

## Wetlands: Hydrology, Excology, and Restoration

**Instructor:** Jennifer L. Bowen  
[jbowen@mbl.edu](mailto:jbowen@mbl.edu)  
508.289.7729 (office)  
774.392.1339 (cell)

**Office hours:** Wednesdays, 4-5 pm, science center lounge, or by appointment

**Course overview:** This course will focus on wetland ecosystems, and will be broken into five primary components of wetlands: ecosystem structure, ecosystem processes (including hydrology, primary productivity, and biogeochemistry), ecosystem function (including food webs and prokaryotic and eukaryotic diversity), ecosystem services and stressors in wetlands, and wetlands reconstruction and management.

**Evaluation:** Grades will be based on the following structure: mid-term exam (25%), final exam (30%), Class participation (5%), student project (40%).

**Textbook:** *Wetlands*, 3<sup>rd</sup> ed. 2000. W. J. Mitsch, and J. G. Gosselink (authors), John Wiley and Sons (publisher).

### Section one: Ecosystem structure

*Week 1: Introduction to wetlands*—Introduction to the course, definitions of wetlands and the different types of wetlands, distribution of wetlands, losses of wetlands. Lecture on designing a good research project.

- **Reading:** *Wetlands*: pp 3-104
- **Reserve reading:** Teal and Valiela, *The Living Filter*. Valiela, Chapter 1, *Doing Science*.
- **Assignment:** Find news articles in main stream media (newspapers (local or regional), *Newsweek*, *Time*, etc.), that are related to wetlands for class discussion.

*Week 2: Paint Shop Pond and the Wellesley Wetland*— Field trip with Dr. Lisa Standley.

- **Reading:** *Wetlands*: pp. 377-401
- **Reserve reading:**

*Week 3: Wetland structure*—Coastal wetlands: Salt marshes, tidal fresh marshes and mangroves; Fresh water wetlands: peatlands, freshwater swamps, riparian ecosystems

- **Discussion:** Wetlands in Current Events. The list of topics generated from this discussion will generate ideas for possible research projects.
- **Reading:** *Wetlands*: pp. 261-289, pp. 307-326. pp. 335-357, pp.419-454, pp. 469-498, pp. 513-551.

*Week 4: Field Trip*—Cape Cod trip: We will visit a range of wetland habitats, including tidal fresh and tidal salt marshes, cedar swamps, freshwater marshes and cranberry bogs.

## Section two: Ecosystem processes

*Week 5: Hydrology and soils*—Definition of hydrological terms, calculating a water budget: fluxes of water into and out of wetlands, importance of watersheds in surface and groundwater flows, evapotranspiration, and changing climate regimes, importance of sea level rise, wetland soils and soil types.

Reading: *Wetlands* pp. 107-164.

Reserve reading: LaBaugh et al. 1986. Wetland ecosystem studies from a hydrologic perspective.

Assignment: *One page project proposal due*

*Week 6: Energetics and biogeochemistry*—Redox chemistry, carbon, nitrogen, phosphorus, and sulfur cycles.

- Reading: *Wetlands* pp. 165-204.
- Reserve reading: Canfield, Thamdrup, and Kristensen *Aquatic Geomicrobiology* pp. 205-269, 314-383.

*Week 7: Mid-term exam; Energetics and biogeochemistry continued*—Primary production in wetlands, nutrient budgets of wetlands (including sources and sinks of major nutrients). Controls on rates of biogeochemical processes: temperature, moisture, substrate availability. Carbon flow through wetlands. Focus on tidal fresh and salt water marshes.

- Reading: *Wetlands* pp. 289-305, pp. 326-333.
- Reserve reading: Canfield, Thamdrup, and Kristensen *Aquatic Geomicrobiology* pp. 95-166.

*Week 8: Energetics and biogeochemistry continued*—Case studies of remaining ecosystem types, with examples from mangrove swamps, freshwater marshes, peatlands, freshwater swamps and riparian wetlands.

- Reading: *Wetlands* pp. 357-373, pp. 401-417, pp. 454-467, pp. 499-511, and pp. 551-567.

## Section three: Ecosystem function

*Week 9: Student presentations: project updates. Biological adaptations to wetlands*—Focus on plant and animal adaptations to stress in salt marshes: anoxia and salinity.

- Reading: *Wetlands* pp. 205-230.
- Assignment: Each student will prepare a 10 minute presentation that reports their research topic and hypotheses, why the topic is of interest to the greater community, and their approach to answering their hypotheses. Each student will also hand in an annotated bibliography of the literature that will potentially be used in their research.

*Week 10: Diversity in wetland ecosystems*—Prokaryotic and eukaryotic diversity in wetland environments. Review of the basic diversity of all organisms. Review on the importance of diversity for ecosystem function. Description of the diversity of wetland systems.

- Discussion: How important is biodiversity in wetland environments?
- Reserve readings:
  - Hacker and Bertness. 1999. Experimental evidence for factors maintaining plant species diversity in a New England salt marsh. *Ecology* 80: 2064-2073.

- Johnson et al. Biodiversity and the productivity and stability of ecosystems. *Trends in Ecology and Evolution* 11: 372-377.
- Zedler et al. 2001. Declining biodiversity: Why species matter and how their functions might be restored in California tidal marshes. *BioScience* 51: 1005-1017.

#### **Section four: Ecosystem services and stressors**

*Week 11: Ecosystem services*—Role of wetland ecosystems in the global environment: Case studies of the ecosystems services provided by wetlands: interception of pollutants, nursery grounds for finfish, shellfish, and waterfowl, exportation of organic matter, buffering coastlines.

- Discussion: Valuing wetlands: can you put a price tag on ecosystems services?
- Reading: *Wetlands* pp. 571-609.
- Reserve reading: Booth, D. E. 1994. Ethics and the limits of environmental economics. *Ecological Economics* 9: 241-252.

*Week 12: Ecosystem stressors, and presenting scientific information*—Role of humans in health and productivity of wetlands, impact of rising sea level, nutrient enrichment, invasive species, over-fishing, urbanization, reclamation. Lecture on proper presentation of scientific research.

- Reading: *Wetlands* pp. 611-638.
- Reserve Reading: Valiela, *Doing Science*, pp. 99-154.

#### **Section five: Wetland reconstruction and management**

*Week 13: Student project presentations. Restoring and creating wetlands* — Why should we restore wetlands? Principles behind the restoration and creation of wetlands, including hydrological and biotic restoration, treatment wetlands, case studies of successful and unsuccessful reconstruction efforts.

- Reading: *Wetlands* pp. 653-724.
- Assignment: **Term paper due.**

*Week 14: A brief examination of the laws that govern wetland use. Final Exam.*—Regulatory agencies and regulations pertaining to wetlands. How to be an advocate for wetlands in your neighborhood.

- Reading: *Wetlands* pp. 639-652.

PLEASE NOTE: Although the internet is a great resource for information, much of which is very reliable, in this course only peer-reviewed articles or text books are appropriate citations. You can use internet data bases to search for primary literature, but ONLY peer reviewed references are acceptable. If there is some question about whether the information is peer-reviewed check with me to see if it is appropriate. I will not tolerate plagiarism of ANY kind, including borrowing from the web. If you found it on the web, trust me, I will find it also. If sections of your research paper are found on the internet, in whole, or in part, you will be given an automatic “0” for the grade on your assignment. Since the term paper is 40% of your grade, this would give you very little hope of passing the class, so just don’t do it!