

Title: Ecosystem Assessment and Remote Sensing project

Purpose of scientific study:

The research will establish study plots in five baldcypress swamp sites within Maryland and Delaware, where we will do climate change and hurricane assessments of tree structure, woody debris, production and regeneration. We will install Surface Elevation Tables (SETs) and water level gages (at select sites), set up production plots and acquire remote sensing data (all sites). Research sites will have five plots, each marked with a 1 foot wooden stake along a 120 m long transect. Each plot will have a leaf litter collector (bucket tethered to the stake) and buried root ingrowth bag. Vegetation surveys and canopy cover photos will be taken at each plot annually, porewater, tree height, seed and soil samples will be collected along the transect, and fallen woody debris will be measured along the transect. At two of the five sites, SETs will be installed (using temporary wooden platforms) to measure changes in soil elevation, and dendrometer bands will be placed on 5 trees. Overall ecosystem health and forest structure will be correlated to remote sensing observations, to calibrate ecosystem models, refine management based on remote sensing and improve projections of future forest structure. An outcome of the project will be to construct a model of ecosystem response to future climate change impacts such as increased storm intensity and frequency, particularly in respect to northeastern swamps. Managers can use the results of the study to help design strategies to minimize the loss of biodiversity and habitat if future climates alter existing conditions in northeastern swamps.

Findings and status:

Beth Middleton, Evelyn Anemaet and student workers visited the latitudinal survey sites in March, September and November of 2013. In March we established transects in five study sites (two in Delaware and three in Maryland), installed five leaf litter traps at each site (to measure above-ground production) and inserted five root ingrowth bags at each site (to measure annual below-ground production), took canopy cover photos and ceptometer measurements (to establish tree structure and light transmittance values), installed dendrometer bands at three sites (to measure tree growth), and sampled soil and porewater. We installed a water level recorder and barometric logger at Trap Pond State Park, DE. In early September Beth and Evelyn prepped the leaf litter traps for sample collection, removed the old root ingrowth bags and inserted new root ingrowth bags, surveyed the vegetation (to determine percent cover by species), measured dendrometer bands, took canopy cover photos, downloaded data from the water level logger and barometric pressure logger, and sampled soil and porewater. We also established an additional study site in Maryland with leaf litter traps and root ingrowth bags, and set up hurricane transects in Maryland and Virginia to monitor vegetation regeneration after disturbance. In November Beth and volunteer workers collected the leaf litter samples, and collected soil, seeds and porewater samples. Throughout 2013 at the National Wetlands Research Center (NWRC) laboratories, we carried out data analysis of the canopy cover photos and began leaf litter sample drying, sorting and weighing, and processing root ingrowth bags, to determine the above- and

below-ground production. Vegetation survey data and dendrometer band measurements were entered into spreadsheets, porewater samples were analyzed for pH and salinity and the results compiled with sample data from other study sites.

Highlight Bullets

- **Publications:** 9 research publications (first author = 7).
- **Talks:** 10 professional presentations/~15 meetings with natural resource managers.
- **Ongoing Research:** Long-term research network on global climate change.
- **Volunteer Program:** 8 public volunteers in program for field and lab work.

Critical Element 1. Conducting work assignments and science programs.

Ongoing

Latitudinal variation in primary production, carbon stores and regeneration in baldcypress swamps of the Mississippi River Alluvial Valley & climate change, 2002-2015.

Vulnerability of baldcypress swamps to climate change in Big Thicket National Preserve (2010-2013).

Elevation change and the effect of test blasting distance on SET elevation in Big Thicket. Cooperative agreement with DESCO-USGS (2011-2013).

Journal Articles IF = impact factor of journal; C = citations

Middleton, B.A. 2013. Rediscovering traditional vegetation management in preserves: trading experiences between cultures and continents. *Biological Conservation* 158:271-279. **IF4.5/** <http://dx.doi.org/10.1016/j.biocon.2012.10.003> Distinction: Top article list: www.science20.com.

Anemaet, E., and B. A. Middleton. 2013. Dendrometer bands made easy: using modified cable ties to measure incremental growth of trees. *Applications in Plant Sciences* 1(9):1300044. **IF/** Distinction: Science Daily article: www.sciencedaily.com/releases/2013/08/130826_183112.htm

Middleton, B.A., M. Jiang. 2013. Use of sediment amendment to rehabilitate the vegetation of sinking baldcypress swamps in coastal forests, Louisiana. *Ecological Engineering* 54:183-191. **IF3.4/ C2** <http://www.sciencedirect.com/science/article/pii/S0925857413000402>. Distinction: Environmental Monitor Interview: <http://www.fondriest.com>.

Tanaka, A., M. Ohtani, Y. Suyama, N. Inomata, Y. Tsumura, B.A. Middleton, H. Tachida, and J. Kusumi. 2012. Population genetic structure of a widespread coniferous tree *Taxodium distichum* in the Mississippi River Alluvial Valley and Florida. *Tree Genetics & Genomes* 8:1135-1147. **IF2.4/C1** www.springerlink.com/openurl.asp?genre=article&id=doi:10.1007/s11295-012-0501-z

Middleton, B.A. and K. McKee. 2012. Can elevated CO₂ modify regeneration from seed banks in freshwater wetlands subjected to rising sea-level? *Hydrobiologia* 683:123-133. **IF2.0/ C1** www.springerlink.com/content/1781862568276815/fulltext.pdf

Book Chapters

Middleton, B.A. 2013. Succession. Wetland Structure and Function. Volume 1. Encyclopedia of Wetlands. Middleton, B.A. (ed.). Springer, UK. (Online First).

Middleton, B.A. 2013. Disturbances, cattle grazing. Wetland Structure and Function. Volume 1. Encyclopedia of Wetlands. Middleton, B.A. (ed.). Springer. (Online first).

Gibson, D.J., and B.A. Middleton. 2013. Succession in Ecological Education. Wetland Structure and Function. Volume 1. Encyclopedia of Wetlands. Middleton, B.A. (ed.). Springer, UK. (Online First).

Middleton, B.A., T. Klinebecker. 2012. The effects of climate-change-induced drought and freshwater wetlands. Middleton, B.A. (editor) Climate change and the function and distribution of wetlands. SWS Global Change Ecology Series, Book 1. Springer, UK.
<http://dx.doi.org/10.1007/978-94-007-4494-3>.

Popular Press/Outreach

Middleton, B.A. 2013. Conservation in an age of climate change. *National Wetlands Newsletter* 35:25.

Middleton, B.A. 2014. Continents apart in vegetation management. *National Wetlands Newsletter* (in press).

Articles submitted/in preparation

Jang, I., B.A. Middleton, B.A., and H.J. Kang. Temperature sensitivities of methane dynamics and related microorganisms in wetlands at different latitudes along the Mississippi River. *Soil Biology and Biogeochemistry* (submitted).

Middleton, B.A., D. Johnson, and B. Roberts. Hydrologic remediation for the Deepwater Horizon Incident drove ancillary primary production increase swamps. *Ecological Applications* (submitted).

USGS Webinars

Middleton, B.A. 2013. Management of prairies and wet sedge meadows. Webinar: Yellow rails and wet grassland management, July-September 2013. Organized by Jane Austin, Northern Prairie Research Center (August, September, November 2013).

Abstracts

Invited Symposia

- Middleton, B.A. 2013. Freshwater restoration of tidal swamps: lessons from remediation during the Deepwater Horizon Incident. Society for Ecological Restoration, Madison, Wisconsin (October 2013).
- Middleton, B.A. 2013. Hydrologic remediation increased primary production in coastal freshwater swamps. Chinese Academy of Science, Changchun, China, 2013.
- Middleton, B.A. 2013. Drought, flooding and salinity as multiple stressors, and insights from hydrologic remediation during the Deepwater Horizon Incident. Society of Wetland Scientists, Duluth, Minnesota (June 2013).
- Kracauer Hartig, E., Middleton, B., and Adamowicz, S. 2013. Setting the stage for preparedness to measure storm impacts in salt marshes. Society of Wetland Scientists, Duluth, Minnesota (June 2013).
- Middleton, B.A. 2013. Freshwater diversions and pulsed hydrology in coastal swamps. Society for Ecological Restoration (October 2013).
- Middleton, B.A. 2013. Multi-stressor interactions, biodiversity and function of wetlands and climate change. SWS, Duluth, Minnesota (June 2012).

Session Organizer

- Middleton, B.A. 2013. Multi-stressor interactions, biodiversity and function of wetlands and climate change. SWS, Duluth, Minnesota (June 2012; symposium co-organizer with Chris Joyce, University of Brighton, UK).

- Organizer and Moderator: Middleton, B.A. 2014. Resilience of future wetlands to climate change. SWS/ASLO Joint Meeting, Portland, Oregon (May 2014; symposium co-organizer with Chris Joyce, University of Brighton, UK).

Contributed Papers at Meetings

- Middleton, B.A. 2013. Freshwater diversions and pulsed hydrology in coastal swamps. Aquatic Sciences, Association for the Sciences of Limnology and Oceanography. New Orleans, Louisiana. (February 2013).
- Marburger, J.E., S.E. Travis, Beth. A. Middleton. 2013. Volunteer Participation in Monitoring of Wetland Invasive Species in Great Lakes National Park. Users Conference and U.S.G.S. Community for Data Integration. Denver, Colorado (May 2013).

Federal and other land manager collaborations and products

- U.S. Forest Service, Central Hardwoods Vulnerability Assessment of Climate Change, St. Paul, MN, 2012-2014.
- Meetings and field visits with Big Thicket NP managers (Jalyn Cummings and Stephanie Burgess) related to hydrology and tree mortality project (November 2012, August 2013, September 2013).
- Meeting with Emile Hebert, Houma leader, Crown Point, Louisiana regarding hydrologic conditions of Jean Lafitte NHP&P prior to 1940s (January 2013).
- Meeting with managers in Snow Hill Field Office of Maryland Department of Natural Resources (Mike Schofield) regarding salinity/sea level rise component of their strategic plan and hurricane damage to Pocomoke River State Forest (September 2013).
- White paper writing team led by Jane Austin, Northern Prairie Research Center on: Yellow rails and wet grassland management (2013-2013; joint project by USGS, FWS and various universities).
- Site visits and calls regarding blasting and SET elevation change in Big Thicket with DESCO (Arthur Perkins and Justin Rowland; January-September 2013).

Volunteers

- Doug Pickering (Cat Island NWR, LA).
- Katie Langley, Gina Botello (NPS interns: Jean Lafitte NHP&P, FL).
- Mona Halvorsen, Alex Dye (Big Thicket Association, Saratoga, TX).
- Leah Anne Gibala Smith (M.S. student Old Dominion). Hurricane plots in cypress forests of the Pocomoke River, Maryland.
- Jynaly Wanang, Mohammed Niang. UL volunteers.

Volunteer Programs

- 1) Purple Loosestrife Global Monitoring with Joy Marburger, Great Lakes Regional Coordinator, Indiana Dunes National Lakeshore; www.nwrc.usgs.gov/special/purplel/index.htm
- 2) Baldcypress Swamp; www.nwrc.usgs.gov/special/bald-cypress/index.htm

Undergraduates/Graduates Research Projects (Thesis and Non-thesis)

- Kelly Fritz (doctoral student, 2012-2013, "Detritivory across a geographical gradient of swamp ecosystems", IGERT, Southern Illinois University, Carbondale, IL

- Amanda Nelson (doctoral student) 2011-2014. *Arundinaria* distribution along a latitudinal gradient in the Mississippi River Alluvial Valley. NSF IGERT, Southern Illinois University, Carbondale, IL.
- Guodong Wang (doctoral student) 2011-2014, “Seed banks and wetland restoration of the Sanjiang Plain, China”, Chinese Academy of Science, Changchun, China. (CAS).
- Guodong Wang (doctoral) 2014. Effects of CO₂ increasing and flooding on regeneration potential of wide ranging *Taxodium distichum* swamps, Chinese Academy of Sciences, Changchun, China.
- Leah Anne Gibala Smith (M.S. student). North American Baldcypress Swamp (NABCSN) production and regeneration in Atlantic Coast baldcypress swamps. Old Dominion, Norfolk, Virginia.