ERS 441/641 Ecology and Management of Invasive Plants
Spring 2003

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Course Objectives:
The overall goal of this course is to understand what environmental and biologic factors contribute to the successful invasion of plants across a landscape and what strategies can be used to mitigate or eradicate those species. Specific objectives include:

- Define invasive species from legal and ecological perspectives
- Understand the difficulties in determining and documenting invasive plants before they are a problem
- Examine hypotheses that explain why plants become invasive
- Survey the ecological, economic, and social impacts of invasive plants
- Discuss management strategies to mitigate or eradicate invasions

These objectives will be achieved through reviews of literature and reference materials coupled with a series of case studies on individual species.

Course Outline:

Date	Topic
Jan 21	Course outline, assignments, and grading
Jan 21, 23, 28	1) Invasive plants: What are they? a) The LAW – State and Federal laws and regulations b) Ecological definitions and characterizations
Jan 28, 30	2) How are they located? a) Eyewitness accounts b) Herbarium records c) Systematic floristic surveys d) Deliberate searches e) Remote sensing
Feb 4, 6, 11, 13	3) What makes a species invasive? a) Vacant niche hypothesis b) Allelopathy hypothesis c) Environmental change hypothesis d) Variable resource availability hypothesis e) Competition hypothesis f) Microevolutionary change hypothesis g) Escape from biotic constraints hypothesis h) Biodiversity hypothesis i) Disturbance and land use hypothesis j) Anthropogenic hypothesis
Feb 18, 20	4) Impacts a) Ecological i) Species replacement ii) Ecosystem functions iii) Threatened & endangered species
Feb 25, 27	b) Economic i) Total environmental damage estimates ii) Methodology (1) Cost effectiveness analyses

Date	Topic
	(2) *Ex ante* analyses
Mar 4, 6	c) Social i) Water quantity and quality ii) Human health
March 6	**Mid-term exam handed out. Due at 8:00 AM on Thursday, March 13**
	5) Management
Mar 11	a) How big of a problem is it? i) USA ii) International
Mar 13	b) Prevent entry i) Vectors ii) Quarantine iii) Legal aspects (1) International (2) USA
Mar 18, 20	**No class: spring break**
Mar 25, 27, Apr 1	c) Control i) Chemical methods ii) Mechanical methods iii) Biological methods iv) Underlying socioeconomic issues d) Eradication
	6) Case studies
Apr 3	a) *Bromus tectorum* (cheatgrass) i) Taxonomy ii) Geographic range (1) Native range (2) Current global range (3) Current North American range iii) What makes it so invasive? (1) Vacant niche (2) Allelopathy (3) Atmospheric CO_2 (4) Resource availability (5) Microevolutionary change (6) Escape from biotic constraints (7) Biodiversity (8) Disturbance / land use (9) Humans iv) Ecological impacts (1) Ecosystem conversion (2) Nitrogen cycling v) Economic impacts (1) Fire fighting & rehabilitation (2) Forage (3) Erosion (4) TES (5) Carbon sequestration vi) Social impacts vii) Management

Date	Topic
	(1) Assessment (2) Prevention (3) Control (4) Eradication
Apr 8, 10, 15, 17, 29; May 1, 6, 13	b) Student presentations *(Note: Class will meet during the scheduled time for the final exam: Tuesday, May 13 from 7:30 – 9:30 AM)*
Apr 22 Apr 24	7) Government programs a) Federal invasive plants programs (Carla D'Antonio) b) Nevada Cooperative Extension weed & invasive plants programs (Sue Donaldson)

Assignments and Grading

Grades will be based on a mid-term take-home exam, an oral presentation, and a written paper. The **mid-term exam** will cover all concepts and knowledge included in Sections 1-4. The exam will consist of 5 essay questions: undergraduate students will answer 4 of the 5 questions, and graduate students will answer all 5 questions. Students may consult their notes, published literature, and web sites, but not anyone else (except the instructor). Exams must be typed or printed; handwritten exams are unacceptable.

The **oral presentation and written paper** will provide a case study of an individual (or group of) invasive species. Each student will be responsible for preparing one case study (oral and written) for the species of his/her choice. The case study should include at least the following items:

- Name (scientific and common) and description, including diagnostic characteristics
- Geographic range (native and new) and favored habitats in its new range
- Biological and ecological characteristics that contribute towards its invasive ability
- Ecological and societal impacts
- Management strategies (what works, what doesn't, and what needs to be tried yet)

25% of the final grade will be based on the mid-term exam, 30% on the oral presentation, and 45% on the written paper using the following criteria and weightings:

1. **Take-home mid-term:** graded on content, but students are expected to utilize proper grammar, spelling, and punctuation. Content includes items such as careful consideration of data and results, critical examination of problems and issues, creativity, and critical thinking.
2. **Oral presentation:** both content and style will be considered. Style includes clarity and neatness of the presentation and composed manner during the presentation. Content will be weighted 4 times greater than style. Everyone in the class will participate in grading as follows:
    - Instructor evaluation = 15%
    - Peer evaluation = 10%
    - Self evaluation = 5%
3. **Written paper:** All written papers are due at the beginning of class on **April 29, 2001**. Written papers must be typed or printed; handwritten assignments are unacceptable. Grading will be based upon both content and style.
    - Content (see above) = 35%
    - Style (*e.g.* grammar, spelling, punctuation, rules of formal writing) = 10%

Graduate students are expected to: 1) answer an additional question on the mid-term exam; 2) give in-depth synthesis of information; 3) use up-to-date, pertinent, peer-reviewed journal articles to substantiate their discussions; 4) critically examine the success and failures of management strategies in biological and ecological contexts; and 5) propose innovative methods to reduce the impacts of invasive plants. Graduate student oral presentations will be longer than those by undergraduate students (25 minutes for graduate vs. 15 for undergraduate), and graduate students are expected to meet with the course instructor during the 2nd, 4th, and 7th weeks of the semester (and more

often if needed) to review their literature search, assessment of critical issues and factors, and proposed methods to mitigate impacts, respectively.

Final letter grades will be based upon a 100 point scale:

A = >90%
B = 80-90%
C = 70-80%
D = 60-70%
F = <60%

NOTE: This course does not use the plus/minus system of grading.

Academic Dishonesty Policy

Students are expected to adhere to the ethical code as described in the UNR Student Handbook. This code specifies that with enrollment, an individual commits to the principles embodied in the code. Academic dishonesty in any form is unacceptable. In the event of an academic dishonesty issue, the procedures for addressing the issue are outlined in the University's "Academic Dishonesty Procedures", which can be obtained from the Director of Student Judicial Affairs.

Reference Materials

The following are a partial list of references and materials available, and should give you a good starting point for acquiring information. Note that many databases and journal articles are available on-line through the UNR Library web site: http://www.library.unr.edu/

Literature databases to search:

AGRICOLA
: Index to agricultural and plant science journals, USDA documents, and state extension service publications primarily from North America. Online version: 1970 - present.

Biological Abstracts
: Indexes journals from all areas of biology, including biochemical, cellular, molecular, ecological and environmental. Online version: 1980 - present.

Biological and Agricultural Index
: Indexes 250 of the major English-language journals in the life sciences and agriculture. Online version: 1983 - present.

Science Citation Index
: The Web of Science - searching by subject, author and cited reference. An excellent current awareness and forward searching tool. Online version: 1980 – present.

Reference literature (note: items with an asterisk are available on-line; books with a call number are on reserve at the Life & Health Sciences Library):

*Abbott (1992) Trends Ecol Evol 7:401-405.
*Baruch & Goldstein (1999) Oecologia 121:183-192.
Brundu G (2001) Plant Invasions: Species Ecology and Ecosystem Management. Backhuys, Leiden. SB613.5 .I58 1999
*Callaway RM, Aschehoug ET (2000) Invasive plants versus their new and old neighbors: A mechanism for exotic invasion. Science 290:521-523.
Cronk QCB, Fuller JL (1995) Plant Invaders. Chapman and Hall, London.
*Crooks JA (2002) Oikos 97:153-166.
*D'Antonio CM, Meyerson LA (2002) Restoration Ecology 10(4):703-713.
*D'Antonio CM, Vitousek PM (1992) Biological invasions by exotic grasses, the grass/fire cycle and global change. Ann Rev Ecol Syst 23:63-87
*D'Antonio et al (2001) Ecology 82:89-104.
Daehler (2001) Bull Ecol Soc Amer 82(1):101-102
Davis & Thompson (2000) Bull Ecol Soc Amer 81(3):226-230
*Davis et al (2000) J. Ecol. 88:528-534.

*Keane RM, Crawley MJ (2002) Trends Ecol Evol 17(4):164-170.
*Levine (2000) Science 288:852-854.
Luken JO, Thieret JW (1997) Assessment and Management of Plant Invasions. Springer, New York. SB613.5 .A77 1997
*Mack RN, Simberloff D, Lonsdale WM, Evans H, Clout M, Bazzaz FA (2000) Biotic invasions: Causes, epidemiology, global consequences, and control. Ecol Appl 10(3):689-710. Note: An "easy-to-read" version of this paper is also available online through the Ecological Society of America's homepage: http://www.sdsc.edu/~ESA/esa.htm, then click on "Publications", then click on "Issues in Ecology", then scroll down and click on "Issue 5".
Mooney HA, Drake JA (1986) Ecology of Biological Invasions of North America and Hawaii. Springer-Verlag, New York. QH102 .E284 1986
Mooney HA, Hobbs RJ (2000) Invasive Species in a Changing World. Island Press, Washington DC. QH353 .I59 2000
National Research Council (2002) Predicting Invasions of Nonindigenous Plants and Plant Pests. National Academy Press, Washington DC. SB990.5 .U6 P74 2002
*Pattison et al (1998) Oecologia 117:449-459.
*Pemberton RW (2000) Predictable risk to native plants in weed biological control. Oecologia 125:489-494.
*Pimentel D, Lach L, Zuniga R, Morrison D (1999) Environmental and economic costs associated with non-indigenous species in the United States. http:///www.news.cornell.edu/releases/Jan99/species_costs.html
*Richardson et al (2000) Diversity & Distribution 6:93-107.
Samson FB, Knopf FL (1996) Ecosystem Management: Selected Readings. Springer, New York. QH75 .E3 1996
Sandlund OT, Schei PJ, Viken A (1999) Invasive Species and Biodiversity Management. Kluwer Academic Press, Dordrecht. SB990 .I58 1999
Shea K, Chesson P (2002) Trends Ecol Evol 17(4):170-178
*Smith SD, Huxman TE, Zitzer SF, Charlet TN, Housman DC, Coleman JS, Fenstermaker LK, Seemann JR, Nowak RS (2000) Elevated CO_2 increases productivity and invasive species success in an arid ecosystem. Nature 408:79-82.
*Species Survival Commission IUCN (1998) IUCN Guidelines for the prevention of biodiversity loss caused by alien invasive species. http://www.iucn.org/themes/ssc/pubs/policy/invasivesEng.htm
*Symstad (2000) Ecology 81:99-109
*Tilman (1999) Ecology 80:1455-1474.
*Van Auken OW (2000) Shrub invasions of North American semiarid grasslands. Ann Rev Ecol Syst 31:197-215.
*Vitousek PM, D'Antonio CM, Loope LL, Westbrooks R (1996) Biological invasions as global environmental change. Amer Scientist 84:468-478

Web Resources:
Global Invasive Species Programme (GISP) web site: http://jasper.stanford.edu/GISP/
The Nature Conservancy, Wildland Invasive Species Program: http://tncweeds.ucdavis.edu/
State of Nevada, Nevada Revised Statutes (see Chapter 555): http://www.leg.state.nv.us/NRS/
State of Nevada, Nevada Administrative Code (see NAC-555): http://www.leg.state.nv.us/NAC/
USDA Current Research Information System: http://cris.csrees.usda.gov/
USGS Biological Resources Division, Science Information System: http://cris.csrees.usda.gov/star/brd.html
USGS Western Ecological Research Center, Invasive Species Research: http://www.werc.usgs.gov/invasivespecies/
World Conservation Union (IUCN), Invasive Species Specialist Group: http://www.issg.org/