

Course Outline

Ecology of Disturbed Habitats (Biology 4115)

Instructor: Dr. Azim Mallik

With the ever increasing human population and recent technological advancement disturbance in natural ecosystems is a fact of life world wide. Most of the influential ecological theories and concepts such as ecosystem, succession, energy flow, competition, biodiversity, material cycling etc. are developed with an underlying assumption that ecosystems are relatively undisturbed. Our increasing demands for resources, however, have touched every hidden corner of the earth. Under the circumstances can we explain or predict changes in ecological systems and processes on the basis of traditional ecological theories and concepts? What are the modern views and concepts in disturbance ecology? This course will discuss the role of disturbance on ecosystem integrity, degradation, recovery and restoration. It will identify the nature of different types of disturbances and sensitivity, resiliency and recovery of ecosystems to disturbance. Solutions to overcome the chronic ecosystem disturbance and ways to revitalize the degraded habitats will be sought with examples of case studies from restoration ecology.

Required Textbook

Environmental Biology (1989, second edition) by Bill Freedman, Academic Press, London.

Students are strongly advised to read the classic and contemporary papers in peer reviewed journals related to disturbance ecology.

Course Structure

Two lectures/discussions per week

- i) First 8-10 lectures by the instructor
- ii) Subsequent classes will be devoted to review and critique of selected journal articles on the subject

3 Lab Assignments

- i) 2 field trips including a full day of field work on a Saturday or Sunday
- ii) 1 controlled experiment in the lab/greenhouse

One Term Paper

- i) 10 page term paper selected from one of the topics listed in the manual

One Class Presentation

- i) 20 minute oral presentation and 5 minute question period on a topic other than the topic selected for the term paper

Lecture Topics

1. Growth of human population: increasing demand for natural resources and ecosystem disturbance.
2. Types of disturbances: natural and human induced.
3. Effects of stress on ecosystems: resiliency, sensitivity and recovery.
4. Air pollution and ecosystem stress: Natural and Industrial emissions.
5. Pesticide, herbicide and fertilizer effects on ecosystems.
6. Effects of disturbance on terrestrial habitats: Clear-cutting of forests. Can clear-cutting emulate natural disturbance?
7. Influence of societal demands and government policy on ecosystem health.
8. Ecosystem management in a changing world: Watershed management.
9. Environmental Impact Assessment
10. Restoration Ecology: Rehabilitation of degraded ecosystems.

Class Discussion Topics

At the end of the class lectures one or two articles from contemporary publications (in journals, books, reports) will be assigned each week for discussion in the class. One student will lead the discussion with a 5-10 minute briefing on the objective, major findings and critics of the results and interpretation. This will be followed by the class discussion. Readings will be emailed to students to read carefully and prepare for the class prior to the discussion. Some materials not available in digital form will be kept on reserve at the university main library for them to consult and copy.

Assigned readings for class discussion

Dates	Articles
Oct. 7	Cohen, J. 1997. Population, economics, environment and culture: and introduction to human carrying capacity. <i>Journal of Applied Ecology</i> 34, 1325-1333.
Oct. 12	Johnstone, J.F., and F.S. Chapin III. 2006. Effects of soil burn severity on post-fire tree recruitment in boreal forests. <i>Ecosystems</i> 9: 14-31.
Oct. 14	Carleton, T.J. & MacLellan, P. 1994. Woody vegetation responses to fire versus clear-cutting logging: A comparative survey in the central Canadian boreal forest. <i>Ecoscience</i> 1: 141-152
Oct. 19	Mallik, A., Bell, F., and Gong, Y. 1997. Regeneration behaviour of competing plants after clear cutting: implication for vegetation management. <i>Forest Ecology and Management</i> 95, 1-10.
Oct. 21	Biswas, S.R. and Mallik, A.U. (2010) Disturbance effects on species diversity and functional diversity in riparian and upland plant communities. <i>Ecology</i> 91(1): 28-35.
Oct. 26	Jasinski, J.P.P., and S. Payette. 2005. The creation of alternative stable states in the southern boreal forest, Quebec, Canada. <i>Ecological Monographs</i> 75 (4): 561-583.
Oct. 28	Siegwart-Collier, S.C. and Mallik, A.U. (2010). Does post-fire abiotic habitat filtering create divergent plant communities in black spruce forests of eastern Canada? <i>Oecologia</i> , DOI: 10.1007/s00442-010-1642-0
Oct. 27	Grime, J.P. 1998. Benefits of plant diversity to ecosystems: immediate, filter and founder effects. <i>Journal of Ecology</i> 86: 902-910.
Nov. 2	Mallik, A.U., Bloom, R.G and Whisenant, S.G. (2010). Seedbed filter controls post-fire succession. <i>Basic and Applied Ecology</i> 11(20): 170-181.
Nov. 4	Bullock, J. 2009. A long-term study of the roles of competition and facilitation in the establishment of an invasive pine following heathland fires. <i>Journal of Ecology</i> 97: 646-656.
Nov. 9	Walker, L., Landau, F., Velázquez, E., Shiels A. and Sparrow, A. 2010. <u>Early successional woody plants facilitate and ferns inhibit forest development on Puerto Rican landslides.</u> <i>Journal of Ecology</i> 98(3): 592-140
Nov. 11	Blom, C.W.P.M. and Voeselek, L.A.C.J. 1996. Flooding: the survival strategies of plants. <i>Trends in Ecology and Evolution</i> 11, 290-295.
Nov. 16	Peñuelas, J and Boada, B. 2010. A global change-induced biome shift in the Montseny mountains (NE Spain). <i>Global Change Biology</i> 9(2): 131 – 140.
Nov. 18	Harris, J.A., J. Hobbs R.J., Higgs, E. and Aronson J. 2010. Ecological Restoration and Global Climate Change. <i>Restoration Ecology</i> 14(2) 170-176.
Nov. 23	Vepakomma, U., Kneeshaw, D. and St-Onge, B. 2010. Interactions of multiple disturbances

	in shaping boreal forest dynamics: a spatially explicit analysis using multi-temporal lidar data and high-resolution imagery. <i>Journal of Ecology</i> 98(3): 526-539.
Nov. 25	Pringle, C. 2001. Hydrologic connectivity and the management of biological reserves: A global perspective. <i>Ecological Applications</i> 11, 981-998.
Nov. 30	Gleick, H. 2000. How much water is there and whose is it? In the world's water 2000-2001 the biennial report on freshwater resources. Island Press: Washington, D.C.
Nov. 21	i) Rapport, D., Costanza, R., and McMichael, A. 1998. Assessing ecosystem health. <i>TREE</i> 13, 397-402 ii) Rapport, D., Gaudet, C., Karr, J., Baron, J., Bohlen, C., Jackson, W., Jones, B., Naiman, R., Norton, B., and Pollock, M. 1998. Evaluating landscape health integrating societal goals and biophysical process. <i>Journal of Environmental Management</i> 53, 1-15..
Nov. 24	Freeman, R. 1999. Restoring Healthy Riparian and Wetland Ecosystems: An Interview with Phil Williams. <i>Ecological Restoration</i> 17, 202-209.

Lab Schedule

Date (Wednesdays)	Lab Activity
September 15	Field Trip (Beaver & Cutting Disturbance)
September 19	All Day Field Trip
September 22	Review of Field Trip & Review of Data Analysis
September 29	Data Entry and ANOVA
October 6	Data Entry and PC-ORD
October 13	PC-ORD
October 20	Preparation for Soil Respiration lab
October 27	Soil Respiration Lab
November 3	Data Entry and Analysis
November 10	Class Presentations
November 17	Class Presentations

Due Dates for Course Work

Term Paper Outline	October 13 th
Term Paper	October 27 th
Lab # 1 Observation & Description of Disturbance	September 15 th
Lab # 2 Microclimatic, Soil and Vegetation Response to Disturbance	First Submission: October 29 th Final Submission: November 5 th
Lab # 3 Soil Respiration	November 24 th
Class Presentation Outline	November 3 rd
Class Presentation	November 10 th and 17 th

Suggested Term Paper Topics

- Discuss the strategies plant species use in adapting to disturbance, selecting at least three species to illustrate different types of adaptation.
- Plant species have diverse methods of dispersal. Discuss how different dispersal methods might assist or inhibit the ability of species to recolonize post-disturbed habitats.
- Introduced species have the ability to create disturbance in an ecosystem. Discuss how introduced species affect an ecosystem and methods for ecosystem restoration.
- Evaluate forestry practices, such as stand retention and larger cutovers that aim to emulate natural disturbance regimes.
- Discuss how habitat fragmentation affects species; using specific examples suggest possible solutions.
- Discuss how the frequency and intensity of disturbance (fire) play a role in post-disturbance ecosystem recovery.
- Discuss the role of disturbance in maintaining biodiversity.
- Compare and contrast natural and anthropogenic disturbances.
- Discuss how landscape ecology and recent technological advances in remote sensing and GIS can broaden ecological understandings and contribute to land management.
- Compare and contrast hydrologic changes in areas disturbed by clear-cutting and fire. Include a brief discussion of plant species responses to these changes.
- Discuss why blowdown occurs and how forest edges can be designed to improve structural stability of edges.
- Discuss the difficulties with determining a landscapes “natural state” and the role of disturbance in maintaining biodiversity.
- Discuss the threats and benefits (if any) of global climate change.
- Global and regional fresh water supply, use & conservation in a changing climate
- What is restoration ecology? How can restoration ecology help in recovering degraded habitats and how can we plan for restoration in a changing climate?

Note: If you have your own idea for a paper, please consult with Dr. Mallik

Suggested Presentation Topics

- Discuss the underlying principles of restoration ecology with an example of a current restoration project
- Discuss how water pollution is threatening drinking water supply
- Discuss the threat of Spruce Budworm to forest resources and some of the management solutions
- Discuss some of the disturbance related issues facing the fishing industry and the potential use of aquaculture
- Discuss environmental disturbances resulting from war (ex. Oil fires in Kuwait/Iraq)
- Discuss global warming and expected climate changes and the potential change in world vegetation, fresh water and human diseases and death
- Discuss the use of herbicides and pesticides in agriculture and some of the alternatives
- Discuss the potential ecological, social and political effects of the damming of the Kamanistiqua river near the gorge
- Discuss the effects of oil spills and some of the clean-up options in relation to a recent spill
- Discuss ecological effects of fire suppression and use of controlled burns
- Discuss some of the ecological effects of noise pollution and/or light pollution
- Overview of the common disturbances plant communities experience in the boreal region (topics include forestry, infestations, mining, hydro dams, industry etc.)
- Discuss methods (may include policies and regulations) in place to mitigate disturbance impacts such risk assessment/cumulative impact assessment and how they could be more effective
- Discuss how species diversity and trait diversity respond to disturbance intensity
- How does the rate and direction of secondary succession is affected by fire severity?

Note: If you have a current issue relating to disturbance you would like to discuss you are encouraged to consult with the instructor.

The laboratory component of the course is divided into 3 parts:

- 1) Observation and description of natural and anthropogenic disturbance on the ecosystem
- 2) Measurement of microclimatic, soil parameters and vegetation recovery in response to disturbance and
- 3) Determination of soil CO₂ evolution at varying moisture and organic matter contents.

Course Evaluation (Distribution of marks)

Term Paper Outline	2.5
Term Paper	10
Class Presentation Outline	2.5
Class Presentation	10
Class Discussion	<u>10</u>
Sub-total	35
Lab # 1	5
Lab # 2	20
Lab # 3	<u>10</u>
Sub-total	35
Final Examination	30
Total:	100