) **Animal Behaviour**. Vol. 63, pp. 495-502. [**skip?**]

2/7: Enemy Release Hypothesis and other potential factors for success

- ["Is invasion success explained by the enemy release hypothesis?"](#) (.pdf file) Colautti et al. (2004) **Ecology Letters**. Vol. 7, pp. 721-733.
- **"Feedback with soil biota contributes to plant rarity and invasiveness in communities."** Klironomos, J.N. (2002) **Nature**. Vol. 417, pp. 67-70

III: The Process of Invasion

2/12: The natural process of invasion and the lag phase (with an intro to pop genetics) – **(RICK)**

- "Lag times in population explosions of invasive species: causes and implications." (1999) Chapter 7 in *Invasive Species and Biodiversity Management*, edited by Sandlund et al., Kluwer Academic Publishers, The Netherlands. pp. 103-125

2/14: Genetic Variation and Bottlenecks – **(RICK)**

- ["Reduced genetic variation and the success of an invasive species."](#) by TsuTsui et al. (2000) *Proceedings of the National Academy of Sciences*. 97(11): 5948-5953. [.pdf file]

- "[Genetic variation increases during biological invasion by a Cuban lizard.](#)" by Kolbe et al. (2004) *Nature*. 431: 177-181. [.pdf file] [[supplementary info](#)]

III: The Process of Invasion - Disturbance

2/21: Direct Disturbance and its Effects on Invasion

- "Disturbance, Diversity and Invasion: Implications for Conservation." by Richard J. Hobbs and Laura F. Huenneke. (1992) **Conservation Biology**. 6(3) pp. 324-337.
- "Experimental evidence on the importance of disturbance intensity for invasion of *Lantana camara* L. in dry rainforest-open forest ecotones in north-eastern NSW, Australia" by J.A. Duggin and C.B. Gentle. (1998) **Forest Ecology and Management**. 109 pp. 279-292.

2/26: Indirect Disturbance and its Effects on Invasion - **Guest Speaker: Dr. Jeff Dukes**

- [Does global change increase the success of biological invaders?](#) by Jeffrey Dukes and Harold Mooney. (1999) **Trends in Ecology and Evolution**. 14(4) pp. 135-139. (.pdf)
- "Impacts of Biological Invasions on Disturbance Regimes." by Michelle C. Mack and Carla M. D'Antonio. (1998) **Trends in Ecology and Evolution**. 13(5) pp. 195-198.

IV: Vectors of Invasion - History

2/28: Introduction and history of invasions

- "The Crown's Relationship with Acclimatization Societies" Chapter 8 in *Effective Exclusion?*, a report prepared by the Waitangi Tribunal. **Read pp. 495-512 (8.1 through 8.3.1) and 529-533 (8.8)** (This is a large document, you do not need to print the entire thing)
- "Weeds" - Chapter 7 in Crosby, A. W. (1986). *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*. New York, Cambridge University Press.

3/5: Introduction and history of invasions, Part 2

- "Changes in the Sea." Chapter 5 in Elton, C. S. (1958). *The Ecology of Invasions by Animals and Plants*. London, Chapman and Hall, Ltd.
- Fosberg, F. R. (1958). "Man as a dispersal agent." *The Southwestern Naturalist* 3: 1-6.

IV: Vectors of Invasion – Current Pathways

3/7: Pathways of introduction and spread

- Each of you has been assigned two readings, based on the type of organism you are studying. That means some of the articles will only be read by one person, others will be read by many. You should be prepared to discuss the key points of your paper, and think about these questions: What are the specific pathways discussed? Are they obvious or obscure? Are they vectors for a few species or many? What are the specific vectors for your study species?
- At least one of the articles each of you is reading comes from this book: [Invasive Species - Vectors and Management Strategies](#), edited by James T. Carlton and Gregory M. Ruiz. Island Press, 2003.
- Some of you will also be reading part of this paper, which I posted on Prometheus: "Horticulture as a pathway of invasive plant introductions in the United States." (2001) by Reichard, S.E. and P. White. Bioscience 51: pp. 103-113
- Others will be reading portions of this report: "[Pathways and Management of Marine Nonindigenous Species in the Shared Waters of British Columbia and Washington](#)" (1997)

3/12: Pathways analysis

- Each of you received a copy of the Final Report of the Invasive Species Pathways Team. The ISPT is an offshoot of the national Invasive Species Advisory Council. Anyone can get a copy of the report [here](#), but the margins in this original version make it difficult to print out.
- Each of you also chose a main pathway to research for this day's class. You will need to choose a specific subpathway to focus on - expect an email from me about it. Collect as much information as you can about this subpathway, and we will fill out our risk assessments **together in class**. Feel free to use web-based resources, but be sure to consider their validity. This will be a graded homework assignment - **I will collect your risk assessments and a list of sources at the end of class.**

IV: Vectors of Invasion – Future Pathways

3/14: The creation of new pathways - (mostly RICK)

- "Mail Order, the Internet, and Invasive Aquatic Weeds." By Stratford H. Kay and Steve T. Hoyle. (2001) Journal of Aquatic Plant Management. 39, pp. 88-91.
- "Bt TRANSGENE REDUCES HERBIVORY AND ENHANCES FECUNDITY IN WILD SUNFLOWERS." By A. A. SNOW, D. PILSON, L. H. RIESEBERG, M. J. PAULSEN, N. PLESKAC, M. R. REAGON, D. E. WOLF, AND S. M. SELBO. (2003) Ecological Applications. 13(2), pp. 279-286.
- "Hybridization as a stimulus for the evolution of invasiveness in plants?" by Ellstrand and Schierenbeck (2000) Proceedings of the National Academy of Sciences. 97(13): 7043-7050 ([link](#))

V: Predicting Invasions - Modeling

3/26: Modeling Species Invasions

There are many models that have attempted to describe or predict invasions. This week we will read selections from the book "Biological Invasions: Theory and Practice." (Shigesada and Kawasaki 1997), and will look at products including Kolar and Lodge's fish model, and models predicting zebra mussel spread.

- "Can we predict the effects of alien species? A case-history of the invasion of South Africa by *Mytilus galloprovincialis* (Lamarck)." By George M. Branch and C. Nina Steffani. (2004) *Journal of Experimental Marine Biology and Ecology*. 300, pp. 189-215.
- Chapter 2 of **Biological Invasions: Theory and Practice**. By **Nanako Shigesada and Kohkichi Kawasaki**. (1997) Oxford University Press, New York.

VI: Invasive Species Impacts

3/28: Economic Impacts

- "ENVIRONMENTAL AND ECONOMIC COSTS ASSOCIATED WITH NON-INDIGENOUS SPECIES IN THE UNITED STATES" By David Pimentel, Lori Lach, Rodolfo Zuniga, and Doug Morrison. (1999) [[Link](#)]
- Article handed out in class about Economics of Invasions, from the book **Invasive Species in a Changing World**

4/2: Ecological Impacts

- Impact and Extinction
- Impact of Trout

VI: Invasive Species Management

4/4: Mechanical controls

Choose two of the following:

- TNC's Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas
 - [Chapter 1](#) (Manual and Mechanical Techniques) (.pdf)
- Plant Management in Florida Waters (Choose either Physical or Mechanical)
 - [Physical Control](#)
 - [Mechanical Control](#)
- NIMPIS: Control options - Rapid Response Toolbox
 - [Physical Control](#) (read whole page, click "More Information" for at least three techniques)
- [CONTROL OF ZEBRA MUSSELS IN RESIDENTIAL WATER SYSTEMS](#)

4/9: Chemical Controls

Pick one from Group A and one from Group B:

Group A

- [TNC's Weed Control Methods Handbook](#): Tools and Techniques for Use in Natural Areas
 - [Chapter 6](#) (Herbicide Properties) (.pdf) + One section from Chapter 7 (The Herbicides)
- NIMPIS: Control options - Rapid Response Toolbox
 - [Chemical Control](#) (read whole page, click "More Information" for at least three techniques)

Group B

- [Zebra Mussel Chemical Control Guide](#) (.pdf, read Section 1, then pick 1 chemical **each** from Sections 2, 3, and 4 [3 chemicals total])
- [Asian Longhorned Beetle Insecticides](#) + **one of the following**:
 - [Insect Control: Horticultural Oils](#) (.pdf)
 - an article from your research project approved in advance by me (article must be specifically about chemical control or have a "meaty" section)

4/11: Biological controls – **Guest speaker, Beth Suedmeyer**

- [Purple Loosestrife](#), Ch. 11 in Biological Control of Invasive Plants in the Eastern United States, Van Driesche, R., et al., 2002, USDA Forest Service Publication FHTET-2002-04, 413 p. (If you prefer, you can download this document as a .pdf from [this link](#).)
- "Indirect effects of host-specific biological control agents." by D. Pearson and R. Callaway. 2003. Trends in Ecology and Evolution, 18(9), pp. 456-461.
- Short response to Pearson and Callaway article by Thomas et al. (TREE 19(2))

4/18: Biological Controls, the negative side –
(RICK)

- "Developing the options for managing marine pests: specificity trials on the parasitic castrator, *Sacculina carcini*, against the European crab, *Carcinus maenas*, and related species." by R.E. Thresher, M. Werner, J.T. Høeg, I. Svane, H. Glenner, N.E. Murphy, and C. Wittwer. 2000. Journal of Experimental Marine Biology and Ecology. v. 254 pp. 37-51.

In-class: discuss what biological controls have been used -or- could be used for your study species.

4/23: Field trip (date subject to change)

Trip with Beth (weekend?) to release biocontrol beetles, visit greenhouse for demo?

Visit to local invaded site TBD

VII: Planning for the future

4/25: ED/RR (Early Detection, Rapid Response) – **Potential Speaker: Jay Baker**

- paper TBD on ED/RR

4/30: Education and Outreach

- Pieces of the Protect Your Waters report [[.pdf](#)])

5/2: A rainbow of species lists

- TBD

VIII: Presentations and wrap-up

5/7 Redefining Invasives?

- “[Charles S. Elton and the dissociation of invasion ecology from the rest of ecology.](#)” (.pdf) (2001). **Diversity and Distributions** 7: 97-102.
- [Chapters 2 and 5](#) in **Invasion Biology: Critique of a Pseudoscience** by David Theodoropoulos.

5/9, 5/14, 5/16 Presentations

Students with Disabilities: If you have a disability and feel you will need accommodations in order to complete course requirements, please contact the Ross Center for Disability Services (Campus Center, 2nd fl., Rm, 2100) at 617-287-7436.

Academic honesty.....