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FROM THE EDITOR'S DESK

Greetings! By now the weather should be starting to cool off. As I write this, it is still hot and humid in western Massachusetts. Along with this summer's unusually persistent, hot and humid weather, we've experienced drought conditions. It wasn't a good year for vernal pool breeding at least in my neck of the woods, while it was good for pioneer species of exposed pond bottoms. During the past 20 years here, I can recall only one or two summers where my backyard pond dried up and never for as long as it has this year (see Notes from the Field). Almost daily, I've had to water a few woody plants we put in the garden this year. Most of the thunderstorms have passed us by, either to the north or to the south. I'm sure Louisiana would be willing to trade places as they've been hit by epic floods. Just makes me think about the nature of wetlands, their fluctuating water levels, and the adaptations of wetland plants and animals.

Ralph Tiner
WSP Editor

> "We are always interested in receiving articles about your projects or articles on the natural history of wetlands, or other wetland topics for publication."

In this issue, besides the President's message, you'll find the lessons learned from a wetland creation project in a floodplain with red parent material, a summary of our Executive Board's outreach to the European Chapter, an introduction to ongoing research on the effect of climate change on coastal wetlands along the South Atlantic Coast, some news releases of interest, and another cartoon from Doug Wilcox (From the Bog). This is the first issue where we've added a new column to WSP – one by the SWS's Managing Director (Michelle Czosek).

Remember that past issues (1-year old or more) of WSP are posted online for anyone to access, while recent issues are available to SWS members only. We are always interested in receiving articles about your projects or articles on the natural history of wetlands, or other wetland topics for publication. If you have questions, please feel free to contact me at rtiner@eco.umass.edu.

Happy Swamping! ■

Note to Readers:
All State-of-the-Science reports are peer reviewed, with anonymity to reviewers.

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Hawley Bog, Massachusetts
by Ralph Tiner

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SOCIETY of WETLAND SCIENTISTS

PRESIDENT'S MESSAGE

I hope your field seasons were rewarding, interesting, and involved a minimum of mosquitoes and poison ivy! It is hard to believe that we are heading towards the fall season again, and with that, the SWS Annual Meeting symposia and contributed sessions proposal season for next year's meeting!! I hope you are all talking with your colleagues about great ideas for symposia for our next Annual Meeting: "Celebrating Wetland Diversity Across the Landscape: Mountains to Mangroves" http://swsannualmeeting.org/ . You still have time to pull a symposium together before the October 16th symposium proposal deadline!

Gillian Davies, PWS
SWS President

U.S. PRESIDENTIAL ELECTION AND AIBS

Thanks to our American Institute of Biological Sciences representative, Dennis Whigham, we were notified of the opportunity for SWS to join, "…fifty-six leading U.S. nonpartisan organizations, representing more than 10 million scientists and engineers…" to call "…on the U.S. Presidential candidates to address a set of twenty major issues in science, engineering, technology, health, and the environment, and…" to encourage, "…journalists and voters to press the candidates on them during the 2016 U.S. Presidential election season." Please see the full report later in this issue of WSP. This seems like a particularly important election year to remind candidates of the importance and relevance of *sound science* to the lives of Americans. Be sure to get out and vote in November!

2017 SWS CALENDAR

Our photo contest for SWS calendar photos just ended on August 12th so keep an eye out for upcoming information about ordering your 2017 SWS calendar. Thank you to all the great photographers who contributed to the contest. And be sure to keep on taking great photos so that you can submit a winner next year!

JUNE 2016 SWS ANNUAL MEETING IN CORPUS CHRISTI, TEXAS

Our Annual Meeting in Corpus Christi was a resounding success, where all enjoyed outstanding presentations, workshops and field trips, as well as the chance to network and re-connect with friends and colleagues. I especially enjoyed a bird watching boat trip and then a kayaking trip to coastal mangroves. Being a New Englander, it is a special treat to get out into wetlands that are so different from the ones I see on a regular basis. SWS students and older folks alike rocked out at the closing event where the band, Spazmatics, kept everyone up way too late. Kudos to the Corpus Christi Local Program Committee led by Scott and Jayme Jecker for planning such a great

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IMMEDIATE PAST PRESIDENT / Kimberli Ponzio
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The Power of SWS to Connect Scientists, Impact Wetlands

Michelle Czosek, CAE
SWS Managing Director

It's hard to believe that summer is almost over, and it's already been almost three months since our successful Annual Meeting in Corpus Christi, Texas. As I write this column, I'm sitting in a Starbucks in Salt Lake City, Utah, having just attended the opening day of the American Society of Association Executives (ASAE) 2016 Annual Meeting. This is the one time each year when 5,000 of my association peers and our industry partners descend on a city to exchange ideas and share best practices, all in an effort to help associations and individuals grow and thrive. It's an experience that rejuvenates me and reminds me how lucky I am to have stumbled (like most association management professionals) into a career that I love.

I've worked in the association industry for longer than I'm going to mention in this column, and I'm constantly amazed at the "Power of A" – the term used by ASAE to demonstrate the reach and impact associations have on people, the economy, legislation and more.

As a member of SWS, it's important for you to know what impact associations have, and the importance of groups like ours. A few of my favorite association statistics:

- The IRS recognized 66,985 trade and professional associations in 2013.
- During the 2013 fiscal year, there were 1,524 new applications for 501(c)(6) status and 45,289 applications for 501(c)(3) .
- Membership organizations of all types employed more than 1.3 million people in 2013.
- Membership organizations generated payroll of nearly $51 billion in 2013.
- Associations represent a major piece of the meetings and conventions industry in the U.S. and that industry supports nearly 1.8 million jobs and accounts for $280 billion in direct spending by attendees.

Those are some pretty impressive numbers!

What's even more impressive is the power associations have to connect people like us to others that are engaged in a common business or career, share a mutual interest or are brought together for the good of a mission-driven organization. There's incredible power in creating a community where we're supportive of each other and share our knowledge so that everyone has a better chance for success.

I'm excited about what lies ahead for SWS and look forward to sharing what I've learned with the rest of the SWS staff, so that we can make this association an even stronger and more connected community than it already is.

I'd love to hear any ideas you have, too, so please feel free to contact me.

I look forward to hearing from you soon! ■

SWS staff members at the 2016 Annual Meeting, assessing what worked well, and what can be changed up for an even better event next year.

Report from Executive Board (EB) Chapter Outreach - Europe Chapter Annual Meeting, May 17-20, 2016

Kimberli J. Ponzio, SWS Past President, Jos Verhoeven, SWS Europe Chapter President

In November 2015, the SWS Board of Directors approved a new initiative through a budget item now called "Chapter Outreach". Europe Chapter President, Jos Verhoeven, requested Kimberli Ponzio's attendance at the Europe Chapter Meeting in Potsdam, Germany, May 2016. One of the main aims of this outreach event was to develop relationships and collaborations that will grow and revitalize the Europe Chapter and allow for efficient means of furthering our mission. The Europe Chapter is in the formative stages of cooperating with other regional entities involved in wetlands to bring them into the SWS fold (perhaps as members or collaborators). Having SWS international leadership at those meetings brings seriousness to the deliberations and demonstrates our commitment to internationalize. Additionally, the "Chapter Outreach" initiative is an effective vehicle for the EB to participate in Chapter activities to enhance Chapter connectivity and communication, promote SWS membership, encourage collaboration with non-SWS entities, potentially develop programs for student involvement, and finally to become a truly international organization that is recognized as the world leader in wetland science.

The following is a report of the outcome of the Europe Chapter Outreach effort.

Jos Verhoeven welcoming SWS Europe Chapter meeting participants.

Meeting participants gathering for lunch after field trips to rewetted fens and acid mining lakes.

Kim Ponzio delivering a SWS promotional presentation at the conference on Friday morning.

MEMBERSHIP

It was very interesting to learn that less than 15% of the nearly 100 attendees at the Europe Chapter meeting were SWS members. This indicates a great potential for building SWS membership in Europe and abroad. In fact, four people joined on-site with paper applications, five joined online and 14 people signed up with an interest in SWS. We intend to follow up with an email offering membership, collaboration, and volunteerism for/with SWS. Prior to the meeting, we identified those countries that are considered developing countries from the list of attendee's addresses to develop a list of those that would qualify for a $25 membership. There were 23 countries represented, eight of which were developing countries. That made membership even more attractive to those attending, especially because those attendees could apply for a gratis SWS membership. Because most attendees were not SWS members, we decided it was appropriate to deliver a SWS

promotional presentation on the final day of the meeting. This 15-minute presentation showed attendees who SWS is, what we do, who we collaborate with, what PCP is, and the benefits of SWS membership. The presentation was very well received by the participants and will certainly have stimulated the willingness to become a member or at least sign up for more information. Matt Simpson (SWS Europe Chapter Treasurer) copied the presentation so that he could use it to further recruit SWS members and collaborators.

COLLABORATION

We were all looking forward to building our collaborative relationships with three other entities that are often involved with the SWS Europe Chapter Annual Meeting –

1. EPCN - European Pond Conservation Network (membership organization) represented by Dr. Margarida Cristo.
2. WETPOL (not a membership organization; holding meetings every 2 yrs on wetlands and water quality) represented by Prof. Dr. Diederik Rousseau.
3. CWA - Constructed Wetland Association (membership organization) represented by Dr. Matt Simpson.

We met with these representatives and all are interested in organizing the SWS European Chapter 2017 meeting to occur in sequence with the EPCN meeting in Faro, Portugal from May 2-6. This would involve an EPCN meeting on May 2-3, a coincident field trip for all participants on May 4, and the following two days (May 5-6) for the SWS portion of the meeting. The logistics (meeting venue, accommodations, etc.) will be primarily handled by EPCN and the registration, as well as, the scientific programming for the SWS portion will be handled by the SWS Europe Chapter. All parties expect to sign a MOC to outline the specifics of the collaborative meeting.

I made an unexpected connection with a scientist who worked in South Africa that told me about the Wetland Indabas that are held there. From the information she sent and upon further research, I found out that a new wetland organization was formed in 2012 called the South African Wetland Society (SAWS) and together with Alanna Rebelo, I'd like to investigate a collaboration between our two societies. This would bring us into a new continent where SWS has only been represented by a few gratis members over the years.

WETLAND ISSUES

To follow up with the letters SWS sent to Macedonia authorities about the protection of wetland ecosystem services at Lake Ohrid and the Studenchisthte Marsh, we had two scientists, Dr. Nadezda Apostolova and Mia Lozanovska, from Macedonia present information from their *Wetland Science and Practice* report on "Studenchishte Marsh as an integral part of ancient Ohrid Lake: a valuable resource worthy of protection". Their longer-format talk was featured first in the scientific line-up of the meeting. Together with the Europe Chapter, we partially supported travel for

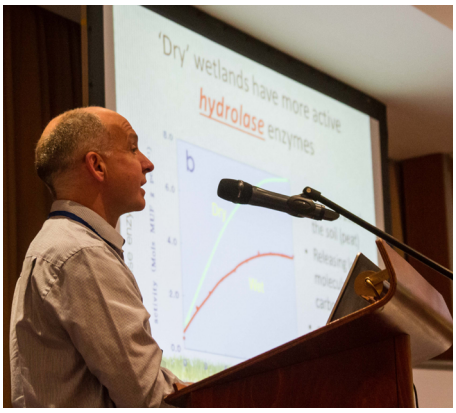
Building relationships with Macedonian scientists, Nadezda Apostolova and Mia Lozanovska and EPCN leader, Margarida Cristo, from Portugal.

Nadezda Apostolova presenting the case for protection of natural resources at Lake Ohrid and Studentchiste Wetland in Macedonia.

the primary author to attend the meeting from SWS President's discretionary funding ($425). There has been quite a bit of media attention to this issue in Macedonia now that it was presented at an important international scientific meeting. There was an article published in the major Macedonian national newspaper (attached) during the meeting and then, the week following the meeting, the author had a 15-minute radio spot on Macedonian radio to elaborate on the reasons why this lake and associated wetland resource should be conserved and restored. Dr. Apostolova credits her ability to attend and present this information at the SWS conference for raising the profile and importance of this case. Just last week, Nadezda informed us that the scientists at the Hydrobiological Institute Ohrid have agreed to host the SWS Chapter Meeting in Macedonia in 2018.

STUDENT AFFAIRS

Europe Chapter leaders have been very keen to build their student membership and we engaged several participants, especially from academia, about encouraging student membership and perhaps starting new student associations in Europe. The promotional SWS presentation made students and professors aware that there are several opportunities for students in wetland science and in SWS, such as travel grants and research grants and possibly participation in the newly forming Wetland Ambassadors Program (especially considering that Jan Vymazal recruited several institutions from Europe to participate in this program). As a result of our interaction with Dr. Chris Freeman from Bangor University, he is interested in forming the very first international (outside the U.S.) SWS Student Association. That's very exciting and unexpected news!



Chris Freeman, Bangor University, presenting his research on wetland enzymology.

FINANCES

I was given the honor of presenting the first SWS Chapter Development Grant to the Europe Chapter leaders during the meeting. Doing this as a formal presentation at the meeting allowed members, participants, and collaborators to view this as positive momentum for the chapter and for SWS expanding its international scope. However, I did witness, firsthand, the difficulties in dealing with another currency since some folks wanted to pay for membership on the spot and I couldn't tell them how many Euros it cost. All the better that we are allowing the Europe Chapter to manage their own bank account now. Maybe we can figure out a way to allow participants to sign up for SWS membership online, right there at the meeting. We also hope to make a SWS banner for the Europe Chapter to use for promoting their meetings and to use during their meetings.

FUTURE DEVELOPMENTS


Conference Chair, Dominik Zak, presents EPCN leader, Margarida Cristo, with a poster award.

Europe Chapter leaders are interested in developing a Professional Certification Program that will enable non-U.S. professionals to become certified Professional Wetland Scientists. Perhaps an EB member and/or their designee (a PCP leader?) can travel to the Faro, Portugal meeting in 2017 to work together with Chapter leaders on this initiative.

OVERALL IMPRESSIONS

I was surprised to learn that no sitting SWS President had ever attended the SWS Europe Chapter meeting since its formation 12 years ago. Long-time members of SWS were excited by this development and are hopeful that interna-


Kim Ponzio presents the first SWS Chapter Development Grant to the Europe Chapter Executive Board (from left: Secretary Keith Edwards, President Jos Verhoeven, Treasurer Matt Simpson)

tional representatives will be able to attend the Europe Chapter meetings on a more regular basis. I was also impressed by the multi-disciplinary nature of the participants with scientists from a variety of backgrounds all coming together to give novel and interesting perspectives on wetland science topics (social scientists, economists, microbiologists, pharmacologists, and limnologists). In fact, by presenting my own research, I think it helped folks to see that SWS leadership is also active in wetland research, management and application of sound scientific principles.

Finally, there are a number of intangible benefits that resulted from Chapter Outreach to the Europe Chapter Meeting. I believe Europe Chapter Leaders feel a more integral part of the Society and see their importance in enhancing our international standing, reputation and influence on wetland science world-wide. The relationships that we build between SWS leaders, participants and collaborators are sure to be fruitful in building membership, trust and camaraderie, collaborative efforts for scientific exchange and in addressing wetland issues. We hope our report allows future EB members to see the value and positive outcomes in investing and cultivating relationships with our Chapter leaders, members, and collaborators around the globe.

NOTE ADDED BY JOS VERHOEVEN

I have little to add to the SWS President's enthusiastic, comprehensive report of her participation in the SWS Europe's annual meeting in Potsdam. Her participation strongly enhanced the profile of SWS as an organization with the participants of the meeting. I am very glad that she accepted the invitation to come to our meeting and the impact of her presence went beyond our expectations. I am also grateful to the SWS Leadership for the financial support under the new Chapter membership fund awarded to our chapter. I think that our aspirations to grow the Chapter, to liaise more formally with other European networks and to develop a Professional Certification Program will be greatly helped by her presence. It was also fortunate that the SWS President could attend the special feature on Studenchishte Wetland, which had been supported earlier so effectively by the SWS Leadership. I hope we can keep these relations between the Europe Chapter and the international SWS Leadership developing further in the future. ■

line-up of events and for garnering $31,500 in sponsorships for the meeting. This is the largest Annual Meeting sponsorship income in recent years!

ASIA CHAPTER INTERNATIONAL WETLAND CONVENTION AND 10TH INTECOL INTERNATIONAL WETLANDS CONFERENCE

As the September issue of *Wetland Science and Practice* goes to print, our Asia Chapter led by Chapter President Wei-Ta Fang is hosting a Chapter Annual Meeting at the International Wetland Convention in Taipei, Taiwan from September 13 – 16. Attendees include scientists from Taiwan, China, Japan, India, the Netherlands, Australia, Switzerland and the United States. Convention hosts and sponsors, including the Taiwan Construction and Planning Agency, Environmental Protection Administration, Forestry Bureau, Water Resources Agency, and the City of Taipei, are generously sponsoring the convention, as well as attendance by Immediate Past President Kim Ponzio, and Past Presidents Jim Perry and Ben LePage, *Wetlands* Journal Editor Marinus Otte, Europe Chapter President Jos Verhoeven, and myself.

Following the convention in Taiwan, over 30 SWS members, including Executive Board members President-elect Arnold van der Valk, Immediate Past President Kim Ponzio, and myself, will be attending and giving presentations at the 10th INTECOL International Wetlands Conference in Changshu, China from September 19 - 24. With close to 100 of our members coming from Asia, we believe that these two meetings present a great opportunity to expand membership in both the Asia and Oceania Chapters, and will be hosting SWS membership outreach efforts at both meetings.

CASS AND SACNAS

With our fellow societies in the Consortium of Aquatic Science Societies (CASS), we will be sponsoring a booth at the upcoming meeting of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) http://sacnas.org/, which will be held from October 13 – 15, 2016, at the Long Beach Convention Center, Long Beach, California. Not only will SWS be able to help staff the booth, but thanks to the support of our Human Diversity Committee, we will be able to contribute to the cost of the booth. Thank you to Alani Taylor and Kim Ponzio for coordinating this effort.

EXECUTIVE BOARD

Your SWS Executive Board is hard at work, and at the end of July met with SWS staff in Madison, Wisconsin for two days of work sessions and teambuilding. Having two days of dedicated time together allowed us to make rapid progress in numerous areas at the start of a new leadership year. We had the opportunity to meet SWS staff and to develop our 2016-2017 Executive Board team's programmatic priorities. We worked on many issues including financials and the upcoming 2017 budget timeline, executive board chapter outreach and an overall plan for chapter sustainability and membership retention, staff and board roles, leadership transition, structuring full Board of Directors meetings to maximize productivity, the assessment process for Annual Meetings, upcoming future meetings, staffing open committee positions, responding to a few recent requests from the Consortium of Aquatic Science Societies and American Institute for Biological Sciences for rapid responses to wetlands issues and discussing our process for rapid responses, structuring our efforts to internationalize more successfully by forming an Internationalization Ad Hoc Committee, outreach to the South African Wetland Society, and the upcoming meetings in Taiwan and China. Phew! Re-reading that, it is hard to believe we covered so much ground in just two days. And we even had time to get to know each other a little better! As a new President, I found it particularly valuable to gather together as team, and to work on SWS business in a collaborative fashion. Thank you to fellow Executive Board members and the SWS staff for making the time to come together for such productive and intensive work sessions.

INTERNATIONALIZATION AD HOC FORMED

One of our major goals in our Strategic plan is to, "Foster the international scope of wetland science and SWS". Over the past year or so, we have been working to address concerns from our international chapters, and have made some good progress. However, to sustain our support for our international chapters and to develop SWS further as, "The world leader in wetland science" (as our Vision statement says), and to address internationalization in an organized and pro-active manner, at our Executive Board meeting in Madison, we decided to form an Internationalization Ad Hoc Committee, chaired by Arnold van der Valk. Additionally, upcoming travel to Asia will allow SWS leadership to hear from many of our international members in person. Although not all of our members work internationally, we are all affected by the well-being of wetlands around the world, and benefit from knowledge that wetland scientists develop around the world, particularly with regard to addressing complex, global problems such as climate change.

CLIMATE CHANGE

SWS continues to build on past efforts to contribute to our understanding of the science of climate change, as it relates to wetlands. Our first year of Webinar programming featured numerous wetlands and climate change speakers. Loretta Battaglia, our Secretary-General, and Julia Cherry, our

Treasurer, are co-editing a series of wetlands and climate change Special Features in our *Wetlands* journal. Past President Jim Perry is working with Dr. Bill Moomaw and other SWS scientists to prepare a State of the Science editorial for *Wetlands*. And most importantly, many of our members continue, day to day, to do climate-related research, to develop sound, science-based climate policies and practices, and to educate our community and the larger world about the role of wetlands and other ecosystems in global climate change and our response to this challenge.

WEBINARS AND ASWM PARTNERSHIP

Check out the SWS website to see the latest webinar programming! In August, our collaborative work with the Association of State Wetland Managers (ASWM) resulted in an August 18 webinar, "Status and Trends of Wetland Restoration", presented by ASWM Executive Director, Jeanne Christie and ASWM Policy Analyst Marla Stelk. Later this fall, the shoe will be on the other foot, and I will be giving a webinar for ASWM on climate change and wetlands.

On September 15, Mary Kentula will present the SWS webinar, titled "Overview and Highlights of the 2011 National Wetland Condition Assessment (NWCA) and Upcoming 2016 NWCA", and on October 20, Loretta Battaglia and Julia Cherry will present a webinar on their recent research on sea level rise and coastal wetlands in Louisiana. Jos Verhoeven will present "History of Wetland Alteration, Use and Restoration in the Netherlands" on November 17, and Ramesh Reddy, our 2016 SWS Lifetime Achievement Award winner, will present "Life in the Mud: Relevance to Food Security, Climate Change and Water Quality" on December 15. And remember, as a member, you can access any of our past webinars at any time by visiting our webinar library on our website (under the Events tab).

I hope you enjoy the cooler weather, and for those in the academic world, the start of a new academic year.

The body of a soil is a sky where seeds and worms and ions fly. Just as the sky links outer space to Earth's surface by means of increasingly dense atmospheric layers, so the soil links the surface to planetary bedrock by means of increasingly dense layers called, appropriately, horizons. Where the bottom layer of the sky rubs up against the top horizon of the soil, all terrestrial life is found.

William Bryant Logan, Dirt, The Ecstatic Skin of the Earth ■

ANNUAL MEETING

Lessons Learned from the Finderne Mitigation Site, Bridgewater, NJ

Roy C. Messaros[1], U.S. Army Corps of Engineers, New York District

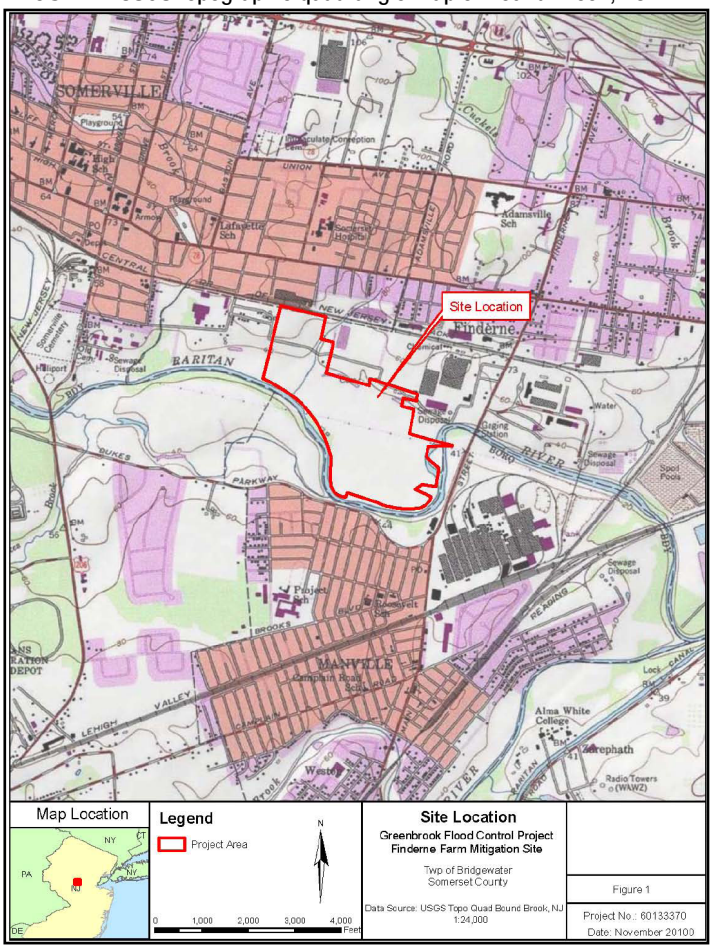
INTRODUCTION

The Finderne Farms wetland mitigation site is located in the Township of Bridgewater, Somerset County, New Jersey on the floodplain of the Raritan River (Figure 1). The Finderne Farms mitigation site (Site) itself is nearly flat and is bordered by the river on the east, south, and west sides. On August 5, 2005 the New Jersey Department of Environmental Protection, Division of Land Use Regulation Program (NJDEP LURP) approved the New York District of the U.S. Army Corps of Engineers' (Corps) wetland mitigation proposal for the Site. Wetland mitigation on the Site was initiated to mitigate for environmental impacts associated with the Green Brook Flood Control Project (e.g., levees and floodwalls) in accordance with the state permit. Construction of the Finderne Farms mitigation site was completed in July 2006 and monitoring occurred for six full growing seasons from 2007 to 2012 to ensure compliance with Corps policy and the NJDEP wetland mitigation regulations.

The Finderne Farms mitigation plan (Plan) was developed for the Site to provide a minimum of 8.87 hectares of created palustrine forested wetland to mitigate for anticipated wetland impacts. Table 1 provides the description of topography and vegetation for the mitigation plan. The overall design goal of the mitigation was to provide in-kind mitigation for wetlands impacted by the Green Brook Flood Control Project at a minimum ratio of 2:1. The Plan also included enhancement areas but the focus of this article will be limited to Creation Area C1 (Figure 2) since it represents nearly half (i.e., 4.13 ha) of the 8.87 ha mitigation project area. Creation Areas C2 and C3 account for 3.82 and 0.92 ha, respectively, of the Site. While many questions may exist regarding the success of a mitigation project, the most basic one involves whether the created site is a wetland.

To evaluate whether Creation Area C1 is a wetland or not the Regional Supplement to the Corps of Engineers Wetland Delineation Manual for the Eastern Mountains and Piedmont Region (USACE 2012) was used. The Regional Supplement included a section focused on how to evaluate hydric indicators for problematic hydric soils and contained more indicators than the Federal Interagency Manual (Federal Interagency Committee for Wetland Delineation 1989) that is used for regulatory purposes in New Jersey. Since the methodology currently used by the Corps nationwide is consistent with the Intermediate-Level Onsite Determination Method outlined in the Federal Interagency Manual, the use of the Regional Supplement in combination with the Federal Interagency Manual satisfied both Corps and NJDEP requirements for identifying wetlands. Wetland identification is typically determined by the presence of hydrophytic vegetation, hydric soils, and signs of wetland hydrology (Environmental Laboratory 1987). Problematic wetlands are defined as those which contain conditions that may make wetland identification difficult. These circum-

FIGURE 1. USGS topographic quadrangle map of Bound Brook, NJ.



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Note: The opinions and conclusions are those of the author and are not intended to represent the official opinion of the U.S. Army Corps of Engineers.

TABLE 1. Description of topography and vegetation for the mitigation design at the Site. The density of trees and shrubs relate to planting design.

Feature	Description	
Topography	Elevation: 9.45 – 10.06 m (NGVD88) Bedding harrow was used to create microtopography.	
Tree Plantings: 1,680 stems/ha	**Scientific Name**	**Common Name**
	Quercus bicolor	Swamp white oak
	Quercus phellos	Willow oak
	Fraxinus pensylvanica	Green ash
	Platanus occidentalis	American sycamore
	Quercus palustris	Pin oak
	Nyssa sylvatica	Black gum
	Alnus serrulata	Smooth alder
Shrub Plantings: 479 stems/ha	*Clethra alnifolia*	Coastal sweet pepperbush
	Cornus amomum	Silky dogwood
	Vaccinium corymbosum	Highbush blueberry
	Viburnum dentatum	Southern arrowwood
Wet meadow seed mix: 56 kg/ha	*Echinochloa crusgalli*	Wild grass
	Poa palustris	Fowl meadow grass
	Elymus virginicus	Virginia wild rye
	Agrostis alba	Black bent grass
	Panicum virgatum	Switchgrass
	Carex spp.	Sedges

stances can occur because field indicators of one or more of the three factors may be obscured or are absent. The Finderne Farms mitigation site is such a site as it is situated in a floodplain with depositional soils derived from red parent material making identification of hydric soil a challenge.

RED PARENT MATERIAL SOILS ON SITE

Soils derived from red parent material are present throughout the Site. These soils are potentially problematic from a wetland delineation perspective due to the red colorization which prevents typical hydric soil indicators from forming. Soils with colors redder than 7.5YR - red parent material soils - fail to develop the low-chroma dominant colors normally found in wetland soils due to the presence of the iron mineral hematite. Some wet red parent material soils may show faint mottling within the A-horizon, however many do not. In these instances, other indicators for wetland determination including observing hydrology and vegetation are heavily relied upon. Berkowitz and Noble (2015) recognized the difficulty with field indicators in the identification of hydric soils and provided guidelines for data collection and submission for the purpose of develop-

FIGURE 2. Finderne Farms mitigation site aerial planting zone location map.

ing and recommending changes to the National Technical Committee for Hydric Soils.

Most of the Site consists of alluvial fine-grained deposits overlying red-brown siltstone and mudstone (shale) of the Jurassic-Triassic aged Passaic Formation (USACE 2014). Lithic material is limited to gravel material along the Raritan River bank, while the only rock outcrops on Site were observed within the slope that borders the northern side of the Site (Figure 3). Red lithic materials of the Passaic Formation are also exposed in northern portion of Finderne Brook, a tributary to the Raritan River on the northwest end of the Site. The Passaic Formation underlies the entire project area. Soils primarily consist of Rowland silt loam. Rowland soils are described as "very deep, moderately well drained to somewhat poorly drained soils formed in alluvial sediments weathered from red and brown shale, sandstone, and conglomerate" (https://soilseries.sc.egov.usda.gov/OSD_Docs/R/ROWLAND.html). The water table "fluctuates between 2 and 6 feet" and the soils are "flooded by streams during wet periods."

METHODS

Since the Site is a floodplain and one dominated by red parent material soils, the guidance provided in the Eastern Mountains and Piedmont Regional Supplement (USACE 2012) was used to evaluate the degree of site wetness and hydric soil properties. This supplement outlines problematic scenarios encountered in the field and contains protocols for dealing with them. While the Federal Interagency Manual also included discussion of red parent material wetlands, the Regional Supplement contains the latest guidance. The red parent material hydric soil indicator (F21) consists of a layer of at least 10 cm starting within the top 25 cm of the surface with a hue of 7.5YR or redder and a value and chroma greater than 2 and less than or equal to 4, containing at least 10 percent depletions or distinct or prominent redoximorphic concentrations as soft masses or pore linings. Depletions should differ in color by having a value one or more higher and chroma one or more lower than the matrix, or have a value of 4 or more and chroma of 2 or less. This indicator was developed for use in areas of red parent material such as residuum in the Piedmont Province Triassic lowlands section or the Paleozoic red beds of the Appalachian Mountains. Ford (2014) cautioned that problematic soils can cause erroneous interpretations and the F21 indicator, although helpful, does not identify all red parent material hydric soils.

Soil borings and data collection at Creation Area C1 were performed from April 4-21, 2014. A series of soil

FIGURE 3. Outcrop of red-brown siltstone and mudstone (shale) at the Finderne Farms mitigation site.

FIGURE 4. View of soil profiles taken from Creation Area C1, from left to right, C1-Ditch, C1-RCG, C1-SG, and C1-Mugwort.

cores were evaluated along a transect from inundated areas to obvious upland (non-wetland) areas to observe changes in soil properties along a topographic gradient. Soil borings were taken with a hand-held auger to depths of approximately 45.7-61.0 cm or to the depth of refusal to examine the soil profile for redoximorphic features. Information collected for each soil profile included horizon depth, texture, color, and the absence or presence of redoximorphic features. Colors of the soil matrix and redoximorphic features were identified using Munsell Color Charts (1975). Hydric soil determinations were based on criteria established in the Federal Interagency Manual (FICWD 1989) and the Regional Supplement (USACE 2012). Soils were also investigated using alpha, alpha-dipyridyl, a reagent that reacts with reduced iron. This reagent can be used to provide evidence that a soil is hydric when other indicators are obscured or lacking. Alpha, alpha-dipyridyl will normally result in changing the soil to a pink or red coloration in soils that are moist or wet and are in a reducing condition.

At each sampling location along the transect, observations were also recorded for the vegetation and hydrology to determine if the location was within a wetland or upland. Species abundance was visually estimated by percent cover within each vegetation stratum. Dominant trees, saplings/shrubs, and herbaceous plants were recorded within sample plots of 9.14-meter, 4.57-meter, and 1.52-meter radius, respectively. The wetland indicator status of each species was identified using the "National Wetland Plant List" (Lichvar et al. 2014).

RESULTS

Hydrology. The Site receives water from several sources including direct precipitation, surface runoff from offsite areas, and flooding from the Raritan River. Water losses include evapotranspiration and runoff. Due to the low permeability of the soils (hydraulic conductivity, K_s = 16.42 cm/day), groundwater likely has little influence on the site's hydrology. The technical standard for wetland hydrology based on monitoring requires 14 or more consecutive days of flooding or ponding, or a water table 30 cm (12 in.) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability) unless an alternative standard has been established for a particular region or wetland type (USACE 2012). Wetland hydrology can be verified by recorded data and/or field observations. Recorded data can be obtained from tide gauges, stream gauges, flood predictions, historical data (i.e., aerial photographs and soil surveys) and piezometers. In the absence of such data, field indicators of wetland hydrology can be used to verify wetland hydrology. For wetland hydrology indicators, there must be a minimum of one primary or at least two secondary indicators in order to satisfy the requirement. Table 2 contains a list of primary and secondary wetland hydrologic indicators observed at Creation Area C1. Within the Site there were five locations (Ditch, RCG, SG, W1, and W2) that exhibited sufficient primary and/or secondary indicators to meet the wetland hydrology requirements. There were two locations (Mugwort and U1) that did not meet the minimum hydrologic indicators.

TABLE 2. Wetland hydrology indicators for the Eastern Mountains and Piedmont Region observed at Creation Area C1. One primary indicator is sufficient to verify wetland hydrology, or in the absence of any primary indicator, at least two secondary indicators are required (USACE 2012).

Planting Area ID	Data Point ID	Primary Indicators	Secondary Indicators	Wetland Hydrology
C1 (PEM)	C1-Ditch	Surface Water (A1) High Water Table (A2) Saturation (A3)	---	Yes
	C1-Mugwort	---	---	No
	C1-RCG	Surface Water (A1) Saturation (A3)	---	Yes
	C1-SG	Surface Water (A1) Saturation (A3)	Geomorphic Position (D2) Microtopographic Relief (D4)	Yes
	C1-U1	---	---	No
	C1-W1	Surface Water (A1) Saturation (A3)	Geomorphic Position (D2) Microtopographic Relief (D4)	Yes
	C1-W2	Surface Water (A1) Saturation (A3) Oxidized Rhizospheres on Living Roots (C3)	Geomorphic Position (D2) Microtopographic Relief (D4)	Yes

Vegetation. Table 3 identifies the species per vegetative strata observed at Creation Area C1 and provides the corresponding wetland indicator status. Four of the seven sampling locations (Ditch, RCG, SG, and W2) had a positive indicator for hydrophytic vegetation, while location W1 was dominated by a *Dicanthelium* grass of undetermined species in association with FACW species. The hydrophytic vegetation status of W1 could not be established by vegetation alone due to lack of identification to the species level, but was later confirmed due to the presence of hydric soil indicators and sufficient indicators of wetland hydrology observed during field work.

Soils. Table 4 summarizes the soil data reported on the standard wetland delineation field forms for each sample location. For C1, both W1 and W2 exhibited red parent material with the corresponding hydric soil indicator F21.

TABLE 3. Vegetation data at Creation Area C1. Dominants were identified following the 50/20 rule in the Regional Supplement.

Planting Area ID	Data Point ID	Stratum	Scientific Name (Common Name)	Absolute % Cover	Dominant Species	Indicator Status	Hydrophytic Vegetation
C1 (PEM)	C1-Ditch	H	*Phalaris arundinacea* (reed canary grass)	50	D	FACW	Yes
		H	*Panicum virgatum* (switchgrass)	45	D	FAC	
		H	*Artemisia vulgaris* (mugwort)	5	ND	UPL	
	C1-Mugwort	H	*Artemisia vulgaris*	90	D	UPL	No
		H	*Humulus japonicus* (Japanese hops)	5	ND	FACU	
		H	*Phalaris arundinacea*	2	ND	FACW	
	C1-RCG	S/S	*Quercus palustris* (pin oak)	3	D*	FACW	Yes
		S/S	*Quercus bicolor* (swamp white oak)	2	D*	FACW	
		H	*Phalaris arundinacea*	70	D	FACW	
	C1-SG	T	*Quercus palustris*	7	D	FACW	Yes
		T	*Quercus bicolor*	2	D	FACW	
		H	*Panicum virgatum*	80	D	FAC	
		H	*Phalaris arundinacea*	2	ND	FACW	
		H	*Juncus effusus* (soft rush)	2	ND	FACW	
	C1-U1	H	*Artemisia vulgaris*	55	D	UPL	No
		H	*Panicum virgatum*	5	ND	FAC	
		H	*Solidago gigantea* (goldenrod)	40	D	FACW	
	C1-W1	H	*Lythrum salicaria* (purple loosestrife)	15	ND	FACW	Yes**
		H	*Bidens frondosa* (devil's beggartick)	10	ND	FACW	
		H	*Dicanthelium sp.*	75	D	Not determined	
	C1-W2	S/S	*Quercus palustris*	5	D	FACW	Yes
		H	*Phalaris arundinacea*	100	D	FACW	

NOTES:

H – herb, S/S – sapling/shrub, and T – tree.

* *Quercus palustris* and *Q. bicolor* are both considered dominant trees since the stratum contains 5% or more absolute cover (USACE 2012).

**Based on indicators of hydric soil and wetland hydrology.

The alpha, alpha-dipyridyl test did not produce a positive reaction. However, a reddish or pink color induced by the reagent (evidence of reduced iron in the soil) is hard to see on red parent material soil.

DELINEATED WETLAND

Creation Area C1 is dominated by palustrine emergent vegetation, with planted saplings of FACW tree species also present. Hummocks were part of the original design of this creation area and varied in height from 0.152 – 0.457 m. The western portion of the wetland, which was also dominated by emergent vegetation, has larger hummocks, e.g., > 0.457 meters. In the eastern portion of the wetland, the hummocks were smaller and the vegetation contained numerous planted tree saplings (see Table 1). Although the presence of hummocks was a feature of the original design, it is likely that post construction size differential occurred as a result of erosion and scour from flooding (i.e., Raritan River overbank inundation) even though the frequency of such events was limited. Switchgrass and planted saplings are found at the southern portion of the wetland, followed by an expanse of reed canary grass with much fewer surviving woody plantings (i.e., *Quercus palustris* and *Q. bicolor*) and a narrow depression (i.e., ditch) running along the northern boundary of the wetland. The ditch is dominated by reed canary grass, purple loosestrife, and soft rush. The soil profile textures were dense clays with faint to distinct mottling and matrix color typically 5YR3/3. The wetland was delineated by taking a series of soil cores in the various communities and identifying the presence or absence of hydric features in the soil profiles. Figure 4 shows the soil cores from the ditch (C1-Ditch), reed canary grass (C1-RCG), switchgrass (C1-SG), and mugwort (C1-Mugwort). Although often obscured by red parent material, redoximorphic features were observed in the ditch, reed canary grass, and switchgrass soil cores. The delineated wetland line often corresponded with the toe-of-slope of the created cut-slopes surrounding the wetland. Uplands adjacent to C1 wetlands were elevated 0.30 m or more above C1 and were dominated by common mugwort along the perimeter. Upland soils were observed to be similar to wetlands however with fewer (e.g., ≥ 50% fewer) redoximorphic concentrations. The upland soils were also loose and friable and showed no evidence of saturation or inundation. The wetland classification system developed by Cowardin et al. (1979) was utilized to classify the delineated wetland vegetated community as palustrine emergent wetland (PEM). Table 5 is a summary of the data for Creation Area C1 showing the results from the hydrology, vegetation, and soil evaluations.

LESSONS LEARNED

From the outset, we should have realized that hydrology indicators would be very important in making a wetland determination in this red parent material floodplain. Although the data for the 2014 wetland delineation indicates success, initial performance criteria from the six-year (2007 – 2012) post-construction monitoring period were not sufficient to

TABLE 4. Soil profile description data at Creation Area C1.

Planting Area ID	Data Point ID	Depth (cm)	Matrix Color (moist)	Matrix	Redoximorphic Features (%, Color, Type, Location)	Texture	Hydric Soil
C1 (PEM)	C1-Ditch	0 - 20.3	5YR4/2	70%	30%, 5YR3/4, Type[1] C, Loc[2] M	SCL	Yes
		20.3	Gravel	---	---		
		20.3 - 45.7	5YR3/4	85%	15%, 7.5YR4/6, Type[1] C, Loc[2] M	SCL	
	C1-Mugwort	0 - 45.7	5YR3/3	98%	2%, 5YR3/4, Type[1] C, Loc[2] M	SCL	No
	C1-RCG	0 - 45.7	5YR3/3	80%	20%, 5YR3/4, Type[1] C, Loc[2] M	SCL	Yes
	C1-SG	0 - 45.7	5YR3/3	90%	10%, 5YR3/4, Type[1] C, Loc[2] M	SCL	Yes
	C1-U1	0 - 5.1	5YR3/3	100%	---	SCL	No
		5.1 - 15.2	5YR3/4	100%	---	SCL	
		15.2 +	---	---	---	Gravel	
	C1-W1	0 - 15.2	7.5YR3/3	90%	10%, 7.5YR3/7, Type[1] C, Loc[2] M	SCL	Yes
		15.2 -20.3	7.5YR3/3	---	---	SCL	
	C1-W2	0 - 15.2	5YR3/3	93%	3%[3], 5YR3/4, Type[1] C, Loc[2] PL	Clay Loam	Yes
		15.2 - 30.5	5YR3/3	80%	20%, 5YR4/6, Type[1] C, Loc[2] PL	Clay Loam	
		30.5 - 45.7	5YR3/3	80%	20%, 5YR4/6, Type[1] C, Loc[2] M	Clay	

1. Type: C = Concentration.
2. Location: PL = Pore Lining, M = Matrix.
3. Remaining 4% not determined.

adequately evaluate the success of establishing wetland hydrology at the Site. Performance standards for success of the Finderne Mitigation Site included:

1. At the end of year-six, the Corps must submit a field wetland delineation of the mitigation project based on the Federal Interagency Manual (FICWD 1989) which shows the exact area of the wetland mitigation project.
2. The Site has an 85 percent survival and 85 percent area coverage of the mitigation plantings or target hydrophytes which are species native to the area and similar to ones identified on the mitigation planting plan. All plant species in the mitigation area are healthy and thriving. All trees are at least 1.52 meters in height.
3. The Site is less than 10 percent occupied by invasive or noxious species such as, but not limited to, *Phalaris arundinacea* (reed canary grass), *Lythrum salicaria* (purple loosestrife), and *Berberis thunbergii* (Japanese barberry).
4. The hydrologic regime will provide sufficient flood storage to impart approximately 7 to 10 days of inundation followed by 7 to 11 days of soil saturation within the upper 30.48 cm of the soil profile during the growing season. The total hydroperiod should range from 14 to 21 days in duration which represents 6.5 to 10 percent of the growing season between March and October (approximately 215 day).

Problems meeting these performance criteria and other issues led the Corps to extend monitoring beyond the initial six-year period. In 2014 the wetland delineation was performed to determine the extent of wetland, recognizing that the original performance criteria may not have adequately addressed critical issues of site hydrology and hydric soils, especially given the red parent materials dominating the site. Evaluating these performance criteria in retrospect provided a valuable opportunity to establish lessons learned that should help in establishing practical criteria for monitoring and evaluating success of future mitigation projects.

Since the Site was designed to be a palustrine wetland and the planted trees were initially at a nominal height (i.e., 0.305 to 0.914 m) it would take a few decades of growth before shading by the canopy could even begin to diminish the presence and persistence of the invasive or noxious species (e.g., *Phalaris arundinacea*, *Lythrum salicaria*, and *Berberis thunbergii*). Once the planted trees attain a height adequate to inhibit the invasive species, the performance criteria could potentially be satisfied; however, the canopy would have to be quite dense to accomplish this and *Berberis* would likely persist as an understory shrub unless targeted for control. Additionally, the time required for the tree canopy to develop that could potentially restrict emergent growth would take a very long time. Due to limited project funding there were no protocols in place for the physical removal or chemical treatment of invasive species. An important lesson learned is therefore to include removal and control of invasive species as part of any mitigation plan. Moreover, if an invasive species is common in adjacent communities it should not be included in the performance standard as it is highly unlikely to keep it out in the long-term, without costly annual control. Performance criteria must be practicable and recognize site limitations. In this case reed canary grass was a dominant species in the neighboring floodplain and therefore it is unlikely to be kept out of Creation Area C1 without a drastic change in wetland hydrology (i.e., permanent or near permanent inundation) or by application of herbicides or other control means. Another consideration is how the establishment of mature trees (i.e., forested condition) will affect the hydrology of the site in the long-term. Trees will dominate the evapotranspiration process and will significantly change the site's hydrology, especially the underlying water tables during the growing season.

The proposed hydrology in performance criteria men-

TABLE 5. Summary of wetland and nonwetland data within Creation Area C1. PEM – palustrine emergent wetland according to Cowardin et al. (1979); DT – passed dominance test for hydrophytic vegetation.

Planting Area ID	Data Point ID	Class	Wetland Hydrology Indicator	Hydrophytic Vegetation Indicator	Hydric Soil Indicator	Wetland
C1 (PEM)	C1-Ditch	PEM	A1, A2, A3	Y-DT	F3	Yes
	C1-Mugwort	Not wetland	---	---	---	No
	C1-RCG	PEM	A1, A3	Y-DT	F8, F19	Yes
	C1-SG	PEM	A1, A3, D2, D4	Y- DT	F8	Yes
	C1-U1	Not wetland	---	---	---	No
	C1-W1	PEM	A1, A3, D2, D4	Y*	F8, F21	Yes
	C1-W2	PEM	A1, A3, C3, D2, D4	Y-DT	F19, F21	Yes

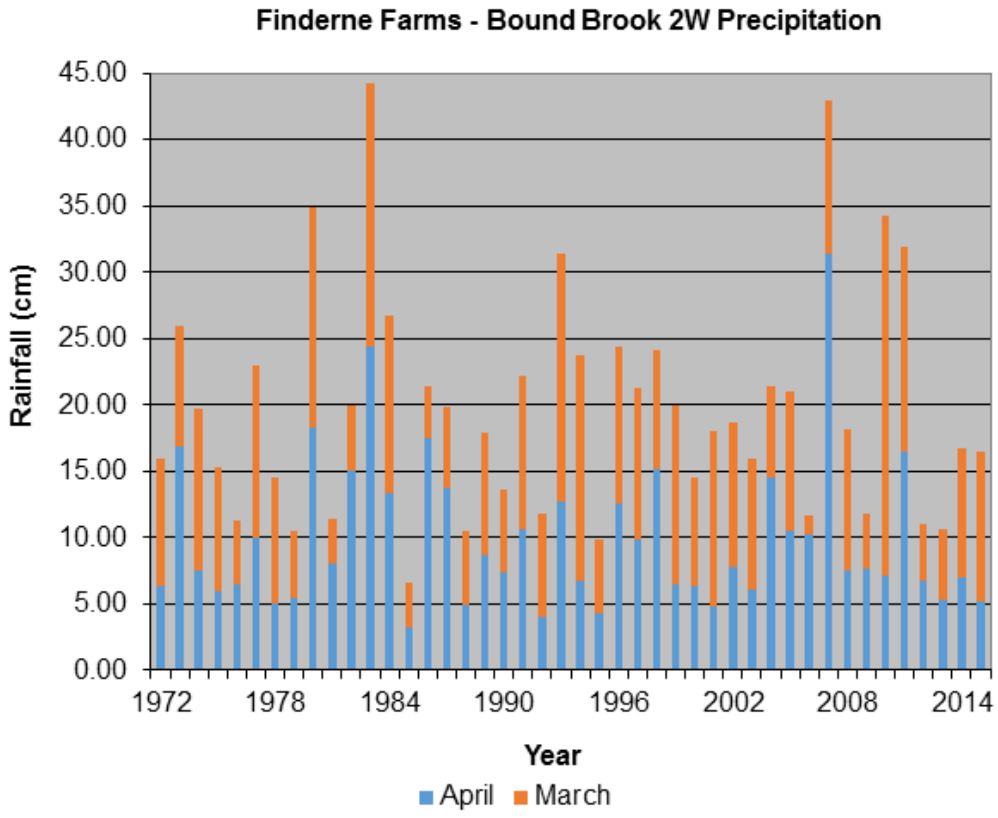
*Problematic vegetation since species of dominant plant could not be established, so based decision on indicators of hydric soil and wetland hydrology and consideration of associated species (all FACW).

tioned above, anticipated a certain frequency of Raritan River overbank inundation (i.e., a minimum of four inundations per year). During the monitoring period (2006 – 2012) the reported incidence of Raritan River overbank flooding did not occur on frequent basis, i.e., less than two times per year on average. When overbank inundation did occur, it was associated with high river discharge velocities (e.g., > 1 m/s) which may have caused the observed vegetation loss/washout. An important lesson learned is planting and stabilizing/securing tree species so they can endure river discharge velocities before they are well established. A viable option would also be to start with larger trees and have them secured with suitable tree staking and straps. It would also be prudent to adequately understand the floodplain dynamics for this Site that included frequency of inundations in addition to maximum discharge velocities. Given the frequency of occurrence for Raritan River overbank flow, inundation did not have a significant contribution to the overall water budget as originally anticipated.

TABLE 6. Rainfall data for the indicated time period.

	Rainfall (cm) in Reported Time Period		
Time Period	**1972 - 2015**	**2007 - 2012**	**2014**
March	9.83	12.17	9.78
April	9.91	12.85	7.01
March+April	19.74	25.02	16.79

FIGURE 5. Total rainfall (cm) for March and April from 1972 to 2015. Note that average rainfall during March and April in these years was 19.74 cm, so rainfall during these months in 2014 was below average.



The performance criteria were developed with the intent of satisfying requirements for a jurisdictional wetland and for establishing a certain plant community that included reducing the spread of invasives. Adequate consideration may not have been given to the challenges of working with red parent material and the presence of invasive species in neighboring wetlands. Clearly more attention needs to be given to monitoring site hydrology, with wet season observations a must.

The initial monitoring program (2007 – 2012) for the Site focused more on the vegetation with less emphasis on hydrology or soils. Considering the limited soil boring sampling time points and more importantly that efforts to evaluate hydrology during the wet season were absent, an evaluation of historic precipitation data was considered to be worthwhile as part of this current effort (2014 delineation). In other words, since an assessment of the Site's hydrology during the six-year monitoring program did not occur, the evaluation of historic rainfall data was considered useful. Moreover, evaluating hydrology during the wet season would be useful in problematic situations involving red parent material; it should be a requirement.

Table 6 is a summary of the rainfall data (Bound Brook 2W precipitation gage) for three time periods: 1) 1972 – 2015, 2) 2007 – 2012, and 3) 2014. The historic monthly average rainfall data for 1972 to 2015 for March and April (combined) was 19.74 cm. For the period of the six-year monitoring program (2007 – 2012) the monthly average rainfall was higher for these months: 25.02 cm for March and April and an average of 12.17 cm for March and 12.85 cm for April. In 2014 the total rainfall for March and April was 16.79 cm which was below the long-term average, yet hydrology observations for Creation Area C1 from April 4-21, 2014 recorded sufficient hydrology indicators for a wetland determination. Since precipitation was actually higher for March and April during the initial monitoring period 2007 – 2012 than rainfall in 2014 where signs of wetland hydrology were documented, it may be reasonable to expect that the hydrology had been adequate for a wetland determination during the six-year monitoring period (2007 – 2012). In other words, since the Finderne Farms

Wetland Delineation Report dated June 15, 2014 (USACE 2014) showed sufficient indicators of wetland hydrology during the more than two-week field investigation it may safely be implied that wetland hydrology likely occurred from 2007 to 2012. Figure 5 is a plot of the historic rainfall data illustrating the total rainfall (cm) for March and April (combined) for 1972 to 2015. As mentioned above, the frequency of Raritan River overbank inundation did not have a measurable benefit to the water budget as was originally anticipated. A valuable lesson learned is that adequately quantifying the temporal aspects of rainfall and understanding long-term conditions can be important to the planning a water budget for any wetland creation project.

The six-year monitoring protocol (2007 – 2012) was less than ideal for the reasons outlined above. For assessing hydrology in red parent materials, a 14-day observation would enable a more thorough evaluation of site wetness and for documenting a hydric soil. Through follow-up monitoring in 2014, the Corps had demonstrated that the original performance criteria did not adequately address the Site's hydrology which was critical for making a jurisdictional wetland determination. The NJDEP gave consideration to lessons learned and accepted the 2014 wetland delineation that documented sufficient wetland area to meet their concerns.

CONCLUSIONS

An adequate understanding of the hydrology at the Site and the challenges of working with red parent material have been significant issues for this mitigation project. After giving special attention to site wetness in 2014 which documented sufficient signs of wetland hydrology for a jurisdictional determination, an evaluation of historic rainfall data (1972 – 2015) further suggested that the Site was likely inundated or saturated at a frequency and duration sufficient during that period to satisfy the wetland hydrology requirement. Finally, it was a more thorough documentation of hydrology and more careful examination of soil properties that resulted in a positive wetland delineation for Creation Area C1 in 2014. Monitoring of wetland hydrology should be an essential element of any wetland mitigation project involving wetland creation. Such monitoring should also include evaluation of site conditions at reference wetlands of the targeted wetland type, even prior to mitigation planning to help with project design. The use of reference wetlands is especially important for problematic wetland types, such as floodplain wetlands where inundation from river flow is the major source of water. ■

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Climate Change and the Fate of Coastal Wetlands

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INTRODUCTION

Coastal wetlands, including tidal marshes and forests, provide a number of key ecosystem services, including habitat for recreationally and commercially important finfish and shellfish, protection from wind, waves, storms and floods, and removal of excess nutrients, namely nitrogen (N) and phosphorus (P), from agricultural and urban runoff (e.g., Tiner 2013). Along the coast, climate change will be manifested as rising sea level with attendant coastal flooding and saltwater intrusion. A more immediate impact which has already been experienced is drought, particularly in late summer and fall. These processes will lead to migration of tidal wetlands inland, where possible, and changes in habitat as freshwater wetlands convert to brackish marsh or open water (Figure 1).

As part of the National Science Foundation's Georgia Coastal Ecosystems Long Term Ecological Research (GCE LTER) project, scientists from seven institutions of higher learning, including the University of Georgia, Indiana University, Virginia Institute of Marine Sciences, University of Houston, University of Florida, Georgia Southern University, College of Coastal Georgia, and the U.S. Environmental Protection Agency, initiated a field experiment - *Seawater Addition Long Term Experiment* or SALTEx - to investigate how saltwater intrusion and increased flooding will alter the direction and pace of change of microbial, plant, and animal communities and key biogeochemical processes in a tidal freshwater marsh. SALTEx consists of an array of field plots that are used to answer three main questions regarding sea level rise and saltwater intrusion:

1. How does long-term, chronic ("press") addition of diluted seawater affect tidal freshwater marsh structure and function?
2. What are the effects of periodic pulsing of diluted seawater to simulate low river flow or drought conditions?
3. What are the effects of freshwater additions?

FIGURE 1. Aerial view of deteriorating tidal marsh in southeastern Georgia.

STUDY AREA

The SALTEx site is located on the Altamaha River near Sapelo Island, Georgia (Figure 2). The Altamaha River is the third largest river on the U.S. East Coast. It is not dammed along the 200-mile (330 km) stretch from the confluence of the Ocmulgee and Oconee Rivers to the Atlantic Ocean, making it one of the most ecologically intact river systems in the East. The river and estuary contain large areas of tidal marsh and forest and extensive alluvial bottomland hardwood forest upstream. The tidal freshwater marsh plant community consists of four dominant species that are common in freshwater marshes of the southeastern U.S.: creeping primrose-willow (*Ludwigia repens*), smartweed (*Polygonum hydropiper*), pickerelweed (*Pontederia cordata*), and giant cutgrass (*Zizaniopsis miliacea*).

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METHODS

The SALTEx experiment was initiated in 2012 and consists of 30 field plots, each 2.5 m on a side. There are three treatments (Press, Pulse, and Fresh) and two types of controls (with and without sides), each consisting of six replicates. The Press treatment plots receive regular (4 times each week) additions of a mixture of seawater and fresh river water (Figure 3a). Pulse plots receive the same mixture of seawater and river water during September and October, which is typically a time of low flow in the river when saltwater intrusion naturally occurs. The Fresh treatment plots receive regular additions of fresh river water. Treatment water is added during low tide to facilitate its infiltration into the soil, and all plots are inundated by astronomical tides at high tide.

Response measurements include (1) soil porewater chemistry and nutrient cycling, (2) plant community, (3) terrestrial and aquatic invertebrates, (4) microbial activity, and (5) soil properties and soil elevation change (Table 1). Baseline (pre-treatment) data were collected in 2013 and early 2014 and treatments were initiated in April 2014.

RESEARCH FINDINGS TO DATE

Changes in porewater chemistry and microbial activity were evident almost immediately following treatment additions. Porewater chloride and sulfate (both present in seawater) and salinity increased within the first month following Press additions (Figure 4a). Hydrogen sulfide produced by sulfate-reducing bacteria also increased (Figure 4b), while the emission of methane (CH_4), a potent greenhouse gas, declined in the Press plots within six months of the start of treatments. The plant community also was affected during the first year of treatments. Creeping primrose-willow, a succulent groundcover species, disappeared from the Press plots during the first summer and never recovered. Smartweed and pickerelweed also declined later during the first year. By the second year of treatments, even the hardy giant cutgrass was in decline in the Press plots. The reduction of plant biomass led to reduced carbon uptake by emergent vegetation, which may lead to long-term declines in soil carbon sequestration. After 18 months of Press additions, vegetation in Press plots was nearly extirpated (Figure 3b) and some Press plots had lost nearly 2 cm of soil elevation, which we attribute to a loss of roots and rhizomes accompanying the loss of aboveground biomass.

FIGURE 2. Site map of the GCE LTER (inset). SALTEx's location is indicated with the black star.

FIGURE 2. (a) Delivery of seawater-river water mixture to a plot. (b) Press plot (replicate 3) in July 2015, 15 months after treatments were initiated. Note the loss of vegetation in the plot as only some giant cutgrass remains, and all other plant species have disappeared. The four porewater wells are visible in each quarter of the plot.

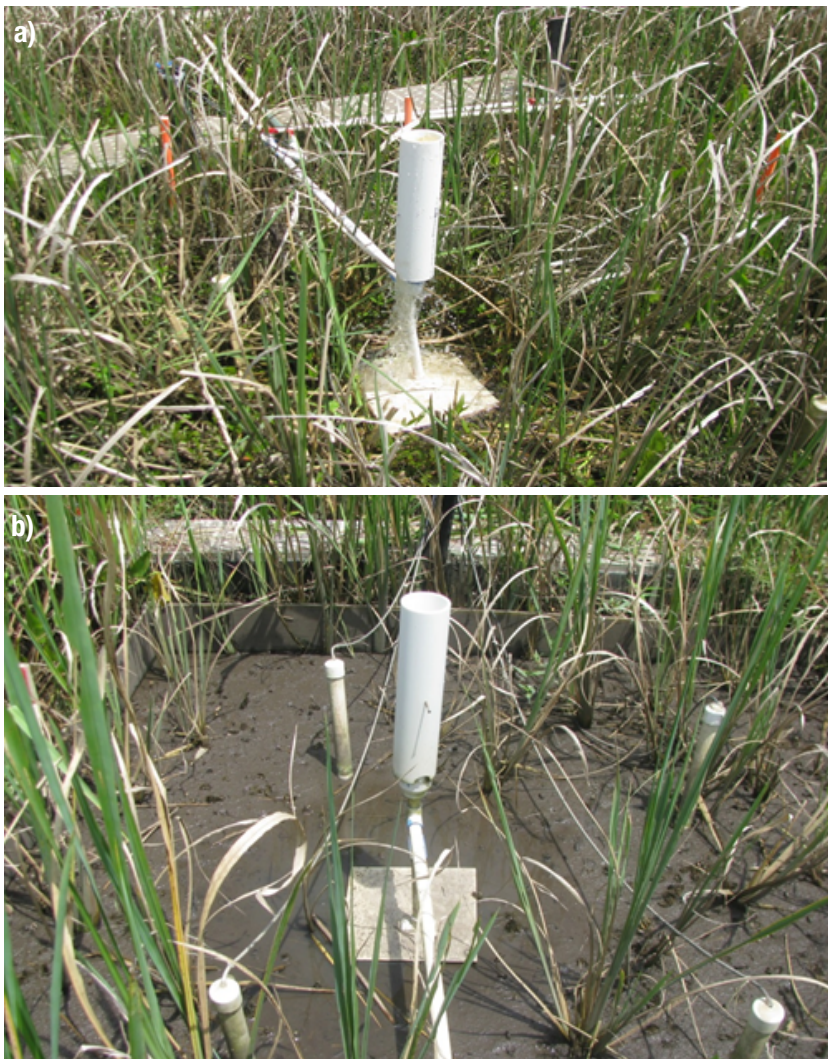
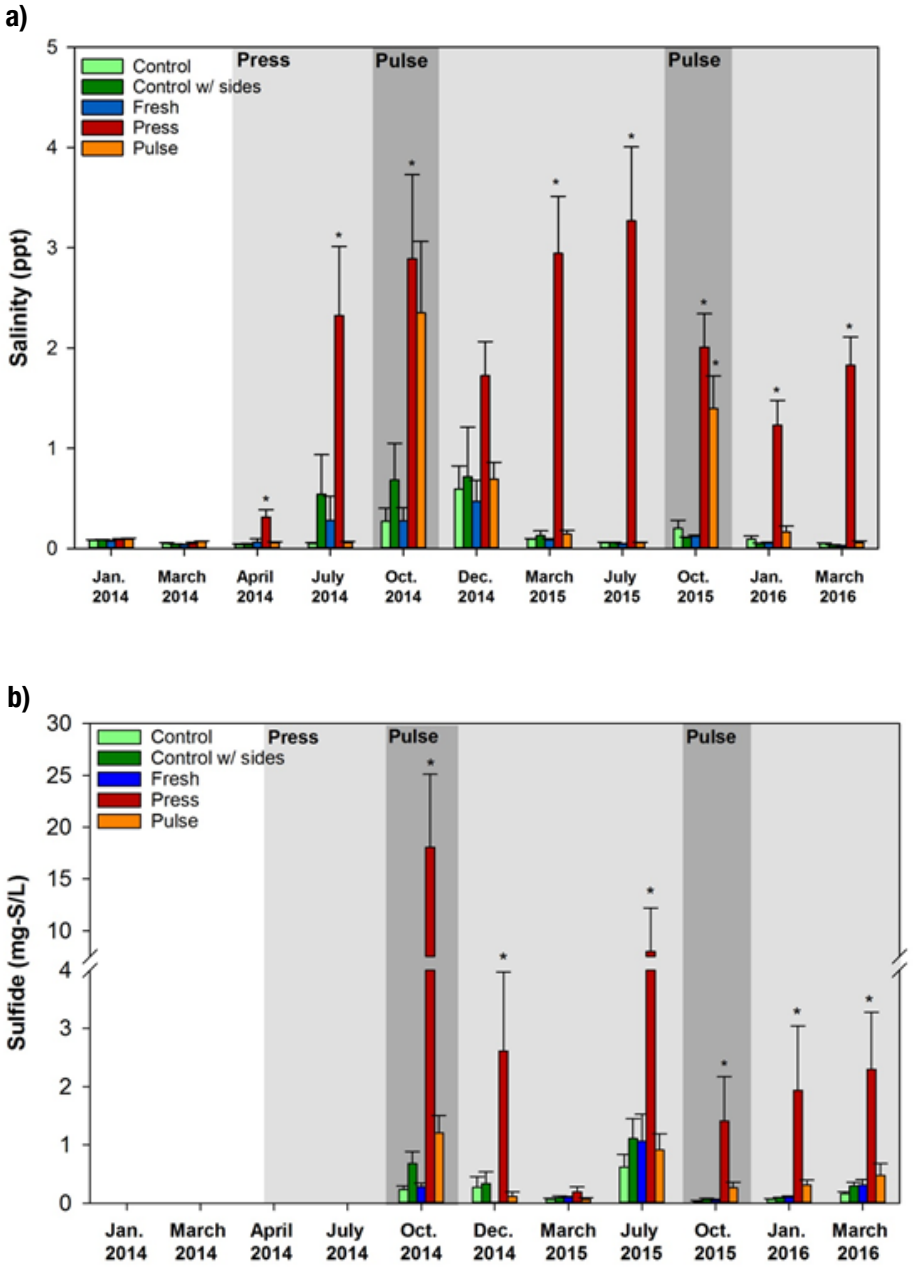


FIGURE 3. Concentrations of salinity (a) and sulfide (b) in SALTEx treatment plots pre- (January and March 2014) and post-treatment. Means with an asterisk (*) are significantly different from other treatments within the same month.



Pulse additions of diluted seawater led to transient increases in porewater salinity and sulfate that disappeared once treatments were halted (Figure 4a). Creeping primrose-willow nearly disappeared from Pulse plots after the first year, recovering only slightly in year 2. Other plant species were not affected by the Pulse addition, nor were greenhouse gas emissions affected.

WHAT IT MEANS

Our preliminary findings suggest that climate change-driven chronic saltwater intrusion will lead to rapid changes in microbial and plant communities with attendant changes in ecosystem services such as productivity, carbon sequestration, and greenhouse gas emissions. Of concern is the loss of vegetation and soil elevation within the first two years of Press addition of diluted seawater. We will continue treatments for several more years to better understand the effects of transient low flow or drought conditions and freshwater additions on tidal freshwater marshes. In addition, we plan to follow recovery of the plots when we discontinue the treatments to see if recovery follows the same trajectories in the different treatments and to see how quickly the system recovers, if at all. SALTEx is complemented by other work in the GCE LTER that examines ecosystems at the landscape scale, such as tracking vegetation productivity and community changes along the Altamaha River annually and relating these changes to salinity and other factors. We also have a long-term monitoring site at a healthy tidal freshwater forest to detect any possible saltwater intrusion in its early stages. We hope that understanding the response

TABLE 1. Measurements to assess the effects of SALTEx treatments on tidal freshwater marsh structure and function.

Porewater:	Salinity, chloride, sulfate, sulfide, dissolved organic C, inorganic and organic forms of N and P
Plant community:	Aboveground biomass, photosynthesis, leaf N and P, benthic microalgae
Animal community:	Grasshoppers, insects, crabs, snails
Microbial community:	Extracellular enzyme activity, diversity
Ecosystem:	Net ecosystem exchange, ecosystem respiration, greenhouse gases (CO_2, CH_4, N_2O)
Soils:	Bulk density, C, N, and P content, organic matter quality and composition, soil elevation, temperature

of marshes and forests to salinization will inform adaptive management strategies of coastal communities. Stay tuned.

ABOUT THE GCE LTER

The Georgia Coastal Ecosystems Long Term Ecological Research site was established in 2000 by the National Science Foundation. It encompasses three adjacent sounds, the Altamaha, Doboy, and Sapelo, that vary in freshwater input, and includes upland, intertidal, and subtidal habitat. The overarching goal of the GCE LTER is to understand how variation in source and amount of freshwater and seawater structure estuarine habitats and processes and to identify and predict changes that occur in response to natural and anthropogenic perturbations. More than 60 participants representing 14 academic institutions and agencies are involved in GCE LTER research and education programs. The field site is based at the University of Georgia Marine Institute on Sapelo Island and is administered by the University of Georgia Department of Marine Sciences. Christopher Craft is a founding member of the GCE LTER and serves on its executive committee (http://gce-lter.marsci.uga.edu/). ■

ABOUT THE INDIANA UNIVERSITY WETLANDS LABORATORY

The Wetlands Lab investigates the effects of human activities such as eutrophication, urbanization, and climate change on freshwater and estuarine wetlands and the ecosystem services they support, as well as how restoration can be employed to re-establish these services. The Lab actively supports graduate and undergraduate research, education, and service (http://www.indiana.edu/~craftlab/home.php).

REFERENCES

Tiner, R.W. 2013. Tidal Wetlands Primer: An Introduction to their Ecology, Natural History, Status, and Conservation. University of Massachusetts Press, Amherst, MA.

AIBS to Hold Communications Boot Camp

The need for effective and influential communication about science never been more important than it is today. Politicians and political interests are redefining and reinterpreting science—with great persistence and impact. While the majority of the public still respect scientists and value science, they often find it challenging to discern who and what is legitimate. The American Institute of Biological Sciences (AIBS) is responding to this need by offering scientists a new professional development opportunity. The AIBS Communications Training Boot Camp for Scientists expands on our highly successful media and science policy training workshops. The program meets the needs of everyone from graduate students to senior researchers and program administrators.

AIBS is the scientific organization that promotes the use of science to inform decision-making that advances biology for the benefit of science and society. The organization has a long and successful track record of engaging, informing, and influencing the public and science policy decision-makers. Our audiences include members of Congress, federal agency heads and program managers, state officials, and university administrators. In addition to working directly with these groups, we routinely engage the public through traditional and new media.

Our staff members have used their decades of science policy and communications experience to develop training materials and resources that provide scientists with the skills needed to successfully communicate about their research with decision-makers and reporters. To date, AIBS has trained more than 1,000 scientists.

AIBS is sponsoring a Communications Boot Camp, an intensive, two-day, hands-on training program in Washington, DC (December 7–8, 2016). Participants will learn:

- How to translate scientific findings for non-technical audiences
- How to tell a resonant story that informs decision-makers
- How to prepare for and participate in a news interview, including broadcast interviews
- How to prepare for and engage in a meeting with a decision-maker
- How to protect your scientific reputation
- How to identify and define the audience you need to reach
- What policymakers want and need to know from a scientist
- What reporters are looking for in an interview
- How the nation's science policy is developed and implemented

Participants will have the opportunity for formal and informal discussions with science policy and communications experts working in Washington, DC. Go online for more information about the Boot Camp including costs and a course outline: https://www.aibs.org/public-policy/communications_boot_camp.html?utm_source=AIBS+Master+List&utm_campaign=69e633d3fa-Bootcamp_Campaign8_4_2016&utm_medium=email&utm_term=0_def270e561-69e633d3fa-171091754. ■

SWS Joins the Call on Presidential Candidates to Address Major Issues in Science, Engineering, Technology, Health and the Environment

In keeping with our mission to promote sound science as a basis for public policy, the Society of Wetland Scientists has joined a large group of nonpartisan scientific societies and organizations to urge all United States 2016 presidential candidates to respond to a series of science-related questions, and to urge the press to question candidates on these subjects. Please see the press release below to read about it, and keep your eyes peeled for information on ScienceDebate.org to see what kind of response each U.S. presidential candidate provides to the American public. The following text was extracted from a news release by Sciencedebate.org.

A blue-ribbon coalition of fifty-six leading U.S. nonpartisan organizations, representing more than 10 million scientists and engineers, are calling on U.S. Presidential candidates to address a set of twenty major issues in science, engineering, technology, health and the environment, and encouraging journalists and voters to press the candidates on them during the 2016 U.S. Presidential election season.

"Taken collectively, these twenty issues have at least as profound an impact on voters' lives as those more frequently covered by journalists, including candidates' views on economic policy, foreign policy, and faith and values," said ScienceDebate.org chair Shawn Otto, organizer of the effort. A 2015 national poll commissioned by ScienceDebate.org and Research!America revealed that a large majority of Americans (87%) say it is important that candidates for President and Congress have a basic understanding of the science informing public policy issues.

The group crowd sourced and refined hundreds of suggestions, then submitted "the 20 most important, most immediate questions" to the Presidential campaigns of Hillary Clinton, Donald Trump, Gary Johnson, and Jill Stein, "along with an invitation to the candidates to answer them in writing and to discuss them on television," said Otto. The questions and answers will be widely distributed to the science community, journalists, and the general public to help voters make well-informed decisions at the ballot box this November.

The list of organizations is a who's who of the American science enterprise.

"Sometimes politicians think science issues are limited to simply things like the budget for NASA or NIH, and they fail to realize that a President's attitude toward and decisions about science and research affect the public wellbeing, from the growth of our economy, to education, to public health. Voters should have a chance to know where the Presidential candidates stand," said Rush Holt, chief executive officer of the American Association for the Advancement of Science (AAAS) and executive publisher of the Science family of journals. "We want journalists and voters to ask these questions insistently of the candidates and their campaign staff."

"By engaging the candidates in a debate focusing on topics in science, engineering, technology, and innovation," said Marcia McNutt, President of the National Academy of Sciences. "it would be an opportunity for all voters to gauge how the candidates would use sound technical information in their future decision making."

"Informing citizens about the health of the nation and discussing pivotal science and policy issues such as mental health, chronic and emerging diseases and other public health threats, and vaccine research, are important to not only advance the national dialogue but also improve the country's overall well-being," said Victor J. Dzau, President of the National Academy of Medicine.

"Ahead lie many Grand Challenges for Engineering whose solution in this century have been posited as necessary for simply maintaining our quality of life," said C. D. Mote, Jr., President of the National Academy of Engineering. "Unfortunately, these challenges stand unrecognized in the US Presidential debates."

THE QUESTIONS

The consortium's list of 20 questions most important science, engineering, health and environmental questions facing the next President are available at http://sciencedebate.org/20questions.

VIDEO

The group created a public service announcement featuring children asking the candidates to debate the big science issues facing the country, at http://sciencedebate.org/#kids

AUDIO

Broadcast-quality audio clips of ScienceDebate.org chair Shawn Otto can be downloaded from:

- How the group developed the questions http://sciencedebate.org/goods/audio/Science%20Debate%20Dot%20Org's%20Shawn%20Otto-%20How%20We%20Developed%20The%20Top%2020%20Presidential%20Science%20Qs.aif
- Why this is important http://sciencedebate.org/goods/audio/Science%20Debate%20Dot%20Org's%20Shawn%20Otto-%20Important%20to%20Answer%20These%20Qs%20on%20Campaign%20Trail.aif
- Some examples http://sciencedebate.org/goods/audio/Science%20Debate%20Dot%20Org's%20Shawn%20Otto-%20Some%20of%20the%20Issues.aif

The groups are asking candidates to provide responses by September 6. ■

This section is intended to inform readers about ongoing wetland research by various universities, government agencies, NGOs and others. When studies are completed, WSP invites short articles that address key findings, while more technical papers are submitted to Wetlands or other peer-reviewed journals. Researchers interested in posting short or more detailed summaries of their investigations are encouraged to contact the WSP editor (please include "WSP Research News" in the email subject box).

RESOURCES

SUBSCRIBE TO WETLAND BREAKING NEWS

The Association of State Wetland Managers produces a monthly newsletter that summarizes current events on wetlands – *Wetland Breaking News*. This is largely a collection of news clips addressing wetland issues. Access the latest issue at: http://aswm.org/news/wetland-breaking-news/892-current-issue#national. Past issues can also be accessed there. Sign up to be put on the mailing list. ■

VIDEO AVAILABLE TO AID IN USING WETLANDS MAPPER

The U.S. Fish and Wildlife Service has produced a video tutorial to help people use the National Wetlands Inventory's "Wetlands Mapper." To access, go to: https://www.youtube.com/watch?feature=player_detailpage&v=CB398gj3O04. ■

PAST ISSUES OF *WETLAND SCIENCE & PRACTICE*

Past issues of WSP can be viewed on the SWS website: http://www.sws.org/Publications/wetland-science-and-practice.html. On Feb. 6, 2015, the SWS board of directors voted to allow free public distribution of past issues of *WSP*. This means that all issues published, except the four most recent issues, are available via the internet to the general public. More recent issues, available for viewing by SWS members only, will be phased in for distribution as they reach the one-year threshold. This means that the audience for *WSP* articles is virtually limitless. Such availability will hopefully stimulate more interest in contributing to the journal. We are working out the details for distribution and welcome this opportunity that will promote the good work done by our members. ■

SWS FREE MONTHLY WEBINAR SERIES

Take advantage of your SWS membership by participating in outstanding educational opportunities without leaving your desk! SWS is pleased to provide a webinar series on wetland science topics of interest. The convenience and flexibility of SWS webinars enables you to educate one or a large number of employees at once, reduce travel expenses, and maintain consistent levels of productivity by eliminating time out of the office. Webinar registration is a complimentary member benefit. A limited number of spots are available for each webinar. If you're unable to participate in the live webinar, all webinars are recorded and archived for complimentary viewing by SWS members. ■

Also, please see the *Wetland Bookshelf* section of this publication for additional resources.

This section provides SWS members with an opportunity to post some of their favorite wetland photos. The intent is to display pictures recently taken, but we'll welcome any outstanding images you want to share with readers. The number of pictures displayed will be limited so all your submissions may not be posted in one issue. Please send your images to the WSP editor at rtiner@eco.umass.edu.

Late Summer notes

As mentioned in my editorial, Massachusetts has experienced drought conditions this summer. Our neighboring town of Amherst has imposed a water ban to insure enough water upon return of the UMass students. My backyard pond dried up in late June or early July and the bottom has been exposed nearly continuously during the past two months. The only exception was after a heavy rain in mid-August that resulted in a few inches of water in the lowest part of the pond basin. That lasted only a few days. Here's some photos of the pond and associated plants. Normally the pond has at least 50% cover by water lilies. ■

The pond on August 13, 2016. Note the greenish tinge to some parts of the bottom where graminoid seedlings have established.

Buttonbush (*Cephalanthus occidentalis*)

Pickerelweed (*Pontederia cordata*)

Cardinal-flower (*Lobelia cardinalis*)

Northern Bugleweed (*Lycopus uniflorus*)

Boneset (*Eupatorium perfoliatum*)

Nodding Ladies' Tresses (*Spiranthes cernua*)

Water lilies (*Nymphaea odorata*) on the exposed pond bottom. Deer have been eating the leaves of this species.

Purple-headed Sneezeweed (*Helenium flexuosum*)

WETLAND BOOKSHELF

If you know of other books and reports on wetlands, please send information to Ralph Tiner, Editor of *Wetland Science & Practice* at: rtiner@eco.umass.edu. Your cooperation is appreciated.

BOOKS

- Wetland Soils: Genesis, Hydrology, Landscapes, and Classification https://www.crcpress.com/Wetland-Soils-Genesis-Hydrology-Landscapes-and-Classification/Vepraskas-Richardson-Vepraskas-Craft/9781566704847
- Creating and Restoring Wetlands: From Theory to Practice http://store.elsevier.com/Creating-and-Restoring-Wetlands/Christopher-Craft/isbn-9780124072329/
- Salt Marsh Secrets. Who uncovered them and how? http://trnerr.org/SaltMarshSecrets/
- Remote Sensing of Wetlands: Applications and Advances. https://www.crcpress.com/product/isbn/9781482237351
- Wetlands (5th Edition). http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118676823.html
- Black Swan Lake – Life of a Wetland http://press.uchicago.edu/ucp/books/book/distributed/B/bo15564698.html
- Coastal Wetlands of the World: Geology, Ecology, Distribution and Applications http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/environmental-science/coastal-wetlands-world-geology-ecology-distribution-and-applications
- Florida's Wetlands http://www.pineapplepress.com/ad.asp?isbn=978-1-56164-687-6
- Mid-Atlantic Freshwater Wetlands: Science, Management, Policy, and Practice http://www.springer.com/environment/aquatic+sciences/book/978-1-4614-5595-0
- The Atchafalaya River Basin: History and Ecology of an American Wetland http://www.tamupress.com/product/Atchafalaya-River-Basin,7733.aspx
- Tidal Wetlands Primer: An Introduction to their Ecology, Natural History, Status and Conservation https://www.umass.edu/umpress/title/tidal-wetlands-primer
- Wetland Landscape Characterization: Practical Tools, Methods, and Approaches for Landscape Ecology http://www.crcpress.com/product/isbn/9781466503762
- Wetland Techniques (3 volumes) http://www.springer.com/life+sciences/ecology/book/978-94-007-6859-8

ONLINE PUBLICATIONS

U.S. ARMY CORPS OF ENGINEERS

- Regional Guidebook for the Functional Assessment of Organic Flats, Slopes, and Depressional Wetlands in the Northcentral and Northeast Region http://acwc.sdp.sirsi.net/client/en_US/search/asset/1047786
- Wetland-related publications:
  -http://acwc.sdp.sirsi.net/client/en_US/default/search/results?te=&lm=WRP
  -http://acwc.sdp.sirsi.net/client/en_US/default/search/results?te=&lm=WRP
- National Wetland Plant List publications: http://rsgisias.crrel.usace.army.mil/NWPL/
- National Technical Committee for Wetland Vegetation: http://rsgisias.crrel.usace.army.mil/nwpl_static/ntcwv.html
- U.S. Environmental Protection Agency wetland reports and searches: http://water.epa.gov/type/wetlands/wetpubs.cfm
- A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Forested Wetlands in Alluvial Valleys of the Coastal Plain of the Southeastern United States ERDC/EL TR-13-1
- Hydrogeomorphic (HGM) Approach to Assessing Wetland Functions: Guidelines for Developing Guidebooks (Version 2) ERDC/EL TR-13-11
- Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing the Functions of Flat and Seasonally Inundated Depression Wetlands on the Highland Rim ERDC/EL TR-13-12

U.S. FISH AND WILDLIFE SERVICE, NATIONAL WETLANDS INVENTORY

- Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York http://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/Characterization_Report_February_2015.pdf or http://www.aswm.org/wetlandsonestop/wetland_characterization_long_island_ny_021715.pdf
- Also wetland characterization/landscape-level functional assessment reports for over 12 small watersheds in New York at: http://www.aswm.org/wetland-science/134-wetlands-onestop/5044-nwi-reports
- Preliminary Inventory of Potential Wetland Restoration Sites for Long Island, New York http://www.aswm.org/wetlandsonestop/restoration_inventory_long_island_ny_021715.pdf
- Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors. Version 3.0. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA.
- Connecticut Wetlands Reports

- Changes in Connecticut Wetlands: 1990 to 2010
- Potential Wetland Restoration Sites for Connecticut: Results of a Preliminary Statewide Survey
- Wetlands and Waters of Connecticut: Status 2010
- Connecticut Wetlands: Characterization and Landscape-level Functional Assessment
- Rhode Island Wetlands: Status, Characterization, and Landscape-level Functional Assessment http://www.aswm.org/wetlandsonestop/rhode_island_wetlands_llww.pdf
- Status and Trends of Prairie Wetlands in the United States: 1997 to 2009 http://www.fws.gov/wetlands/Documents/Status-and-Trends-of-Prairie-Wetlands-in-the-United-States-1997-to-2009.pdf
- Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States 2004 to 2009. http://www.fws.gov/wetlands/Documents/Status-and-Trends-of-Wetlands-In-the-Coastal-Watersheds-of-the-Conterminous-US-2004-to-2009.pdf
- The NWI+ Web Mapper – Expanded Data for Wetland Conservation http://www.aswm.org/wetlandsonestop/nwiplus_web_mapper_nwn_2013.pdf
- Wetlands One-Stop Mapping: Providing Easy Online Access to Geospatial Data on Wetlands and Soils and Related Information http://www.aswm.org/wetlandsonestop/wetlands_one_stop_mapping_in_wetland_science_and_practice.pdf
- Wetlands of Pennsylvania's Lake Erie Watershed: Status, Characterization, Landscape-level Functional Assessment, and Potential Wetland Restoration Sites http://www.aswm.org/wetlandsonestop/lake_erie_watershed_report_0514.pdf

U.S. FOREST SERVICE

- Historical Range of Variation Assessment for Wetland and Riparian Ecosystems, U.S. Forest Service Rocky Mountain Region. http://www.fs.fed.us/rm/pubs/rmrs_gtr286.pdf
- Inventory of Fens in a Large Landscape of West-Central Colorado http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5363703.pdf

U.S. GEOLOGICAL SURVEY, NATIONAL WETLANDS RESEARCH CENTER

- Link to publications: http://www.nwrc.usgs.gov/pblctns.htm (recent publications are noted)
- A Regional Classification of the Effectiveness of Depressional Wetlands at Mitigating Nitrogen Transport to Surface Waters in the Northern Atlantic Coastal Plain http://pubs.usgs.gov/sir/2012/5266/pdf/sir2012-5266.pdf
- Tidal Wetlands of the Yaquina and Alsea River Estuaries, Oregon: Geographic Information Systems Layer Development and Recommendations for National Wetlands Inventory Revisions http://pubs.usgs.gov/of/2012/1038/pdf/ofr2012-1038.pdf

U.S.D.A. NATURAL RESOURCES CONSERVATION SERVICE

- Link to information on hydric soils:http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/

PUBLICATIONS BY OTHER ORGANIZATIONS

- The Nature Conservancy has posted several reports on wetland and riparian restoration for the Gunnison Basin, Colorado at: http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/Colorado/science/climate/gunnison/Pages/Reports.aspx (Note: Other TNC reports are also available via this website by looking under different regions.)
- Book: Ecology and Conservation of Waterfowl in the Northern Hemisphere, Proceedings of the 6th North American Duck Symposium and Workshop (Memphis, TN; January 27-31, 2013). Wildfowl Special Issue No. 4. Wildfowl & Wetlands Trust, Slimbridge, Gloucestershire, UK.
- Report on State Definitions, Jurisdiction and Mitigation Requirements in State Programs for Ephemeral, Intermittent and Perennial Streams in the United States (Association of State Wetland Managers) http://aswm.org/stream_mitigation/streams_in_the_us.pdf
- Wetlands and People (International Water Management Institute) http://www.iwmi.cgiar.org/Publications/Books/PDF/wetlands-and-people.pdf

ARTICLES OF INTEREST FROM VARIED SOURCES

- Comparative phylogeography of the wild-rice genus Zizania (Poaceae) in eastern Asia and North America; American Journal of Botany 102:239-247. http://www.amjbot.org/content/102/2/239.abstract

LINKS TO WETLAND-RELATED JOURNALS AND NEWSLETTERS

JOURNALS

- Aquatic Botany http://www.journals.elsevier.com/aquatic-botany/
- Aquatic Conservation: Marine and Freshwater Ecosystems http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-0755
- Aquatic Sciences http://www.springer.com/life+sciences/ecology/journal/27
- Ecological Engineering http://www.journals.elsevier.com/ecological-engineering/
- Estuaries and Coasts http://www.springer.com/environment/journal/12237
- Estuarine, Coastal and Shelf Science http://www.journals.elsevier.com/estuarine-coastal-and-shelf-science/
- Hydrobiologia http://link.springer.com/journal/10750
- Hydrological Sciences Journal http://www.tandfonline.com/toc/thsj20/current
- Journal of Hydrology http://www.journals.elsevier.com/journal-of-hydrology/
- Wetlands http://link.springer.com/journal/13157
- Wetlands Ecology and Management http://link.springer.com/journal/11273

NEWSLETTERS

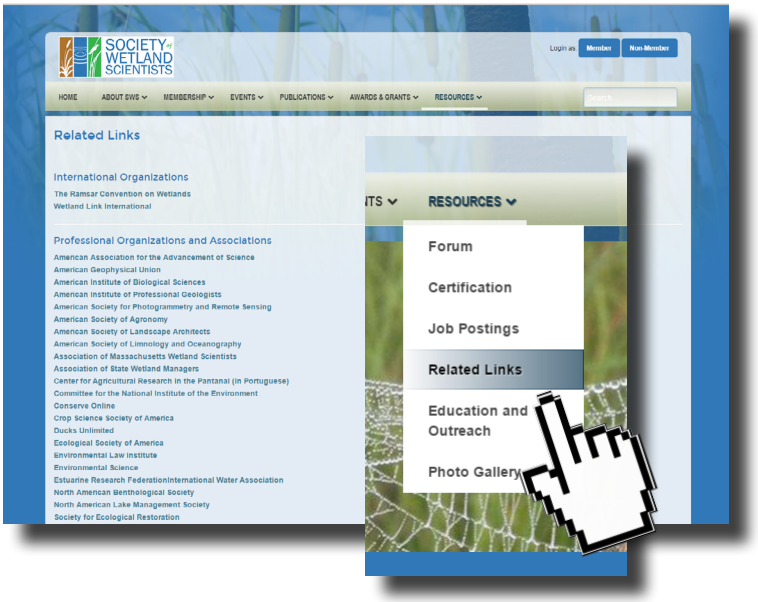
- Biological Conservation Newsletter (this monthly newsletter contains a listing of articles that include many that address wetland issues – current and others back to 1991 in the "Archives") http://botany.si.edu/pubs/bcn/issue/latest.htm#biblio
- Wetland Breaking News (Association of State Wetland Managers) http://aswm.org/news/wetland-breaking-news
- National Wetlands Newsletter (Environmental Law Institute) http://www.wetlandsnewsletter.org/welcome/index.cfm

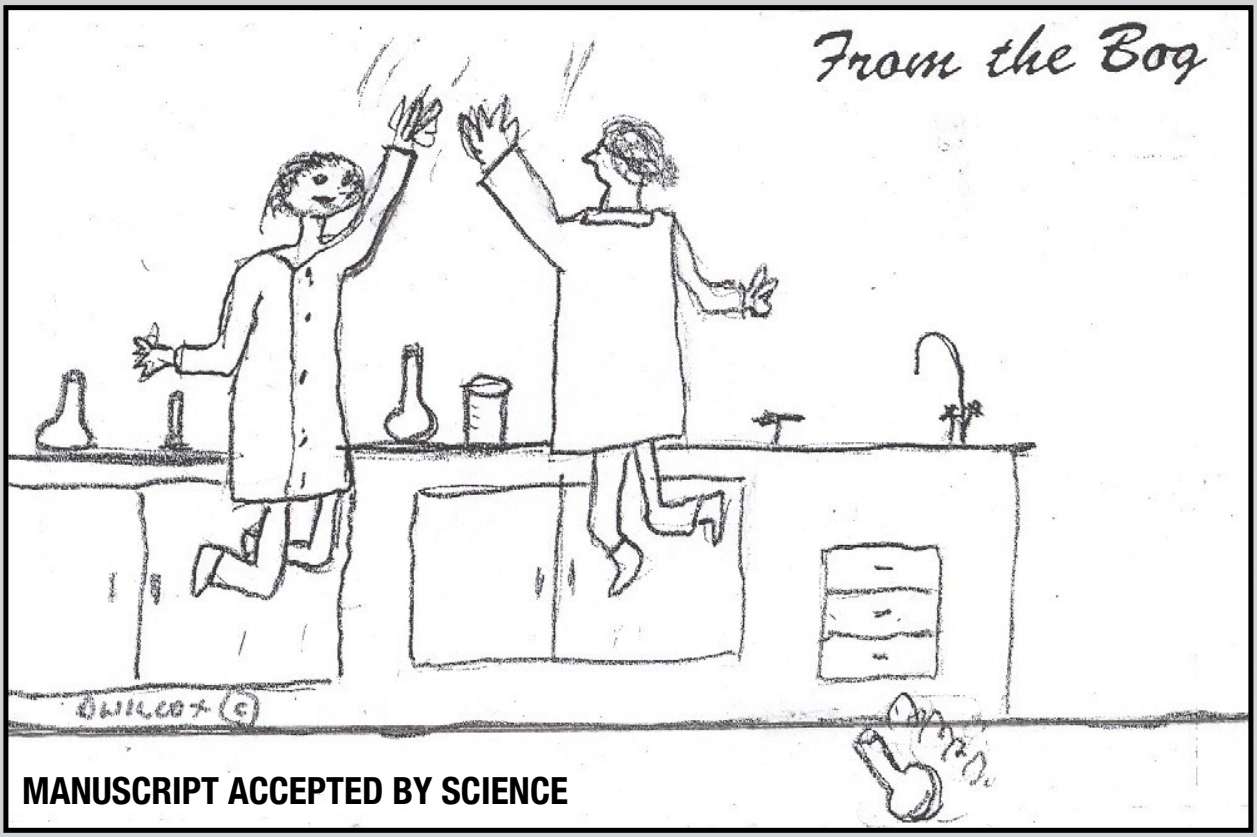
WEB TIP

Resources at your fingertips!

For your convenience, SWS has compiled a hefty list of wetland science websites, books, newsletters, government agencies, research centers and more, and saved them to sws.org.

Find them on the Related Links page [sws.org](sws.org).





wetland science & practice

The WSP is the formal voice of the Society of Wetland Scientists. It is a quarterly publication focusing on the news of the SWS, at international, national and chapter levels, as well as important and relevant announcements for members. In addition, manuscripts are published on topics that are descriptive in nature, that focus on particular case studies, or analyze policies. All manuscripts should follow guidelines for authors as listed for Wetlands as closely as possible. All papers published in WSP will be reviewed by the editor for suitability. Letters to the editor are also encouraged, but must be relevant to broad wetland-related topics. All material should be sent electronically to the current editor of WSP. Complaints about SWS policy or personnel should be sent directly to the elected officers of SWS and will not be considered for publication in WSP.