

ESF 539: Coastal Geoecology of New England Autumn 2011

Pre-trip meetings:

September 7, 5-7:30pm

September 14, 5-7:30pm

Field dates:

September 17-21, 2011

Cape Cod National Seashore

Instructor: Dr. Rachel Thiet

Phone: 603-283-2337

Office hours: Thursdays 11AM-1PM and by appointment

In this five-day field study course we will examine the geoecology of glaciated coasts in New England using Cape Cod as a model system. Course themes include landscape to local-scale depositional and erosional processes as influenced by coastal climate and disturbance; barrier island dynamics and the ecological role of estuaries; geological and climatic controls on coastal evolution; vascular plant succession and soil ecological processes on active dune systems; terrestrial ecology of coastal inlands; effects of coastal development and other human impacts on physical and ecological processes; and management issues in New England coastal systems.

Course objectives

Provide you with a working background of the geological and ecological history and dynamics of coastal ecosystems, using Cape Cod a model system

Provide you with experience in field research techniques focused on salt marsh restoration, coastal change monitoring, and integrating geological and ecological data

Discuss and consider approaches to management of complex, linked human and natural systems

Gain exposure to education, outreach, and public awareness initiatives on Cape Cod

Required text

Oldale, R.N. 2001. Cape Cod, Martha's Vineyard, and Nantucket: The Geologic Story. On Cape Publications, Yarmouth Port, MA.

Acquire this book immediately and read it in its entirety prior to the field component of the course.

Optional text

Strahler, A., 1988. A Geologist's View of Cape Cod. Parnassus Books.*

*This book is out of print but is widely available at reasonable cost (<\$15) through web outlets (abebooks.com; amazon.com; half.com, etc.).

Additional required readings (posted in the “Required readings” folder in Resources in Sakai)

As I have not assigned an ecology textbook, these required readings provide you with important background information about the ecology of the various ecosystems we’ll be visiting on Cape Cod.

Donnelly, J., and M. Bertness, 2001. Rapid Shoreward Encroachment of Salt Marsh Cordgrass in Response to Accelerated Sea-Level Rise. *Proceedings of the National Academy of Science*, 98(25): 14218-14223.

Holdredge, C., M. Bertness, and A. Altieri, 2008. Role of crab herbivory in die-off of New England salt marshes. *Conservation Biology* 23(3): 672-679.

Langley, J.A., K.L. McKee, D.R. Cahoon, J.A. Cherry, and J.P. Megonigal. 2009. Elevated CO₂ stimulates marsh elevation gain, counterbalancing sea-level rise. *Proceedings of the National Academy of Science* 106(15):6182-6186.

Motzkin, G., R. Eberhardt, B. Hall, D.R. Foster, J. Harrod, and D. MacDonald. 2002. Vegetation variation across Cape Cod, Massachusetts: environmental and historical determinants. *Journal of Biogeography* 29:1439-1454.

Redfield, A., 1972. Development of a New England salt marsh. *Ecological Monographs* 42(2): 201-237.

Smith, S.M., M. Hanley, and K.T. Killingbeck. 2008. Development of vegetation in dune slack wetlands of Cape Cod National Seashore (Massachusetts, USA). *Plant Ecology* 194:243-256.

Smith, S., 2009. Multi-decadal changes in salt marshes of Cape Cod, MA: photographic analyses of vegetation loss, species shifts, and geomorphic change. *Northeastern Naturalist* 16(2): 183-208.

I will set up a library in the herbarium of all required and many recommended readings, as well as additional print and map resources. Please use these materials freely, but limit check-out time so they are available for others.

Because this course runs early in the semester, it is essential that you prepare early for both the pre-trip and field components

Evaluation and verification

Your learning will be evaluated and verified through participation in and preparation for the pre-trip meeting, in-field discussion and exercises, a small group presentation detailing geo-ecological linkages of a setting selected in the field, and your responses to a final set of essay

questions due three weeks after the field studies trip. Specifically, there are four course assignments, each described in detail below:

1. Presentation of background research (pre-trip meeting)
2. Landform or plant species overview (in field)
3. Small-group research and presentation (in field)
4. Completion of final essay questions (post-trip)

Assignment 1: Presentation of background research (pre-trip)

The pre-trip meetings on September 7 and 14 are intended in part to orient you to Cape Cod National Seashore. Four groups of four students each will contribute to these class sessions by researching and teaching your colleagues about a broad topic relating to Cape Cod in a presentation (≤ 20 min) at our pre-trip meeting on September 14. *Each of you should select your top three topic choices from the list below and post your choices to the folder titled “Pre-trip research choices” in Resources in Sakai no later than Friday, August 26.* I will establish research groups based on your first and second choices, and will post the final research teams and topics to the same folder in Sakai no later than Monday, August 29.

Background-research topics: pre-trip meeting

Paleoecology (trends, trajectories of postglacial ecological history of Cape Cod)
Geological history (physical origin and evolution of Cape Cod)
Terrestrial community ecology (forests, dunes, and/or heathlands)
Salt marsh ecology and restoration
History of land use on Cape Cod
Soil development and patterning on Cape Cod
Marine weather and climate affecting Cape Cod, including tides
Beach processes and coastal erosion
Other? Get a group together around a specific topic and run it by me

Assignment 2: Landform or plant species overview (in-field)

During the trip, we will visit several different field sites that have unique geological and ecological qualities. I have prepared lessons and enlisted the support of scientists, managers, and educators on Cape Cod. In addition, each of you, in pairs, will be responsible for learning about a specific landform or plant species, which you and your partner will teach your colleagues about in the field. Choose a landform **or** plant species from the list below, and be prepared to give a very brief (5-7 min) presentation about your topic on one of our trip days. Time limit will be strictly enforced.

Suggested landforms list (how formed, relative stability and longevity)

Barrier island / barrier beach / spit
Marine scarp
Hanging valley

Inlet
Tidal delta
Parabolic dune
Outwash plain / pitted outwash
Kettle / kame

Suggested plant species list (ecological niche, phenology, physiology, ecology, plant-soil interactions, other interesting characteristics)

Dune and other upland plants:

American beachgrass (Ammophila breviligulata)
Pitch pine (Pinus rigida)
Scrub oak (Quercus ilicifolia)
Scotch broom (Cytisus sp.)
Poverty grass (Hudsonia tomentosa)
Sweet fern (Comptonia peregrina)
Beach pea (Lathyrus maritimus)
Salt spray rose (Rosa rugosa)
Bayberry (Myrica pensylvanica)
Beach plum (Prunus maritima)
Bearberry (Arctostaphylos uva-ursi)
Lichen (Cladonia spp.) (not precisely a plant, but it's an option because it's all over the Province Lands sand dunes)

Salt marsh plants:

Salt marsh cordgrass (Spartina alterniflora)
Salt meadow grass (Spartina patens)
Glasswort (Salicornia spp.)
Seaside lavender (Limonium carolinianum)
Widgeon grass (Ruppia maritima)
Atlantic sea blite (Sueda linearis)
Eelgrass (Zostera marina)
Giant reed grass (Phragmites australis) (not a salt marsh plant, but a persistent invasive exotic in CC salt marshes)

Assignment 3: Small-group research and presentation (some pre-trip, mostly in-field)

A central objective of this course is for students to integrate geological and ecological concepts as they are manifest on Cape Cod. For this assignment, four student groups of four students each will choose a geo-ecological setting on Cape Cod to highlight in a 30-35 minute presentation on our last evening of the trip. Small groups will be arranged at our second pre-trip meeting based upon your respective interests so you can begin to gather and review resources prior to the trip; however, the majority of your preparation for this in-field research project and presentation will occur on Cape. Your presentation about the setting may build upon our large-group lesson at a site we visit or may explore a new setting; all presentations should address how geological and ecological processes interact to result in features at that particular unique site. Although you will

have several hours to work on the presentation on Tuesday afternoon, your group should be thinking about the content and organization of your presentation immediately after the second pre-trip meeting, once you decide upon a setting to highlight.

Examples topics/issues for small-group research projects:

Cape Wind project

Coastal erosion (multi-scale/topic)

Monomoy coastal processes, ecosystem dynamics, and land management issues

Cape Cod hydrology and water resource issues

Fire ecology and management

Terrestrial ecosystem management and restoration (e.g., dunes, heathlands)

Environmental education outreach programs/issues

Aquaculture / shellfishing

Other? Get a group together around a specific topic and run it by me

Assignment 4: Final essay questions (post-trip)

Over the course of the trip, I will develop a set of essay questions to hand out on the last day of the trip. You will work individually to prepare responses, which are due on Monday, October 17; each essay response should be one to two pages long, double-spaced, and 12-point font. The essay questions will require you to synthesize key course concepts presented in the field by the instructors, your colleagues, and the scientists, managers, and educators we meet.

If You Have Learning Disabilities or Special Needs

In accordance with Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act, and simple justice and decency, AUNE does not exclude or discriminate against otherwise qualified students with disabilities. Students with physical or learning disabilities, which are diagnosed by a qualified professional and disclosed to the Student Disability Services Coordinator, may request and receive reasonable accommodations that will allow them to participate in their graduate program fully. If you have a documented learning disability, need special accommodation to optimize your learning, and/or need special accommodation for any class activity, please talk with the instructor as soon as possible. This information will remain confidential. For more information, please contact Leatrice Oram, Assistant Vice President of Academic Affairs at 603-283-2128 or by email at loram@antioch.edu.

FIELD SCHEDULE: September 17-21, 2011

September 17 (Saturday)

Depart from ANE for Cape Cod at 8:00 am – Arrive on Cape Cod by 12:00pm

12:00-1:00pm: Lunch at Box Lunch, Wellfleet

1:00-2:30pm: NPS Salt Pond Visitor Center, self guided orientation to CC National Seashore

2:30-6:00: drop/organize personal gear at National Park Service housing, shop and dinner

6:30-8:00: CCNS Nauset Marsh overlook, orientation visit with Shelley Hall, CACO Chief of Natural Resource Management

September 18 (Sunday)

7:00-8:00am: breakfast and pack lunches at National Park Service houses
8:30-11:00am: Geocology of active and stabilized parabolic dunes: Province Lands, Race Point Visitor Center; some plant presentations
11:00-12:00pm: 50th Anniversary Celebration event TBD
12:00-1:00pm: Lunch at Race Point
1:30pm: Check-in at NEED Coast Guard Beach house
2:30-5:30pm: Coast Guard Beach, Eastham beaches: monitoring/measuring shorezone change; some landform presentations
6:00: Dinner at Coast Guard Beach house

September 19 (Monday)

7:00-8:00am: breakfast and pack lunches at Coast Guard Beach house
8:30-9:30am: Shellfish restoration at Salt Pond, Rachel Hutchison, Natural Resources Specialist, Town of Eastham Department of Natural Resources
10:00am-12:30pm: Salt marsh ecology and restoration at Herring River, Dr. Steve Smith, CACO Plant Ecologist; some plant presentations
12:30pm: Lunch at Great Island picnic area
1:00-5:30pm: Free time
6:30pm: Dinner in Provincetown

September 20 (Tuesday)

7:00-8:00am: breakfast and pack lunches at Coast Guard Beach house
8:30am-12:00: Stabilized terrestrial coastal systems: Atlantic White Cedar swamp and heathlands restoration at CACO Marconi HQ
12:00-1:00pm: Lunch at Marconi HQ overlook
1:00-5:30pm: small-group research project time: linking geological and ecological systems
5:30-6:30pm: dinner at Coast Guard Beach house: Chef Rachel
6:30-8:30pm: Presentations of small-group research

September 21 (Wednesday)

Breakfast, pack, clean Coast Guard Beach house, and free time on beach
Depart CC by 11:00am, return to ANE by 3:00pm

Equipment list

Autumn weather on the Cape is variable, so keep this in mind when packing your equipment and clothing. Plan for a variety of conditions, and pack with Lyme-carrying deer ticks in mind, e.g., pack long pants that you can tuck into your boots.

Warm sleeping bag
Sleeping pad (Thermarest, Ridgerest)
Pillow
Clothes for 45-65°F weather
Raingear
Warm jacket/fleece

Light gloves
Insect repellent
Hiking boots/shoes
Hip waders (yes, you **will** need them)
Waterproof knee boots (yes, you **will** need them)
Water shoes or sandals
Sun hat and sunscreen
Towel
Binoculars
Field guides
Camera
Field notebook
Required readings and supplemental resources
Food for special dietary needs
Personal snacks for long field days

Recommended supplemental readings

These supplemental readings may help with your pre-trip and in-field research projects. They are not posted in Sakai; obtain these papers on your own and contact me if you have trouble finding anything.

Bertness, M.D., C. Holdredge, and A.H. Altieri. 2009. Substrate mediates consumer control of salt marsh cordgrass on Cape Cod, New England. *Ecology* 90(8):2108-2117.

Bertness, M.D. 1999. *The Ecology of Atlantic Shorelines*. Sinauer Associates, Inc., Sunderland, MA.

Buchsbaum, R.N., J. Catena, E. Hutchins, and M. James-Pirri. 2006. Changes in salt marsh vegetation, *Phragmites australis*, and nekton in response to tidal flushing in a New England salt marsh. *Wetlands* 26(2):544-557.

DiGregorio, M.J. and J. Wallner. 1989. *Cape Cod Wildflowers: A Vanishing Heritage*. University Press of New England, Hanover and London.

Donnelly, J., 2006. A Revised Late Holocene Sea-Level Record for Northern Massachusetts, USA. *Journal of Coastal Research* 22(5):1051-1061.

Eberhardt, R.W., D.R. Foster, G. Motzkin, and B. Hall. 2003. Conservation of changing landscapes: vegetation and land-use history of Cape Cod National Seashore. *Ecological Applications* 13(1): 68-84.

Fagherazzi, S., R. Torres, C. Hopkinson, and D. Van Proosdu. 2005. Salt marsh geomorphology: physical and ecological effects on landform. *Geophysical Union, EOS Transactions* 86(6):57-58 (February 6, 2005).

Feagin, R.A., D.J. Sherman, and W.E. Grant. 2005. Coastal erosion, global sea-level rise, and the loss of sand dune plant habitats. *Frontiers in Ecology and the Environment* 3(7): 359-364.

Finch, R. 1986. *Outlands: Journeys to the Outer Edges of Cape Cod*. David R. Godine, Publisher, Boston, MA.

Foster, D.R. and G. Motzkin. 2003. Interpreting and conserving the openland habitats of coastal New England: insights from landscape history. *Forest Ecology and Management* 185:127-150.

Gates, D.A., E. Norman, and M. Norman. 1975. *Seasons of the Salt Marsh*. The Chatham Press, Old Greenwich, CT.

Gerhardt, F. and D.R. Foster. 2002. Physiographical and historical effects on forest vegetation in central New England, USA. *J. of Biogeography* 29:1421-1437.

Gosner, K.L. 1978. *Peterson Field Guide: Atlantic Seashore from the Bay of Fundy to Cape Hatteras*. Houghton Mifflin Company, Boston, MA.

MacQuarrie, B. 2009. In Chatham, an austere utopia yields to a relentless tide. *Boston Globe* (June 25, 2009). Available online at: http://www.boston.com/news/local/massachusetts/articles/2009/06/25/in_chatham_an_austere_utopia_yields_to_a_relentless_tide/.

Motzkin, G., W.A. Patterson III, and N.E.R. Drake. 1993. Fire history and vegetation dynamics of a *Chamaecyparis thyoides** wetland on Cape Cod, Massachusetts. *J. of Ecology* 81(3):391-402.

*Atlantic white cedar. (We will be visiting the rare and beautiful Atlantic white cedar swamp on Cape Cod during our trip.)

Motzkin, G. and D.R. Foster. 2002. Grasslands, heathlands and shrublands in coastal New England: historical interpretations and approaches to conservation. *J. of Biogeography* 29:1569-1590.

Mulligan, A. and E. Uchupi. 2003. New Interpretations of glacial history of Cape Cod may have important implications for groundwater contaminant transport. *American Geophysical Union, EOS Transactions* 84(19):177-188 (May 13, 2003).

Neill, C., W.A. Patterson III, and D.W. Crary, Jr. 2007. Responses of soil carbon, nitrogen, and cations to the frequency and seasonality of prescribed burning in a Cape Cod oak-pine forest. *Forest Ecology and Management* 250:234-243.

NH Dept of Environmental Services Coastal Program. 2005. *Life in NH Salt Marshes: A Quick-Reference Field Guide*. Available online at: <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-04-19.pdf>.

Parshall, T., D.R. Foster, E. Faison, D. MacDonald, and B.C.S. Hansen. 2003. Long-term history of vegetation and fire in pitch pine-oak forests on Cape Cod, Massachusetts. *Ecology* 84(3):736-748.

Smith, S.M., R.M.M. Abed, and F. Garcia-Pichel. 2004. Biological soil crusts of sand dunes in Cape Cod National Seashore, Massachusetts, USA. *Microbial Ecology* 48:200-208.

Teal, J. and M. Teal. 1971. *Life and Death of the Salt Marsh*. Ballantine Books, NY.

Thoreau, H.D. 1865. *Cape Cod*. Penguin Books, NY.

Tiner Jr., R. W. and A. Rorer. 1987. *A Field Guide to Coastal Wetland Plants of the Northeastern United States*. Cushing-Malloy.

USGS. 2002. Vulnerability of U.S. National Parks to Sea-Level Rise and Coastal Change. USGS Fact Sheet FS-095-02 (September 2002).

Williams, E. 2006. Mung Warrior: National Seashore researchers take a look at a yucky seaweed problem. *Cape Cod Times* (July 6, 2006): page A-12.

Winkler, M.G. and P.R. Sanford. 1995. Coastal Massachusetts pond development: edaphic, climatic, and sea level impacts since deglaciation. *J. of Paleolimnology* 14:311-336.

Web Resources

The following links will take you to resources that will familiarize you with Cape Cod, and with the various scientific, educational, and conservation programs currently underway there.

NPS Cape Cod National Seashore (CACO)

<http://www.nps.gov/caco/index.htm>

In-depth CACO resource / research pages (links to ongoing research and monitoring protocols)

<http://www.nps.gov/caco/naturescience/cape-cod-ecosystem-monitoring.htm>

NPS Atlantic Learning Center (research needs and opportunities in CACO)

<http://www.nps.gov/caco/naturescience/atlantic-research-center.htm>

Provincetown Center for Coastal Studies

<http://www.coastalstudies.org/>

Gulf of Maine Council on the Marine Environment

www.gulfofmaine.org

Woods Hole Oceanographic Institution (WHOI)

<http://www.whoi.edu/>

Sea Grant Program – links to regional coastal and estuarine research

<http://www.who.edu/seagrant/>
<http://www.who.edu/seagrant/research/index.html>

Emergency contact numbers:

Rachel Thiet cell: 603-903-0506*

Cape Cod National Seashore: 508-349-3785

*Please have friends and loved ones call my cell in case of emergency, and use the other number only if I do not answer my phone