wetland science & practice
published by the Society of Wetland Scientists
Vol. 34, No. 3 September 2017

## FROM THE EDITOR'S DESK

**Greetings! The big news from the federal government on wetlands is the proposed change in the definition of "waters of the United States"** that rescind the Clean Water Rule and re-codify the regulatory text that existed prior to 2015. The proposed rule is open to public comments until late September (see notice in Wetland Practice section). The Society has joined other organizations in requesting a time extension given the significance of the proposed changes (see SWS News section). EPA and the Corps will then redefine jurisdictional waters using what will likely be a less encompassing interpretation than has been used in recent decades. We've made tremendous gains in wetland conservation since the 1970s and will have to see how any changes affect wetland conservation nationwide.

Ralph Tiner
WSP Editor

In this issue we have two articles – one by Doug Wilcox on the history of the society's journal – *Wetlands* and the other by Steve Kloiber and Doug Norris on Minnesota wetland trends. The former article is the first of a series on the history of early wetland science that is being coordinated by Arnold van der Valk and Gordon Goldsborough (see their introduction to the series). Scott Jecker sent me a notice on the South Central Chapter's upcoming fall chapter meeting. Doug Wilcox also provided another cartoon in his "From the Bog" series – this one offering another constructive use of common reed (*Phragmites australis*).

Locally it's been an interesting summer weather wise. We've had a good bit of rain since last summer's drought, but my pond has not completely recovered. Rushes have taken over the deeper portion of the pond which now has only shallow water. A few of the water lilies remain, hopeful for higher water levels when they will again seek to regain their prominence. The shoreline is filled with cardinal flowers and purple-headed sneezeweed (see images in Notes from the Field). With the Fall ahead, we're looking forward to the glow of the autumn foliage.

Meanwhile, think about contributing an article to one of our upcoming issues. For the December issue, we'll need your manuscript by early November and for the March issue by early February.

Happy Swamping! ■

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### COVER PHOTO:

*Pond and wet meadow along East River Crested Butte, Colorado (Ralph Tiner photo)*

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

## PRESIDENT'S MESSAGE

**One of the major objectives of the SWS Strategic Plan 2015-2020 is to make SWS an effective international scientific society with a global reach.** This plan identified a number of specific actions that should be done to achieve this ambitious goal.

Some progress has been made toward meeting the internationalization objective, including travel by members of the Executive Board to international chapters (Asia, Europe), the establishment of a new chapter in China, and more cooperation with a number of international societies and organization (Ramsar, INTECOL, and Society for Ecological Restoration). An Internationalization Committee also was established that I chaired whose goal was to make specific recommendation for making SWS a more international society. There were also two discussions about internationalizing SWS at our annual meeting in June in San Juan, one at the Board of Directors meeting and another for members outside of the US. These resulted in a series of proposed action items that are very much in concert with those in our Strategic Plan. Among the more important of these are:

Arnold van der Valk
SWS President

### DEVELOPING AN INTERNATIONALIZATION STRATEGY

SWS does not have the resources or manpower to try to develop new chapters simultaneously in several parts of the world. SWS should prioritize its internationalization efforts by identifying regions that seems most likely to be suitable for establishing new chapters.

### REDUCING LANGUAGE BARRIERS

SWS should translate its recruiting materials into other languages, especially Spanish, French, and Chinese. SWS should also develop subtitled versions of its webinars.

### ESTABLISHING AN INTERNATIONALIZATION FUND

Internationalization will require money. The proposed internationalization fund would set aside a percent of the SWS annual budget to promote internationalization efforts. The main purposes of this fund would be to (1) provide travel funds for SWS leaders to promote SWS outside the US; (2) provide travel funds to enable wetland leaders and students from developing countries to attend SWS meetings; (3) set up a competitive small-grants program for wetland scientists in developing countries that could be used to fund any wetland related project or program, not just research; and (4) establish travel grants that SWS members could apply for to attend meetings outside the US as SWS representatives. Our budget already contains funds for some of these initiatives.

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SOCIETY of WETLAND SCIENTISTS

## Help Launch the SWS YouTube Channel

The Society of Wetland Scientists' mission is to promote understanding, conservation, protection, restoration, science-based management and sustainability of wetlands. Currently, SWS fulfills its mission with member benefits that include access to webinars, newsletters, research journals, a discussion forum and regional and international meetings. In efforts to expand its member benefits and further its mission, SWS is proud to announce a new multimedia initiative.

Videos are an effective way to share information in modern communications. The SWS New Media Team is launching the SWS YouTube channel in hopes of sharing our mission with a wider audience. Videos featured on the channel will reflect our mission by focusing on wetland-related topics and will be used to teach and share information. SWS members and non-members will be able to share their work and experiences by submitting their own relevant videos to be featured on the YouTube channel.

With this effort, we hope to expand our network of wetland scientists, managers, and current and future students to support our mission and the conservation of wetlands, globally. Please consider taking this short survey (https://www.surveymonkey.com/r/8LS63LL) to help us understand what you would like out of this new initiative. The survey will close on Friday, September 8, 2017. Thank you in advance for your participation and for supporting the SWS New Media Team. ■

## Wetland Ambassadors Program Calls for Mentors

The Society of Wetland Scientists is looking for Research Mentors for our 2018 Wetland Ambassadors Program! Serving as a research mentor can be a unique and valuable opportunity for you to make progress in your wetlands research with the assistance of a graduate student (a.k.a. Wetland Ambassador) who possesses a different perspective. Learn more here: http://sws.org/Awards-and-Grants/wetland-ambassadors-graduate-research-fellowship.html.

If you are interested in applying to be a Research Mentor and you will be available to host a student in your laboratory/workplace during the upcoming summer of 2018, please complete the application (https://docs.google.com/forms/d/e/1FAIpQLScMYZoK8mXZHcBu_NPXq2d-_AS3C-gyVq4kw7JLznGhPRzdoCw/viewform?c=0&w=1) by Friday, September 8, at 11:59 p.m. EDT. Filling out the form does not commit you to serving as a Research Mentor, but means that you would like to be placed on a list that will be distributed with our application announcement to graduate students in the fall. Our research mentor selection committee will alert you of your status by the end of September. ■

## SWaMMP Application Now Open

The SWS Multicultural Mentoring Program (SWaMMP) works to increase diversity within the Society of Wetland Scientists and throughout the environmental sciences. SWaMMP enables undergraduate students from underrepresented groups to attend and receive full travel benefits to the SWS Annual Meeting, held in Denver, CO, on May 29 - June 1, 2018. The Annual Meeting offers students valuable career guidance and opportunities to network with leading wetland science professionals from around the world.

**PROGRAM BENEFITS:**

- Conference registration, lodging and all travel expenses to the SWS Annual Meeting
- Individual career mentoring
- Postgraduate and career workshops
- The opportunity to present research posters
- Networking opportunities to meet professionals from diverse fields
- Membership in SWS for one year following the award

**APPLICANTS:**

Participants must be citizens or permanent residents of the United States or its possessions and be undergraduate students enrolled in a degree program (part-time or full-time) leading to a baccalaureate or associate degree. Spring 2018 graduates are eligible; Fall 2017 graduates are not.

For the purposes of these awards, applicants must belong to one or more of the following groups that have traditionally been underrepresented in wetland sciences: Black/African Americans, Hispanics/Latinos, Native Americans, Indigenous Alaskans, Native Pacific Islanders (Hawaiian/Polynesian/Micronesian).

Do you know someone who may be interested? Learn more about the 2018 program here (http://sws.org/images/pdfs/SWaMMP-application-flyer-final.pdf), or visit the Multicultural Mentoring Program webpage (http://sws.org/Awards-and-Grants/sws-undergraduate-mentoring-program-swammp.html) for more information. Contact Dr. Vanessa Lougheed (vlougheed@utep.edu) with any questions.

Applications due November 3, 2017. ■

## Submit for Special Feature of *Wetlands*, SWS Annual Meeting Symposium

*Wetlands* is soliciting papers that are focused on the role that wetlands play and played in the emergence and development of our diverse cultures and social structures, and the various aspects of wetlands that are deemed important and define the culture. Inevitably, much of this information is likely to be a part of the culture's oral history and *Wetlands* will respect and honor this traditional information.

The goal of this effort is to obtain a sufficient number of papers that could be published in a special feature of *Wetlands* and presented as a Symposium in the upcoming 2018 Annual SWS Meeting in Denver.

**Submission Deadlines**

Symposium Presentation: November 21, 2017
Special Feature in *Wetlands*: July 1, 2018

Learn more here: http://sws.org/Publications/wetlands-journal.html. ■

## Monthly Webinar Series

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

**MORE INFORMATION ABOUT WEBINARS:**

www.sws.org
>Events >Upcoming Webinars

**MISSED A WEBINAR?**

View webinar archives at:
www.sws.org
>Events >Past Webinars

## Exciting New Developments for *Wetlands*

*Marinus L. Otte, Editor-in-Chief*

*Wetlands* is pleased to announce that it has expanded the themed categories under which it will publish papers in the field of wetland science. These essentially are continuous series, open to submissions at any time, which will be recognized by a banner across the top of each article. This serves to highlight the breadth of the topics *Wetlands* will consider for publication, and a focus for researchers and managers.

The categories are:

- **General** – Any papers that do not fit the categories below.
- **Mark Brinson Reviews** – Limited submissions, see info at Wetlands web pages.
- **Wetlands in the Developing World** – Any papers about wetlands in the developing world.
- **Applied Wetland Science** – How is our scientific knowledge translated into practice?
- **Socio-economic Aspects of Wetlands** – Importance and value of wetlands to human society.
- **Ramsar** – Any papers about Ramsar wetlands, about the Convention or related subjects.
- **Wetlands Education** – Formal and informal, specialized and public education.
- **Wetlands Restoration** – How do we restore wetlands, and how successful are we?
- **Wetlands Conservation** – How does it work, and how successful are we?
- **Constructed Wetlands** – What are the latest advances in constructed wetlands?
- **Ecosystem Services of Wetlands** – Anything about ecosystem functioning and services of wetlands.
- **Wetlands and Indigenous People** – Past and present importance, in every way imaginable, of wetlands to indigenous people around the world.

Within all categories, except for the Mark Brinson Reviews, regular research articles, review articles, or short communication can be submitted. For further information, see the *Wetlands* web pages at http://www.springer.com/life+sciences/ecology/journal/13157. ■

RAMSAR SECTION SURVEY

**PROMPT RESPONSE NEEDED**

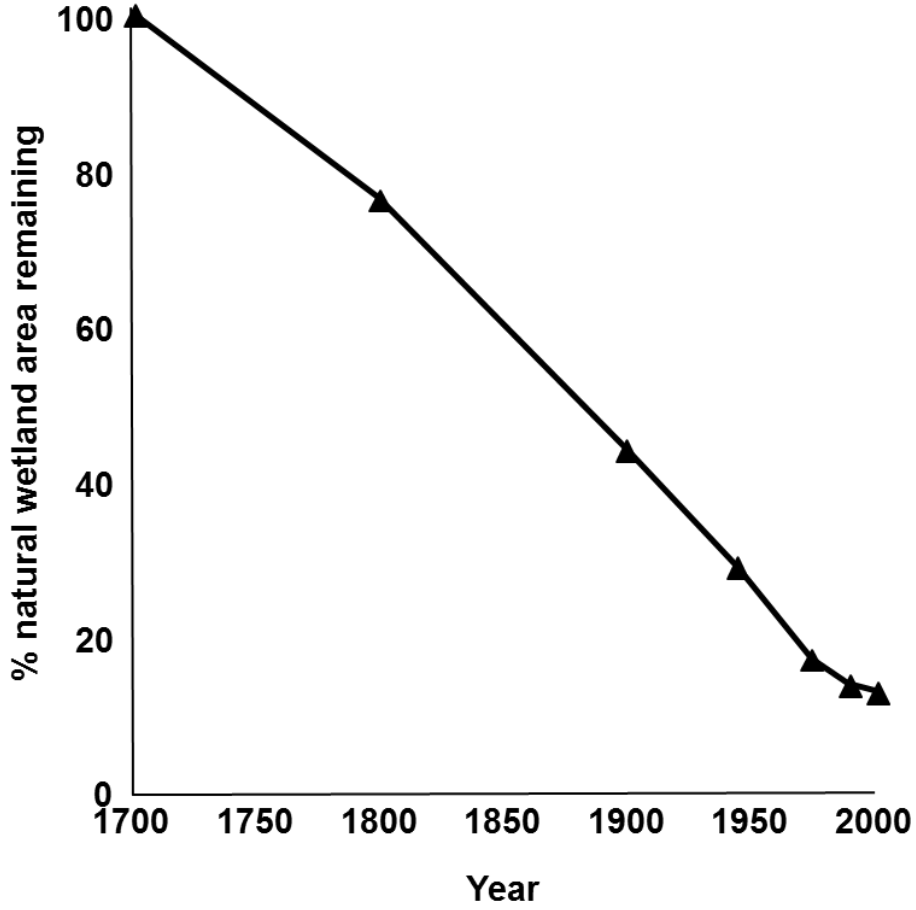
# What Is the State of the World's Remaining Wetlands? SWS Members' Help Urgently Needed!

*Nick Davidson, SWS Ramsar Section Chair; Matthew Simpson, SWS Ramsar Section Vice-Chair; Rob McInnes, SWS Ramsar Section past-Chair*

## THE ISSUE

We know that humankind has been enthusiastically draining and converting natural inland and coastal wetlands for centuries and that this has been happening worldwide. Recent evidence suggests that we may have lost as much as 87% of the world's natural wetlands since 1700 AD (Figure 1), and that the rates of conversion were almost four times faster in the 20th century than in previous centuries (Davidson 2014). Despite increasing recognition of the great importance of wetlands for the ecosystem services they deliver to people, this wetland conversion is continuing, and it is estimated that 30% of remaining natural wetlands have been lost since 1970 (Dixon et al. 2016).

**FIGURE 1**. Long-term losses of the world's natural wetlands since 1700 AD. From Davidson (2014), reproduced with permission of the publisher.




But we have much less information about the state of our remaining wetlands – that remaining 13% at the bottom of the graph in Figure 1. Yet knowing about the state of health of our remaining wetlands is vital information in order to inform decision-taking and policy-making, including by the Ramsar Convention on Wetlands. The SWS Ramsar Section has, over the last two years, been considering this issue, reviewing the information available and how to try to improve this important knowledge gap, through symposia, workshops and discussions including at the SWS annual conferences in 2015 and 2016, and at the 10th INTECOL wetlands conference in 2016.

## NEXT STEPS

From the outcomes of these SWS processes and discussions the SWS Ramsar Section, in collaboration with other wetland expert networks (including the World Wetland Network (WWN, www.worldwetnet.org) and the Wildfowl & Wetlands Trust (WWT, www.wwt.org.uk), has started an initiative seeking to improve access to knowledge about the status and trends of our remaining wetlands. One part of this initiative is the current preparation of a set of journal papers assessing existing information and knowledge of wetland status and trends and gaps in this knowledge, and making recommendations for future improvements. These are due for publication later in 2017.

The second part of the initiative is to undertake a qualitative assessment of as many of the world's wetlands as possible. This is being done through a simple online questionnaire about the current state, and trends in that state, of wetlands. It has been designed to be filled in (in about 10 minutes) by anyone who knows about a wetland or wetlands (large or small, protected or un-protected). This questionnaire approach has been fully endorsed by

the SWS Executive Board and was launched in April 2017. The questionnaire is available in different languages, so as to make it accessible and easy to use by as many different people around the world as possible.

Results of this questionnaire survey will be summarised in WSP and circulated to all those who have participated by submitting information on their wetland, and it is also planned to prepare a more formal journal paper on the results for submission to *Wetlands*. The results will also be presented to the Ramsar Convention.

This SWS Ramsar Section initiative provides a great example of how SWS expertise can and does contribute to informing the science-policy interface of the Ramsar Convention, in line with the Ramsar-SWS Memorandum of Cooperation which has been renewed on the occasion of the SWS Europe Chapter conference in Faro, Portugal in May 2017.

## HOW CAN SWS MEMBERS HELP?

Have you been undertaking research in a wetland? Are you restoring a wetland? Do you live near a wetland and have watched it change over the years? Have you been visiting a wetland over the years just to enjoy its wonderful nature? We are sure that most, or all, SWS members have such knowledge and information about a wetland – otherwise you wouldn't be a SWS member!

All SWS members should have already received an email from SWS announcing the survey, so this article acts as a reminder that if you have not already contributed, please do so now. The deadline for completing the survey is 30 September 2017.

Your knowledge is really vital to the success of this survey. Go online, at: http://www.worldwetnet.org/about-us/world-wetlands-survey-2017 . There the questionnaire can be filled in the language of your choice. You can do this online in one of six languages: English, Spanish, French, Arabic, Russian or Chinese. If you prefer, for some languages you can download the questionnaire as an Excel form, currently available in English, French, Spanish, Arabic and Japanese. Save your completed form, with the wetland name in the filename, and email it to: wli@wwt.org.uk

Our big thanks to all SWS members in helping to make this important gap-filling survey a big success! Particular thanks if you have already contributed to the survey – and thanks in advance if you are about to! ■

## REFERENCES

Davidson, N.C. 2014. How much wetland has the world lost? Long-term and recent trends in global wetland area. *Marine and Freshwater Research* 65: 934-941.

Dixon, M.J.R., J. Loh, N.C. Davidson, C. Beltrame, R. Freeman, and M. Walpole. 2016. Tracking global change in ecosystem area: The Wetland Extent Trends index. *Biological Conservation* 193: 27–35.

# SWS Joins CASS in Comment Letter to EPA and USACE

SWS joined other CASS societies in signing this comment letter to EPA and USACE, requesting an extension of the comment period for the proposed rule to rescind the WOTUS Clean Water Rule. ■


August 3, 2017

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

The Honorable Douglas W. Lamont Senior Official Performing the Duties of the
Assistant Secretary of the Army for Civil
Works Office of the Assistant Secretary
of the Army for Civil Works
Department of the Army 104 Army Pentagon Washington,
DC 20310–010

Dear Administrator Pruitt and Deputy Assistant Secretary Lamont:

We are writing on behalf of our 20,000 members to urge the EPA and US Army Corps of Engineers to extend the public comment period for the proposed rule that seeks to rescind the 2015 Clean Water Rule (80 FR 37054). We request at least a six month comment period, the same time period your agencies provided for comment on the 2015 Clean Water Rule.

The planned 30-day comment period is an inadequate amount of time for stakeholders to engage meaningfully in the rulemaking process. Further, it minimizes the input of over one million people who participated in the development of the 2015 rule.

EPA and the Army Corps crafted the 2015 rule to clarify longstanding confusion over which water bodies were protected under the Clean Water Act. The agencies held over 400 meetings with a variety of stakeholders, including small business owners, farmers, energy companies, states, counties, municipalities, other federal agencies, sportsmen and conservation groups, and environmental organizations. A rulemaking of this nature with tremendous consequences for the wellbeing of all citizens deserves a transparent, inclusive and meaningful opportunity for public comment.

Many of our members participated the development of an extensive report on the connectivity of wetlands to downstream waters[1] that provides the scientific evidence in support of the 2015 rule. We would appreciate a meaningful opportunity to comment on the re-codification of the rule to ensure that the science is appropriately considered in this process.

Wetlands and headwater streams provide vital services that promote human health and safety. Wetlands keep our streams, lakes, and groundwater cleaner by treating urban and agricultural runoff through natural processes. They also provide water during times of drought and absorb runoff and floodwaters, which reduces disaster recovery costs.

[1] U.S. Environmental Protection Agency (USEPA). 2013. Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence. US Environmental Protection Agency, Washington, D.C. EPA/600/R-11/098B.

Wetlands sustain essential habitat for wildlife, fish, and waterfowl to feed, nest, breed, spawn, and rear their young. Our nation's wetlands cover a small portion of our landscapes (<6% of the land area in the lower 48 states) but they play a very significant role in protecting the water that we all depend on.

Considering the critical functions of our nation's wetlands and headwater streams, the far-reaching implications on aquatic species and their habitat from repealing the rule, and the robust public participation in developing the 2015 rule, we urge EPA and the Army Corps to extend the comment period so stakeholders can understand the concerns that remain and continue to contribute in a useful way.

The Consortium of Aquatic Science Societies (CASS) is comprised of nine professional societies representing almost 20,000 individuals with diverse knowledge of the aquatic sciences. Those members work in the private sector, academia, non-governmental organizations, and various tribal, state, and federal agencies. CASS represents professional scientists and managers who combine deep subject matter expertise, a commitment to independent objectivity, and the critical review of environmental information, along with a passion for the natural places and resources that form the foundation of American greatness. With a shortened comment period, little time is provided for them to voice their opinions about a rulemaking that greatly affects the water, habitat and aquatic species they have dedicated their lives to studying, managing and protecting.

Sincerely,

Consortium of Aquatic Science Societies

Joseph Margraf
President
American Fisheries Society

Linda Duguay
President
Association for the Sciences
of Limnology and Oceanography

Robert R. Twilley
President
Coastal and Estuarine Research Federation

Heidi Dunn
President
Freshwater Mollusk Conservation Society

Erin Dunlop
President
International Association
for Great Lakes Research

Frank Wilhelm
President
North American Lake Management Society

Tim Nelson
President
Phycological Society of America

Colden Baxter
President
Society for Freshwater Science

Arnold van der Valk
President
Society of Wetland Scientists

## North Central Chapter Native American Initiative

The SWS-NCC is starting an initiative to celebrate the interaction between Arts and Science and the intrinsic connections between Native American culture, water and wetlands. We recognize the traditional, cultural and spiritual importance of water and wetlands to people around the world, and wish to better celebrate those connections.

Native American artists are invited to contribute on the theme of *water* and *wetlands* at our annual meeting in Fargo, ND, Oct 12-14, 2017. We are focusing on student and emerging artists, but any artist is welcome to contribute.

The works will be exhibited in the Red Raven Espresso Parlor (https://www.facebook.com/RedRaveNEP/) at 916 Main Ave, Fargo, ND 58103 from Oct 12-31. Work must be delivered to Petra Gunderson Leith at the Red Raven by October 2, 2017.

A $100 stipend is available for at least 10 artists to cover expenses. Preference will be given to student and emerging artists. These funds are from donations, and we hope to still receive more donations. Any funds available after stipends and costs have been covered will be used for awards.

The press will be invited to the opening of the conference (Oct 12th) and of the exhibit (Oct 13th).

The works will be curated by Petra Gunderson Leith at the Red Raven. Please send applications, including a bio, a statement of interests and a declaration that the work will be ready to be exhibited on time to Marinus Otte at marinus.otte@ndsu.edu.

For further information, contact Marinus Otte at marinus.otte@ndsu.edu. ■

## SWS chapter meetings

2017 PACIFIC NORTHWEST CHAPTER MINI-MEETING
September 26 - 27
Kelso, WA

CENTRAL CHAPTER 2017 ANNUAL MEETING
October 11 - 13
Laclede, MO

FALL 2017 SOUTH CENTRAL CHAPTER MEETING
October 11 - 13
Middlesboro, KY

NORTH CENTRAL CHAPTER ANNUAL MEETING
October 12 - 14
Fargo, ND



## 2018 SWS Annual Meeting Website Is Now Live

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

*Wetland Science: Integrating Research, Practice and Policy - An Exchange of Expertise* will focus on the intercommunication of the most recent developments in wetland science, practice and policy between the different sectors of SWS. It will encourage collaboration and partnerships among wetland researchers, practitioners, managers and policymakers, with the overall goal of improving wetland science.

The 2018 meeting website is now live! Registration and abstract submissions will open in November. In the meantime, visit swsannualmeeting.org to stay up-to-date on all meeting developments. ■

## Symposium and Workshop Proposals Deadline: October 16, 2017

### SYMPOSIUM PROPOSALS

The SWS Program Committee is now accepting symposium proposals. Symposium proposal organizers are encouraged to be creative while also focus on the meeting's theme, *Wetland Science: Integrating Research, Practice and Policy - An Exchange of Expertise*. Symposia that are not directly related to the theme will be considered if they involve groundbreaking areas of research, technology, management, policy or combinations thereof. Visit the Symposia page (https://www.swsannualmeeting.org/symposia) on the meeting website for more information and to submit a proposal form (https://static1.squarespace.com/static/5967a224725e258a852d731e/t/598b811eebbd1a0fc65623da/1502314783481/SWS+2018+Symposium+Call+for+Proposals+Form.pdf). Submission deadline is October 16, 2017. For any questions, please contact Emily Viles at eviles@sws.org. ■

### WORKSHOP PROPOSALS

Do you have an interest in leading a workshop? Send your idea by submitting a workshop proposal form (https://static1.squarespace.com/static/5967a224725e258a852d731e/t/598b7da359cc68b824ce8067/1502313892243/SWS+Call+for+Workshops+Form+2018.pdf) for the Program Committee's consideration. Workshops relevant to the meeting's theme are particularly encouraged with the goal of allowing attendees to dig deeper into their specializations, learn and apply new methodologies and discover ideas that pique their curiosity. The workshop proposal deadline is October 16, 2017. Please contact Emily Viles at eviles@sws.org with any questions. ■

## Support the SWS Annual Meeting

### SPONSOR

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

Not sure which sponsorship opportunity to choose? Construct your own sponsorship package to fit your unique needs and goals. To discuss sponsorship and reserve an opportunity for your company, please contact Amanda Safa (asafa@sws.org). ■

### EXHIBIT

SWS meetings gather the highest level of wetland professionals, researchers and managers to provide an unequalled opportunity for you to network and build countless professional connections. Simply complete and return the Exhibitor Agreement to reserve your booth today! For more information visit the Exhibitors page on the meeting website (https://www.swsannualmeeting.org/exhibit). Agreements must be received by April 30, 2018. To discuss exhibiting at the 2017 SWS Annual Meeting, contact Amanda Safa (asafa@sws.org). ■

### SILENT AUCTION

The SWS Rocky Mountain Chapter will host a silent auction during the Poster Session reception on Friday, June 1, 2018. All proceeds will go directly to the Chapter to support future Chapter initiatives including support for students in wetland science and funding for student research. Members and friends of the wetland science community are invited to donate an item or service.

Donations may be related to the wetland profession, such as field equipment, or personal interests, such as books, movie passes, sports memorabilia, or gift cards. Silent auction items will be on display for all registrants to see and bid on.

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

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

### PROMOTING WETLAND SCIENCE EDUCATION/TRAINING

SWS should promote the training on wetland scientists in the developing world through training or educational programs in conjunction with various national, regional, and international development and conservation organizations. SWS should develop standards for courses in wetland science. It should develop short, online courses dealing with a variety of wetland topics (classification, restoration, hydrology, soils, etc.). There is a strong demand for such online courses in wetland science, especially in developing countries. These could be developed in conjunction with other organizations (e.g., Association of State Wetland Managers, Ramsar) and various universities. Having accessible and affordable courses relevant to wetland ecologists and managers around the world that are sponsored by SWS would significantly improve the visibility of SWS internationally.

### BECOMING MORE REGIONALLY INVOLVED

SWS needs to become more involved in regional programs and activities dealing with wetlands. It needs to establish a new committee to deal with international wetland issues. This committee would be charged with monitoring international wetland issues/disputes and maintaining the list of such issues. This list should be developed in consultation with the international chapters and sections, especially the Ramsar and Public Policy and Regulation Sections.

### SCHEDULING ANNUAL AND REGIONAL MEETINGS

Have more SWS annual meetings outside of North America. SWS needs to develop a new method for deciding on the location of its annual meetings. Travel costs and language barriers make it difficult for wetland scientists in many countries to attend the SWS annual meeting. To promote more involvement with SWS, regional SWS meetings should be held in various parts of the world. These regional meetings, whenever possible, should be joint meetings with existing local wetland societies.

### DEVELOPING MORE SECTIONS

Sections are inherently international in scope, and they attract members from different regions of the world. Expanding the number of sections and making them equal in status to chapters would make SWS more attractive to wetland scientists around the world.

During the upcoming year, my highest priority will be to implement the proposed recommendations for internationalizing SWS. To do this will require much discussion at a variety of levels, the Executive Board, Board of Directors, standing committees (e.g., Ways and Means, Bylaws), chapters, and sections (e.g., Education, Public Policy and Regulation). Some of these recommendations can be implemented fairly easily, but others will require a major reallocation of funds in our budget and even some changes in our bylaws. Ultimately, the entire membership will need to vote to approve any changes in the society's bylaws that internationalization may require. Changes to our bylaws for equalizing the status of sections and chapters have been proposed, and these should be submitted to the membership soon for a vote.

Because the ongoing internationalization effort will significantly affect the future of the society, I will keep you posted on the progress that is being made. If you have any suggestions or ideas for promoting the internationalization of SWS, please let me know (valk@iastate.edu). If you are interested in participating in any of these proposed efforts to internationalize SWS, please let me know. We will need all the help that we can get to achieve our strategic goal to internationalize SWS. Our efforts toward achieving this goal will greatly strengthen the Society and its ability to serve wetland scientists and to protect wetlands around the world. ■

# The History of Wetland Science – A Forthcoming Series in *Wetland Science & Practice*

*edited by Arnold van der Valk and Gordon Goldsborough*

## INTRODUCTION TO THE SERIES

The Society of Wetland Scientists was founded in 1980 and will soon be 40 years old. It seems timely to us to begin to document the history of this new science before it is too late. Many of the people, and even institutions, who influenced its development have recently died or closed, and many other pioneering wetland scientists have retired or will soon retire. Given this situation, we would like to capture the early history of our science by getting the people who created it to write about their reasons for becoming wetland scientists and their contributions to the field. This series of articles will focus on two major topics: (1) the contributions of major scientists working in wetlands to the development of wetland science, and (2) the roles of major wetland institutions and organizations in the development of wetland science. Each article will highlight major advances, organizational and/or intellectual, that have shaped wetland science in the United States and around the world.

We have invited a number of distinguished wetland scientists to contribute articles in the series. We also like to invite anyone interested in the history of wetland science to submit an article for this series. We are particularly interested in accounts of the history of wetland science outside of the United States. If you would like to contribute an article to this series, please contact either of the editors of this series, Arnold van der Valk, Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA 50011 (valk@iastate.edu) or Gordon Goldsborough, Department of Biological Sciences, University of Manitoba, Winnipeg, MB R3T 2N2, Canada (gordon.goldsborough@umanitoba.ca). ■

# History and Role of the Journal *Wetlands* in Developing the Field of Wetland Science

*Douglas A. Wilcox*[1]

**ABSTRACT:**

Development of wetland science as a distinct field required consolidation of wetland-related publications in a recognized wetland journal. Growth of the Society of Wetland Scientists was thus tied to developing its own publication outlet. *Wetlands* debuted as the proceedings of the SWS meeting held in 1981, became a peer-reviewed proceedings in 1982, and was opened to outside submissions in 1983. Major changes in the journal through the years included gaining coverage in important abstracting services, switching to a larger page format, creating key word and author indices, developing an electronic distribution option, converting to an on-line submission process, increasing exposure, and growing larger. Manuscript submissions increased, more papers were published, and more pages were produced. The journal moved to two issues in 1988, three issues in 1989, four issues in 1993, and six issues in 2010. Growth of the journal transformed it into the top journal in wetland science, with submissions coming from around the globe. The journal is multi-disciplinary in scope, exposing readers to a variety of ideas, methods, and applications. Consolidating efforts from many fields of expertise with a focus on wetlands helped to develop a broad, ecosystem-based science that is now globally recognized.

## HISTORY OF THE JOURNAL

The advancement of wetland science as a distinct field of endeavor was closely related to founding and growth of the Society of Wetland Scientists. An underlying pinion for the recognition and stature of scientific societies is support of publications with credibility in the greater scientific world. The Society of Wetland Scientists was founded in 1980 and promptly began the process of developing publications. The *SWS Bulletin* was initiated as a non-refereed publication containing news about wetlands and updates on SWS activities. It evolved to *Wetland Science and Practice* in 2009 and made a more recent transition to a refereed publication. *SWS Research Briefs* was added in 2008 as a non-technical refereed outlet for short summaries of wetland research directed toward managers, policy-makers, and the general public. However, a key piece in the effort of the SWS founders to make wetland science a recognized field of its own was creation of the journal *Wetlands* – here I report its history.

The first issue of the journal was a non-refereed proceedings from the second SWS annual meeting held in Alexandria, Lousiana in 1981. Janie Harris, Paul Knutson, and Robert Soots, Jr. comprised the Editorial Board responsible for that single issue of Volume 1, which contained 18 articles and 214 pages and was printed by SWS. Volume 2 was a single issue refereed proceedings, with Robert Soots, Jr. serving as Editor and printing done by Fink's Printing and Graphics, Inc. in Gaithersburg, Maryland. *Wetlands* evolved to an open-submission refereed journal with the single issue of Volume 3 in 1983; Armando de la Cruz served as Editor, with six supporting Associate Editors and printing by Precision Press in Wilmington, North Carolina. Gene Silberhorn became editor in 1984 and produced single issue Volumes 4-7. I was indoctrinated into the journal business when Gene added me as an Associate Editor in 1984.

In 1986, Gene announced his resignation as Editor to make his successful run for SWS Vice-President (and then President). At a fateful INTECOL meeting in the Carrier Dome at Syracuse University, I had a discussion with fellow Associate Editor and then SWS President Courtney Hackney regarding future editorship. I described my vision for a quarterly journal and my goal of making *Wetlands* the number one choice for publication of the best papers related to wetlands. I volunteered to take over, and Courtney agreed. He may have taken the decision to the Board, although maybe not, as SWS activities were less controlled in those days.

In my early days as Editor-in-Chief, I sought advice and assistance from others. I increased the number of Associate Editors by adding Sandra Brown, Paul Glaser, James Grace, Curtis Richardson, Milton Weller, and Thomas Winter in a deliberate effort to cover the variety of fields of expertise in wetland science with good people. Robert Wetzel advised me that to attract good manuscripts, the journal must be covered in *Current Contents* and other abstracting services so that published papers would be seen by others

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and cited. *Current Contents* proved to be a tough battle because they required evidence that a journal is published on a regular schedule. With two on-time issues of Volume 8 in 1988, they were convinced. The journal was soon included in 24 abstracting and referral services (Table 1).

Wetland manuscripts had previously been spread among a myriad of journals, some of which are listed in Table 2. However, *Wetlands* offered potential authors the advantage that their papers would appear in the mailbox of more wetland scientists than those in any other journal. The journal grew along with the growth in SWS membership, and three issues were published in Volume 9. At the urging of then SWS Past President Mark Brinson, the journal changed to a larger page format with Volume 12 in 1992, and printing was moved to Allen Press in Lawrence, Kansas. A blue-gray cover also replaced the previous goldenrod cover. The goal of quarterly publication was reached with Volume 13 in 1993.

In 1995, I assigned a work-study student to develop a Key Word Index and Author Index for all papers published in Volumes 1-15. Those indices were published in Volume 16, No. 1, and yearly updates were included in each succeeding volume through 2006. The SWS website (http://www.sws.org) was created in 1996, and the journal page included listing of the Editorial Board, Instructions for Authors, Table of Contents for all past issues, Table of Contents for issues in press, and (through 2006) a searchable Key Word Index and Author Index. As a result of the ties with Allen Press, SWS became a charter member of BioOne in 1999, which made the journal available electronically in many college and university libraries beginning with Volume 20. Distribution of BioOne library subscription fees based on relative use of individual member journals resulted in fund transfers to SWS often equivalent to the costs for producing one of the four yearly issues. The BioOne process made all new issues of the journal available electronically, but it took the effort of Barry Warner to scan and digitize all manuscripts published in previous Volumes 1-19 and make them available electronically on CD.

After 20 years of service, I retired as Editor-in-Chief at the end of 2006. Darold Batzer was selected as the new editor and brought with him new ideas and practices, including invited special feature papers. Bridgham et al. (2006) was the first paper featured, and it has become the most cited *Wetlands* article. Darold also established an award for outstanding Associate Editor. The journal began on-line submissions in 2007, and a new glossy cover displaying a different wetland photograph on each issue was introduced with Volume 29 in 2009. Volume 30 marked the move from Allen Press to Springer Science and Business Media in New York, New York and conversion from four to six issues per year, available both electronically and in hard copy. The transition to Springer eliminated the need for journal support from SWS memberships and made *Wetlands* a net source of income for SWS. Darold completed his term as Editor-in-Chief in 2011 and was succeeded by Marinus Otte, who continued to maintain the updates and upgrades, as well as adding the invited Mark Brinson

**TABLE 1.** List of abstracting and referral services covering *Wetlands* by 1989.

| | |
|---|---|
| AESIS | Georef |
| Agricola | Inside Conferences |
| Aquaphyte | Life Sciences Collection |
| Aquatic Science and Fisheries Abstracts | National Wetlands Newsletter |
| BIOSIS | Oceanic Abstracts |
| CAB Abstracts | Pollution Abstracts |
| CAB Health | Restoration and Management Notes |
| Current Contents | Science Citation Index |
| Energy Science and Technology | Social SCISEARCH |
| Environline | Toxline |
| Environmental Bibliography | Uncover |
| Geobase | Water Resources Abstracts |

**TABLE 2**. Partial listing of journal outlets for wetland-related manuscripts when *Wetlands* began publication in 1981. Edited books, agency reports, and gray literature were other options.

| | |
|---|---|
| American Journal of Botany | Estuarine, Coastal, and Shelf Science |
| American Midland Naturalist | Fishery Bulletin |
| Applied Ecology | Ibis |
| Aquatic Botany | Journal of Ecology |
| The Auk | Journal of Soil and Water Conservation |
| Bulletin of the Torrey Botanical Club | Journal of Wildlife Management |
| Canadian Journal of Botany | Limnology and Oceanography |
| Colonial Waterbirds | Rhodora |
| Ecology | Soil Science Society of America Journal |
| Estuaries | Water Resources Bulletin |

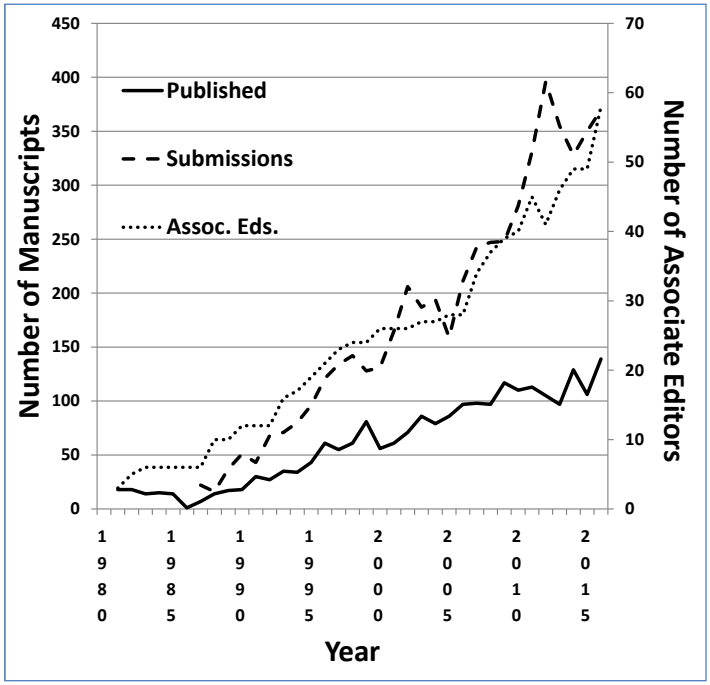
Review Series. Marinus also broadened the international scope of the Editorial Board. The journal cover changed in 2012 to a multi-color set of photographs that remains the same on each issue. The formatting of some of the internal material also changed in 2014.

## GROWTH OF THE JOURNAL

Data are lacking regarding submissions prior to 1987, but new manuscript submissions increased from 22 in 1987 to 68 by 1992 to 142 in 1998 (Figure 1). They reached 206 in 2002 thanks to a boost from special issue manuscripts and averaged over 180 until on-line submissions were introduced, which raised the average to about 250, and they are now averaging over 350. The change to an on-line process also increased submissions by non-U.S. authors, which had averaged about 15% of the total in recent years but jumped to 50% in 2010. By 2016, submissions by non-U.S. authors had increased to 83%.

More overall submissions meant more papers published each year. Totals increased from the teens in the late 1980s to more than 50 by 1996, more than 80 by 2003, nearly 100 by 2006, more than 110 by 2009, and an average of about 115 in recent years (Figure 1). Total pages increased from 197 in 1988 to 488 in 1991; the journal then switched to a larger page format, and total pages increased from 234 in 1992 to 577 in 1997 to 806 in 2002 to 1167 in 2006 and since have averaged over 1250. The numbers of issues, manuscripts, and pages per year include 13 special issues, 83 special feature papers, 12 review papers, and 98 book reviews. More submissions meant more work, especially by Associate Editors that assign manuscripts to referees, review manuscripts, and make the initial judgment on acceptance. To spread the workload, more Associate Editors were added through the years to keep pace with submissions (Figure 1), resulting in an unintentional but strong correlation between submissions and Associate Editors ($r = 0.967$, $p = 0.000$). Acceptance rates averaged about 55% through 1997, about 43% through 2006, and about 36% since then. The journal was first assigned an Impact Factor (IF) of 0.644 in 1997, and IF has increased steadily since then to 1.573 for 2016 (the most recent measure).

**FIGURE 1**. Changes in numbers of manuscripts submitted and published in *Wetlands* during the first 36 years, along with the number of Associate Editors handling manuscripts.




## RELATION TO EVOLUTION OF WETLAND SCIENCE

How has the journal *Wetlands* helped shape the field of wetland science? Perhaps foremost, it put a brand name on the work done by legions of plant ecologists, hydrologists, wildlife biologists, biogeochemists, invertebrate ecologists, soil scientists, herpetologists, geologists, remote sensing specialists, and paleoecologists, among others, working across a range of ecosystems from salt marshes to peatlands to freshwater marshes to swamps of many kinds. Those scientists were no longer on the outer fringe of another field, they were center stage in their own science. Every paper published in *Wetlands* was about wetlands, just as every presentation made at an SWS meeting was about wetlands. There was an identity, and the journal's title stated it in a single word.

The broad scope of disciplines within wetland science, and therefore papers published in the journal, exposed individuals to new ideas, methods, and applications for their work. For example, plant ecologists were no longer fixed on botanical journals, and hydrologists were no longer fixed on hydrology journals. The argument could be made that "ecohydrology" had its origins in wetland science. This intellectual cross-fertilization also served to strengthen the new scientific field.

Without participation from scientists in the variety of disciplines described above, advancement of wetland science would not have occurred. A conscious effort was made to invite, cajole, and plead to get many of the leading scientists in each discipline to serve as Associate Editors for *Wetlands*. Their names in the journal and their expertise and hard work in ensuring the quality of papers published did not go unnoticed. Those scientists also published their own work in the journal and brought in their colleagues and students. Publishing in *Wetlands* gained prestige. Zhang et al. (2010) reviewed Science Citation Index to generate a ranking of journals that publish wetland-related papers. *Wetlands* was at the top of the list with three times

more papers published during their 1991-2008 time window than any other journal (Table 3). As I reviewed every word and punctuation mark in every citation of 1019 papers published during my 20 years as editor, my greatest joy was in watching the number of citations of papers in *Wetlands* steadily increase. Citations identify quality papers, and quality papers make for a quality journal. As *Wetlands* gained stature as the leading journal in its field, wetland science found firm footing. ■


## ACKNOWLEDGMENTS

I thank Darold Batzer and Marinus Otte for reviewing this manuscript and providing input on changes implemented during their terms as Editor-in-Chief, as well as data on recent submissions. I also thank Arnold van der Valk and Gordon Goldsborough for encouragement to piece together this history.


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**TABLE 3**. Number of wetland papers published and general subject category of journals, 1991-2008, from Zhang et al. (2010).

| Journal Name | Number of Manuscripts | Subject Category |
|---|---|---|
| Wetlands | 850* | ecology, environ. sciences |
| Ecological Engineering | 358 | ecology, environ. engineering, environ. sciences |
| Hydrobiologia | 269 | marine/freshwater biology |
| Journal of Environmental Quality | 206 | environ. sciences |
| Journal of Wildlife Management | 192 | ecology, zoology |
| Aquatic Botany | 189 | plant sciences, marine/ freshwater biology |
| Environmental Management | 176 | environ. sciences |
| Water Research | 173 | environ. engineering, environ. sciences, water resources |
| Biological Conservation | 163 | biodiversity conservation, ecology, environ. sciences |
| Journal of Hydrology | 156 | civil engineering, geosciences, water resources |
| Environmental Science and Technology | 153 | environ. engineering, environ. sciences |
| Biogeochemistry | 149 | environ. sciences, geosciences |
| Science of the Total Environment | 145 | environ. sciences |
| Ecological Applications | 143 | ecology, environ. sciences |
| Soil Science Society of America Journal | 126 | soil science |
| Journal of Geophysical Research | 126 | Geosciences |
| Journal of Coastal Research | 117 | environ. sciences, physical geography, geosciences |
| Chemosphere | 112 | environ. sciences |
| Water Resources Research | 102 | environ. sciences, limnology, water resources |
| Water, Air, and Soil Pollution | 102 | environ. sciences, atmospheric sciences, water resources |
| Freshwater Biology | 100 | marine/freshwater biology |

* Correct number for *Wetlands* should be 1158.

# Monitoring Changes in Minnesota Wetland Area and Type from 2006 to 2014

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## INTRODUCTION

It has been estimated that Minnesota has lost approximately half of its original pre-settlement wetlands due to draining and filling for agriculture and development, with some regions of the state having lost more than 90 percent of their original wetlands (Anderson and Craig 1984). Other studies have demonstrated more recent wetland losses for portions of Minnesota. Oslund et al. (2010) reported wetland loss of 4.3% over an approximately 27 year period (circa 1980 to 2007) for southwestern Minnesota.

Concern regarding the loss of the ecosystem services these wetlands provide such as flood attenuation, water quality protection, wildlife habitat, and groundwater recharge (Mitsch and Gosselink 2000), has resulted in national and Minnesota state policy goals of "no net-loss" of wetland quantity and quality (CEQ 2008; Minn. Statutes 103A.201). The Minnesota Wetland Conservation Act (WCA) of 1991 (Laws of Minnesota 1991, Chapter 354) prohibits the draining and filling of protected wetlands unless replaced by restored or created wetlands of equal public value (Forsberg 1992). The WCA is implemented through a network of local government units with oversight from the Minnesota Board of Water and Soil Resources. While the WCA does not preclude wetland loss, any permitted losses should theoretically be replaced by wetlands of equal value. However, there are questions about the overall effectiveness of this program, considering the potential for wetland loss under statutory exemptions or through unreported violations. Assessing whether or not the state is achieving its no net-loss goal requires objective data regarding the quantity and quality of wetlands over time.

There are two broad approaches to assessing wetland gains and losses. One is a programmatic approach, based on aggregating data from state and federal wetland impact permitting programs and governmental and private-sector wetland restoration programs. While useful in obtaining a thorough understanding of general trends and causes of wetland gains and losses, the programmatic approach has deficiencies in obtaining an accurate depiction of actual, on-the-ground change (incomplete reporting and inconsistent terminology and classification issues between programs may reduce accuracy). The other approach is an assessment of wetland land cover, generally involving analysis of aerial or satellite imagery over time to reveal actual changes on the ground.

Within the imagery-based assessment, efforts can be grouped into three methodological categories: 1) comparing existing land cover or wetland inventory data from two different times, 2) updating wetland inventories with new imagery, and 3) probabilistic sampling combined with imagery analysis. These approaches vary in the completeness of the analyses and their applicability for analyzing changes over large geographic areas, as well as in effort and cost.

The first method uses readily available land cover data from different time periods to perform a change analysis for an entire study area. Wright and Wimberly (2013) and Lark et al. (2015) relied on the Cropland Data Layer (CDL) from the National Agricultural Statistics Service (NASS) to assess land cover change for the Western Corn Belt region and the conterminous United States, respectively. Similarly, Johnston (2013) assessed wetland losses for the Prairie Pothole Region of North and South Dakota using a combination of the CDL, the U.S. Geological Survey's National Land Cover Data (NLCD), and the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI).

The second method is to conduct an inventory-based assessment to report on wetland changes. This effort involves updating a prior wetland inventory using similar survey methods and documenting wetland changes in the process. Changes are detected through manual interpretation of aerial imagery. The NWI program has done this for many specific geographic areas in the northeastern U.S. (e.g., Tiner and Foulis 1992; Tiner and Zinni 1988; Tiner et al. 2012) and for two relatively small states - Delaware and Connecticut (Tiner et al. 2011, 2013).

The third method is a probabilistic approach based on selecting sample plots, acquiring periodic aerial imagery, and then mapping wetland change using manual photo-interpretation. This approach is best for examining changes over large geographic areas as typified by the U.S. Fish and Wildlife Service's (USFWS) national wetland status and trends monitoring program (Dahl and Bergeson 2009). California and Minnesota both have wetland status and trend monitoring programs based on this model (Lackey

and Stein 2013; Kloiber 2012). A variation of this approach was used in southern and western Minnesota where investigators selected sample plots and compared the original NWI data (which was photo-interpreted) to an updated wetland photo-interpretation for a later time period (Oslund et al. 2010; Genet and Olsen 2008). There are other approaches to imagery-based wetland change detection, but the majority of the examples found in the literature fall into one of these three categories.

The obvious advantages to a method using existing land cover datasets like the CDL and NLCD are that costs are considerably lower than creating new data and it allows for complete spatial coverage for the change analysis. The principal disadvantage to this method is that datasets like the CDL and NLCD were not designed for this purpose. They typically have very low classification accuracies for wetland land cover. The wetland classes in the CDL are directly derived from the NLCD (NASS 2016) and the reported user's accuracy for woody wetlands and emergent wetland for the 2006 NLCD were 29% and 39%, respectively (Wickham et al. 2013). As a result, wetland change results using CDL or NLCD data will likely have relatively low degree of confidence. In addition, the spatial resolution of the CDL and NLCD are much lower than the typical spatial resolution of most aerial imagery. The NLCD is a raster dataset with a 30-meter spatial resolution. More recent CDL data also have a 30-meter spatial resolution, but for Minnesota CDL data prior to 2010 have a spatial resolution of 56 meters. In addition, these datasets often involve some spatial filtering. As a result, smaller changes in wetland may be under-represented.

Incorporating wetland trends analysis into updates of wetland inventories provides the most comprehensive assessment of change. While this can be done in an efficient manner and works well for areas of limited geographic scope, it is a costly effort for large geographic areas.

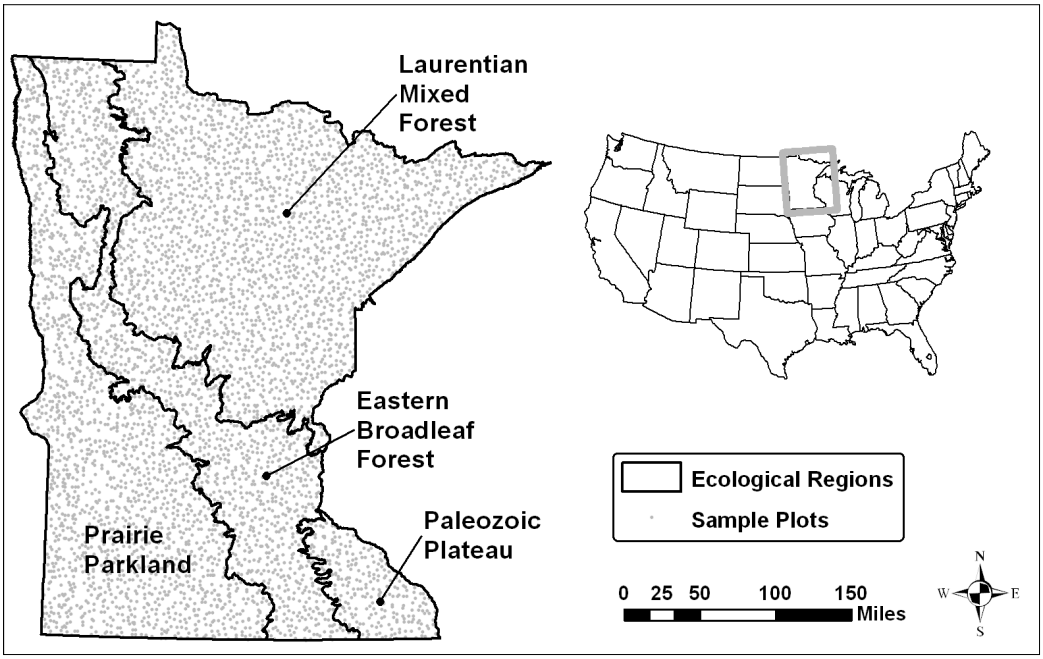
The primary advantages of the probabilistic method using aerial photo-interpretation are that it can detect relatively small changes and, if done properly, it can provide higher wetland classification accuracies than what can be obtained through examining land cover data like the NLCD and CDL. For example, Kloiber (2010) previously reported a wetland-upland classification accuracy of 94% for the Minnesota Wetland Status and Trends Monitoring Program (WSTMP). Similarly, the accuracy of the national wetland status and trends program has an overall accuracy greater than 95% (Mitch Bergeson, pers. comm. 2016). A probability-based wetland status and trend monitoring program for California reported a wetland classification accuracy of 97% (Stein et al. 2016). The disadvantages of this method is that is more expensive and time consuming to implement than the first method, although it is less costly than incorporating wetland trends into updates of wetland inventories.

This paper presents the results of an analysis of wetland areal changes in Minnesota for three monitoring cycles covering the period from 2006 to 2014 using data from the probability-based Minnesota WSTMP (Kloiber et al. 2012).

## METHODS

Changes in land cover were mapped for 4,990 randomly-selected, permanent plots located throughout Minnesota (Figure 1). All plots are 2.59 square kilometers (1 mile square) in area except for those that happen to fall on the state boundary, which were clipped to the boundary. Aerial imagery with approximately 0.5 meter resolution was acquired on a repeating three-year cycle: 250 plots were surveyed annually and the remaining 4,740 plots were divided equally into three panels with one panel surveyed each year of the cycle. The baseline imagery was acquired in stereo.

**FIGURE 1**. Study location includes 4,990 randomly selected 2.59 square kilometer plots distributed across Minnesota, U.S.A. Each grey dot represents a sample plot. The ecological regions shown here are a modified version of the Ecological Classification System of Cleland et al. (1997) modified as described in Kloiber (2010).



Sample plot locations were selected using the generalized random tessellation stratified (GRTS) design (Stevens and Olsen 2004). The GRTS design was used to ensure an adequate spatial distribution of sample plots. Further details of the program design and procedures are described by Kloiber et al. (2012), but are briefly summarized here.

Land cover was mapped and classified (Table 1) with geographical information systems (GIS) software (ArcGIS version 10.2 – ESRI Inc.) using a photo-interpretation approach. GIS polygons were created for each photo-interpreted land cover feature. The baseline data were originally interpreted from stereo imagery and then digitized. Special modifiers were added to the land cover attributes to indicate man-made or modified (m) and artificially flooded (af) features. Extensive field validation was used to measure the accuracy of the baseline land cover classification, which was found to correctly distinguish between wetland and upland 94% of the time and correctly classify the more detailed land cover types 89% of the time (Kloiber 2010). Field validation averaged about 500 sites per year, typically spread across 50 randomly selected primary sampling plots (about 1% of plots per year). The results of the field validation for 2009-2011 were essentially identical to 2006-2008. Consequently, the field work component was suspended in 2013 and is currently being re-designed to focus on different quality control issues.

Land cover polygons from the baseline assessment (2006-08) were overlaid on aerial photography for the second sample cycle (2009-11) to assess changes between these first two cycles. Subsequently, the data from the second cycle was overlaid on aerial photos for the third sample cycle (2012-14) (Figure 2). Changes in wetland extent (gains, losses or change of type) were recorded by splitting land cover polygons as necessary to reflect changes and entering the updated land cover attribute in a second database field. Photo-interpreters also classified the cause of each change as either "direct" when there was direct visual evidence of the cause such as a new road or new drainage structure, or "indirect" when the cause of the change could not be ascertained from the imagery. Analysis of the most recent imagery sometimes reveals classification errors from previous assessment periods, which are corrected and reported as updated results. A previous change analysis reported results for the period from 2006 to 2011 (Kloiber and Norris 2013). Here we also provide updated results for the first change analysis resulting from subsequent data corrections.

Pivot tables and summary statistics were generated using Microsoft Excel (Excel version 2013 – Microsoft Corporation). Hypothesis testing was performed using statistical software (JMP® version 12.0 - SAS Institute). We used the non-parametric Wilcoxon signed rank test (SAS Institute 2012) to assess whether the paired differences in wetland proportion between plots had changed between the first and second cycle as well as between the second and third cycle.

Features that did not change and non-target changes were excluded from further analysis. Non-target changes

**TABLE 1**. Land cover codes for the Minnesota wetland status and trends monitoring program.

| System | Code | Class Name | Description |
|---|---|---|---|
| Deepwater | DW | Deepwater | Lakes, reservoirs, rivers, streams |
| Wetland | FO | Forested wetland | Forested swamp |
| | SS | Shrub swamp | Woody shrub or small tree marshland |
| | EM | Emergent wetlands | Marshes, wet meadows, and bogs |
| | AB | Aquatic bed | Wetlands with floating and submerged aquatics |
| | UB | Unconsolidated bottom | Open water wetland, shore beaches and bars |
| | CW | Cultivated wetland | Wetlands in agricultural fields |
| Wetland modifiers | *m* | Manmade | DW, UB, AB or EM of artificial origin |
| | *af* | Artificially flooded | Aquaculture, sewage treatment, wetland treatment systems, mine tailing ponds |
| Upland | U | Urban | Cities, incorporated developments |
| | R | Rural development | Non-urban developed areas, infrastructure |
| | A | Agricultural | Cultivated lands and managed upland pasture |
| | N | Natural | All natural upland including forested and wooded land as well as grassland, prairies, and state and federal agricultural set-aside lands. |
| | O | Other / Transitional | All uplands not otherwise classed |

included changes among upland land uses and changes between upland and artificially flooded features (labeled "af"). Artificially flooded features typically serve an industrial or commercial purpose, have little natural wetland function, and usually do not meet the regulatory wetland definition. Examples include mine tailing discharge basins from active mining facilities and wastewater stabilization ponds. These types of features, although they are inundated, commonly lack both hydric soils and hydrophytic vegetation. Conversion of natural wetlands to an artificially flooded feature was considered as a wetland loss, and change from an artificially flooded feature to a wetland without this attribute was regarded as a wetland gain.

As defined by Cowardin et al. (1979), the boundary between deepwater habitat and adjacent wetlands is based on the depth of water or the extent of visible vegetation. However, in practice, it can be difficult to determine this boundary with accuracy from aerial imagery because water turbidity frequently obscures submergent vegetation or other indicators of depth. Therefore, the photo-interpretation convention used in this study is that areas of open water larger than 8.9 ha (20 acres) without visible aquatic vegetation were classified as deepwater habitat, whereas areas of visible aquatic vegetation were classified as aquatic bed. There can be considerable year-to-year variability in the extent of aquatic vegetation. This type of apparent community shift was considered non-target for this analysis. As a result, observed changes between aquatic bed wetland and deepwater habitat were not counted as a wetland gain or loss.

The area of wetland gain, loss and change of type were tabulated for all sample plots. To extrapolate the results statewide, the area of the measured changes in each plot was first normalized by dividing by the plot size. We then calculated the mean of these normalized proportional changes and multiplied this by the area of the state. Wetland changes were also calculated for four ecological regions of the state (Figure 1) based on the Ecological Classification System (Cleland et al. 1997) as modified for this program by the Minnesota Department of Natural Resources (Kloiber 2010). These regions were selected for use in this analysis because the type and abundance of wetland resources in each of them are fairly distinct (Kloiber 2010).

In an effort to understand at least one potential driver of wetland trends, we also evaluated the potential effect of antecedent precipitation on wetland change. We selected twelve common land cover changes of interest, such as change from emergent wetland to upland and change from emergent to cultivated wetland. Plots were then categorized with regard to whether the selected changes occurred within them or not (1 = the selected change occurred, 0 = the selected change did not occur) from the first sample cycle (2006 – 2008) to the third sample cycle (2012-2014). The first and third sample cycles were used for the comparison to maximize the number of plots exhibiting a wetland change and increase the probability of detecting a relationship between precipitation and wetland type change, if one exists. Seasonal precipitation grids were obtained for the trend analysis period from the Minnesota State Climatologist. Precipitation from spring and the preceding winter (December- February) and fall (September-November) were aggregated and joined to the data from the wetland monitoring plots, accounting for the year each plot was monitored. For example, panel 1 was first monitored in 2006, so the data from the wetland monitoring plots were joined to the gridded precipitation data from September 2005 through May 2006. The effect of precipitation differences between the first and third cycle were then evaluated using the Kruskal-Wallis rank sum test.

## RESULTS

### MEASURED GAINS FROM AND LOSSES TO UPLAND

Within the sample plots, we observed a gain of 219.2 hectares of wetland from upland for the second to the third monitoring cycle (2009-11 vs 2012-14) and a concurrent loss of 65.5 hectares (Table 2), producing a net increase of 153.7 hectares. About two-thirds of the gains from upland

**FIGURE 2**. An example of wetland mapping is shown. The image on the left shows a forested wetland dominated by black spruce in the spring of 2006, while the image on the right shows the same site in the summer of 2010. In the later image, the wetland has been split by a relocated and expanded rural highway.

**2006** **2010**

and almost 90% of the losses to upland were classified as direct, indicating that there is usually visual evidence of human intervention in most of the observed changes. The revised analysis for the first trend reporting period (2006-2011) shows a gain of 104.4 hectares of wetland along with a concurrent loss of 46.5 hectares, producing an overall net increase of 57.9 hectares. This is a slightly larger net gain than the previously reported increase of 50 hectares within the sample (Kloiber and Norris 2013), but the difference is within the margin of uncertainty.

Much of the wetland change observed was associated with agricultural land (Table 3). Over half (60%) of the wetland gains and a high proportion (76%) of the wetland losses in the period from 2009 to 2014 occurred on agricultural land. For the previous assessment period, agricultural land was involved in about half of the gains and half of the losses (Kloiber and Norris 2013). Rural developed land and natural land made up most of the remainder of wetland losses and gains between the second and third monitoring cycle. Wetland changes were observed for urban lands, but these contributed less than 1% of the gain and less than 3% of the loss.

For 2009-2014, the wetland type with the largest gross gain from upland for the most recent reporting period was emergent wetland with a gross increase of 90.9 hectares (including man-made emergent wetlands), accounting for 41% of the total gain (Table 4). However, 44.3 hectares of emergent wetland were lost to upland during this same period. The changes for emergent wetlands for this reporting period stand somewhat in contrast to the changes observed between the first and second cycle for which there was a gross gain from upland of 35.3 hectares and a concurrent loss of 30.5 hectares.

The largest net gains from upland for the 2009-2014 reporting period were seen in the unconsolidated bottom wetland class (i.e., ponds) with a gross gain of 71.7 hectares (33% of the total gains) and a loss of only 2.2 hectares. The changes for unconsolidated bottom wetlands for this reporting period are generally consistent with the change observed from the first to the second monitoring cycle, in which there was a gain of 60.6 hectares and a concurrent loss of 8.1 hectares.

Cultivated wetlands show a gross gain of 46.8 hectares between cycles two and three, which is larger than the gross gain of 6.9 hectares shown in the previous assessment. Forested and scrub shrub wetlands both showed small gains and losses in both trend assessment periods.

**TABLE 2**. Observed wetland gains from upland, losses to upland, and net change in hectares.

| Reporting Period | Direct Gain (ha) | Indirect Gain (ha) | Direct Loss (ha) | Indirect Loss (ha) | Net Change (ha) |
|---|---|---|---|---|---|
| 2009-2014 | 149.1 | 70.1 | 57.9 | 7.6 | 153.7 |
| 2006-2011 | 65.9 | 38.5 | 44.8 | 1.7 | 57.9 |

**TABLE 3**. Upland and non-wetland land cover role in observed wetland change in hectares.

| | Wetland Change 2006-2011 | | Wetland Change 2009-2014 | |
|---|---|---|---|---|
| **Cover Code (see Table 1)** | **Gain from (ha)** | **Loss to (ha)** | **Gain from (ha)** | **Loss to (ha)** |
| **A** | 56.4 | 27.8 | 130.8 | 49.7 |
| **ABmaf** | 0.0 | 0.0 | 0.0 | 0.0 |
| **EMmaf** | 0.0 | 0.0 | 0.0 | 0.0 |
| **N** | 27.1 | 1.8 | 44.4 | 3.9 |
| **O** | 0.0 | 4.4 | 0.0 | 0.0 |
| **R** | 18.4 | 12.3 | 40.4 | 10.2 |
| **S** | 0.0 | 0.0 | 0.0 | 0.0 |
| **U** | 2.1 | 0.3 | 1.3 | 1.8 |
| **UBmaf** | 0.4 | 0.0 | 2.3 | 0.0 |
| **Total** | **104.4** | **46.5** | **219.2** | **65.5** |

## MEASURED TYPE CHANGES

Changes between wetland types are frequently larger than the wetland gains and losses to and from upland. For example, there appears to be a dynamic relationship among wetlands shifting back and forth between aquatic bed wetlands and unconsolidated bottom wetlands or deepwater habitat. For the first trend assessment period, 209 hectares of aquatic bed wetland shifted to unconsolidated bottom wetland and 233 hectares of wetland shifted in the opposite direction. At the same time, 295 hectares of aquatic bed wetland shifted to deepwater habitat, while 123 hectares shifted the opposite direction. The results for the second trend assessment period were roughly similar with respect to these shifts for these three types. Some of this apparent shift between aquatic bed and unconsolidated bottom may reflect difficulties in detecting submerged vegetation using photo-interpretation.

Also, in the first trend assessment period we observed a net shift of 102 hectares from emergent wetlands to cultivated wetlands. However, in the most recent assess-

ment period we observed a net shift of 15.4 hectares from cultivated wetland to emergent wetland. In another notable change for the most recent reporting period, we observed a shift of 368 hectares of forested wetland to scrub shrub wetland, possibly due to timber harvesting.

### HYPOTHESIS TESTING FOR NO-NET-LOSS

Given that the data do not follow a normal probability distribution (Kloiber and Norris 2013), we used the non-parametric Wilcoxon signed rank test (SAS Institute 2012) to determine if the paired differences of wetland proportion for each plot between time periods are statistically different from zero, indicating a change in wetland area. This test indicated that the observed direct, indirect, and total wetland change were significantly different from zero for both the 2006-08 to 2009-11 comparison and the 2009-11 to 2010-12 comparison. All comparison results were significant at $p<0.001$. Thus, we conclude that we did observe a slight net increase in wetlands for both assessment periods.

### GEOGRAPHIC DISTRIBUTION OF GAINS AND LOSSES

The occurrence of observed changes in wetland is distributed across the state (Figure 3). However, slightly more wetland change was observed in the Prairie Parkland and Eastern Broadleaf Forest ecological regions in terms of both the number of plots showing changes and the mean size of the change. In addition, most of the plots exhibiting wetland loss tend to fall along the vegetation tension zone from the northwest to the southeast, while plots exhibiting wetland gains are more broadly distributed.

In terms of the number of plots exhibiting wetland change, approximately 2% of the sample plots in the Laurentian Mixed Forest and Paleozoic Plateau were found to exhibit wetland gains or losses from 2009 to 2014, whereas wetland gains or losses were observed for approximately 5% and 6% of the sample plots in the Prairie Parkland and Eastern Broadleaf Forest regions. In terms of the area of wetland change for the 2006-11 assessment period, the net gain

**TABLE 4**. Observed wetland gains and losses by wetland type (conversions from and to non-wetland) in hectares.

| | 2006-2011 | | 2009-2014 | |
|---|---|---|---|---|
| **Cover Code (see Table 1)** | **Gain (ha)** | **Loss (ha)** | **Gain (ha)** | **Loss (ha)** |
| **A** | 0.0 | 0.1 | 1.1 | 0.2 |
| **ABm** | 1.1 | 0.0 | 0.0 | 0.0 |
| **CW** | 6.9 | 2.0 | 46.8 | 12.7 |
| **EM** | 34.8 | 30.2 | 86.0 | 39.5 |
| **EMm** | 0.5 | 0.3 | 4.9 | 4.8 |
| **FO** | 0.2 | 1.7 | 5.7 | 1.1 |
| **SS** | 0.2 | 4.1 | 3.0 | 5.0 |
| **UB** | 15.9 | 0.7 | 37.4 | 0.0 |
| **UBm** | 44.7 | 7.4 | 34.3 | 2.2 |
| **Total** | **104.4** | **46.5** | **219.2** | **65.5** |

**TABLE 5**. Summary statistics and hypothesis testing for proportional wetland change from 2009-2011 to 2012-2014.

| | Net Direct Change | Net Indirect Change | Net All Change |
|---|---|---|---|
| **Mean** | +0.00684% | +0.00507% | +0.01191% |
| **Standard Deviation** | 0.17428% | 0.10801% | 0.20585% |
| **Standard Error of the Mean** | 0.00247% | 0.00153% | 0.00291% |
| **Upper 95% Mean** | 0.01167% | 0.00807% | 0.01762% |
| **Lower 95% Mean** | 0.00200% | 0.00207% | 0.00620% |
| **N** | 4990 | 4990 | 4990 |
| **Signed Rank Test Statistic** | 234253 | 180538 | 385131 |
| **Signed Rank Test Prob > \|t\|** | <0.0001 | <0.0001 | <0.0001 |

**TABLE 6**. Summary statistics and hypothesis testing for proportional wetland change from 2006-2008 to 2009-2011.

| | Net Direct Change | Net Indirect Change | Net All Change |
|---|---|---|---|
| **Mean** | +0.00140% | +0.00289% | +0.00429% |
| **Standard Deviation** | 0.10844% | 0.04777% | 0.11918% |
| **Standard Error of the Mean** | 0.00154% | 0.00068% | 0.00169% |
| **Upper 95% Mean** | 0.00441% | 0.00422% | 0.00760% |
| **Lower 95% Mean** | -0.00161% | 0.00157% | 0.00099% |
| **N** | 4990 | 4990 | 4990 |
| **Signed Rank Test Statistic** | 145289 | 121621 | 250114 |
| **Signed Rank Test Prob > \|t\|** | <0.0001 | <0.0001 | <0.0001 |

in wetlands for the Eastern Broadleaf Forest and Prairie Parkland regions were +0.012% and +0.0087% (Figure 4). For the same period, the Laurentian Mixed Forest showed a very small net loss of wetlands of -0.0023%. The Paleozoic Plateau had a net increase in wetlands for this period of +0.0027%, but this change was not statistically significant. For the 2009-14 assessment period, the net increase in wetland area for the Eastern Broadleaf Forest and Prairie Parkland were about 50-60% larger than they were for the previous assessment period. For the Laurentian Mixed Forest region, the 2009-14 wetland change reversed from the previous period with a net change of +0.0085%. Using the Wilcoxon signed rank test, we found that all of the regional net wetland change results were statistically significant ($P<0.01$), except for within the Paleozoic Plateau.

## STATEWIDE WETLAND GAINS AND LOSSES

Using the mean proportional changes observed in our random sample, we extrapolated the wetland changes for the entire state by multiplying the mean proportional changes by the total state area of 218,550 square kilometers (Table 7). The updated wetland change results from 2006 to 2011 show an estimated net gain of 980 hectares (a gain of 0.023% as a percentage of all wetlands), which is slightly larger than the previously reported net gain of 842 hectares (Kloiber and Norris 2013). The difference is due to corrections made to the GIS data subsequent to the original analysis. For the assessment period from 2009 to 2014, the statewide estimate of wetland change shows a net gain of 2,610 hectares (a gain of 0.060% as a percentage of all wetlands). The results between the two assessment periods are not strictly additive because occasionally wetland features gained in one assessment period can become losses in the subsequent period and vice versa. The overall statewide net change calculated from 2006 to 2014 is a gain of 3,600 hectares.

## STATEWIDE WETLAND TYPE CHANGES

In addition to outright wetland gains and losses, we also extrapolated statewide wetland type changes. There are many potential wetland type changes, but one subset of these is of particular interest. Changes between emergent, cultivated, and unconsolidated bottom wetlands (Figure 5) are of particular interest because they may result in changes for important wetland functions. This subset of wetland type changes may also have an important human-induced component. The baseline assessment indicates that

**FIGURE 3**. Net wetland change in area from 2009 to 2014 by sample plot. Plots are symbolized according to the magnitude and direction of wetland change with larger triangles for larger changes. Plots with net wetland gains are symbolized with green triangles that points up, whereas plots with net losses are symbolized with red triangles that point down.

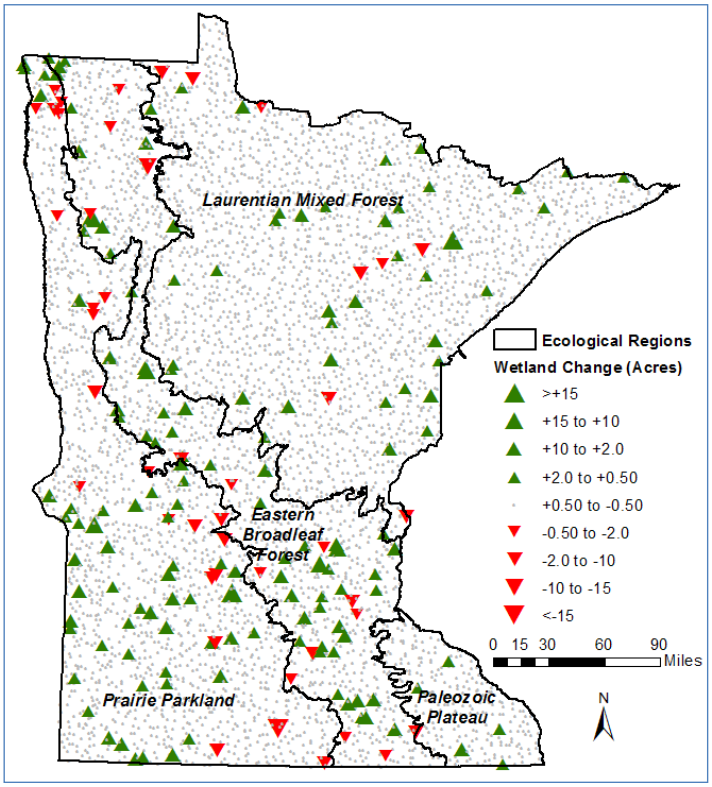



**FIGURE 4**. Estimated net wetland change for each of the four ecological regions for the two assessment periods; 2006-11 and 2009-14.

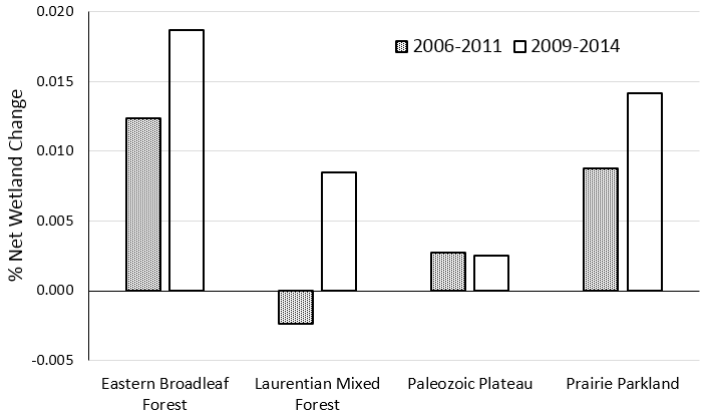



**TABLE 7**. Summary statistics and hypothesis testing for proportional wetland change from 2009-2011 to 2012-2014.

| | Statewide Wetland Change (2006-2011) (ha) | Statewide Wetland Change (2009-2014) (ha) |
|---|---|---|
| **Gross Gain** | +0.00289% | +0.00429% |
| **Gross Loss** | 0.04777% | 0.11918% |
| **Net Change** | 0.00068% | 0.00169% |

there were an estimated 1.27 million hectares of emergent wetland in the state, compared to 174,000 hectares of unconsolidated bottom wetlands and 58,700 hectares of cultivated wetland. There was an estimated net shift of 1,630 hectares of emergent wetland to cultivated wetland from 2006 to 2014 (Figure 6). There was also a net shift of 700 hectares of emergent wetland to unconsolidated bottom wetlands. These changes were partly offset by a net gain of 860 hectares of emergent wetland created from upland. Overall, this still represents a net loss of 1,470 hectares of emergent wetland from 2006 to 2014. Shifts from emergent to cultivated wetland were largely (95%) attributed to direct human causes. Shifts in the reverse direction were mostly (77%) attributed to indirect (undetermined) causes (Table 8). Shifts between emergent and unconsolidated bottom wetlands in either direction were largely (>90%) attributed to indirect causes.

## EFFECT OF ANTECEDENT PRECIPITATION

In many cases, the influence of human actions on wetland change is directly visible in the aerial imagery. In other cases, the source of change is not readily apparent. In an effort to better understand the source of these indirect changes, we evaluated the potential effect of differences in antecedent precipitation for twelve possible wetland change scenarios involving emergent, unconsolidated bottom, and cultivated wetlands as well as upland.

On average, statewide wetland plots were generally slightly drier in the third cycle compared to the first cycle with a grand mean of 1.5 centimeters less precipitation for the previous 9-month period. Significant differences in antecedent precipitation ($p<0.05$) between the first and third sample cycles were observed for five out of the twelve wetland change scenarios evaluated (Table 9). The seven wetland changes that were not associated with significant precipitation differences had generally lower occurrence frequencies.

Wetland plots that exhibited shifts from emergent to cultivated wetlands were significantly drier in the third sample cycle compared to the first cycle than the average plot (-5.4 cm instead of -1.4 cm). While this observation seems to support the hypothesis that the conversion of emergent wetlands is potentially facilitated by drier conditions, the converse shift from cultivated to emergent wetland was also correlated with significantly drier antecedent precipitation (-9.5 cm instead of -1.4 cm). However, if the shifts from cultivated wetlands to emergent wetlands are part of an intentional restoration effort, these would occur regardless of the precipitation patterns.

Shifts from emergent to unconsolidated bottom wetlands and the converse shift were also both correlated with drier than average conditions for the antecedent 9-month period. Emergent wetlands are usually associated with lower water levels than unconsolidated bottom wetlands, so we might expect less precipitation to potentially favor the development of emergent vegetation, but the fact that we also observed lower antecedent precipitation for wetlands that shift the opposite direction suggests that precipitation patterns alone do not adequately explain these shifts. It is important to recognize that even wetlands of the same type can vary widely with respect to their relative dependence on various source water mechanisms (e.g., runoff, stream flow, groundwater, and precipitation). Therefore, we cannot necessarily expect a simple relationship between the variability of a single hydrologic driver such as precipitation and changes in wetland type. Importantly, there are also human effects that are not readily discernable by simply examining aerial imagery, such as the potential impact of agricultural tile drainage and local water table drawdown from water appropriations.

We also saw a significant correlation between wetter conditions and apparent cultivated wetland gain from upland. We hypothesize that this may be an artifact of

**FIGURE 5**. Examples of photo signatures for cultivated, unconsolidated bottom, and emergent wetlands.

**Cultivated** **Unconsolidated bottom** **Emergent**

the climate conditions for the baseline assessment period of this monitoring program. If these sites were drier than normal for the initial period, they may have been classified as upland due to the lack of a wetland signature. However, in subsequent monitoring cycles, the wetter conditions may have revealed a wetland signature of the cultivated wetland. Over time, as we build a longer record of aerial imagery for these sites, we should improve our ability to distinguish these cultivated wetlands.

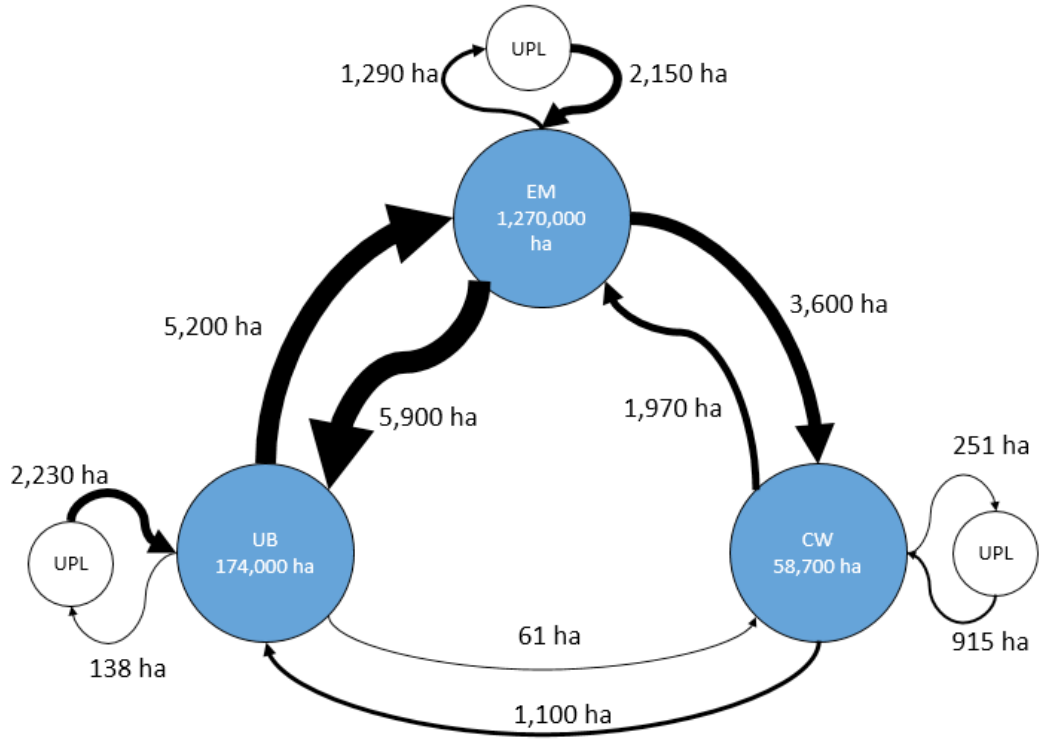
## DISCUSSION

The 1991 Minnesota Wetland Conservation Act established a statewide policy calling for no-net-loss in the quantity, quality, and biological diversity of the state's wetlands (Minn. Statute 103A.201). The results from the first three sample cycles of the wetlands status and trends monitoring program, covering the period 2006 to 2014, indicate an overall net gain of wetlands for the state. For the most recently analyzed assessment period (2009-14), there was an estimated statewide net gain of 2,610 hectares, which was larger than the net gain of 980 hectares for the first trend assessment period (2006-11). These gains are relatively small compared to the overall area of wetlands in the state. Nonetheless, these statistically significant gains suggest that the no-net-loss goal was nominally met with respect to wetland quantity, but not necessarily quality, for the study period.

There are reasons to be cautious about declaring that the overall policy objective of no-net-loss has been met. The first caveat is that there may be important ongoing losses of wetland quality and function. The national wetland status and trends program has reported that most wetland gains in the conterminous United States were due to gains in un-vegetated wetland "ponds" (Dahl 2006; Dahl 2011), which agrees with the results of the WSTMP that the largest net gains in Minnesota come from unconsolidated bottom wetlands. An assessment of depressional wetlands in Minnesota found that man-made basins, which are predominantly classified as unconsolidated bottom, were in worse biological condition than natural basins that are typically a mosaic of emergent, aquatic bed, and unconsolidated bottom wetland types (Genet 2015). In addition, our results show that gains in emergent wetland from upland are offset by type changes from emergent to other wetland types with potentially lower quality and function, specifically shifts to unconsolidated bottom wetlands and cultivated wetlands. Unconsolidated bottom and cultivated wetlands are characterized by a lack of hydrophytic vegetation implying a loss of wetland function for fish and wildlife habitat. Furthermore, a statewide wetland condition assessment of all wetland types using floristic quality assessment showed that while many of Minnesota's wetlands are of high quality, there is a stark regional difference with most of the high quality wetland located in the northeastern part of the state, while wetlands in the southwestern part of the state are largely degraded (Bourdaghs 2015). Taken together, these results suggest that while there may be small net gains in wetland quantity, there are potential ongoing loses of wetland function.

The second reason for caution about the nominal net gain observed by the WSTMP is that other stud-

**FIGURE 6.** Wetland changes involving emergent (EM), cultivated (CW), and unconsolidated bottom (UB) wetlands from 2006 to 2014. The line weight reflects the magnitude of the type change and the arrow shows the direction of the change. This figure shows a net shift from emergent wetlands to cultivated and unconsolidated bottom wetlands.



ies have shown different results. In particular, Dahl (2014), using a similar probabilistic sampling approach, showed significant wetland losses for the Prairie Pothole Region (PPR), which includes southern and western Minnesota as well as North and South Dakota. He reported an overall loss of 30,080 hectares for all wetland types within the PPR or 2,509 hectares/year from 1997 to 2009; whereas, the Minnesota WSTMP reported a statewide gain of 870 hectares/year from 2009 to 2014 (net gain of 2,610 hectares divided by the three year cycle). Furthermore, Dahl reported a loss of 38,582 hectares of emergent wetlands in the PPR with most of that occurring in Minnesota. This appears to conflict with the results presented here. However, there are some potentially important differences between the Minnesota WSTMP and Dahl's study of the PPR which may explain this apparent discrepancy.

Clearly, one difference is the time period of the two studies; from 2006-2014 for our study as opposed to 1997-2009 for the Dahl study. So one possible explanation is that there was a real change in the wetland trend between the two time periods, although it is not clear what might be causing any such trend, if it really exists. Another difference is the sampling intensity which likely to be an important factor. Dahl had 156 plots in the portion of the PPR in Minnesota whereas we had nearly 10 times that number (1,475 plots) within the Prairie Parkland Province of Minnesota. Even accounting for Dahl's larger plot size (10.36 square kilometers), the total sampled area for the WSTMP in the Prairie Parkland Province was more than double that of Dahl's. The smaller sample size of Dahl's study will result in larger uncertainty in the estimated wetland change. Finally, there are likely differences pertaining to the treatment of cultivated wetlands. We previously reported an estimate of 27,393 hectares of cultivated wetland for the Prairie Parkland Province in Minnesota (Kloiber 2010), whereas Dahl (2014) reported 20,878 hectares of cultivated wetland for the entire PPR. Cultivated wetlands exist at a rather uncertain boundary between features that are clearly wetland and features that have clearly been converted to effectively-drained agricultural land. Differences between these two studies in classifying cultivated wetlands may have an effect on the trend results. Overall, the differences in geographic scope, time period, sampling design and intensity, and classification methodology makes a direct comparison of results between these two studies difficult.

Other wetland change studies have also shown varied results, but all of these also cover the different geographic areas and time periods. Nationally, the U.S. Fish and Wildlife Service reported annual percentage change in wetlands of -0.055%, +0.030%, and -0.012% for the reporting periods 1986-1997, 1998-2004, and 2004-2009, respectively (Dahl 2011). The net change in Minnesota wetlands from this study are +0.018% and +0.049% for the reporting periods 2006-2011 and 2009-2014. We have previously compared our results to other regional estimates of wetland change for southwestern Minnesota (Kloiber and Norris 2013). In these studies, both Oslund (2010) and Genet and Olsen (2008) reported net wetland losses for southwestern Minnesota. However, both of these studies used the National Wetlands Inventory as the baseline for their studies, which dates from circa 1980. The difference in the respective study periods between these various efforts may account for much of the difference in results. This not only substantially predates the study period for the WSTMP, but importantly, it also predates the 1985 implementation of the Swampbuster provision of the federal farm program, which has been shown to have substantially slowed the loss of wetlands on agricultural lands (Dahl 2000; Haufler 2005).

Finally, in attempting to explain certain results of our study, we hypothesized that observed shifts between emergent, cultivated, and unconsolidated bottom wetlands and uplands (Figure 6) may be influenced by climate patterns. Under drier conditions, emergent wetlands may be more susceptible to conversion to cultivated wetlands. Minnesota state and federal regulations all contain provisions that potentially allow wetland vegetation to be cleared and crops to be planted if conditions are dry enough to allow farm equipment to operate. If wetter conditions return, sites that previously appeared as cultivated wetland (or they might even appear to be cultivated upland) may revert to unconsolidated bottom wetlands as precipitation and water tables rebound. The precipitation analysis presented here provides

**TABLE 8**. Proportion of selected wetland changes with directly human causes and indirect causes

| Change Category | %Direct | %Indirect |
|---|---|---|
| EM-CW | 95% | 5% |
| CW-EM | 23% | 77% |
| UB-CW | 17% | 83% |
| CW-UB | 76% | 24% |
| EM-UB | 9% | 91% |
| UB-EM | 8% | 92% |
| EM-UPL | 92% | 8% |
| UPL-EM | 66% | 34% |
| CW-UPL | 79% | 21% |
| UPL-CW | 62% | 38% |
| UB-UPL | 88% | 12% |
| UPL-UB | 27% | 73% |

mixed evidence, with some results supporting and other results contradicting this hypothesis. Additional information on the geographic distribution of agricultural tile drainage and groundwater appropriation could also be incorporated into this analysis, where it is available. Over time, using the data from this ongoing monitoring program and additional analysis, we should be able to better resolve the potential effect that climate variability and other factors may have on wetland changes.

## SUMMARY

The State of Minnesota has been operating a wetland status and trends monitoring program (WSTMP) since 2006. Wetland change is monitored using remote sensing data for 4,990 random plots, with each plot being 2.59 square kilometers (one square mile) in size, and conducted over repeating 3-year sampling cycles. The analysis presented here includes the results from three complete sampling cycles; 2006–2008, 2009–2011, and 2012–2014. We found small, but statistically significant net gains in wetland area. Extrapolating the results statewide indicates that Minnesota had a net gain of 980 hectares (+0.023%) of wetland from 2006 to 2011 and a net gain of 2,610 hectares (+0.060%) from 2009 to 2014. In spite of nominally achieving the State's no-net-loss goal with respect to wetland quantity, the data suggest important reasons to be concerned about the state of wetlands in Minnesota. First, much of the observed gains were unconsolidated bottom type wetlands (ponds) that typically have limited wildlife habitat value. Second, there are conversions between wetland types, such as emergent wetlands converted to cultivated wetlands or to unconsolidated bottom wetlands that, while not a loss of wetland area, undoubtedly represent a loss of wetland function. To fully achieve the no-net-loss policy, we will have to gain a more complete understanding of the drivers of these observed wetland changes. Given the diversity of wetlands and the complexity of teasing out the potential influence of multiple drivers, this will be a challenging effort. ■

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**TABLE 9.** Antecedent 9-month precipitation differences associated with select observed wetland changes from 2006-2011 to 2012-2014.

| Change Category | Probability | Mean Precipitation Difference for Plots without Specified Wetland Change (cm) | Mean Precipitation Difference for Plots with Specified Wetland Change (cm) | Count of the Plots with Specified Wetland Change |
|---|---|---|---|---|
| EM -> CW | 0.0137* | -1.4 | -5.4 | 73 |
| CW -> EM | 0.0011* | -1.4 | -9.5 | 22 |
| UB -> CW | 0.0911 | -1.5 | -11.0 | 4 |
| CW -> UB | 0.8939 | -1.5 | -1.1 | 4 |
| EM -> UB | 0.0203* | -1.4 | -3.1 | 230 |
| UB -> EM | <0.0001* | -1.2 | -5.9 | 261 |
| EM -> UPL | 0.1256 | -1.5 | -3.6 | 64 |
| UPL -> EM | 0.1352 | -1.5 | 0.6 | 115 |
| CW -> UPL | 0.5389 | -1.5 | -2.3 | 12 |
| UPL -> CW | 0.0294* | -1.5 | 3.2 | 54 |
| UB -> UPL | 0.1983 | -1.5 | 6.6 | 6 |
| UPL -> UB | 0.9495 | -1.5 | -1.6 | 55 |

* Statistically significant at the $p<0.05$ level using the Kruskal-Wallis rank sum test with a one-way Chi-squared approximation.

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# EPA and the Corps Propose Changes to the Definition of "Waters of the U.S."

The US EPA and the Army Corps have initiated two phases to change the definition of "waters of the U.S." Phase 1 involves the repeal of the 2015 Clean Water Rule. The comment period now ends September 27 (original comment due date was August 27 but they gave a 1 month extension). They are required to provide responses to comments. The public can submit comments, identified by Docket Id. EPA-HQ-2017-0203, at regulations.gov. Phase 2 will involve developing a new Clean Water Rule consistent with Scalia SCOTUS opinion. They will accept recommendations on this definition until November 27, but are not planning on making formal responses to this input. They are offering teleconferences and a D.C. small entities in-person meeting for public participation (see notice below).

The following is an excerpt from the EPA and Corps' August 18 announcement about public meetings on the definition of the waters of the United States.

"**SUMMARY**: The Environmental Protection Agency (EPA) and the U.S. Department of the Army (the agencies) will hold ten teleconferences to hear from stakeholders their recommendations to revise the definition of "Waters of the United States'' under the Clean Water Act (CWA). Nine of the teleconferences will be tailored to a specific sector, i.e., agriculture (row crop, livestock, silviculture); conservation (hunters and anglers); small entities (small businesses, small organizations, small jurisdictions); construction and transportation; environment and public advocacy (including health and environmental justice); mining; industry (energy, chemical, oil/gas); scientific organizations and academia; and stormwater, wastewater management, and drinking water agencies. One of the teleconferences will be open to the public at large. The teleconferences will run throughout the fall on Tuesdays from 1:00 p.m.-3:00 p.m. eastern time, beginning on September 19, 2017. In addition, the agencies will hold an in-person meeting with small entities on October 23, 2017 from 9:00 a.m.-11 a.m., and will accept written recommendations from any member of the public.

**DATES**: Written recommendation must be received on or before November 28, 2017.

**ADDRESSES**: Submit your recommendations, identified by **Docket ID No. EPA-HQ-OW-2017-0480**, at http://www.regulations.gov. This docket, established as a courtesy to the stakeholder community, will be included in the administrative record of the regulation revising the definition of "Waters of the United States'' under the Clean Water Act (CWA). The agencies will not be formally responding to the recommendations. Follow the online instructions for submitting recommendations. Once submitted, your submission cannot be edited or removed from Regulations.gov. The agencies may publish any submission received to the public docket. Do not submit electronically any information you consider to be Confidential Business Information (CBI) or information whose disclosure is restricted by statute.

**FOR FURTHER INFORMATION CONTACT**: Ms. Damaris Christensen, Office of Water (4504-T), Environmental Protection Agency, 1200 Pennsylvania Avenue NW., Washington, DC 20460; telephone number: (202) 566-2428; email address: CWAwotus@epa.gov; or Ms. Stacey Jensen, Regulatory Community of Practice (CECW-CO-R), U.S. Army Corps of Engineers, 441 G Street NW., Washington, DC 20314; telephone number: (202) 761-5903; email address: US-ACE_CWA_Rule@usace.army.mil.

**SUPPLEMENTARY INFORMATION**: On February 28, 2017, the President issued an Executive Order (E.O.) entitled "Restoring the Rule of Law, Federalism, and Economic Growth by Reviewing the "Waters of the United States'' Rule''. This E.O. states that it is in the national interest to ensure that the Nation's navigable waters are kept free from pollution, while at the same time promoting economic growth, minimizing regulatory uncertainty, and showing due regard for the roles of the Congress and the States under the Constitution. The E.O. directs the agencies to review the Clean Water Rule for consistency with these priorities and publish for notice and comment a proposed rule rescinding or revising the rule, as appropriate and consistent with law. Further, the E.O. directs that the agencies shall consider interpreting the term "navigable waters,'' as defined in 33 U.S.C. 1362(7), in a manner consistent with the opinion of Justice Antonin Scalia in Rapanos v. United States, 547 U.S. 715

(2006). Justice Scalia's opinion considers CWA jurisdiction as including relatively permanent waters and wetlands with a continuous surface connection to relatively permanent waters. The agencies are implementing the E.O. in two steps to provide as much certainty as possible as quickly as possible to the regulated community and the public during the development of the ultimate replacement rule. For the first step, the agencies proposed on July 27, 2017, a rule to re-codify the regulation that was in place prior to issuance of the Clean Water Rule and that is being implemented now under the U.S. Court of Appeals for the Sixth Circuit's stay of that rule.\1\ The comment period for this first step proposed rule is open until September 27, 2017.

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\1\ The Clean Water Rule was promulgated on June 29, 2015 (80 FR 37054). It was in effect in most of the country for a two-month period before the Sixth Circuit Court of Appeals issued a nationwide stay. The agencies are currently implementing the previous regulatory definition of "waters of the United States'' in light of the stay.

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For the second step, the agencies plan to propose a new definition that would replace the approach in the 2015 Clean Water Rule with one that is consistent with the approach outlined in the E.O. In June 2017, the agencies completed consultation processes with tribes as well as state and local governments on the step 2 rulemaking. The meetings described below will provide other interested stakeholders opportunity to provide pre-proposal feedback on this second step rule to revise the definition of "waters of the U.S.'' Both EPA and the Corps are aware that the scope of CWA jurisdiction is of intense interest to a broad array of stakeholders and therefore want to provide time for broad pre-proposal input. The teleconferences in this notice are intended to solicit recommendations for Step 2 and potential approaches to defining "waters of the United States.'' During the upcoming teleconferences, EPA will provide brief background information on the step 2 rulemaking, and progress to date. Stakeholders will have the opportunity to provide input, particularly with regard to the charge in the E.O. and opinion of Justice Scalia. The teleconferences will be held on a weekly basis beginning September 19 and will continue each Tuesday thereafter for ten weeks. Each will run from 1:00 p.m. to 3:00 p.m. eastern time. Information on how to register for each of these meetings is available on the EPA Web site at https://www.epa.gov/wotus-rule/outreach-meetings. Registration for each webinar will close a week prior. Persons or organizations wishing to provide verbal recommendations during the teleconference will be selected on a first-come, first-serve basis. Due to the expected volume of participants, individuals will be asked to limit their oral presentation to three minutes.

Supporting materials and comments from those who did not have an opportunity to speak can be submitted to the docket as discussed above. The schedule for the Waters of the US webinars is as follows:

- **Tuesday, September 19, 2017**
  Small entities (small businesses, small organizations and small governmental jurisdictions);
- **Tuesday, September 26, 2017**
  Environment and public advocacy;
- **Tuesday, October 3, 2017**
  Conservation, e.g., hunters and anglers;
- **Tuesday, October 10, 2017**
  Construction and transportation;
- **Tuesday, October 17, 2017**
  Agriculture;
- **Tuesday, October 24, 2017**
  Industry;
- **Tuesday, October 31, 2017**
  Mining;
- **Tuesday, November 7, 2017**
  Scientific organizations and academia;
- **Tuesday, November 14, 2017**
  Stormwater, wastewater management and drinking water agencies; and
- **Tuesday, November 21, 2017**
  Open to general public.

**Monday, October 23, 2017**, an in-person meeting with small entities. 9:00 to 11:00 a.m. Eastern Time at the U.S. EPA's Headquarters located at 1200 Pennsylvania Avenue NW., Washington, DC 20003.

Purpose: To facilitate the building security process, and to request reasonable accommodation, those who wish to attend must contact Joan B. Rogers (202-564-6568 or rogers.joanb@epa.gov), no later than Friday, October 13, 2017. RSVPs will be accepted until October 13, or until room capacity has been reached (100 max), whichever occurs first.

Dated: **August 18, 2017**. Bu: John Goodin, Acting Director, Office of Wetlands, Oceans and Watersheds, Office of Water, Environmental Protection Agency.

Dated: **August 18, 2017.** By: Douglas W. Lamont, Deputy Assistant Secretary of the Army (Project Planning and Review), performing the duties of the Assistant Secretary of the Army for Civil Works." ■

# WETLAND BOOKSHELF

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

## BOOKS

- Wetland Indicators – A Guide to Wetland Formation, Identification, Delineation, Classification, and Mapping https://www.crcpress.com/Wetland-Indicators-A-Guide-to-Wetland-Identification-Delineation-Classification/Tiner/p/book/9781439853696
- Wetland Soils: Genesis, Hydrology, Landscapes, and Classification https://www.crcpress.com/Wetland-Soils-Genesis-Hydrology-Landscapes-and-Classification/Vepraskas-Richardson-Vepraskas-Craft/9781566704847
- Creating and Restoring Wetlands: From Theory to Practice http://store.elsevier.com/Creating-and-Restoring-Wetlands/Christopher-Craft/isbn-9780124072329/
- Salt Marsh Secrets. Who uncovered them and how? http://trnerr.org/SaltMarshSecrets/
- Remote Sensing of Wetlands: Applications and Advances. https://www.crcpress.com/product/isbn/9781482237351
- Wetlands (5th Edition). http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118676823.html
- Black Swan Lake – Life of a Wetland http://press.uchicago.edu/ucp/books/book/distributed/B/bo15564698.html
- Coastal Wetlands of the World: Geology, Ecology, Distribution and Applications http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/environmental-science/coastal-wetlands-world-geology-ecology-distribution-and-applications
- Florida's Wetlands http://www.pineapplepress.com/ad.asp?isbn=978-1-56164-687-6
- Mid-Atlantic Freshwater Wetlands: Science, Management, Policy, and Practice http://www.springer.com/environment/aquatic+sciences/book/978-1-4614-5595-0
- The Atchafalaya River Basin: History and Ecology of an American Wetland http://www.tamupress.com/product/Atchafalaya-River-Basin,7733.aspx
- Tidal Wetlands Primer: An Introduction to their Ecology, Natural History, Status and Conservation https://www.umass.edu/umpress/title/tidal-wetlands-primer
- Wetland Landscape Characterization: Practical Tools, Methods, and Approaches for Landscape Ecology http://www.crcpress.com/product/isbn/9781466503762
- Wetland Techniques (3 volumes) http://www.springer.com/life+sciences/ecology/book/978-94-007-6859-8

## ONLINE PUBLICATIONS

### U.S. ARMY CORPS OF ENGINEERS

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

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

- Wetland Characterization and Landscape-level Functional Assessment for Long Island, New York http://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/Characterization_Report_February_2015.pdf or http://www.aswm.org/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
- Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors. Version 3.0. U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA.
- Connecticut Wetlands Reports
- Changes in Connecticut Wetlands: 1990 to 2010
- Potential Wetland Restoration Sites for Connecticut: Results of a Preliminary Statewide Survey
- Wetlands and Waters of Connecticut: Status 2010
- Connecticut Wetlands: Characterization and Landscape-level Functional Assessment
- Rhode Island Wetlands: Status, Characterization, and Landscape-level Functional Assessment http://www.aswm.org/wetlandsonestop/rhode_island_wetlands_llww.pdf

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

### U.S. FOREST SERVICE

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

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

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

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

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

### PUBLICATIONS BY OTHER ORGANIZATIONS

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

### ARTICLES OF INTEREST FROM VARIED SOURCES

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

## LINKS TO WETLAND-RELATED JOURNALS AND NEWSLETTERS

### JOURNALS

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

### NEWSLETTERS

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

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

Here are photos of my pond during last year's drought and today (August 24, 2017). The seedlings of Juncus were present at the end of last season and have flourished to cover the pond bottom, while the water lilies are recovering but not dominant as in the past due to low water levels. ■

Pond – August 13, 2016

Pond – August 24, 2017

Close up showing abundance of rushes and water lilies in shallow water (August 24, 2017).

## About *Wetland Science & 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.

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

### HOW YOU CAN HELP

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

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

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

## WSP Manuscript – General Guidelines

### LENGTH:

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

### STYLE:

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

### TEXT:

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

### FIGURES:

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

### REFERENCE CITATION EXAMPLES:

- Claus, S., S. Imgraben, K. Brennan, A. Carthey, B. Daly, R. Blakey, E. Turak, and N. Saintilan. 2011. Assessing the extent and condition of wetlands in NSW: Supporting report A – Conceptual framework, Monitoring, evaluation and reporting program, Technical report series, Office of Environment and Heritage, Sydney, Australia. OEH 2011/0727.
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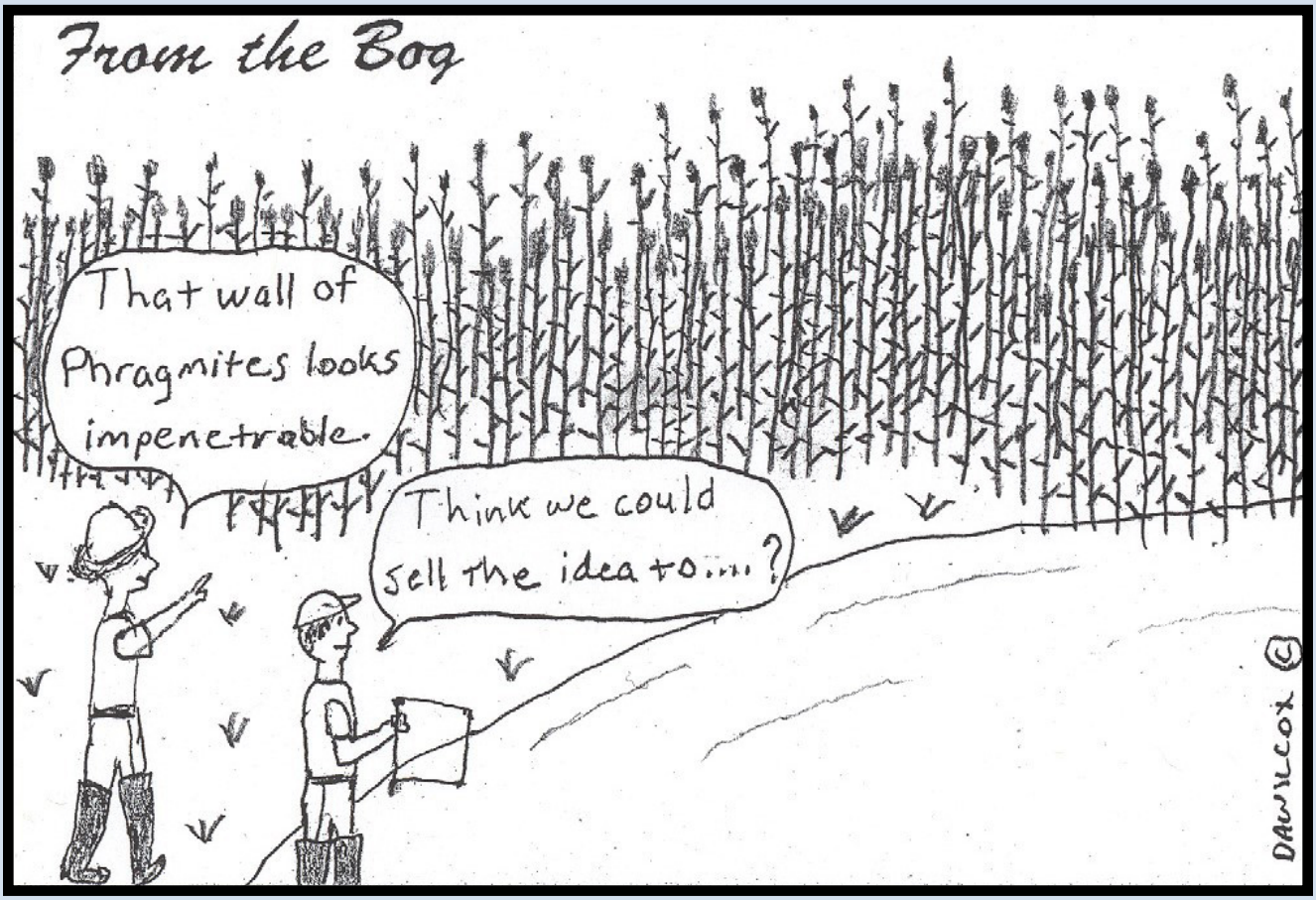
- Cooper, D.J. and D.M. Merritt. 2012. Assessing the water needs of riparian and wetland vegetation in the western United States. U.S.D.A., Forest Service, Rocky Mountain Research Station, Ft. Collins, CO. Gen. Tech. Rep. RMRS-GTR-282.

WEB TIP

# Resources at your fingertips!

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

Find them on the Related Links page sws.org.


## *Phragmites* entrepreneurs

wetland science & practice

WSP is the formal voice of the Society of Wetland Scientists. It is a quarterly publication focusing on the news of the SWS and providing important announcements for members and opportunities for wetland scientists, managers, and graduate students to publish brief summaries of their works and conservation initiatives. Topics for articles may include descriptions of threatened wetlands around the globe or the establishment of wetland conservation areas, and summary findings from research or restoration projects. All manuscripts should follow guidelines for authors listed above. All papers published in WSP will be reviewed by the editor for suitability and may be subject to peer review as necessary. Most articles will be published within 3 months of receipt. Letters to the editor are also encouraged, but must be relevant to broad wetland-related topics. All material should be sent electronically to the current editor of WSP. Complaints about SWS policy or personnel should be sent directly to the elected officers of SWS and will not be considered for publication in WSP. ■