

BIO 172 – Topics in Introductory Biology: The Biology of Alien Invasions – Spring 2015

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Tuesdays, 9:30-12:30, BIO 222 -- Drop-in office hours: Monday & Friday 10:00-11:00

You may also make an appointment by emailing the Biology Department Secretary, Luz Morales, at lmorales@tcnj.edu

This is a biology course that satisfies the liberal learning requirement in the area of natural science and quantitative reasoning (without lab).

No prerequisite, one course unit.

“ Our planet and society are faced with profound challenges resulting from human activity on a global scale. One of the most important challenges is the introduction of alien (non-native) species into new territories that are oceans and continents away from where they evolved and have always lived. Some of these species become invasive in their new territories, causing major disruptions in the invaded ecosystems. Given the many services that well-functioning natural ecosystems provide for human society, and our obligation to preserve the diversity of life on Earth, scientific investigation of alien invasions is of critical importance to a sustainable future. Students in this course will explore the current science and socio-environmental concerns about biological invasions, with in-depth reading, discussion, writing, field trips, and group-based scientific work. ”

I. TCNJ's liberal learning goals for the natural sciences: connections to the course

Students should understand the process of scientific investigation and the major features of scientific reasoning as they develop a selected, substantive knowledge of basic natural science content.

- **Students should be able to understand distinctive ways in which information is acquired in the natural sciences. They will be able to appreciate differences between basic and applied research in natural science.** You will read about diverse scientific perspectives on biological invasion, to see how scientists work within a community of scholars. The science of biological invasions spans both basic and applied scientific problems.
- **Students will be able to understand the concept of “theory” and the use of models in natural science. They will be able to gain familiarity with the process of hypothesis testing as applied to investigations conducted by natural scientists.** The science of biological invasions is rich in theory and models that inform a wealth of empirical studies that test specific hypotheses. You will learn about many of the main theories, be exposed to a set of field studies that test hypotheses, and test your own hypotheses with experimental studies.
- **Students will be able to explain how the basic natural sciences interface with one another.** Invasion biology is inherently interdisciplinary, drawing on ecology, evolution, genetics, physiology, epidemiology, chemistry, and mathematics.
- **Students will be able to understand how modern societies are constructed on an infrastructure of technological and scientific advances and be familiar with landmark discoveries that shaped at least one natural science discipline. They will understand how natural scientists evaluate social problems and formulate ethical solutions that incorporate scientific reasoning and the application of appropriate scientific principles.** Biological invasions are closely connected to a wide variety of socio-economic problems resulting from disruptions of ecosystem services. You will learn about the work of scientists in this area who have extended their work to explicitly consider the societal dimensions of the problem.
- **Students should acquire a substantive body of factual natural science knowledge, principles, and concepts, including proper use of scientific terminology and vocabulary.** Because you will bring a scientific perspective to the problem of biological invasion, your weekly learning will be infused with new scientific knowledge and language.

II. Course content learning goals

You will develop answers to these main, core questions:

- What is biological invasion by non-native species?
- Why do biological invasions happen?
- What are the ecological and socio-economic consequences of biological invasion?
- How are scientific approaches used to understand biological invasions?
- How can science help us to control invasive species?

III. Course performance learning goals

Your learning in this course will be accomplished via a diverse collection of experiences that will encourage you to think independently about biology and formulate answers to the core questions for this course. You will:

- Integrate careful reading from scientific books and papers with your learning from class.
- Participate in discussions and problem-solving during class.
- Connect biological concepts to interpretation of quantitative data presented in class and readings.
- Collaborate with classmates to develop and carry out scientific research.
- Develop scientific writing skills that includes presentation and interpretation of quantitative data.
- Develop the ability to orally present scientific evidence that supports conclusions about problems within invasion biology.
- Contrast differing scientific perspectives about complex scientific and societal problems within invasion biology.

IV. Assessment of student learning

Your progress toward mastery of the concepts and practices of invasion biology will be assessed with a variety of performance indicators, including

- **Quality of participation during in-class activities.** This allows you to gain credit for your on-going weekly work in the course (the process of doing science is just as important as the products of that work). Participation will be assessed by periodic checks of in-class written work associated with problem solving or discussions and evaluation of in-class presentations. Unexcused absence will therefore affect your grade.
- **Quality of out-of-class written work, including a final term paper.** You will be writing several papers that will reflect your understanding of the scientific and societal problems of invasive species. Papers will be graded on both their content and the quality of the writing.
- **Performance on weekly quizzes.** These will provide regular checks on your content learning from class activities and readings. The quizzes will evaluate your ability to think independently, synthesize your learning from the different experiences, show your understanding of concepts, and test your factual knowledge base.

Your grade will be calculated with a point system, with the different learning indicators weighted like this (some items will be letter graded and converted to points, some will be point-graded):

Learning indicator	Points
In-class activities	
In-class writing to learn (when collected)	20
Answers to pre-discussion prompts (11; 5 pts each; can skip one)	50
Your species choice	5
Your species - biology: Oral presentation	20
Your species - ecology: Oral presentation	20
Your species - societal problem: Oral presentation	20
Invasive earthworm calculations	10
Scientific debate: consequences of invasion (group grade)	20
Assignments due on Mondays at 10 am	
Your species - biology: PowerPoint slides	10
Your species - ecology: PowerPoint slides	10
Your species - societal problems: PowerPoint slides	10
Short paper on testing invasion hypothesis	20
Prepared questions for visiting scientists	10
Term paper outline and annotated bibliography	40
MIVI Experiment paper	50
Quizzes	
7 quizzes (10 pts each)	70
Term paper	
Final term paper due during exam week	100
TOTAL	485

The final letter grade will be assigned based on this scale of percentage of points earned :

Grade	Range	Learning has been . . .	Grade	Range	Learning has been . . .
A	93-100%	outstanding	C+	77-79%	
A-	90-92%	excellent	C	73-76%	fair
B+	87-89%	very good	C-	70-72%	
B	83-86%	good	D+	67-69%	
B-	80-82%		D	60-66%	poor
			F	<60%	failing

V. Resources:

Required:

Simberloff, D. 2013. Invasive species: what everyone needs to know. Oxford University Press, New York.

ISBN 978-0-19-992203-1

Thompson, K. 2014. Where do camels belong? Why invasive species aren't all bad. Greystone Books, Vancouver

ISBN 978-1-77164-096-1

Jaffe, M. 1997. And no birds sing: A true ecological thriller set in a tropical paradise. Barricade Books, New York

ISBN 1-56980-109-6

Plus additional readings as assigned in class.

Books on reserve in the library:

Alexander, J. 2009. Pandora's locks.

Coates, P. 2007. American perceptions of immigrant and invasive species: Strangers on the land.

Cox, G.W.. 2004. Alien species and evolution : the evolutionary ecology of exotic plants, animals, microbes, and interacting native species.

Davis, M.A. 2009. Invasion biology.

Elton, C. 1958/2000. The ecology of invasions by animals and plants, with a foreword by D. Simberloff.

Keller, R.P., M.C. Cadotte, and G. Sandiford. 2015. Invasive species in a globalized world.

Lockwood, J.L., M.F. Hoopes, and M.P. Marchetti. 2013. Invasion ecology.

Mooney, H.A. 2005. Invasive alien species : a new synthesis.

Myers, J.H. 2003. Ecology and control of introduced plants.

Newman, J.A. 2011. Climate change biology.

Perez. L. 2012. Snake in the grass.

Richardson, D.M. 2011. Fifty years of invasion ecology : the legacy of Charles Elton.

Simberloff, D. and M. Rejmánek. 2011. Encyclopedia of biological invasions.

Also as an e-book: <http://libcat.tcnj.edu:7009/vwebv/holdingsInfo?bibId=742229>

Some useful on-line resources

Center for Invasive Species and Ecosystem Health: www.invasive.org

National Invasive Species Information Center: www.invasivespeciesinfo.gov

National Association of Invasive Plant Councils (NAIPC): <http://www.naeppc.org>

. . . and the state council web sites listed there

Search the TCNJ library catalogue for many electronic references (search terms like "invasive species" and "ecology")

VI. Learning Activities

Week	Dates Start to End/Class	Main Topics	Book chapters to complete before class (other readings TBA)	In-class activities (subject to change)	Due this week by 10:00 am Monday (before Tuesday class)
1	1/27	SNOW DAY – no class			
2	1/28 - 2/3	Introductions to each other, to biological invasions & non-native (“alien”) species, and to the course	Simberloff, Ch. 1 Thompson, Ch. 1	Meet and greet The what and why of alien species Discussion of readings On-campus field excursion Research & choose your species	Discussion Q&A
3	2/4 – 2/10	Basic biology of your invasive species	Simberloff, Ch. 2 Thompson, Ch. 2	Quiz & Discussion of readings Individual 5-minute presentations	Discussion Q&A; Species PowerPoint #1
4	2/11 – 2/17	Basic ecology of your invasive species, Part I (half class due to snow)	Simberloff, Ch. 3 Thompson, Ch. 3 Jaffe Ch. 1-3	Quiz Individual 5-minute presentations I	Discussion Q&A; Species PowerPoint #2
5	2/18 – 2/24	Basic ecology of your invasive species, Part II Scientific method; An experimental approach to invasion biology: <i>Microstegium vimineum</i> (MIVI) - competition	Simberloff, Ch. 4 Thompson, Ch. 4 Jaffe Ch. 4 -5	Quiz & Discussion of readings (Wk 4 & 5) Individual 5-minute presentations II Mini-lecture ; Design MIVI experiment	Discussion Q&A
6	2/25 – 3/3	Designing an experiment Ecological & societal problems due to your invasive species I	Simberloff, Ch. 5 Thompson, Ch. 5 Jaffe Ch. 6-8	Quiz Individual 5-minute presentations Set up MIVI experiment	Discussion Q&A; Species PowerPoint #3
7	3/4 - 3/10	Ecological & societal problems due to your invasive species II Evolution ideas; biocontrol of invasive species	Simberloff, Ch. 6 Thompson, Ch. 6 Jaffe Ch. 9-10	Discussion of readings Mini-lecture Field trip to Beneficial Insect Lab	Discussion Q&A
8	<i>(includes break)</i> 3/11 – 3/24	Ecological & societal problems due to your invasive species III Invasion hypotheses	Simberloff, Ch. 7 Thompson, Ch. 7 Jaffe Ch. 11-13	Quiz & Discussion of readings Mini-lecture Small groups: (Deer) x (Invasives) ² in NJ : hypotheses, experiments, predictions, and data	Discussion Q&A

Week	Dates Start to End/Class	Main Topics	Book chapters to complete before class (other readings TBA)	Activities (subject to change)	Due this week by 10:00 am Monday (before Tuesday class)
9	3/25 – 3/31	Guest invasion biologists	Something on each species	Q & A with Dr. Clement: <i>Viburnum</i> beetle Q & A with Dr. Pecor: virile crayfish Q & A with Dr. Elderkin: zebra mussels Q & A with Dr. Reinert: boa constrictors	Prepared questions for visiting scientists; Short paper on testing invasion hypothesis
10	4/1 – 4/7	Invasion hypotheses and the scientific process cont.:	Simberloff, Ch. 8 Thompson, Ch. 8 Jaffe Ch. 14 - 16	Discussion of readings Review & revisit of invasion hypotheses paper Writing the MIVI experiment paper	Discussion Q&A
11	4/8 – 4/14	Data collection/analysis from MIVI experiment	Simberloff, Ch. 9 Thompson, Ch. 9 Jaffe Ch. 17 - 19	Quiz & Discussion of readings Harvest plants, record height and biomass Calculate means and variances, do t-tests	Discussion Q&A; OPTIONAL: MIVI Experiment paper draft Intro/Methods/Prediction
12	4/15 – 4/21	Invasive species at TCNJ	Simberloff, Ch. 10 Thompson, Ch. 10 Jaffe 20 - 21	Quiz & Discussion of readings On-campus field excursion: plants and earthworm extraction Calculating invasive earthworm load	Discussion Q&A; Term paper outline with annotated bibliography
13	4/21 – 4/28	Scientific debate: Consequences of invasion case study	Simberloff, Ch. 11 Thompson, Ch. 11 Jaffe 22 – 23 Case study materials	In-class debate prep and debate	MIVI Experiment paper final
14	4/29 – 5/5	Biological invasion in the suburban landscape: role of deer	Simberloff, Ch. 12 Thompson, Ch. 12	Discussion of readings Field trip to Curlis Lake Woods	Discussion Q&A
Exam	Period	Term Paper due Friday May 15, 10:50 AM			Term paper due

Readings

Throughout the semester we will do weekly readings from two scientists' books (Simberloff and Thompson) with somewhat opposing views on the problem of biological invasions. Most weeks we will spend some time discussing these readings. In order to give you credit for being prepared for this important part of the course, you will respond in writing to discussion prompts prior to class. The almost-weekly quizzes also will allow you to show that you have carefully done the reading. We also will have a few other short readings to be announced as the semester proceeds.

Policies

- **Missing class:** TCNJ does not require that you attend class, just to attend class. However, in our course there will be in-class activities each week that usually will be graded in some fashion and can not be made up. For that reason, and because we only meet once per week, you should never miss a class. If you do, and there is graded work that can not be made up, you only will be excused with a doctor's note. Any missed, graded work will simply be eliminated as part of your final grade calculation. Without an excuse you will receive a zero for that grade.

TCNJ attendance policy: <http://policies.tcnj.edu/policies/digest.php?docId=9134>

- **All written work** must be produced using a word processor with a 12 point font, double spaced with 1.25" margins. Any work that requires a graph or table must also be computer generated. Microsoft Excel is available on the terminals in the computer lab and is sufficient for producing simple graphs and charts. Microsoft Word is also available and easily makes tables.
- **For group work**, it is your responsibility to make sure that everyone does their fair share. Work out any problems in this area with the professor, early!
- You must adhere to TCNJ's **academic integrity** policy <http://policies.tcnj.edu/policies/digest.php?docId=7642>
- Alert the professor for any needs related to the **Americans with Disabilities Act (ADA)**. <http://policies.tcnj.edu/policies/digest.php?docId=9206>
- **Field excursions**

Some class meetings will involve outdoor activity, and perhaps travel off campus. You will be responsible for traveling to off-campus sites with student-arranged carpools. When it is cold, dress very warmly in layers, with a hat, and wear or pack raingear! Wear sturdy, water-proof shoes! It is going to be colder outside than you think.

Classroom Philosophy and Some Tips : I view every student in this course as an adult learner who is responsible for her/his own intellectual development. What I offer to you in class is just one part of your learning process. The rest is up to you! Each one of you has made an active choice to be in this course. Thus I start from the assumption that every student brings to each class meeting a genuine desire to think about biology of invasions and where it fits in the greater world. My goal as your professor is to encourage you in your efforts to think and learn about this fascinating subject. I also hope that you start to listen to the news as it applies to our topic. Bring in news clippings or tell me about reports you hear or read. Help me to show the class the links between biology and society. You will learn the most and develop your intellect the most when you are actively engaged in the process, and this applies to both your own reading and to the classroom setting. So be an active reader – take notes on your reading, bring questions about it to class, and form a study group early to regularly discuss the reading and class activities. **Studying and homework:** Think about how much time you need to devote to this class (and all of your classes, in fact) to learn deeply. As a rule of thumb, the faculty suggest that for credit hour earned for a class at college, you should spend 2-3 hours outside of class on. TCNJ courses are one unit, which is equivalent to 4 credits, so 8-12 hours per week is an adequate range of time spent outside of class. Some weeks it may be slightly more, some weeks it may be slightly less, and where you fall on this range will depend strongly on your study habits. In general, if you are taking four course units this semester and you want to learn well in every class, then you should be spending about 40 hours a week outside of class on your college studies. College is a full-time job, plus you have to go to class! Studies show that most learning takes place when students consistently engage with the material outside of class and with other students. **The deeply engaging experiences designed for your out-of-class work are how this course fulfills TCNJ's "fourth hour" of credit for a course that has class meetings for three hours per week.**