wetland science & practice
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FROM THE EDITOR'S DESK

For those of us in the Northern Hemisphere, we're looking forward to Spring when the landscape gets progressively greener and to putting another Winter behind us. The vernal pools out back are filled with water so we're expecting a loud chorus of frogs this year. I am always happy to hear the first sounds of the wood frogs in March, followed by high pitched trills of the spring peepers and, last but not least, the chirping of the gray treefrogs from the tree tops.

Ralph Tiner
WSP Editor

In this issue we have two articles that are part of two series – one on early wetland scientists and the other on principles of wetland construction and restoration. The former is an article about Stephen Forbes by SWS President Arnold van der Valk. The second is the first contribution of a few by Mal Gilbert – this one is an introduction to his experiences building and restoring wetlands over the last 40 years and includes the first of a number of case studies that will be presented in the next few issues of Wetland Science and Practice. The issue also contains six summaries of student projects where SWS has awarded grants; project summaries for the remaining six student awardees will be published in the June issue. Also added to this issue are updates from two SWS chapters and an introduction to SWS's new Education Chapter. Bill Mitsch submitted a contribution on his concern about the status of U.S. participation in the worldwide effort to recognize wetlands of international importance, Joy Zedler offered an introduction to her online book about Waubesa wetlands, and Doug Wilcox submitted another cartoon for our enjoyment.

I added a unit on "Wetlands in the News" that contains links to several online articles about wetlands. I encourage folks to submit links to similar e-articles so readers can learn what is happening to wetlands around the world. WSP continues to seek short articles highlighting your work in wetlands or on the natural history of wetlands. If you are preparing a presentation or poster for the SWS Annual Meeting in Denver, please seriously consider converting it to a contribution for WSP. This should require only a minimum of effort and will get the information out to the world at large. Meanwhile, thanks to all who contribute to WSP.

Happy Swamping! ■

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COVER PHOTO:
Young alligator in springtime in South Carolina. (Ralph Tiner photo)

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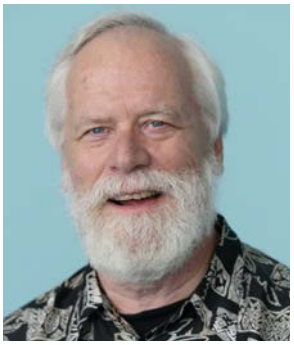
Note to Readers: All State-of-the-Science reports are peer reviewed, with anonymity to reviewers.

PRESIDENT'S MESSAGE

If you Google SWS, you find a link to the Website of the "Society of Wetland Scientists (SWS), an International Organization." It is the "international organization" that I always find striking. I am not sure when SWS began to declare itself as an international organization. Whenever it was, it marked a major potential change in our mission. The reality is that we are still in the early stages of becoming an international organization.



Arnold van der Valk
SWS President

SWS was founded in 1980. It adopted an administrative structure based on geographic units, chapters, each of which had a vote on the organization's Board of Directors. Initially all the chapters were American, but SWS gradually began to add international chapters. Today we have six international chapters in Asia, Canada, China, Europe, Oceania, and a catchall International Chapter. Today, we also have 10 American chapters. It means that the Central Chapter (Missouri and Kansas) has the same representation on the Board as all of Europe or China. This geographic imbalance on the Board of Directors makes SWS look like it is an American society to non-Americans.

This is not a problem with Sections. Section membership is open to all members of the Society. Sections have no geographic boundaries.

If we want to be a truly international organization, SWS needs to rethink the role of chapters in its governance. I hasten to add that I am not suggesting eliminating any chapters or changing their funding. They play an important role in the Society by providing educational and networking opportunities for members. What I am suggesting is that the representation of chapters on the Board of Directors may need to be changed. Rather than every chapter having a voting member on the Board, we could consolidate the chapters for this purpose into regions with each region having a vote on the Board. For example, we could have four US regions: North East, South East, Central, and West. How the representative of a region would be chosen needs to be discussed and debated. It could be done in several ways. For example, it could be rotated among the chapters in a region or the chapters in a region could vote for their representative.

SWS in 2020 will be forty years old. We need to begin to plan for this major anniversary, not just to celebrate our accomplishments, but also to plan for our future. We need to ensure that the Society continues to grow in membership and influence around the world. Our current governance structure reflects our past. Because of its strong American bias, it will make it more difficult to evolve into an international organization. Our upcoming anniversary is an opportunity for us to reexamine our governance structure. To this end, as part of the planning for the 40th anniversary of SWS, I am going to establish an ad hoc planning committee for our anniversary that will include a subcommittee that will examine our governance.

If you have any ideas or suggestions for how SWS should celebrate its upcoming anniversary, please send them to me (valk@iastate.edu). ■

wetland science & practice

SOCIETY of WETLAND SCIENTISTS

Submit a Video to Be Featured on the SWS YouTube Channel

The SWS mission is to promote understanding, conservation, protection, restoration, science-based management and sustainability of wetlands. The SWS New Media Team launched the SWS YouTube channel to share our mission with a wider audience. To help us with this initiative, we ask for members and non-members alike to share their work and experiences by submitting a video to be featured on our YouTube channel! Featured videos will showcase various wetland topics that help to further our mission. Visit theNew Media Initiative page (http://sws.org/About-SWS/new-media-initiative.html) to learn more and to submit a video! ■

Check Out the SWS Natural Disaster Relief Board

In the wake of numerous natural disasters around the world, SWS supports all those who were affected. As SWS President Arnold van der Valk said, "SWS stands by all those affected by recent natural disasters. Our hearts go out particularly to our members affected both personally and professionally. If it happened to you, it happened to all of us."

Now, SWS is proud to be an international resource for members and communities in need to connect with those offering support. We are collecting both requests for help and offers of support. Please join us in this initiative to help unify and strengthen our SWS community. Learn more: http://sws.org/Resources/sws-natural-disaster-relief.html. ■

Submit Your children's Artwork in the Youth Art Contest

We'll be accepting submissions for our Youth Art Contest from February 2 – April 2, 2018. All artworks must be submitted through our online form by April 2, 2018, at 11:59 p.m. GMT. This year's theme is Wetland Wildlife. Learn more: http://sws.org/Resources/education-and-outreach.html. ■

AGE CATEGORIES

- Grades 1 - 4
- Grades 5 - 8

PRIZES

For each age category, first, second and third place winners will be awarded the following prizes:

- 1st place - $50.00 USD
- 2nd place - $25.00 USD
- 3rd place - $10.00 USD

SWS Education Section Launches in 2018

Contributed by Derek Faust, SWS Education Section Chair

Hopefully you have heard the news that there are several new SWS sections, including an Education Section. This was announced at the Annual Meeting in Puerto Rico, in SWS Newsletter emails, and on the SWS Facebook page. We are all passionate about wetlands and through the Education Section you can help educate students of all ages and get them excited about wetlands, too!

The main purpose of the SWS Education Section is to promote wetland science education for students of all ages and for the general public. The section's specific goals are to: 1) provide professional development opportunities for teachers and instructors at annual and regional meetings of SWS through workshops and symposia; 2) encourage the development and dissemination of educational materials about wetlands that can be incorporated into curricula at all educational levels; and 3) recognize teachers, organizations, and institutions who have made a significant contribution to improving the teaching of wetland science.

While the SWS Education Section did not have any activities in 2017 because it did not yet have official members, that will change in 2018. When you renew your SWS membership, I encourage you to take the opportunity to join the Education Section and help it successfully take off in 2018. One initiative that started in 2017 was the launch of the SWS Education Section Facebook page (https://www.facebook.com/SWSEducation/). Like and follow the page to find out about #WetlandWednesday posts, which feature a photo(s) or videos and an interesting wetland fact. If you have photos, videos, or ideas for #WetlandWednesday posts, please contact Education Section Chair Derek Faust (derek.faust@ars.usda.gov).

One opportunity to contribute to the section will be at the 2018 Annual Meeting in Denver. A brainstorming meeting open to all attendees at no additional cost will be held to have an open discussion and brainstorm ideas to determine what roles the SWS Education Section will play in providing education and outreach opportunities and events for SWS members, educators, and the general public. Examples of events and opportunities organized by the Education Section may include developing K-12 wetland curricula, symposia on education techniques/topics/labs used in wetland science courses, and international wetland education programs. Expanding on these ideas and discussing other ideas is the primary objective of this brainstorming meeting and will help the Education Section make a strong and successful start at promoting wetland education!

If you are interested in any fashion in the work of the SWS Education Section, please attend the brainstorming meeting in Denver and/or contact Derek Faust. Remember to like and follow us on Facebook and add the Education Section to your SWS membership! ■

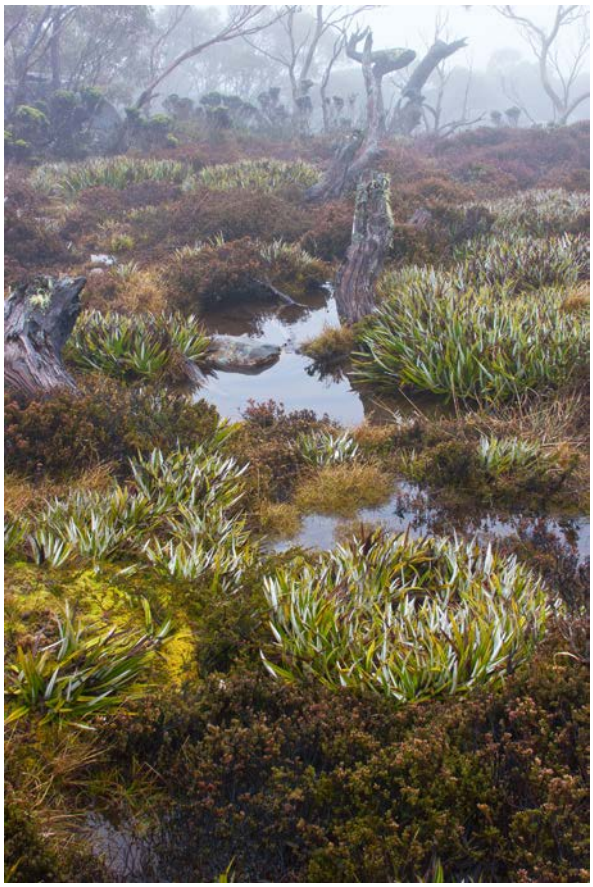
Congratulations to the SWS Photo Contest 2017 Winners

Thank you to all who submitted photos in this year's contest and those who voted!

Grand Prize Winner: Mark DeDina for *Floating Islands in Dubuque, Iowa*

1st Prize Winner in the Wetland Restoration category: Lorene Lynn for *Cottongrass in the Arctic Oilfields*

1st Prize Winner in the Wetland Wildlife category: Kyle Filicky for *Sundew Snack*



1st Prize Winner in the International Wetlands category: Mary Allessio Leck for *Mt. Wellington Preserve, a World Heritage site* in Hobart Tasmania

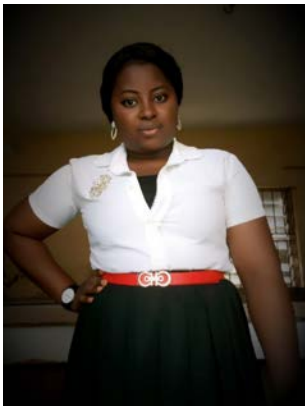
SWS "Wetlands" Journal Table of Contents Now Available

You can access the table of contents for the most recent issue of *Wetlands* via the following link: https://link.springer.com/journal/13157/38/1?wt_mc=alerts.TOCjournals.

You'll also find a link to open access articles at this address and information on how to publish in that journal. ■

SWS Awards Grants to 12 Students

All SWS student members conducting undergraduate or graduate level research in wetland science at an accredited college or university who have not previously been awarded an SWS Research Grant are eligible to apply for a student research grant. In 2017, twelve students received a grant to support their studies. In the next two issues of *Wetland Science and Practice*, a summary of these projects will be presented to highlight their research. This issue includes the summaries for six student projects, while summaries for the remaining students will be published in the June issue. Thanks to David Bailey, Chair of the SWS Student Research Grants Subcommittee, for his coordination and to the students for their summaries and photographs.



OYINDAMOLA ROSELINE ADARAMOYE
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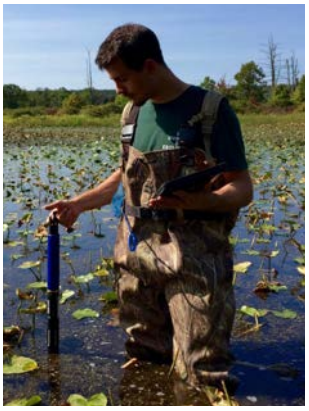
The Socio-ecological Effects of Sand Mining on the Fisheries of Lagos Lagoon Complex, Lagos, Nigeria

Sand dredging is rapidly becoming an ecological problem as demand increases in many industries and construction sector. Sand mining has negative impacts on the life of aquatic organisms due to the destruction of their habitat, which leads to loss in fisheries output, migration and destruction of spawning grounds. This study was conducted between February and July, 2017 on three selected water bodies (Badagry Creek, Ologe Lagoon and River Owo) in Lagos, Nigeria with different intensity of sand extraction. Standard methods were used for the analysis of physico-chemical parameters, primary productivity (measured in terms of chlorophyll-a abundance), length-weight relationship and condition factor. Some of the water quality variables (turbidity, electric conductivity, total dissolved solids, total suspended solids, total solids and ammonia) were significantly ($p<0.05$) higher in Badagry Creek and Ologe Lagoon than Owo River, where there is no sand mining activity. All the condition factors (K) value except for *Tilapia* zilli from Badagry Creek fall outside the range (2.9-4.8) recommended as suitable for matured fresh water fish. The results of this study showed that sand mining may have negatively affected the health of Badagry Creek and Ologe Lagoon and consequently, their suitability to sustain aquatic life has equally been affected.



DEVIN DIGIACOPO
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Ecological Implications of Evolved Tolerance to Pesticides in Amphibians

Wetlands are frequently contaminated with pesticides from nearby agricultural, industrial and urban zones. These ecosystems contain many taxa which are highly sensitive to these chemicals. Yet some organisms, including the wood frog (*Lithobates sylvaticus*), are capable of increasing tolerance to pesticides. Studies recently discovered that amphibians can achieve higher pesticide tolerance via two mechanisms: 1) evolution of higher, constitutive tolerance over multiple generations, or 2) rapidly inducing higher tolerance to pesticides within a single generation via phenotypic plasticity. While both mechanisms of pesticide tolerance allow organisms to persist when faced with pesticides, tolerance is likely associated with costs which vary depending on the environment (degree of pesticide contamination) and the mechanism by which tolerance is achieved (constitutive vs. plastic). We hypothesized that individuals with constitutive tolerance will incur a cost (e.g. reduced growth, increased disease susceptibility, etc.) regardless of the environment because resources are constantly being allocated towards maintaining pesticide tolerance. In contrast, because individuals with plastic tolerance only induce increased tolerance when exposed, we predict that these individuals will not face costs in pesticide-free environments. To test these hypotheses, we assessed the growth, anti-parasite behavior and parasite susceptibility of constitutive vs. plastic populations of wood frogs in pesticide and pesticide-free environments. This work seeks to understand the evolutionary responses that allow wetland organisms to persist when faced with chemical contamination, as well as the costs they may incur as a result.

ELISABETH POWELL
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The Effect of Open Marsh Water Management Practices on the Carbon Balance of Tidal Marshes in Barnegat Bay, New Jersey

Salt marsh physical structure has been modified in order to control mosquito populations since the early 1900s.).Open marsh water management (OMWM) was a technique first applied in New Jersey in the 1950s. OMWM was developed as a technique to overcome many of the negative habitat impacts that had been associated with ditching, which reduced marsh groundwater levels and mosquito breeding, but also had negative effects on wildlife through reduced fish populations. The major objective of OMWM was to eliminate mosquito breeding while simultaneously improving habitat for fish populations and other wildlife. This practice has been extensively used in the mid-Atlantic and is seen in Massachusetts, New York, Connecticut, Florida, and Louisiana. This practice involves excavation of areas of marsh, making shallow ponds in order to bring mosquito larvae-eating fish to reduce the population of mosquitos in a given area. While the New Jersey Mosquito Commission reports this large-scale habitat alteration has successfully, reduced mosquito populations local wetland scientists and managers are increasingly concerned about consequences of OMWM to valued ecosystem functions, such as nutrient removal and carbon sequestration, and nesting of obligate salt-marsh breeding bird species. Natural coastal wetlands are very productive ecosystems. Wetland vegetation capture and store carbon in plant tissue via photosynthesis and also bury carbon within anaerobic sediments (Kuehn et al., 2004). The anaerobic sediments are important for carbon storage because organic decomposition by microbes is slow without oxygen (Kuehn et al., 2004). The construction of ponds within marsh habitats likely have many potential impacts on net carbon sequestration of these areas. This proposed research will thus address an unstudied impact of OMWM on carbon sequestration, a valued ecosystem function of coastal marshes. This research is specifically needed because of the overwhelming spatial extent of pond construction in New Jersey coastal marshes, and because the managers need information on impacts of OMWM techniques to ecosystem functions in order to decide whether the practice should be continued.

JANET WALKER
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and San Diego State University
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Understanding the Non-trophic Effects of Animals on Community Cynamics in California Salt Marshes

Animals influence community structure and ecosystem function via trophic interactions, however animals can also impact communities through non-trophic pathways, such as ecosystem engineering via burrowing. In salt marshes, for example, crabs can burrow into soils surrounding marsh vegetation and thereby alleviate hypoxic stress for plants. The activities of such organisms may mitigate the impacts of climate change by reducing environmental stress that would otherwise change plant communities. Importantly, such stress reductions could shift plant-plant interactions towards more negative, competitive interactions. The central goal of this research is to address how animals can influence community dynamics by modifying plant interactions via non-feeding pathways in Pacific coast salt marshes. We are conducting a multi-factorial, manipulative caging experiment at four salt marshes - two southern California sites and two northern California sites – in order to examine how burrowing crabs impact the interactions of two dominant salt marsh plants, *Spartina foliosa* (Pacific cordgrass) and *Sarcocornia pacifica* (pickleweed). The experiment is scheduled to run for three years (2016 to 2018) in order to detect impacts of crab density on plant community structure and belowground processes. In 2016, we found that the strength and direction of the crab effect on the two dominant plants was related to the identity of the dominant crab species and the associated size and number of their burrows. We will continue to assess both temporal and latitudinal differences in crab effects in order to increase our understanding of the non-trophic effects of animals on community dynamics across varying abiotic conditions. In order to better manage, preserve, and restore salt marsh systems, the aggregate effect of community interactions must be identified, understood, and upheld.

LEAH NAGLE
SUNY-ESF
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Identifying Quality Vernal Pools: Factors Influencing Amphibian Survival in Small, Isolated Wetlands

In the northeastern United States, vernal pools are small, isolated wetlands that flood annually and usually dry out by mid to late summer. These temporary wetlands provide important ecosystem services and increase local biodiversity by supporting unique aquatic communities and providing important nursery habitat for a variety of species. Small, isolated wetlands are typically the most abundant type of wetland in the landscape, but they are disappearing because they are easily destroyed and often lack regulatory protection. Where vernal pools are protected—generally at the state level—they are often regulated as habitat for threatened or endangered species. Regulatory agencies often focus on breeding effort, or the number of egg masses laid by target species, as an efficient way to identify vernal pools and assess pool quality. However, few studies have tracked larval survivorship across a range of environmental gradients to assess whether egg mass counts are truly a reliable indicator of larval habitat quality across these gradients. In light of this, the objectives of my study are to 1) assess amphibian survival throughout the spring and summer in a large sample of pools that varied by hydroperiod, origin, water quality, and other factors, 2) test and refine a vernal pool rapid assessment protocol, and 3) develop a rule-based model for land managers to use to assess vernal pools and make informed decisions about prioritizing conservation efforts in different parts of New York State. By combining comprehensive and feasible assessments with concrete management guidelines based on the latest science, we seek to improve conservation outcomes and ensure the long-term sustainability of vernal pools throughout the region.

MOLLIE NUGENT
University of Alabama
manugent@crimson.ua.edu

Interactive Effects of Sediment and Nitrate Subsidies on Surface Elevation Dynamics in Brackish Marshes

In recent months, the United States has been reminded of the extent to which hurricanes can negatively impact coastal inland communities. The negative effects of these storms can be mitigated, in part, by coastal wetlands, underscoring the importance of understanding storm impacts to wetland ecosystems. Large hurricanes can affect the structure and function of coastal wetlands, and my research explores whether hurricanes, or other large sedimentation events, are benefiting coastal plants through sediment and nutrient subsidies. Sediment subsidies to marshes, whether delivered during storm and flood events or via restoration activities (e.g., sediment pumping, dredging or diversions), are critical for marsh elevation maintenance and persistence in the face of sea-level rise. The goal of my study is to examine the effects that these subsidies can have on biological feedbacks to marsh surface elevation. In a controlled greenhouse experiment, I have measured a suite of response variables, including above- and belowground plant production and surface elevation change, for a full growing season following the application of sediment and nutrient treatments. Thus, this study will enhance our understanding of how marsh plant communities respond to sediment and nutrient additions, which may have important consequences on marsh surface elevation dynamics and inform restoration strategies aimed at preventing further wetland losses. ■

SWS Joins Other Scientific Organizations in Comment Letter

All SWS letters of comment can be reviewed here: http://www.sws.org/Resources/letters-of-comment.html.

The American Fisheries Society • American Institute of Biological Sciences • Association for the Sciences of Limnology and Oceanography • Coastal and Estuarine Research Federation • Ecological Society of America • Freshwater Mollusk Conservation Society • International Association for Great Lakes Research • North American Lake Management Society • Phycological Society of America • Society for Ecological Restoration • Society for Freshwater Science • Society of Wetland Scientists

December 12, 2017

The Honorable Scott Pruitt
Administrator
U.S. Environmental Protection Agency
Office of Policy Regulatory Reform
Mail Code 1803A
1200 Pennsylvania Ave NW
Washington, DC 20460

The Honorable Ryan Fisher
Acting Assistant Secretary of the Army for Civil Works
Office of the Assistant Secretary of the Army for Civil Works
Department of the Army
104 Army Pentagon
Washington, DC 20310–0104

RE: DOCKET ID NO. EPA-HQ-OW-2017-0644; FRL-9970-57-OW;
DEFINITION OF "WATERS OF THE UNITED STATES" - ADDITION OF AN APPLICABILITY DATE TO 2015 CLEAN WATER RULE

Dear Administrator Pruitt and Mr. Fisher:

On behalf of our nearly 200,000 members, the undersigned science societies respectfully submit the following comments in response to your solicitation regarding the proposed rule, Definition of "Waters of the United States" - Addition of an Applicability Date to 2015 Clean Water Rule, EPA-HQ-OW-2017-0644, published in the Federal Register on November 22, 2017. The undersigned societies are science-based organizations with diverse areas of expertise in the ecological, hydrologic and biological sciences. Our members work in the private sector, academia, and various tribal, state and federal agencies. We support wetland and aquatic resource research, education, restoration and sustainable management, and foster sound science. Thus, we promote science-based policy-making for the benefit of aquatic resources and the goods and services these resources supply in support of the health and economy of local communities.

We strongly oppose the proposed rule, Definition of "Waters of the United States" - Addition of an Applicability Date to 2015 Clean Water Rule. The Clean Water Rule became effective on August 28, 2015, and the proposal to add an "applicability date" would effectively suspend the Clean Water Rule for two years from the date of final action on the proposal. In *Clean Air Council v. Pruitt*, the U.S. Court of Appeals for the D.C. Circuit recently stated that an order delaying a rule's effective date is "tantamount to amending or revoking a rule." 862 F.3d 1, 6 (D.C. Cir. 2017). Thus, the EPA and Army Corps of Engineers' most recent proposal is an attempt to amend the Clean Water Rule. Accordingly, we renew our earlier objections to the agencies' proposed rulemakings[1]: **any agency action concerning "Waters of the United States" (WOTUS)—including the effective suspension of the Clean Water Rule—must be supported by peer-reviewed science and a valid economic analysis.** The proposed rule to add an "applicability date" to the Clean Water Rule currently lacks any such support.

[1] See comments submitted by the undersigned societies on November 20, 2017, regarding the proposed rule, Definition of "Waters of the United States" - Pre-proposal Outreach Comments, EPA-HQ-OW-2017-0480, and comments submitted by the undersigned societies on September 21, 2017, regarding the proposed rule, Definition of "Waters of the United States" - Recodification of Pre-existing Rules, EPA-HQ-OW-2017-0203.

We fully support the definition of WOTUS in the 2015 Clean Water Rule, which was overwhelmingly supported by peer-reviewed science, underwent an extensive stakeholder process, and provides greater certainty, consistency, clarity, and stability of regulation than previous WOTUS definitions. We oppose[2] the proposed rule to rescind the definition of WOTUS as promulgated in the 2015 Clean Water Rule because the proposed rule to rescind is unsupported by the peer-reviewed science, and because the critical analysis that supported the 2015 Clean Water Rule has not been subjected to rigorous independent peer review, has not undergone a robust public comment process, and poses a significant threat to the integrity and security of our drinking water, public health, fisheries and wildlife habitat. Further, we vehemently object[3] to a definition of WOTUS based on Justice Antonin Scalia's plurality opinion in *Rapanos v. United States*, 547 U.S. 715 (2006), which would make it impossible to achieve the objective of the Clean Water Act and is unreasonable in light of the scientific literature and current knowledge. The agencies should reaffirm the existing 2015 Clean Water Rule, or develop a WOTUS definition and associated revised rule that is as scientifically, legally, economically and ecologically robust as the 2015 Clean Water Rule.

We support the 2015 Clean Water Rule's definition of WOTUS, and we urge the EPA and the Army Corps of Engineers not to add an "applicability date" to the Clean Water Rule as proposed in the most recent rulemaking. Such agency action effectively amends the Clean Water Rule and thus, must be supported by peer-reviewed science and a valid economic analysis.

Sincerely,

Douglas J. Austen, Executive Director
American Fisheries Society

Robert Gropp, Ph.D., Co-Executive Director
American Institute for Biological Sciences

Linda Duguay, President
Association for the Sciences of Limnology and Oceanography

Robert R. Twilley, President
Coastal and Estuarine Research Federation

Katherine S. McCarter, Executive Director
Ecological Society of America

Heidi Dunn, President
Freshwater Mollusk Conservation Society

Erin Dunlop, President
International Association for Great Lakes Research

Frank X. Browne, President
North American Lake Management Society

Timothy A. Nelson, President
Phycological Society of America

Bethanie Walder, Executive Director
Society for Ecological Restoration

Colden Baxter, President
Society for Freshwater Science

Arnold van der Valk, President
Society of Wetland Scientists

[2] We incorporate by reference the comments submitted by the undersigned societies on September 21, 2017, regarding the proposed rule, Definition of "Waters of the United States" - Recodification of Pre-existing Rules, EPA-HQ-OW-2017-0203.

[3] We incorporate by reference the comments submitted by the undersigned societies on November 20, 2017, regarding the proposed rule, Definition of "Waters of the United States" - Pre-proposal Outreach Comments, EPA-HQ-OW-2017-0480.

Take Full Advantage of Your Membership Through SWS' Monthly Webinar Series

Participate in outstanding educational opportunities without leaving your desk! SWS is pleased to provide its webinar series that addresses a variety of wetland topics. 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.

We are proud to announce that our webinars are now pre-approved by the SWS Professional Certification Program. Webinar registration is a complimentary member benefit. Certificates of completion are available upon request and can be used towards PWS certification. 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.

Webinars are now viewable with subtitles on YouTube! The Webinar Committee is excited to announce that our free webinar recordings are now available on the SWS YouTube channel. SWS supporters around the world can watch the webinars with subtitles in their native language. To view the webinars with subtitles, click the "CC" button in the bottom, right-hand corner of the video. You can change the language of the subtitles by clicking on the settings button in the bottom, right-hand corner and going to subtitles/CC > auto-translate > and choosing the language of your choice. Attend a webinar with subtitles: http://sws.ontrapages.com/youtuberegistration. ■

MORE INFORMATION ABOUT UPCOMING WEBINARS:
www.sws.org
>Events >Upcoming Webinars

MISSED A WEBINAR?
View webinar archives at:
www.sws.org
>Events >Past Webinars

Don't Miss the March Webinar!

The March webinar, ***Livestock grazing affects microbial activity at different soil depths via the groundwater level with potential implications for carbon sequestration,*** will be presented by Dr. Kai Jensen, University of Hamburg and Amr Keshta, Ph.D. candidate, University of Maryland. Amr Keshta was SWS's first Wetland Ambassador and will be summarizing some of the work he did during his Fellowship.

At the coastal marshes of the Wadden Sea (Germany), livestock grazing has been practiced for centuries. It is, however, unclear how grazing affects ecosystem services and functions. Livestock grazing in salt marshes might have a negative or positive impact on soil Carbon stocks based on the grazing history and the management practices.

This webinar is open to the public, so invite your friends! The webinar will be held on **Thursday, March 15, 2018, at 1:00 p.m. EDT**. More information. ■

South Central Chapter Activities

Contributed by Amber Robinson, Jodie Murray Burns, and Scott Jecker

The South Central Chapter continues to offer courses/training/tours to promote the Society, wetland science/practice, and generate revenue for the chapter.

ANNUAL CHAPTER MEETING

The South Central Chapter annual meeting will be held in Little Rock, Arkansas October 10-12, 2018.

CAREER AWARENESS - NOVEMBER 2017

The South Central Chapter's Arkansas Education and Outreach Coordinator, Jodie Murray Burns, participated in a career awareness event at the Creekside Middle School in Bentonville, Arkansas, this past November 2017. Approximately 550 total attended the school event which included about 200 middle school students. Sixty students entered the booth's free t-shirt and book bag drawings by answering 3 questions from the booth display - one each on wetlands, environmental regulations and endangered species.

Ms. Burns had a great time talking to the parents and students about wetlands and related environmental topics. She says, "If anyone else sees an opportunity to speak in your schools during a career awareness event or something similar, I highly recommend it. You can actually get quite a bit of teaching in your presentations about the value of wetlands and awareness about environmental laws to a wide range of ages."

ATCHAFALAYA BASIN SWAMP TOUR IN HENDERSON, LOUISIANA – COMING IN SPRING (APRIL/MAY) OF 2018

At 1.4 million acres in size – an area bigger than the State of Delaware, the Atchafalaya Swamp is an unmatched wonder of America, filled with majestic cypress swamps and an incredible diversity of birds, fish, and reptiles that inhabit its skies and waterways. Located between Lafayette and Baton Rouge, the Atchafalaya Swamp has come to symbolize life in Louisiana that must be protected and preserved. In the Spring of 2018, the South Central Chapter will host a 90 minute swamp tour through the mysterious swamps of the Atchafalaya Basin to educate participants on its rich diversity and unique wetland habitat. Participants are sure to catch a glimpse of the once endangered American alligator and an assortment of migratory bird species during the excursion. Allon y'all!

BIRDING TOUR – LAKE MARTIN ROOKERY, LOUISIANA – APRIL 1, 2017

On April 1st, 2017 members of the SWS-South Central Chapter enjoyed a morning of birding at the Lake Martin Rookery located near Lafayette, Louisiana. Led by expert birder Walker Wilson, the group learned to identify bird species by call and sight. With scopes and binoculars in hand, the birders viewed egrets, roseate spoonbills, herons, and songbirds tending to their nests and rearing young in one of Louisiana's best bird rookeries. https://www.facebook.com/SOUTHCENTRALSWS/photos/pcb.1729723020652013/1729721423985506/?type=3&theater ■

Western Chapter 2017-2018 Events

Contributed by Russ Huddleston, Chapter President

EVENTS FROM 2017

In April 2017 the Chapter sponsored a field trip to the Jepson Prairie Preserve in Solano County. This 1566 acre preserve contains one of the best remaining examples of northern claypan vernal pools and California prairie.

We added a new Student Chapter at the Middlebury Institute for International Studies (MIIS), Monterey, California. MIIS is a graduate school within Vermont's Middlebury College (http://www.middlebury.edu/offices/administration/planning/mdata/MIIS).

The Chapter was well represented at the Annual Meeting in Puerto Rico, including presentation of numerous talks and posters from students at California State University, Long Beach, Middlebury Institute for International Studies, and Chapman University.

In October, Professor Michelle Stevens and her students from Sacramento State University held wetlands education day for Riverview Middle School Students. This annual event is funded by a grant from Pacific Gas and Electric Company that was given to SWS in support of the program. Dr. Stevens and her college students, along with PG&E and ERM volunteers led a group of 46 Riverview Middle School students through a hike along the Bay Point Regional Shoreline and provided hands-on activities to explain the science behind the wetlands.

PLANNED EVENTS FOR 2018

We have just begun the planning process for 2018 and at this point we have no definitive dates but planned activities include the following;

A Webinar with Dr. Martin C. Rabenhorst, Professor of Pedology at the University of Maryland who will be presenting on "Oxide-Coated Films - an Improved IRIS Technology to determine the presence of hydric soils."

We will be doing another Chapter-sponsored field trip to Jepson Prairie in the Spring.

We are investigating some type of joint event with the Western Section of the Wildlife Society.

In October Dr. Stevens will be doing the Bay Point Wetlands Education Program with Riverview Middle School. ■

Wetland scientists from the Western Chapter and students from the University of California, Davis exploring vernal pools at the Jepson Prairie Preserve in Solano County, California. (Photos courtesy of Russ Huddleston)

China and Asia Chapters Schedule Joint Meeting in 2018

The 2018 SWS - China Chapter and Asia Chapter Joint Meeting: Wetlands and Ecological Civilization will be held at the Comprehensive Building, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, P. R. China from August 17 to 21, 2018. The scientific program of the forum reflects the many recent advances and breakthroughs in wetland science as well as the challenges that we face in a changing world. The forum will provide a good opportunity for participants to exchange ideas, establish collaborations, and make new friends in Asia. All SWS members are invited to attend. Please visit the webpage: http://shidi2018.csp.escience.cn/dct/page/1 for details.

If you have any questions, please contact:
Wei-Ta Fang, Ph.D.
President, SWS Asia Chapter
Associate Professor, Graduate Institute of Environmental Education
National Taiwan Normal University
5F, 63-3 Hsing-An St.
Taipei, Taiwan 10416
Mobile phone: +886 939859399
E-mail: wawaf@hotmail.com; wtfang@ntnu.edu.tw ■

Get Involved with Your Local Chapter

With more than 3,000 members around the world, SWS encourages you to participate in your local chapter to get the most out of your membership. These chapters provide a local resource for networking, education and other wetland-related events.

One chapter subscription is included with your membership. You are welcome to subscribe to as many chapters as you like for a small additional fee. More information about Chapters: http://www.sws.org/Membership/chapter-membership.html ■

Upcoming chapter meetings

- **13th Europe Chapter Meeting**
  April 30 – May 4, 2018
  Ohrid, Macedonia

- **2018 Asia Chapter and China Chapter Joint Meeting: Wetlands and Ecological Civilization**
  August 17 - 21, 2018
  Changchun, P. R. China

SWS Attends the Wetland Congress in Columbia

We are excited to be steadily expanding our international reach through efforts of our members and leaders around the world!

Luisa Ricaurte, Ph.D., co-chair of the SWS International Chapter, presents at the Wetland Congress in Columbia.

SWS presented an award to Professor Wolfgang Junk, as well as three student SWS membership awards, during the Congress.

Join Us - 2018 SWS Annual Meeting

The Society of Wetland Scientists' 2018 Annual Meeting will be hosted at the Hilton Denver City Center in Denver, Colorado, May 29 - June 1, 2018.

The meeting, themed *Wetland Science: Integrating Research, Practice and Policy - An Exchange of Expertise*, will focus on the intercommunication of the most recent developments in wetland science, practice and policy between the different sectors of SWS. It will encourage collaboration and partnerships among wetland researchers, practitioners, managers and policymakers, with the overall goal of improving wetland science. Please visit swsannualmeeting.org for info about the Annual Meeting.

CALL FOR SWAMMP MENTORS

The SWS Multicultural Mentoring Program (SWaMMP) is dedicated to increasing diversity in the field of wetland science by offering undergraduate students, from underrepresented groups, full travel awards to the SWS Annual Meeting. SWaMMP is currently seeking mentors for the 2018 program to help guide student award recipients throughout meeting events and activities, including a pre-meeting orientation session on the evening of Tuesday, May 29, and a luncheon on the last day of the meeting, Friday, June 1. Because of this, mentors will be expected to attend the Annual Meeting for its complete duration.

Mentors must have a minimum of two years of graduate experience and must have attended at least two other Annual Meetings. Every effort will be made to pair the students with mentors who share similar interests, such as restoration, hydrology, etc. If you would like to volunteer to be a mentor, please contact Vanessa Lougheed (vlougheed@utep.edu), SWaMMP Coordinator, as soon as possible.

PLAN TO ATTEND!

You won't want to miss the educational presentations, workshops, field trips, and symposia, as well as the camaraderie of networking with like-minded scientists. Register today at https://www.swsannualmeeting.org/register/. We can't wait to see you in May! ■

Support the SWS Annual Meeting

SPONSOR THE MEETING

A variety of sponsorship levels are available on a first-come, first-selected basis and are sure to provide international exposure among leaders in wetland science. For more information: https://www.swsannualmeeting.org/sponsor.

Not sure which sponsorship opportunity to choose? Construct your own sponsorship package to fit your unique needs and goals. To discuss sponsorship and reserve an opportunity for your company, please contact Amanda Safa (asafa@sws.org). More info about sponsorship opportunities on the following two pages.

RESERVE EXHIBIT SPACE

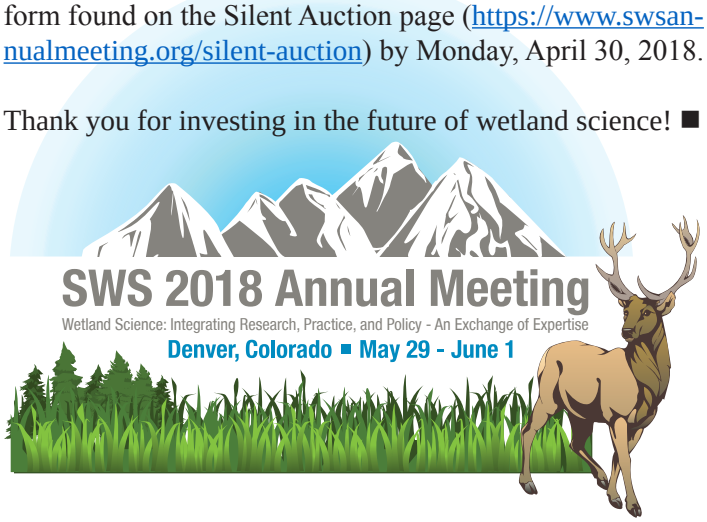
Reserve your spot to network and build professional connections with the highest level of wetland professionals at the 2018 Annual Meeting. Simply complete and return the Exhibitor Agreement to reserve your booth today! For more information visit the Exhibitors page on the meeting website (https://www.swsannualmeeting.org/exhibit). Agreements must be received by April 30, 2018. To discuss exhibiting at the 2018 SWS Annual Meeting, contact Amanda Safa (asafa@sws.org).

DONATE TO THE SILENT AUCTION

The SWS Rocky Mountain Chapter will host a silent auction during the Poster Session Reception on Thursday, May 31, 2018. All proceeds will go directly to the chapter to support future chapter initiatives, including support for students in wetland science and funding for student research.

Please indicate your interest by returning the donation form found on the Silent Auction page (https://www.swsannualmeeting.org/silent-auction) by Monday, April 30, 2018.

Thank you for investing in the future of wetland science! ■



Sponsorship Opportunities

A variety of sponsorship levels are available on a first-come, first-selected basis and are sure to provide international exposure among leaders in wetland science. Not sure which sponsorship opportunity to choose? Construct your own sponsorship package to fit your unique needs and goals.

CONTRIBUTING LEVEL — $500

Help make the SWS 2018 Annual Meeting a success by making a general contribution.

BRONZE LEVEL — $1,000

- **DAILY PLENARY SPEAKER.** The 2018 Annual Meeting will feature three highly renowned plenary speakers who will present the latest wetland research. Three opportunities available.
- **DAILY MORNING & AFTERNOON REFRESHMENTS.** Attendees will enjoy light snacks and beverages during daily morning and afternoon refreshments. Six opportunities available.

SILVER LEVEL — $2,500

- **POSTER SESSION & SILENT AUCTION.** The 2018 poster session will showcase the latest wetland research and provide an opportunity to meet with experts to learn about their scientific studies. The Rocky Mountain Chapter will also be holding a silent auction to help fund Chapter activities.
- **STUDENT MIXER.** A great opportunity for student attendees to mingle, exchange ideas and learn about opportunities for involvement in SWS.
- **ATTENDEE PEN.** Attendees will receive a meeting-themed pen in their attendee bag which will feature the sponsor's logo.

GOLD LEVEL — $5,000

- **HOTEL ROOM KEY.** All guests will receive a custom hotel key card as they check in under the SWS hotel block which will feature the sponsor's logo.
- **ATTENDEE BAG.** Meeting-branded attendee bags will be distributed to all participants containing important meeting materials. The sponsor's logo will be featured on each bag.
- **LANYARDS.** Meeting-themed lanyards will be distributed to each attendee at registration which will feature the sponsor's logo.
- **WATER BOTTLE.** Attendees will receive a meeting-themed water bottle in their attendee bag which will feature the sponsor's logo.

PLATINUM LEVEL — $7,500

- **WELCOME RECEPTION.** The 2018 Annual Meeting will kick off with a special Welcome Reception providing attendees the chance to network with friends, old and new, over hors d'oeuvres and cocktails.
- **MOBILE APP.** Attendees will be able to access the meeting program, general meeting information and session details via their smart phones and the web. The sponsor's logo will be featured on the homepage of the app.
- **WIFI.** Internet access will be available at the meeting venue. The sponsor's logo will be featured on the landing page with the option to customize the WIFI network and password.

BENEFITS OF SPONSORSHIP	$500	$1,000	$2,500	$5,000	$7,500
Logo + hyperlink featured on meeting website	★	★	★	★	★
Logo featured on onsite sponsor signage	★	★	★	★	★
Special recognition during sponsored event		★	★		★
One marketing item dropped in attendee bag			★	★	★
One complimentary registration to the SWS Annual Meeting				★	
Two complimentary registrations to the SWS Annual Meeting					★
One complimentary exhibit booth at the SWS Annual Meeting					★

**Prices in U.S. dollars.*

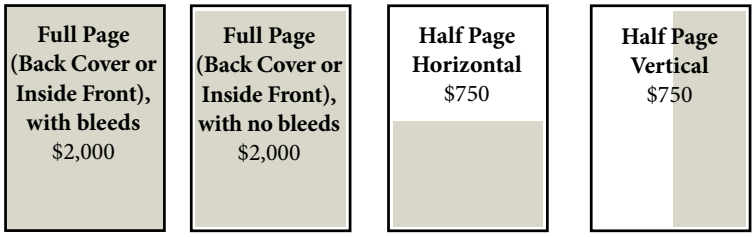
Conference Journal Advertising Opportunities

Increase your visibility at the SWS 2018 Annual Meeting by participating as an advertiser in the Conference Journal. Limited ad space available and insertion is on a first-come, first-served basis. Don't miss this special opportunity to showcase your brand to conference attendees.

SIZE OPTIONS (*prices in U.S. dollars)

Select	Size/Placement	Size	Rate
☐	Full Page (Back Cover or Inside Front Cover), with bleeds	6.5"w x 11"h + .125" bleeds	$2,000
☐	Full Page (Back Cover or Inside Front Cover), with no bleeds	6"w x 10.5"h	$2,000
☐	½-Page Horizontal *	6"w x 5.125"h	$750
☐	½-Page Vertical *	2.875"w x 10.5"h	$750

** Only eight ½-page ads will be sold.*



CONTACT AND BILLING INFO

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Phone: (incl. country + city code) _____

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Fill in this section for billing, if different from main contact:

Company name: _____

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Street address: _____

City/State/Postal code: _____

Country _____

Phone: (incl. country + city code) _____

Email: _____

☐ Advertisment attached/enclosed ☐ Advertisement arriving separately

IMPORTANT DATES

Advertising reservation deadline: March 29, 2018
Artwork submission deadline: April 5, 2018
Please send this reservation form, as well as print-ready art files, to asafa@sws.org.

SUBMISSION GUIDELINES

The advertising art file that you submit must follow these guidelines:

- .Pdf file type
- High-resolution, of at least 300 dpi
- CMYK color space
- Any bleeds need to be at least .125"

To discuss sponsorship or advertising opportunities, contact Amanda Safa, asafa@sws.org, 608-310-7855.

Stephen A. Forbes, Antecedent Wetland Ecologist?

Arnold G. van der Valk[1], Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA

ABSTRACT

Stephen A. Forbes (1844-1930) was an American entomologist/zoologist who was born, raised and largely educated in northern Illinois. He spent most of his professional career as the director of the Illinois Natural History Survey and as a faculty member and administrator at the University of Illinois. Early in his scientific career, he studied fish and bird diets by examining the stomach contents of these animals. In 1887, he published his most famous and influential paper, "The lake as a microcosm," which contains one of the earliest formulations of what came to be called the ecosystem. In this paper, Forbes describes a hypothetical isolated, small lake as being a microcosm that is in equilibrium. This equilibrium is the result of trophic interactions among the organisms in the microcosm that limit the sizes of both predator and prey populations. Forbes believed that natural selection was responsible for limiting the reproductive capacities of predators and prey. Although energy transfer among trophic levels is not the main focus of his paper, Forbes postulated that food (energy) is one of the main factors structuring ecosystems, but he did not explicitly discuss the energetics of his lake microcosm. Forbes' microcosm is based on his studies of the shallow portions of small, glacial lakes in northern Illinois that were dominated by aquatic plants. Today his microcosm would be classified as a palustrine or lacustrine wetland.

STEPHEN ALFRED FORBES

Stephen Alfred Forbes (1844-1930; Figure 1) was a major figure in the development of ecology, especially animal ecology, in the United States during the last quarter of the nineteenth and first quarter of the twentieth century (Kingsland 1985; van der Valk 2011). He was an entomologist interested in insect pests of crops and diseases of insects, but he also did research on fish and birds. He pioneered the use of stomach contents to work out food webs in both aquatic and terrestrial systems. Much of his research was done in response to crop pest issues facing farmers in Illinois. His research career started in the mid-1870s when he decided to try to solve the "Bird Question." Were birds beneficial to farmers or not? Birds ate insects that damaged crops, but birds also ate some kinds of crops, particularly grains. It was trying to answer this question that got Forbes looking at stomach contents of birds as a way to figure out what they were eating. Throughout his career Forbes advocated that ecologists should emphasize research that would benefit farmers, fishermen, hunters, etc. who ultimately supported their research (Forbes 1915, 1922).

FIGURE 1. Stephen Alfred Forbes (1844-1930). From Howard (1932).

Forbes was born, raised, and mostly educated in northern Illinois. He spent the Civil War in the Union Army fighting in southern states (Mississippi, Alabama and Tennessee). After the war, he studied medicine in Chicago, but never finished medical school. Instead he got interested in natural history

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and eventually became the curator of the Illinois State Natural History Society Museum and an instructor of zoology at Illinois State Normal University. He then helped establish the Illinois State Laboratory of Natural History and became its first director. Forbes had a distinguished career are both a researcher and administrator: Illinois State Entomologist, professor of zoology and entomology at the University of Illinois, and Dean of the College of Science at the University of Illinois. He served as president of a number of scientific societies, including the Ecological Society of America, and was elected a member of the National Academy of Sciences. For a detailed account of Forbes' life and times, see Howard (1932) and especially Croker (2001), and for an evaluation of his scientific career, Lovely (1995).

Most of his scientific publications deal with some aspect of applied entomology. During his lifetime, he published nearly 400 books and papers (see Lovely 1995), of which only 33 deal with aquatic topics, primarily fish and their foods. At first glance, Forbes does not seem to have ever studied wetlands. Not one of his aquatic papers has any term like bog, marsh or swamp, in the title. The closest that you get is an 1884 paper, "Destruction of fish food by bladderwort (*Utricularia*)." This is a half-page note describing the invertebrates found in some *Utricularia* bladders. He includes the same information in "The lake as microcosm" (Forbes 1887).

THE LAKE AS A MICROCOSM

Stephen A. Forbes is best known today as the author of "The lake as a microcosm," which was a paper he delivered to members of the Peoria Scientific Association on February 25, 1887 and that was published in the their Bulletin (Forbes 1887).[2] This talk and resulting paper are based on research that he and his colleagues conducted starting in the mid-1870s that focused on the food of Illinois fishes (Forbes 1880b). Because of its significance for the development of the ecosystem concept (Odum 1968; Hagen 1992; Golley 1993; Hansson et al. 2013), a great deal has been written about this paper (Bocking 1990; Lovely 1995; Schneider 2000; Croker 2001; and numerous papers cited by them). It is considered to be a classic paper in the history of ecology. An excerpt from it was included in Kormondy's *Readings in Ecology* (1965) in the section on The Concept of the Ecosystem. This was an early and influential compilation of the most important papers in the development of ecology. The entire 1925 reprinted version of the paper is included in Real and Brown (1991) *Foundations of Ecology: Classic Papers with Commentaries*. It is the first paper in this volume in the section called Foundational Papers.

Today, only the concluding pages of this classic paper are of general interest. In them, Forbes outlines his beliefs that the organisms in the lake microcosm are part of a *community of interest* and that predator-prey interactions have evolved so that the lake microcosm is in equilibrium. Although Forbes showed that food webs were an important link among species at different trophic levels in his idealized lake microcosm, his emphasis is not on ecosystem energetics, but on demonstrating that species interactions result in community or assemblage stability. Nevertheless, this paper is seen as a pioneering exploration of ecosystem energetics (Odum 1968; Hagen 1992; Golley 1993; Hansson et al. 2013). This is not, however, the central focus of the paper. Forbes wanted to show that the struggle for existence that Darwin proposed as a major mechanism for natural selection would result in an adjustment of reproductive rates for both predators and prey and that this would result in stable population sizes of all the components of the microcosm. The results of this balanced mortality is that primeval, natural communities or assemblages are in equilibrium, unless disrupted for some reason, especially by man. This is an idea that Forbes had previously developed in more detail in an 1880 paper, "On some interactions of organisms" (Forbes 1880a).

Forbes had also introduced his concept of a microcosm in another paper published in 1880: "The food of fishes" (Forbes 1880b). "For a clear conception of the general and intricate interdependence of the different forms of organic life upon the earth, one can not [sic] do better than to study thoroughly the life of a permanent body of fresh water, -- a river or smaller stream, or better then these, a lake. The animals of such a body of water are, as a whole, curiously *isolated*, -- closely related among themselves in all their interests, but so far independent of the life of the land about them that if every terrestrial plant and animal were annihilated it would doubtless be long before the general multitude of the inhabitants of the lake or stream would feel the effects of this event in any important way." (Forbes 1880b, p. 19). "Consequently, one finds in a single body of water a far more complete and independent equilibrium of organic life and activity than in any equal body of land. It forms a little world within itself, -- a microcosm within which all the elemental forces are at work and the play of life goes on in full, but on a small scale as to bring it easily within the mental grasp." (Forbes 1880b, p. 19). "Nowhere can one see more clearly illustrated what may be called the *sensibility* of such an organic complex, -- expressed by the fact that whatever affects any species belonging to it, must speedily have its influence of some sort upon the whole assemblage." (Forbes 1880b, p. 19). These quotes are from Forbes' earlier papers on the "The food of fishes." Virtually

2 He also gave this talk as a commencement address at the University of Indiana that same year (Croker 2001).

the same arguments and language are used to justify why a lake is an ideal system for examining what is responsible for the stability of natural (organic) assemblages in "The lake as a microcosm." In fact, in "The lake as a microcosm" Forbes was recycling much of what he had already published in 1880 in "The food of fishes" and "On some interactions of organisms."

In both his 1880b and 1887 papers, Forbes never adequately defines what he means by a microcosm. It seems to be just an isolated piece or part of the natural world with clear boundaries that is isolated from the rest of nature. Because such situations are rare, as Forbes himself makes clear, this makes it a concept of rather limited utility. If most of the world cannot be easily divided into different microcosms, including all terrestrial communities and most other aquatic communities, how do these non-microcosms differ from microcosms? Forbes in "The lake as a microcosm" seems to be explaining the exception, not the rule. Nevertheless, Forbes does stress that all pieces or parts of nature need to be studied as a unit, and this became a central tenet in ecology (Croker 2001).

Exactly what kind of lakes did Forbes have in mind? Forbes is very specific about the answer to this question. In the "The lake as a microcosm" Forbes describes in considerable detail the small lakes of northern Illinois and their flora and fauna that he used as the basis for his idealized lake microcosm. Forbes (1887) distinguishes two broad classes of small lakes, which he refers to as "fluviatile" lakes, i.e., those associated with rivers and their floodplains, and "water-shed" [sic] lakes, i.e., those small lakes not associated with rivers.

Forbes describes fluviatile lakes as highly dynamic because they are regularly flooded by overflowing rivers. "Enough has been said to illustrate the general idea that the life of waters subject to periodical expansions of considerable duration, is peculiarly unstable and fluctuating; -- that each species swings, pendulum-like, but irregularly, between a highest and a lowest point, and that this fluctuation affects the different classes successively, in the order of their dependence upon each other for food." (p. 539; *note that all page numbers that follow are for the 1925 reprint of the 1887 paper*). Forbes then switches to water-shed lakes, which according to him are the much more stable lakes.

Water-shed lakes in northern Illinois are found on "a nearly level plateau with slight irregularities of the surface, many of these will probably be imperfectly drained and the accumulating water will form either marshes or lakes, according to the depth of the depression." (p. 539). These

FIGURE 2. Postcard of Fox Lake, circa 1910. Reprinted with the permission of the Lake County Forest Preserve Dunn Museum.

lakes were glacial in origin and formed in depressions in glacial till. Forbes used his studies of specific lakes (Fox, Long, Cedar, and Deep) in northeastern Illinois (Lake County) and nearby Geneva Lake in southeastern Wisconsin to develop his ideal lake microcosm. The field work on these lakes was done between 1880 and 1882 (Croker 2001). These lakes, as described by Forbes (1887), are small, but they do differ in size and depth. Most of them have "marshy" vegetation along the margins and their basins generally were not very deep, although they usually had one or more deeper spots. For example, the northern and eastern basins of Fox Lake (Figures 2 and 3) "were visibly shallow – covered with weeds and feeding waterfowl…" (p. 541). Forbes' estimate that most of the lake is less than 2 fathoms deep (ca. 3.6 m), but he did find a small deep area of 5 fathoms (9 m). Most of the other lakes had comparable deep areas: 11.5 m for Long Lake; 8.3 m for Cedar Lake (much of the lake, however, was much shallower and "full of water plants"); 9.5 m for Deep Lake; while Geneva Lake was the exception at 41 m.

Forbes spends most the paper describing the vegetation and animal communities of these small lakes. "… so clogged with weeds that a boat can scarcely be pushed through the mass; when, lifting a handful of the latter he finds them covered with shells and alive with small crustaceans; and then, dragging a towing net for few minutes, finds it lined with myriads of diatoms and other microscopic Algae, and with multitudes of Entomostraca [an old term for some orders of Crustacea], he is likely to infer that these waters are everywhere swarming with life." (p. 542). He goes on to describe the vegetation and its associated fish fauna in more detail. "Among the weeds and the lily-pads upon the shallows and around the margins, the *Potamogeton*, *Myriophyllum*, *Ceratophyllum*, *Anacharis* and *Chara*, and the common *Nelumbium* [*Nelumbo*, Figure 3] – among these fishes chiefly swim and lurk, by far the commonest being barbaric bream or "pumpkin seed" of northern Illinois, splendid with its green and scarlet and purple and orange. Little less abundant is the common perch (*Perca lutea*), in the larger lakes – in the largest outnumbering bream itself." (p. 542). There were also game fish, including black or large-mouth bass (most common), pickerel, gar, and dog fish. He notes that the fish fauna of these small lakes is very different from that of Lake Michigan ("burbot, white fish, trout, lake herring or cisco, etc.)" (p. 543). The water in these small, shallow lakes is much too warm in the summer to support the cold-water fish found in Lake Michigan. The invertebrate fauna (bivalves, insects, worms, Crusta-

FIGURE 3. Postcard of an American lotus (Nelumbo lutea Willd.) bed in Fox Lake in the early twentieth century. Reprinted with the permission of the Lake County Forest Preserve Dunn Museum.

cea, and Entomostraca, primarily cladocera, ostracods, and copepods) of small lakes is also described and sometimes compared with the invertebrate fauna of Lake Michigan, which Forbes had also studied (Forbes 1882).

Forbes notes that "The system, of aquatic animal life rests essentially upon the vegetable world, although perhaps less strictly than does the terrestrial system, and in a large and deep lake vegetation is much less abundant than in a narrower and shallower one, not only relatively to the amount of water but also to the area of the bottom. From this deficiency of plant life results a deficiency of food for Entomostraca, whether of algae, of Protozoa, or of higher forms, and hence, of course, a smaller number of the Entomostraca themselves, and these with more slender bodies, suitable for more rapid locomotion and wider range." (p.546). Forbes' pioneering work on food of fishes (Forbes 1880b) had demonstrated that Entomostraca are a key component of lake food chains for fish, especially young fish, of nearly all species. "…the marshes and shallower lakes are the favorite breeding grounds of fishes, which migrate to them in spawning time if possible, and it is from the Entomostraca found here that most young fishes get their earliest food supplies …." (p. 547).

Having set the scene, Forbes then goes on to consider some of the interactions among animals in these lakes with a focus on black or large-mouth bass. The emphasis is on the food eaten by bass, especially young bass, and on bass competitors and predators. "…all our young fishes except the Catostomidae feed at first almost wholly on Entomostraca, so that the little bass finds himself at the very beginning of his life engaged in a scramble for food with all the other little fishes in the lake. In fact, not only young fishes but a multitude of other animals as well, especially insects and the larger Crustacea, feed upon these Entomostraca, so that the competitors of the bass are not confined to members of its own class. Even mollusks, while they do not directly compete with it do so indirectly, for they appropriate myriads of the microscopic forms upon which the Entomostraca largely depend for food. But the enemies of the bass do not all attack it by appropriating its food supplies, for many devour the little fish itself. A great variety of predaceous fishes, turtles, water-snakes, wading and diving birds, and even bugs of gigantic dimensions destroy it on the slightest opportunity. It is in fact hardly too much to say that fishes which reach maturity are relatively as rare as centenarians among human kind." (p. 548).

Not only are other fish species and other animals competitors of the bass for Entomostraca, but so are some plants. "As an illustration of the remote and unsuspected rivalries which reveal themselves on a careful study of such a situation, we may take the relations of fishes to the bladderwort-—a flowering plant which fills many acres of the water in the shallow lakes of northern Illinois. Upon the leaves of this species are found little bladders—several hundred to each plant—which when closely examined are seen to be tiny traps for the capture of Entomostraca and other minute animals. The plant usually has no roots, but lives entirely upon the animal food obtained through these little bladders." (p. 548). Forbes then goes on to discuss the results of his studies of the content of *Utricularia* bladders: they contained mostly Entomostraca.

Finally, in the last two pages Forbes gets to the take-home messages of his paper. (1) Natural assemblages like his lake microcosm are in equilibrium. "Perhaps no phenomenon of life in such a situation is more remarkable than the steady balance of organic nature, which holds each species within the limits of a uniform average number, year after year, although each one is always doing its best to break across boundaries on every side. The reproductive rate is usually enormous and the struggle for existence is correspondingly severe. Every animal within these bounds has its enemies, and Nature seems to have taxed her skill and ingenuity to the utmost to furnish these enemies with contrivances for the destruction of their prey in myriads. For every defensive device with which she has armed an animal, she has invented a still more effective apparatus of destruction and bestowed it upon some foe, thus striving with unending pertinacity to outwit herself; and yet life does not perish in the lake, nor even oscillate to any considerable degree, but on the contrary the little community secluded here is as prosperous as if its state were one of profound and perpetual peace. Although every species has to fight its way inch by inch from the egg to maturity, yet no species is exterminated, but each is maintained at a regular average number which we shall find good reason to believe is the greatest for which there is, year after year, a sufficient supply of food." (p. 549).

Forbes continues "It is a self-evident proposition that a species can not [sic] maintain itself continuously, year after year, unless its birth-rate at least equals its death-rate. If it is preyed upon by another species, it must produce regularly an excess of individuals for destruction, or else it must certainly dwindle and disappear. On the other hand, the dependent species evidently must not appropriate, on an average, any more than the surplus and excess of individuals upon which it preys, for if it does so it will continuously diminish its own food supply, and thus indirectly but surely exterminate itself. The interests of both parties will therefore be best served by an adjustment of their respective rates of multiplication such that the species devoured shall furnish an excess of numbers to supply the wants of the devourer, and that the latter shall confine its appropriations

to the excess thus furnished. We thus see that there is really a close community of interest between these two seemingly deadly foes." (p. 549).

(2) Natural selection is the mechanism responsible for the equilibrium of natural assemblages as exemplified by small lakes. "And next we note that this common interest is promoted by the process of natural selection; for it is the great office of this process to eliminate the unfit. If two species standing to each other in the relation of hunter and prey are or become badly adjusted in respect to their rates of increase, so that the one preyed upon is kept very far below the normal number which might find food, even if they do not presently obliterate each other the pair are placed at a disadvantage in the battle for life, and must suffer accordingly. Just as certainly as the thrifty business man who lives within his income will finally dispossess his shiftless competitor who can never pay his debts, the well-adjusted aquatic animal will in time crowd out its poorly-adjusted competitors for food and for the various goods of life. Consequently we may believe that in the long run and as a general rule those species which have survived, are those which have reached a fairly close adjustment in this particular.' (pp. 549-550).

Forbes summarizes his discussion about the equilibrium that he thinks characterizes natural assemblages: "Two ideas are thus seen to be sufficient to explain the order evolved from this seeming chaos; the first that of a general community of interests among all the classes of organic beings here assembled, and the second that of the beneficent power of natural selection which compels such adjustments of the rates of destruction and of multiplication of the various species as shall best promote this common interest." (p. 550).

Forbes was not the first early ecologist to postulate that natural, undisturbed communities or assemblages are in equilibrium because of interactions among their component species. Earlier Möbius had come to a similar conclusion based on his studies of oyster beds (van der Valk 2017). Many historians of ecology have pointed out the similarity of the Forbes' lake microcosm and Möbius biocönose (e.g., Bocking 1990; Lovely 1995; Croker 2001; van der Valk 2011). Möbius published his paper on oyster beds in 1877 and an English translation was published in 1883 (Rice 1983) in a fisheries publication that Forbes was known to read. Forbes, however, had developed his basic ideas about the stability of natural assemblages by 1880 in a paper entitled "On some interactions of organisms" (Forbes 1880a). In fact, he points to this earlier paper for a "fuller statement" about his position in the 1925 version of "The lake as a microcosm." How much Forbes' thinking was influenced by Möbius will probably never be known for certain (Lovely 1995; Croker 2001). Forbes does not cite Möbius in his 1887 paper or in the 1925 reprint of it or in any of his earlier publications like "The food of fishes" (Forbes 1880b). The idea that natural assemblages were inherently stable, the balance of nature as it was called at that time, was common in the nineteenth century among naturalists and early ecologists (Egerton 1973). It is not surprising that Forbes and Möbius held similar views. It should be noted, however, they believed that very different mechanisms were responsible for assemblages being in equilibrium. Forbes held that it was mechanisms regulating food supplies while Möbius emphasized competition for space. Forbes, however, made a more compelling and detailed case for his view that primeval, natural assemblages are in equilibrium as a result of trophic interactions in his 1880 paper "On some interactions of organisms" (Forbes 1880a). Ironically, this paper is largely forgotten today.

LAKES OR WETLANDS?

It is clear from reading Forbes' papers that the small "lakes" on which he modeled his idealized "microcosm" were really wetlands as defined by Cowardin et al. (1979). Based on his descriptions of them (mostly shallow, dominated by aquatic plants; see Figures 2 and 3) and their fauna, they were either large palustrine wetlands or in some cases wide lacustrine wetlands associated with small lakes. In fact, most large palustrine wetlands in the Upper Midwest are called lakes. There was no other term to describe them during the nineteenth century when this area was first settled.

Forbs seems to have been attracted to these wetlands because of their obvious high production of both plants and animals. His brief descriptions of deep water areas in lakes are mostly negative in tone: "singularly barren of both plant and animal life" and "as simple and scanty as … a desert" (Forbes 1925, p. 542). The fluviatile lakes, undoubtedly also wetlands, are too prone to disturbances, which disrupt the "harmony of interactions among organic groups" (Forbes 1880a, p. 5). The lake microcosm for Forbes seems to represent a glimpse into the primeval condition of the natural world that is free from human disturbances. It "presents a settled harmony of interaction among organic groups which is in strong contrast with the many serious maladjustments of plants and animals found in countries occupied by man." (Forbes 1880a, p. 5). Because these wetlands are well delimited and highly isolated systems with clear boundaries like giant fishbowls or wading pools full of "organic life," Forbes finds it easier to comprehend their overall organization and workings.

It is the aquatic plants in these wetlands which give them a three-dimensional structure that seems to make

them attractive to Forbes. The structure created by this dense vegetation made it easier for him to envision the various food webs and the interactions among the animals that affect a specific organism in a food web. The aquatic plants also made these lakes appear to be more stable. In larger and deeper lakes not dominated by aquatic plants, a variety of currents continuously alters the distribution and abundance of organisms at a variety of time scales. The food webs of Forbes' wetlands are static, rather than dynamic. Forbes ignores seasonal and interannual changes in them. This makes it easier to comprehend and describe their food webs. At the time that the paper was written, Forbes and his colleagues had only sampled small Illinois lakes for a couple of years and only in October. This may go a long way to explain why Forbes believed these wetlands to be such stable entities.

Although Forbes did not realize it, he was studying the food webs of wetlands, which he viewed as being in some kind of primeval conditions and as yet unaffected by man. This was not true of the uplands of northern Illinois which in Forbes' time had been largely converted to farmland. Forbes thus was an antecedent wetland ecologist, a scientist whose work was influential in the development of wetland ecology, but who did not consider himself to be a wetland ecologists (van der Valk 2017). The same features of wetlands (isolation, high productivity, and stability) that attracted Forbes to wetlands seem also to have played a role in later studies of ecosystem energetics. Forbes never quantified food (energy) flows within wetlands from trophic level to trophic level. This would be done by the next generation of ecologists working in wetlands: Raymond Lindeman (1942) at Cedar Creek Bog, Minnesota, and Howard Odum (1957) at Silver Springs, Florida. Starting with Forbes, wetlands have played a major role in the development of ecosystem ecology. ■

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Principles of Wetland Creation and Restoration: Reflections

Part 1: Introduction and Case Study #1 - Wyandot Project

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Through working for over 40 years as an applied wetland scientist on various projects for the U.S. Department of Agriculture, U.S. Army Corps of Engineers, U.S. Air Force, and for the private sector, I have learned much about wetland construction and restoration and wish to share some of my experiences with others through a series of articles in *Wetland Science & Practice*. This is the first of the series which addresses basic elements of planning and design and presents the first of five case studies of wetland construction projects. The series highlights key aspects of project planning and uses the case studies to show real world results. It is not intended to be a how-to treatise but hopefully provides readers with perspective on the challenges involved in this practice.

EARLY WETLAND CREATION AND RESTORATION PROJECTS

Wetland science has evolved during my career that began in the 1970s. Early efforts to create wetlands focused on impoundment and pond construction for agricultural purposes or waterfowl habitat as exemplified by the USDA's Water Bank Program and by the US Fish and Wildlife Service and state wildlife agencies. These projects involved diking of coastal and inland wetlands to create impoundments or building ponds and potholes through various means. In the late 1970s and early 1980s, I planned, designed and installed a number of projects that intentionally created "wetland components" in backwater and littoral fringe areas of man-made ponds with intent to function as transitional habitat for waterfowl, amphibians, fish, songbirds, and game and non-game mammals. Around 1988, I was asked to design and construct a replacement wetland to compensate for wetland impacts occurring on a project site in central Pennsylvania. Given my training and work on soil surveys, I first looked at soil surveys and chose a suitable place on the landscape that would likely receive sufficient hydrology to sustain the wetland. The target wetland type would be a very shallow USDA pond dominated by emergent vegetation. This was the common wetland creation approach by USDA and was also promoted by Donald A. Hammer in his 1992 publication - *Creating Freshwater Wetlands* (Hammer 1992, 1996).

FROM WATERFOWL IMPOUNDMENTS AND FARM PONDS TO VEGETATED WETLANDS

As wetland regulations expanded across the country[2] and mitigation to compensate for permitted losses became standard practice, "wetlands" became a focus for research and a recognized science and field of study for college students. Wetland mitigation has included wetland restoration, enhancement, and creation as well as monetary compensation and strengthening protection of existing wetlands through acquisition or perpetual easements. See *Compensating for Wetland Losses under the Clean Water Act* (Zedler et al. 2001) for details.

For mitigation, creation of in-kind wetlands (e.g., loss of forested wetland with a created forested wetland) began to receive more attention than creating a waterfowl or farm pond – a permanent or nearly permanent water body. This type of wetland creation required more analysis than simply excavating to a depth below the existing water table at a site or holding back water through in-stream impoundments, or impounding existing wetlands. For these new initiatives, knowledge of the temporal fluctuations of water levels and water tables and vegetative responses to such dynamics became essential in designing wetland creation and restoration projects.

THE IMPORTANCE OF HYDROGRAPHS

In the early 1990s, after numerous discussions with other wetland restoration/creation practitioners, I learned how to calculate and prepare site hydrographs from which the depth, duration, and timing of water pulses into and through a site could be predicted before a wetland was built. A "hydrograph" is a graphic representation of the current hydroperiod of a wetland, or the potential hydroperiod that might be achieved for a candidate site (see Chapter 2 in Tiner 2015 for examples for the diversity of wetlands found across the U.S.). Hydrographs are generally prepared to show variations of water volume available monthly and volumes that are likely to be retained or held within the wetland each month after losses due to evapotranspiration, infiltration, and outflow of surplus water are accounted

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2 Wetland regulations played a major role in advancing wetland science especially in the areas of wetland identification and mitigation through research at the U.S. Army Corps of Engineers Waterways Experiment Station or funded by the Corps.

for. The typical hydrograph generated for wetland creation projects covers a 12-month temporal span, usually on a calendar year basis. However, the temporal span may be compressed or expanded depending on the needs of the individual application, perhaps covering just the typical growing season months, or expanding the temporal span to cover preceding and following years. The effect of calculating monthly volumes is to tamp down the "noise and scatter" that is often associated with attempting to plot individual storm events (that cannot be predicted with absolute accuracy for future years), or the effect of intense consecutive daily temperature anomalies that can skew attempts to quantify evapotranspiration losses. The resulting hydrograph generated in this assessment process allows a designer to see general trends that tend to repeat over successive years with similar patterns of precipitation and temperature variations. This allows the designer to anticipate site hydrology and devise means to mimic the conditions of the desired wetland type.

For comparison, "naturally occurring" wetlands in the locale serve as "reference sites" (Brinson 1996). The morphology, vegetation, resident and migratory animals, and functions of these reference sites are then assessed to assist in the physical design of the constructed or restored wetlands.

By the mid- to late 1990s, this approach for evaluating all candidate project sites for wetland construction and/or restoration was standard practice. This protocol involved preliminary data collection and assessment in order to address a series of fundamental questions. If this first step proved to be encouraging, a more rigorous investigation of a potential project site would follow.

BASIC QUESTIONS FOR SITE SELECTION

The preliminary questions that needed to be answered in evaluating potential sites for wetland creation or restoration often include the following:

- Is this site in an appropriate landscape position to persist as a wetland?
- Where is the water that will drive the proposed wetland coming from (e.g., groundwater, runoff, direct precipitation, or recurring flooding events)?
- How much water (volume) can be expected at this site? How will we deal with surpluses?
- When will the water arrive (e.g., seasonal timing vs. storm event driven pulses)?
- How long will the water persist after the wetland is fully "charged"?
- What range of water depths will be needed to promote the desired suites of vegetation (species zonation) and thereby the wetland appearance and functions? Can the depths be adjusted through grading, elevation changes, simple outlet/inlet weir placement, or not?
- How will water depths and persistence affect vegetation zonation and diversity? Can we predict the appearance (i.e., form, vegetation cover types, and species composition) of the wetland over time?
- What functions do we want the wetland to perform in 10 years, in 50 years?
- What are the soil properties within the project area (e.g., textures, coarse fragment content, relative homogeneity, aquitards, and hydraulic conductivity)? Can the soils be managed to accommodate the proposed use?
- Are surrounding land uses compatible with or potentially beneficial to the project area? Are surrounding land uses detrimental?
- Are there any encumbrances to the potential conversion to wetlands (e.g., public perceptions, potential hazards, existing covenants, deed restrictions, easements, and agreements)?

After considering these questions, a particular site would only be pursued further if the answers proved to support the potential for the site to be converted to functioning wetlands. Ancillary functional assessment techniques might also be applied as needed (e.g., WET II [Adamus et al. 1987], ORAM [Mack 2001], and HGM [Smith et al. 1995]).

LEARNING FROM EXISTING PROJECTS

Concurrent observation of wetlands constructed by others in several early permitting scenarios circa 1983-1990, revealed that projects could "fail to thrive", or might be much less functional with excess water just as easily as they might fail without adequate hydrology (e.g., Brown and Veneman 1988; McCoy, R.W. 1992). Even the best of planting schemes, strategies for soil amendment, and post-planting irrigation efforts could not be expected to overcome an inappropriate site hydrograph (hydroperiod). By studying and then calculating the hydrographs of natural local wetlands, a preferred hydrograph for the design area could then be prepared and presented. Once sites were deemed suitable for construction or restoration, other factors could be considered such as water chemistry (including salinity), nutrient loading, climate, solar aspect, surrounding land uses, potential for disturbance and herbivory, and the origin and nature of the wetland substrate soils. This hypothesis and documented results from multiple wetland construction projects continued to be reviewed and evaluated through continuing professional education courses, white papers, symposia, meetings, and in contracted work

and writings for the U.S. Army Waterways Experiment Station. As a result, much of this information remained well out of the academic mainstream for several years after it was first applied and modified on various project sites.

Application of these fundamental approaches to planning, site selection, design/grading, construction, planting, and continued monitoring led progressively over the last four decades to much more predictable on-the-ground results and ever-increasing confidence that viable and functional wetland creation and restoration projects are entirely achievable. Despite published assertions to the contrary, several projects had already demonstrated that we have the tools and knowledge to design and predict initial outcomes on constructed wetland sites, and we can do much better than creation of manmade ponds. With resolve to share and apply available knowledge and acquired skills through seminars, professional education courses, expanded research, and careful documentation we can continue to improve and have greater confidence in our ability to achieve predictable outcomes.

WETLANDS ARE DYNAMIC ECOSYSTEMS

On occasion, an element that is overlooked by designers and the agencies charged to oversee wetland creation and restoration projects is an acknowledgement that wetlands, natural and created, are dynamic systems, and they will change over time in response to changing environmental conditions. Relatively minor or catastrophic events such as drought, disease, flooding, herbivory, infestations, landslides, fire, violent storms, petroleum or chemical spills, volcanic eruptions, adjacent land use changes (mainly urban development, road construction, land clearing, and installation of dams/dikes/levees), will generate both functional and long-term change in wetland systems. Although we may be able to predict with some degree of confidence the outcome of created or restored sites after 5 or 10 years of proactive monitoring (and often, with maintenance adjustments as necessary), we must recognize that successional development, competition, and adaptation will remain the processes by which all dynamic natural systems manage to persist and continue to function in the landscape. We cannot, therefore, figuratively expect to preserve wetland systems (natural or created) as though they might be "coated with urethane and be fixed in the landscape" forever. Rather, as living and truly functional systems, wetlands are not static. As practitioners and scientists, we must expect these unique resources to adapt and potentially to change their form and functions over time as wetland "causal factors" change (Keddy 2017). In light of predictions of climate change and recent disturbances such as massive flooding, drought, wildfires, mudslides, and melting of polar ice, we will certainly be in a position to observe, study, attempt remediation, and to document recovery and resilience or, perhaps sadly, the lack thereof on a grand scale.

In this forum, there is not sufficient opportunity to explain fully the maturation of concepts related to the importance of soils as a medium for rooting and growth of hydrophytes in constructed wetlands, nor the subtleties of carbon/nitrogen ratio, phosphorous release in newly anaerobic soil environments, carbon sequestration as a function of newly created wetland systems, the roles and importance of planting, seeding, and symbiotic soil microorganisms. Nor will I detail issues and lessons learned regarding organic amendments to wetland substrates, use of upland "topsoils" vs. borrowed "hydric" soils, expand on the techniques applied to generate site hydrographs, discuss construction nuances in great detail, or the need to design most created wetlands to be entirely "self-sustaining" (without complex water-control structures or typical dam/dike/levee structures). Rather, at the end of this series I will offer recommendations based on what I've learned.

CASE STUDIES

Five freshwater case study sites that have been followed during the course of the last four decades will be offered as documentation of the apparent effectiveness of the protocols espoused above. Hydrology sources for the case study sites vary and include overbank flooding, direct precipitation, surface water runoff, and ground water. The nuances of how the hydrographs were analyzed and balanced at each site to generate target vegetation zonation are not discussed in detail, but the preliminary site assessment questions presented above that were critical to siting, design, and construction of each project will be addressed. A set of images illustrate key aspects of the project with discussion points addressed in the captions.

CASE STUDY 1. FLOODPLAIN WETLAND RESTORATION, LITTLE TYMOCHTEE CREEK, WYANDOT COUNTY, OHIO - 1993

Location: Crawford, Wyandot County, Ohio (Figure 1).

Introduction: This site was proposed and constructed as mitigation for wetland impacts to relatively small and scattered emergent and scrub-shrub wetland inclusions occurring within farmed fields, along hedgerows, and ponded areas adjacent to existing borrow operations that would be removed as part of ongoing borrow excavation operations for a nearby residual waste landfill. Because the total wetland impact acreage was limited to under one acre, this action was permitted as a "Nationwide 26" permit action. Despite the impact areas being mostly in "upper-terrace" somewhat disturbed landscape positions (that drained down-gradient and into the adjoining floodplain and riparian corridor of Little Tymochtee Creek), a floodplain

"lower-terrace" replacement site was ultimately chosen on the opposite side of the creek from landfill operations. The permittee and the oversight regulatory agencies reached agreement that replacement functions would have significant benefit if provided within and along this same riparian corridor that abuts the landfill operations. As a result, the site chosen was considered acceptable due to its proximity to the impact wetlands and its potential to provide significant functional replacement within the same watershed (Little Tymochtee Creek, Wyandot County, Ohio).

Project Sponsors: County Environmental of Wyandot, owned at the time by Envirite Corporation of Canton, Ohio.

Project Objectives: Primary objectives of this project were to restore a floodplain wetland by creating an emergent and scrub/shrub bottomland wetland approximately 4.0-acres in size[3] within the floodplain/floodway of Little Tymochtee Creek (Figure 1). These objectives were to be accomplished through "restoration" of a drained and actively farmed floodplain field and creation of deeper water refugium areas (less than 1.0-meter-deep at maximum water depth) within the wetland footprint to mimic sloughs and isolated (oxbow) stream meanders.

Planning and Design: Initial remote sensing and field surveys completed for candidate replacement sites in the locale intentionally targeted actively farmed fields with poorly drained and/or very poorly drained soils, often referred to as *prior converted cropland*.[4] In this case, areas with poorly drained Sloan silt loam soils became the focus. It is likely that the site chosen had been a forested wetland in the distant past. The project site was situated within the floodplain and riparian corridor of Little Tymochtee Creek on the opposite side of the creek from the landfill operations (Figure 2).

To emulate and improve upon some of the habitat features associated with the impacted wetlands, it was

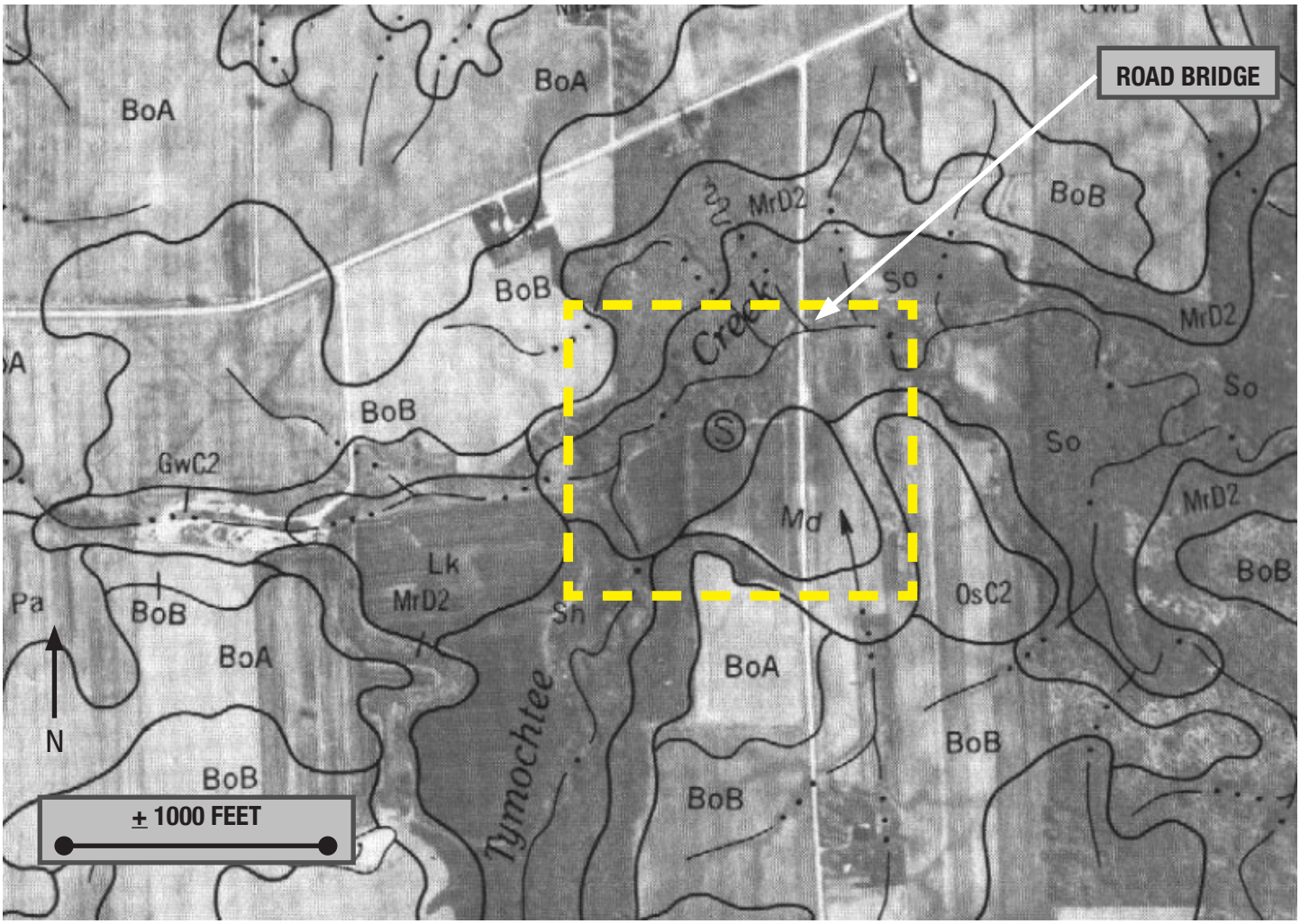
FIGURE 1. Site of wetland restoration site in Crawford, Ohio (Wyandot County).

3 The restored wetland ultimately exceeding 5-acres in size when constructed.

4 At the time of this project and still being referenced today, "prior converted cropland" is defined, by the USDA Soil Conservation Service (in Section 512.15 of the National Food Security Act Manual, August 1988), as wetlands which were both manipulated (drained or otherwise physically altered to remove excess water from the land) and cropped before December 23, 1985, to the extent that they no longer exhibited important wetland values. Specifically, prior converted cropland can be inundated for no more than 14 consecutive days during the growing season. Prior converted cropland generally does not include pothole or playa wetlands. In addition, wetlands that are seasonally flooded or ponded for 15 or more consecutive days during the growing season are not considered prior converted cropland.

the design team's intent to convert the farmed candidate site to emergent and scrub-shrub vegetation cover types within a slough-like depression that would also include forested components over time. During site selection, nearby reference wetlands were largely lacking for this model because similar areas had also been cleared, graded, drained, and farmed. When examining historic Google™ Earth images of the general area, remnant "signatures" of old cut-off meanders and oxbows in actively farmed fields and in disjunct areas surrounded by stands of trees could be seen. Based on the poorly drained soils depicted in USDA NRCS National Cooperative Soil Survey mapping, the design team expected that the candidate site would have soils acceptable for restoration. This was confirmed with an initial site visit which noticed that the field had been tile drained. Further investigation with backhoe excavations revealed clay/clay loam soil horizon(s) at a depth of about 30 inches. This layer was several inches thick, was firm in place, and nearly massive in structure. Consequently, potential for excess hydrology losses from vertical infiltration were considered to be unlikely. Further examination of the upper soil horizons showed redox features starting at shallow depths, suggesting that prior to drainage, a high water-table occurred within inches of the soil surface and likely persisted for very long duration in most years (i.e., a mollic epipedon meeting contemporary F6 and/or A12 hydric soil indicators). These data reinforced the assumption that the deeper clay layers were in fact functioning as an aquitard to perch groundwater in the upper horizons (especially when evapotranspiration losses are minimal). Furthermore, saturation and a "free" water table were noted to essentially disappear by mid-summer in nearby forested sites with similar soils. Because the water table appeared to be perched rather than connected to a regional "true"

FIGURE 2. USDA Soils Mapping circa 1980 provides the local hydrogeomorphic setting of the candidate restoration site. This mapping was used to initially screen the area for candidate sites with good potential to be either restored or converted to functioning wetlands. The scale provided is approximate. The "circled S" symbol indicates the location of the "typical pedon/profile" description for the Sloan soil series (So) recorded for the Wyandot County, Ohio National Cooperative Soil Survey (Steiger and Hendershot 1982). This symbol also marks the approximate northern limit of the constructed wetland.



water table, it was judged to be a bit too nebulous/transient to exploit as a quantifiable input from ground water in the planning process. While the 1982 Soil Survey had described the water table in Sloan soils as being "apparent," they also noted its absence later in the growing season. It was also noted that the nearby stream channel of Little Tymochtee Creek was deeply incised with base flows perhaps 8-feet below the adjacent fields. Collectively, these observations and data suggested that readily available water perched above the clay loam horizon(s) would simply be depleted by evapotranspiration (ET) in most years, especially in the forested parts of the riparian corridor. Once the free water was depleted from the upper horizons, only the confined deeper water table (below the clay substratum) would be evident in the underlying alluvium. So, doing a simple analysis of the typical precipitation distribution affecting runoff and direct precipitation landing on the site itself as inputs, minus ET losses, and assuming that infiltration losses would be limited due to the spring "perched" water table above the deeper clay/clay loam horizon(s), a simplified water budget was sketched out. A rudimentary water budget was also prepared for a somewhat disturbed forested "reference site" about a mile downstream, but this site was not an especially good model for what the design team was inclined to accomplish on the candidate site, so it was mostly discounted and not expected to be "mirrored" per se. Nevertheless, preparing the candidate site hydrograph showed that the project site would be sufficiently wet in most years to meet the Corps' minimum wetland hydrology requirements even without anticipated overbank flooding. Also, as noted above, the project site had been extensively tile-drained, and it was thought that the springtime and early-summer water table could be raised again to within several inches of the soil surface simply by removing the tile drains. Looking at water inputs minus losses (primarily losses from Thornthwaite ET calculations), the reference site and project site appeared to be very similar. It was also noted, however, that the more mature trees in the "forested reference" area would be even more aggressive in pulling water out via ET and therefore more efficient in lowering the early growing season perched water table. Considering these variables, the project also included plans to create a depressional basin that would hold early growing season hydrology and then experience drawdown in most years as ET losses would accelerate with increasing daily temperatures. The "basin" floor was designed with flat to gently sloping edges around the outer limits of the footprint with deeper linear refugium depressions (mimicking "meander scars") and higher linear mounded "raised bed" inclusions fashioned parallel to the deeper depressions (to mimic "remnant stream bank natural levees") within the wetland floor. A simple stone-lined inlet and outlet channel was placed to allow expected floodwaters to back into the site and then flow out as floodwaters recede. Vegetation zonation was expected to develop based on graded contour elevations and anticipated persistence of inundation and saturation. A softened shrub-dominated transition zone was projected to develop along the fringes of the site and on interior raised beds. Parts of the scrub-shrub cover types were expected to eventually support larger bottomland hardwood trees as were other minimally and seasonally inundated areas within the wetland footprint. A significant percentage of the deeper water emergent area and refugium depressions within the wetland floor was expected to resist colonization by tree species due to persistent shallow inundation. Originally, this site was also intended to provide an opportunity to observe and document the successional development of plant community zonation where the site was intentionally allowed to re-vegetate from natural "seed rain" imported with flooding events. Only a few modest plantings of buttonbush (*Cephalanthus occidentalis*) as cuttings were introduced to the site in the first growing season following grading and application of an erosion control seeding of annual ryegrass and oats. Targeted wildlife use emphasized wading birds, amphibians, local and migratory songbirds, and waterfowl.

Site Hydrology: Hydrology sources acknowledged in hydrograph preparation for the candidate site were direct precipitation and runoff from an 11-acre localized drainage area. A HEC-RAS[5] analysis was done for the project area and upstream watershed. The original HEC-RAS calculations were completed by a consulting engineering firm from Toledo, Ohio. Although the HEC-RAS calculations suggested occasional overbank flooding from the adjacent creek, preliminary results suggested that a single significant 24-hour storm event between a 2-year and 5-year frequency probability (approximately a 2.5-inch storm event) could be expected to generate backwater flooding from the bridge just to the north of this site. However, because these events could not necessarily be anticipated to occur annually, this source was not used in the initial assessment of site hydrology. Also, no groundwater contribution was anticipated or factored into the development of the site hydrograph calculations. As noted above, water losses through infil-

5 HEC-RAS is a software package developed by the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center headquartered in Davis, California. The acronym is short for Hydrologic Engineering Center – River Analysis System. Calculations allow users to predict flooding events and high-water elevations that might be expected in floodplain and floodway landscape settings for different storm events. At the time this project was being planned, use of the HEC-RAS calculations often required multiple cross-sections of watershed floodplains to be physically surveyed in order to project water runoff volumes onto the floodplain cross-sectional areas. HEC-RAS has been used to prepare FEMA Flood Hazard Boundary Maps.

tration were projected as being negligible early in the growing season but perhaps increasing as the water table is depleted and drops due to ET losses after July 1. The hydrographs that follow show the projected average water depths in the basin over the course of a "typical" year chosen from meteorological data available prior to 1995 (Figures 3 and 4). The hydrographs can be adjusted to vary based on the depth of maximum water storage projected for the design grading plan and the size of the wetland footprint. Neither hydrograph accounts for occasional filling of the basin by overbank flooding, but the actual occurrences of HEC-RAS anticipated overbank flooding events are noted on the post construction hydrograph with a star. Remarkably, these events were rendered somewhat inconsequential, by the fact that the wetland would have already been filled or filling from precipitation and local runoff inputs at the time the flooding was predicted.

Construction: As noted, a grading plan was prepared for the candidate site and field reference surveying benchmarks were established by the excavation contractor. The excavation contractor established a grid of grade stakes marked with cut and fill instructions for the heavy equipment operators to follow. A site "grading supervisor/foreman" was on site with surveying equipment to monitor elevations and to ensure that all tile drains were removed as the grading plan was being implemented, substrate soils were being re-applied, and the stone lined inlet/outlet was being installed. The site sponsor provided stumps and woody debris for placement following grading. Touch-up grading was accomplished after stump placement, and the floor of the site was immediately seeded with a temporary erosion control seeding of oats and annual ryegrass. Outer disturbed upland areas were limed, fertilized, seeded (permanent seed mix) and mulched. Prior to the start of the 1994 growing season, Little Tymochtee Creek experienced the equivalent of a threshold flooding event (confirmed by the HEC-RAS calculations) and the replacement wetland was inundated for several consecutive hours before floodwaters receded. This event imported significant "seed rain" of hydrophyte species from upstream areas. A few days following this flooding event, approximately 50 *Cephalanthus occidentalis* dormant cuttings were installed along the linear raised beds in late April 1994. No additional planting/seeding followed as re-vegetation of this site was left entirely to natural seed rain colonization, competition,

FIGURE 3. Predictive hydrograph prepared for the Wyandot case study site. This rendition did not incorporate HEC-RAS analysis calculations suggesting overbank flooding for storms exceeding 2.5-inches in a 24-hour timespan. This presentation shows the monthly water storage depths for the predictive hydrograph if the candidate site was perfectly flat. Actual depths planned for the wetland floor grading plans varied from 0-inches to 36-inches, averaging ±10-inches for the entire wetland footprint. Arrows indicate drawdown and recovery.

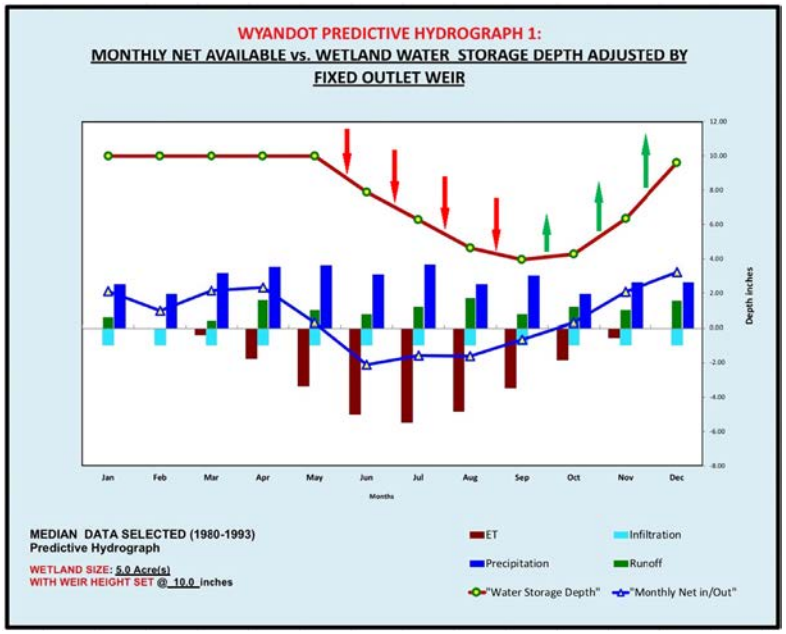
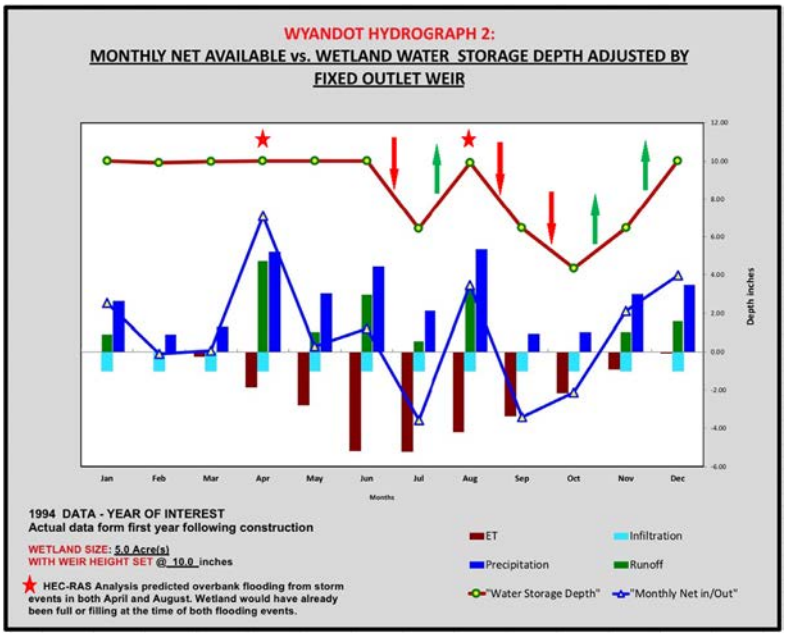


FIGURE 4. This hydrograph shows the water depth response to the actual precipitation events recorded and documented for the year immediately following construction. Ironically, two overbank flooding events predicted by the HEC-RAS analysis (illustrated by stars) occurred in this timespan, yet both events occurred either with the wetland already being "full" (April) or filling or nearly full (August). In any event, comparing the predictive hydrograph with the actual behavior of water provided by largely "unpredictable" natural events still shows the site as having adequate hydrology but also experiencing volume drawdowns driven by seasonal increases in ET losses.



and successional development. An academic researcher was sought to monitor, collect data, and report on this "natural recruitment" process, but none was found to have interest in the project.

Project Initiated: September 1993; wetland construction completed in November 1993.

Monitoring: Site monitoring was conducted intermittently during the first six years following site construction. This monitoring was required by permit conditions, but formal monitoring reports were only required at two-year intervals. Monitoring reports were required to be submitted to the USACE as a condition for issuance of the "Nationwide" permit action. The project area was released from additional monitoring requirements and was accepted as a jurisdictional wetland by the USACE on April 13, 2000. The progress of the project is detailed in the photo documentation that follows.

FIGURE 5. Reshaping and adjustment of the wetland floor to designed elevations. "Topsoil" materials were stockpiled and re-applied six to twelve inches deep to approximate the final finished elevations of the wetland floor and to act as the wetland "substrate" (the medium for plant growth and the microbial/invertebrate microbiome).

FIGURE 6. Following finish grading, stumps and other woody debris were placed to create escape cover for amphibians and singing/sentry platforms for various birds. The final task prior to onset of winter conditions was to protect the wetland from erosion. A combination of oats and annual ryegrass was seeded to provide rapid cover of the site. Effective as protective cover, these grasses did not compete with colonizing hydrophytes and soon succumbed to inundation. Yet, remnant stems and leaves acted to catch and hold "seed rain" from spring flooding in 1994 and to add detrital organic matter and nutrients to the soil substrate.

FIGURE 7. The inundated wetland floor seen at full springtime capacity in early April 1994.

FIGURE 8. Black and white aerial image of site as seen on May 5, 1995. Constructed wetland is to left of road, between the road and Little Tymochtee Creek (dashed line indicates the direction of flow of the creek).

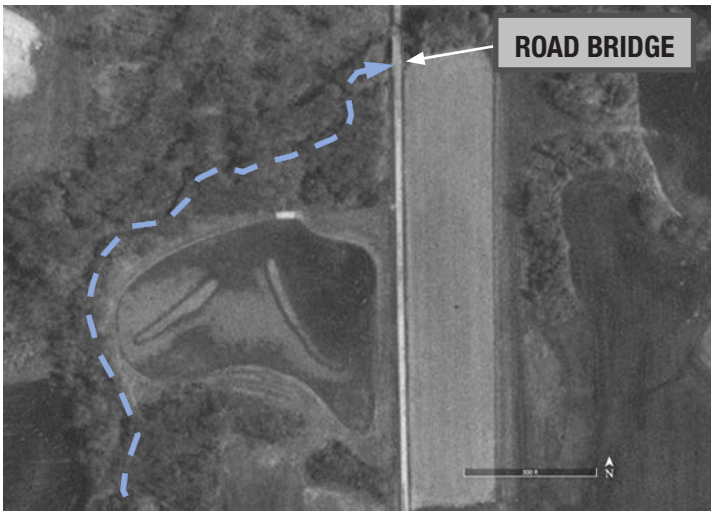


FIGURE 9. Site in July 1996. In this instance, other than the permittee, the U.S. Army Corps of Engineers was the primary reviewing "stakeholder." The Corps agreed to allow the site to vegetate primarily via "seed rain" carried in with overbank flooding from the adjacent creek. Hydrologic analysis of the watershed and runoff calculations predicted late winter or springtime flooding of this location in eight out of ten years. With the amount of potential seed rain expected, the site received only token plantings of buttonbush (*Cephalanthus occidentalis*) cuttings. The "experimental design" for the site was to allow natural succession that would be documented over several years of observation. By the end of 1996, the dominant pioneering plant species was broad-leaf cattail (*Typha latifolia*) giving the appearance of a nearly monocultural stand. Although hidden in this view, significant dense patches of water plantain (*Alisma subcordatum*), broad-leaved arrowhead (*Sagittaria latifolia*), soft-stemmed bulrush (*Schoenoplectus tabernaemontani*), and giant bur-reed (*Sparganium eurycarpum*) were also noted within the expanse of cattail.

FIGURE 10. Site in August 2007 showing a shift in emergent vegetation from 1995 to 2007. During the fall and winter of 1996, muskrats (*Ondatra zibethicus*) colonized the wetland. These animals initiated a remarkable herbivory turnover of the wetland plant cover as they systematically removed more than 95% of the cattail biomass on the site. The wetland had transitioned from an early-successional, predominantly arenchymatous plant community to a sedge meadow with shrub components by 2000. Since then, the evolution of the site has continued to the condition shown here. Silky dogwood (*Cornus amomum*), buttonbush, and arrowwood (*Viburnum dentatum*) dominate the fringes of the site with burreed and occasional patches of duck-potato dominating the shallows in spring and early summer. Smartweeds (*Persicaria hydropiperoides* and *P. amphibia*) intermingle with burreed in mid-summer and grow to cover areas where shallow open water had been expressed eariler in the spring. The development of the site remains dynamic with sapling trees (green ash *Fraxinus pensylvanica*, cottonwood *Populus deltoides*, black willow *Salix nigra*, sycamore *Platanus occidentalis*, and red maple *Acer rubrum*) scattered throughout the wetland floor and its transitional "edge".

FIGURE 11. The developing shrub and sapling tree "soft edge" (photo foreground and background) of the site as seen in August 2007.

FIGURE 12. When the site experiences typical seasonal drawdowns surface water remains only in the deeper refugium areas of the wetland floor. The water depths anticipated for this site through calculation and preparation of hydrographs mirrored (or "approximated") the observed timing of water in wet, dry, and more typical "median" years.

FIGURE 13. Extreme late growing season drawdown is not always this well expressed. Occasional heavy thunderstorms and rapid rise of the water level in the adjacent stream often keep the wetland floor inundated or saturated throughout the summer months. Amphibians abound along with green and great blue herons, various probing/wading birds, as well as an occasional bald eagle.

FIGURE 14. Mussel gametes washed in during flooding events mature to support various foraging mammals. Raccoon have been seen feeding on mussels and frogs. Mink are suspected from telltale tracks in seasonally exposed mudflats.

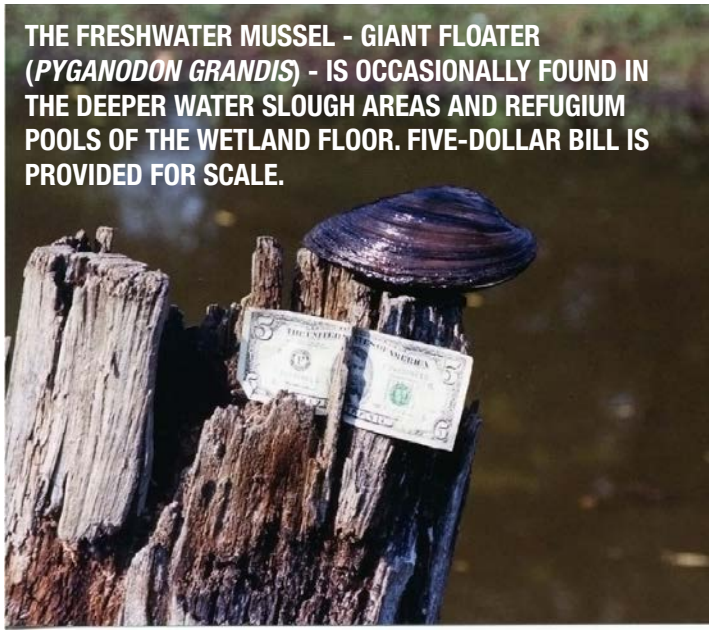
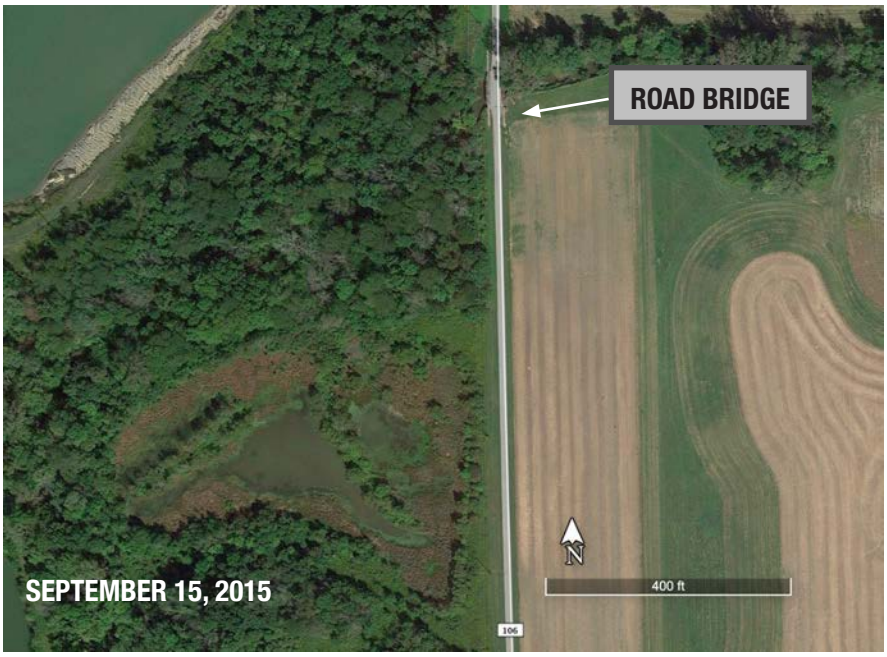


FIGURE 15. The seasonal dynamics of site vegetation dominance change throughout the growing season. Note the species and distribution in this springtime view as compared with the late season view shown in Figure 10.

FIGURE 16. September 2015 aerial image of site as seen with late season drawdown. Regardless of 25-years of progressive successional development, the site remains in a transitional stage, now moving towards 30% areal coverage by shrub and tree species. *Sparganium eurycarpum* remains as the dominant herbaceous species. Cattail colonization is still suppressed by muskrat herbivory. The wetland is clearly providing a number of significant and important physical, chemical and biological functions in its landscape setting. To a large extent, this site has been successful because it was sited in a landscape position where it was also able to profit from an anthropogenic modification. The roadway and bridge crossing of the floodway combine to alter natural "out-of-bank" flooding that would historically spread more uniformly within and along the riparian corridor floodway. The constriction of the cross-sectional flow path under the bridge in combination with the floodway damming-effect of the raised roadway, combine to create a predictable back-water flooding regime of the project area for much higher frequency storm events. These man-made stream corridor modifications were openly acknowledged and factored into the design of this site. Perhaps this approach was somewhat serendipitous with regard to what are now natural flooding regimes, but it acknowledges that roads, bridges, dams, dikes, levees and water control structures are very likely to remain in the landscape for many future generations.



Lessons Learned: Among the more important lessons learned from this project were the following.

- This project emphasized the importance of coordination with regulatory stakeholders in developing an acceptable mitigation alternative.
- This project highlighted the importance of remote sensing for initial identification of candidate sites.
- Thoroughly investigate candidate site hydrology and soils and prepare hydrographs to reinforce your assumption that the site will have adequate hydrology that is also timed to mirror the cycles apparent in other nearby wetland sites.
- Use reference sites even if they are not entirely consistent with the results you are seeking. For example, in this case the project site was planned to emulate a floodplain meander/oxbow depression. Although no such example was readily available along the reach of Little Tymochtee Creek, remnant sites that had been cleared, graded and drained for agriculture or that had simply been avoided by farmers were still available as points of reference to help project appropriate vegetation zones within the candidate site footprint.
- Prepare a detailed and properly engineered grading plan and insure that excavation and grading contours transferred to the field match those presented in the grading plans. This is facilitated by having a qualified excavation contractor who is capable of following grading plans and establishing critical elevations within the project area footprint.
- Have a plan for reestablishing and pushing vegetation in a preferred direction. This will start in nearly all cases by establishing a good erosion control seeding that will not compete with your preferred hydrophytes once site hydrology has been fully expressed. In this very unusual case study, natural seed rain, competition, herbivory, and successional development have all come together to support tiered hydrophyte-dominated cover types that are relatively free of invasive species. Despite this relative success and the ultimate form and function achieved for this site, development and implementation of an aggressive planting plan is still strongly recommended. Hydrophyte seeding can be accomplished with erosion control mixes,

but planting of cuttings, propagules, and containerized plants should occur only after or concurrent with observation of maximum site hydrology ("full" inundation of the site but not during short or longer-term flooding events).

- If intentionally placing larger stumps, logs or other woody materials in areas that are prone to flooding plan to anchor any of the larger pieces that you would prefer to keep on-site. This should be obvious, but it is sometimes overlooked and can have negative effects both on-site and in down-stream off-site properties.
- If a particular project has potential to generate an academic research paper, arrange in advance to acquire an interested principal investigator and student to support the effort. Consider modest funding to facilitate the research/data collection effort. This site had excellent potential to track and document natural successional development following "disturbance." Unfortunately, it was a missed opportunity.

ACKNOWLEDGMENTS

Many people have influenced my view of wetland creation and restoration over the years. Several people provided vital insight including Gary Pierce, Tom Straw, Mary Davis, Mary Landin, Roy Lewis, Richard Novitzki, Paul Keddy, Ralph Tiner, Ed Garbisch, Michael Rolband, Kurt Philipp, Ken Dunne, and Charles Newling. My interactions with these people and many others have helped me in understanding hydrology vital to preparing site hydrographs from which the depth, duration, and timing of water pulses into and through a site could be predicted before a wetland was built. These people have also been mentors and teachers who have individually influenced my understanding and appreciation of the nuances and subtleties of wetland and aquatic ecosystems. Through their kindness and patience they have helped me to appreciate that there is always something new to be learned. ■

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World Wetland Day and Ramsar Wetlands in the USA—Uncertainty for the Future

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Professor Emeritus of Environmental Sciences, The Ohio State University
Courtesy Professor, School of Geosciences, University of South Florida

I gave a presentation with a similar title in Ft. Myers, Florida on February 2, 2018, to celebrate World Wetlands Day, which is always on February 2. The panel I was a part of at a regional water resources conference was designed to celebrate the Ramsar Wetland Convention and describe the USA's and other countries' roles. The full presentation is posted at https://www.swfwrc.org/docs/presentations/Mitsch_180202.pdf

For a primer on the Convention on Wetlands, called the Ramsar Convention, go to www.ramsar.org.

At the end of my presentation, I described recent signs that predict a sad future for the Ramsar Convention on Wetlands in the USA and especially for ever increasing our meager number of Ramsar Wetlands of International Importance in the USA. The USA has 38 such "wetland gems" (Figures 1 and 2,Table 1) nominated and approved through a properly arduous procedure of ecological review and political approval over the last 30 years, but no new ones have been approved for the last two years. By comparison, the United Kingdom has 174 Ramsar-listed Wetlands of International Importance, Mexico has 142, and little Denmark, the size of Ohio, has 43. The USA should have 380 Ramsar sites, for goodness sake.

I concluded my presentation by summarizing a few recent situations regarding Ramsar wetlands in Florida and the USA:

1. Nationally, mostly nothing new or positive has happened with Ramsar in the USA since the new Federal administration came in place in January 2017 and in Florida a few years before that.
2. In 2016, the State of Florida blocked the nomination of Charlotte Harbor Estuary as a Ramsar Wetland of International Importance that was years in development by The Nature Conservancy. Reasons for this veto were never explicitly clarified. Reconsideration was recently announced, only to run into a recent Federal blockade (see #3 below).
3. Future USA Ramsar Wetlands of International Importance being discussed for many locations around the country, some for years, (see Figure 2 and bottom of Table 1) have been blocked by a ban on new sites imposed by the U.S. Fish & Wildlife Service in Falls Church, VA. Sites being discussed in the U.S. National Ramsar Committee (an NGO organization that supports Ramsar activities in the USA but is independent from government agencies) included the Fakahatchee Strand, Ding Darling National Wildlife Refuge, Chassahowitzka National Wildlife Refuge, and Lake Wales Restoration Wetland, all in Florida, Cedar Bog in Ohio, the Lower Wisconsin Riverway in Wisconsin, several wetland sites in Puerto Rico (which sadly has no Ramsar wetland sites), the New York Niagara River Corridor (a collaboration with Canada), Salt Plains National Wildlife Refuge in Oklahoma, Pocosin Lakes in North Carolina, and New Jersey's Pinelands.

FIGURE 1. Audubon's Corkscrew Swamp Sanctuary that became a Ramsar wetland in March 2009 (photo by W.J. Mitsch).

1 Contact: wmitsch@fgcu.edu. *Note*: The views expressed in this article are those of the author and do not necessarily reflect those of the US National Ramsar Committee.

4. The Florida Everglades remains on the Montreux List, a relatively short list of Ramsar wetlands that are seriously threatened by human or other impacts and "where changes in ecological character have occurred, are occurring or are likely to occur." It is the only USA wetland on that list. There was some discussion earlier of petitioning for the removal of the Florida Everglades from this "bad wetlands" list, but that would probably result in gigantic public opposition in south Florida, given the lack of many tangible Everglades restoration results in the last 20 years and some indications that things have gotten worse in those 20 years and might continue to unravel with sea level rise and more frequent hurricanes and coastal storms.
5. The U.S. Fish and Wildlife Service recently withdrew from any participation with the U.S. National Ramsar Committee, thereby prohibiting the USNRC from proposing any new Ramsar sites in the USA for at least four years and possibly eight. The USNRC, managed by unpaid volunteers who belong because of their love of wetlands, for its part, has made some progress in tighten its ship in the past few years and focusing on new members and few but strategic activities.

I conclude that the Ramsar Convention on Wetlands, one of the most brilliant and inclusive international efforts in conservation of important ecosystems in the world, is in trouble in the USA. It is perhaps a result of our nation's recent attempts to return to the 1950s when we were indeed on top of the democratic world and efforts to remold agencies in the Department of Interior to refrain from any international designations of our landscape that might jeopardize future economic development of fossil fuels, housing, and agricultural expansion. While the USA has already been removed from UNESCO, it is essential that we remain a player in the world's most important convention related to conservation of our waters and wildlife--the Ramsar Convention on Wetlands. ■

FIGURE 2. Location of current Ramsar Wetlands of International Importance (green dots) and sites that were being discussed by the USNRC as potential Ramsar wetlands (red dots) in the USA. See Table 1 for the names of the sites.

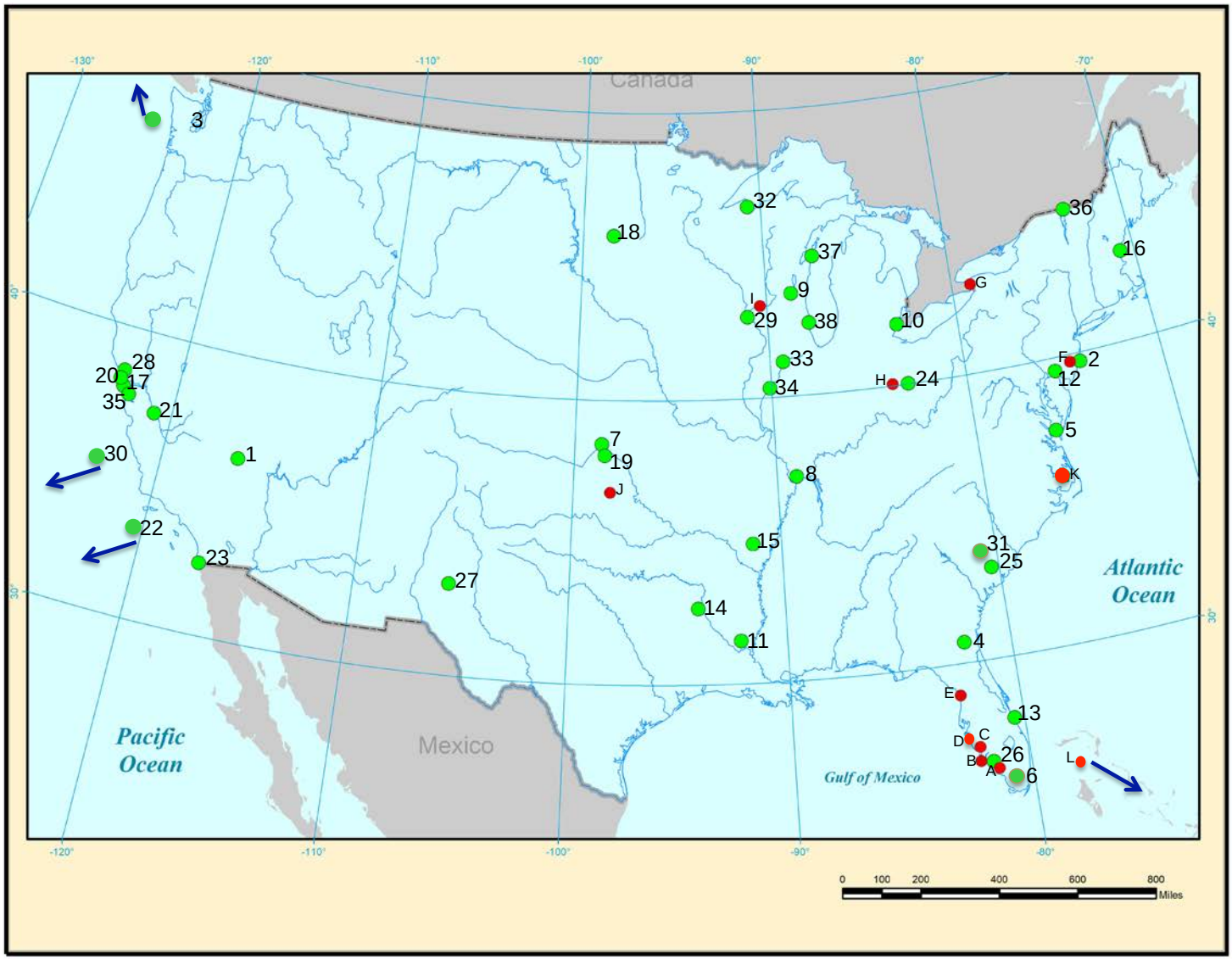


TABLE 1. List of current Ramsar sites in the USA (numbers at green dots in Figure 2) and sites that were being discussed by the USNRC as potential Ramsar wetlands (letters at red dots in Figure 2).

Number/Letter on Figure 2	Site Name	U.S. state(s)	Date of Ramsar site designation
1	Ash Meadows National Wildlife Refuge	Nevada	18-Dec-1986
2	Edwin B. Forsythe National Wildlife Refuge	New Jersey	18-Dec-1986
3	Izembek Lagoon National Wildlife Refuge	Alaska	18-Dec-1986
4	Okefenokee National Wildlife Refuge	Georgia, Florida	18-Dec-1986
5	Chesapeake Bay Estuarine Complex	Virginia	6-Apr-1987
6	Everglades National Park MR	Florida	6-Apr-1987
7	Cheyenne Bottoms	Kansas	19-Oct-1988
8	Cache River and Cypress Creek Wetlands	Illinois	21-Nov-1989
9	Horicon Marsh	Wisconsin	12-Apr-1990
10	Humbug Marsh	Michigan	4-Dec-1990
11	Catahoula Lake	Louisiana	18-Jun-1991
12	Delaware Bay Estuary	Delaware,New Jersey	20-May-1992
13	Pelican Island National Wildlife Refuge	Florida	14-Mar-1993
14	Caddo Lake	Texas, Lousiana	23-Oct-1993
15	Cache - Lower White Rivers	Arkansas	11-Jan-1994
16	Connecticut River Estuary and Tidal River	Connecticut	14-Oct-1994
17	Bolinas Lagoon	California	9-Jan-1998
18	Sand Lake National Wildlife Refuge	South Dakota	8-Mar-1998
19	Quivira National Wildlife Refuge	Kansas	12-Feb-2002
20	Tomales Bay	California	21-Oct-2002
21	Grassland Ecological Area (GEA)	California	2-Feb-2005
22	Kawainui and Hamakua Marsh Complex	Hawaïi	2-Feb-2005
23	Tijuana River National Estuarine Research Reserve	California	2-Feb-2005
24	Wilma H. Schiermeier Olentangy River Wetland Research Park	Ohio	18-Apr-2008
25	Francis Beidler Forest	South Carolina	30-May-2008
26	Corkscrew Swamp Sanctuary	Florida	23-Mar-2009
27	Roswell Artesian Wetlands	New Mexico	20-Jan-2010
28	Laguna de Santa Rosa Wetland Complex	California	16-Apr-2010
29	Upper Mississippi River Floodplain Wetlands	Minnesota, Iowa, Wisconsin, Illinois	1-May-2010
30	Palmyra Atoll National Wildlife Refuge	Pacific Region	1-Apr-2011
31	Congaree National Park	South Carolina	2-Feb-2012
32	Kakagon and Bad River Sloughs	Wisconsin	2-Feb-2012
33	Sue and Wes Dixon Waterfowl Refuge at Hennepin & Hopper Lakes	Illinois	2-Feb-2012
34	The Emiquon Complex	Illinois	2-Feb-2012
35	San Francisco Bay/Estuary (SFBE)	California	2-Feb-2013
36	Missisquoi Delta and Bay Wetlands	Vermont	20-Nov-2013
37	Door Peninsula Coastal Wetlands	Wisconsin	6-Oct-2014
38	Chiwaukee Illinois Beach Lake Plain	Wisconsin and Illinois	25-Sep-2015
Proposed Sites			
A	Fakahatchee Strand	Florida	
B	Charlotte Harbor Estuary	Florida	
C	Ding Darling National Wildlife Refuge	Florida	
D	Lake Wales Restoration Wetland	Florida	
E	Chassahowitzka National Wildlife Refuge	Florida	
F	Pinelands	New Jersey	
G	Niagara River Corridor	New York/Canada	
H	Cedar Bog	Ohio	
I	Lower Wisconsin Riverway	Wisconsin	
J	Salt Plains National Wildlife Refuge	Oklahoma	
K	Pocosin Lakes	North Carolina	
L	Several wetland sites	Puerto Rico	

Book Highlight - *Waubesa Wetlands: New Look at an Old Gem*

Contributed by Joy Zedler, Aldo Leopold Professor Emerita, UW-Madison

Waubesa Wetlands: New Look at an Old Gem provides insight into the unique wetlands along Wisconsin's Lake Waubesa. John Herm's poem about Sandhill cranes opens a unique book about a unique site in south central Wisconsin. Eight chapters progress from *Looking Back* and *Looking Around*, to *Looking Up* (birds), *Looking Down* (birds-eye view), and *Looking Ahead* (threats). Actions and watershed initiatives are suggested for residents, volunteers, and decision-makers in *Looking for Solutions*, and the benefits of a wetland ethic are posed in *Looking Inward* to help upstream citizens appreciate and conserve downstream wetlands. Graphic Designer Kandis Elliot provided maps, aerial photos, and illustrations of wildlife and plants on nearly every page. Over 200 references complete the book.

The wetlands at the toe of Lake Waubesa are unique**.** They exist where dozens of springs flow year-round from an artesian basin. Over ~6,000 thousand years, the Wetlands accumulated up to 90 feet of sedge-based peat. Today, a mosaic of 11 plant- and 8 aquatic-community types creates diverse vegetation and wildlife habitat. The rare calcareous fens grade into sedge meadows and lakeshore marshes that serve as nurseries for fish and ducks. Of 194 bird species recorded for the area, the Sandhill crane has become Town of Dunn's "mascot". The distinctive bugling of this 5-ft tall wader is often audible, and small groups are often visible in rural fields. This "umbrella species" links Waubesa Wetlands to nearby uplands during summer foraging, and its annual migration links Wisconsin to Florida and the Caribbean.

Much of the significance of Waubesa Wetlands' comes from its unique cultural histories that depict Native American usage after the glaciers melted, scientific research that has spanned a century, and 30 years of outdoor-classroom use by Professor Calvin DeWitt. Perhaps most amazing is our citizen-initiated wetland-protection program. Town of Dunn residents voluntarily sell their development rights in exchange for conservation easements! Town residents voluntarily tax themselves to fund this unique program. To date, over 30 properties are protected. Still, many residents and decision-makers in upstream watersheds are unaware of the downstream riches and the threats caused by urban expansion and climate change.

As I wrote about the phenomenal springs, I began to understand why Native Americans attributed spiritual aspects to springs in a landscape that is frozen in winter and steamy in summer. Clear, cool, clean water is a priceless resource that we can still enjoy. The toe of Lake Waubesa and its adjacent Wetlands escaped much of the drainage that promoted farming in south central Wisconsin and neighboring states. The toe also escaped urbanization, despite being just 7 miles south of the state Capitol in Madison. Two miles south of the Capitol, Monona Wetlands succumbed to weed invasions following unchecked development that increased surface runoff 20-fold and high-capacity wells that depleted groundwater for drinking. Just 5 miles south of Monona Wetlands, the watersheds and aquifers of Waubesa Wetlands are similarly vulnerable.

In *Looking Ahead*, I explain how urbanization and the changing climate will stress the remnant wetland ecosystems. Scientists predict catastrophic droughts, unprecedented storms, heavy rainfalls, too-early and too-late frosts, and other calamities, all of which will threaten native species and likely favor aggressive alien invaders. Extreme storms could release more water, more nutrients, and more toxic contaminants into downstream wetlands. Together, extreme events and urbanization will likely interact to degrade our wetland gem, which is why more citizens and decision-makers need to know that Waubesa Wetlands provide ecosystem services that are important locally, regionally and internationally. In *Looking for Solutions*, I recommend watershed management and offer many suggestions for agencies and citizens to conserve downstream wetlands.

There's no excuse not to explore this eBook—*it's free so it's affordable; it's online so it's easy to find* at http://www.town.dunn.wi.us/land-use/historic-documents/. It will soon be in print for those who've exhausted their screen-time. In addition to Kandis Elliot's original artwork, the book contains Calvin DeWitt's deep understanding of its aquifers, peat reserves, and wildlife. Dr. Madeline Fisher edited the text to help non-technical readers. This book is for all to enjoy and **use** in conserving wetlands. ■

Waubesa Wetlands adjacent to Murphy's Creek, which flows into the toe of Lake Waubesa. Madison's Capitol Dome is visible in the isthmus between Lake Mendota (far upper right) and Lake Monona. (Photo courtesy of Cal DeWitt and Nadia Olker).

Waters of the United States Applicability Date Published

On February 6, the U.S. Army and EPA published a revised Clean Water Rule in the Federal Register that includes an applicability date. The purpose of the applicability date is to provide continuity and regulatory certainty for regulated entities while the agencies continue to consider possible revisions to the 2015 rule. Stay up-to-date on all WOTUS news by subscribing to the SWS News page. ■

Wetlands in the News

Listed below are some links to some random news articles that may be of interest. Members are encouraged to send links to articles about wetlands in their local area. Please send the links to WSP Editor at ralphtiner83@gmail.com and reference "Wetlands in the News" in the subject box. Thanks for your cooperation. ■

West Coast wetlands future.
https://www.scientificamerican.com/article/west-coast-wetlands-could-nearly-disappear-in-100-years

Remains of cypress swamp found on bottom of the Gulf of Mexico.
https://www.npr.org/2018/02/09/584116280/scientists-long-buried-ice-age-forest-offers-climate-change-clues

California seeks to strengthen protection for state waters.
https://www.revealnews.org/article/california-is-preparing-to-defend-its-waters-from-trump-order/

Illegal wetland filling in Florida.
http://www.orlandosentinel.com/news/os-park-bark-illegal-wetlands-20180205-story.html

Threats to Wisconsin wetland regulations.
https://www.jsonline.com/story/news/politics/2018/02/05/gop-plans-whittle-down-regulation-wisconsin-wetlands-move-lauded-business-derided-von-clash-interest/1088977001/

http://www.uppermichiganssource.com/content/news/The-Latest-Assembly-OKs-wetland-permit-exemptions-bill-474277043.html

Wetland fill in Wisconsin.
https://www.jsonline.com/story/news/local/wisconsin/2018/01/03/foxconn-not-expected-need-permit-army-corpsface-scrutiny-federal-environmental-impact-statement-proj/998482001/

Need support for protection of urban wetlands in Rwanda.
http://www.newtimes.co.rw/section/read/229013/

Concern for logging old growth in U.S. swamps.
https://www.alternet.org/environment/logging-wetland-forests-corporate-profit-american-south-ruining-its-own-backyard

Use of LiDAR helps find Mayan megapolis in Guatemalan jungle including irrigated fields in swamps.
https://news.nationalgeographic.com/2018/02/maya-laser-lidar-guatemala-pacunam/

https://www.npr.org/sections/thetwo-way/2018/02/02/582664327/game-changer-maya-cities-unearthed-in-guatemala-forest-using-lasers

Images of Pantanal wetlands.
https://www.theguardian.com/environment/gallery/2018/feb/02/brazils-pantanal-the-worlds-biggest-wetland-in-pictures

Changes to Migratory Bird Treaty Act.
http://www.ccbbirds.org/2018/01/03/using-the-sword-of-damocles-to-decapitate-the-migratory-bird-treaty-act/

Carbon storage in tidal wetlands - blue carbon.
https://www.scientificamerican.com/article/climate-scientists-unlock-the-secrets-of-blue-carbon/

Readers are encouraged to submit wetland photos for inclusion in this section of the journal. When submitting material please provide some information on the image that can be used to prepare a caption. Submissions should go to WSP Editor at: ralphtiner83@gmail.com; please reference "Notes from the Field" and send low to medium resolution image (1 Mg or less will suffice for this e-publication).

Paul Minkin (U.S. Army Corps of Engineers, New England District, Concord, MA) saw this in the field last summer and thought it might put a smile on your face. ■

Smiling water lotus (*Nelumbo lutea*) from impoundments at Great Meadows National Wildlife Refuge, Concord, Massachusetts. (Courtesy of Paul Minkin)

For the latest news on wetlands and related topics, readers are referred to the Association of State Wetland Managers website. Their "Wetland Breaking News" section include links to newspaper articles that should be of interest: https://www.aswm.org/news/wetland-breaking-news. Their blog – the Complete Wetlander – may also be of interest: https://www.aswm.org/wordpress/. Additional resources are listed below. Please help us add new books and reports to this listing. If your agency, organization, or institution has published new publications on wetlands, please send the information to Editor of Wetland Science & Practice at ralphtiner83@gmail.com. Your cooperation is appreciated. ■

BOOKS

- Wetland Indicators – A Guide to Wetland Formation, Identification, Delineation, Classification, and Mapping https://www.crcpress.com/Wetland-Indicators-A-Guide-to-Wetland-Identification-Delineation-Classification/Tiner/p/book/9781439853696
- 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 https://www.amazon.com/Floridas-Wetlands-Natural-Ecosystems-Species/dp/1561646873/ref=sr_1_4?ie=UTF8&qid=1518650552&sr=8-4&keywords=wetland+books
- 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
- Wildflowers and Other Plants of Iowa Wetlands
- https://www.uipress.uiowa.edu/books/2015-spring/wildflowers-and-other-plants-iowa-wetlands.htm
- Wetland Restoration: A Handbook for New Zealand Freshwater Systems https://www.landcareresearch.co.nz/publications/books/wetlands-handbook
- Wetland Ecosystems https://www.wiley.com/en-us/Wetland+Ecosystems-p-9780470286302
- Constructed Wetlands and Sustainable Development https://www.routledge.com/Constructed-Wetlands-and-Sustainable-Development/Austin-Yu/p/book/9781138908994

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
- Wetland Plants and Plant Communities of Minnesota and Wisconsin (online publication) http://www.mvp.usace.army.mil/Missions/Regulatory/?Page=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/
- Field Indicators of Hydric Soils of the United States, Version 8.1 (online publication) https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053171.pdf

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
- Waubesa Wetlands: New Look at an Old Gem (online publication) http://www.town.dunn.wi.us/land-use/historic-documents/

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 https://link.springer.com/journal/11273

NEWSLETTERS

Two of the following newsletters have been terminated yet maintain archives of past issues. The only active newsletter is "Wetland Breaking News" from the Association of State Wetland Managers.

- Biological Conservation Newsletter contained some articles that addressed wetland issues; the final newsletter was the January 2017 issue; all issues now accessed through the "Archives") http://botany.si.edu/pubs/bcn/issue/latest.htm#biblio
- For news about conservation research from the Smithsonian Institution, please visit these websites:
  -Smithsonian Newsdesk http://newsdesk.si.edu/
  -Smithsonian Insider http://insider.si.edu/
  -The Plant Press http://nmnh.typepad.com/the_plant_press/
  -SCBI Conservation News http://nationalzoo.si.edu/conservation
  -STRI News http://www.stri.si.edu/english/about_stri/headline_news/news
- Wetland Breaking News (Association of State Wetland Managers) http://aswm.org/news/wetland-breaking-news
- National Wetlands Newsletter (Environmental Law Institute) – access to archived issues as the newsletter was suspended in mid-2016 due to the changing climate for printed publications. https://www.wetlandsnewsletter.org/

SUBMISSION GUIDELINES

About *Wetland Science & Practice*

Wetland Science and Practice (WSP) is the SWS quarterly publication aimed at providing information on select SWS activities (technical committee summaries, chapter workshop overview/abstracts, and SWS-funded student activities), brief summary articles on ongoing or recently completed wetland research, restoration, or management projects or on the general ecology and natural history of wetlands, and highlights of current events. *WSP* also includes sections listing new publications and research at various institutions, and links to major wetland research facilities, federal agencies, wetland restoration/monitoring sites and wetland mapping sites. The publication also serves as an outlet for commentaries, perspectives and opinions on important developments in wetland science, theory, management and policy.

Both invited and unsolicited manuscripts are reviewed by the *WSP* editor for suitability for publication. Student papers are welcomed. Please see publication guidelines at the end of this issue.

Electronic access to Wetland Science and Practice is included in your SWS membership. All issues published, except the the current issue, are available via the internet to the general public. At the San Juan meeting, the SWS Board of Directors voted to approve release of past issues of WSP when a new issue is available to SWS members only. This means that a WSP issue will be available to the public four months after it has been read by SWS members (e.g., the June 2017 issue will be an open access issue in September 2017). Such availability will hopefully stimulate more interest in contributing to the journal. And, we are excited about this opportunity to promote the good work done by our members.

HOW YOU CAN HELP

If you read something you like in WSP, or that you think someone else would find interesting, be sure to share. Share links to your Facebook, Twitter, Instagram and LinkedIn accounts.

Make sure that all your SWS colleagues are checking out our recent issues, and help spread the word about SWS to non-members!

Questions? Contact editor Ralph Tiner, PWS Emeritus (ralphtiner83@gmail.com). ■

WSP Manuscript – General Guidelines

LENGTH:

Approximately 5,000 words; can be longer if necessary.

STYLE:

See existing articles from 2014 to more recent years available online at:
http://www.sws.org/category/wetland-science-practice.html

TEXT:

Word document, 12 font, Times New Roman, single-spaced; keep tables and figures separate, although captions can be included in text. For reference citations in text use this format: (Smith 2016; Jones and Whithead 2014; Peterson et al. 2010).

FIGURES:

Please include color images and photos of subject wetland(s) as WSP is a full-color e-publication.
Image size should be less than 1MB – 500KB may work best for this e-publication.

REFERENCE CITATION EXAMPLES:

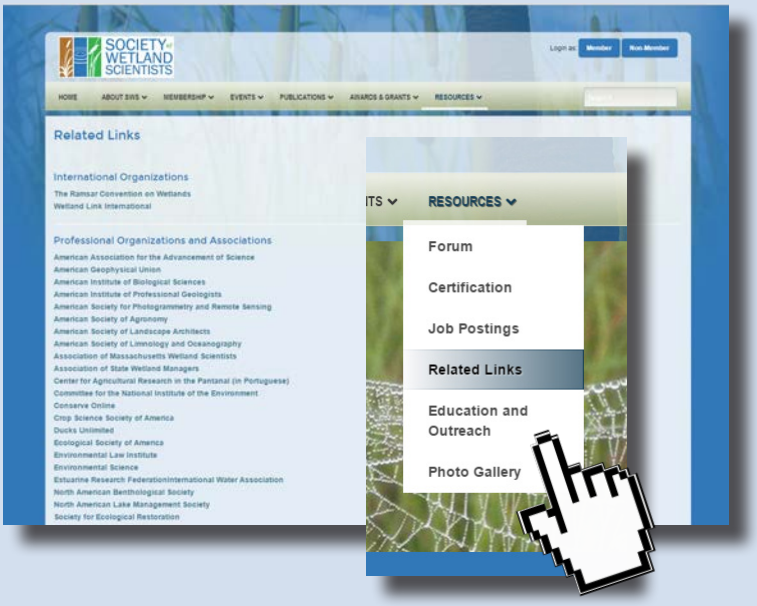
- Claus, S., S. Imgraben, K. Brennan, A. Carthey, B. Daly, R. Blakey, E. Turak, and N. Saintilan. 2011. Assessing the extent and condition of wetlands in NSW: Supporting report A – Conceptual framework, Monitoring, evaluation and reporting program, Technical report series, Office of Environment and Heritage, Sydney, Australia. OEH 2011/0727.
- Clements, F.E. 1916. *Plant Succession: An Analysis of the Development of Vegetation*. Carnegie Institution of Washington. Washington D.C. Publication 242.
- Clewell, A.F., C. Raymond, C.L. Coultas, W.M. Dennis, and J.P. Kelly. 2009. Spatially narrow wet prairies. *Castanea* 74: 146-159.
- Colburn, E.A. 2004. *Vernal Pools: Natural History and Conservation*. McDonald & Woodward Publishing Company, Blacksburg, VA.
- Cole, C.A. and R.P. Brooks. 2000. Patterns of wetland hydrology in the Ridge and Valley Province, Pennsylvania, USA. *Wetlands* 20: 438-447.
- Cook, E.R., R. Seager, M.A. Cane, and D.W. Stahle. 2007. North American drought: reconstructions, causes, and consequences. *Earth-Science Reviews* 81: 93-134.
- Cooper, D.J. and D.M. Merritt. 2012. Assessing the water needs of riparian and wetland vegetation in the western United States. U.S.D.A., Forest Service, Rocky Mountain Research Station, Ft. Collins, CO. Gen. Tech. Rep. RMRS-GTR-282.

WEB TIP

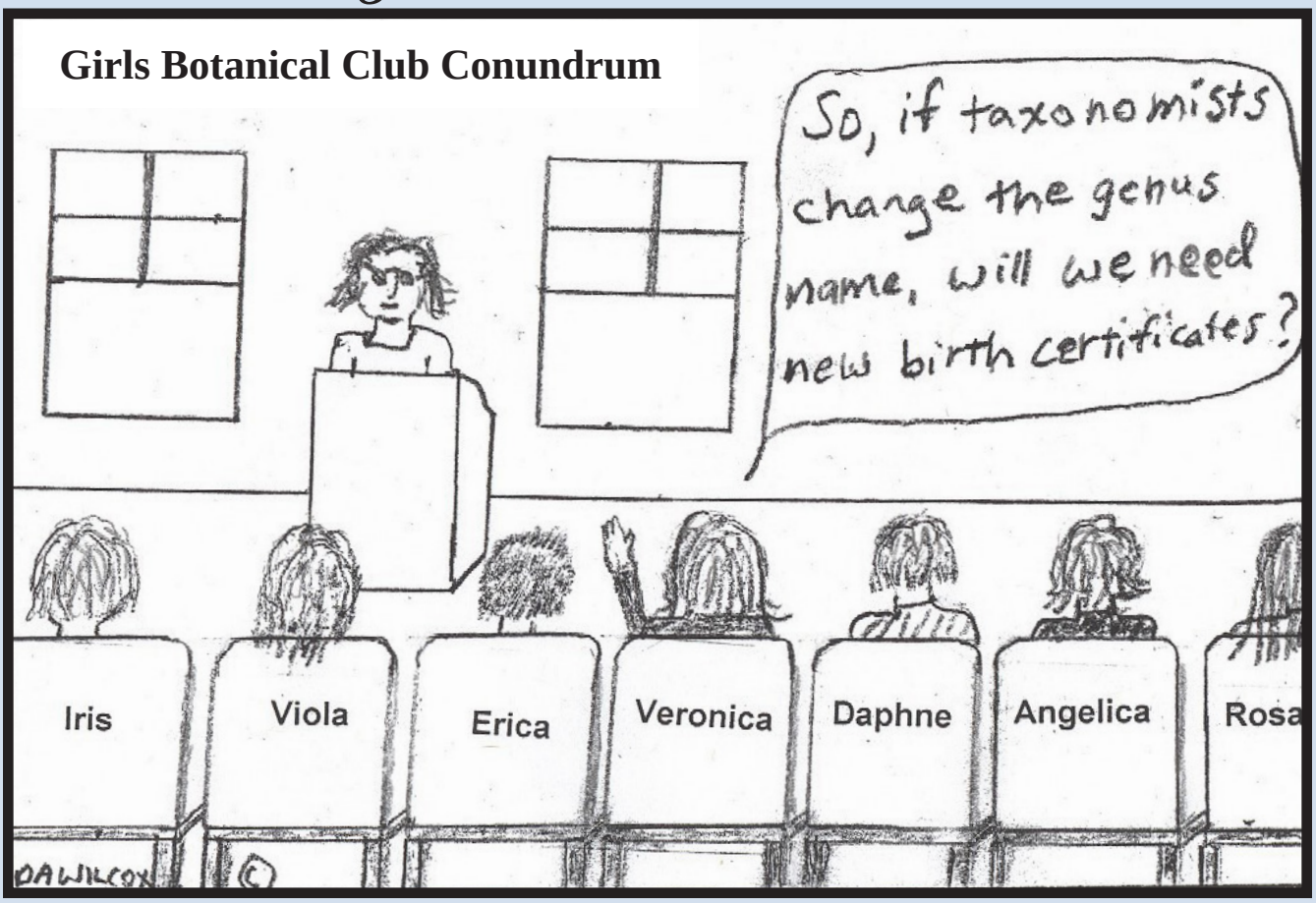
Resources at your fingertips!

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).



From the Bog



by Doug Wilcox

wetland science & practice

WSP is the formal voice of the Society of Wetland Scientists. It is a quarterly publication focusing on the news of the SWS and providing important announcements for members and opportunities for wetland scientists, managers, and graduate students to publish brief summaries of their works and conservation initiatives. Topics for articles may include descriptions of threatened wetlands around the globe or the establishment of wetland conservation areas, and summary findings from research or restoration projects. All manuscripts should follow guidelines for authors listed above. All papers published in WSP will be reviewed by the editor for suitability and may be subject to peer review as necessary. Most articles will be published within 3 months of receipt. 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. ■