

# wetland science & practice

published by the Society of Wetland Scientists

Vol. 34, No. 1 Mar 2017



**Here it is mid-February and I'm sitting down to write this message.** Normally I'd say something about the weather and how we in the Northern Hemisphere are looking forward to spring – when my yard turns from white to green. Yet the way things are going in the U.S., it's been particularly difficult to focus on anything but politics as it has invaded so many aspects of life, even science-based conservation (e.g., <http://goodnature.nathab.com/science-based-conservation-under-attack-in-2017/>).



Ralph Tiner  
WSP Editor

One of our readers sent me a link to an article about how Canadian scientists dealt with a former prime minister who put rules in place to restrain government scientists from speaking freely about their work and who closed research libraries with documents thrown into dumpsters (see note under “Wetland Science”). Just as I composed the introduction to that news note, my wife told me about a new bill - HR 861 - that was filed last week in Congress. The bill proposes elimination of the EPA. While it is not law at this point, it is a sign of the kind of changes that some folks are aiming for.

Environmental protection, as many of us have supported and worked to secure, is under siege. Our careers and livelihoods have largely been based on or supported by such protection whether you work for universities, government agencies, or private industry. For the older wetlanders in our organization, we all remember the time when wetlands were regarded as wastelands (just 50 years ago) and their “best use for society” required drainage for agriculture or filling for residential, commercial, or industrial development. I remember being enlightened and inspired by John and Mildred Teal’s – *Life and Death of the Salt Marsh*. The only reason that “wetland” became a household word is because wetlands have been recognized as valuable natural resources worthy of protection through regulations. Are we really destined to go back to the 1950s in all aspects of American life? Is there a new reality on the horizon?

For this issue, we have two articles - one showing an example of how one organization has helped protect and restore a vernal pool in Ontario and emphasizing the need for more attention to vernal pool conservation across the province. The other article describes a restoration/enhancement project designed to also serve as a research study to evaluate the effectiveness of thin layer placement of dredged material to help salt marshes combat rising sea level. This issue also contains some other news about wetlands. Be sure to keep up with latest information on current wetland issues by checking the SWS’s wetland news on our webpage (<http://sws.org/About-SWS/news.html>) and by subscribing to the Association of State Wetland Managers’ “Wetland Breaking News” listed in the Wetland Bookshelf under “Newsletters” in this issue of WSP. Doug Wilcox has provided another cartoon in his “From the Bog” series; this one relates to a recent operation he had.

As many of you are planning presentations or posters for our upcoming annual meeting in Puerto Rico, please consider converting your work into a short paper for *Wetland Science & Practice*. For example, many of the posters I’ve seen in the past should be easily converted to WSP articles. While your presentation or poster may be witnessed by conference participants, putting the information in print will reach a much larger audience...something to think about. Please feel free to contact me if you have questions ([ralptiner83@gmail.com](mailto:ralptiner83@gmail.com)). Meanwhile, I look forward to seeing you at the meeting.

Happy Swamping! ■

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Cover photo:

*Copperhead (Agkistrodon contortrix) camouflaged by fallen leaves in a South Carolina flatwood.*  
Photo courtesy of Ralph Tiner.

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SOCIETY OF WETLAND SCIENTISTS  
22 N Carroll St., Ste 300, Madison, WI 53703  
608-310-7855



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

## PRESIDENT'S MESSAGE

“Looking at soil as memory, a repository of recorded changes and renewals, may yield what some say is most urgently needed in biospheric research today: a forward-looking outlook—a sense of hope. That quaint, distinctly non-scientific term is cropping up now, more and more, even in the august academic literature (Swaigood and Sheppard, 2010; Garnett and Lindenmayer, 2011; Orr, 2011; Balmford, 2012, p. 1–17; Knight, 2013; Stevenson and Peterson, 2016; Head, 2016). It is the interface between memory and yearnings, the tension between what is remembered and what can yet be. The soil, by virtue of its memory, is a conveyor of hope, foreshadowing tomorrow’s fruitfulness in insights sprouting today. Seen across long



Gillian Davies, PWS  
SWS President

durations, soil is innately resilient, often able to renew itself, to resurrect its life-sustaining functions, even after damaging upheavals and disturbances.

– H. Henry Janzen, (*The Soil Remembers*, Soil Sci. Am. J., 80:1429-1432. December 22, 2016)

**I note the recent date when these inspiring words were published, and observe that we are in need of hope, now more than ever.** Hope is a well of energy that propels us through challenging times. Hope allows us to be present, despite our fears. In my last *Wetland Science & Practice* President’s Address, I spoke about the need for the SWS to remember who we are in the face of uncertainty, and to, “Be Prepared to Be Present”. In another sense, I realize, we need to be present on the land, to feel the hope that Janzen speaks of. By finding time to savor our natural world, we recharge our well of hope, and we give ourselves the energy to be present in challenging times.

In these challenging times, scientists are re-examining our role in the public sphere. At the February Annual Meeting of the American Association for the Advancement of Science (AAAS) in Boston, speeches



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# wetland science & practice

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## Your Participation and Our Growth Adds Up to a Powerful Society

Michelle Czosek, CAE, SWS Managing Director



Michelle Czosek, CAE  
SWS Managing Director

It's hard to believe that we're already midway through the first quarter of 2017. I want to thank everyone for your past participation in SWS. We appreciate the contribution of your time and talents, whether it was by contributing an article to *Wetlands* or *WSP*, attending the Annual Meeting or participating in a webinar. Every time you take time out of your day to participate, we all benefit.

Your membership truly is one of those things where you get more out of it, if you put more into it. I encourage you to make the most of your SWS membership by getting involved in a committee, submitting an article, posting a question on the discussion forum, volunteering to present a webinar, following us on Instagram and Twitter or attending the Annual Meeting and your respective chapter meetings. However you choose to get involved, I promise it will prove to be a valuable experience and well worth the effort!

We have a lot in store for you in 2017, including:

- Our Annual Meeting in San Juan, Puerto Rico, on June 5-8. Humberto the Frog is anxious to meet you and share more Puerto Rico facts!

- The continuation of our monthly webinars (free to members) with expert presenters covering timely wetland topics of interest.
- The launch of the Wetland Ambassadors Graduate Research Fellowship.
- More student research grants and Society awards.

So, what are you waiting for? It's time to get engaged! I not only challenge you to participate this year, but also to reach out to someone you know and invite them to join SWS. By inviting them to join, you'll allow them the unique opportunity to see the power of our society. You'll introduce them to the possibility of developing both personally and professionally, and allow them to meet new friends and contacts along the way.

The bigger our organization, the more opportunity there is for everyone. It's the growth of the organization that fuels everything. As our community grows, so will our opportunities to build connections with and learn from others. Our strength is in the knowledge and resources that we all collectively bring to the table.

SWS has a large, diverse membership base and you help us build on this strong foundation when you assist in bringing new members to our association. So, share your love of wetlands with others. Anyone can be a member. If you need help reaching out to potential new members, feel free to contact anyone on the SWS staff and we'll be happy to help. ■



## About Wetland Science and Practice

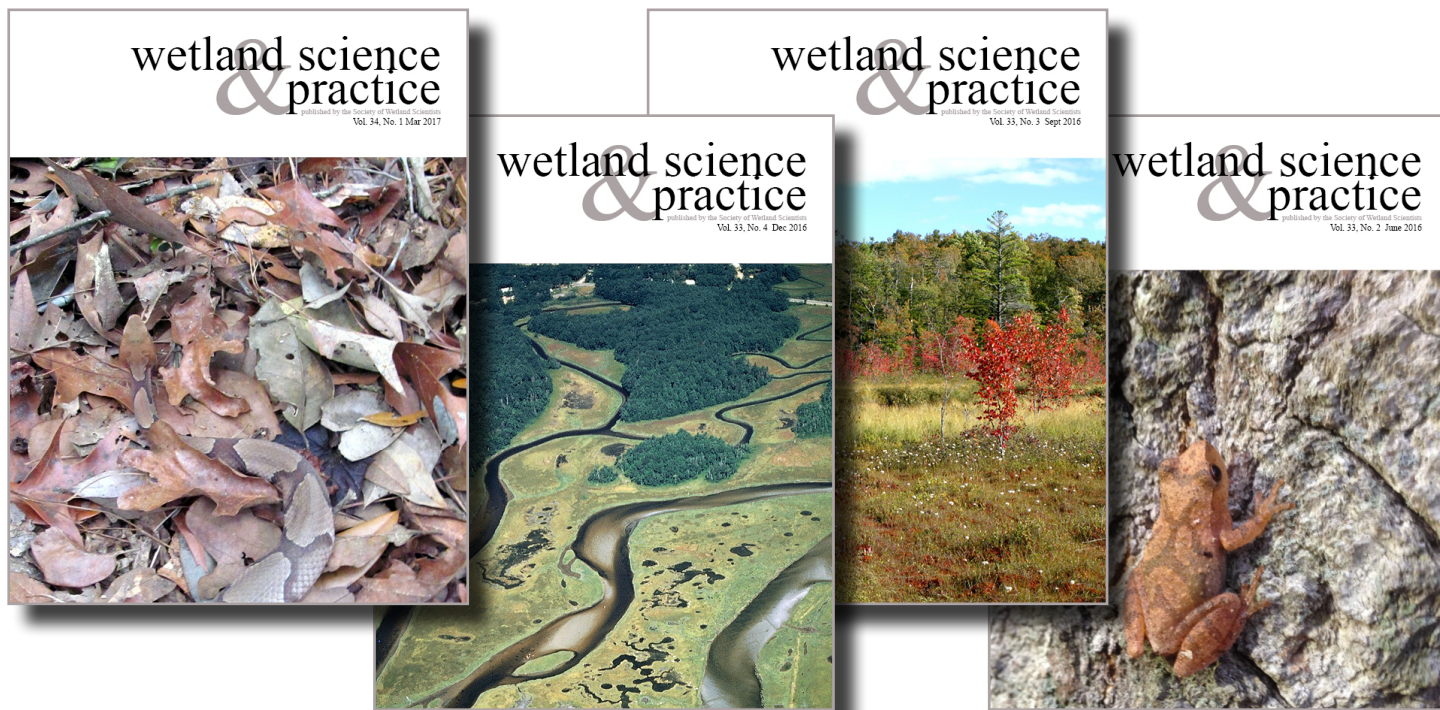
*Wetland Science and Practice* is the SWS quarterly publication aimed at providing information on select SWS activities (technical committee summaries, chapter workshop overview/abstracts, and SWS-funded student activities), brief summary articles on ongoing or recently completed wetland research, restoration, 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. Questions? Contact editor Ralph Tiner, PWS Emeritus ([ralphtiner83@gmail.com](mailto:ralphtiner83@gmail.com)).

[Electronic access to \*Wetland Science and Practice\*](#) is included in your SWS membership. All issues published, except the four most recent issues, are available via the internet to the general public. More recent issues, available for viewing by SWS members only, will be phased in for distribution as they reach the one-year threshold. This means that the audience for *WSP* articles is virtually limitless. Such availability will hopefully stimulate more interest in contributing to the journal. 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, 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! ■



## SWS Action to Support Clean Water Rule

On March 1st, the Society joined with other concerned natural resource organizations in writing to President Trump and to Congress to express support for the Clean Water Rule drafted by the U.S. EPA and U.S. Army Corps of Engineers. The rule defines the geographic scope of waters of the U.S. with respect to the Federal Clean Water Act and is currently under review by the U.S. Court of Appeals for the 6th Circuit. Our letter states that the SWS agrees with the *amici curiae* brief filed with the court by wetland and water specialists in support of the Clean Water Rule (see the letter to President Trump below and the letter to Congress on the following two-page spread). ■



March 1, 2017

President Donald Trump  
The White House  
1600 Pennsylvania Avenue NW  
Washington, DC 20500

Re: Endorsement of *Amici Curiae* Brief of Wetland and Water Scientists in Support of the Clean Water Rule

Dear President Trump:

The Society of Wetland Scientists (SWS), American Fisheries Society (AFS), American Institute of Biological Sciences (AIBS), Ecological Society of America (ESA), Phycological Society of America (PSA), Society for Ecological Restoration (SER), and Society for Freshwater Science (SFS) support the sustainable management of the nation's waters. We are science-based organizations with diverse areas of expertise in the ecological and biological sciences. Our collective 200,000+ members and 130+ professional societies and research organizations work in the private sector, academia, and various tribal, state and federal agencies. As non-profit organizations, we support and foster sound science, education, restoration and management of wetlands and other aquatic resources. Thus, we track policies and actions that affect these aquatic resources and we promote science-based policy-making.

The United States Court of Appeals for the Sixth Circuit is reviewing the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers' Clean Water Rule, which defines the geographic coverage of the Clean Water Act. Recently, wetland and aquatic scientists filed an *amici curiae* brief with the court in support of the Clean Water Rule. The organizations that have signed this letter agree with the brief and its use of sound science to explain the urgent need for the Clean Water Rule.

The Clean Water Rule was developed using the best available science, technical experts, and >1,000 peer-reviewed scientific studies. The *amici curiae* brief describes how wetlands, streams, and adjacent waters significantly affect the chemical, physical, and biological integrity of traditional navigable waters, interstate waters, and the territorial seas. We urge you to repeal the February 28<sup>th</sup>, 2017 Executive Order pertaining to WOTUS, and encourage you to review the scientists' *amici curiae* brief and to defend the Clean Water Rule instead. The *amici curiae* brief is available at: <http://stetson.edu/law/amiciuriae>

Wetlands provide many services that promote human well-being including economic and non-economic benefits. Foremost, they keep our streams, lakes, and groundwater cleaner by 'treating' urban and agricultural runoff; this treatment includes reducing the negative effects of pollutants, transforming harmful nitrates into harmless nitrogen gas, trapping sediment, and removing pathogens. They store water, and thus are a source of water during times of drought. Many

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and scientific understanding of the world's wetland resources*

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wetlands soak up runoff and floodwaters, which reduces peak flood-flows and avoids costly flood damage. Lastly, wetlands sustain essential habitat for wildlife, fish, and waterbirds to feed, nest, breed, spawn, and rear their young in ‘productive nurseries.’

The nation’s wetlands cover a tiny proportion of our landscapes (<6% of the lower 48 states), yet they contribute many times their ‘fair’ or proportional share in services to human well-being—often more than 10 times as much as predicted from their area.\* Like diamonds, they can be small, but extremely valuable.

Current science overwhelmingly supports the Clean Water Rule, as detailed in the scientists’ *amici curiae* brief. All people depend on the nation’s waters, and so we urge you to support the Clean Water Rule, which is needed for us to achieve the Clean Water Act’s objective to restore and maintain the chemical, physical, and biological integrity of the nation’s waters.

Respectfully,

Gillian T. Davies  
President, Society of Wetland Scientists

Timothy A. Nelson  
President, Phycological Society of America

Joe Margraf  
President, American Fisheries Society

Bethanie Walder  
Executive Director, Society for Ecological Restoration

Robert Gropp  
Co-Executive Director, American Institute of Biological Sciences

Emily Bernhardt  
President, Society for Freshwater Science

David M. Lodge  
President, Ecological Society of America

\* Calculation is based on data in Costanza R, et al. 1997. The value of the world’s ecosystem services and natural capital. *Nature* 387:253–260. This was reinforced by a recent update in Costanza R, et al. 2014. Changes in the global value of ecosystem services. *Global Environmental Change* 26:152–158. For more information, see Zedler, JB, Kercher, S. 2005. Wetland resources: Status, trends, ecosystem services, and restorability. *Annual Review of Environment and Resources* 30:39–74.

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## SWS Action to Support Clean Water Rule, continued from previous page



March 1, 2017

U.S. Senate  
Washington, DC 20510

U.S. House of Representatives  
Washington, DC 20515

Re: Endorsement of *Amici Curiae* Brief of Wetland and Water Scientists in Support of the Clean Water Rule

Dear Members of Congress:

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## Annual Meeting Registration Is Now Open:

[www.swsannualmeeting.org](http://www.swsannualmeeting.org)

### FIELD TRIPS AND WORKSHOPS PROMISE EXPLORATION, DEEP LEARNING

SWS is pleased to present exciting field trip and workshop options as part of the SWS 2017 Annual Meeting in Puerto Rico. Dig deeper into your research interests by participating in one of these hands-on activities from sites including the El Yunque National Forest, Las Cabezas de San Juan Nature Reserve, Northeast Ecological Corridor and the Jobos Bay National Estuarine Research Reserve. Get full descriptions of each opportunity at [www.swsannualmeeting.org](http://www.swsannualmeeting.org). Additional registration fees are required. ■

### DONATE TO THE SILENT AUCTION

The SWS South Atlantic Chapter will host a silent auction at the Annual Meeting, during the Poster Reception on Thursday, June 8, 2017. All proceeds will go directly to support future chapter initiatives. Members and friends of the wetland science community are invited to donate an item or service by completing the donation form by May 1, 2017. Your donation will be acknowledged in connection with the event and, if needed, a letter to acknowledge your donation for tax purposes can be provided. For more information, visit the Annual Meeting Silent Auction page. For any questions, please contact William Conner at [wconner@clermson.edu](mailto:wconner@clermson.edu) or Diane De Steven at [ddesteven@fs.fed.us](mailto:ddesteven@fs.fed.us). ■

### RESERVE EXHIBIT SPACE

Reserve your spot to network and build professional connections at the Annual Meeting with the highest level of wetland professionals. The exhibition will be held on June 6 – 8, 2017, from 8:00 a.m. to 4:30 p.m. To learn more, contact Amanda Safa at [asafa@sws.org](mailto:asafa@sws.org), or visit the Annual Meeting Exhibitor page. Agreements must be received by April 14, 2017. ■

### TAKE TIME FOR NETWORKING AND SOCIAL EVENTS

We've scheduled plenty of time during the Annual Meeting to connect with colleagues and learn from your peers. The Welcome Reception on Monday night is a great way to kick things off. On Tuesday, a special mixer is planned for students. The Awards Lunch and Annual Membership Meeting on Wednesday is a must for recognizing fellow and future scientists and for catching up on the latest SWS news. Back again is the Poster Session and Silent Auction on Wednesday evening — the fun is in the bidding! Stick around on Thursday evening for the Closing Event—a kayak tour of one of Puerto Rico's bioluminescent bays (additional registration fee required.) Sign up soon! Space is limited. ■

### MAKE YOUR TRAVEL PLANS

SWS has secured a block of rooms at the Sheraton Puerto Rico Hotel. Located only a few steps from the Puerto Rico Convention Center, this hotel is sure to fill up fast! Visit the meeting website for booking instructions and more information. ■

Society of Wetland Scientists Annual Meeting

**SWS 2017**  
*Puerto Rico*  
June 5-8

Celebrating Wetland Diversity  
Across the Landscape:  
Mountains to Mangroves



### HUMBERTO FINDS HOME ON TWITTER

Follow our Annual Meeting mascot, Humberto the Frog, on Twitter, [@HumbertoTheFrog](https://twitter.com/HumbertoTheFrog), where he shares #FrogFacts about Puerto Rico and helps you prepare for the upcoming meeting. ■



## Sponsorship Opportunities

A variety of sponsorship levels are available on a first-come, first-selected basis and are sure to provide international exposure to supporting organizations. 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 2017 Annual Meeting a success by making a general contribution. Sponsor's logo will be featured on the meeting website with a link to their corporate page, on signage at registration and in the meeting mobile app.

### BRONZE LEVEL \$1,000

- **DAILY PLENARY SPEAKER.** The SWS 2017 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

- **STUDENT MIXER.** This special reception will provide students the opportunity to exchange ideas and network with expert wetland professionals. All attendees welcome.
- **AWARDS LUNCH & ANNUAL MEMBERSHIP MEETING.** Meeting registrants will be invited to attend this special event to honor SWS award winners and catch up on the latest SWS initiatives.
- **POSTER SESSION & SILENT AUCTION RECEPTION.** The 2017 poster session will showcase the latest wetland research and will provide an opportunity for all meeting attendees to network. The South Atlantic Chapter will also be holding a special silent auction to help fund Chapter activities.
- **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.

### GOLD LEVEL \$5,000

- **REGISTRATION BAG.** Meeting branded registration bags will be distributed to all participants containing relevant meeting materials. The sponsor's logo will be featured on each registration bag.
- **LANYARDS.** Meeting themed lanyards will be distributed to each attendee at registration. The sponsor's logo will be featured on each lanyard.
- **WATER BOTTLE.** Attendees will receive a meeting themed water bottle at registration which will feature the sponsor's logo.

### PLATINUM LEVEL \$7,500

- **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.
- **WELCOME RECEPTION.** The SWS 2017 Annual Meeting will kick off with a special Welcome Reception.

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 registration 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 are quoted in US dollars.*

To discuss sponsorship opportunities for your company, contact Amanda Safa, [asafa@sws.org](mailto:asafa@sws.org), 608-310-7855.

## **SWS Sponsoring World Wetlands Day-Inspired Youth Art Contest**

February 2 is recognized around the globe as World Wetlands Day (WWD). In celebration of WWD, SWS is holding a youth art contest. The contest opened February 2 and closes on April 2, 2017. Finalists will be announced in May for American Wetlands Month, and will be judged at the SWS Annual Meeting in June.

For children in grades 1-5:

- Drawings on standard size (8.5 x 11”) paper
- Theme: “Image of Your Favorite Wetland”
- 1st place: \$50, 2nd place: \$25, 3rd place: \$10

For students in grades 6-12:

- Drawing, photograph, or combination
- Image on standard size (8.5 x 11”) paper.
- Theme: “Wetlands for Protecting and Serving People”
- 1st place: \$50, 2nd place: \$25, 3rd place: \$10

Entries should include student’s name, grade level, city, state, country and parent’s email address on the back of the drawing. Please send original artwork to the following address:

SWS Wetland Promotions Subcommittee  
22 N. Carroll St., Ste. 300  
Madison, WI, USA 53703

*Note that all submissions will become the property of SWS for promotional and educational purposes and that submissions will not be mailed back. Artwork must be received by April 2, 2017 to qualify. Only one submission is allowed per person. ■*



Drawing by Allie Duberstein, 1<sup>st</sup> grade

## **SWS’s New Media Initiative**

*Prepared by Beth Middleton, Jere Boudell, Karen McKee and Kara Miller (New Media Subcommittee)*

SWS has launched its New Media Initiative. Soon we will be asking members to submit phone apps for field work (Jere Boudell, App Editor) and videos of their projects (Media Editor, to-be-announced). We will work toward offering other new visual media, e.g., story boards, interactive graphics, and other media in the future. Watch the website for developments in upcoming weeks.

### **CALL FOR MEDIA EDITOR VOLUNTEER**

The SWS New Media Subcommittee is looking for a volunteer Media Editor to handle member submitted videos on wetland-related topics. The responsibilities of this editor will be to view videos submitted by members related to research, education and outreach. Video topics could include environmental problems, unique and special wetlands, research projects, Wetland Association student activities, and other topics of interest for SWS members. These videos will be posted on the SWS YouTube channel for member viewing.

The Media Editor responsibilities will be similar to those of a publication editor. This editor will receive videos, and handle the review process. The Editor will send reviewer comments back to the maker of the video, accepting, rejecting or requesting further revision of the video.

If you are interested in serving as the New Media Editor for SWS, please contact Kara Miller ([kmiller@sws.org](mailto:kmiller@sws.org)) or Beth Middleton ([bam8040@louisiana.edu](mailto:bam8040@louisiana.edu)). ■

## President's Message continued from page 3

and panel sessions addressed concerns that, "...scientists could face wide-ranging political conflicts and challenges, and will have to decide how to meet them". (Washington Post, 2/18/2017). The same article noted that historian and Harvard scholar Naomi Oreskes pointed out that, "...history does not support the idea that "taking a public position on an urgent issue undermines the credibility of science." While on an American Institute for Biological Sciences conference call to discuss how scientific societies should respond to the current policy environment in the U.S., a Canadian colleague commented that Canada had recently experienced a similar policy climate, and that the Canadian march for science seemed to be a real turning point in moving away from policies that were suppressing and rolling back science and science-based policies.

SWS remains a non-partisan organization, and we also remain an organization that is charged, in our Mission, Vision and Strategic Plan <http://www.sws.org/category/governance.html>, with promoting sound science in wetland policy and stewardship, as well as promoting "...understanding, conservation, protection, restoration, science-based management, and sustainability of wetlands". We will adhere to both principles, and to the ideal of welcoming respectful dialogue and debate on wetland issues.

With the recent change in U.S. Administrations, we are beginning to see significant changes in U.S. government policies and actions. Although the U.S. is just one country, we are all aware that these policies and actions have worldwide consequences. The new U.S. Administration, and/or some members of Congress, have made it clear, in numerous ways, that they intend to do their best to roll back or eliminate environmental protections, including eliminating the Waters of the United States Clean Water Rule, eliminating and/or de-funding U.S. EPA, repealing the Endangered Species Act, selling or giving U.S. federal lands away, limiting the ability of federally employed scientists to share research, data, and other forms of science and fact-based information, appointing those who refute anthropogenic climate change and the need to address it, to leadership positions, exhibiting aversion to scientific facts when they do not support their political agenda, and taking positions and actions that do not support diversity or international collaboration with long-time allies.

As one example, the White House website <https://www.whitehouse.gov/america-first-energy> states: "For too long, we've been held back by burdensome regulations on our energy industry. President Trump is committed to eliminating harmful and unnecessary policies such as the Climate Action Plan and the Waters of the U.S. rule.

Now, more than ever, we need our members to be "Prepared to Be Present", to be active, and to raise our voices collectively, as a strong and vibrant Society, and with our partner societies and organizations. The Executive Board has already put several actions into motion, as outlined below. There are other actions that we can take that will re-

main faithful to our SWS identity, and that will embody our Mission, Vision and Strategic Plan.

Thus far, we have:

1. Written a letter in support of the Waters of the United States Clean Water Rule, posted it on our website, and shared it with our partner organizations with a request that they join us in signing the letter. Once we hear back from them, we will send the letter to the U.S. Administration and Congress. Thank you to the SWS scientists (Royal Gardner, Joy Zedler, Jim Perry, Eugene Turner, Marinus Otte, Siobhan Fennessy) and attorneys (Erin Okuno and Stephanie Tai) who contributed to the preparation of the letter and the associated amicus brief.
2. Had discussions with our partner organizations about effective responses in this policy environment. All are in agreement that collaborative responses, such as jointly signed letters, are particularly valuable responses. There is a sense that it is important for scientists to speak up on behalf of science and policies that are supported by science.
3. Established a group of SWS and other scientists to prepare a short literature review on climate change and wetlands (with a goal to publish very soon) that will be the basis for a climate change and wetlands letter to the U.S. Administration and Congress, and, we hope, will be co-signed by partner societies.
4. Loretta Battaglia and Julia Cherry are co-chairing a Special Feature series for Wetlands that will focus on wetlands and climate change. This is a longer-term project, and has been in the works for a while now.
5. Are establishing a group of SWS scientists to prepare a letter in support of the Swampbuster provision of the Farm Bill, if this provision is targeted for repeal or weakening.
6. Have discussed with Alani Taylor, Chair of the Human Diversity Committee, ideas for supporting SWS members and students who may be at risk of having their travel visa revoked by the new U.S. Administration.
7. The SWS *ad hoc* Internationalization Committee continues to support our chapters that are located outside of the U.S., and their members. Our continued efforts to stay in touch with, and support, all of our chapters around the world will allow us to incorporate feedback from our international members.
8. Have sent an email to SWS membership regarding the AIBS Congressional visits day, planned for April 25 and 26 in Washington, DC. Our new CASS representative, Quentin Stubbs, will be participating on our behalf. If you are interested in attending, please contact our AIBS representative, Dennis Whigham, for details.
9. Are planning an SWS presence at the March for Science in Washington, D.C. on April 22nd. We will communicate more as these plans develop, and

would love to have you join us, or attend a satellite march in another location.

10. And, perhaps most importantly, we all continue our daily work as wetland scientists.

By adhering to our Mission, Vision and Strategic Plan, we will be able to implement actions that are soundly rooted in our shared identity as a society of wetland scientists, while respecting the diversity of experiences, perspectives and identities of our members. As I mentioned in my last WSP message, our collective work brings with it the power of our global community, so that we can “be prepared to be present” in our work to meet the challenges ahead of us. By being present on the land, we find the hope to carry on our SWS Mission.

## SUMMARY OF RECENT SWS ACTIVITIES

### Webinars

In February, Tim Purinton, Director of the Massachusetts Division of Ecological Restoration, gave an excellent webinar titled, “Liquid Assets: Building and Sustaining a State Based Aquatic Ecological Restoration Program”. If you were not able to join us for the webinar, be sure to check it out in our webinar library. In March, Stephen Crooks, Principal of Wetland Science and Coastal Management at Silvestrum Climate Associates, LLC and Tiffany Troxler of Florida International University will present, “The Challenges and Successes of Incorporating Coastal Wetlands into the U.S. Inventory of GHG Emissions and Sinks”.

### Ramsar

Nick Davidson represented SWS at the Ramsar Scientific and Technical Review Committee meeting in Gland, Switzerland from February 13 – 17, 2016, which SWS member Roy Gardner chaired. The STRP is making major progress on preparing the State of the World’s Wetlands report, as well as several policy briefs. Numerous SWS members are very active on the US National Ramsar Committee, includ-

ing committee chair Bill Mitsch, secretary Ralph Tiner, and SWS representative Siobhan Fennessy. The USNRC held a meeting/conference call on February 2nd, World Wetlands Day, and is making progress on identifying and evaluating new Ramsar sites in the U.S. Jos Verhoeven, Nick Davidson and Gillian Davies are coordinating with the Ramsar Secretariat, in anticipation of the renewal of the SWS-Ramsar Memorandum of Cooperation, which is anticipated to be signed at the Europe Chapter Annual Meeting in Faro, Portugal in early May.

### World Wetlands Day

SWS celebrated World Wetlands Day by sponsoring a student (K – 12) art contest. Artwork may be submitted any time between February 2 and April 2, 2017. Thirty finalists in each grade grouping will be chosen, and announced in May, which is American Wetlands Month. At the SWS Annual Meeting in Puerto Rico, SWS members attending the conference will judge and select the winners, who will be awarded cash prizes!

### SWS Executive Board and Board of Directors Mid-Year Meetings

The Executive Board and SWS staff met in Baltimore, Maryland, for the mid-year Executive Board meeting, mid-year Board of Directors conference call, and to vet potential venues for the 2019 SWS Annual Meeting. The 2019 SWS Annual Meeting will be hosted by the Mid-Atlantic Chapter.

### Quebec City 2020 – SWS, Society for Ecological Restoration, and the Canadian Land Reclamation Association Joint Annual Meeting

Gillian Davies, Michelle Czosek, and Gordon Goldsboro (Canadian Chapter President) met with SWS members Line Rochefort and Jacques Brisson, as well as SER Executive Director Bethanie Walder, SER Board Chair and Chapter Chairs, Canadian Land Reclamation Association President Andrea McEachern and Chapter Chairs, and conference center representatives to discuss plans for a potential joint meeting of the three societies in Quebec City in 2020. Following this meeting, a preliminary meeting proposal has been submitted to, and approved by, the SWS Future Meetings Committee. The FMC has forwarded their approval, along with the proposal, to the Board of Directors for a final vote by the BOD.

### 2017 Puerto Rico Annual Meeting!

Humberto the Frog wants to see you in Puerto Rico! If you have not yet registered, visit our website to see all the great field trips, workshops, and plenary speakers.



Best Regards,  
Gillian T. Davies ■



SWS, SER, and CLRA leaders met to plan the 2020 Joint Annual Meeting in Quebec City and find time to visit the Quebec City Ice Palace at the Winter Carnival. What a great venue!

## Marsh Restoration Using Thin Layer Sediment Addition: Initial Soil Evaluation

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### INTRODUCTION

Many coastal wetlands display degradation attributable to various factors including land development, erosion, salinization, and a lack of sediment inputs (Baras et al. 2003; Baumann et al. 1984). Additionally, conditions may worsen as impacts associated with sea level rise as well as increases in storm frequency and intensity exacerbate marsh stressors (Hauser et al. 2015). Marshes naturally exhibit a mosaic of vegetated and open water areas (Adamowicz and Roman 2005). However, studies document marsh fragmentation and subsequent degradation by examining an increase in the conversion of vegetated areas to open water (Figure 1; Turner 1997; Day et al. 2000).

Conceptual models of marsh degradation describe three processes: 1) drowning - whereby accretionary processes are outpaced by sea level rise, 2) edge retreat - caused primarily by wave erosion at lower marsh margins, and 3) marsh pond (sometimes referred to as pools or pannes) collapse - in which open water areas fail to maintain elevation relative to rising sea level and expand through continued edge erosion (Mariotti 2016). DeLaune and others (1994) described the process as pond initiation, in which newly formed open water areas allow for marsh degradation via erosion, collapse, and other mechanisms. In response, wetland restoration projects have been implemented over the past three decades to stabilize and enhance marsh ecosystems (Warren et al. 2002). Techniques include erosion control, invasive species removal, and re-establishment of natural wetland vegetation and tidal flow regimes (GM-CHRS 2004; Jackson 2009). Notably, in a recent article Smith and Niles (2016) highlights the need for improved



**FIGURE 1.** Site conditions in a degrading marsh near Avalon, New Jersey, USA in which portions of the marsh have shifted from vegetated areas to shallow open features that display signs of erosion and subsidence (left). Within vegetated sections of the marsh, *Spartina alterniflora* roots form a dense root mat that helps to stabilize marsh soils (right).

approaches to documenting marsh degradation and determining the potential benefits and/or risks associated with marsh restoration.

Broome and others (1988) identified important components in marsh restoration including elevation of the site in relation to tidal regime, slope, exposure to wave action, soil chemical and physical characteristics, nutrient supply, salinity and availability of viable propagules for revegetation. These factors highlight the need for restoration strategies that counterbalance subsidence, support a stable platform for plant growth, and keep pace with expected sea level rise while maintaining natural patterns of wetland hydrology and vegetation. The intentional application of sediments into marsh habitats has the potential to help achieve restoration goals by allowing the marsh to maintain elevation despite ongoing subsidence or sea level rise.

Dredged materials have been utilized for many years in wetland creation and restoration projects (Faulkner and Poach 1996; Craft 1999; Cahoon and Cowan 1988). Commonly, materials are deposited within diked containment areas, adjacent to shorelines, or in open water until target elevations are reached (Landin et al. 1989; USACE 1983; Berkowitz et al. 2015). The placement of dredged material

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directly onto the marsh surface remains challenging due to the need to achieve target elevations while maintaining or rapidly establishing the native plant communities that stabilize marsh soils (DeLaune et al. 1994). As a result, much interest has focused on the application of thin layers of dredged materials within existing marshes to support marsh elevation while enhancing existing habitat.

Wilbur (1992) defined thin layer placement techniques as the application of dredged materials to a thickness that does not transform the receiving habitat's ecological functions. Others have defined thin layer placement utilizing

**FIGURE 2.** Site preparation prior to thin layer sediment application included placement of coir logs to target areas receiving sediment additions (top). Thin layer placement of dredged materials involves spraying a dredged sediment slurry onto the marsh surface (bottom). (Photo courtesy of Tim Welp)



a layer thickness criteria ranging from as little as a few centimeters up to 50 cm. Sediment application typically occurs via the spraying of fluidized dredged materials onto the marsh surface (Figure 2). Ray (2007) provided a review of thin layer placement case studies. For example, Reimold and others (1978) performed initial small-scale studies in which *Spartina alterniflora* successfully recovered following the placement of 23 cm of dredged materials on the marsh surface. Placement of thick layers reduced or prevented plant recovery by rhizomes (Ford et al. 1999; Schriff et al. 2008). Other studies examined thin layer placement

techniques designed to restore or enhance degraded marshes through evaluation of plant communities (Pezeshki et al. 1992; Ford et al. 1999), invertebrates (Croft et al. 2006), soil organic matter and bulk density (Slocum et al. 2005), and marsh resilience following a disturbance (Stagg and Mendelssohn 2011).

### TESTING THIN LAYER SEDIMENT TO RESTORE DEGRADING SALT MARSH IN NEW JERSEY

Current efforts are utilizing thin layer applications of dredged materials to address concerns regarding marsh degradation and enhancement of marsh resilience and habitat within a large wetland complex located near Avalon, New Jersey, USA (Figure 3). The *S. alterniflora*-dominated marsh displayed several signs of instability including erosion, expansion of open water areas, and fragmentation. Sediment placement occurred between November 2015 and March 2016. Dredged sediments were obtained during channel maintenance from the federally-maintained New Jersey Intracoastal Waterway following Superstorm Sandy. Sediment placement depths ranged from 5-20 cm in vegetated areas and up to 50 cm in open water portions of the marsh. Primary project goals include stabilization of the marsh platform, increasing the elevation of recently developed open water areas to promote vegetation establishment, and evaluating the potential benefits of thin layer sediment application for other restoration activities. Stabilization of the degraded Avalon marsh will also provide continued benefits to the barrier island community of Avalon by maintaining protection from waves and erosion. Monitoring efforts to document restoration outcomes began in 2016 and will continue during 2017 and beyond.



Project partners will be monitoring responses of vegetation, fauna, and other factors to the thin layer placement effort, while our team is focused on soil physical, nutrient and biogeochemical properties. Soils provide the physical substrate supporting plant growth and soil microbial communities have been shown to respond quickly to changes in the environment (Slocum et al. 2005; Harris 2009). As a result, we believe that examining soil physical, nutrient, and microbial properties associated with restoration techniques remains an important component in evaluating restoration

**Figure 3.** Location of the tidal marsh in coastal New Jersey, USA. Note the location of the New Jersey Intracoastal Waterway, the source for dredged materials utilized in the thin layer application. The areas highlighted in white outline the portions of the marsh receiving thin layer sediment application.



trajectory and success (Table 1; Berkowitz 2013; Berkowitz and White 2013). Prior to dredged material placement, soil core samples were collected in vegetated and open water areas within the restoration footprint and in adjacent control regions of the marsh (Figure 4). The combination of pre-application data with subsequent soil collections will allow investigation of baseline soil property differences between vegetated and open water features in the marsh as well as change detection within control and treatment areas where thin layer applications have occurred.

**FIGURE 4.** Sampling conditions differed between open water areas and *S. alterniflora*-dominated sections of the marsh as indicated by the lack of soil stability in the open water areas. (Photo courtesy of Bobby McComas)



**TABLE 1.** Soil parameters being evaluated following thin layer sediment application and anticipated marsh response

<i>Physical properties</i>		<i>Anticipated marsh response</i>
Bulk density	Particle size	Soil horizon development; bulk density decrease; dredge material incorporated into the original soil material
Root distribution	Moisture content	
<i>Nutrient status</i>		
Soil organic matter	Total carbon	Accumulation of organic C, N, and P; C sequestration; improved nutrient cycling over time
Total phosphorus	Total nitrogen	
Extractable nitrate	Extractable ammonium	
Total dissolved nitrogen	Soluble reactive phosphorus	
Dissolved organic carbon		
<i>Microbial activity</i>		
Microbial biomass carbon	Microbial biomass nitrogen	Microbial communities become established; marsh functions dependent on microbes return to comparable marsh levels
Potentially mineralizable nitrogen		

We anticipate the partial recovery of marsh functions following dredged material placement based upon previous studies. For example, Craft and others (1999) examined constructed and planted *S. alterniflora* marshes over a 25-year period reporting accumulation of soil organic C and soil N and decreases in bulk density. However, soil properties did not correspond with values observed in a natural marsh. Thin layer placement applications may increase recovery timelines, due to the presence of potential seed sources for vegetation and microbial populations. Microbial communities represent a small but active nutrient pool in the soil environment, regulating biogeochemical cycling and bioavailability of nutrients (White and Reddy 2001). As marsh functions develop over time we expect soil horizon development, organic C, N, and P accumulation, as well as bulk densities and nutrient cycling to approach levels identified in the control marsh areas. Analysis of pre-treatment and initial post-treatment samples collected after thin layer placement of dredged materials are ongoing and should

lend insight into the implications and potential benefits of restoration techniques utilizing thin layer sediment application (Figure 5).

For further information on this project, please feel free to contact the senior author or the project leads Monica Chasten from the USACE Philadelphia District and Dave Golden from the New Jersey Department of Environmental Protection Division of Fish and Wildlife. ■

#### ACKNOWLEDGMENT

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**FIGURE 5.** *S. alterniflora* emerging from dredged materials utilized for marsh restoration via thin layer sediment application. The photos were taken approximately six months (a, b), nine months (c), and 18 months (d) after placement of dredged material.



funded jointly through the 2013 Disaster Relief Appropriations Act (Superstorm Sandy recovery) and National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Competitive Grant. The authors would also like to acknowledge the project leads Monica Chasten from the USACE Philadelphia District and Dave Golden from the New Jersey Department of Environmental Protection Division of Fish and Wildlife and the dedicated team including Ms. Metthea Yepsen from The Nature Conservancy and Ms. Jackie Jahn from GreenVest LLC., and all the other staff from the Green Trust Alliance and the Stone Harbor Wetlands Institute who assisted with these projects. Special acknowledgements are also offered for the dredging contractor, Barnegat Bay Dredging, Inc. dredge captains and crew whose innovation, teamwork and dedication contributed greatly to making this project successful. The authors would like to acknowledge the assistance of the USACE ERDC Program Managers, Ms. Linda Lillycrop and Dr. Todd Bridges for continual support of USACE Philadelphia District efforts to bring the Avalon marsh restoration project to fruition.

## REFERENCES

- Adamowicz, S. C. and C.T. Roman. 2005. New England salt marsh pools: a quantitative analysis of geomorphic and geographic features. *Wetlands* 25: 279-288.
- Barras, J., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kilner, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2003. Historical and projected coastal Louisiana land changes: 1978-2050. United States Geological Survey Open File Report 03-334.
- Baumann, R.H., J.W. Day, and C.A. Miller. 1984. Mississippi deltaic wetland survival: sedimentation versus coastal submergence. *Science* 224: 1093-1095.
- Berkowitz, J.F. and J.R. White. 2013. Linking wetland functional rapid assessment models with quantitative hydrological and biogeochemical measurements across a restoration chronosequence. *Soil Science Society of America Journal* 77: 1442-1451.
- Berkowitz, J.F. 2013. Development of restoration trajectory metrics in reforested bottomland hardwood forests applying a rapid assessment approach. *Ecological Indicators* 34: 600-606.
- Berkowitz, J.F., N. Beane, D. Evans, B. Suedel, and J. Corbino. 2015. Ecological survey of a dredged material supported wetland in the Atchafalaya River, Louisiana. *Wetland Science and Practice* 32(1).
- Broome, S.W., E.D. Seneca, and W.W. Woodhouse. 1988. Tidal salt marsh restoration. *Aquatic Botany* 32(10): 1-22.
- Cahoon, D.R. and J.H. Cowan, Jr. 1988. Environmental impacts and regulatory policy implications spray disposal of dredged material in Louisiana wetlands. *Coastal Management* 16: 341-362.
- Craft, C., J. Reader, J.N. Sacco, and S.W. Broome. 1999. Twenty-five years of ecosystem development of constructed *Spartina alterniflora* (Loisel) marshes. *Ecological Applications* 9: 1405-1419.
- Croft, A.L., L.A. Leonard, T. Alphin, L.B. Cahoon, and M. Posey. 2006. The effects of thin layer sand renourishment on tidal marsh processes: Masonboro Island, North Carolina. *Estuaries and Coasts* 29: 737-750.
- Day Jr., J.W., L.D. Britsch, S.R. Hawes, G.P. Shaffer, D.J. Reed, and D. Cahoon. 2000. Pattern and process of land loss in the Mississippi Delta: A spatial and temporal analysis of wetland habitat change. *Estuaries* 23: 425-438.
- DeLaune, R.D., J.A. Nyman, and W.H. Patrick Jr. 1994. Peat collapse, ponding and wetland loss in a rapidly submerging coastal marsh. *Journal of Coastal Research* 10: 1021-1030.
- Faulkner, S.P., and M.E. Poach. 1996. Functional Comparison of Created and Natural Wetlands in the Atchafalaya Delta, Louisiana. Technical Report WRP-RE-16. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Ford, M.A., D.R. Cahoon, and J.C. Lynch. 1999. Restoring marsh elevation in a rapidly subsiding salt marsh by thin-layer deposition of dredged material. *Ecological Engineering* 12: 189-205.
- Gulf of Maine Council Habitat Restoration Subcommittee (GMCHRS). 2004. The Gulf of Maine Habitat Restoration Strategy. Gulf of Maine Council on the Marine Environment.
- Harris, J. 2009. Soil microbial communities and restoration ecology: facilitators or followers? *Science* 325(5940): 573-574.
- Hauser S., M.S. Meixer, and M. Laba. 2015. Quantification of impacts and ecosystem services loss in New Jersey coastal wetlands due to hurricane sandy storm surge. *Wetlands* 35: 1137-1148.
- Jackson, A. 2009. Wetland Restoration in Delaware: A Landowner's Guide. Department of Natural Resources and Environmental Control. Dover, DE.
- Landin M.C., J.W. Webb, and P.L. Knutson. 1989. Long term monitoring of eleven Corps of Engineers habitat development field sites built of dredged material, 1974-1987. Technical Report D-89-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Mariotti, G. 2016. Revisiting salt marsh resilience to sea level rise: Are ponds responsible for permanent land loss? *Journal of Geophysical Research: Earth Surface* 121: 1391-1407.
- Pezeshki, S.R., R.D. DeLaune, and J.H. Pardue. 1992. Sediment addition and growth of *Spartina alterniflora* in deteriorating Louisiana Gulf Coast salt marshes. *Wetlands, Ecology and Management* 1: 185-189.
- Ray, G.L. 2007. Thin layer placement of dredged material on coastal wetlands: A review of the technical and scientific literature. ERDC/EL TN-07-1. US Army Corps of Engineers. Vicksburg MS.
- Reimold, R. J., M. A. Hardisky, and P. C. Adams. 1978. The effects of smothering a *Spartina alterniflora* salt marsh with dredged material. Dredged Material Research Program Technical Report D-78-38. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
- Schrift, A.M., I.A. Mendelssohn, and M.D. Materne. 2008. Salt marsh restoration with sediment-slurry amendments following a drought-induced large scale disturbance. *Wetlands* 28: 1071-1085.
- Slocum, M.G., I. Mendelssohn, and N.L. Kuhn. 2005. Effects of sediment slurry enrichment on salt marsh rehabilitation: Plant and soil responses over seven years. *Estuaries* 28: 519-528.
- Smith, J. and L. Niles. 2006. Are salt marsh pools suitable sites for restoration? *Wetland Science and Practice* 33(4): 101-109.
- Stagg, C.L. and I.A. Mendelssohn. 2011. Controls on resilience and stability in a sediment-subsidized salt marsh. *Ecological Applications* 21: 1731-1744.
- Turner, R.E. 1997. Wetland loss in the northern Gulf of Mexico: Multiple working hypotheses. *Estuaries* 20: 1-13.
- U.S. Army Corps of Engineers (USACE). 1983. Engineering and Design, dredging and dredge material disposal. Engineering Manual 1110-2-5025. March 25, 1983.
- Warren, R.S., P.E. Fell, R. Rozsa, A.H. Brawley, A.C. Orsted, E.T. Olson, V. Swamy, and W.A. Niering. 2002. Salt marsh restoration in Connecticut: 20 years of science and management. *Restoration Ecology* 10: 497-513.
- White, J.R. and K.R. Reddy. 2001. Influence of selected inorganic electron acceptors on organic nitrogen mineralization in everglades soils. *Soil Science Society of America Journal* 65: 941-948.
- Wilber, P. 1992. Thin-layer disposal: Concepts and terminology. Environmental Effects of Dredging. Information Exchange Bulletin D-92-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

## A Call for Action to Protect Vernal Ponds in Ontario

Gail Krantzberg<sup>1</sup> and Nick Luymes, McMaster University, Hamilton, ON; Dave Taylor, Douglas Markoff, and Kirushanth Gnanachandran, The Riverwood Conservancy, Mississauga, ON

### INTRODUCTION

Vernal ponds are broadly defined as ephemeral wetlands that predictably form in permanent basins during the cooler part of the year. They are considered to be vernal since they dry up during the summer months. According to Zedler (2003) they are particularly abundant on the Pacific Coast and in various forms in the glaciated landscapes of the north and northeast of the United States. In Ontario, they are generally situated in shallow depressions within forested terrain (Rheinhardt and Hollands 2007). Vernal ponds serve an important local biodiversity function due to their situation within surrounding terrestrial habitats. As with other wetlands in Ontario, vernal ponds are threatened by numerous anthropogenic stressors (Mahaney and Klemens 2008).

An important and often undervalued class of wetlands, vernal ponds (also called vernal pools) are one of many types of geographically isolated wetlands which are defined by Tiner (2003, p. 495) as “hydrophytic plant communities surrounded by terrestrial plant communities or undrained hydric soils surrounded by non-hydric soils.” Mitsch and Gosselink (2000) and Marton et al. (2015) explain that these wetlands are formed by natural forces that create depressions on the landscape wherein precipitation, near surface (i.e., interstitial) water, or groundwater create saturated soil conditions for sufficient duration for hydric soils and hydrophytic plant assemblages to develop.

Tiner (2003) identified iconic examples of U.S. vernal ponds similar to those in central Canada that are the primary habitat for animal species that require relatively predator-free ponds for feeding or breeding, including many amphibians. Some amphibians including mole salamanders and wood frogs depend on the ephemeral nature of vernal ponds for successful offspring development. Due to periodic dry phases, these ponds preclude the establishment of permanent fish populations that would normally prey upon the amphibian early life stages (Burne and Griffin 2003). Species like wood frog (*Rana sylvatica*), fairy shrimp and many mole salamanders are dependent on vernal ponds for

their reproduction. Vernal ponds provide critical habitat for significant species like the nationally threatened Jefferson salamander (*Ambystoma jeffersonianum*). The destruction of these ponds will result in the loss of the species that are dependent on vernal ponds for their survival and that cannot successfully complete their lifecycle in other habitats (Amphibian Voice 2004).

Many species of adult frogs and salamanders seek out vernal ponds early in the season and mate and lay eggs in shallow ponds. The young develop in the pools and metamorphose to their terrestrial form, after which they disperse into non-aquatic habitats in the surrounding landscape where they feed and hibernate (Kenney and Burne 2001; Gibbons 2003; Calhoun and deMaynadier 2008). It is the attribute of predator-free pools that appears to be critical (Zedler 2003). Many amphibians cannot successfully reproduce in permanent waters where the eggs and aquatic stages of the young are highly vulnerable to predation. Elimination of these “unconnected” wetlands could be devastating to amphibians (Semlitsch and Bodie 1998).

Vernal pools contribute to the connectivity of habitats through the establishment of dense pool networks. These networks provide important travel corridors between larger wetlands and support immigration and emigration across multiple pools (Leibowitz 2003; Compton et al. 2007). Species of turtles, snakes and birds use vernal pools as temporary sanctuaries during migration to rest, drink and forage for food (Mitchell et al. 2007). Vernal pools are also home to diverse shrub and herbaceous plant communities including Rice Cutgrass – Bulrush Vernal Pool, Woolgrass – Manna Grass Mixed Shrub Marsh, and Buttonbush Wetland. The vegetation often closely fits the Red Maple Forest Type ([http://www.naturalheritage.state.pa.us/VernalPool\\_Vegetation.aspx](http://www.naturalheritage.state.pa.us/VernalPool_Vegetation.aspx)). Some species are only found in the unique semi-permanent environments provided by the pools (Cutko and Rawinski 2008). The ecological relationships associated with vernal pools maintain forest biodiversity and contribute to many important ecological services ranging from carbon sequestration to water storage (Hunter 2007). In order to conserve these important services, proper understanding and management of potential threats is required.

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The integrity of vernal pool habitat is dependent on specific hydrologic, biologic, and chemical conditions. Anthropogenic stressors can compromise the stability of these conditions and lead to a loss of ecological function (Mahaney and Klemens 2008). Prominent stressors for vernal pools include urban or rural development, invasive species, and climate change. Development is considered to be the greatest threat to vernal pool habitat (Mahaney and Klemens 2008). Besides directly removing habitat, development can lead to many indirect threats, such as nonpoint source pollution and loss of connectivity. For example, runoff from roads and agriculture can end up in the vernal pool basin, compromising the chemical integrity of the receiving water body (Whigham and Jordan 2003). Like development, invasive species and climate change compromise the function of vernal pool habitat. Invasive species outcompete native species, leading to a loss in biodiversity (Cutko and Rawinski 2008). Climate change that involves reduced precipitation or alters precipitation pattern impacts the hydrology of vernal pools and may lead to shorter periods of inundation (Brooks 2009). This is a problem for species, such as mole

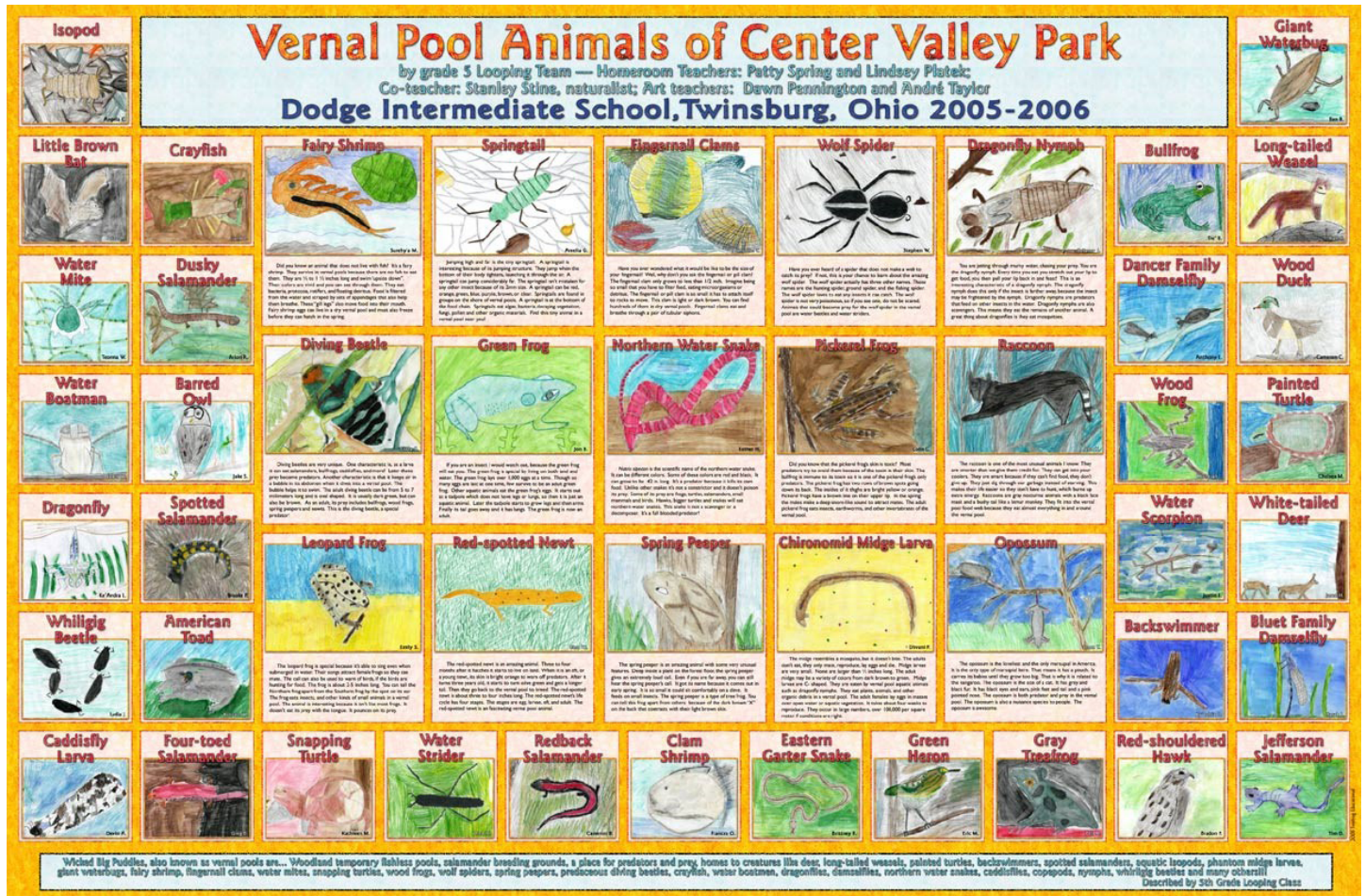
salamanders, that require a certain amount of time in order for their offspring to complete metamorphosis.

Threats from development are not limited to the pool basin. The forested upland surrounding the pools also provides essential habitat for vernal pool species and is similarly susceptible. For example, roads that intersect with upland habitat act as barriers for organisms trying to migrate to the pool (Leibowitz 2003). Moreover, destruction of habitat surrounding the pool degrades or eliminates other habitat necessary to complete the life cycle of vernal pool-dependent animals.

### SOCIETAL BENEFITS

Citizen science is increasingly seen as a way to engage the public in science, improve scientific literacy and interest in science, and inform participants about particular topics, such as insect ecology, vernal pool conservation, or climate change (Lowman et al. 2009). This is a major departure from most of the history of citizen science, when projects were set up mainly to achieve scientific objectives. Instead, many are now being organized primarily as a means to

**FIGURE 1.** Example of a vernal pool school project in Ohio, where students helped create an educational sign for a local park. (<http://www.vernalpool.org/treefrog/pop/06T-DIS-VPA.htm>)



**FIGURE 2.** Location of the MacEwan Pond within Riverwood (Latitude 43.56582 Longitude: -79.67030). (<http://www.riverwoodconservancy.org/>)



improve participants' scientific literacy and understanding of the topics they were studying (Bonney et al. 2009a). Miller-Rushing et al. (2012) believe that this renewed interest in citizen science, enriched with the perspectives and data provided by the long tradition of public participation in science, will broaden the engagement of the public in ecological research and lead to improvements in scientific education and insight.

Educators can use vernal pools to teach environmental and ecological concepts (Windmiller and Calhoun 2007). They use vernal pools for outdoor laboratories and in the development of associated education programs (Pressier 2000).

The Region of Peel upper tier municipality, in evaluating the significance of the vernal pool in Meadowvale, Mississauga, Ontario, points out that since a large portion of this natural area is public, opportunities exist to map, monitor and potentially control invasive species at that location. The use of the area by the public also presents an opportunity for educational messaging and awareness-raising by various means on themes revolving around the ecology of the area, environmental stewardship, and habitat restoration. Maintenance and enhancement, where possible, of natural buffers along the Credit River is encouraged by the municipality. Also encouraged is the maintenance of

natural linkage between each of the sections of the natural area and adjacent natural and successional habitats (Region of Peel Meadowvale Station Woods. [http://www.peelregion.ca/planning-maps/NAI/site\\_summaries/Meadowvale\\_Station\\_Woods.pdf](http://www.peelregion.ca/planning-maps/NAI/site_summaries/Meadowvale_Station_Woods.pdf)).

The benefits of vernal pools are still an active area of research in northeastern North America (e.g., Calhoun and deMaynadier 2008; Lane and D'Amico 2010). Such research will increase our understanding of the conservation value of vernal pools. This value can be weighed against the value of proposed disturbances to help guide the decisions of land use planners.

Wetlands perform many ecosystem services, including aquifer recharge, carbon sequestration, biogeochemical processing, floodwater attenuation, improvement and maintenance of water quality and quantity, food and fiber provisioning, and maintenance of wildlife refuge (Lane and D'Amico 2010). Other research into ecosystem services provided by isolated or depressional wetlands have identified carbon sequestration in prairie potholes (Euliss et al. 2006), phosphorous and nitrogen processing and assimilation in emergent marshes (Whitmire and Hamilton 2005; Dunne et al. 2007), provision of water storage capacity in urban and agricultural landscapes (Gamble et al. 2007; Gleason et al. 2007), and pesticide degradation and/or sequestration in isolated pools in farmed systems (Skagen et al. 2008). Lane and D'Amico (2010) contend that water storage in wetlands has far-reaching effects. They state that "hydrology in a given site or suite of sites drives the creation and maintenance of vegetation structure and wildlife habitat, redoximorphic potential and microbial activities, and organic matter concentration for sorption of pesticides and other contaminants."

The social benefits of vernal pools have been less studied. Potential social benefits that should be researched in Ontario include the use of vernal pools in outdoor education, their aesthetic value, and their influence on air and water quality. Vernal pools provide an interesting ecological learning opportunity for students in Ontario's education system. Their small size, diverse ecology, and wide distribution make vernal pools an accessible teaching resource. Vernal pools often go relatively unnoticed due to their ephemeral nature. In fact, the public typically perceives vernal pools in negative light because they can act as mosquito breeding habitat. Vernal pool curricula in schools can increase public awareness of the benefits of vernal pool ecosystems and thereby encourage a positive perception for the public at large.

The use of vernal pools in laboratories and curricula is not new (Figure 1). Schools in the U.S. have collaborated with local governments, state governments, researchers, and conservation groups to develop lesson plans around vernal pool ecology (Gruner and Haley 2007). Some schools have gone so far as to create long-term monitoring programs for the vernal pools. In Ontario, the Ontario Vernal Pool Association now visits schools to give presentations on the importance of vernal pools.

**CASE STUDY: MACEWAN POND, RIVERWOOD**

Roughly 12,000 years ago a chunk of the last continental glacier broke off and sat surrounded by a lake formed by the melting ice in Mississauga, Ontario. In time the glacier would recede but the land-bound iceberg remained (Chapman and Putman 1984). Glaciers ground down rock and in the process created sand. The sand was blown about by the katabatic winds that blew off the glacier. Some of that sand swirled around the chunk of ice and when that iceberg finally melted a depression was left in the ground.

The depression filled with water. The glacial lake retreated as it drained first down the Mississippi River valley, then through the Hudson River Valley and finally (as the lake levels decreased and the ice retreated further north) out the St. Lawrence (Meltzer 2010; Strock 2004). That depression (i.e., a kettle pond; [http://geo.msu.edu/extra/geogmich/kettle\\_lakes.html](http://geo.msu.edu/extra/geogmich/kettle_lakes.html)) remained and is now called MacEwan Pond (Figure 2).

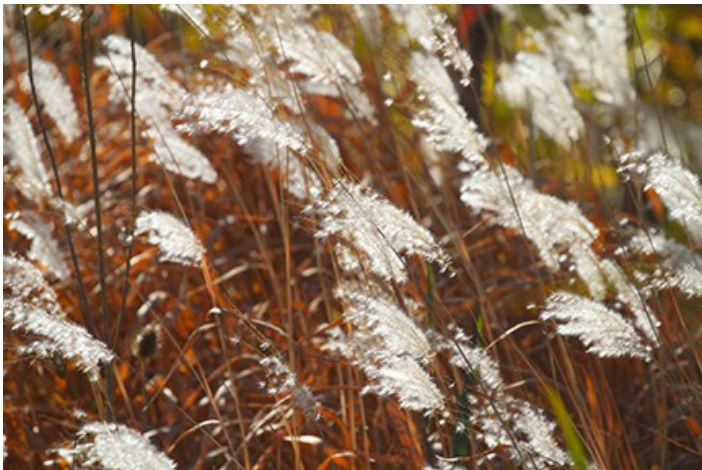
The character of the pond and its landscape setting have changed over the millennia as the climate changed. The pond was first surrounded by conifers, then by deciduous forests and finally by the mixed Great Lakes forest of today (Riley 2013). Through treaties with the Mississauga tribe the land along the Lake Ontario shore and the Credit River was purchased by the Canadian government in the early 1830s. It was then subdivided into 200-acre plots. By 1840 the land was being cleared around the pond. The great forests that had stretched unbroken from Quebec to the Great Plains were being cut down and used to fuel a new economy (Taylor 2013).

**FIGURE 3.** A variety of animals frequent MacEwan Pond: a) painted turtles, b) leopard frog, c) muskrat, and d) wood duck. (Photos courtesy of Nick Luymes)



The pond became a “farmer’s pond” surrounded by fields of orchards and fenced off from cattle and farming practices (R. MacDonald, pers. comm., January 2017). For over 130 years its status as such remained unthreatened, however in the latter part of the 20th Century, there was concern over its future status as the character of the province was changing from an agricultural community where 80% of the population farmed to an urban community where 80% of the people worked in towns and cities (<http://www5.statcan.gc.ca/subject-sujet/theme-theme.action?pid=3867&lang=eng&more=0&MM>). In the mid-1980s, a small group of Mississauga residents lobbied to save the 160 acres of farmland around the wetland. At that time, the Mississauga Garden Council lobbied the City of Mississauga to keep it in the public purview. The City was undecided on their use of the property once they had purchased it in 1989 (<https://localwiki.org/mississauga/Riverwood>), but they had a vision to maintain it as a central green space for the public. The Mississauga Garden Council, now The Riverwood Conservancy (TRC; <http://www.theriverwoodconservancy.org/>), was successful in collaborating with the City and the Credit Valley Conservation Authority to secure “Riverwood” for the public.

**FIGURE 4.** Common Reed (*Phragmites australis*) in MacEwan Pond 2012. (Photo courtesy of Nick Luymes)



**FIGURE 5.** MacEwan Pond in 2006. (Photo courtesy of Nick Luymes)



Construction in Riverwood saw a new entrance road completed in 2005, and to keep the pond intact a berm was built (R. MacDonald, pers. comm. January 2017). A bioswale was built to filter water from the parking lot before it reached the pond thereby reducing the impact of storm-water run-off. In 2006 the public could stand at the edge of the pond and see a variety of animals including turtles, frogs, muskrat and several bird species in the water (Figure 3) plus deer that came down to drink. A diversity of plants colonized its edges.

The pond now serves as a teaching resource where students are able to sample water and examine microscopic aquatic life. Through various programs at the Riverwood Conservancy, students learn how to chemically, physically, and biologically analyze water samples. They use probes, nets, GPS, and other tools to investigate the health of the ecosystem. Students get to explore human impact on the system, collect benthic invertebrates and other bio-indicators, and submerge themselves in their learning. Through the L.E.A.D.S. (Leadership in Environmental Achievements through Diversity and Skills) programs, secondary students are brought out of the classroom into the varied habitats of Riverwood (e.g., ponds, meadows and gardens)

**FIGURE 6.** MacEwan Pond in 2013. (Photo courtesy of Nick Luymes)





to connect students with nature through hands-on scientific inquiry (e.g., conduct field research and build technical and leadership skills) and also help prepare them for future careers in science and geography.

For travellers who stopped to visit Riverwood, the pond provided a window into historic hydrogeologic events. The last few years have seen the pond change into a true vernal pond and then recede into a virtually water-free depression (Taylor 2013). There are three major causes for this: 1) prolonged droughts, 2) the establishment of the invasive common reed (*Phragmites australis*; Figure 4), and 3) changes brought about by construction of gardens and parking lots adjacent to the pond (R. MacDonald, pers. comm. January 2017). Where historically water was retained most of the year in the pond, it is now dry for most of the year (Figures 5 and 6).

To the best of our knowledge, *Phragmites* first established itself in the pond in the summer of 2011. This was in the north-west corner of the pond, where it was outcompeting another invasive plant, purple loosestrife (*Lythrum salicaria*). By 2015, it had taken over 900m<sup>2</sup> of the pond, with some populations of cattails (*Typha* sp.) still functioning, and sparse purple loosestrife stands intact. In 2016, The Riverwood Conservancy initiated efforts to control *Phragmites* by removing seed heads to stop potential seed spread and cutting down the stems and in the winter months to allow for the re-establishment of open water (Figures 7 and 8). From March until May 2016, open water habitat was re-established in the pond, enabling breeding frogs and waterfowl to return. Given the extensive root system and energy reserves of *Phragmites*, it is anticipated that the plants will grow back. In 2017 efforts will be made to cut down the plants in August and September, when most of its energy is in the shoot and belowground energy reserve is at its minimum. This should help weaken the plant, potentially decreasing stalk growth for future years. A priority of The Riverwood Conservancy is to bring the pond back to a healthy and resilient condition by aggressively addressing the *Phragmites* problem (as noted above) and dredging the pond to re-establishing open water habitat. Until the dredging is completed, it is unlikely that *Phragmites* will be successfully eliminated from the pond.

At present, following dredging of pond sediment to at least one meter's depth, the plans for pond restoration include deeper areas at the inlet for sedimentation, raptor poles, an accessible boardwalk and outdoor classroom, an accessible shoreline classroom with sitting rocks, and landscape restoration planting (Figure 9).

#### **NEED FOR MORE GOVERNMENT ACTION ON VERNAL POOLS**

The protection of wetlands has been identified as a priority by the Ontario Ministry of Natural Resources and Forestry (MNRF). The MNRF is currently creating a wetland conservation strategy that will outline the province's goals related to awareness, knowledge, collaboration and policy development. Ontario currently grants protection from

**FIGURE 7.** Common reed stand in MacEwan Pond, October 2013. (Photo courtesy of Kirushanth Gnanachandran)



**FIGURE 8.** Open waters re-established after *Phragmites* removal, March 2016. (Photo courtesy of Kirushanth Gnanachandran)



alteration and development to provincially significant wetlands (Ministry of Municipal Affairs and Housing 2014). A wetland is considered to be provincially significant if it meets specific criteria outlined in the Ontario Wetland Evaluation System (OWES). There are currently only four types of wetlands in Ontario that can be given the status of provincial significance: marshes, swamps, fens and bogs (MNRF 2014). Despite having a detailed protection strategy for large Ontario wetlands, vernal pools are not considered to be provincially significant unless they are part of a larger, provincially significant wetland complex (MNRF 2014). On their own, vernal pools are granted protection from development and alteration if they are known to be habitat for a “*species at risk*” (MNRF 2007). Only a select number of “*species at risk*” are known to be obligate users of vernal pools, so protection is limited to specific geographic areas. In order to protect the biodiversity and ecosystem services provided by vernal pools, additional protection is needed.

The dissemination of information regarding vernal pools has been sparse in Ontario. Vernal pools are mentioned in one of the appendices of the OWES, but only as a feature to make note of, if present, within the wetland under evaluation. On the government webpage for wetland conservation, the MNR does not recognize vernal pools as classified wetlands. Similar webpages for U.S. states contiguous with Ontario (e.g., Michigan, Ohio, and New York) do recognize vernal pools as an independent class of wetland and will often include additional information dedicated to vernal pools. The small body of vernal pool research in the province may be related to this lack of special recognition. Moreover, there are no government research grants to encourage research in vernal pools.

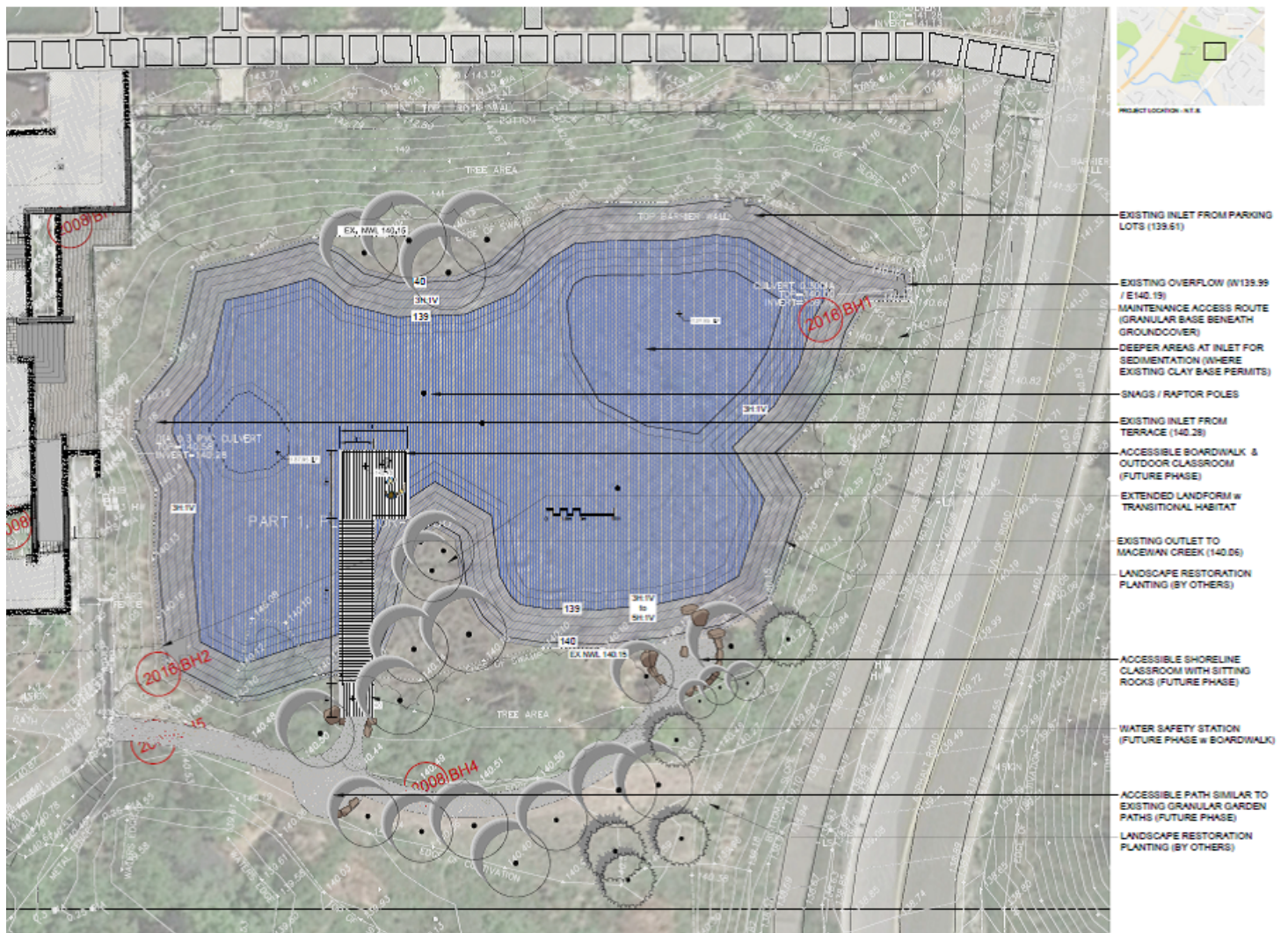
The Ontario Vernal Pool Association (OVPA) is perhaps the most prominent organization promoting vernal pool awareness across the province. The OVPA organizes workshops, hikes and presentations for schools and municipalities (Mahaney and Klemens 2008). The OVPA stresses

that the pools act as accessible outdoor laboratories where students can learn biological concepts such as biodiversity and metamorphosis, as has been the case with The Riverwood Conservancy. The OVPA also works with municipal governments to establish plots of land with vernal pools as natural heritage sites (Mahaney and Klemens 2008). Under the Planning Act, natural heritage sites in Ontario are protected from development that would be incompatible with the current function of the site.

## CONCLUSION

We recommend more attention be paid to the unique features vernal pools provide, and that their protection and restoration be a provincial priority. While the landscape around Riverwood's MacEwan Pond resembles little of its historic setting (Figure 10), work continues to bring back to health the function of the MacEwan Pond for the benefit of biodiversity of the region, and education of youth and adults about environmental science and conservation. ■

**FIGURE 9.** MacEwan Pond Restoration Plan. (Courtesy of The Riverwood Conservancy)



## ACKNOWLEDGEMENTS

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## REFERENCES

Amphibian Voice. 2004. *Newsletter of the Adopt-A-Pond Wetland Conservation Programme*. Sponsored by Banrock Station Wetlands Foundation Canada. Vol 14 (1).

Bourgeau-Chavez, L. L., Lee, Y. M., Battaglia, M., Endres, S. L., Laubach, Z. M., & Scarbrough, K. 2016. Identification of woodland vernal pools with seasonal change PALSAR data for habitat conservation. *Remote Sensing* 8(8): 1–21.

Brooks, R.T. 2009. Potential impacts of global climate change on the hydrology and ecology of ephemeral freshwater systems of the forests of the northeastern United States. *Climatic Change* 95: 469–483.

Burne, M.R. and C.R.Griffin. 2005. Habitat associations of pool-breeding amphibians in eastern Massachusetts, USA. *Wetlands Ecology and Management* 13: 247–259.

Calhoun, A.J.K. and P.G. deMaynadier (eds.). 2008. *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL.

Calhoun, A. and M. Klemens. 2002. *Conserving Pool-Breeding Amphibians in Residential and Commercial Developments in the Northeastern United States*, Metropolitan Conservation Alliance, Wildlife Conservation Society.

Chapman, L.J. and D.F. Putman. 1984. *The Physiography of Southern Ontario*. Ontario Ministry of Natural Resources, Ottawa, Canada. Ontario Geological Survey Special Volume 2.

Compton, B. W., McGarigal, K., Cushman, S. A., & Gamble, L. R2007. A resistant-kernel model of connectivity for amphibians that breed in vernal pools. *Conservation Biology* 21(3): 788–799.

Cutko, A. and T. Rawinski. 2008. Flora of northeastern vernal pools. Chapter 5. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. pp. 71–104.

DEP, 2007. Natural Resources Protection Act. Maine Department of Environmental Protection, Augusta, ME.

DEP, 2009. Vernal Pools: A Significant Wildlife Habitat. Maine Department of Environmental Protection, Augusta, ME.

Ducks Unlimited Canada. 2010. *Southern Ontario wetland conversion analysis: final report*. Ducks Unlimited. Barrie, ON.

**FIGURE 10.** Aerial view of MacEwan Pond, circa 1912, surrounded by forests and farmland. (Photo supplied by R. MacDonald)



- Dunne, E.J., J. Smith, D.B. Perkins, M.W. Clark, J.W. Jawitz, and K.R. Reddy. 2007. Phosphorus storages in historically isolated wetland ecosystems and surrounding pasture uplands. *Ecological Engineering* 31: 16–28. doi:10.1016/j.ecoleng.2007.05.004
- Eigenbrod, F., S. Hecnar, and L. Fahrig. 2009. Quantifying the road-effect zone: threshold effects of a motorway on anuran populations in Ontario, Canada. *Ecology and Society* 14(1). <http://www.ecologyandsociety.org/vol14/iss1/art24/>
- Euliss, N.H. Jr, R.A. Gleason, A. Olness, R.L. McDougal, H.R. Murkin, R.D. Robarts, R.A. Bourbonniere, and B.G. Warner. 2006. North American prairie wetlands are important nonforested land-based carbon storage sites. *The Science of the Total Environment* 61: 179–188.
- Freda, J., 1991. The effects of aluminum and other metals on amphibians. *Environmental Pollution* 71: 305–328.
- Gamble, D.L. and W.J. Mitsch. 2009. Hydroperiods of created and natural vernal pools in central Ohio: A comparison of depth and duration of inundation. *Wetlands Ecological Management* 17: 385–395.
- Gamble, D., E. Grody, J. Undercoffer, J.J. Mack, and M. Micacchion. 2007. *An ecological and functional assessment of urban wetlands in Central Ohio Volume 2: Morphometric surveys, depth-area-volume relationships and flood storage function of urban wetlands in central Ohio*. Ohio EPA Technical Report WET/2007-3B, Ohio Environmental Protection Agency, Columbus, OH.
- Gibbons, J.W. 2003. Terrestrial habitat: a vital component for herpetofauna of isolated wetlands. *Wetlands* 23: 630–635.
- Gleason R.A., B.A. Tangen, M.K. Laubhan, K.E. Kermes, and N.H. Jr. Euliss. 2007. *Estimating water storage capacity of existing and potentially restorable wetland depressions in a subbasin of the Red River of the North*. U.S. Geological Survey Open File Report 2007-1159. U.S. Geological Survey, Reston, VA.
- Gruner, H. and R. Haley. 2007. Vernal pools as outdoor laboratories for educators and students. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. pp. 299–318.
- Haxton, T. and M. Berrill. 1999. Habitat selectivity of *Clemmys guttata* in central Ontario. *Canadian Journal of Zoology* 77: 593–599.
- Hunter Jr., M. 2007. Valuing and conserving vernal pools as small-scale ecosystems. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. pp. 1–10.
- Karraker, N.E. and J.P. Gibbs. 2009. Amphibian production in forested landscapes in relation to wetland hydroperiod: A case study of vernal pools and beaver ponds. *Biological Conservation* 142: 2293–2302.
- Kenney, L. P., and M. R. Burne. 2001. *A Field Guide to the Animals of the Vernal Pools*. Massachusetts Division of Fisheries and Wildlife and the Vernal Pool Association, Westborough, MA.
- Lane C.R. and E. D'Amico. 2010. Calculating the ecosystem service of water storage in isolated wetlands using LiDAR in North Central Florida, USA. *Wetlands* 30: 967–977.
- Leibowitz, S.G. 2003. Isolated wetlands and their functions: an ecological perspective. *Wetlands* 23: 517–531.
- MacCallum, W. 2009. *Guidelines for the certification of vernal pool habitat*. Commonwealth of Massachusetts. Division of Fisheries and Wildlife, Westborough, MA.
- Markle, C.E. and P. Chow-Fraser. 2014. Habitat selection by the Blanding's Turtle (*Emydoidea blandingii*) on a protected island in Georgian Bay, Lake Huron. *Chelonian Conservation and Biology* 13: 216–226.
- Marton, J.R., I.F. Creed, D.B. Lewis, C.R. Lane, N.B. Basu, M.J. Cohen and C.B. Craft. 2015. Geographically isolated wetlands are important biogeochemical reactors on the landscape. *BioScience* 65: 408–418.
- Meltzer, D.J. 2010. *First Peoples in a New World: Colonizing Ice Age America*. University of California Press, Berkeley, CA.
- Van Meter, R., L.L. Bailey, and E.H.C. Grant. 2008. Methods for estimating the amount of vernal pool habitat in the northeastern United States. *Wetlands* 28: 585–593.
- Miller-Rushing, A., R. Primack, and R. Bonney. 2012. The history of public participation in ecological research. *Front Ecol Environ* 10: 285–290.
- Ministry of Municipal Affairs and Housing. 2014. *Provincial Policy Statement*. Ottawa, ON.
- Mitchell, J., P. Paton, and M. Reed. 2007. The importance of vernal pools to reptiles, birds, and mammals. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. 169–192.
- Mitsch, W.J. and J.G. Gosselink. 2000. The value of wetlands: importance of scale and landscape setting. *Ecological Economics* 35: 25–33.
- Ontario Ministry of Natural Resources and Forestry (OMNRF). 2014. *Ontario Wetland Evaluation System*. 3rd Edition. Ottawa, ON.
- Ontario Ministry of Natural Resources and Forestry (OMNRF). 2007. *Endangered Species Act*. Ottawa, ON.
- Preisser, E., J. Kefer, and J. Lawrence. 2016. Vernal pool conservation in Connecticut: an assessment and recommendations. *Environmental Management* 26: 503–513.
- Region of Peel Meadowvale Station Woods. Accessed on January 23, 2017. [http://www.peelregion.ca/planning-maps/NAI/site\\_summaries/Meadowvale\\_Station\\_Woods.pdf](http://www.peelregion.ca/planning-maps/NAI/site_summaries/Meadowvale_Station_Woods.pdf)
- Rheinhardt, R. and G. Hollands. 2007. Classification of vernal pools: geomorphic settings and distribution. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. pp. 11–30.
- Riley, J.L. 2013. *The Once and Future Great Lakes, an Ecological History*. McGill-Queens University Press, Montreal, QC. pp. 3–13, plate 15.
- Semlitsch, R.D., and J.R. Bodie. 1998. Are small, isolated wetlands expendable? *Conservation Biology* 12: 1129–1133.
- Skagen, S.K., C.P. Melcher, and D.A. Haukos. 2008. Reducing sedimentation of depressional wetlands in agricultural landscapes. *Wetlands* 28: 594–604.
- Strock, P.L. 2004. *Journey to the Ice Age, Discovering an Ancient World*. University of British Columbia Press, Vancouver, BC.
- Taylor, D. 2013. *Riverwood: A Journey through Time Climate and Change*. The Riverwood Conservancy, Mississauga, ON.
- Tiner, R.W. 1997. NWI Maps: What they tell us. *National Wetlands Newsletter* 19: 5–12.
- Tiner, R.W. 2003. Geographically isolated wetlands of the United States. *Wetlands* 23: 494–516.
- Whigham, D. and T.E. Jordan. 2003. Isolated wetlands and water quality. *Wetlands* 23: 541–549.
- Whitmire, S.L. and S.K. Hamilton. 2005. Rapid removal of nitrate and sulfate in freshwater wetland sediments. *Journal of Environmental Quality* 34: 2062–2071.
- Windmiller, B. and A. Calhoun. 2007. Conserving vernal pool wildlife in urbanizing landscapes. In A.J.K. Calhoun and P.G. deMaynadier (eds.). *Science and Conservation of Vernal Pools in Northeastern North America*. CRC Press, Boca Raton, FL. pp. 233–252.
- Zedler, P.H. 2003. Vernal pools and the concept of “isolated wetlands”. *Wetlands* 23: 597–607.

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## **Scientists Discover Largest Tropical Peatland in Africa**

*The January 11 issue of the NY Times reported on this*

<https://www.nytimes.com/2017/01/11/science/peat-swamp-congo-global-warming.html>

Scientists have mapped what they say is the largest peatland in the tropics, an area larger than New York State in the Congo Basin [in Central Africa](#).

The peat, which consists of slowly decomposing vegetation in swamp forests, has been accumulating for more than 10,000 years. As in all peatlands, the vegetation is a natural storehouse of carbon taken from the atmosphere — in this case, about 30 billion metric tons of carbon, or roughly equivalent to the carbon in two decades of fossil fuel emissions in the United States.

“It’s astonishing to me that in 2017 we can be making these kinds of discoveries,” said Simon Lewis, a professor at the University of Leeds in England and an author of a [study](#) on the peatlands being published on Wednesday in the journal Nature. ■

## **The Future of Science in U.S. - Counsel from our Northern Neighbor**

In what appears to be the first major political assault on science conducted by and environmental protection directed by the U.S. federal agencies, Representative Matt Gaetz (FL) introduced H.R. Bill 861 to terminate the U.S. Environmental Protection Agency on February 3, 2017 (<https://www.congress.gov/bill/115th-congress/house-bill/861/all-info?r=124>). The bill is now in committee. How do we as scientists respond to this and other administrative actions that slash research budgets and eliminate environmental safeguards?

The New York Times recently published an article about how Canadian scientists dealt with politics that were threatening their research. One of our readers thought that you might find this article of interest. Click the link below to read the article:

[https://www.nytimes.com/2017/02/14/opinion/when-canadian-scientists-were-muzzled-by-their-government.html?\\_r=0](https://www.nytimes.com/2017/02/14/opinion/when-canadian-scientists-were-muzzled-by-their-government.html?_r=0) ■

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

- 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)  
[-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/ntcww.html](http://rsgisias.crrel.usace.army.mil/nwpl_static/ntcww.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](http://erdc.gov/ERDC/EL-TR-13-1)
- Hydrogeomorphic (HGM) Approach to Assessing Wetland Functions: Guidelines for Developing Guidebooks (Version 2) [ERDC/EL TR-13-11](http://erdc.gov/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](http://erdc.gov/ERDC/EL-TR-13-12)

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

- Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York [http://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/Characterization\\_Report\\_February\\_2015.pdf](http://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/Characterization_Report_February_2015.pdf) or [http://www.aswm.org/wetland-sonestop/wetland\\_characterization\\_long\\_island\\_ny\\_021715.pdf](http://www.aswm.org/wetland-sonestop/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-one-stop/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](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](http://www.aswm.org/wetland-science/134-wetlands-one-stop/5044-nwi-reports)
- [Potential Wetland Restoration Sites for Connecticut: Results of a Preliminary Statewide Survey](http://www.aswm.org/wetland-science/134-wetlands-one-stop/5044-nwi-reports)
- [Wetlands and Waters of Connecticut: Status 2010](http://www.aswm.org/wetland-science/134-wetlands-one-stop/5044-nwi-reports)
- [Connecticut Wetlands: Characterization and Landscape-level Functional Assessment](http://www.aswm.org/wetland-science/134-wetlands-one-stop/5044-nwi-reports)
- Rhode Island Wetlands: Status, Characterization, and Landscape-level Functional Assessment [http://www.aswm.org/wetlandsonestop/rhode\\_island\\_wetlands\\_llww.pdf](http://www.aswm.org/wetlandsonestop/rhode_island_wetlands_llww.pdf)

## 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](http://acwc.sdp.sirsi.net/client/en_US/search/asset/1047786)

- 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](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](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](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](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](http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5363703.pdf)

### U.S. GEOLOGICAL SURVEY, NATIONAL WETLANDS RESEARCH CENTER

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

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

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

### PUBLICATIONS BY OTHER ORGANIZATIONS

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

- Wetlands and People (International Water Management Institute) <http://www.iwmi.cgiar.org/Publications/Books/PDF/wetlands-and-people.pdf>

### ARTICLES OF INTEREST FROM VARIED SOURCES

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

### LINKS TO WETLAND-RELATED JOURNALS AND NEWSLETTERS

#### JOURNALS

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

#### NEWSLETTERS

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://nrmnh.typepad.com/the\\_plant\\_press/](http://nrmnh.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](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/>

### Wetland Science & Practice 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.

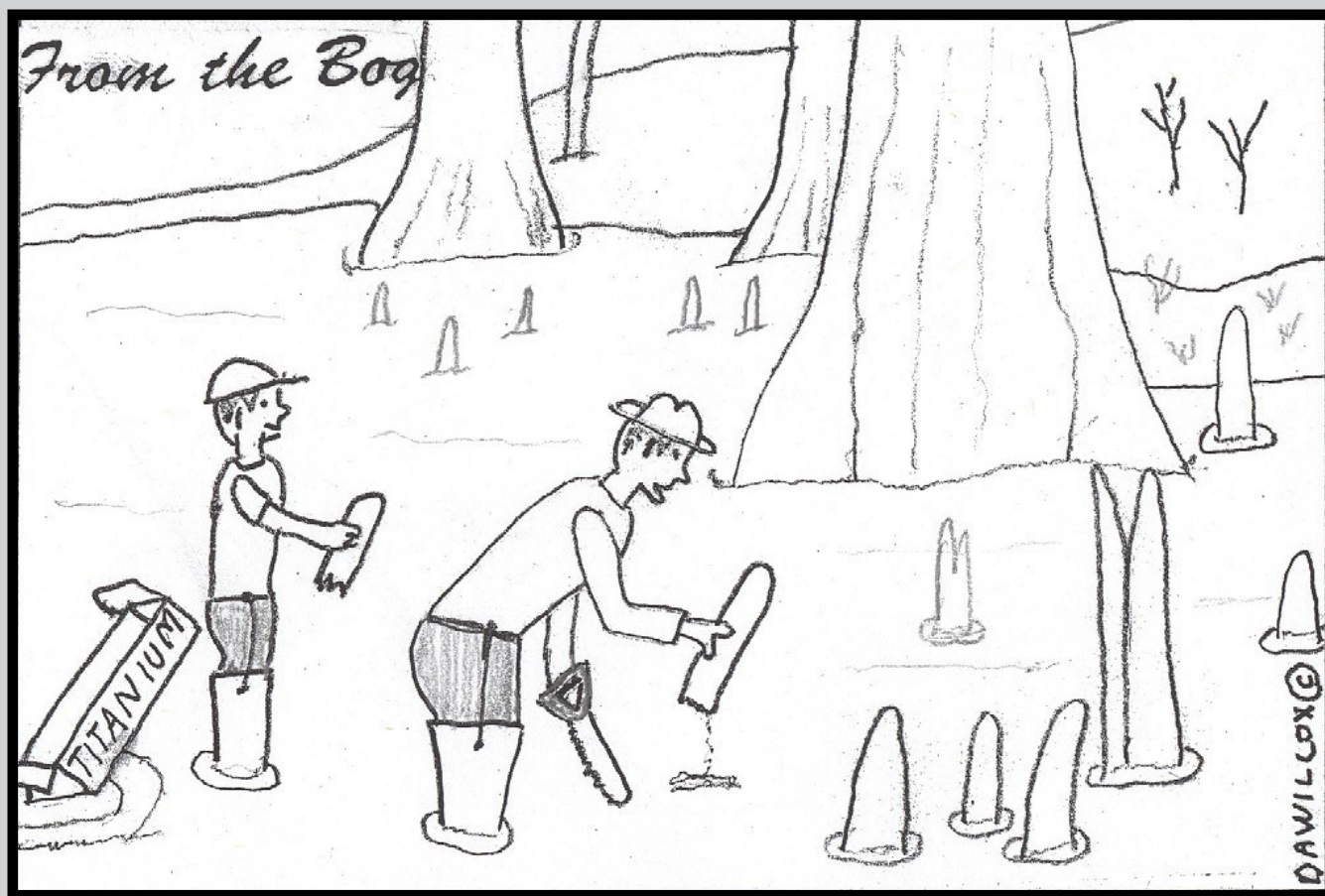
If you have questions, please contact the editor, Ralph Tiner at [ralphtiner83@gmail.com](mailto:ralphtiner83@gmail.com) ■



# 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](http://sws.org).



## Bald cypress knee-replacement surgery

### wetland science & practice

The WSP is the formal voice of the Society of Wetland Scientists. It is a quarterly publication focusing on the news of the SWS, at international, national and chapter levels, as well as important and relevant announcements for members. In addition, manuscripts are published on topics that are descriptive in nature, that focus on particular case studies, or analyze policies. All manuscripts should follow guidelines for authors as listed for Wetlands as closely as possible.

All papers published in WSP will be reviewed by the editor for suitability. Letters to the editor are also encouraged, but must be relevant to broad wetland-related topics. All material should be sent electronically to the current editor of WSP. Complaints about SWS policy or personnel should be sent directly to the elected officers of SWS and will not be considered for publication in WSP.