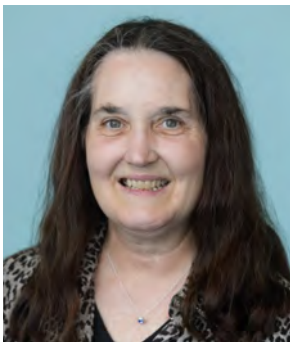
wetland science & practice
published by the Society of Wetland Scientists
Vol. 35, No. 3 Special Issue 2018

Proceedings of the 2018 Annual Meeting of the Society of Wetland Scientists
May 29-June 1, 2018 | Denver, Colorado, USA

PRESIDENT'S MESSAGE

There has been much enthusiasm expressed about our 2018 annual meeting in Denver with 633 attendees, including 134 students, and 466 presentations and abstracts. The meeting was a great success both educationally and financially for SWS. I must give a very big thank you to the Rocky Mountain Chapter organizing committee led by Andy Herb, and the AMPED staff led by Amanda Safa. We hope for future success with the 2019 meeting in Baltimore (May 18-31, 2019).



Beth Middleton
U.S. Geological Survey,
Wetland and Aquatic
Research Center
SWS President

We are excited to begin publishing the meeting abstracts again and will do so each year in the July issue of this publication. This issue contains the accepted abstracts from the 2018 Denver meeting.

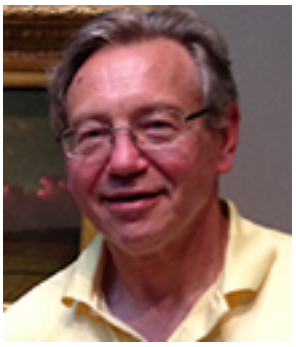
Building on discussions from the meeting, several initiatives are moving forward. A new Riparian Section proposed by Malia Volke has enough signatures to move forward to the SWS Board for acceptance as a section. Chapter and Section consortia are having occasional conference calls this year, which we hope will help the chapter presidents and section chairs to find solutions to shared problems. The 40th Anniversary Celebration planning continues for a year of activities in 2020. SWS continues to find ways to internationalize, by encouraging work in Traditional Ecological Knowledge. We are providing wetland science insights to moderated sessions at the Ramsar Conference of the Contracting Parties in Dubai.

Summer is a quiet time with universities not in session, field work, and summer vacations. My July was a blur of field work in the cypress swamps of the Mississippi River Alluvial Valley and the Atlantic and Gulf Coast (see: the SWS Instagram page: www.instagram.com/societywetlandscientists). If you have an interesting picture to share on your summer activities, please post them on the SWS Instagram page.

I look forward to hearing from you about your ideas and concerns for SWS. Please contact me: middletonb@usgs.gov ■

INTRODUCTION TO THIS ISSUE

The Society of Wetland Scientists (SWS) was created in 1980 as a non-profit science-based organization for scientists and technical specialists working in wetlands to share and develop new information about wetlands that would promote better understanding and conservation of wetlands and through that effort, to recognize an emerging scientific discipline focused on wetlands (i.e., wetland science). The mission of the SWS is to promote understanding, conservation, protection, restoration, science-based management, and sustainability of wetlands.



Ralph Tiner
WSP Editor

SWS has two journals for communicating information about wetlands: *Wetlands*, the premier international journal focused on publishing technical, peer-reviewed research-based articles and *Wetland Science & Practice* which publishes summary articles on a variety of topics ranging from scientific studies and restoration projects to wetland management and natural history, in addition to providing updated information on SWS activities and challenges facing today's wetlands. *Wetlands* is available to SWS members and to others through subscription, while *Wetland Science & Practice* is a full-color e-publication that is available online free to the public after 3 months of its initial release to SWS members (http://sws.org/Publications/wetland-science-and-practice.html).

SWS sponsors annual meetings that bring together wetland scientists from around the globe to highlight their activities in research and management and exchange their ideas and concerns about wetland conservation and management. Hundreds of presentations are given over the course of a few days. Presenters prepare abstracts for submission to SWS prior to the meeting for acceptance and for organizing talks during the conference. In an effort to bring the information from SWS annual meetings to a wider audience, SWS decided to publish the abstracts as the July issue of *Wetland Science & Practice*. The current plan is to publish them in every July issue so the results are available to all members shortly after the meeting and to the public worldwide in October when the July issue of WSP is posted for open access. This is the first issue for this purpose, hence the introduction.

This special issue contains abstracts from our 2018 annual meeting held in Denver, Colorado, USA from May 29 through June 1. Abstracts are arranged by the topics that they were assigned for presentation at the meeting. No attempt was made to further organize them. Special thanks to Kristin McGuine for her extra efforts in compiling this special edition!

We hope that this publication will alert readers about ongoing activities by researchers and wetland managers and that it will also foster improved communication among wetland specialists working in similar areas. ■

PROCEEDINGS

Proceedings from the 2018 Annual Meeting of the Society of Wetland Scientists

Wetland Science: Integrating Research, Practice, and Policy – and Exchange of Expertise

May 29-June 1, 2018

Hilton Denver Center City, Denver, Colorado, USA

WETLAND SCIENCE & PRACTICE

Vol. 35, No. 3 Special Issue 2018

COVER PHOTO:

Cover: Wild horses at Chincoteague National Wildlife Refuge by Ralph Tiner For more information on these horses go to http://www.chincoteague.com/ponies.html

SOCIETY OF WETLAND SCIENTISTS

22 N Carroll St., Ste 300, Madison, WI 53703
608-310-7855
www.sws.org

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

TABLE OF CONTENTS

Vol. 35, No. 3 Special Issue 2018

Biology & Ecology: Animals

PRESENTATION 1278
PRESENTED DURING *WETLAND FAUNA*, 06/01/2018, 03:20 - 04:40

SUCCESSION AND BETA-DIVERSITY AMONG INVERTEBRATE COMMUNITIES IN SOUTHEASTERN BEAVER-CREATED WETLANDS

Bush, Bryana, University of Georgia, Athens, GA
Batzer, Darold, University of Georgia, Athens, GA

Southeastern US beaver-created wetlands are generally transitory systems caused by regional weather patterns and a history of extreme sedimentation resulting in unstable stream beds. Beaver dams in the Southeast are regularly breached, rebuilt, relocated, or abandoned which creates complexes of newly-created, mature, and abandoned beaver wetlands within a stream network. To compare invertebrate communities among the three basic habitat successional stages, invertebrates were sampled in newly formed (created within 2 years; n = 4), mature (established for >15 years; n = 4), and abandoned wetlands (breached dams; n = 3) and associated streams (n=3) in October 2013 and May 2014 in Oconee National Forest in Georgia, USA. Each wetland type had a relatively high number of taxa (>60 families) and there was strong seasonal variation in invertebrate communities. In October, invertebrate communities differed among all successional stages and stream communities varied from all but abandoned ponds. In May, only the mature beaver wetland communities were different from both streams and newly formed or abandoned ponds. Seasonal differences in community structure suggest that seasonal change as well as longer-term succession strongly control invertebrate community structures in these beaver wetlands. We hypothesize that beaver wetlands with multiple successional stages increase beta (β)-diversity of watersheds. ■

Biology & Ecology: Biogeochemistry-Carbon Cycling / Sequestration

PRESENTATION P06
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

RESTORING CARBON SEQUESTRATION PROCESSES IN A DEGRADED WET MEADOW

Baldwin, Lydia, Colorado State University, Fort Collins, CO

Wet meadows throughout the Sierra Nevada that were historically disturbed are currently losing both soil water holding capacity and the ability to store carbon. While these wetlands formerly functioned as sinks of carbon dioxide, they could now act as significant sources of CO2 to the atmosphere. Given the imminent threat of climate change, it is vital to explore techniques to facilitate the potential recovery of a greenhouse gas sink. Furthermore, the maintenance and addition of carbon to soil can also enhance its water holding capacity. I am testing whether the reestablishment of a sedge dominated community at Tuolumne Meadows, a high elevation wet meadow in Yosemite National Park, will restore the meadow to a carbon accumulating ecosystem. In 2016, 20,000 Carex scopulorum (mountain sedge) were planted into the meadow and by the end of the summer of 2018, over 100,000 more will also be planted. Gross primary production and plant respiration are being monitored to create a model of growing season carbon dynamics to determine if these treatments increase the meadow's carbon storage. The outcome of this restoration project will inform land managers facing similar issues of drying meadows with potentially large losses of CO2. ■

PRESENTATION 1061
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS II*, 05/31/2018, 01:00 - 02:50

SALTWATER INTRUSION CAUSES VEGETATION LOSS AND CATASTROPHIC SOIL SUBSIDENCE IN A TIDAL FRESHWATER MARSH: A FIELD MANIPULATION

Craft, Christopher, Indiana University, Bloomington, IN
Solohin, Elena, Indiana University, Bloomington, IN
Widney, Sarah, Indiana University, Bloomington, IN
Smith, Dontrece, University of Georgia, Darien, GA

Replicate (n=6) field plots in a tidal freshwater marsh (Georgia) were treated with Press (continuous) or Pulse (2 months annually in fall) additions of dilute seawater for four years to simulate the effects of sea level rise and drought, respectively, on processes that regulate soil elevation capital in these organic-rich soils. Soil surface elevation was monitored two times each year during the four dosing experiment using rod sedimentation-erosion tables (RSET's). Replicate Control (untreated, freshwater addition) plots were measured/monitored simultaneously.

Seawater additions to Press plots led to increased porewater salinity of 2-5 psu and increased sulfate and sulfide – an indicator of sulfate reduction - within several months and they remained elevated during the three year study period. Press additions caused a significant reduction in belowground biomass and, more importantly, root production needed to build soil elevation capital. Surprisingly, decomposition measured using root bags was unaffected by seawater addition.

In Press plots, loss of the root mat and lack of carbon (C) inputs from root production resulted in a 10 mm/yr decline in soil surface elevation, with a cumulative decline of 3 cm in the first three years. Soil surface elevation in other treatments – Control, Freshwater addition, Pulse – increased though the rate of increase in the Pulse plots (2.5 mm/yr) was less than half that measured in Control and Freshwater addition plots (6 mm/yr).

Our findings indicate chronic saltwater intrusion reduces plant productivity and C inputs to the soil, leading to dramatic loss of soil elevation capital in a short period of time. Pulse additions of seawater have lesser effect though soil accretion is reduced by half relative to Control plots. In the future, chronic and acute saltwater intrusion is likely to reduce the resilience of tidal freshwater wetlands to other natural and anthropogenic stressors. ■

PRESENTATION 1088

PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS II*, 06/01/2018, 01:00 - 02:30

CARBON STORAGE IN US WETLANDS

Nahlik, Amanda M., US Environmental Protection Agency, Corvallis, OR
Fennessy, M. Siobhan, Kenyon College, Gambier, OH

Wetland soils contain some of the densest stores of soil carbon in the biosphere. However, there is little understanding of the quantity and distribution of carbon stored in US wetlands or of the potential effects of human disturbance on these stocks. We provide statistically-defensible estimates of soil carbon stocks for wetlands at regional and national scales and describe how soil carbon stocks vary by anthropogenic disturbance to the wetland. To estimate carbon stocks in wetlands of the conterminous US, we used data gathered in the field as part of the 2011 National Wetland Condition Assessment (NWCA) conducted in a partnership between the USEPA and the states. During the growing season, field crews collected soil samples by horizon from 120-cm deep soil pits at 967 randomly selected wetland sites. Soil samples were analyzed for bulk density and organic carbon. We applied site carbon stock averages by soil depth back to the national population of wetlands and to several subpopulations, including five geographic areas and anthropogenic disturbance level. Disturbance levels were categorized by the NWCA as least, intermediately, or most disturbed using a priori defined physical, chemical, and biological indicators that were observable at the time of the site visit.

We find that wetlands in the conterminous US store a total of 11.52 PgC – roughly equivalent to four years of annual carbon emissions by the US – with the greatest soil carbon densities in the Eastern Mountains and Upper Midwest region, averaging 478±58 tC ha-1. Furthermore, our data suggest a relationship between carbon stock density and anthropogenic disturbance, with greater carbon density in least disturbed wetlands (407±51 tC ha-1) than in most disturbed wetlands (236±47 tC ha-1). These data provide the first empirical, unbiased estimates of soil carbon for targeted populations of wetlands in the conterminous US. This is also the first time the relationship between human disturbance and wetland carbon stocks has been demonstrated on a national scale. This effort exemplifies the power of collecting national data, and the results of this research further support indicator development efforts for future NWCA surveys. The data we provide here are useful to effectively identify characteristics of wetlands or types of wetlands in particular geographic areas that contain disproportionately large carbon stores – critical insight should one wish to manage ecosystem pools of carbon. ■

PRESENTATION 1144

PRESENTED DURING *BIOGEOCHEMISTRY/CARBON CYCLE*, 05/31/2018, 01:10 - 02:50

PATTERNS OF BRYOPHYTE DIVERSITY AND NUTRIENT AVAILABILITY IN VERNAL POOLS LOCATED IN CENTRAL PENNSYLVANIA, USA

Rainford, Shauna-kay, The Pennsylvania State University, University Park, PA
Drohan, Patrick, The Pennsylvania State University, University Park, PA

Here, bryophyte biomass, species richness count, and a number of soil nutrient indices are compared in six vernal pools spread across the Appalachian Plateau and the Ridge and Valley to examine patterns in nutrient availability and bryophyte diversity. A three-level nested ANOVA was used to compare bryophyte and soil nutrient attributes (i.e. carbon (C), nitrogen (N), phosphorus (P), chemically fractionated recalcitrant index for C (RIC) and N (RIN), pH, cation exchange capacity (CEC), and base cation percent saturation) at four depths (0-5 cm, 5-10 cm, 10-15 cm and 15-20 cm) between the two regions. Results show there was a significant difference in the amount of bryophyte species richness, but not biomass, between the two regions. Total C, N, and RIN were significantly different across regions at depths of 0-5 cm, 5-10 cm, and 10-15 cm, but demonstrated no significant differences from 15-20cm, while soil C:N and RIC were not significantly different at all depths between the regions. We observed a constant retention of recalcitrant C, as revealed by RIC with depth

in all vernal pools except for one, for which RIC increased in the soil at 0-5 cm. While P content was significantly different between the two regions at all depths, which was expected due to differences in parent material between the two provinces, no significant differences were found for pH, CEC, or base cation percent saturation with depth between the regions. Our results suggest that wetland soils of different physiographic origin may experience differences in bryophyte species richness, and C and N availability, yet differences in these properties do not appear to impact the ability of such wetland soils to sequester carbon in terms of bryophyte biomass or recalcitrant C retention capacity. As such, similarities in C input via bryophyte biomass and carbon retention (as expressed by RIC) may lead to vernal pools having the same C sequestering ability throughout this region. ■

PRESENTATION 1145
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS I*,
05/30/2018, 09:55 - 11:35

NITROGEN ENRICHMENT ALTERS CARBON FLUXES IN A NEW ENGLAND SALT MARSH

Geoghegan, Emily, Villanova University, Chester Springs, PA
Caplan, Joshua Temple University, Ambler, PA
Leech, Francine, Bryn Mawr College, Bryn Mawr, PA
Weber, Paige, Bryn Mawr College, Bryn Mawr, PA
Bauer, Caitlin, Villanova University, Villanova, PA
Mozdzer, Thomas, Bryn Mawr College, Bryn Mawr, PA

Vegetated coastal wetlands are incredibly productive ecosystems that can act as effective coastal or 'blue' carbon stores due to high rates of carbon sequestration, low decomposition rates, and negligible levels of CH4 emissions. Recently, there has been a surge in studies inventorying blue carbon in coastal ecosystems. However, the effects of chronic nutrient enrichment on blue carbon dynamics have rarely been measured directly through experimental fertilization. In our study, we examined the ecosystem-level effects of long-term nitrate enrichment on greenhouse gas (CO2 and CH44) flux dynamics along creek banks of a *Spartina alterniflora*-dominated New England salt marsh. We measured CO2 and CH4 fluxes over two growing seasons using static, gas-tight chambers along one experimental creek fertilized for 13 years and one unfertilized reference creek. We found that nitrogen enrichment increased gross primary productivity (GPP) by 67-113% and ecosystem respiration (Reco) by 8-65%. However, nitrogen had no discernible effect on overall net ecosystem exchange (NEE). Despite similar levels of NEE, we believe that nitrogen-induced stimulation of Reco could transform this salt marsh from a well-established carbon sink into a source of atmospheric carbon. Our results suggest that, in combination with prior findings of nitrogen enrichment weakening soil structure, increased nitrogen input to tidal salt marshes has the potential to reverse the carbon storage function of salt marsh ecosystems through enhanced respiration of previously sequestered carbon. ■

PRESENTATION 1151
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*,
05/30/2018, 01:10 - 02:50

EXAMINING THE USE OF INTEGRATED CONSTRUCTED WETLANDS FOR THE MANAGEMENT OF MINE-INFLUENCED WASTEWATERS IN THE PYRITE BELT OF THE IBERIAN PENINSULA

Harrington, Caolan, VESI Environmental Ltd., Cork, Cork, Ireland
Carty, Aila, VESI Environmental Ltd., Cork, Cork, Ireland
Soler, Reyes Parga, Matsa Mining, Almonaster la Real, Huelva, Spain
Gómez, Macarena, Matsa Mining, Almonaster la Real, Huelva, Spain

The management of acid mine drainage (particularly ones containing heavy metals) is environmentally and economically challenging. A meso-scale (x4 replication) and two pilot-scale (x2 replication) helophyte vegetated systems were designed, constructed and commissioned for the Matsa Mining Corporation's facility at Almonaster la Real, Huelva, Spain. The details of their design largely follow those of Integrated Constructed Wetlands (ICW), pioneered in Ireland for the treatment of a wide range of wastewater sources.

The primary aim of the study is to examine atmospheric water-loss through helophyte vegetation and to determine their potential for on-site water management at the Matsa mine. Designed to mimic the function of shallow (100mm – 200mm deep) natural wetlands, they have rigorous control of inflow and measurement of outflow. The secondary aim of the project is to determine the ICW's capacity in the removal of Sulphates (SO4) and heavy metals from the mine's processing waters. These contain Sulphate concentrations in excess of 4,000mg/l with high concentrations of poly-thionates and low pH levels. These trials are a further development of an earlier meso-scale trial that was constructed at the Lundin Mining's nearby facility in the Castro Verde municipality, Portugal.

Continued vegetation survival at the Matsa sites indicate that the native plant species (Typha angustifolia and Phragmites australis) are capable of sustained low-pH, as well as high Sulphate and sulphate-oxidation conditions.

Sulphate and heavy metal reductions have been recorded in both pilot-scale trials with a corresponding increase in pH levels. This passive management approach to on-site wastewater treatment may yield an environmentally robust approach for the mining industry in the Iberian Peninsula, but also further afield.

Previous trials in Ireland for mine closure plans have led to the construction of a full-scale ICW as part of the closure, remediation and management plan (CRAMP) for the Galmoy lead and zinc mine in north Co. Kilkenny, Ireland. This ICW passively intercepts and sustainably treats all runoff from the tailings cap, which contains elevated levels of Sulphates and Ammonia.

Although in the early stages of development and operation, the ICW trials at the Matsa Mining facility in Huelva show potential for a low-input, environmentally-coherent approach to managing and treating highly variable wastewaters from mine processing activities. ■

PRESENTATION 1177

PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE II*, 06/01/2018, 01:00 - 02:50

DISTURBANCE MORE THAN CLIMATE OR ELEVATION IS THE MAIN FACTOR CONTROLLING CO2 EXCHANGE RATES IN TROPICAL ANDEAN PEATLANDS IN COLOMBIA

Benavides, Juan, Pontifical Xavierian University, Bogota, Cundinamarca, Colombia

Tropical Andean peatlands are a diverse ecosystem with the ability to store large amounts of carbon. Nationwide mountain peatlands store up to 5% of the country carbon inventories at a high density with up to 250 Mg ha-1 of carbon. They cover large areas of the tropical alpine region (páramos) and develop in almost any depression able to store water above 3.100. of elevation. The carbon accumulation rates of peatlands in the tropical Andes have been strongly related to elevation and mean annual temperature that partially controls plant production and belowground decomposition rates. Human disturbances are widespread in the tropical Andes. Human dominated land uses in the form of agriculture or grazing has been a common feature for the last 200 years greatly affecting the páramo landscape. Here we explored the patterns of daily carbon flux exchange in 7 peatlands across a diverse gradient of elevation, vegetation types and human disturbance seeking to identify the main controls of CO2 efflux rates in tropical Andean peatlands. Our results indicated that the peatlands under heavy human influence had a negative overall exchange rate with high production rates but even higher heterotrophic respiration rates. All sites showed a strong control of plant production rates with water table level and PAR radiation. Autotrophic and heterotrophic respiration rates were controlled by air and soil temperature respectively. Our results indicate that long term peatland requires strong actions to reduce and manage human influence of this important ecosystems to maintain their ability to store carbon. Despite the large amounts of carbon stored in páramo peatlands and the emissions risk associated with increasing human activities economical incentives to prevent carbon emissions from natural ecosystems focus on forested areas, leaving behind treeless ecosystems in the tropical alpine areas. ■

PRESENTATION 1208

PRESENTED DURING *PEATLANDS*, 05/30/2018, 03:20 - 05:00

THE TRIALS AND TRIBULATIONS OF DATING RECENTLY DEPOSITED PEATS AND WETLAND SEDIMENTS

Drexler, Judith, US Geological Survey, Sacramento, CA
Fuller, Christopher, US Geological Survey, Menlo Park, CA

210Pb and 137Cs dating have routinely been used to date recent peat and wetland sediments since the early application of these techniques by Goldberg (1962) and Delaune et al. (1978). These dating approaches require that numerous assumptions be met before they can be used to estimate rates of vertical accretion and carbon accumulation in wetlands. Such assumptions include stable stratigraphy, minimal wash-in or erosion, lack of mobility of 137Cs and 210Pb within peat/sediments, and minimal burrowing by animals. Here I will discuss the challenges inherent in accurately dating peat and wetland sediment cores collected in California, Washington, Maine, Virginia, North Carolina, and South Carolina, USA between 2005 and 2017. Cores were sectioned to 2-cm intervals, ground, and dated for both 137Cs and 210Pb using gamma spectrometry. Our analysis shows that both 137Cs and 210Pb can be mobile in wetland peats. Further, our data show that 137Cs appears to be nearing obsolescence as a dating method is most of North America. Dating peats and wetland sediments requires patience, diligence, and attention to assumptions as well as careful analysis of the resulting data so that erroneous core data can be identified and omitted. A new approach will be presented for estimating uncertainty in 137Cs dating, which uses the ratio of the 50% interquartile range of 137Cs around each peak in actual cores to that of idealized cores determined using modeled 137Cs fallout. Uncertainty analysis is a key component of dating and should be included, along with all radioisotope data, in any papers using 210Pb and 137Cs to estimate rates of vertical accretion and carbon accumulation. ■

PRESENTATION 1222
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE II*, 06/01/2018, 01:00 - 02:50

COMPARISON OF MOUNTAIN PEATLANDS CARBON CYCLING FROM THE ROCKIES AND ANDES

Chimner, Rod, Michigan Technological University, Houghton, MI

Mountain peatlands are numerous along much of the American Cordillera that extends ~16,000 km from Alaska to Tierra del Fuego. The objective of this talk is to compare carbon cycling in mountain peatlands from Colorado and peatlands in Colombia, Ecuador and Peru. Mountain peatlands in both Colorado and the Andes occur in distinctive elevation zones. Peatlands in southwestern Colorado occur primarily in the subalpine zone from 2,290-3,800 m (mean 3,200 m), whereas peatlands in the tropical Andes range from 3,000-4,900 m (mean 4,000 m). Initiation ages are similar between the regions (2,000-9,000 years bp). However, peat depth and accumulation rates are greater in the Andes compared to Colorado (average thickness 5 m vs 2 m, accumulation rates 0.5 vs 0.25 mm/yr). Instantaneous CO2 emission measurements indicate that peatlands in Colorado have larger gross primary production, ecosystem respiration, net ecosystem exchange, and methane fluxes. The carbon fluxes from both regions have similar patterns with regard to water table levels. In conclusion, mountain peatlands are numerous and occupy similar hydrogeomorphic positions in both mountain ranges, but carbon cycling rates vary, creating different rates of peat accumulation. ■

PRESENTATION 1271
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS I*, 05/31/2018, 09:45 - 11:35

WARMING ACCELERATES MANGROVE EXPANSION AND SURFACE ELEVATION GAIN IN A SUBTROPICAL WETLAND

Geoghegan, Emily, Villanova University, Chester Springs, PA
Langley, Adam, Villanova, Ardmore, PA
Coldren, Glenn, Indian River State College, Ft. Pierce, FL
Feller, Ilka, Smithsonian Environmental Reserach Center, Edgewater, MD
Chapman, Samantha, Villanova University, Villanova, PA

Climatic warming can change how coastal wetland plants grow, thus altering their capacity to build land and keep up with rising seas. As freeze events decline with climate change, mangroves expand their range to higher latitudes and displace salt marsh vegetation. Warmer air temperatures will likely alter above- and belowground plant dynamics as this dramatic coastal wetland biome shift proceeds. We used a large scale in situ warming experiment in a subtropical wetland to increase both marsh and mangrove ecosystem air temperatures. We assessed how two years of warming influenced above- and belowground plant growth and surface elevation relative to sea level. We found that chronic warming doubled plant height and accelerated the transition of salt marsh to mangrove vegetation, as indicated by a 4-fold increase mangrove canopy volume in warmed plots. Surface elevation gain, a measure of soil-building capacity, increased due to warming over a two-year period and these changes in surface elevation were driven by increased mangrove root production in warmed plots. Our findings suggest that warming can both facilitate the dramatic plant range shift occurring in many coastal ecosystems and help coastal wetlands to keep pace with sea level rise. ■

PRESENTATION 1272
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE II*, 06/01/2018, 01:00 - 02:50

INFLUENCE OF HYDROLOGY, VEGETATION, AND LAND USE ON CARBON DYNAMICS IN MOUNTAIN PEATLANDS

Flett, Dana, Colorado State University, Fort Collins, CO
Cooper, David, Colorado State University, Fort Collins, CO

Fen wetlands serve as significant carbon storage reservoirs relative to their abundance on the landscape yet disturbances to these ecosystems are common. To understand the natural functioning of these ecosystems and the potential effects of cattle grazing, I measured water table dynamics, vegetation composition, CO2 fluxes, and impacts from cattle trampling at four fens in the Bucks Lake Wilderness in the northern Sierra Nevada of California. I compared areas trammeled by cattle with visually intact areas, and contrasted the impacts from cattle trampling to the effects of water table drawdown due to erosion gullies. The primary goal of this study was to understand the carbon dynamics of fens in the northern Sierra Nevada of California and investigate the potential effects of cattle grazing and drainage.

Four stands of vegetation were identified in each fen and vegetation types were validated using cluster and indicator species analyses. Net ecosystem production (NEP) and ecosystem respiration (ER) were measured throughout the growing season in full sunlight using an Infrared Gas Analyzer. Measurements were made bi-weekly during the growing season (June-September 2016). Percent impact was measured as a continuous variable at all plots with visible hoof punching and ranged from 15-100% bare ground. Replicates were averaged across impact type, community,

site, and date. Fixed effects of the mixed model include 4 vegetation types, 6 dates, and two levels of impact plus all interactions. Random effects included site and community IDs to account for repeated measures of the same community in both impacted and non-impacted areas.

Cattle trampling reduced gross primary productivity (GPP) and negatively affected carbon sequestration potential. Increased disturbance was linearly correlated to greater potential for carbon losses. At low vegetation cover NEP was positive, indicating carbon loss. Carbon storage potential was 1/10th in impacted areas compared with non-impacted areas in ORAL community types (p-value < 0.0001) and 1/5th in SPSU communities (p-value = 0.0009).

Soil temperature was not significantly different in impacted areas and non-impacted areas and CO2 dynamics did not depend on variations in the water table. NEP in areas affected by water table drawdown were not significantly different than hydrologically intact areas suggesting that cattle hoof punching has a greater negative effect on carbon sequestration than water table decline. ■

PRESENTATION 1273
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS I*, 05/30/2018, 09:55 - 11:35

EFFECTS OF NUTRIENT ENRICHMENT ON CARBON DYNAMICS IN THE SALT - MARSH MANGROVE ECOTONE

Simpson, Lorae, Whitney lab for Marine Bioscience, St. Augustine, FL
Feller, Ilka, Smithsonian Environmental Reserach Center, Edgewater, MD
Osborne, Todd, University of Florida, St. Augustine, FL

Globally, coastal wetland vegetation distributions are changing in response to climate change. In the southeastern United States, increased winter temperatures over the past 4 decades have resulted in poleward expansion of mangroves at the expense of saltmarsh, altering mangrove productivity, carbon (C) fluxes and ecosystem C storage. The magnitude and direction of change will be dependent on environmental variables, and nutrient enrichment is among one of the key drivers of productivity in mangroves. Alteration of carbon dioxide (CO2) efflux and decomposition due to eutrophication has the potential to alter C dynamics of marine ecosystems currently undergoing change. We measured CO2 efflux, belowground decomposition, and soil C in the mangrove – salt marsh ecotone in St. Augustine, Florida to, (1) estimate CO2 flux rates and belowground decomposition in a nitrogen limited ecotonal ecosystem and (2) elucidated the effects of nutrient enrichment on ecosystem C storage. Nutrient enrichment resulted in an increase in mangrove biomass and soil CO2 efflux, and a decrease in belowground decomposition of cotton strips. Soil C was significantly different across treatments. Consequently, we assert that the net change on ecosystem C stock and flux is dependent on nutrient status of the system. ■

PRESENTATION P02
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ECOSYSTEM RESPIRATION OF A *SUAEDA SALSA* WETLAND IN THE LIAOHE RIVER DELTA, NORTHEAST CHINA

Yu, Xueyang, Qingdao Institute of Marine Geology, Qingdao, Shandong, China
Ye, Siyuan, QIMG, CGS, Qingdao, shandong, China

Ecosystem respiration is the main carbon emission process in coastal wetlands. To gain a better understanding of gaseous carbon loss from a coastal wetland covered by Seepweed (Suaeda Salsa) and to evaluate the influence of environment factors to the ecosystem respiration, a multi-year in-situ experiment based on chamber method was carried out in the growing season of 2012~2014. By partitioning total carbon dioxide(CO2) flux into soil respiration (Rsoil) and plant respiration (Rplant), we found that during mid-summer, ecosystem CO2) respiration rates (Reco) were within the range of 844.5~1150.0 mg CO2 m-2 h-1, while it could be as low as 31.7~110.8 mg CO2 m-2 h-1 in the beginning and the end of growing seasons. Aboveground S. Salsa averagely covered 79.1% of total biomass, and Rplant dominated Reco during inundated periods. It is estimated that 1 gram S. Salsa (dry weight) could porduce approximately 1.41~1.46 mg CO2 per hour during mid-summer. When water level was below soil surface, Rsoil was exponentially correlated with air temperature. Based on our observation, an empirical model was developped to estimate system respiration of S. Salsa marsh in the Liaohe River Delta. The model could be potentially applied in regional carbon budget estimation. ■

PRESENTATION 1329
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE I*, 06/01/2018, 09:45 - 11:35

CARBON STOCKS, ACCUMULATION RATES, AND MAPPING TECHNIQUES ACROSS TROPICAL MOUNTAIN WETLANDS OF SOUTH AMERICA

Hribljan, John, Michigan Technological University, Houghton, MI
Suarez, Esteban, Universidad San Francisco de Quito, Cumbaya, Quito, Ecuador

Lilleskov, Erik, USDA Forest Service, Houghton, MI
Chimner, Rod, Michigan Technological University, Houghton, MI

Tropical wetlands provide many important ecosystem services, including storing large amounts of carbon, yet are experiencing high rates of land use/land cover change within a changing climate. Therefore, carbon inventories and rapid large scale mapping activities are urgently needed to quantify current tropical wetland extent and their carbon stocks. As part of the Sustainable Wetlands Adaptation and Mitigation Program (SWAMP), we are working in South America to develop carbon inventories and remote sensing methods to provide detailed data on tropical Andean wetlands. We are using a combination of soil coring, carbon dating, extensive ground validation, and multi-date, multi-sensor satellite data to improve wetland mapping capability and accuracy, provide detailed belowground carbon inventories, and increase our understanding of tropical mountain ecology. Throughout the tropical Andes our research has revealed a high density of wetlands that have rapidly accumulated (mean long-term carbon accumulation rate ~28 g m2 yr-1) carbon-rich soils (mean carbon storage ~1800 Mg ha-1). These data will serve as a resource for monitoring, mitigation opportunities, and sustainable management of these wetlands. ■

PRESENTATION 1330
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS I*, 05/30/2018, 09:55 - 11:35

THE EFFECT OF OPEN MARSH WATER MANAGEMENT PRACTICES ON THE CARBON BALANCE OF TIDAL MARSHES IN BARNEGAT BAY, NEW JERSEY

Powell, Elisabeth, Academy of Natural Sciences of Drexel University, Philadelphia, PA
Watson, Elizabeth, Academy of Natural Sciences, Philadelphia, PA
Martin, Rose, ORISE, Narragansett, RI
Raper, Kirk, Academy of Natural Sciences of Drexel University, Philadelphia, PA

The physical structure of salt marshes have been modified in order to control mosquito populations since the early 1900s. Open marsh water management (OMWM) is a mosquito control technique first applied in New Jersey in the 1950s. It has been extensively used in the mid-Atlantic and is also seen in Massachusetts, New York, Connecticut, Florida, and Louisiana. This practice involves excavation of areas of marsh, making shallow ponds in order to bring mosquito larvae-eating fish to reduce the population of mosquitoes in a given area. This practice has resulted in nearly 10,000 ponds in Barnegat Bay, NJ alone. It is unclear to what extent the ecosystem function (e.g. nutrient removal and carbon sequestration) is being altered. Here, we will discuss our findings on the net greenhouse gas flux in the areas of salt marsh that have excavated for ponds, intact marsh, and in dead plant areas to identify changes in carbon sequestration associated with OMWM practices in Barnegat Bay, New Jersey. ■

PRESENTATION 1340
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS I*, 05/30/2018, 09:55 - 11:35

SALT MARSH VEGETATION INFLUENCE ON CARBON-BASED SERVICES AND MICROBIAL COMMUNITIES

Barry, Aidan, University of Connecticut, Storrs, CT
Ooi, Sean, Khan University of Connecticut, Bolton, CT
Helton, Ashley, University of Connecticut, Storrs, CT
Elphick, Chris, University of Connecticut, Storrs, CT
Steven, Blaire, Connecticut Agricultural Experiment Station, New Haven, CT
Lawrence, Beth, University of Connecticut, Storrs, CT

Coastal marshes are important "blue carbon" reservoirs that are increasingly threatened by sea-level rise and invasive species. Restoration efforts often aim to restore salt marsh vegetation composition, but it is unclear how vegetation shifts associated with restoration and sea level rise alter microbial community composition and respiration rates. In 2017, we surveyed 20 Connecticut salt marshes (10 tidally restored, 10 unrestored) and sampled plants and soils from three vegetation zones (Spartina alterniflora, S.patens, Phragmites australis). We quantified above- and below-ground biomass, a suite of sediment characteristics (pH, conductivity, soil moisture, % carbon, and several ion concentrations), soil respiration rates (SIR: substrate induced respiration; Cmin: carbon mineralization), and are in the process of sequencing sediment bacterial 16S rRNA genes. While none of our response variables differed between tidally restored and unrestored sites, we observed strong differences among vegetation zones. We observed higher rates of microbial respiration (SIR, Cmin) in the sediments of both Spartina spp. zones than P. australis. P. australis had greater aboveground biomass and lower root to shoot ratios than both Spartina spp. zones. These data suggest that P. australis sediments may have higher carbon storage capacity than native Spartina sediments. Future analyses will examine how sediment characteristics relate to microbial respiration, and multivariate analyses will examine relationships between microbial community composition, microbial respiration, vegetation zones, and wetland restoration. Together, our data will provide insight into potential feedbacks between coastal marsh plants and microorganisms as well as their link to carbon based services. ■

PRESENTATION 1389
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*, 05/30/2018, 01:10 - 02:50

TEMPORAL- SPATIAL DISTRIBUTION AND SOURCES OF BULK ORGANIC MATTER AND ALIPHATIC HYDROCARBONS IN THE SHALLOW SEA WETLAND OF THE LIAODONG BAY, CHINA

Ding, Xigui, Qingdao Institute of Marine Geology, Qingdao, Shandong, China
Ye, Siyuan, QIMG, CGS, Qingdao, shandong, China
Guo, Zhigang, Fudan University, Shanghai, Shanghai, China
Yuan, Hongming, QIMG, CGS, Qingdao, Shandong, China
Laws, Edward A., Louisiana State University, Baton Rouge, LA

Liaodong Bay (LDB), one of the three important bays of the Bohai Sea, is located in the northeast of China and impacted by the discharges of five rivers. This study area, the shallow sea wetland (SSW), is located in the north of the LDB and has a water depth < 6.0 m. In recent years it has been impacted by exploitation of the Liaohe oil field and rapid regional industrialization and urbanization. To quantify some aspects of that impact, fifty-three surface sediment samples and one sediment core were collected from the SSW of LDB. The samples were analyzed for total organic carbon (TOC), total nitrogen (TN), the stable carbon isotopic composition (δ13C) of the organic matter, and concentrations of n-alkanes. The grain size distribution of the sediments was closely correlated with TOC concentrations. The finest sediments contained the highest TOC concentrations, evidence of the vital impact of hydrodynamics on the accumulation of sedimentary organic matter. The n-alkane, TOC/TN ratios, δ13C values, carbon preference index (CPI), odd-even preference (OEP), and terrigenous/aquatic ratio (TAR) as well as the ratio of pristane to phytane (Pr/Ph) indicated that the sediment organic matter was derived from a combination of terrigenous and marine sources. The maximum TAR of the surface sediments occurred adjacent to the mouth of Liaohe River, presumably because of riverine discharge of organic matter. The δ13C, CPI, OEP, and TAR of the sediment core indicated that the n-alkanes were derived from a mixture of terrigenous and marine organic matter, with the domination from terrigenous contribution. Analysis of the CPI and OEP indicated that the sediment core was slightly polluted by petroleum, presumably from the nearby the Liaohe oil field. The Pr/Ph ratios ranged from 1.04 to 1.82 with a mean of 1.37, an indication that the redox conditions in the core were oxidative or weakly reductive, conditions that are not conducive to the preservation of marine organic matter and therefore consistent with the greater contribution of terrigenous organic matter in the core. This study has provided important information that has facilitated assessment of the impact of human activities on the LDB and the development of policies that will improve environmental conditions in the SSW of LDB and other coastal ecosystems in China.

Keywords: Sediment, Organic matter, n-alkanes, Source, Liaodong Bay ■

PRESENTATION 1395
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*, 05/30/2018, 01:10 - 02:50

ASSESSING THE CONTRIBUTION OF GLOMALIN-RELATED SOIL PROTEIN TO SOIL ORGANIC CARBON IN TWO MODELS OF COASTAL WETLAND RESTORATION

McClellan, S. Alex, Louisiana State University, Baton Rouge, LA
Elsey-Quirk, Tracy, Louisiana State University, Baton Rouge, LA
Laws, Edward A., Louisiana State University, Baton Rouge, LA
DeLaune, Ronald D., Louisiana State University, Baton Rouge, LA

Coastal wetlands can function as sinks for CO2, with much of the fixed carbon stored in the soil pool. Yet, little information exists about the sources of soil carbon, despite the importance of identifying its recalcitrant forms. Glomalin-related soil protein (GRSP), an operationally-defined pool of soil organic matter (SOM) and a putative product of arbuscular mycorrhizal fungi (AMF), has received much attention in studies of terrestrial soil organic carbon (SOC) as a potential contributor to long-term C storage and, more recently, has been the focus of several studies of wetland soil C sequestration. However, the links between GRSP, AMF, and soil C sequestration remain tenuous, despite numerous assertions to the contrary throughout the literature. To determine how GRSP accumulates in developing coastal wetland soils, the extent to which it contributes to total SOC, and how it compares to refractory SOC, we are currently estimating GRSP-C, total and refractory SOC, and AMF colonization within the rhizosphere along two chronosequences of wetland soils in coastal Louisiana—one, a series of dredge-sediment created saltmarshes and the other, a prograding freshwater delta-chosen as distinct models of coastal wetland restoration. Additionally, we are estimating GRSP-C based separately on two methods of measurement: the commonly-used Bradford protein assay versus amino acid analysis paired with CHN elemental analysis. Our preliminary results suggest that in our study sites i) GRSP contribution to total SOM increases to a steady proportion within 20–30 years since subaerial establishment, regardless of wetland type, soil depth, or AMF colonization; ii) the Bradford assay grossly overestimates

the protein concentration in GRSP extract solutions by 2–12 fold compared to amino acid analysis-based measurements; and iii) most of the carbonaceous component of the GRSP extracts is not accounted for by protein. While we tentatively conclude that GRSP may not be, in and of itself, a significant soil C sink nor a unique biomarker of AMF in these wetlands, our complete analysis will include GRSP-C and refractory SOC estimates within these sites and will provide further insight into the utility of GRSP as an indicator of C sequestration potential in restored wetlands. ■

PRESENTATION P05

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EXPLORATION OF TOP-DOWN AND BOTTOM-UP CONTROLS OF METHANE PRODUCTION IN NORTHERN PEATLANDS

Tinucci, Carson, Chapman University, Orange, CA
Zalman, Cassandra, Chapman University, Orange, CA
Woerndle, Glenn, Chapman University, Orange, CA
Bridgham, Scott University of Oregon, Eugene, OR
Keller, Jason, Chapman University, Orange, CA

Peatlands are important ecosystems in the global carbon cycle, storing one-third of the total terrestrial soil carbon and producing the potent greenhouse gas methane as a by-product of microbial decomposition. In these ecosystems, methane production can be controlled by many factors such as substrate availability, a top-down mechanism, and microbial community composition and population size, a bottom-up mechanism. This project explored the top-down and bottom-up controls on methane production in northern Minnesota peatlands. Surface (0-25 cm) and deep (100-150 cm) peat were collected from two Sphagnum-dominated peatlands in northern Minnesota and anaerobically incubated in the laboratory for six weeks. Various treatments were applied to the soils: addition of 2-bromoethanesulfonate (BES) to selectively inhibit methanogenesis; addition of labile carbon in the form of 13C-labeled glucose to mitigate potential carbon limitation; inoculation of deep peat with the surface microbial community; and incubation at either 4 or 14 degrees C to determine the effect of temperature on microbial dynamics. Carbon dioxide, methane, and hydrogen concentrations were determined using gas chromatography and the flow of carbon was isotopically traced using cavity ring down spectroscopy. Isotopic analyses suggest that temperature has no effect on dominant methanogenic pathway. Additionally, a shift in dominant methanogenic pathway was observed in the inoculum treatments from one of the sites. Data from isotopic and gas chromatography analyses demonstrate that the addition of glucose does not significantly increase methane production; in contrast, the addition of microbes from surface peat into samples taken from deep peat stimulated methanogenesis. These preliminary data suggest that these systems may be controlled by microbial community composition, a bottom-up mechanism, rather than substrate availability; however, further analyses of the microbial community and substrate availability are needed to confirm this finding. ■

PRESENTATION 1401

PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT I*, 05/31/2018, 09:45 - 11:35

CLIMATE CHANGE IMPACTS ON NORTHERN WETLANDS AND FEEDBACKS TO GLOBAL CLIMATE

Natali, Sue, Woods Hole Research Center
Roulet, Nigel, McGill University, Montreal, Quebec, Canada

Surface air temperatures in the northern high latitudes are increasing twice as fast as the rest of the planet. As the climate warms, the large pool of carbon stored in northern soils and permafrost (perennially frozen ground) is at risk of being thawed, decomposed, and released to the atmosphere as greenhouse gasses, CO2 and CH4, which may shift the northern region from a carbon sink to a source by the end of the 21st century. Unless fossil fuel emissions are greatly reduced, an additional 130-160 Pg of permafrost carbon may be released to the atmosphere by 2100. Much of the carbon stored in northern high latitudes is contained in peatlands and wetlands, which have been removing carbon from the atmosphere for thousands of years. However, the negative climate feedback that results from long-term carbon accumulation and storage by wetlands is, in part, offset by CH4 emissions. In permafrost regions, increased temperature will have both direct and indirect effects on wetland carbon storage. Warming will directly enhance greenhouse gas emissions from wetlands by increasing rates of microbial decomposition, and will also indirectly affect carbon emissions because ground thaw can dramatically alter hydrology and wetland area. Wetland area is projected to increase in northern regions due to thawing of ice-rich permafrost, which can result in ground collapse and inundation, and may also substantially increase CH4 emissions. Accounting for these changing carbon emissions from northern wetlands is critical for mitigating the effects of global climate change. ■

PRESENTATION P03
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EFFECTS OF PLANT TRAITS AND WATER QUALITY ON CARBON FLUXES IN FRESHWATER WETLANDS

Donato, Mary, University of Connecticut, Oakville, CT
Johnson, Olivia, University of Connecticut, Storrs, CT
Lawrence, Beth, University of Connecticut, Storrs, CT

Freshwater wetlands of the temperate north are exposed to a range of water contaminants that may shift their function including salt intrusion due to sea level rise, road salt contamination, and nitrogen enrichment from agricultural and urban runoff. It is largely unknown how these drivers of change interact with different plant species to affect wetland carbon (C) fluxes. We utilized a factorial design of 64 experimental mesocosms (378.5L tanks) to investigate how four common eastern North American wetland plants (Carex stricta, Phragmites australis, Spartina pectinata, Typha latifolia) respond to four water matrices (fresh water, sea salt, road salt, nitrogen). During the 2017 growing season, we measured carbon dioxide (CO2,) and methane (CH4) fluxes monthly using transparent chambers attached to a continuous real-time gas analyzer. At the end of the 2017 growing season, we quantified above- and below-ground biomass, root porosity, and pore water chemistry (NH4+, NO3-, SO4-, Cl-, DOC). Preliminary results suggest sea salt decreases CH4 emissions and nitrogen addition increases uptake of CO2 across species. Both CH4 emissions and CO2 uptake increased over the course of the sampling season. Initial analyses revealed little to no difference in root porosity, but species and treatment differences in root to shoot ratio suggest biomass allocation may drive variation in C gas flux. Further analyses will investigate relationships among plant traits, water chemistry, and C fluxes. Together, our findings will inform priorities for management of water pollutants and freshwater wetland function of the temperate north. ■

PRESENTATION 1435
PRESENTED DURING *BIOGEOCHEMISTRY/CARBON CYCLE*, 05/31/2018, 01:10 - 02:50

ASSESSING THE BIOGEOCHEMICAL IMPACT OF STORM LAYER SEDIMENTS IN MANGROVES AFFECTED BY HURRICANE IRMA

Chambers, Lisa G., University of Central Florida, Orlando, FL
Breithaupt, Joshua, Univ. of South Florida, St. Petersburg, FL
Hurst, Nia, University of Central Florida, Orlando, FL
Duga, Evan, University of Cental Florida, Orlando, FL
Smoak, Joseph, Univ. of South Florida, St. Petersburg, FL
Kominoski, John, Florida International University, Miami, FL

Hurricane Irma made landfall on peninsular southwest Florida as a Category 3 storm in September 2017. It caused extensive damage to mangrove forests, and an estimated storm surge of 1.4 – 1.8 m deposited a layer of marine sediment. Hurricane pulses may lead to ecosystem carbon loss via increased soil respiration, enhanced by tree mortality and light-induced soil temperature increases, but coastal storms can also increase organic carbon burial rates. The objectives of this research were to (1) compare biogeochemical characteristics of storm layer sediments to the underlying soils, and (2) examine the potential of storm layer sediments to act as a "cap" that reduces atmospheric fluxes of CO2 and CH4 from the soil. In January 2018, we collected mangrove forest soils along Shark River Slough in Everglades National Park from sites 2, 4, and 8 km upstream from the Gulf of Mexico. At each site we collected triplicate cores for destructive analyses, and six intact cores for gas exchange measurements. Before H. Irma, we found that soil organic carbon content increased from 15% at the site nearest the Gulf of Mexico to 29% at the site 8 km upstream; conversely total phosphorus (the limiting nutrient in the ecosystem) decreases from 0.38 mg cm-3 to 0.15 mg cm-3 at the same sites. After H. Irma, the average (± 1 SD) depth of the storm layer ranged from 4.3 ± 0.3 cm at the site near the river mouth to 3.3 ± 0.8 cm at the site 8 km upstream. Pre- and post-Irma sediments were analyzed for the content of organic matter, calcium carbonate, total nutrients, extractable nutrients, enzymes and microbial biomass. Additionally, fluxes of CO2 and CH4 were quantified for the pre- and post-storm sediments via bottle incubations, as well as using intact soil cores with and without a storm layer present. ■

PRESENTATION 1459
PRESENTED DURING *MEASURING WETLAND GREENHOUSE GAS FLUXES: NOVEL METHODS, EXCHANGING IDEAS, AND INFORMING MANAGEMENT*, 05/30/2018, 03:10 - 05:00

DIURNAL CYCLES OF DISSOLVED METHANE, OXYGEN AND CARBON DIOXIDE FLUXES IN A PRAIRIE POTHOLE WETLAND

Martens, Christopher, University of North Carolina at Chapel Hill, Chapel Hill, NC
Goldhaber, Martin, U.S. Geological Survey, Lakewood, CO
Mills, Christopher, U.S. Geological Survey, Lakewood, CO
Mendlovitz, Howard, University of North Carolina at Chapel Hill, Chapel Hill, NC
Wahl, Timothy, University of North Carolina at Chapel Hill, Chapel Hill, NC
Haase, Karl, US Geological Survey, Reston, VA
Bansal, Sheel, U.S. Geological Survey, Jamestown, ND

The Prairie Pothole Region hosts millions of biologically productive wetlands and lakes that significantly influence North American carbon budgets based on largely daytime measurements of CO2 and CH4 water-air fluxes made during 2009-2016. During a five-day period in August, 2016, we conducted continuous, in situ sensor measurements of the concentrations of the dissolved gases CH4, O2, and CO2 at discharge wetland P8 in the Cottonwood Lake Study Area in North Dakota to investigate and quantify processes controlling diurnal variability in their fluxes. The measurements were made at multiple depths in shallow (<1 m) pond water and included simultaneous measurements of temperature (T) and turbidity to quantify mixing, and pH to track dissolved inorganic carbon speciation.

Under typical summer conditions, the P8 water column goes through a diurnal cycle from highly stratified to nearly isothermal driven by a diurnal air temperature change (max daytime T of 31 ºC; min at night of 15 ºC). Temperature stratification is maximum with a bottom-surface water difference of 5-8 ºC at approximately 18:00 following daytime heating and is minimal at approximately 9:00. Dissolved CO2 and CH4 are concentrated in bottom waters during stratification but respond dramatically to changes in stratification leading to significant diel variability in projected fluxes across the water-air interface. O2 varies in response to mixing processes, air-water exchange and light availability for photosynthesis causing O2 increases from sunrise until mid-afternoon. Late afternoon and overnight respiration losses and diel variations in mixing seen in T and turbidity results cause O2 decreases throughout the unstratified nighttime water column. Temporal variability in CO2 concentrations reflects a balance between production by respiration, uptake during photosynthesis, air-water exchange and mixing as stratification intensifies and breaks down. Water column CH4 concentrations range from ≤ 1 to > 20 μM and generally follow CO2 with maximum values at 2:00−3:00.

On 08/18/2016, an extreme wind event with wind speeds approaching 20 m s-1 enhanced P8 mixing and inhibited re-stratification leading to major gas exchange and uniform water column gas concentrations in CO2, CH4 and O2 for at least several days. Our data show that quantifying greenhouse gas behavior in prairie pothole water bodies requires accounting for diel behavior and recognition of extreme, storm-induced mixing events. ■

PRESENTATION 1463
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE II*, 06/01/2018, 01:00 - 02:50

CARBON SEQUESTRATION AND METHANE EMISSIONS IN A TROPICAL ALPINE WETAND ALONG A WATER TABLE GRADIENT

Villa, Jorge A., Corporacion, Universitaria Lasallita, Caldas, Antioquia, Colombia

Tropical alpine ecosystems are key providers of water at watershed scales. However, other services are poorly understood limiting holistic valuations of ecosystem services. Climate regulation in tropical alpine wetlands trough carbon sequestration and methane emissions is a service rarely assessed on these ecosystems. Aiming to contribute to a holistic understanding of tropical alpine wetlands ecosystem services, the objective of this study was to determine the variation of carbon sequestration and methane emissions in a tropical alpine wetland along a water table gradient. To this end, we stablished three sampling points along a replicated water table gradient (i.e. dry, intermediate and deep). Water level was monitored from June 2015 to September 2017 in piezometers. Around each piezometer we stablished 20x20m plots to assess plant cover, species frequency and composition. Sequestration was from unaltered soil cores sectioned in 2-cm depth increments, dated using Pb-210 and dry combusted to determine organic carbon content. Methane emissions were measured 8 times during 13 months using static chambers. Carbon sequestration (g-Cm-2yr-1) in the first gradient was 32.3 at the dry point, 47 at transition and 35 at deep. Similarly, it was 30.9, 63.2 and 31.6 in the replicated gradient. Shannon-Wiener vegetation index was also the highest at intermediate (2.54 and 2.78), and lower at dry (2.37 both gradients) and deep (2.16 and 1.59). Median emissions (mgCH4-Cm-2d-1) (Q1-Q3) in each sampling point were: 164 (19.9–167) in dry, 2.6 (0–7.3) in transition and 88.9 (72.3–184) in deep for the first gradient. In the second gradient, they were: 26.9 (10.7–68.2) in dry, 34.1 (14.9–60) in transition and 8.7 (0–24.3) in deep. Carbon sequestration and methane emissions showed a close link with water levels and plant diversity, but in a different manner. These results must be considered in resource management decision making processes. ■

PRESENTATION P04
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EFFECTS OF TEMPERATURE ON THE POTENTIAL FOR HUMIC SUBSTANCE REDUCTION IN A NORTHERN MINNESOTA PEATLAND

Rush, Jessica, Chapman University, Orange, CA
Keller, Jason, Chapman University, Orange, CA
Zalman, Cassandra, Chapman University, Orange, CA
Woerndle, Glenn, Chapman University, Orange, CA
Hanna, Emily, Chapman University, Orange, CA
Hanson, Paul, Oak Ridge National Laboratory, Oak Ridge, TN
Bridgham, Scott, University of Oregon, Eugene, OR

Peatlands store one-third of terrestrial soil carbon and are responsible for a significant fraction of the global flux of the potent greenhouse gas methane. Thus, understanding the controls of methane flux from peatlands has important implications for the global climate. Recent work suggests that the microbial reduction of humic substances can suppress methane production, constraining peatland methane flux in response to ongoing climate change. This study aimed to investigate both the direct and indirect effects of temperature on humic substance reduction in a northern Minnesota peatland. To determine the direct temperature effects on potential humic substance reduction, soil cores were collected from a peatland in northern Minnesota as part of the Spruce and Peatland Responses Under Changing Environments (SPRUCE) project. Soils from 10-20, 75-100 and 175-200 cm depth increments were incubated anaerobically at 5°C or 18°C for 84 days. Potential humic substance reduction potential (as electron shuttling capacity) occurred faster, and suppression of methane ended sooner in warmer incubations. Indirect temperature effects (e.g., through changes in soil quality) were explored in SPRUCE enclosures that were experimentally warmed to +0, +2.25, +4.5, +6.75 and +9°C for approximately 2 years. There was no indirect effect of warming on potential humic substance reduction when these soils were incubated at a common temperature (18°C) for 42 days. However, incubations of soils under in situ redox conditions from the experimentally warmed enclosures did show that temperature indirectly influenced humic substance reduction by regulating the availability of oxidized humic substances through changes in water-table levels. Taken together, this suggests that in the short-term, direct effects of warming will diminish the potential for humic substance reduction to suppress methane production, but this may be mediated by indirect, ecosystem-level changes, like lowered water-table levels, resulting from warming. ■

PRESENTATION 1533
PRESENTED DURING *BIOGEOCHEMISTRY/CARBON CYCLE*, 05/31/2018, 01:10 - 02:50

SOIL RESPIRATION AND METHANE EMISSIONS IN FRESHWATER TIDAL BOTTOMLAND FORESTS, SOUTH EASTERN U.S.A.

Allan, Craig, UNC Charlotte, Charlotte, NC
Farley, Bryan, UNC Charlotte, Charlotte, NC
Vinson, David, UNC Charlotte, Charlotte, NC
Zheng, Minrui, UNC Charlotte, Charlotte, NC
Tang, Wenwu, UNC Charlotte, Charlotte, NC
Trettin, Carl, USDA Forest Service, Cordesvilles, SC

Gross and microbial soil respiration rates, methane emission and the environmental variables (soil temperature, water level position and soil redox) were measured along a freshwater tidal gradient in a bottomland hardwood forest, Santee Experimental Forest in coastal South Carolina from May 2015 through January 2016. Our overall goal was to assess whether a tidally influenced moisture regime resulted in significant differences in gaseous carbon emissions in comparison to gravity drained sites in this bottomland forest environment. Soil respiration and methane emission rates were measured with standard static chamber techniques, with chambers situated on hummock and hollow sites representative of the microtopograhy found along the tidal gradient. Wetland microtopography was found to significantly influence soil respiration but significant differences in soil respiration was not measured between similar topographic sites along the tidal gradient. Methane emissions were measured at two locations along the tidal gradient with tidally impacted hollows exhibiting significantly higher emission rates than all other sites measured during the study. A novel parallel computing approach was used used to develop a high resolution DEM extracted from LiDAR coverage of the study site to define the hummock/hollow microtography at each measurement site. We use this high resolution DEM in conjunction with our chamber measurements to derive annual estimates of soil respiration and methane emissions for this wetland environment. ■

PRESENTATION 1570
PRESENTED DURING *BIOGEOCHEMISTRY/CARBON CYCLE*, 05/31/2018, 01:10 - 02:50

PRODUCTION AND EMISSION OF METHANE IN DISTURBED AND UNDISTURBED AREAS IN A PEAT BOG IN OHIO

Rey, Camilo, The Ohio State University, Columbus, OH
Slater, Julie, The Ohio State University, Columbus, OH
Hao, Yushan, The Ohio State University, Columbus, OH
Grau-Andres, Roger, The Ohio State University, Columbus, OH
Davies, Matt, The Ohio State University, Columbus, OH
Bohrer, Gil, The Ohio State University, Columbus, OH

Peatlands store large amounts of carbon but they also emit methane (CH4), a powerful greenhouse gas. Understanding the fluxes of CH4 in peatlands is important to predicting the greenhouse gas budget of the planet. Of particular interest are peatlands in the state of Ohio because the state is located on the southern edge of northern peatland distribution where only 2% of the original peatland area remains. The objective of this study was to determine changes in CH4 production and transport in disturbed vs. undisturbed peatlands in Ohio. To achieve this, we studied Flat Iron Bog, near Akron, Ohio, a reserve owned by the Nature Conservancy that has an undisturbed natural bog and a bog that has been disturbed due to draining and other human activity. We used pore-water sediment samplers 'peepers' to monitor CH4 concentration at different depths in the soil and used non-steady state chambers to measure CH4 emissions at different sites within the disturbed and undisturbed areas in the bog. This information was used to create representations of zones of production and consumption of methane within the peat profile. We also monitored at multiple positions in the bog air and soil temperatures, relative humidity and water level depth using dip wells. Using a diffusion model along the peat profile in multiple sites, we estimate the differences on CH4 production and consumption between disturbed and undisturbed sites. The information from this study can be used to understand how disturbance can affect the natural dynamics of the carbon cycle and inform models of methane production that incorporate the effects of peatland disturbance on methane emissions. ■

PRESENTATION P07
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE EFFECTS OF WILLOW ENCROACHMENT ON PEAT ACCUMULATION IN AN HERBACEOUS PEATLAND FOLLOWING DRAINAGE AND FIRE

Dell, Jessica, Florida Atlantic University, Lake Worth, FL
Benscoter, Brian, Florida Atlantic University, Davie, FL

Peatlands cover only 3% of the world's land area but store a third of the world's soil carbon. Soil carbon storage in historically herbaceous peatlands is threatened by shrub encroachment following altered hydrology. Morphological and physiological differences between shrubs and herbaceous vegetation can reduce peat accumulation by altering primary production relative to soil decomposition rates. Natural and anthropogenic changes to the hydrology and fire regimes of peatlands can further alter production and decomposition. This project examines the effects of shrub encroachment by Carolina willow (Salix caroliniana) on peat accumulation processes in a subtropical, sawgrass (Cladium jamaicense) dominated peatland located within the Upper St. Johns River Basin, FL. Above and belowground production and soil decomposition were monitored in sawgrass and willow areas over time following reduced water levels and a prescribed fire. Production was compared between willow and sawgrass under seasonal hydrological conditions with nondestructive allometric equations and fine root ingrowth bags. The decomposition of leaf litter was assessed with decomposition bags using a reciprocal site-source design under seasonal hydrological conditions. Willow had greater aboveground production than sawgrass during the growing season, but sawgrass maintained greater belowground production. Standing willow increased the decomposition of both sawgrass and willow litter. Willow litter decomposed at a greater rate than sawgrass in both sawgrass and willow areas. Decomposition was amplified by reduced water levels. Willow increased aboveground production, but this could likely be offset by the increase in decomposition. Altered peat accumulation processes and drivers including primary production and soil decomposition can ultimately reduce carbon storage in peatlands. The loss of stored carbon within peatland soils would have major effects and could feedback to enhance climate change and promote further shrub encroachment. ■

PRESENTATION 1605
PRESENTED DURING *PEATLANDS*, 05/30/2018, 03:20 - 05:00

CARBON AND NUTRIENT SEQUESTRATION AND STORAGE IN HIGH ALTITUDE PEATLANDS OF PERU

Fennessy, M. Siobhan, Kenyon College, Gambier, OH
Wardrop, Denice, Penn State University, University Park, PA
Byrd, Brandon, Kenyon College, Gambier, OH
Nassry, Michael, Penn State, University Park, PA
Craft, Christopher, Indiana University, Bloomington, IN

The Andes region of Peru is one of the most biologically rich regions of the world, containing wetlands that provide many ecosystem services. Wetland types include the high altitude bofedale peatlands (3,200-500 m), which are meltwater-supported wetlands that comprise part of a sub-glacial landscape. Climate change has driven changes in the region including reductions in glacial meltwater. Little is known about the biogeochemistry of bofedales, specifically their carbon and nutrient storage capacity and the impacts of landscape change on potential feedbacks to climate change, for instance, increases in carbon emissions. Here we present data from four bofedales in the Andes and compare C sequestration rates to the flux of the greenhouse gasses, methane and carbon dioxide, in order to determine whether they vary by location or water source. We were able to quantify carbon sequestration using radiometric (137-Cs, 210-Pb) dating. Rates varied between 75 and 166 g C m^2 yr. This was offset by methane and carbon dioxide emission rates (measured using non-steady-state chambers), making their function in the accretion and storage of carbon unclear. Rates of nitrogen and phosphorus accumulation were positive, varying from 5-15 g N m^2 yr and 0.4-1.9 g P m m^2 yr. Because wetlands play an integral role in the ecosystem services provided to the region, an understanding of their basic biogeochemistry and hydrology is essential to determine their relative vulnerability and resiliency to climate change and better inform conservation measures. ■

PRESENTATION P01
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

CARBON FLUXES IN ANDEAN PEATLANDS OF PERU

Byrd, Brandon, Kenyon College, Gambier, OH
Wardrop, Denice, Penn State University, University Park, PA
Craft, Christopher, Indiana University, Bloomington, IN
Nassry, Michael, Penn State, University Park, PA
Fennessy, M. Siobhan, Kenyon College, Gambier, OH

Bofedales are high altitude peatlands located in the Andes mountains of South America that are sites of carbon sequestration and storage. Peatlands are important sites of carbon storage, that have the potential to contribute to climate change mitigation by holding carbon that would otherwise be released to the atmosphere. They are also natural sources of methane, a potent greenhouse gas. We collected soil cores and quantified carbon accretion rates using radiometric dating (137-Cs, 210-Pb). Methane emissions were measured using non-steady state chambers at four sites between 2015 and 2017. Carbon accretion rates ranged from 75 to 166 g C m^2 yr. However, this was offset by high methane emission rates, which ranged from 0.64 105 g CH4-C m^2 yr. Methane emission rates were spatially variable, with coefficients of variation at the sites ranging from 0.5 to 1.3. Based on the relatively high carbon accretion rates and the net global warming potential of methane, our research suggests that these peatlands are carbon sinks. However, trends suggest that warming may increase methane emission rates over time, with the potential to turn these systems from net carbon sinks to sources. ■

PRESENTATION 1617
PRESENTED DURING *BIOGEOCHEMISTRY/CARBON CYCLE*, 05/31/2018, 01:10 - 02:50

METHANE EMISSIONS IN TWO DIFFERENT HYDROGEOMORPHIC TROPICAL LOWLANDS WETLANDS IN SOUTH AMERICA

Villa, Jorge, Ohio State University, Columbus, OH
Quevedo Jimenez, Julio Cesar, National University of Colombia, Medellin, Antioquia, Colombia
Moreno, Flavio, National University of Colombia, Medellin, Antioqui, Colombia

Tropical wetlands play a key role in the global methane (CH4) budget. Even though its area is comparatively of less extension they contribute to more than 60%-80% of global CH4 emissions. Also, there are few studies of methane emissions in tropical wetlands and this implies a higher uncertainty of the CH4 emission data. The objective of this study is to determine the total emission of CH4 and its variation over one hydrologic year in two lowland wetlands (one isolated and the other one connected to a river) belonging to the alluvial plain of the middle basin of the Magdalena river in the department of Antioquia-Colombia, and its environmental drivers. Each month and a half sampling of gas exchange was conducted using non-steady state chambers in four main distinct land-water zones of cover types in the wetlands: open water, open water with macrophytes, mud and high land. There also was measured environmental variables with a portable weather station and physicochemical variables in each zone. The preliminary results indicate

that the isolated wetland has higher CH4 emission than the connected one because of a more reduced environment. Also, the mud flats have a relative higher CH4 emission than the other zones and its just followed by the vegetation zone. This suggests that CH4 bubbling is a very active and important pathway of gas emission in the tropics. ■

PRESENTATION 1622
PRESENTED DURING *ENVIRONMENTAL CHANGE AND THE WETLAND SEDIMENT ARCHIVE*, 05/31/2018, 09:45 - 11:35

COMPARISON OF ORGANIC MATTER SOURCE AND CARBON BURIAL RATES IN TIDAL SALT MARSHES AND SEAGRASS BEDS OF BAHÍA SAN QUINTÍN, MÉXICO

Krause, Johannes, Drexel University, Philadelphia, PA
Watson, Elizabeth, Academy of Natural Sciences, Philadelphia, PA
McDonnell, Julianna, UC Riverside, Riverside, CA
Gray, Andrew, University of California Riverside, Riverside, CA
Hinojosa Corona, Alejandro, CICESE, Ensenada, Baja California, Mexico

Coastal ecosystems provide a wide range of ecosystem services, as they provide habitat for fish and wildlife, support high biological productivity, and allow for improved coastal quality. Concern with mitigating greenhouse gas emissions has drawn attention to the carbon storage functions of coastal wetlands and seagrass beds. Even though they represent only a small fraction of marine areas, they can account for as much as 55 % of photosynthetically produced carbon stored in marine systems. In recent years, studies have emphasized the temporal and spatial variability in carbon burial of coastal wetlands and seagrass meadows and pointed out a need for a better understanding of its mechanisms. This study compared carbon burial rates in tidal salt marshes and adjacent seagrass beds of the upwelling-dominated estuary Bahía San Quintín in Baja California, Mexico. Additionally, the source of organic matter to these systems was investigated with help of isotopic and stoichiometric mixing models. By comparing these important factors in coastal carbon sequestration in marsh and seagrass beds, we better understand the nuances of the carbon cycle within the estuary, and evaluate the carbon storage functions of coastal estuaries. ■

PRESENTATION 1634
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS I*, 05/30/2018, 09:55 - 11:35

TOWARDS A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING TRADEOFFS IN BIODIVERSITY AND CARBON FUNCTION IN COASTAL WETLANDS

Lawrence, Beth, University of Connecticut, Storrs, CT

Coastal wetlands provide a broad array of ecosystem services including biodiversity provision and carbon sequestration that are increasingly subjected to drivers of global change (i.e., nutrient loading, dominant macrophyte invasion, water level variation associated with climate change) that alter their ability to provide these services. Wetland managers along the Laurentian Great Lakes and Atlantic coastlines face challenging decisions, as dense monocultures of invasive macrophytes are typically less diverse but more efficient at sequestering carbon, resulting in a tradeoff between biodiversity and climate-related functions. My analysis of these tradeoffs will draw on examples from northern Great Lakes and southern New England coastal wetlands. In Michigan we are investigating how large scale (up to 60 x 60-m experimental plots) management treatments of Typha-invaded wetlands alter the provision of biodiversity (plant, macroinvertebrate, bird, fish) and carbon services (CO2, CH4 emissions, and internal turnover). In Connecticut coastal wetlands, we recently conducted a survey of 20 wetlands to test how restoration and vegetation zonation may be altering carbon stability. By highlighting commonalities and differences among the physical, biological, and anthropogenic controls influencing the ecological function of these seemingly distinct systems, I aim to identify opportunities to promote more resilient coastal wetland management. ■

Biology & Ecology: Biogeochemistry-Nutrient Cycling

PRESENTATION 1100
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*, 05/30/2018, 01:10 - 02:50

TREATMENT OF A SMALL STREAM IMPACTED BY AGRICULTURAL DRAINAGE IN A CONSTRUCTED WETLAND

Vymazal, Jan, Czech University of Life Sciences Prague, Praha 6, Czech Republic, Czech Republic
Dvořáková Březinová, Tereza, Czech University of Life Sciences Prague, Praha 6, Czech Republic, Czech Republic

During the period 2014-2016, removal of nutrients, organics and suspended solids from a small rural stream impacted by agricultural drainage in a natural and semi-constructed wetlands was evaluated. In 2014, the wetland was irregularly flooded during high flows in the stream, in 2015, the stream bed was cleaned and as a result the water level dropped down by about 0.5 meters, thus no flooding occurred. In 2016, the stream was blocked and water was permanently diverted into a wetland dominated by Phalaris arundinacea, Carex nigra and Scirpus sylvaticus. The results clearly revealed a positive role of permanent flooding resulting in the highest removal of all monitored parameters, i.e. nitrogen (38%), phosphorus (40%), BOD5 (42%) and suspended solids (67%). The permanent flooding increased aboveground biomass of P. arundinacea and C. nigra while S. sylvaticus was eliminated by permanent flooding. The repeated harvest yielded higher aboveground biomass for P. australis and S. sylvaticus, while for C. nigra one harvest provided more biomass. In 2016, the removal expressed as the loading averaged 1102 kg TN/ha yr and 894 kg NO3-N /ha yr and the plant uptake was responsible for removal of 36.1% TN. The average removal of total phosphorus amounted to 164 kg P /ha yr with plant uptake being responsible for 18.7%. Average removal of BOD5, COD and TSS amounted to 1108, 5953 and 9220 kg / ha yr, respectively. While the removal of BOD5 and COD increased exponentially with increasing water temperature, removal of TSS was not affected by water temperature. The results proved that slightly modified natural wetlands with negligible investment costs can be as effective as fully constructed wetlands to treat agricultural drainage. ■

PRESENTATION 1128
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS I*, 05/31/2018, 09:45 - 11:35

THE TENSILE ROOT STRENGTH OF SPARTINA PATENS: RESPONSE TO ATRAZINE AND NUTRIENTS

Hollis, Lauris, Louisiana State University, Baton Rouge, LA

Roots and rhizomes provide structural support in organic coastal wetland soils in a manner similar to reinforcement bars in reinforced concrete. The ability of coastal marshes to resist erosive forces such as storm surge and wave action may be diminished by factors weakening this belowground biomass. We conducted a 9 month greenhouse experiment using Spartina patens in a 6x3x4 factorial design of six different high/low nitrogen and phosphorus concentrations (HN, LN, HP, LP, Np, nP) and three concentrations of atrazine (5.0, 3.0, and 1.0 µg L-1) that are commonly found in the field. The objective was to test if tensile root strength decreased due to nutrient addition and/or atrazine exposure. A Mecmesin MultiTest-1d motorized stand was used to test the tensile strength of individual live roots with diameters ranging from 0.5 to 1.0 mm. An analysis of variance revealed that there was a highly significant difference in the tensile root strength of live roots for all nutrient combinations and atrazine levels vs. control ($p<0.0001$). The tensile root strength declined with all nutrient and atrazine treatments vs. control. The nutrient-atrazine treatments were significant for all 18 combinations ($p<0.0001$), which was evidence of possible interactive effects. The belowground biomass also atrophied in the nutrient and atrazine treatments. There was no significant difference in tensile root strength, however, between the various concentrations of nutrient treatments or various concentrations of atrazine treatments. The decreased tensile root strength of S. patens due to stressors such as nutrient enrichment and atrazine exposure may be an indication of belowground biomass degradation as well as reduced soil shear strength, and may imperil the sustainability of coastal wetlands dominated by this species. ■

PRESENTATION 1146
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES I*, 06/01/2018, 09:45 - 11:35

USE OF BIOMATERIAL SUBSTRATES IN FLOATING WETLANDS DESIGN

Bowles, Mason, BioEmergent Wetland Solutions, Seattle, WA

Floating wetlands, also known as floating treatment wetlands or floating islands, are steadily being incorporated into the treatment and improvement of urban water quality. Floating wetlands consist of a constructed floating structure which supports the hydroponic growth of wetland vegetation. The floating structure holds plant stems above the water surface with roots submerged below the surface to enable plants to draw nutrients from the water column. The substrates of naturally-occurring floating wetlands, formed in the late successional stage of lakes, consist of interbedded living plant tissue, organic litter, and inorganic sediments. These floating substrates achieve buoyancy from plant arenchyma and trapped microbial gases including methane (CH4), carbon dioxide (C02) and nitrogen (N). Commercial floating wetland designs make adaptive use of a variety of polymer-based materials as functional analogs for reference substrates. Polymer-based open cell foam fabricated out of polypropylene, PET and HDPE provide durable rooting substrates that can be made buoyant with the addition of injectable expanded polystyrene (EPS). In the salmon-bearing waters of the Pacific Northwest, concerns about the long-term fate and transport and sustainability of using these polymer-based materials in aquatic environments has led to investigations into the use of biomaterials. Three types of biomaterial substrate have been tested. These materials included Mycoboard, fabricated from wood fibers bonded with stabilized fungal mycelium, Wood Straw, fabricated of chipped alder wood veneer, Marsh Mat, fabricated from coir coconut fibers adhered with natural rubber latex. A variety of wetland plant species have been tested in these substrates including hardstem bulrush (Scirpus acutus), smallfruit bulrush (Scirpus microcarpus), swordleaf rush (Juncus ensifolius) and slough sedge (Carex obnupta). Preliminary results indicate that some substrates are better suited to supporting rhizomatous tissue, while other substrates are more quickly colonized by stolons. After two growing seasons all biomaterial substrates have demonstrated the capacity to support wetland macrophytes and floating wetlands. ■

PRESENTATION P09
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

NUTRIENT REMOVAL CAPACITY OF FLOATING TREATMENT WETLANDS

Keilhauer, Mary, University of Nebraska-Lincoln, Lincoln, NE

Floating treatment wetlands (FTWs) are a promising technology for improving water quality and removing pollutants from lakes. FTWs have potential to passively treat impaired water bodies with little infrastructure change or construction as compared to traditional treatment wetlands. FTWs, composed of manmade buoyant mats planted with hydrophytes, have many environmental benefits that have yet to be understood and quantified. Specifically, the impact of varying FTW designs (i.e., plant type, loading rates) for pollutant reduction needs to be further explored in these systems. Therefore, the goal of this project was to quantify the removal potential of nitrogen and phosphorus and create FTW placement recommendations based on lake flow patterns. To examine the impacts of the natural environment on FTW treatment nutrient removal, depth and velocity sensors in conjunction with water quality meters at various depths were used to map a lake in Lincoln, NE. Findings were then integrated into a mesocosm study focused on nitrogen and phosphorus removal in FTW systems. The study quantified plant uptake and denitrification potentials in FTW systems. Three treatments were evaluated in replicates of three: 1. Only water (Control), 2. FTW with monoculture macrophytes, and 3. FTW with diverse macrophytes. Each mesocosm was tested with and without water recirculation pumps to imitate water movement in lake systems. Vegetative diversity, nitrogen loading, temperature, and hydraulic movement were controlled during each experiment. Throughout the experiments, daily grab samples were taken to determine nutrient removal rates. The mesocosm and field experiments together provide a basis for recommendations on the placement and sizing of FTWs to maximize removal potential. Further, this project is expected to provide a clearer understanding of FTW removal capacity of nitrogen and phosphorus and sizing and placement recommendations based on field deployment and mesocosm experiments. ■

PRESENTATION P10
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

SELENIUM CYCLING WITHIN A CONSTRUCTED TREATMENT WETLAND IN A HEAVILY URBANIZED COASTAL WATERSHED

Wise, Maureen, Irvine Ranch Water District, Irvine, CA
Parsons, Sheryl, Irvine Ranch Water District, Irvine, CA
Swift, Ian, Irvine Ranch Water District, Irvine, CA

Selenium is present in wetlands in several forms and is known to bioaccumulate, causing reproductive and developmental harm in wildlife. Selenate [Se(VI)] is moderately toxic and bioavailable, whereas the selenite [Se(IV)] form is highly toxic and bioavailable in aquatic ecosystems. Elemental selenium [Se (0)] is found naturally in sediments and can be a product of microbial production in anoxic environments. In the early 2000s, selenium was identified as a pollutant of concern in the San Diego Creek Watershed (Orange County, California, USA), where it is mobilized into surface water from marine-derived sediments via urban runoff and shallow groundwater intrusion.

The use of treatment wetlands to reduce pollutant loads from urban runoff is becoming an increasingly common method to meet regulatory requirements limiting a variety of pollutants from entering surface and groundwater resources. The San Joaquin Marsh (SJM) is an example of a wetland constructed to treat urban runoff from a 25,697 hectare portion of the San Diego Creek watershed which drains into the ecologically important Upper Newport Bay. The SJM is a complex of surface treatment ponds and seasonally flooded riparian areas which began receiving flows from this heavily-urbanized watershed in 1998. Monthly surface water grab samples from 2009-2016 were collected, and selenium species were analyzed using inductively coupled plasma mass spectrometry.

As residence time increases in the SJM, selenium concentrations decrease while proportions of selenite and selenate increase and decrease respectively. During the 2009-2016 monitoring period, there was a mean selenium reduction from 16.6 µg/L to 5.9 µg/L, an increase in selenite from 3.5 µg/L to 5.2 µg/L, and a decrease in selenate from 16.6 µg/L to 5.9 µg/L from influent to effluent. These shifts in selenium concentrations were all statistically significant. Although there was an overall benefit of total selenium reduction through the wetland, concentrations of the more bioavailable selenite increased which may offset the ecosystem benefits. As selenium becomes a more prevalent pollutant of concern in western North America, understanding its biogeochemical cycling within wetland ecosystems will play a more critical role in watershed management. ■

PRESENTATION 1233
PRESENTED DURING *BIOGEOCHEMISTRY/NUTRIENT CYCLING*, 05/31/2018, 03:20 - 05:00

ADAPTING TO SEA-LEVEL RISE: SALTWATER INTRUSION AND NUTRIENT CYCLING IN COASTAL FARMLAND AND TIDAL SALT MARSH

Weissman, Dani, University of Maryland, College Park, Baltimore, MD
Tully, Katherine, University of Maryland, College Park, MD

As the world's climate changes, ecosystems along rural coastlines are becoming more vulnerable to sea-level rise and undergoing major disruptions in nutrient cycling. Tidal salt marshes, riparian forests, and farmland converge on coastlines, forming unique transitional ecosystems. Effective nutrient management requires a better understanding of phosphorus (P) and nitrogen (N) cycling in these intersecting areas. With centuries of farming and fertilization, N and P in excess of plant demand can accumulate in soils (known as legacy nutrients). Sea level rise and associated saltwater intrusion following storm events can remobilize legacy nutrients years or even decades after application, supplying a persistent but unpredictable source of nutrients to downstream waterways. In this study, I examine the potential impact of legacy nutrients on P and N loading in the Chesapeake Bay. Study sites are located along the lower eastern shore of Maryland. Soil and soil porewater were collected from active fields, salt-damaged farms, and marshes and analyzed for phosphate, nitrate, and ammonium. To tease apart the effects of the ion constituents of saltwater on nutrient mobility, soils from these sites were also treated with varying concentrations salts in both aerobic and anaerobic microcosms.

Field results show that concentrations of phosphate and ammonium in soil porewater were significantly higher in salt marshes than in other coastal ecotones. Furthermore, porewater nutrient concentrations differed by land use type. Salt marsh soils with a prior history of heavy fertilizer application contain phosphate concentrations up to ten times that of nearby forest soils. There was also a positive correlation between soil porewater salinity and phosphate and ammonium concentrations. In microcosm experiments, anaerobic soils released significantly more phosphate over their incubation period than aerobic soils in the deionized water control treatment. This suggests that anaerobic soil conditions may enhance phosphate release. Saltwater intrusion may greatly enhance the potential of soil nutrient release due to ion exchange with seawater in combination with reduced oxygen levels characteristic of hydric soils. By quantifying these inputs and identifying some of the biogeochemical processes that enhance their release into waterways, this study will provide crucial information for land managers attempting to improve water quality in coastal agricultural areas. ■

PRESENTATION 1247
PRESENTED DURING *BIOGEOCHEMISTRY/NUTRIENT CYCLING*, 05/31/2018, 03:20 - 05:00

DID YOU GUESS WHICH THING WAS NOT LIKE THE OTHERS? EVALUATION OF WETLAND NUTRIENT STOICHIOMETRY AND HOMEOSTASIS IN A SUBTROPICAL TREATMENT WETLAND.

Julian, Paul, University of Florida, Ft Pierce, FL
Wright, Alan, University of Florida, Ft Pierce, FL
Gerber, Stefan, University of Florida, Gainesville, FL
Bhomia, Rupesh, University of Florida, Gainesville, FL
Osborne, Todd, University of Florida, St. Augustine, FL

Ecological nutrient stoichiometry is the result of changes to elemental mass balances due to biological and ecological processes. Evaluating the relative changes in carbon (C), nitrogen (N) and phosphorus (P) ratios in aquatic and terrestrial ecosystems can advance our understanding of biological processes, nutrient cycling and decomposition of organic matter. Nutrient stoichiometric homeostasis relates ambient stoichiometric conditions to a species stoichiometric composition. Prior studies suggest that plant species degree of homeostasis ranges from weak to non-homeostatic. The degree of homeostasis of a plant species could indicate its sink strength. In wetland ecosystems, vegetation is a sizeable, highly variable and dynamic sink of nutrients.

This study investigated wetland nutrient stoichiometry across several ecosystem compartments (i.e. water, soil, vegetation) in two treatment flow ways (FW) of the Everglades Stormwater Treatment Area, south Florida (USA). These FWs include an emergent aquatic vegetation system dominated by Typha spp.(cattail) and a submerged aquatic vegetation system composed of species such as Chara spp. (muskgrass) and Potamageton spp. (pondweed). This study demonstrated that C, N, and P stoichiometry can be highly variable within and between wetland ecosystem compartments in a P-limited ecosystem. Generally, total P declined along the flow path in all ecosystem compartments, whereas trends in total N and C were not consistent. Meanwhile, TN:TP relationships increased as C:N and C:P varied in various compartments along the treatment flow paths. Nutrient homeostasis of dominant emergent and submerged aquatic vegetation (EAV and SAV, respectively) within two treatment FWs was also investigated. This study confirmed the hypothesis that wetland vegetation is non-homeostatic along different vegetation communities with homeostasis coefficients of 0.67 ± 0.04 and 0.78 ± 0.03 for EAV and SAV respectively.

Assessment of wetland nutrient stoichiometry between and within ecosystem compartments suggest decoupling of organic matter decomposition from nutrient mineralization which may have significant influences on nutrient removal rates and contrasting dominant vegetation communities. Furthermore, vegetation within the STAs provides a large nutrient sink with relatively constant uptake pressure suggesting that vegetation, along with other factors, influence ambient nutrient conditions within a given FW. ■

PRESENTATION 1248
PRESENTED DURING *BIOGEOCHEMISTRY/NUTRIENT CYCLING*, 05/31/2018, 03:20 - 05:00

LET'S TAKE A RIDE DOWNSTREAM. TRANSLATING NUTRIENT SPIRALING CONCEPTS TO WETLAND ECOSYSTEMS.

Julian, Paul, University of Florida, Ft Pierce, FL
Gerber, Stefan, University of Florida, Gainesville, FL
Reisinger, Alexander, University of Florida, Gainesville, FL
Larios Mendieta, Kalindhi, University of Florida, Gainesville, FL

Wetlands are strong nutrient sinks with large nutrient storage reservoirs and long retention times. Given this ecosystem function, treatment wetlands have been used to reduce pollutant loads to downstream ecosystems. In contrast to wetlands, stream ecosystems transport and recycle nutrients they receive from the landscape, with variable amounts of nutrient retention and removal occurring within a given stream ecosystem. However, both streams and wetlands have a common thread of nutrient transport, uptake, and release, and therefore, similar modeling frameworks have been developed. These models typically take the form of first-order uptake models with varying levels of hydrologic or hydraulic data integration. The occurrence of unidirectional flow in streams has given rise to the concept of nutrient spiraling in stream biogeochemical models, but there is no obvious analog for wetlands.

This study compared different modeling approaches related to nutrient cycling in streams and wetlands with the overall objective of translating stream nutrient spiraling concepts to wetland ecosystems using data collected along two flow ways within the Everglades Stormwater Treatment areas during semi-prescribed flow events. Using data collected during these flow events, we applied stream nutrient spiraling concepts to quantify nutrient dynamics in these wetlands. Further, we compared these wetland spiraling estimates with nutrient retention estimates traditional wetland modeling approaches. This study demonstrated the utility and function of nutrient spiraling concepts in a wetland context by providing a simple quantitative approach for incorporating hydrologic, biological, and chemical processes to quantify nutrient dynamics.

Prior studies of these treatment wetlands have suggested that flow ways behave biogeochemically like a stream, albeit at slower velocities and with higher net reten-

tion. Therefore, the translation of nutrient spiraling metric such as uptake length, the dominant component in nutrient spiraling, from stream to wetland ecosystems may be a useful metric to evaluate overall system function in a holistic manner. Uptake length effectively integrates hydrologic and non-hydrologic factors to relate the transport and utilization of nutrient in flowing waters. Our analysis of flow and nutrient concentrations in treatment wetlands show that the nutrient spiraling concept expands beyond just streams. Further development and expansion of these approaches. ■

PRESENTATION 1334
PRESENTED DURING *BIOGEOCHEMISTRY/NUTRIENT CYCLING*, 05/31/2018, 03:20 - 05:00

POTENTIAL DENITRIFICATION RATES VARY WITH DOMINANT VEGETATION ZONES IN SOUTHERN NEW ENGLAND COASTAL SALT MARSHES

Ooi, Sean Khan, University of Connecticut, Bolton, CT
Barry, Aidan, University of Connecticut, Storrs, CT
Lawrence, Beth, University of Connecticut, Storrs, CT
Elphick, Chris, University of Connecticut, Storrs, CT
Helton, Ashley, University of Connecticut, Storrs, CT

Soil microbial denitrification is an important ecosystem function that reduces reactive nitrogen in coastal marshes and may vary with plant traits of dominant vegetation. Dominant zones of coastal salt marsh vegetation are shifting with sea-level rise and with tidal restoration. The goal of our study was to determine how potential denitrification rates vary among dominant vegetation zones in restored and unrestored coastal salt marshes in Connecticut. At 10 tidally restored and 10 unrestored sites, we quantified potential denitrification rates using denitrification enzyme activity assays (DEA) on sediment collected from vegetation zones dominated (>50% cover) by Spartina alterniflora, Spartina patens, and Phragmites australis. We also quantified a suite of plant biomass and soil chemistry parameters (Cl-, SO4-, NO3-, NH4+, PO4+, pH, EC). The average potential denitrification rate in the S. alterniflora zone (mean ± std. error; 0.90 ± 0.39 µg N/ g dry soil/ hour) was significantly lower than in both the S. patens (3.02 ± 1.21 µg N/ g dry soil/ hour) and P. australis zones (9.18 ± 7.94 µg N/ g dry soil/ hour). These results suggest that as tidal restoration and sea-level rise facilitate the expansion of S. alterniflora zones, the capacity of coastal salt marshes to remove nitrogen via denitrification may decrease. Although tidal restoration has been shown to shift patterns of vegetation dominance, our preliminary results show potential denitrification rates are not significantly different between restored and unrestored sites. Further analyses will examine the mechanisms driving potential denitrification differences between vegetation zones by exploring relationships among potential denitrification, plant biomass and soil chemistry parameters. Because our results suggest that denitrification rates vary with vegetation zones, explicitly incorporating shifting vegetation under scenarios of sea-level rise and tidal restoration is critical for predicting the future role of coastal wetlands in nitrogen cycling. ■

PRESENTATION 1358
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY I*, 05/30/2018, 09:45 - 11:35

MODELING HOW WETLAND RESTORATION IMPACTS NITROGEN AND CARBON CYCLING IN FORMER CRANBERRY FARMS

Balogh, Stephen, US EPA, Narragansett, RI
Wigand, Cathleen, US EPA, Narragansett, RI
Martin, Rose, ORISE, Narragansett, RI
Hackman, Alex, Massachusetts Department of Fish and Game, Boston, MA
Ballantine, Kate, Mount Holyoke College, South Hadley, MA

In population-dense Massachusetts (USA) acquiring historical wetlands for ecological restoration efforts can be difficult and expensive. Retiring cranberry bogs create a rare opportunity to restore historical wetlands. Environmental managers face important decisions about how to restore cranberry bogs and which ecosystem services to prioritize for actions. While restoration projects often succeed in rapidly recovering some plant and animal communities, some ecosystem structure and functions, such as soil carbon content or denitrification can take decades to be fully realized. We built an explanatory model to formalize our assumptions about restoration and recovery of wetland ecosystems in former cranberry farms. We focused on the impacts of wetland restoration on the nitrogen and carbon cycles, because the reduction of non-point nutrient pollution on Cape Cod is a priority for state and local officials. When available, we included empirical data on nitrogen and carbon stocks and transformations collected across a chronosequence of restored and fallow former cranberry farms in the region. Otherwise we included production and transformation functions from the wetlands restoration literature. We report key nitrogen and carbon pathways linked with nutrient transformations and identify data gaps in our models. ■

PRESENTATION 1361
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES II*, 06/01/2018, 01:00 - 02:50

REGULATION OF ENVIRONMENTAL FACTORS CONTROLLING DENITRIFICATION USING A FLOATING TREATMENT WETLAND SYSTEM

Roach, Lewis, Floating Wetland Solutions, North Augusta, SC

An innovative Floating Treatment Wetland (FTW) system was installed in August, 2015 at the Saranac Young Life Camp's wastewater treatment facility to remove nitrate from nitrified wastewater. The Young Life design eschewed the conventional FTW design method of relating nutrient removal on a pound of nutrient removed per square foot of FTW planted surface area. Alternatively, the Young Life FTW system was designed to regulate the environmental factors controlling denitrification. The essential elements for nitrate reduction are nitrate, the absence of oxygen, carbon, and microbial habitat. Submerged and non-submerged floating wetland modules were installed in a newly constructed, 5600 ft2 lined lagoon. In 2016, the first year of operation, nitrates were reduced by 50% at loads of 12 lb N per day. Several design modifications were made, and in the second year of operation in 2017, nitrates were consistently reduced to <0.1 mg/l, essentially a 100% reduction, at nitrate loads of 12 lb/day. In 2017, the 5600 ft2 lagoon had an areal nitrate removal rate of 4361 mg/m2/day without carbon supplement and over 10,000 mg/m2/day with carbon supplement, an order of magnitude higher than rates reported in the literature for both natural and constructed wetlands, and amongst the highest ever reported. ■

PRESENTATION 1470
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*, 05/30/2018, 01:10 - 02:50

EFFECTS OF SEASONALITY AND HURRICANE EVENTS ON WATER QUALITY AND DOM CYCLING ALONG A SALINITY GRADIENT IN FLORIDA

Schafer, Tracey, University of Florida, St. Augustine, FL
Osborne, Todd, University of Florida, St. Augustine, FL
Reddy, K. Ramesh, University of Florida, Gainesville, FL
Ward, Nicholas, Pacific Northwest National Laboratory, Sequim, WA
Julian, Paul, University of Florida, Ft Pierce, FL

Biogeochemical cycles and water quality characteristics show distinctive patterns that depend on environmental conditions, weather patterns, salinity levels, and seasonality. These characteristics influence dissolved organic matter composition and cycling within coastal waterways. A ten-mile stretch of Pellicer Creek and the Intracoastal Estuary near St. Augustine, FL was used as a study site to observe and monitor these parameters. During summer months, dissolved organic carbon concentrations in Pellicer Creek, FL increased with increased precipitation and runoff. Turbidity levels also increased, as salinity decreased, and pH was affected throughout the waterway. Opposite patterns were seen in winter months where precipitation was much lower. However, disturbance events, such as hurricanes, can quickly alter normal patterns and cause nutrient levels to rise quickly in the freshwater inland part of the waterway and then flow out into the estuary and into the Atlantic Ocean. Salinity levels suddenly peak as sea water is pushed inland and then decrease drastically as rainfall causes runoff of substantial amounts of freshwater. These events can over-shadow normal seasonality fluctuations and alter normal biogeochemical patterns for weeks to months after a hurricane has passed. ■

PRESENTATION 1497
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS II*, 05/30/2018, 03:20 - 05:00

HAS MARINE DERIVED NITROGEN RETURNED TO RIPARIAN AREAS SINCE DAM REMOVAL ON THE ELWHA RIVER, WA, USA?

Kane, Wendal, University of Florida, Ft Pierce, FL
Bastow, Justin, Eastern Washington University, Cheney, WA

The removal of the Elwha and Glines Canyon dams on the Elwha River, WA, USA, in 2012 and 2014 respectively, opened up ~60km of spawning habitat that was inaccessible to anadromous pacific salmon for a century. Anadromous fish, which spawn in freshwater but spend majority of their lives in the ocean, are sources of nitrogen to riparian vegetation. However, no studies have surveyed for marine derived nitrogen (MDN) in soil food webs. By utilizing the naturally distinct isotopic signature (denoted as ‰ δ15N) of two different nitrogen sources, marine derived via anadromous fish and atmospherically derived via a nitrogen fixing plant, this study aims to measure the extent to which MDN has entered the soil food webs and vegetation of floodplains of the Elwha River watershed. In July 2017, we sampled riparian soil, soil fauna, and vegetation along three tributaries, representing either the lower, middle, or upper Elwha. Nitrogen subsidies from anadromous fish may not influence all areas of the Elwha watershed equally, because of the presence of a nitrogen fixing plant, Alnus rubra. To address this, we collected samples at each site in separate stands of A. rubra and Acer macrophyllum, a non-nitrogen fixing tree. Isotope samples were sent out for analyses in September 2017. We hypothesized that samples from A.

macrophyllum stands adjacent to tributaries that have had salmon spawning since dam removal will have more MDN than soil food webs upstream of Glines Canyon Dam, where anadromous fish have yet to colonize. Preliminary analyses did not detect the presence of MDN in soil or vegetation at any of the three tributaries that we sampled. However, the understory vegetation at the middle tributary had a higher δ15N (1 ‰ , $p<0.05$) and soil nitrogen (1%, $p<0.001$) than the other two tributaries. We suspect this to be from upstream A. rubra or anthropogenic influence. Laboratory analyses of soil fauna are ongoing. ■

PRESENTATION 1615
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES I*, 06/01/2018, 09:45 - 11:35

FLOATING ISLANDS: PAST, PRESENT AND FUTURE

Davidoff, Wendy, Floating Island International, Shepherd, MT
Kania, Bruce, Floating Island International, Shepherd, MT

Bruce Kania, Founder of Floating Island International, will provide a historical perspective around human efforts to employ nature's wetland effect to improve water quality. Bruce lives and works in Shepherd, Montana, where he runs a research center that tracks efficacy of floating treatment wetland's ability to cycle nutrients into appropriate biota.

Floating Island International leads a world-wide network in design and manufacturing of floating treatment wetland solutions. FII has over 7,000 islands launched since 2005. Today the company's BioHaven brand is bringing nature's wetland effect to fresh, brackish and marine water settings across the world. BioHavens in marine settings have withstood several hurricanes and typhoons, as well as massive snowfalls off the coast of Alaska. Bruce will touch on the implications associated with the purposeful integration of nature's model with human purpose. He will set the stage for a compelling vision around the idea that water can once again be a premier quality-of-life amenity, even in aquatic settings that are currently impaired. ■

PRESENTATION 1645
PRESENTED DURING *BIOGEOCHEMISTRY/NUTRIENT CYCLING*, 05/31/2018, 03:20 - 05:00

NITROGEN REMOVAL EFFICIENCY AND GREENHOUSE GAS EMISSIONS IN WETLANDS RECEIVING NON-POINT SOURCE NITRATE LOADS

Crumpton, William, Iowa State University, Ames, IA
Stenback, Greg, Iowa State University, Ames, IA
Hoglund, Hannah, Iowa State University, Ames, IA
Ellickson, Ian, Iowa State University, Ames, IA

Wetland restoration is a promising strategy for reducing surface water contamination in agricultural watersheds and in particular for reducing agricultural nitrate loads to the Mississippi River and its tributaries. However, there is some concern over GHG emissions from wetlands and in particular nitrous oxide emissions from wetlands intercepting high nitrate loads. Over the past decade, more than 80 wetlands have been restored through the Iowa Conservation Reserve Enhancement Program with the explicit goal of intercepting and reducing nonpoint source nitrate loads. We measured nitrogen mass balances and greenhouse gas emissions of a selected subset of these wetlands to evaluate their effectiveness at reducing agricultural, nonpoint source nitrogen loads, and to evaluate their effect on net greenhouse gas emissions. The monitored wetlands were selected to ensure a broad spectrum of major external forcing functions affecting wetland performance including hydraulic loading rate, residence time, nitrate concentration, and nitrate loading rate. Nitrogen loads to the wetlands were primarily in the form of nitrate and all of the wetlands were effective in reducing both nitrate and total N loads. Nitrate removal efficiency (expressed as annual percent mass removal) ranged from 8-91% and was primarily a function of hydraulic loading rate and temperature. Mass nitrate removal ranged from 120-2800 Kg N / ha of wetland/year and was primarily a function of hydraulic loading rate, temperature, and nitrate concentration. The wetlands were highly efficient at denitrifying nitrate to N2, with fractional yields of N2O-N averaging less than 0.5% of total nitrate removal. N2O emission rates were similar to rates from cropland and CH4 emission rates were similar to rates for restored depressional wetlands in Iowa. In combination, results from the current study and prior work support the expectation that N2O emissions will increase with increases in nitrate loading. However, results also demonstrate that N2O emissions from wetlands constructed or restored on former agricultural land are similar to emissions from cropland that the wetlands replace. In addition, denitrification in freshwater wetlands produces a lower fractional N2O yield than would otherwise be produced in downstream riverine and marine systems. As a result, to the extent that wetlands reduce nitrate loads to these downstream waters, overall N2O emissions across these combined systems would be reduced. ■

PRESENTATION P08
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

FACTORS INFLUENCING DENITRIFICATION IN AGRICULTURALLY ADJACENT WETLANDS

Gutierrez, Karina, College of Western Idaho, Nampa, ID

Lake Lowell, Nampa ID is an area of interest in soil quality due to its multiple uses in agricultural irrigation, local recreation, and wildlife refuge. The use of fertilizers in this area has the possibility of changing soil quality. A change in soil nutrients, erosion, and chemical composition can all influence water quality around Lake Lowell. With the help of equipment use from College of Western Idaho and Boise State University we have been examining chemical composition from previous soil samples from the lakeshore wetland. Phosphate and nitrate levels have been examined throughout the project quantify biogeochemical transformations in the area. Carbon levels are also an area of interest as they help produce a healthy soil ecosystem. An unhealthy soil ecosystem could influence eutrophication in addition to an increase in algae blooms and poor water quality. Preliminary results include nitrogen accumulation, vegetation, organic matter, and land use may be factors that influence denitrification in the area. We are seeking to understand the factors that affect soil quality in the Lake Lowell area that may benefit a healthy lakeshore ecosystem. ■

Biology & Ecology: Ecosystem Science

PRESENTATION 1132
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS I*, 05/31/2018, 09:45 - 11:35

HITTING A MOVING TARGET: SYNCHRONY OF AVIAN MIGRATION AND WETLAND PULSE DYNAMICS IN THE SEMI-ARID INTERMOUNTAIN WEST, USA

Donnelly, Patrick, USFWS, Missoula, MT
Dugger, Bruce, Oregon State University, Corvallis, OR
Collins, Daniel, U.S. Fish and Wildlife Service, Albuquerque, NM

Wetland dynamics in semi-arid environments provide a model system to evaluate the synchrony of resource pulses and wildlife migration. We used remote sensing to reconstruct spatiotemporal flooding of seasonal wetlands across regions of the Great Basin in southern Oregon, northeast California,and northwest Nevada, USA. We then linked these patterns to waterfowl migration chronologies over a 32 year period to examine alignment of bird migration and wetland abundance. We found chronology of earlier migrating species to be partially misaligned with spring wetland pulses. On average peak numbers of these birds occured two weeks prior to species more synchronous with cresting wetland resources and as a result experienced wetland densities within landscapes at one third the rate of later arrivals. Fall migration chronology of all species aligned with annual wetland minimums, where flooding of seasonal wetland sites occurred at approximately 13% the rate of peak spring pulse abundance. High rates of interseasonal variability in flooding patterns resulted in dynamic spatiotemporal shifts in wetland resource availability throughout the study period. Although we found wetland availability to be relatively constant within the three month spring and fall migration periods monitored, the mean probability of individual wetland sites to be flooded during the same two week period during this time was only 40%. Ecological patterns observed mirrored pioneering behavioral traits typical of migratory waterfowl that are adaptive in their spatial movements to optimize shifts in landscape condition. At broad scales our results suggest a potential bias in wetland utilization by waterfowl species that must target a moving subset of landscape wetland resources aligned with specific spatiotemporal chronology of spring and fall migration. Our findings reinforce the importance synchronizing wetland conservation outcomes to the life-cycle demands of transitory wildlife by ensuring resource availability is matched in time and space with species demands. ■

PRESENTATION 1137
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS* I, 05/31/2018, 09:45 - 11:35

UTILIZING NATURAL COASTAL WETLANDS FOR WASTEWATER MANAGEMENT: IDENTIFYING CRITICAL KNOWLEDGE GAPS

Shifflett, Shawn, ORISE Postdoctoral Fellow at USEPA, Cincinnati, OH
Schubauer-Berigan, Joseph, US Environmental Protection Agency, Cincinnati, OH

Coastal wetlands are important natural resources that offer significant ecosystem services like flood protection, water quality improvement, and carbon sequestration. In the southeastern United States, some low income communities are relying on coastal wetlands for the management of secondarily treated effluents in forested and emergent wetlands. Advocates for this practice have argued that wetlands can assimilate nitrogen from wastewater loading, which can improve cypress-tupelo swamp productivity, and enhance marsh accretion rates to mitigate the effects

of sea level rise. However, emerging research in coastal wetlands and the environmental impacts of wastewater treatment poses new questions about the potential risks introduced by this practice. This interdisciplinary talk will review current research on the allocation of plant biomass in fertilized coastal wetlands, highlight the occurrence and fate of pharmaceutical and personal care products (PPCPs) in municipal wastewater operations, and report the environmental impacts of antibiotic-resistant bacteria based on peer-reviewed literature. These efforts show that there is more research needed at both local and watershed scales to evaluate how these risk factors impact ecosystem integrity and to better understand the tradeoffs with this wastewater management practice. Furthermore, continuous long-term datasets are needed in these systems to understand what factors may be influencing wetland resilience. ■

PRESENTATION 1191
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT I*, 05/31/2018, 09:45 - 11:35

EFFECTS OF PRECIPITATION EXTREMES ON STRESSED COASTAL VEGETATION

Middleton, Beth, USGS, Lafayette, LA

Lack of adequate freshwater is becoming a key conservation issue for coastal freshwater swamps. During drought years, freshwater in estuaries also may be limited due to increased anthropogenic water usage. When freshwater is limited, salinity levels can increase to levels that kill freshwater vegetation in world estuaries. This presentation will review several studies that explore the effects of precipitation level on salinity, and subsequent effects on estuarine vegetation health. In Big Thicket National Preserve (BTNP, TX), salinity levels rose above 6 ppt during the drought of 2011−12, so that freshwater tree species began to die. Subsequently, a new project was launched to track groundwater salinity levels in tidal freshwater swamps across the Gulf of Mexico (USGS and UF). After the extreme flooding event associated with Hurricane Harvey in 2017, salinity levels dropped in BTNP. In general, when freshwater input is high, salinity levels are low along coastal rivers. Earlier research during the hydrological remediation effort to push oil offshore in Louisiana demonstrated that freshwater could lower salinity even when salinity levels were relatively low during the Deepwater Horizon Incident in Jean Lafitte National Historical Park and Preserve (JLNHP&P; LA). After this hydrologic remediation, tree production increased in JLNHP&P by three times over previous years. Similarly, tree health increased dramatically after two months of hydrologic remediation in a study of Eucalyptus forests along the Murray River (Australia). These studies suggest that both flooding events and hydrologic remediation can reduce salinity levels in coastal forests especially following drought. Such management tools may help managers to offset future conservation problems due to climate and land-use change. ■

PRESENTATION 1200
PRESENTED DURING R*EGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES I*, 05/30/2018, 09:45 - 11:35

ESTABLISHING MINIMUM LEVELS IN WETLANDS AND LAKES - LESSONS LEARNED

Hancock, Michael, Southwest Florida Water Management District, Brooksville, FL

The natural landscape of west-central Florida is characterized by numerous lakes, wetlands, and river systems, which are often strongly influenced by an underlying karst hydrogeologic system. Due to this interactive relationship, regional ground-water withdrawals have affected the health of wetlands, lakes, and watercourses in the area.

In 1996, the Florida Legislature adopted a statute requiring the state's five Water Management Districts to begin the process of establishing minimum flows and levels (MFLs). Minimum levels are defined as the level of water in surface-water bodies and aquifers below which significant harm to the water resources of the area will occur (Chapter 373, Florida Statutes). The Southwest Florida Water Management District (SWFWMD) was specifically required to begin by establishing MFLs for priority waters within the northern Tampa Bay area, followed by other regions of the District. In response, the SWFWMD established minimum levels for 41 wetlands, 15 lakes, and seven Floridan aquifer monitor wells. Since that time, minimum levels for over 160 lakes and wetlands have been adopted.

The process of establishing the initial MFL methodologies was an interdisciplinary effort, incorporating science, policy, and legal input. Techniques were developed to correlate hydrologic and biologic functions in surface-water systems, and to connect the health of lakes with that of surrounding wetlands. Over the years of establishing MFLs, improvements to methods were identified, and new tools were developed. This presentation will discuss the status of these efforts, which have produced a more holistic approach to water management, an improved line of communication between scientists of various disciplines and policy-makers, and a change in direction for future data collection, research, and water supply planning. ■

PRESENTATION P40
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

PIGMENTATION EFFECTS ON MORTALITY IN A ROCK POOL ROTIFER WHEN EXPOSED TO UVR.

Apodaca, Rachael, University of Texas at El Paso, El Paso, TX
Baeza, Maribel, University of Texas at El Paso, El Paso, TX
Walsh, Elizabeth, University of Texas at El Paso, El Paso, TX

The amount of ultraviolet radiation (UVR) reaching the Earth's surface has been increasing due to global climate change. UVR negatively affects aquatic life by mutating DNA, slowing locomotion, and reducing lifespan. An increased resistance to UVR has been demonstrated in pigmented zooplankton. Bdelloid rotifers are aquatic microinvertebrates that exhibit a tolerance to UVR and can survive periods of desiccation in ephemeral habitats. This may be especially true for Pleuretra lineata found in rock pools located in El Paso, TX. Rock pools are seasonal wetlands that fill after it rains and are populated by highly pigmented P. lineata. The objective of this study is to determine the effects of desiccation and UVR exposures on bdelloids with high (HP), moderate (MP), or no pigmentation (NP). We hypothesized that the degree of pigmentation and length of desiccation will influence survival after UVR exposure. P. lineata were desiccated for one (1D) or seven (7D) days. They were then exposed to low (130 µW/cm2) or high (375 µW/cm2) UVR for 2 hrs, and percent survival was assessed 48 hrs. after exposure. Results indicate that HP desiccated for 1D and exposed to low UVR had the highest survival rate (mean±SD, 85±5) and NP desiccated for 7D and exposed to high UVR had the lowest (44±3). Tukey post hoc tests indicated a significant difference in recovery between HP vs. NP ($p<0.0001$) and MP vs NP ($p=0.0009$). Thus, higher pigmentation led to increased survival. Similarly, reduced desiccation period led to increased survival ($p=0.0038$). Future work will include repeating exposures higher UVR doses. This study increases our understanding of how seasonal climatic changes affect organisms living in specialized wetland habitats, and the role pigmentation may play in their survival. ■

PRESENTATION P35
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

CHANGES IN THE WATER DELIVERY SYSTEM IN A DESERT WETLAND AND ITS EFFECTS MACROINVERTEBRATE COMMUNITIES

Pina, Anna, University of Texas at El Paso, El Paso, TX
Orona, Viridiana, The University of Texas at El Paso, El Paso, TX
Lougheed, Vanessa, UTEP, El Paso, TX

The relatively rare freshwater ecosystems in the arid southwestern United States are highly vulnerable to climate change. Thus their understanding and protection is critical. The Rio Bosque (RB) wetland (El Paso, TX) was created in 1997 and has been without a perennial water source since that time. In 2016, substantial improvements to the water delivery system allowed the delivery of water to two wetland cells for the entire summer, resulting in the flooding of more than 30 acres and the development of diverse wetland vegetation. This project aimed to examine how aquatic macroinvertebrate communities at the RB were improved through the provision of a year-round water source. Samples of invertebrates were collected from two different sites at the RB in summers of 2014 and 2016, and 4 different sample sites in 2017. The specimens were then identified to genus or species-level. In 2014, samples were from a small vegetated channel flooded by groundwater, whereas wetland ponds receiving treated wastewater were sampled in 2016 and 2017. Dragonflies and damselflies (Odonata) were the predominant aquatic species, followed by dipterans, ephemeropterans and coleopterans. Multivariate analysis (NMDS) indicates that the community composition was different among the 3 sampling years, although there appeared to be no difference in the occurrence of sensitive species. 2016 and 2017, while similar, remained separated on the NMDS; possibly due to dramatic changes in vegetation between the two years. These results will be compared with data collected from other sites throughout the region to determine how this created wetland contributes to regional diversity. ■

PRESENTATION 1287
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS I,* 05/31/2018, 09:45 - 11:35

PLAYAS AND SALINE LAKES – THREATENED SYSTEMS OF THE SEMI-ARID HIGH PLAINS

Haukos, David, U.S. Geological Survey, Manhattan, KS
Conway, Warren, Texas Tech University, Lubbock, TX

The semi-arid High Plains of the western Great Plains (west of the 100th meridian) are transitional from the eastern, mesic mixed- and tall-grass prairies to the western, semi-arid and arid ecosystems of North America. Ecology of the High Plains landscape has been greatly altered through prairie conversion to row-crop agriculture, unmanaged grazing by domestic livestock, fossil and renewable energy development, and climate change. Hydrological features of the High Plains are dominated by playas - small, numerous, recharge, depressional freshwater wetlands; saline lakes – large, scarce, discharge, saline to hypersaline wetlands fed by freshwater springs; and High Plains or Ogallala aquifer - the largest aquifer in North America. These three hydrological features are interconnected as playas recharge the aquifer, which discharges into saline lakes. These interconnected hydrological features create a system that is the ecological foundation for the High Plains and provides critical ecological goods and services. Due to irrigation demands since the mid-1900s, the saturated thickness of the Ogallala aquifer has declined to the point where irrigation is not feasible currently or in the near future throughout much of the High Plains. The aquifer decline caused nearly all springs discharging into saline lakes to cease flow, effectively drying out saline lakes and altering the ecological state from that of a predictable surface water source to one dictated by unpredictable precipitation events. Approximately 20% of playas have been lost from the landscape, <1% are free of any anthropogenic impacts, and function of nearly 60% has been degraded to the point of the playa network system nearing discontinuity. Such loss and degradation among these hydrological features have greatly reduced the capacity of the High Plains hydrological system to provide ecological goods and services. Large-scale conservation planning that considers and incorporates network dynamics of interconnected hydrological features would maximize provision of ecological goods and services within these unique systems. ■

PRESENTATION 1298
PRESENTED DURING *ECOSYSTEM SCIENCE II*, 06/01/2018, 01:10 - 02:50

THE SHRINKING LAKE CHAD!: URGENT NEED FOR CONCERTED EFFORT BY MEMBER COUNTRIES TO SAVE IT FROM EXTINCTION

Ndimele, Prince Emeka, Lagos State University, Ojo, Lagos State, Nigeria, Ojo, Lagos, Nigeria
Disu, Maryam Olasumbo, Lagos State University, Ojo, Lagos, Nigeria

Lake Chad is located in the far west of Chad, bordering on north-eastern Nigeria. The Chari River, fed by its tributary, the Logone, provides over 90% of Lake Chad's water, with a small amount coming from the Yobe River in Nigeria/ Niger. Over half of the lake's area is taken up by its many small islands (including Bogomerom archipelago), reed beds and mud banks, and a belt of swampland across the middle divides the northern and southern halves while the shorelines are largely composed of marshes. Lake Chad is economically important, providing water to more than 68 million people living in the four countries surrounding it (Chad, Cameroon, Niger, and Nigeria) on the edge of the Sahara. Other ecosystem services provided by the lake are: fishing, transportation, science and education, etc. Lake Chad is rich in flora and fauna; it holds about 86 species of fish, elephant, hippopotamus, crocodile, and large communities of migrating birds including wintering ducks, ruff (Philomachus pugnax) and other waterfowl and shore birds. All this organisms are on the decline. As a matter of fact, some can no longer be found within and around the lake because of its present size. The impact assessment report of Lake Chad Basin noted that the demand for water for irrigation has increased fourfold due to fluctuations of the basin in response to climate cycles leading to dramatic environmental changes. In 1963, the lake surface covered 25,000 Km2. Today, it covers 1,350 Km2, which represents about 1,750% reduction in surface area within 54 years and annual loss in area of approximately 438 Km2. If this trend continues, Lake Chad will completely disappear in 2020!, which is three years from now. The disappearance of Lake Chad is attributed to a variety of factors such as overuse of water resources, climate change, poor enforcement of environmental legislation, and weak capacity for water resources management. According to Fort Lammy Convention, which set up the basin, member states are required to abstain from measures likely to alter the water budget, water quality, integrated water resources management, or water access by other member states. The Convention also recognizes the right of member states to plan projects within the "Conventional Basin" in consultation with the Lake Chad Basin Commission (LCBC). However, most of these recommendations have not been adhered to by the member states, which has contributed significantly to the decline of its surface area. ■

PRESENTATION 1309
PRESENTED DURING *ECOSYSTEM SCIENCE II*, 06/01/2018, 01:10 - 02:50

IMPACTS OF ROAD DEICING SALT ON THE STRUCTURE AND FUNCTION OF FORESTED WETLANDS IN SOUTHERN NEW ENGLAND.

Walker, Samantha, University of Connecticut, Ashford, CT
Lawrence, Beth, University of Connecticut, Storrs, CT

Forested wetland ecosystems are ubiquitous throughout New England and provide critical ecosystem services to the region (i.e., flood mitigation, water quality treatment, biodiversity support), though they are increasingly threatened by road fragmentation and our growing reliance on road deicing salts (largely NaCl). To investigate the impacts of road deicing salts on the structure and function of forested wetlands, we surveyed 15 road-adjacent red maple (Acer rubrum; n = 9) and Atlantic white cedar (Chamaecyparis thyoides; n = 6) dominated wetlands in eastern Connecticut during summer 2017. We quantified a suite of soil parameters (Na+, K+, Mg2+, Ca2+, pH, electrical conductivity, heavy metals, total N, soil moisture, C:N) along transects extending 165 meters into each wetland, and at the red maple sites, we also quantified the vegetation community composition (ground cover, shrub density, canopy cover, tree density). With increasing distance from roads, soil salinity (EC and Na+) decreased and soil base cation (K+, Mg2+, Ca2+) concentrations increased. These patterns are likely a result of cation exchange reactions whereby Na+ displaces other base cations. Preliminary analyses of the vegetation community data do not indicate strong spatial patterns with distance from road, as we observed no changes in invasive or native species abundance, diversity indices, species richness or evenness. The residence time of road salt-enriched water at these sites may not be extreme enough to alter vegetation composition, though continued displacement of plant macronutrients may have long-term consequences for the mineral nutrition of roadside vegetation. Future analyses will use multivariate statistical methods to investigate how plant functional groups vary with distance from the road and soil parameters. Together our data will improve our understanding of the impacts of road deicing salts on temperate forested wetlands and inform policy makers in the region. ■

PRESENTATION 1320
PRESENTED DURING *AFRICAN RIVERS*, 06/01/2018, 01:10 - 02:50

ASSESSING NIGER-DELTA WETLAND RESOURCES: A CASE-STUDY OF MANGROVE ECOSYSTEM

Falana, Olayiwola Gausu, Lagos State University, Ojo, Lagos, Nigeria
Ewenla, Oyindamola Lois, Lagos State University, Ojo, Lagos State, Nigeria

The Niger Delta is located in the Atlantic coast of Southern Nigeria and is the world's second largest delta with a coastline of about 450km. The Niger Delta region occupies a surface area of about 112,110km2, representing about 12% of Nigeria's total surface area. The Delta's environment can be broken down into four ecological zones: coastal barrier islands, mangrove swamp forests, freshwater swamps, and lowland rainforests. The mangrove swamps of Niger Delta, which is the largest delta in Africa constitute the dominant wetland ecosystem in the Niger Delta region and covers an area of about 1,900km2. Mangroves constitute important nurseries for fishes, crustaceans, sponges, algae and other invertebrates, and also acts as a sink, retaining pollutants from contaminated tidal water. The Niger Delta mangrove together with the creeks and rivers are a major source of food and livelihood for about 30 million people, which represents more than 17% of Nigeria's population. Other ecosystem services provided by this unique environment are flood control, ground water re-fill, reservoir of biodiversity, fuel wood, cultural values etc. This ecosystem also plays important role in climate change mitigation because of its high blue carbon sequestration potential. This is particularly important because of continuous gas flaring in Niger Delta from petroleum operations, which releases carbon dioxide among other gases into the atmosphere. This wetland is potentially a good site for ecotourism and also qualifies to be a world heritage site and Ramsar site if proper steps are taken. The benefits derivable from this fragile ecosystem are under severe threat by anthropogenic stressors. These include the installation of pipelines and seismic exploration by oil companies, crude oil pollution, deforestation, urbanization etc. This paper discusses the extent of depletion and loss of mangrove ecosystem in the Niger Delta region and the value of its goods and services. ■

PRESENTATION 1322
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION III*, 05/30/2018, 03:20 - 05:00

THE IMPACTS OF WETLAND RESTORATION ON FISH PRODUCTIVITY IN NIGERIA

Owodeinde, Fatai Gbolahan, Lagos State University, Ojo, Lagos State, Nigeria, Ojo, Lagos, Nigeria

Wetland is one of the resources of high value which has been exposed to indiscriminate use. It is an important ecosystem to fish and loss or degradation of wetland will have a direct consequence on sustainable fisheries. This paper reviewed the term "wetland", its functions and values, importance to fish production in Nigeria and threats to its sustainability. The term "wetland" has been defined by various researchers especially based on their profession and their needs but up till today there is no single definition accepted by all users. In Nigeria, the most commonly adopted is that of RAMSAR convention. Wetland has both marketed and non-marketed functions and values. They provide essential link in the life cycle of 75 percent of the fish and shell fish commercially harvested in the world and are vital to fish health. Despite the importance, there have been exceptional losses of wetlands. Lagos state alone has witnessed more than 96 percent loss. Major threats to wetlands are: agriculture, development, pollution and climate change. Therefore proper management of the wetland ecosystem is important in other to ensure continuous fish production. ■

PRESENTATION P38
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EVIDENCE OF CONNECTIVE CORRIDOR FOR MOUNTAIN STREAM WETLAND YANGMINGSHAN NATIONAL PARK, NORTHERN COAST OF TAIWAN

Chen, Liang Hsien, Chinese Culture University, Taipei, Taiwan

Physical obstacles impacts of stream habitat connective corridor on catadromous species in northern coast stream, Taiwan. The life history of catadromous species require intact corridors between ocean and freshwater habitats in stream habitat. Stream habitat connectivity is the persistence of catadromous species use both freshwater and marine habitats to complete their life history, exposing organisms to in-stream, estuarine and sea environmental impacts and risks by climate events and anthropogenic barriers in northern coast. The natural disturbances Mei-Yu, northeastern monsoon and Typhoon are the normal event that occurs every year in northern coast of Taiwan. Populations of catadromous species Eriocheir japonicus have declined during the past decades in northern coast stream. Declines have been attributed majority to blockage of migration routes, overexploitation and flooding by typhoons and heavy rains. This study examines the effects of the climate variability and physical barriers on (1) the life history traits (2) and population dynamics of the E. japonicus running to the upstream. We conducted a long-term surveys stream in Lo-Mei Stream. The Lo-Mei stream in northern coast is draining from Yangmingshan National Park area, near Taipei in northern Taiwan. The population has been declining since the 1998 and now at its lowest level, the abundance and biomass of E. japonicus were high in midstream station, but low values in upstream. The life history of crabs consists of four stages: (1) early larval development in the sea; (2) upstream juvenile migration; (3) adult maturation in freshwater; and (4) adult return migration to the sea. Catadromous species of crustaceans E. japonicus was able to migrate upstream over the physical obstacles. The individuals on upstream habitat of physical obstacles appears to be timed to maximize growth and body size. The individuals reaches a size at which stream environment condition are optimum for its growth and survival in the adult habitat than in the larval habitat. Furthermore, high densities of migratory crab in a bottleneck below migration barriers could lead to greater competition and low discharge. The maintenance of catadromous species population will require effective and holistic stream wetland management strategies, we look forward to future research on the flow affects and the efficacy of corridor approaches to conserve and maintain the migratory organisms and stream habitat. ■

PRESENTATION 1372
PRESENTED DURING *ECOSYSTEM SCIENCE II*, 06/01/2018, 01:10 - 02:50

LTERNATIVE STABLE STATES IN INHERENTLY UNSTABLE SYSTEMS: AN EXAMPLE FROM THE PRAIRIE POTHOLE REGION OF NORTH AMERICA

Mushet, David, US Geological Survey, Jamestown, ND
McKenna, Owen, United States Geological Survey, Jamestown, ND

We recently identified a shift in many of the wetlands in the Prairie Pothole Region of North America to a new "stable" state. This shift was driven by a prolonged period of increased precipitation that led to the transport of dissolved salts into the ponds of wetlands located at mid and lower elevational positions in localized wetland complexes. Prairie-pothole wetland ecosystems are known for their dynamic responses to changes wrought by cyclical fluctuations between wet and dry periods (i.e., the wet/dry cycle

of the region). The Wetland Continuum is a conceptual framework that was designed to represent these fluctuations in wetlands at differing positions along a hydrologic (and elevational) gradient ranging wetlands that primarily recharge groundwater to those that primarily receive groundwater discharge. The Wetland Continuum facilitates the interpretation of biological studies of wetland ecosystems by identifying communities that could be expected to occur in wetlands at different locations along the groundwater gradient at different positions in the wet/dry cycle. Once the relation of a wetland to groundwater is determined, the expected communities are then driven largely by climate fluctuations as water levels rise and fall in response to changes in precipitation and snowmelt inputs, and evaporative and evapotranspirative losses.

The temporal fluctuations at a given position along the groundwater axis of the Wetland Continuum can be considered the "stable" state of these inherently unstable systems. However, under prolonged conditions at either extreme of the wet/dry cycle, salts in a wetland basin can either accumulate or be lost. Thus, when more normal wet/dry cycling resumes, the new community assemblages in a wetland will be representative of communities at a different location along the groundwater axis of the Continuum, i.e., the state will have shifted. Communities will continue to fluctuate in response to climate variations, but will be representative of this new "alternative stable state" until either another prolonged wet or dry period shifts the wetland in an opposite direction, or even further in the same direction. Thus, while the stable state of prairie-pothole wetlands is that of dynamic change in response to climate cycles, this state can shift to an alternative stable state of instability in response to extreme and prolonged events that shift underlying abiotic factors, such as salt loading, in a wetland basin. ■

PRESENTATION 1377
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS I*, 05/31/2018, 09:45 - 11:35

ARID WETLANDS: CHALLENGES AND OPPORTUNITIES

Reid, Frederic, Ducks Unlimited, Rancho Cordova, CA

Arid wetland systems are often low in plant and animal diversity, but can provide unique habitats for specific communities and great abundance of certain species on a seasonal basis. Because of an arid climate and limited amounts of water, there is a perception that the Great Basin and Tulare Basins of western North America are of limited value to waterfowl and other waterbirds.. Yet because of the scarcity of these marshes and wetlands in a dry region, their value to wildlife may be far greater than in wetter regions. Surface modifications to intercept precipitation and snow-melt runoff have resulted in the single greatest impact to arid wetlands. Hydrologic alterations have occurred in Carson Sink, Tulare and Klamath Basins, as well as brackish Owens and Mono Lakes. In addition to water diversions, water quality degradations continue in western US wetlands. Dams on the Carson, Walker, Humboldt, and Bear rivers have greatly impacted wetlands in terminal basins. Water availability in the single most limiting factor for most wetland managers in arid environments. In order to mimic the natural hydrologic cycle of spring runoff and progressive drying throughout the summer, managers must have adjudicated water rights. If corridors of quality waterbird habitats are to exist in western North America, hydrologic integrity must be restored to these wetlands and enhancement of historical pathways that are currently degraded must be a priority. ■

PRESENTATION 1383
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS I*, 05/31/2018, 09:45 - 11:35

IMPACTS OF THE *DEEPWATER HORIZON* OIL SPILL ON LOUISIANA SALT MARSHES

Hester, Mark, University of Louisiana, Lafayette, LA
Willis, Jonathan, Nicholls State University, Thibodaux, LA
Rhouhani, Shahrokh, Newfields Companies, LLC, Atlanta, GA
Steinhoff, Marla, NOAA, Seattle, WA

Salt marshes are a critical component of Louisiana's coastal zone that are well recognized for the suite of important ecosystem services they provide, including nursery habitat, primary production, and carbon sequestration, among others. The provision of many of these ecosystem services is greatly influenced by the health and abundance of the dominant plant species, which in Louisiana salt marshes is Spartina alterniflora. The Deepwater Horizon oil spill, which began on April 20, 2010 approximately 66 km off the coast of Louisiana, is the largest oil spill in American coastal waters recorded to date, with millions of gallons of oil estimated to have been spilled. Subsequent to the spill, a Natural Resource Damage Assessment (NRDA) was conducted. The coastal wetland vegetation component of the Deepwater Horizon oil spill NRDA revealed significant injury to the plant productivity and health of Louisiana salt marshes exposed to oiling. Specifically, marsh sites experiencing trace or greater vertical oiling of plant tissues displayed reductions in live cover and live peak standing crop, particularly in the marsh edge zone, for the majority of this four year study. Similarly, elevated chlorosis of plant tissue,

as estimated by a vegetation health index, was detected for marsh sites with trace or greater vertical oiling in the first two years of the study. Key environmental factors, such as hydrologic regime, elevation, and soil characteristics, were generally similar across plant oiling classes, indicating that the observed injury to plant health and productivity was the result of plant oiling and not potential differences in environmental setting. Although fewer significant impacts to health and productivity were detected in the latter years of the study, this in part reflects a reduced sample size due to shoreline erosion in the region and should not be considered indicative of full recovery of the ecosystem. ■

PRESENTATION P36
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

DECOMPOSITION RATES OF DIFFERENT LITTER TYPES IN LONGLEAF PINE WETLANDS: THE CONSEQUENCES OF ALTERED FIRE REGIMES

Carson, Khalil, Georgia Southern University, Statesboro, GA

Disturbances play crucial roles in many ecosystems, but common forms of disturbance are often artificially altered or removed by anthropogenic factors. Historically, Longleaf Pine forests of the southeastern U.S. experienced regular wildfires in intervals ranging from 1–10 years depending on habitat type. Fire suppression became widespread during the 1900s, and the effects on upland forests have been well documented. However, the impacts of altered fire regimes on wetlands embedded within Longleaf Pine forests have been less studied. Here, we examine decomposition rates and invertebrate communities in three pine flatwoods wetlands. We placed packs containing three different types of litter (Longleaf Pine, Black Gum, and Wiregrass), into three wetlands. Replicates of each litter type were placed in two different habitat types in each wetland: high canopy, low herbaceous cover (i.e., fire-suppressed) or low canopy, high herbaceous cover (i.e., fire-maintained). In one wetland, a second set of replicates was added to remove sets at two different time intervals. The litter bags in this replicate were left in the wetland for 25d, while the other replicates remained in the wetland for >100d. After retrieval, we removed all invertebrates colonizing bags and measured decomposition rates. After 25d, average decomposition rates regardless of habitat were faster in Black Gum (–0.015±0.002) than in pine (–0.010±0.001) and wiregrass (–0.008±0.001). This trend remained after 104d, with, on average, only 53% of Black Gum litter remaining compared to 76% of pine and 77% of wiregrass litter. We did not find any effect of habitat type on decomposition rates. Invertebrate samples from litter bags are still being processed, but we predict communities will differ based on litter and habitat type. Measuring the decomposition rates of several common litter types presents us with a better understanding of how altered disturbance regimes impact fundamental ecosystem processes. ■

PRESENTATION 1485
PRESENTED DURING *ECOSYSTEM SCIENCE II*, 06/01/2018, 01:10 - 02:50

USING INTERDISCIPLINARY SCIENCES FOR THE DESIGN AND PERFORMANCE OF THE COONAMESSETT RIVER RESTORATION

Turek, James, NOAA National Marine Fisheries Service, Narragansett, RI
Gladfelter, Elizabeth, Town of Falmouth, Falmouth, MA
Buesseler, Wendi, Coonamessett River Trust, Falmouth, MA
Ford, Eric, Massachusetts Department of Fish and Game, Boston, MA
Lambert, Beth, Massachusetts Department of Fish and Game, Boston, MA
Nelson, Nick, Interfluve, Cambridge, MA

The Town of Falmouth, MA and its project partners have worked diligently for more than a decade to plan and implement the restoration of ecosystem services to the Coonamessett River, a small coastal watershed in southeastern MA. The $3.5 million project focuses on 56 acres of former cranberry bog property with channelized stream now owned and managed by the town. The project involves the removal of two low-head, former cranberry operation dams; replacement of a fish-friendly road culvert; restoration of 2.2 miles of free-flowing stream by reestablishing a natural channel with low-gradient meanders, tributary channels, large wood placement, and restored, lowered elevation floodplain with a native riparian wetland community; and unimpeded passage by diadromous and resident fishes using this small river. These restoration activities are to restore riverine connectivity between the 158-acre glacial-kettle Coonamessett Pond and the Great Pond estuary discharging to Nantucket Sound. The restoration of stream, riparian wetland and floodplain habitats and their ecological services in a glacial outwash plain setting is also expected to increase both ecological and local community resiliency. Restoration of the initial project phase began in 2017. Project partners have conducted substantial ecological baseline surveys and monitoring of the project area, to be discussed in this presentation, including surface water quality conditions; presence and abundance of fish populations including alewife (Alosa psuedoharengus), blueback herring (A. aestivalis) and American eel (Anguilla rostrata)

and their movements using passive integrated tag (PIT) telemetry; groundwater and soil conditions using ground-penetrating radar (GPR); vegetation and plant community surveys; and drones for site mapping and assessment. Post-restoration monitoring begins in 2018 and is expected to extend for 3 years or more. ■

PRESENTATION P39
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

HOW IS THE MICROTOPOGRAPHY OF ARCTIC WETLANDS CHANGING?

Fuson, Tabatha, The University of Texas at El Paso, El Paso, TX

Microtopographic variability and change is an important determinant of wetland structure and function in the Arctic. As Arctic wetlands respond to climate change and permafrost and surface hydrology are altered, there is also a strong propensity for microtopographic change. Subsidence can follow thawing of ice rich permafrost or drainage of inundated wetlands, and heaving can result from thaw bulb and/or ice wedge growth. To date, few studies have tracked microtopographic change at high spatial resolution over multiple years and multiple studies and position papers have recently elevated the urgency of this research. The primary objectives of this Masters research project, is to quantify the spatial and temporal microtopographical change in four contrasting locations on the North slope of Alaska using terrestrial light detection and ranging (LIDAR) technologies, and determine how microtopographic change is associated with shifts in surface hydrology and seasonal vegetation phenology.

Ten years of Lidar data has been collected for each site and will be filtered, cleaned, and compared using ArcGIS, Rhiscan Pro, and CloudCompare softwares. Each cloud will be filtered to remove noisy and unwanted points that might negatively influence the results. In order for the point clouds to be representative of the true surface, a vegetation removal tool will then be used. A difference comparison analysis will then be conducted from each cloud for each year and both the year to year and overall change trends will be described. Changes in surface hydrology and vegetation phenology will be determined from spectral analysis of digital imagery that was acquired concomitantly with LIDAR data. Interpretation and discussion of the results will focus on elements of change that have the potential to impact biodiversity, surface energy budgets, and wetland-atmosphere carbon exchange. ■

PRESENTATION P34
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

A HALF CENTURY OF BIOPHYSICAL CHANGE IN POLYGONIZED TUNDRA ON THE COASTAL PLAIN OF NORTHERN ALASKA

Orejel Gonzalez, Mariana, The University of Texas at El Paso, El Paso, TX
Villarreal, Sandra, GSRC, Baton Rouge, LA
Cody, Ryan, UTEP, El Paso, TX
Escarzaga, Stephen, UTEP, El Paso, TX
Hollister, Robert, Grand Valley State University, Allendale, MI
Webber, Patrick, Michigan State University, East Lansing, MI
Tweedie, Craig, University of Texas at El Paso, El Paso, TX

Polygonized tundra landscapes are widespread in the Arctic. Within these landscapes, there is a tight coupling between surface microtopography, surface hydrology, vegetation, and permafrost dynamics. A change in any one of these elements appears to cause cascading ecosystem structural and functional change. Models suggest such change could impact various elements of the Earth System. To date, few studies have examined the interaction between the biophysical elements controlling ecosystem structure and function in polygonized landscapes over decade to half century time scales. Nonetheless, there is a well-recognized urgency for advancing knowledge in this area.

By rescuing and resampling a historic research site established in the early 1970's during the International Biological Programme (IBP) near Barrow, Alaska, this Masters project is documenting how the vegetation cover, surface hydrology, and microtopography of this fragile polygonized tundra landscape has changed over the last 45 years. Resampling efforts have utilized the same sampling approaches first employed at the site and others that utilize modern technologies. Interpretation and discussion of results are focused on elements critical to the structure and function of polygonized tundra landscapes. ■

PRESENTATION P37
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EFFECTS OF BRACKISH WATER IRRIGATION IN THE RESTORATION OF THE WESTERN AL-HAMMAR MARSH, IRAQ

Al-Quraishi, Ali, University of Florida, Gainesville, FL
Kaplan, David, University of Florida, Gainesville, FL

The Al-Hammar marsh is one of the three major marshes of Mesopotamian marshlands (Iraqi marshes), which are the largest wetland ecosystem in the Middle East. Since 1970, The Al-Hammar marsh has been severely damaged due to

human-induced changes. For example, upstream countries have constructed many dams on the upper Euphrates River, reducing water flow to Iraq, and the marsh was also actively drained by the regime of Saddam Hussein. The total area of the Al-Hammar was approximately 2,800 km2 before 1970, which includes permanent and seasonal marshes and lakes. After decades of regular draining and reduced flows this area has decreased by over 90 percent (total area of 267 km2 in 2009). After the collapse of the Hussein regime in 2003, the restoration of the western Al-Hammar begun and the water budget analyses of the marsh in the eight years following re-flooding revealed an ongoing water deficit and rising the salinity concentration, especially in the summer because of the high temperature and evapotranspiration rates. Therefore, in 2010, the MOD which is highly saline agricultural drainage water (TDS of 5000-8000 mg/L), began to be used as an alternative source of water to restore the marsh. While the MOD water flows helped to alleviate the water deficit from the Euphrates river, this brackish water also raised the salinity of the marsh, which formed saline-sodic soil conditions and death most of the flora and fauna. Additionally, untreated wastewater is being released directly into the marsh as well, further compromising water quality. The main goal for this study is to carry out a salinity balance for the fresh, brackish, and waste water by using an earthwork mixing basin with water baffles and find the optimal mixing ratio of these waters with more turbulence in the mixing zone and more aeration. ■

PRESENTATION 1517
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES I*, 05/30/2018, 09:45 - 11:35

FUNCTIONAL RESPONSE OF CYPRESS DOME WETLANDS TO HYDROLOGIC RECOVERY

Anderson, Christopher, Auburn University, Auburn, AL
Bartholomew, Megan, Auburn University, Auburn, AL

A study was conducted to evaluate the functional response of cypress dome wetlands at Starkey Wilderness Park (SWP), in New Port Richie, Florida, USA. As a municipal wellfield, SWP has a history of hydrologic alterations. Continuous and increasing groundwater pumping since the 1970s has been shown to impact surface water features in the wellfield including cypress domes (geographically-isolated forested wetlands). Starting in 2007, alternate water supplies were secured and groundwater withdrawals were reduced by nearly 75%. This has resulted in the passive recovery of water levels in many parts of the SWP. As part of current research and ongoing monitoring efforts, detailed hydrologic, edaphic, and vegetative data were collected in over 27 cypress dome swamps throughout the SWP. We compared vegetation communities before and after pumping reductions to assess potential community responses. All wetlands were categorized into groups based on the severity of past hydrologic alteration (i.e., least altered, marginally altered and altered). Results showed that all wetlands responded to hydrologic recovery with greater understory richness however only the marginally affected wetlands were on a trajectory to becoming comparable with least altered wetlands. Using a subset of these wetlands (n=12), an additional evaluation compared soil decomposition rates between wetlands in the different hydrologic groups. Surrogate organic matter (popsicle sticks) was deployed to evaluate decomposition rates above and below ground for a period of 56 weeks. Differences were detected among all groups but least- and marginally-altered wetlands tended to be more similar than altered wetlands. Variation in hydrology and edaphic conditions supported a wider range of decomposition rates in the most altered sites and likely contributed to differences with the other two groups. We discuss these results in the context of limitations of restoration associated with hydrologic recovery and determining the appropriate restoration goals at SWP and beyond. ■

PRESENTATION 1542
PRESENTED DURING *RIPARIAN ECOSYSTEMS I: ECOLOGICAL PATTERNS AND EFFECTS*, 05/31/2018, 09:45 - 11:35

CUMULATIVE IMPACT LEGACIES CREATE NOVEL RIPARIAN FORESTS ON LARGE, MULTI-USE RIVERS (SACRAMENTO, CA AND RHÔNE, FRANCE)

Stella, John, SUNY College of Environmental Science and Forestry, Syracuse, NY
Piégay, Hervé, National Center for Scientific Research (CNRS), Lyon, Rhône-Alps, France
Raepple, Bianca, National Center for Scientific Research (CNRS), Lyon, France, France

In populous, water-limited regions, humans have profoundly altered the river and floodplain environment to satisfy society's demands for water, power, navigation and safety. River management also profoundly alters riparian forests, which respond to cumulative changes in disturbance regimes and sediment dynamics. In this study, we compare forest and floodplain development along two of the most heavily modified rivers in mediterranean-climate regions, the middle Sacramento (California, USA) and the lower Rhône (SE France). The Sacramento was dammed in 1942 and is now managed for irrigation, hydropower and flood control. The Rhône channel was engineered for navigation prior to 1900, and since then has been dammed and divert-

ed at 18 sites for hydropower and irrigation. We conducted extensive forest inventories within both systems, and compared pre- versus post-dam patterns of deposition and associated forest development.

On the Sacramento, forest composition showed shifting tree species dominance across a chronosequence of >110 years. The transition from willow to cottonwood (Populus) occurred within 20 years, and the transition to mixed forest started after 50 years. On the Rhône, the pre- versus post-dam surfaces contrasted in several, less predictable ways. Rhône floodplain forests that established in the pre-dam period were at higher relative elevation and had greater plant species diversity than those that emerged in the post-dam period. Contrary to expectations, trees on the pre-dam surfaces were denser and smaller overall than on the post-dam period, suggesting that the older forest sites had been cut or otherwise disturbed relatively recently. Both rivers showed a strong understory presence on young floodplains by Acer negundo (box elder), which is non-native and invasive in Europe, suggesting similar processes of colonization and propagation in both systems. Overall, the Sacramento's riparian forests, which have experienced fewer cumulative impacts over the last century, show an orderly progression of forest dynamics, whereas the Rhône floodplains, which are much less geomorphically dynamic, support a novel riparian ecosystem, with no predictable structural patterns. Nevertheless, Sacramento River riparian communities provide a useful reference for future forests on the Rhône, where significant efforts are underway to improve riparian structure and function in conjunction with restored flooding and geomorphic processes. ■

Biology & Ecology: Landscape Science

PRESENTATION 1024
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS I*, 06/01/2018, 09:45 - 11:35

SURROUNDING LAND COVER TYPES AS PREDICTORS OF PALUSTRINE WETLAND VEGETATION QUALITY IN CONTERMINOUS USA

Stapanian, Martin, U.S. Geological Survey, Sandusky, OH
Gara, Brian, The Nature Conservancy, Dublin, OH
Schumacher, William, Ohio Environmental Protection Agency, Groveport, OH

The loss of wetland habitats and their often-unique biological communities is a major environmental concern. We examined vegetation data obtained from 380 wetlands sampled in a statistical survey of wetlands in the USA. Our goal was to identify which surrounding land cover types best predict two indices of vegetation quality in wetlands at the regional scale. We considered palustrine wetlands in four regions (Coastal Plains, North Central East, Interior Plains, and West) in which the dominant vegetation was emergent, forested, or scrub-shrub. For each wetland, we calculated weighted proportions of eight land cover types surrounding the area in which vegetation was assessed, in four zones radiating from the edge of the assessment area to 2 km. Using Akaike's Information Criterion, we determined the best 1-, 2- and 3-predictor models of the two indices, using the weighted proportions of the land cover types as potential predictors. Mean values of the two indices were generally higher in the North Central East and Coastal Plains than the other regions for forested and emergent wetlands. In nearly all cases, the best predictors of the indices were not the dominant surrounding land cover types. Overall, proportions of forest (positive effect) and agriculture (negative effect) surrounding the assessment area were the best predictors of the two indices. One or both of these variables were included as predictors in 65 of the 72 models supported by the data. Wetlands surrounding the assessment area had a positive effect on the indices, and ranked third (33%) among the predictors included in supported models. Development had a negative effect on the indices and was included in only 28% of supported models. These results can be used to develop regional management plans for wetlands, such as creating forest buffers around wetlands, or to conserve zones between wetlands to increase habitat connectivity. ■

PRESENTATION P12
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

METACOMMUNITY: SPATIAL AND ENVIRONMENTAL DRIVERS OF PLANTS DIVERSITY AMONG GEOGRAPHICALLY ISOLATED WETLANDS IN CENTRAL MEXICAN HIGHLANDS

Lobato de Magalhães, Tatiana, Autonomous University of Queretaro, Queretaro, Queretaro, Mexico
Martínez, Mahinda, Autonomous University of Queretaro, Queretaro, Queretaro, Mexico

Community similarity decreases with the spatial distance between sites. However, environmental heterogeneity has been considered the most important generator of beta diversity in wetlands.Geographically isolated wetlands (GIWs) have proven to be appropriate sites for testing metacommunity ecological theories, due to their well-delineated shapes. Understanding which factors most influence plant

communities' distribution throughout space is essential to conserve weytland biodiversity. The study aimed to analyze to what degree spatial and environmental covariates explain community variation, incorporating geographical, landscape, and co-occurrence patterns of nested plant species. We compiled the occurrence of 126 species in 39 wetlands in Central Mexico highlands at elevations from 1,900 to 2,700 m a.s.l. We used the Hierarchical Modelling of Species Communities method. Distance plus environmental variables defined plant community similarities better than distance alone. The main environmental factors that explain wetland plant species distribution were latitude (30% of explained variance), climate (21%), and land use coverage (19%). Aquatic plants were affected by the surrounding land cover. The expected species richness for the coverage scenarios was 15.7 (agriculture), 15.0 (forest) and 8.5 (native grassland). Thus native grassland maintained fewer species than other vegetation cover types. However, we observed a higher proportion of widespread and weed species in wetlands surrounded by agriculture. Regarding community similarity, wetlands embedded in agricultural and native grassland had the most similar plant communities (similarity = 0.82), followed by wetlands embedded in agricultural and forest landscapes (0.74), while wetlands embedded in forest and native grassland landscapes had the most different plant communities (0.55). Our results suggested that: (1) The similarity in community structure does not necessarily increase with spatial proximity between sites, (2) Large-scale environmental heterogeneity is an important pattern of beta diversity within wetlands, (3) Agricultural coverage impacts wetlands' plant composition and also promotes weed richness and biological invasion, and (4) Forest coverage can act as a barrier to wetland connectivity and promotes more preserved ecosystem. Knowledge of spatial and environmental effects in metacommunities is a requirement to promote wetland conservation policies. Connectivity is also essential for conservation because it contributes to maintaining plant diversity in GIWs. ■

PRESENTATION P11
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

COMMUNITY PLANNING OF URBAN GREEN INFRASTRUCTURE FOR WETLAND ECOSYSTEM SERVICES

Hargiss, Christina, NDSU, Fargo, ND
Riley, Jesse, NDSU, Fargo, ND
Norland, Jack, NDSU, Fargo, ND

Stormwater that falls in urban areas often has little chance to infiltrate the ground. Therefore it enters the watershed untreated. For this reason, ecosystem services provided by wetlands should be utilized to detain and treat water in urban ecosystems. The Fargo Project is a detention basin that holds stormwater drained from nearby impervious surfaces. As water runoff travels over the land, parking lots, sidewalks, roads, and building roofs it collects chemicals, nutrients, sediment, and debris. Through impoundment and native vegetation establishment stormwater runoff can benefit from wetland like features designed and implemented into the landscape. The goal of this project is to run stormwater through green infrastructure that mimics wetlands in makeup and function. Five different seed mixes were planted in replicate at the site in the spring of 2016 to test establishment. Additionally, water quality was sampled monthly in 2016 and 2017 to determine how water quality changed as the water (both surface and ground) traveled through the site. Water quality was also measured during three storm events at three sites, including the Fargo Project, to determine the constituents in the water as it enters and recedes from the basin. Initial vegetation data reveal that certain seed mixtures establish while others failed, specifically some native forbs disappear if covered in water soon after planting. Detention basins are unique systems and native seed mixtures are responding in different manners due various moisture and temperature regimes found in these systems. Water quality results indicate that particulates settle in the basin during storm events and while removing concrete from the basin is aesthetically pleasing there is currently minimal impact on water quality. If successful the Fargo project may serve as a model for other municipalities to meet economic, natural, and social demands of residents improving ecosystem services. ■

PRESENTATION 1221
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE III*, 06/01/2018, 03:10 - 05:00

FRAMING CLIMATE CHANGE AND MOUNTAIN WETLANDS IN THE TROPICAL ANDES

Polk, Molly, University of Texas at Austin, Austin, TX

Inhabited for millennia, tropical Andean landscapes are legacies of both natural and human processes. Such is the case in Huascarán National Park, a high alpine environment in north-central Peru famous for its tropical glaciers. Wetlands inside the park consist of peatlands and wet meadows and the spatial configuration of these wetlands is changing for reasons linked to climate change and glacier recession. Pastoralist communities use the park to seasonally graze cattle, sheep, and horses, an activity that negatively impacts wetlands through herbivory and trampling.

Pastoralists are adapting to glacier recession through shifts in land use, further complicating wetland change. As a consequence, the wetlands are dually affected by natural and human processes. Given the coupled natural-human dynamics of these wetlands, the objective of this research is to explore how to frame and therefore better understand these changing ecosystems for the benefit of science and policy-makers. Methods combine dissimilar epistemological approaches: geospatial analysis (remote sensing and GIS) and ecological oral histories. Forty-two ecological oral histories were conducted with participants who have extensive landscape knowledge through ongoing experiences inside the park; these were subsequently evaluated thematically. Six Landsat images ranging from 1987 to 2011 were analyzed to quantify the changing spatial patterns of wetlands. The image analysis shows that patches of wetland land cover are shrinking, fragmenting, and disappearing. The ecological oral histories reveal that wetlands are decreasing in area and drying out, changes accompanied by ecological shifts, decreasing water quality and quantity, and loss of aesthetics. Critical physical geography offers a framework in which to systematically interpret wetland change that is the product of coupled natural and human processes affected by glacier recession. The application of critical physical geography not only allows for a holistic and nuanced characterization of changing wetlands, but also illuminates future lines of collaborative, policy-relevant research. ■

PRESENTATION 1571
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES II*, 05/30/2018, 01:00 - 02:50

EFFECTS OF WETLAND EPHEMERALITY ON BIRD DIVERSITY IN THE PLAINS AND PRAIRIE POTHOLES REGION

Harter, Joanna, University of Wyoming, Laramie, WY
Murphy, Melanie, University of Wyoming, Laramie, WY

A strong understanding of the factors that generate and maintain biodiversity in wetland habitats is crucial to developing effective conservation strategies. Freshwater wetlands support high biodiversity, but the maintenance of this biodiversity is vulnerable to hydrologic change. Wetlands dependent on precipitation as a primary water source are highly responsive to climate variation, especially shallow, isolated wetlands that dry and refill in response to precipitation and temperature. The persistence of surface water in wetlands over time, "wetland ephemerality," is an important factor in maintaining productive and diverse wetland habitat for waterfowl and other birds. To understand how wetland ephemerality influences bird diversity at local and regional scales, we modeled species richness of breeding birds as a function of wetland ephemerality across the Plains and Prairie Potholes Region, USA. We estimated wetland ephemerality from probabilistic classifications of surface water in Landsat images that represent the range of climate variation from 1984 to 2013. Species richness estimates and functional diversity metrics were derived from multiple existing bird occurrence databases. In our models, we also included a suite of landscape metrics related to wetland type, size, shape, and metrics related to amount and configuration of grassland and cropland surrounding bird occurrence locations. Preliminary results indicate that wetland ephemerality is an important variable in predicting bird species richness, although the proportion of grassland and wetland in the landscape may be stronger predictors. Understanding how patterns of bird species richness are affected by historic variation in wetland ephemerality can provide a foundation for predicting how richness patterns and avian communities may change under different climate scenarios. ■

PRESENTATION 1598
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES II*, 06/01/2018, 01:00 - 02:50

CONSERVATION AND RESTORATION OF TIDAL FLOATING WETLANDS OF MISSISSIPPI RIVER DELTA

Holm, Guerry, Jacobs/CH2M, Baton Rouge, LA
Sasser, Charles, Louisiana State University, Baton Rouge, LA

In the Mississippi River Delta Plain, tidal floating wetlands have a broad extent, covering over 140,000 ha (346,000 ac). These peat-generating wetlands are natural components of the delta cycle and persist today in places where relic delta lobes have subsided concomitant with rising seas, resulting in buoyant organic-rich substrates that can adjust to varying degrees of water level change. They also occur in mineral-rich areas where river delta building is re-occurring. We will present a forward-looking geographical assessment of how floating marshes may become a last line of natural defense to certain coastal communities. Given that moderate sea-level rise projections could result in sea level increasing of 0.7 m (2.3 ft) over the next 50 years, many of the brackish and saltwater marshes will convert to open water. Likewise, as salt transport reaches further inland, the future footprint of these peat-based inland wetlands will be determined by the delivery capacity of freshwater and sediment from the Mississippi River to provide nourishment and protection from marine transgression. While there are numerous restoration projects that will dredge sediment with purchased energy to restore marshes where they have been lost, in contrast, using the

natural energy and subsidies of freshwater and sediments from the Mississippi River provides the comprehensive measure to conserve the remaining wetlands, which will eventually become ultimate lines of defense and essential fish and wildlife habitat. ■

Biology & Ecology: Microbes

PRESENTATION 1054
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES III*, 06/01/2018, 03:10 - 05:00

MODELING OF FLOATING TREATMENT WETLANDS

Reinsel, Mark, Apex Engineering, PLLC, Missoula, MT
Kania, Bruce, Floating Island International, Shepherd, MT

Floating islands (floating treatment wetlands or FTWs) are a method for improving water quality by removing excess nutrients and other contaminants. The patented BioHaven is the FTW embodiment that Floating Island International (FII) began to implement in the field in 2005. Numerous BioHaven case studies have been developed since then to analyze water quality improvements. Those data have been used to predict the quantity of BioHavens required for new projects using a simple Excel spreadsheet model.

The most common contaminants in BioHaven applications are total nitrogen, total phosphorus, total suspended solids and biochemical oxygen demand, but the FII model also addresses ammonia, nitrate, chemical oxygen demand, several metals and coliforms. The model can address waterways with continuous flow or no flow ("batch systems"). Continuous-flow systems are more common. The model includes a correction for water temperature.

Based on initial and final contaminant concentrations, along with water flow rates or volumes, FTW removal rates have been calculated as kg/yr/m3 (kg per year per cubic meter of proprietary BioHaven matrix). Removal rates have been developed for both wastewater (high concentration) and stormwater or lake water (low concentration) applications from various case studies in the southern and northern U.S., as well as New Zealand. These removal rates, which are substantially higher than published rates for standard constructed wetlands, will be presented. Applicable removal rates are updated as case study data are generated from FII installations (approximately 7,000 islands currently in the water) around the world.

The model is used to predict FTW volumes required to treat a specified flow or volume of water, given influent concentrations and required/desired effluent concentrations. It is in the process of being validated - i.e., field-scale results are now being generated to compare to model predictions.

An Excel spreadsheet model based on FTW case study data has proven invaluable for determining the applicability, scope and approximate cost of the technology for new applications. The model will continue to be refined as new data become available. ■

PRESENTATION 1118
PRESENTED DURING E*COLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY I*, 05/30/2018, 09:45 - 11:35

"REWILDING" THE SOIL: THE EFFECT OF ECOLOGICAL RESTORATION ON THE SOIL MICROBIOME OF COASTAL WETLANDS

Andras, Jason, Mount Holyoke College, South Hadley, MA

The successful restoration of many desirable ecosystem functions, ranging from water purification to climate regulation, is dependent on soil biogeochemical processes. These processes are in turn governed largely by the complex communities of microbes that reside in the soil. The recent advent of metagenomic techniques has spurred significant advances in our understanding of the community ecology of soil microbes, but the field is still developing rapidly, and the tools and principles are just beginning to make their way into ecological restoration. In the present study, we used 16s amplicon sequencing to survey the resident microbial communities of soils sampled from wetlands with a range of land use and restoration histories. Specifically study sites were either active cranberry farms, retired cranberry farms, or former cranberry farms that had been restored to function as the peat bogs they once were. Based on previous results, these site types are known to differ in important biogeochemical functions, such as denitrification and greenhouse gas emissions, and restoration efforts do appear to put soils on a developmental trajectory toward natural reference bogs. Our project aims to characterize key differences in microbial community structure among these different site types and identify characteristics that are associated with desirable biogeochemical functions. Preliminary results will be discussed. ■

PRESENTATION P13
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE MISSING METRIC: AN EVALUATION OF MICROORGANISM IMPORTANCE IN WETLAND ASSESSMENTS USING SOIL FUNGI

Onufrak, Aaron, Wright State University, Dayton, OH
Hossler, Katie, Wright State University, Dayton, OH
Rúa, Megan, Wright State University, Dayton, OH

In the contiguous US, an estimated 50% of original wetland areas have been lost since the late 1700s. In growing recognition of the importance of preserving wetland ecosystem function, federal and state agencies have developed proxy-based functional-assessment procedures to manage and preserve remaining wetland areas. Ohio uses the Ohio Rapid Assessment Method (ORAM) to score wetland quality based on six metrics: wetland size, buffer width and surrounding land use, hydrology, habitat alteration and development, special wetland communities, and vegetation. Currently, the ORAM, and many other wetland scoring systems, do not consider microorganisms when determining wetland quality. This is particularly notable, because fungi are considered the primary decomposers of organic material in many wetlands and play an important role in nutrient cycling in all major wetland types. We aim to (1) determine the extent to which ORAM scores describe soil fungal community composition, and (2) assess how soil physicochemical variables structure fungal communities in freshwater marshes. Our central hypothesis is that wetlands with higher quality ratings will have more diverse fungal communities that differ in composition from lower quality wetlands. In Summer 2017, we scored six freshwater depressional emergent marshes following the ORAM. In each wetland, two to three dominant strata were identified based on vegetation community. We established five sampling stations per strata using a stratified random design; three soil cores (11.5cm x 10 cm) were collected per station. Soil bulk density, pH, texture, and Carbon, Nitrogen, and Phosphorus were measured using two soil cores. DNA was extracted from the third core, amplified using the ITS1F and ITS2 PCR primers, and then sequenced on the Illumina MiSeq platform at the Ohio State University Molecular Cellular Imaging Center. Sequences were processed using the bioinformatics pipeline Quantitative Insights into Microbial Ecology. Our results indicate that bulk density and pH decrease with ORAM score and soil water content increases with ORAM score. We then use univariate and multivariate analyses to determine the extent to which ORAM score, soil physicochemical properties and vegetation structure fungal community composition. This information provides crucial support for developing a new assessment method or adjusting existing assessments so that microorganism communities are considered. ■

PRESENTATION 1610
PRESENTED DURING *ECOSYSTEM SCIENCE II*, 06/01/2018, 03:20 - 05:00

SEASONAL VARIATION SHINES THE LIGHT ON MICROBIAL COMMUNITY INTERACTIONS

Weisenhorn, Pamela, Argonne National Laboratory, Lemont, IL
O'Loughlin, Edward, Argonne National Laboratory, Lemont, IL
O'Brien, Sarah, University of Illinois Chicago, Chicago, IL
Marshall, Christopher, University of Pittsburgh, Pittsburgh, PA
Kemner, Kenneth, Argonne National Laboratory, Lemont, IL
Flynn, Theodore, Argonne National Laboratory, Lemont, IL

While the collection of microorganisms present in an environment define the potential metabolic behavior of a microbiome, it is the interactions among community members that determine their realized metabolic activity. This may be of particular importance in redox dynamic environments where steep concentration gradients of redox-sensitive metabolites favor different microbial guilds with unique metabolic capabilities. In this study, we collected samples weekly from unvegetated wetland sediment in a permanently flooded freshwater wetland with controlled water depth to investigate seasonal effects on microbial community composition and interactions among community members. Samples were extracted using the MoBio PowerSoil extraction kit and sequencing of the V4 region of the rRNA gene was performed using the Illumina MiSeq platform according to the Earth Microbiome Protocol. In addition to observed shifts in the relative abundance of individual community members, we found highly dynamic microbial interactions. We generated monthly microbial interaction networks using the Molecular Ecological Network Analysis pipeline. This analysis showed pronounced shifts in the overall architecture of these networks through time, with the community coalescing into a single, dominant interacting cluster in December before expansion to multiple clusters in February, followed by recoalescing in May. We additionally found shifts in both the average frequency and strength of interactions among community members. By comparing interactions among individual community members through time, we were able to identify both stable and transient relationships among community members. This project showed that seasonal variation in environmental conditions affects not only community membership, but also the way that community members interact with each other. We propose that deeper interrogation of both stable and conditional partnerships through application of genome-scale metabolic modeling approaches can be used to illuminate the mechanisms underpinning these interactions and improve our understanding of these important communities. ■

Biology & Ecology: Multi-trophic interactions

PRESENTATION 1436
PRESENTED DURING *ECOSYSTEM SCIENCE I*, 06/01/2018, 09:55 - 11:35

COMPARING THE DIET OF AN IMPORTANT WETLAND RESIDENT IN A NATURAL AND CREATED MARSH

Robinson, Katie, University of San Diego, San Diego, CA
Talley, Drew, University of San Diego, San Diego, CA

Southern California has experienced an approximately 90% loss in wetland habitat. This decline of Pacific coastal wetlands is concerning due to the vital roles these habitats serve for endangered and threatened species. In addition, these habitats serve the important ecosystem functions of nutrient regulation, water quality maintenance, buffering wave energy, and transfer of carbon. To mitigate these losses, many salt marsh habitats have been restored and created. However, these restored and created habitats may not provide equivalent ecosystem function as natural salt marsh habitat. This study assesses potential differences in food web dynamics of a natural and created marsh habitat through an examination of the diet of a ubiquitous and abundant species in southern California wetlands, the California Killifish (*Fundulus parvipinnis*). As a salt-marsh resident fish, *F. parvipinnis* transfers energy and nutrients off of the marsh surface, with direct and indirect ramifying impacts on their predators and prey. Fundulus parvipinnis individuals were collected on a weekly basis during their peak spawning period to provide a more extensive examination of potential differences and shifts in diet. Gut content and stable isotope analyses were conducted to provide specific and broad insights into the diet of collected individuals. Differences in prey category composition were discovered between the natural and created marsh habitats. In addition, similar ontogenetic diet shifts were observed in both the created and natural marsh habitats. This information provides insight into the ecological function of both natural and created habitats, and helps to address the need to understand both structural and system features that affect the subsequent food web dynamics of a system. ■

PRESENTATION 1469
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES III*, 06/01/2018, 01:10 - 02:50

FIDDLER CRAB AND PLANT INTERACTIONS: FACILITATION IS A TWO-WAY STREET IN GULF COAST TIDAL MARSHES

Murphy, Gwendolyn, University of Southern Illinois, Cobden, IL
Battaglia, Loretta, Southern Illinois University, Carbondale, IL

Facilitation influences tidal marsh ecosystem structure in a variety of ways and is expected to increase in stressful environments such as tidal marshes. By ameliorating stress, facilitation plays a key role in estuarine dynamics. Research in tidal marshes dominated by the grass Spartina alterniflora suggests that plant characteristics like above- and below-ground biomass shape the distribution of fiddler crab burrows. In turn, fiddler crab activity can enhance primary productivity by increasing plant above- and below- ground biomass, redox potential, and soil nutrient levels. These interactions have not been examined in micro-tidal Gulf Coast marshes where the rush Juncus roemerianus forms the most extensive vegetation zone and S. alterniflora is restricted to a narrow band along the low intertidal zone. We do not know how fiddler crab burrows will affect plant growth in the four dominant Gulf Coast vegetation zones (salt marsh, brackish marsh, salt pannes and fresh marsh). To determine if fiddler crabs influence primary productivity, a key driver of estuarine food webs, we erected twelve 2.5 m2 enclosures and an equal number of fiddler crab exclusion units (controls) across the tidal marsh vegetation gradient. To reduce potential legacy of burrow effects, fiddler crabs were removed on sight and baited out of all units. Sex, size and species of fiddler crabs removed were recorded. Locally caught fiddler crabs were then added to experimental units. Additions were based on our average removal of fiddler crabs per vegetation zone. Plant above- and below-ground biomass was sampled within all units to determine effects of burrowing on plant growth. Bioturbating organisms are thought to indirectly affect plant growth by directly impacting soil characteristics. Therefore, we also sampled soil variables including pH, salinity, percent organic matter and redox potential where applicable. Preliminary results suggest that fiddler crab additions may promote plant above- and below-ground biomass for those residing at the wetter end of the gradient (salt and brackish marsh), but have less influence on the growth of plants positioned higher up the elevation gradient. Environmental stress generally weakens in tidal marshes from intertidal zone to high marsh which is less frequently flooded. Consequently, it is likely that fiddler crab burrowing is more facilitative to intertidal vegetation coping with the stress of daily tidal inundation. ■

Biology & Ecology: Plants

PRESENTATION 1043
PRESENTED DURING *ECOSYSTEM SCIENCE I*, 06/01/2018, 09:55 - 11:35

SITE-SPECIFIC EFFECTS OF BURROWING CRABS ON PLANT COMMUNITY COMPOSITION IN CALIFORNIA SALT MARSHES

Walker, Janet, UC Davis/SDSU, San Francisco, CA
Long, Jeremy, San Diego State University, San Diego, CA

Although habitat-modifying animals, such as burrowing crabs, have well-known impacts on primary production, less is known about their influence on plant species composition. This is surprising given that such animals often inhabit assemblages of plant species who may display species-specificity in their response to habitat modifiers. We manipulated crab presence in mixed plant assemblages dominated by two species (Spartina foliosa, Sarcocornia pacifica) at three sites in southern California (KF1, KF2, SDL). At each site, crab inclusion cages contained a representation of the local crab composition (Pachygrapsus crassipes, Uca crenulata) and abundance. Every month from April to October 2016/2017, we measured several plant metrics, including morphology (stem density, plant height), plant community structure (percent cover), and reproductive investment (number of flowers and seeds). We observed site-specificity with respect to the main effect of crabs on plant communities. This site-specificity was driven by larger effects of crabs at two sites (KF1, SDL) than the other site (KF2). At KF1 and SDL, crabs increased pickleweed, but not cordgrass, cover. We hypothesize that crab impacts varied between our sites because of differences in the crab communities. P. crassipes created larger burrows at KF1 with an average burrow diameter of 3.45 ± 0.12 cm (means±SE), while KF2 and SDL were composed of primarily U. crenulata with associated burrow diameters of 2.27 ± 0.09 cm and 0.95 ± 0.03 cm. However, a crab effect may have been detected at SDL due to the high number of burrows (58.67 ± 2.67; means±SE) compared to KF1 and KF2 (16.15 ± 0.91 and 19.89 ± 0.72, respectively). Together, these data suggest that the identity and density of the burrowing crab species may determine the impact of these habitat modifiers on plant community composition. In 2017 and 2018, the relative crab effect on plant community composition will be compared latitudinally, between southern and northern California. ■

PRESENTATION 1109
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES II*, 06/01/2018, 09:55 - 11:35

BOTTOMLAND HARDWOOD TREE SPECIES REGENERATION: SEEDLING RESPONSE TO FLOOD TIMING

Kroschel, Whitney, Louisiana State University, Baton Rouge, LA

Bottomland hardwood forests (BLH) are floodplain forests of the southeastern United States that are structured by their surface and subsurface hydrological regimes. Hydrologic alterations within the past century have substantially altered formative processes and as a result, BLH are exhibiting a wide range of fundamental changes. Specifically, many stands are exhibiting signs of species composition transitioning from hydric to more mesic communities. The regeneration phase in forests is often the most susceptible to changes in environmental conditions and there is some evidence to support this in BLH; however seedling species-specific responses to flooding remain limited or unknown. Previous studies have focused on absolute flood tolerance of 1-year old seedlings and information is lacking on flood tolerance immediately following germination. In a controlled greenhouse experiment we tested the effects of post-germination flooding on three different BLH species. Groups of 15-20 Nuttall oak (Quercus texana), sugarberry (Celtis laevigata), and American elm (Ulmus americana) seedlings were submerged for either 5, 15, 25, or 0 days (control). Morphological features, survival, and recovery were evaluated post-treatment. All species demonstrated impeded or no growth during flood treatments compared to controls. Nuttall oak seedlings had the highest survival rate compared to the other two species. ■

PRESENTATION 1205
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES III*, 06/01/2018, 01:10 - 02:50

GENOTYPIC DIVERSITY OF *SPARTINA ALTERNIFLORA* MODULATES THE RESPONSE TO ENVIRONMENTAL PERTURBATION

Zogg, Greg, University of New England, Biddeford, ME
Travis, Steven, University of New England, Biddeford, ME

Ecologists have a longstanding interest in the role biodiversity plays in ecosystem functioning, noting many positive effects including increased productivity and stability in the face of disturbance. More recently, it has become clear that intraspecific, or genotypic, diversity of foundational plant species can be a functional surrogate for interspecific diversity, particularly in species depauperate ecosystems. We

conducted a series of experiments, in which we manipulated genotypic diversity of the salt marsh plant Spartina alterniflora, in order to determine the role of genotypic diversity in modulating response to environmental perturbations. We found that increased genotypic diversity of S. alterniflora reduced the negative effects of: a) competition with an invasive plant (Phragmites australis); b) snail herbivory (Littorina littorea); and c) sea-level rise. Our results suggest that plant genotypic diversity contributes to the stability of salt marshes, and underscores the importance of establishing and maintaining genotypically diverse mixtures of S. alterniflora during marsh restoration ■

PRESENTATION 1257
PRESENTED DURING *SEA LEVEL RISE*, 05/30/2018, 03:20 - 05:00

HOME FIELD ADVANTAGE? OBSERVING THE POTENTIAL OF LOCAL ADAPTATION OF AVICENNIA GERMINANS ESTABLISHMENT DYNAMICS ALONG AN INTERTIDAL GRADIENT

Grogan, Shannon, University of South Florida, Tampa, FL
Bell, Susan, University of South Florida, Tampa, FL

In response to sea-level rise, establishment of propagules at higher tidal elevations outside of their native range is a requirement for the continued existence of black mangrove (Avicennia germinans) populations. Avicennia germinans dispersal dynamics suggest that propagules abscising from parent trees of a lower tidal position can disperse to higher tidal positions given facilitative hydrodynamic forces. Observation of adult A. germinans residing in higher tidal positions of southwest Florida indicates that propagules are cable of successfully establishing and reaching reproductive age at these novel elevations. Many plant populations exhibit local adaptation but it is unknown whether propagules of parental trees occupying a higher tidal position would have increased establishment success compared to propagules stranded at this higher tidal position that originated from a lower tidal position. To quantify the influence of parental tree origin on propagule establishment success and establishment rate, a small-scale reciprocal transplant experiment was conducted between A. germinans propagules of lower intertidal (LI) and middle intertidal (MI) positions. Regardless of parental tree origin position, A. germinans propagules had greater establishment success in the LI position. Propagules also established more quickly in the LI position with an average time to establishment of approximately 27 days compared to propagules stranded in the MI position (approximately 37 days). Propagules of LI origin had greater establishment success than propagules of the MI position when stranded in the MI position. Our results indicate that environmental factors associated with stranding tidal position had a stronger effect on propagule establishment than parental tree origin position. Our findings also suggest that if facilitative hydrodynamic forces are present, propagules originating from a LI position may have a higher potential to contribute to the successful expansion of A. germinans populations than propagules of a MI origin. ■

PRESENTATION 1267
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE II*, 06/01/2018, 01:00 - 02:50

VEGETATION PATTERNS AND ENVIRONMENTAL CONTROLS IN HIGH-ALTITUDE PEATLANDS OF THE NORTHERN ECUADORIAN ANDES

Suarez, Esteban, Universidad San Francisco de Quito, Cumbaya, Quito, Ecuador
Hribljan, John, Michigan Technological University, Houghton, MI
Chimner, Rod, Michigan Technological University, Houghton, MI
Lilleskov, Erik, USDA Forest Service, Houghton, MI
Chimbolema, Segundo, Universidad San Francisco de Quito, Quito, Pichincha, Ecuador

High-elevation peatlands of the paramo ecosystems of the Northern Andes are receiving increasing attention due to their biological diversity, their large reservoirs and exceptional rates of carbon accumulation, and their role in water regulation. However, information about the structure and composition of plant communities of these peatlands is still scarce. Moreover, little information is available about the environmental factors that control the structure and distribution of the heterogeneous plant communities that characterize these peatlands. By studying the composition of plant species along the environmental gradients of 15 peatland sites in Northern Ecuador, in this paper we explore the influence of environmental factors (e.g. water table level, altitude, water chemistry) in the structuring of different vegetation types in these ecosystems. Based on the dominant plant species that provide the main structure the vegetation, three types of peatland plant communities were identified. These peatland types (Cushion, Graminoid, and Sedge dominated communities), which have been corroborated by remote sensing and ground surveys, seem to be mostly controlled by the combined influence of altitude, and water table level. Areas with higher and more constant water table level tend to be dominated by sedges, while areas with more variable water table level are dominated by cushion plants in the higher elevations (above ≈ 4200 m), or by graminoid communities at lower elevations (3500 - 4200 m). Plant species richness was high across

all peatland types, and decreased strongly with elevation, except for the dense peatlands dominated by Carex pichinchensis, which occurred at low elevations but had lower species richness. Previous studies in this area have shown that peatlands can account for as much as 25% of paramo landscapes of the Northern Andes. Our study highlights the importance of these high elevation peatlands in terms conserving the biodiversity and the ecosystems services associated with the Northern Andean environments. ■

PRESENTATION 1269
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS I*, 05/30/2018, 01:00 - 02:50

INVASIVE CATTAIL SPECIES CONTRIBUTING TO REMEDIATION AND NATURAL RECOVERY OF A CRUDE OIL IMPACTED WETLAND IN THE AMAZON

Morris, Kevin, ERM, Malvern, PA
Ross, Derek, ERM, Malvern, PA

An oil battery (Site) located in the Peruvian Amazon rainforest experienced releases of crude oil that resulted in a large impacted area of approximately 11 hectares. Aerial photographs from 1996 provided insight to the extent of the overall impact. Quickbird images from 2008 indicated a reduced impact and significant natural recovery of both indigenous (aguajal) and non-indigenous flora (cattails). A case was made to the national environmental agency to limit the total liability and focus of future Site characterization and remediation efforts. To make that case, extensive ecological and microbial surveys along several transects across the impacted area were conducted.

The multiple lines of evidence support the observations that the crude oil is exhibiting signs of severe weathering and degradation into a residual, tar-like substance that due to its lower mobility posing less hazard to the environment. The ecological studies indicated plant species such as cattail (Typha domingensis), which are resistant to petroleum hydrocarbons, have colonized much of the wetland area that was initially impacted by the historic oil releases. Along the perimeter of the impacted areas, the cattails are being replaced, through natural successional processes, with woody species that are more representative of the regional forests (e.g., Mauritia-dominated Aguajal). Microbial analysis identified petroleum-degrading bacteria are abundant in the crude-oil impacted matrices, and therefore, there is a potential for further microbiological breakdown of the residual constituents. Detailed forensic chemical analysis further demonstrated that significant weathering and mass removal of the petroleum hydrocarbons is occurring. These multiple lines of evidence were presented to the Agency who agreed with our position that due to the sensitive nature of the surrounding and recovering ecosystem, that aggressive mass removal of oil-impacted matrices across the vegetated areas would be very destructive and provide no net environmental benefit to the wetland community. ■

PRESENTATION P16
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

DIFFERENCES IN VEGETATION DEVELOPMENT OF PEATLANDS AFTER GLACIER RETREAT IN A TROPICAL HIGH ELEVATION (COLOMBIA)

Valbuena, Carlos E., Pontifical Xavierian University, Bogota, Bogota, Colombia
Benavides, Juan, Pontifical Xavierian University, Bogota, Cundinamarca, Colombia
Rozo, Anamaria, Pontifical Xavierian University, Bogota, Bogota, Colombia

The rapid transformation of ecosystems due to climate change has led to the creation of new conditions that determine the establishment of plant communities and processes such as net primary productivity and the emission of greenhouse gases. Peatlands are resilient ecosystems dominated by a few dominant species that make up most of the peat soil. In high elevation wetlands the distribution of peat forming species is controlled by combination of hydrology, water chemistry and temperature (elevation). Wetlands have developed in recently deglaciated areas in the tropics with an apparent similarity to existing wetlands at lower elevations. Understanding vegetation change over time will allow us to determine the trajectory of wetlands after glacial retreat, and will provide insights to the fluxes and stocks of carbon in the soil. We seek to compare the succession of the vegetation and the carbon content in recently formed peat through an altitudinal gradient in six peatlands of the Nevados National Natural Park after the glacial retreat. For this, we characterized the surface vegetation, historical vegetation using macrofossils from 6 peat cores and carbon content from the same cores. We found that vegetation on the surface is dominated by Distichia muscoides (80%), followed by other vascular plants such as Calamagrostis (8%) and Werneria in (7%) and the remaining area was covered by mosses such as Campylopus and Breutelia. The macrofossils remains show that for older wetlands as the depth increases the vegetation is dominated by plants such as Calamagrostis and Campylopus and in a smaller percentage by D. muscoides. The cores from recent wetlands show a clear dominance of Calamagrostis and D. muscoides throughout the entire core.

The most recent wetlands showed higher carbon stocks at intermediate and superficial depths, unlike the older wetlands where carbon was concentrated in the deepest and more dense part of the peat. We hypothesize that the dominance of D. muscoides on the surface at present is due to a stable water table and that the presence of Calamagrostis in the macrofossils could be due to the presence of this in the surrounding vegetation. Our results indicate that recent peat has a more stable plant composition during its development than older peatlands. Our next questions will address if the uniformity of plant composition in recent peat is due to a lack of development of the D. muscoides domes due to higher water table from glacier meltwater. ■

PRESENTATION 1302
PRESENTED DURING *RIPARIAN ECOSYSTEMS II: PHYSICAL AND BIOTIC DRIVERS OF CHANGE*, 05/31/2018, 01:00 - 02:50

EFFECTS OF DROUGHT ON CARBON STABLE-ISOTOPE RATIOS OF RIPARIAN COTTONWOOD TREES IN THE WESTERN GREAT PLAINS

Friedman, Jonathan, U.S. Geological Survey, Fort Collins, CO
Stricker, Craig, US Geological Survey, Denver, CO
Csank, Adam, University of Nevada, Reno, NV
Zhou, Honghua, Xinjiang Institutue of Ecology and Geography, Urumqi, Xinjiang, China

Annual ring width of riparian plains cottonwood (Populus deltoides subsp. monilifera) is strongly correlated with precipitation and flow in the western Great Plains, enhancing investigations of prehistoric and recent drought. Because growth of trees is influenced by multiple environmental drivers, multiple proxies are needed to improve these investigations. This study demonstrates the added value of carbon stable-isotope ratios. We analyzed the 13C/12C ratio of each annual ring in cores of seven cottonwood trees (two cores per tree) from the floodplain of the Little Missouri River in the North Unit of Theodore Roosevelt National Park, North Dakota, USA. To distinguish effects of age from those of climate variation we used seven trees established in a wide range of years, 1788, 1830, 1876, 1899, 1908, 1947, and 1972. We corrected for change over time in the 13C/12C ratio of atmospheric CO2, and, because a juvenile effect was observed, removed the first 26 years from each series. We measured stable-isotope ratios using whole wood and, for every fourth ring, purified cellulose. We also measured the proportions of cellulose, hemicellulose and lignin as a function of tree age. The isotope ratio of whole wood decreased with increasing years from pith, a trend that would need to be removed before extracting an environmental signal. In contrast, the isotope ratio of the cellulose component was insensitive to tree age, allowing use for drought reconstruction without age detrending. Cellulose content of wood decreased and hemicellulose content increased with increasing years from pith, explaining the age-related trend in the isotope difference between cellulose and whole wood. Mean adjusted cellulose stable-isotope ratio was negatively correlated (r = -0.58) with annual precipitation in June, July and the previous October for the years 1896-2010. The negative correlation illustrates decreased discrimination by the leaf against 13C under drought stress, and the correlation magnitude demonstrates that growth of cottonwood in western North Dakota is limited by water availability. The correlation between isotope ratio and ring width was only -0.24, indicating that these proxies are not redundant. We conclude that carbon-isotope ratios in cellulose from cottonwood tree rings can be used for drought investigation without age detrending. ■

PRESENTATION 1345
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES III*, 06/01/2018, 01:10 - 02:50

WOODY VEGETATION DYNAMICS ON A MISSOURI RIVER RESERVOIR DELTA

Beall, Catherine, University of South Dakota, Vermillion, SD
Dixon, Mark, University of South Dakota, Vermillion, SD

Damming has negatively impacted riparian ecosystems along the Missouri River, reducing channel dynamism, sediment transport, and regeneration of dominant riparian tree species (Populus deltoides and Salix spp.) over the last six decades. However, geomorphically-active tributaries may provide tree regeneration opportunities where they join the mainstem river or its reservoirs. Reservoir deltas have formed in several places along the Missouri due to sediment inputs from the mainstem or tributary rivers into reservoir slackwaters. In a 2015 BioScience article, Volke et al. suggested that reservoir deltas may provide conditions conducive to recruitment of riparian trees, including cottonwood, which are limited elsewhere on the regulated river system. One of these deltas occurs at the confluence of the Niobrara River with the Missouri River just above the Lewis and Clark Reservoir in southeast South Dakota and northwest Nebraska. We are investigating patterns of riparian tree regeneration on this delta through sampling of woody vegetation plots, dendrochronology, and analysis of historical aerial photography. We sampled 30 plots across 17 patches of woody vegetation stratified by region within the ~70-km delta in summer 2017. Within each plot, we took cores or slabs from a few representative trees to determine approximate establishment dates. Our initial results suggest a pattern of primarily recent regeneration that is spread throughout the delta, with many trees

establishing after high water events in 1998 and 2010-2011, and with an increase in mapped areas of young forests since 2006. The occurrence of regeneration throughout the delta was an unexpected result, as we initially expected tree regeneration to be concentrated within older sections of the delta. Understanding the dynamics of river-reservoir deltas may be vital for managing specific riparian and riverine habitats, as well as forecasting long-term effects on riverine landscapes and reservoir storage capacity. ■

PRESENTATION 1387
PRESENTED DURING *WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE*, 05/31/2018, 03:10 - 05:00

RIPARIAN FLOW-RESPONSE GUILD FRAMEWORK AND MONTANE STREAMS: GUILD DISTRIBUTION MODELING TO EVALUATE IMPACTS OF FLOW ALTERATION ON RIPARIAN VEGETATION

Scott, Julian, USFS, Fort Collins, CO

Understanding the ecologic results of altering stream flow regimes is a challenge for resource managers and conservationists. The Riparian Flow-Response Guild Framework, coupled with probabilistic distribution modeling, offers an objective approach for quantifying and predicting riparian vegetation dynamics in response to novel hydrologic conditions. Flow-Response Guilds are groups of plant species with similar functional traits and shared response to riparian hydrology dynamics. Along rivers, species possessing similar adaptations for water acquisition, tolerance to disturbance, and strategies for dispersing and recolonizing river margins will respond in similar ways to changes in flow regime. While more commonly applied in arid and semi-arid climates, this work demonstrates the efficacy of modeling Riparian Flow-Response Guilds to quantify riparian vegetation response to altered stream flows in wetter montane climates. Species-level presence-absence data of woody and herbaceous riparian plants were collected for nine reaches from five alpine rivers in the Medicine Bow-Routt National Forest (central Rocky Mountains, USA). Species were grouped into guilds based on widely available trait data (both continuous and categorical measures). Guild distributions were quantitatively linked to frequency of inundation using reach-level hydraulic modeling and logistic regression. We found that guild distribution response to frequency of inundation varies by valley morphology and reach hydrology, particularly in regards to shallow groundwater hydrology. Stream-gage flow records were modified to simulate flow alteration scenarios common to US Forest Service lands. Guild distribution models were then used to predict probable impacts on guild distributions from these novel hydrologic conditions. ■

PRESENTATION 1439
PRESENTED DURING *WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE*, 05/31/2018, 03:10 - 05:00

I AM WORKING REMOTELY, AND AM HAVING TROUBLE GETTING THE AGENDA OUT FOR SOME REASON. GEORGIA IS ON VACATION TODAY.

Hough-Snee, Nate, Meadow Run Environmental LLC, Leavenworth, WA
Merritt, David, USDA Forest Service, Fort Collins, CO

Many riparian plant species have evolved strategies that allow them to establish, grow, and survive along streams and their floodplains. While these riparian plants' life-history strategies have been identified along many rivers and their hydrologic relationships identified, they have only rarely been used to plan floodplain and riparian restoration along a major river. Here we apply the riparian vegetation-flow response guild framework, which links trait-based guilds of riparian plant species to streamflow regimes, to meet three restoration planning needs along reaches of the San Joaquin River, California, USA. We identified suitable floodplain habitats for (1) natural vegetation recruitment, (2) maintenance of existing mature, woody vegetation, and (3) potential restoration planting zones. We used plant morphological and physiological traits to identify woody and herbaceous riparian plant guilds with similar evolved strategies, and then modeled these guilds responses to flow regulation by Friant Dam. We found that there is currently limited floodplain habitat for natural recruitment of hydrophytic riparian trees and shrubs along the San Joaquin River. This means that restoration of many riparian plant species will have to take an active approach including planting, seeding, and/or environmental flows. We close by outlining potential restoration strategies for riparian plant guilds based on the likely factors limiting the natural regeneration and survival of groups of riparian species. ■

PRESENTATION 1451
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES II*, 06/01/2018, 01:00 - 02:50

LIVING ISLANDS – INITIATION OF NATURAL FLOATING WETLANDS FOR LAKE SHORE DEVELOPMENT

Günther, Henning, Hochschule für Technik und Wirtschaft Dresden University of Applied Sciences, Dresden, Germany

Lakeshores provide many ecosystem services, but human changes in the morphology of the lakeshore have an impact on biocenosis and their food webs. Therefore, deadwood and vegetation are used to develop habitat structures with the aim of improving ecological status. Soil bioengineering

techniques introduce dynamic riparian vegetation stands near to nature forming the basis for site-specific habitat structures. A new construction technique is supposed to initiate the development of floating reed stands, developing during the sedimentation process of water bodies. Organic materials and vegetation typically found in the sedimentation zone of freshwater lakes are the basis for the technique, initiating the natural development and progression of the construction towards nature-like floating mats. We studied the construction technique and the vegetation in the first two years of their development. In addition, research focused on the oxygen saturation of the water within the organic structure and on external influences such as wave action. In the second year of the experiment, comparable anaerobic site conditions established, known as the reason for the natural auto-buoyancy of floating wetlands. Thus, by initiating a natural-like development, these artificial floating vegetation stands are able to achieve natural auto-buoyancy. Large installations for habitat enhancement appear possible due this natural auto-buoyancy and low maintenance expenses. In the initial phase, waterfowl have eaten away the plants, so that some of the plants were not able to strengthen the structure sufficiently with their roots. Structural changes of the technique are therefore necessary, in order to successfully complete the first phase. The German Federal Environmental Foundation funded the project. ■

PRESENTATION 1455

PRESENTED DURING *WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE*, 05/31/2018, 03:10 - 05:00

HOW WILL CHANGING STREAMFLOW SHAPE FUTURE RIPARIAN VEGETATION IN COASTAL CALIFORNIA? LINKING RIPARIAN PLANTS TO STREAMFLOW USING FUNCTIONAL GUILDS.

Reynolds, Lindsay, U.S. Forest Service, Fort Collins, CO
Merritt, David, USDA Forest Service, Fort Collins, CO
Scott, Julian, USFS, Fort Collins, CO
Lytle, David, Oregon State University; Tonkin, Jonathan, Oregon State University
Rogosch, Jane, University of Washington
Olden, Julian, University of Washington

In arid and semi-arid regions of the western US, climate change is expected to affect stream flow through increases in temperature and changes in precipitation patterns. In many cases, baseflows are expected to decline, snow melt runoff will occur earlier, and rain-driven flood events may be more intense. Low flow and peak flow changes in streamflow regime will affect riparian plant communities, potentially forcing dramatic changes in riparian forest composition. To understand how riparian plant communities will shift under future hydrologic conditions, we use a functional guilds approach to distribution modeling. We identified plant traits related to moisture availability and disturbance, measured these traits in the field, and then grouped species into guilds with similar traits values. We used historic streamflow data to model riparian species distribution along two rivers in coastal California: the San Antonio and the Santa Margarita Rivers. We then use rainfall-runoff models driven by future climate data to project future riparian plant distribution in coastal California rivers. Results show that riparian guild occurrence varies considerably along hydrologic gradients both within river reaches and between river basins. We tested guild occurrence along rivers in different ecoregions and under different hydrologic regimes to understand how riparian plant communities vary across broad spatial scales and under both current and future hydroclimate conditions. Drought-tolerant guilds that included deep-rooted and high wood-density species are present at the margins of floodplain communities where drier conditions exist and more hydric guilds composed of wetland-obligate species occurred closer to the active channel. By using plant guilds instead of individual species, we are able to understand where similar guilds, composed of different species, occur across broad, regional spatial scales. Functional guild models can be used as restoration and land management tools to guide and understand plant community composition under future climate and management scenarios. ■

PRESENTATION 1559

PRESENTED DURING *RIPARIAN ECOSYSTEMS II: PHYSICAL AND BIOTIC DRIVERS OF CHANGE*, 05/31/2018, 01:00 - 02:50

EXTENSIVE DIE BACK AND MORTALITY OF RIPARIAN SALICACEAE ALONG THE BILL WILLIAMS RIVER, ARIZONA

Shafroth, Patrick, U.S. Geological Survey, Fort Collins, CO
Johnson, April, Pennsylvania State University, University Park, PA
Thaxton, Richard, U.S. Geological Survey, Fort Collins, CO
Sesnie, Steven, U.S. Fish&Wildlife Service, Albuquerque, NM
Friedman, Jonathan, U.S. Geological Survey, Fort Collins, CO

Low water availability is the most commonly reported cause of stress, die back and mortality in riparian forests dominated by trees in the Salicaceae family (cottonwood (Populus) and willow (Salix)) in semiarid western North America. Reduced water availability can be the result of low streamflow conditions that result from weather or climatic factors, but often water management associated with dam operations and/or groundwater pumping contribute to low water stress in riparian forests.

The Salicaceae forests of the lower Bill Williams River (BWR) in western Arizona are unique and of high conservation value. Extensive crown die back and mortality of riparian trees along the lower Bill Williams River occurred between 2014-2017. We are using remotely sensed (Landsat, Enhanced Vegetation Index--EVI) and field (tree cover, mortality, growth) data to quantify this forest decline. In addition, we are analyzing available surface and groundwater data to examine the working hypothesis that riparian forest die back is due to declining water availability. At the landscape scale, departures from long-term average EVI values indicate relatively stable conditions in the upper 36 km of the BWR, but dramatic declines in the lower 14km of the BWR between 2014-2017. Field data from 26 plots sampled in spring 2017 reveal that the percentage of dead cottonwood and willow trees in the lower BWR ranged from 30-100%, and living trees in those plots had crown volumes only 5–37% of potential maximum. A several year period of reduced surface water flow volumes released from Alamo Dam at the upstream end of the BWR, combined with groundwater pumping upstream of the declining forest suggest a connection between reduced water availability and Salicaceae mortality.

In addition to improving our understanding of this forest die back event on the BWR, our work is contributing to efforts to quantify the minimum amount of water necessary to keep Salicaceae trees alive and vigorous, and to predict how changes in flow, groundwater levels, precipitation and temperature affect survival. Understanding these general relations and key thresholds could potentially help avert this sort of event on the BWR in the future, as well as along other rivers around the West. In some cases, as with the BWR, such information can be used to help quantify managed streamflow releases downstream of dams to prevent the die off of iconic Salicaceae forests. ■

PRESENTATION 1572

PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION IV*, 05/31/2018, 09:55 - 11:35

A META-ANALYSIS OF WETLAND SEED BANKS

McArthur, Amanda, Griffith University, Lake Villa, IL
Capon, Sam, Griffith University, Nathan, Queensland, Australia

Wetlands are a priority for conservation and restoration efforts globally. Soil seed banks are a key component of revegetating wetlands, and maintaining ecosystem health. Most previous studies of soil seed banks have focused exclusively on analyzing individual seed banks. This study compiled a database using species lists from many studies to investigate the structural and compositional characteristics of wetland soil seed banks across continental, climatic, and ecosystem scales in order to identify soil seed bank traits that hold true globally. This study was conducted as a nonsystematic meta-analysis of the structure and species composition of over 40 soil seed banks. No significant differences among climates, countries, or ecosystems for most structural characteristics of seed banks, but there were significant compositional differences among countries and climates. In Australia there were significant differences between wetland and riparian seed banks as well. The patterns found by this study may aid future restoration projects in establishing project targets, and may assist in future research of soil seed banks. ■

PRESENTATION 1583

PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES IV*, 06/01/2018, 03:20 - 05:00

DRIVERS OF BIRD-DISPERSED EXOTIC PLANT SPECIES IN THE SOUTHEASTERN UNITED STATES

Sipek, William, Southern Illinois University-Carbondale, Carbondale, IL
Battaglia, Loretta, Southern Illinois University, Carbondale, IL

Exotic plant species degrade ecosystems that lack their natural predators and competitors. These invasives often have high growth rates and proliferate rapidly after colonizing habitat openings created by disturbances. Many produce fleshy fruits and are spread by frugivorous birds, replacing native fruit in their dispersers' diets and forming mutualistic relationships with local frugivorous fauna. If fruit-feeders forage on multiple plants then these plants may indirectly affect the dispersal of fellow fruit-producers through contagious dispersal, allowing facilitative relationships to form between various native and exotic plant species. This study aims to answer two questions: (1) How do disturbance regimes impact the growth and spread of Triadica sebifera, a common exotic tree in the Southeastern United States? (2) How do native and exotic plant species affect the contagious dispersal of native and exotic plants. The study sites are located in the Grand Bay National Estuarine Research Reserve (GBNERR) in coastal Mississippi and in the Weeks Bay National Estuarine Research Reserve (WBNERR) in coastal Alabama. At both sites, samples of T. sebifera were cut in order to determine the impacts of known disturbance events (wildfires and tropical storms) on the growth and recruitment of this tree through the study of its growth rings. Seed traps have been set up underneath specimens of T. sebifera, one fellow exotic fruit-producing species (Cinnamomum camphora), and three native fruit-producers (Morella cerifera, Ilex vomitoria, and Persea borbonia). The identification of the scarified seeds in these traps will reveal potential

contagious dispersal between the focal species. Preliminary analyses indicate that recruitment of T. sebifera is most prevalent following severe tropical storm events(e.g. Hurricane Katrina). It also appears that the spread of native species is dominant in this ecosystem regardless of the plant species acting as a hub for contagious dispersal. ■

PRESENTATION 1600
PRESENTED DURING *SEA LEVEL RISE*, 05/30/2018, 03:20 - 05:00

MOVIN' ON UP: MYCORRHIZAL MUTUALISMS AND ASSISTED MIGRATION OF COASTAL PLANT SPECIES

Delfeld, Brad, Southern Illinois University Carbondale, Carbondale, IL
Battaglia, Loretta, Southern Illinois University, Carbondale, IL
Weisenhorn, Pamela, Argonne National Laboratory, Lemont, IL
Morgan, Benjamin, Northwestern University, Evanston, IL
Egerton-Warburton, Louise, Chicago Botanic Garden, Glencoe, IL

Coastal marshes are among the first ecosystems to be altered by climate change. With increasing sea level rise, assisted migration may be necessary to establish founder populations in more favorable upslope habitats. Mycorrhizal mutualisms could play a key role in determining success of these moving populations. The objectives of this study are: (1) to identify potential mycorrhizal relationships by determining whether assemblages of spores exhibit zonation mirroring that of coastal plant communities and (2) to test whether abundance and composition of mycorrhizae in roots of a dominant marsh species (Juncus roemerianus) differ with simulated assisted migration into upslope soils. Soil samples and seeds for trap plants were collected from the coastal coenocline at Grand Bay National Estuarine Research Reserve in coastal Mississippi. A total of 1694 unique operational taxonomic units (OTUs) was found across the entire gradient. The soil samples had an average of 196.25 OTUs per sample while the root samples were less diverse with an average of 29.04 OTUs per sample. The DNA analysis of the soil samples show that the Glomeromycete spores exhibit little to no zonation on the seaward end of the gradient (salt and brackish marsh), but moving upslope to the fresh marsh and pine woodlands, the spore composition becomes increasingly zoned. Species richness and abundance in the soil samples increased along the elevation gradient; they were highest in the pine woodlands and lowest in the salt marsh. The salt marsh showed isolation in its species composition sharing only two OTUs with the other three zones. The brackish marsh, fresh marsh and pine woodlands exhibited species overlap among most of the dominant OTUs. These results indicate that apart from the salt marsh, these plant-mycorrhizae relationships can persist after upslope migration of coastal plant species. ■

PRESENTATION 1607
PRESENTED DURING *WETLAND REGULATIONS & DELINEATION*, 05/30/2018, 03:20 - 05:00

WHAT THE FAC IS UP WITH ASPEN IN THE PACIFIC NORTHWEST?

Yahnke, Amy, WA Dept of Ecology, Olympia, WA

Several regional floras and plant community descriptions specific to Oregon and Washington identify Populus tremuloides as a component of plant communities dominated by FAC and FACW species. Those communities occur on sites characterized as "poorly drained", "moist", or in areas where "seeps" and "subirrigation" occur, and which are described as "forested swamps", "bogs" or "riparian" wetlands. Herbaria records were nearly twice as likely to reference some association with wetness and plants with FAC or wetter indicator statuses than with dryness and plants with FACU or drier indicator statuses. Personal observations from agency staff and scientists, and private consultants indicate that P. tremuloides is consistently found in association with plants of FAC or wetter indicator status, and in areas delineated as wetlands. The current status of FACU for P. tremuloides has the potential to impair the accuracy of wetland delineations performed in the Arid West and Western Mountains, Valleys, and Coast regions throughout Washington and Oregon, and potentially in other states covered by those regional supplements to the Corps of Engineers Wetland Delineation Manual. It may also increase disputes related to delineations where P. tremuloides is a dominant species. This talk will review the evidence and discuss the current standing of the wetland indicator status of P. tremuloides in the Pacific Northwest. ■

PRESENTATION P17
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

QUANTIFYING FUNCTIONAL TRAIT VARIATION OF BULRUSH GENOTYPES TO INFORM WETLAND RESTORATION

Hager, Rachel, Utah State University, Logan, UT
Kettenring, Karin, Utah State University, Logan, UT

To restore functioning wetlands, we need to understand how different plant sources may vary over large geographical ranges in functional traits and how that variation can be captured to best support the restoration of a multitude of functions. On the Great Salt Lake in Utah, land managers treat aggressive, invasive Phragmites; however, native wetland plants are not naturally returning following Phragmites control. In a mesocosm study, we identified and quantified the variation of functional traits between and within populations of three native bulrush species (Schoenoplectus acutus, S. americanus,

and Bolboschoenus maritimus), to better understand their intraspecific variation. Rhizomes of these three species were collected in the spring of 2016 and 2017 across twenty-eight wetland sites spanning six states in the Intermountain West (Montana, Idaho, Utah, Nevada, Arizona, and Wyoming). These rhizomes were grown in outdoor mesocosm pools over multiple generations to minimize maternal effects. We quantified functional traits including date of emergence, growth rate, tallest stem height, number of seed heads, number of seeds per seed head, aboveground biomass, and belowground growth characteristics. We document substantial differences in mean and variation of the different functional traits across the source locations and along abiotic gradients. Variation of functional traits between and within sites provides a strong potential for more targeted restoration planning. Based on these findings we can make recommendations to land managers on restoration material best suited for their restoration sites based on desired wetland function. ■

PRESENTATION 1629
PRESENTED DURING *SEA LEVEL RISE*, 05/30/2018, 03:20 - 05:00

CONTRASTING TRAJECTORIES OF FLOODPLAIN FOREST DEMOGRAPHY ALONG A SALINIZATION GRADIENT

White, Elliott, University of Florida, Gainesville, FL
Kaplan, David, University of Florida, Gainesville, FL
Middleton, Beth, USGS, Lafayette, LA

Transects were established in the coastal riverine floodplain forests of the lower reach of the Suwannee River in the late 1990s. We re-surveyed two of the sites for historical comparison. The sites we selected are 5.2 river kilometers (rkm) and 42.2 rkm from the mouth of the river. In the original survey, every tree of 10+ cm DBH and 3+ m in height was recorded to the species level along with its location on the transect and DBH. Our study, visiting the two aforementioned sites, used the same procedure as the original study. Both sites were surveyed along a 10 m wide belt transect. Soil salinity samples were taken as a part of the original study. Groundwater depth and salinity probes were installed at each site for our study. Our sensors have been recording 15-minute data from 2016 to present.

Comparing historical and current data indicates that the sites are developing in different ways and at different rates. The DBH of trees at the downstream site grew at an average rate of .1 cm/yr opposed to .45 cm/yr at the upstream site. The 15-19 cm DBH size class represented the largest group at 37.6% and 45% of the upstream and downstream communities, respectively, in the original survey. The resurvey showed that 20-24 cm DBH is the largest size class of the upstream site representing 15%, whereas the downstream site stayed at 15-19 cm DBH with a representation of 30.9%. An NMDS of the sites shows the the current upstream sites is statistically similar to the historical site. The current downstream site is more similar to the upstream sites than it is to the historical site. This indicates that the two sites were more similar to one another in the past and have diverged over the past 20 years.

Over the time period from the original survey to now, groundwater salinity at the downstream site as increases from .25 ppt to 2ppt and the upstream continues to be fresh. A stream gage, located 5 rkm from the downstream site and 30 rkm from the upstream sites, shows a general decrease in river discharge and increase in stage over the 20 years. The decrease in discharge allows saltwater to intrude further upstream as does sea level rise as indicated by increasing river stage. These indicates that sea level rise and changes in river parameters is having an impact on saltwater intrusion and ultimately forest structure. These are two synergistic drivers of saltwater intrusion that might not reverse their trends in the near future. ■

PRESENTATION 1662
PRESENTED DURING *WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE*, 05/31/2018, 03:10 - 05:00

WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE

Merritt, David, USDA Forest Service, Fort Collins, CO

The fields of botany and plant ecology have advanced in fits and starts over the past several hundred years. These classifications have evolved from rudimentary classifications of plants based on color, physiognomy, and practical uses, such as human consumption, fiber, and medicinal applications, to taxonomic classifications that consider floristics and genetic interrelationships. Recently, an application of functional grouping of plants (guilds) with similar responses to environmental resources and stressors has found a range of applications in river management. Once identified, the distributions of riparian response guilds can be modeled as a function of environmental gradients, and these models may be used to understand how human caused changes to flow regimes, climate change, or other natural and anthropogenic stressors may impact floodplain habitat suitability for different riparian vegetation-flow response guilds. Applications of the riparian response guild framework range from aiding in identifying suitable environmental flows (designer flows), to designing and monitoring riparian restoration efforts, to characterizing habitat and structural attributes of riparian landscapes. I will present examples from the western US, Portugal, Spain, and Sweden linking nearly a decade of work linking plant functional traits to applied landscape and floodplain management and restoration. ■

Biology & Ecology: Other

PRESENTATION 1058
PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION I*, 05/31/2018, 01:00 - 02:50

INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE AND WISDOM INTO WETLAND PROTECTION, MANAGEMENT AND RESTORATION IN THE PACIFIC NORTHWEST

Storm, Linda, U.S. Environmental Protection Agency, Seattle, WA
James, Justine, Quinault Indian Nation, Tahola, WA
Eide, Greg, Quinault Indian Nation, Taholah, WA
Park, Cavin, Quinault Indian Nation, Taholah, WA
Hall, Jon, Tulalip Tribes of Washington, Tulalip, WA

Several Pacific Northwest tribes of North America have developed wetland program plans incorporating tribal cultural values and traditional ecological knowledge. These plans identify core elements with specific actions to develop and strengthen tribal protection of wetland resources, both on and off reservation. Funding and technical assistance from the U.S. EPA Region 10 supports tribes to integrate western scientific approaches and tribal ecological knowledge, practice and wisdom into wetland management. Tribal wetland monitoring and assessment is relied upon to establish wetland restoration priorities and to develop wetland protection mechanisms. Traditional ecological knowledge and ecosystem management practices are applied in wetland management by identifying wetland restoration priorities and practices to be implemented. This presentation will share key examples of the powerful and important work of Pacific Northwest tribes who are integrating tribal cultural values and traditional ecological knowledge into their wetland ecosystem management and restoration. The intention of this presentation is not only to highlight this great work, but also to increase awareness about how tribal ecological knowledge is integrated into wetland management, protection and ecological restoration. The presentation will highlight the Tulalip Tribes' and the Quinault Indian Nation's wetland program work. For example, when the Tulalip Tribes collect wetland monitoring and assessment data, information is recorded on the accessibility (e.g., walking distance and terrain type) to wetland plant species that are culturally important to tribal elders and a Wetland Cultural Values Checklist is completed for each site with input from both the Cultural Resources and Natural Resources Departments. The Quinault Indian Nation has used EPA funding to print a limited number of an Ethnobotany Guidebook, involving ethnographic interviews with tribal elders and knowledge keepers; identified culturally significant wetlands to protect and restore; and implemented restoration projects that bring back traditional management practices. The Quinault Nation is also developing wetland water quality standards informed by their wetland monitoring data and cultural value assessments. ■

PRESENTATION 1068
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS II*, 05/30/2018, 03:10 - 05:00

PHYTOREMEDIATION AND MICROBIAL DEGRADATION PILOT STUDIES FOR A FORMER SOLID WASTE MANAGEMENT UNIT IN NORTHERN CALIFORNIA

LePage, Ben, Pacific Gas and Electric Company, San Ramon, CA
Gray, Bob, Pacific Gas and electric Company, San Ramon, CA
Warner, Jim, ERM, Walnut Creek, CA
Breckenridge, Amy, ERM, Walnut Creek, CA
Morris, Kevin, ERM, Malvern, PA
Lind, Debbie, ERM, Walnut Creek, CA

A former 73-acre solid waste management unit (SWMU) is located adjacent to a coastal estuary with an extensive tract of non-impacted tidal wetlands. The SWMU contains a layer of historically-discharged waste composed of fine-grained material that contains a number of chemicals of concern (COCs), including total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), and metals. In addition, due to the site's setting and history, the waste material is also highly saline and sodic. Pilot studies are currently being performed to evaluate the effectiveness of phytoremediation and microbial degradation of the COCs for achieving our remedial goals, with the goal of eventually restoring the SWMU to an estuarine wetland similar to that which surrounds the area. Microbial degradation in the rhizosphere and uptake by plants are expected to produce long-term reductions in TPH/PAH concentrations and redistribution/bioavailability reduction of metals. The results of the ongoing pilot studies are designed to document microbial degradation processes/rates and plant uptake with different plant types, soil amendments, soil aeration methods, and irrigation approaches. Previous studies demonstrated that native plants will grow in the waste with plant diversity, density, and root zone penetration varying with plant type, composting, soil conditioning, irrigation, and meteorological conditions. Indigenous microbial communities are being characterized, including population density related to the presence of roots, mechanical aeration, and amendments. COC degradation and pathways are being documented. The results of our initial studies demonstrate that phytoremediation together with microbial degradation are a potentially cost effective and efficient remedy for large scale restoration projects. ■

PRESENTATION P14
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

MACROINVERTEBRATE COMMUNITY RESPONSE TO A GRADIENT OF URBANIZATION IN THE WHITE OAK BAYOU WATERSHED

Nilz, Joshua, University of Central Arkansas, Conway, AR
Entrekin, Sally, University of Central Arkansas, Conway, AR
Stoughton, Stephanie, University of Central Arkansas, Conway, AR

Urban development from increasing human population results in the alteration and homogenization of stream and wetland habitats by increasing sedimentation, nutrient loading, and altering water chemistry. Wetlands are susceptible to degradation from urban development through connections with streams that drain urbanized watersheds and proximity to development resulting in altered water chemistry (e.g. dissolved oxygen, conductivity, sediment loading) and habitat conditions that could affect macroinvertebrate community structure. Alteration to macroinvertebrate community structure can result in changes to community function. Macroinvertebrate community structure will be used to demonstrate the impact of urbanization across a gradient in nine wetlands within the White Oak Bayou. Water quality and habitat assessments will be used as well. Samples were collected using 250um dipnets and a standardized technique. Community level analyses will be used to draw conclusions. As percent watershed urbanization increases, we predict fewer sensitive macroinvertebrate taxa and lower diversity from habitat homogenization and degraded water quality. ■

PRESENTATION 1288
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION IV*, 05/31/2018, 09:55 - 11:35

COMPARING CREATED AND NATURAL DEPRESSIONAL WETLANDS THROUGH TROPHIC COMPLEXITY OF MACROINVERTEBRATE COMMUNITIES.

Eisele, Shante, Wright State University, Dayton, OH
Hossler, Katie, Wright State University, Dayton, OH

Wetland creation is a process utilized for environmental remediation and particularly, for mitigating the historic and contemporary loss of natural wetlands. While created wetlands may have the physical appearance of natural wetlands, they can exhibit diminished ecosystem functioning and lack other characteristics of their natural counterparts. One significant component of natural wetlands is the macroinvertebrate community. Although many studies have examined these communities in natural and created wetlands, few have compared macroinvertebrate trophic structure between these systems. Knowledge of trophic structure can be indicative of the functional processes (e.g. productivity, nutrient cycling) occurring in wetlands. The objective of this study is to better understand benthic macroinvertebrate community composition and trophic structure in created and natural wetlands. Our central hypotheses are that macroinvertebrate communities in created wetlands have (1) differing composition and (2) less complex trophic structure with shorter food-chain length compared to natural wetlands. For six created wetlands (age range 5–15 years since construction) and two natural depressional, freshwater wetlands in Ohio, we conducted vegetation surveys to determine dominant vegetation communities (strata), then collected macroinvertebrates and soil cores from the different strata in each wetland. Macroinvertebrates were sorted to family or genus, freeze dried, and submitted for stable isotope analysis in order to determine food-chain length and trophic complexity (e.g. number of trophic niches) of the communities. We also assessed macroinvertebrate community characteristics such as abundance, diversity and composition, as well as functional feeding group composition. Soil cores were used to determine bulk density, texture, and C:N profile of the soil in the wetlands. A combination of univariate (e.g. ANOVA) and multivariate (e.g. NMDS, PERMANOVA) statistical techniques will be used to compare macroinvertebrate community characteristics and trophic structure between the two wetland types. We will discuss the differences and similarities between macroinvertebrate communities in natural and created wetlands, and what factors (e.g. soil development, vegetation community, wetland age) might be driving these differences or similarities. The results of this study will help inform land management decisions with respect to the preservation of natural wetland function. ■

PRESENTATION 1307
PRESENTED DURING *RIPARIAN ECOSYSTEMS I: ECOLOGICAL PATTERNS AND EFFECTS*, 05/31/2018, 09:45 - 11:35

HISTORIC FLOODPLAIN LAND COVER CHANGE ON THE SOUTH PLATTE RIVER, COLORADO, USA

Katz, Gabrielle, Metropolitan State University of Denver, Denver, CO
Salo, Jessica, University of Northern Colorado, Greeley, CO

Since the 1840's, water management has substantially altered the hydrology of the South Platte River in Colorado. Although the river experiences considerable natural interannual flow variability, the altered annual flow regime is characterized by enhanced seasonal consistency of surface

and ground water levels. Today, the river supports a broad cottonwood-willow riparian forest that established from 1900-1930, in a pulse of channel narrowing that accompanied historic hydrologic alterations. The status of this forest in not well understood, and little is known about its historic spatio-temporal pattern of development. We developed and tested GIS methods to assess historic riparian land cover change and channel movement on the South Platte River downstream of Greeley, Colorado. We digitized floodplain land cover on orthophotos or georectified aerial photographs taken at ~10 year intervals for three 30 km river segments in Weld, Morgan and Logan Counties, Colorado. The active channel (including sand bars, and multiple channel threads) comprised 9-10% of the digitized area in 1998, 4-8% in 2006, and 9-10% in 2015. At all three study segments, active channel area decreased 7-55% between 1998/1999 and 2006, a period of low annual peak flows. Between 2006 and 2015, a period that included high flows in 2013, active channel area increased 10-110%. Changes in channel area were accompanied by contrasting changes in agricultural land use, which comprised 18-51% of floodplain land cover in 1998/1999, 20-54% in 2006, and 17-50% in 2015. Over all river segments and time periods, dense riparian forest comprised 7-26% of the floodplain area, while open forest comprised 2-16%. However, patterns of riparian forest change differed among the three segments. At the two upstream segments, dense forest cover incrementally declined 37-40% from 1998/1999 to 2015, while open forest cover increased. In contrast, at the downstream river segment dense forest cover increased by 50%, while open forest slightly decreased. Further research will examine floodplain land cover at earlier time periods, and compare spatio-temporal dynamics among the three river segments. Understanding historic rates and patterns of South Platte River riparian land cover dynamics provides important context for informing management of this critical natural resource. ■

PRESENTATION 1312
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED I*, 06/01/2018, 09:45 - 11:35

CONSTRUCTED WETLAND TREATMENT SYSTEMS: METALS REMOVAL DESIGN FOR UTILITY WASTEWATER

Bland, Katie, Burns & McDonnell, Kansas City, MO
Snider, Chris, Burns & McDonnell, Kansas City, MO
Morrison, Jared, Westar Energy, Topeka, KS

Industrial and utility water consumers face increasingly stringent regulations for discharge of wastewater to surface waters. As regulations become more stringent, industrial clients are seeking treatment technologies that are effective, have low capital costs, and low maintenance requirements. While constructed wetland treatment systems (CWTS) are more commonly used for storm water runoff, municipal wastewater treatment polishing, and in mining water treatment applications, this technology is emerging as a viable solution for wastewater streams for the industrial and power sectors as well.

Constructed wetlands use natural biological processes to reduce the concentrations of constituents in wastewater and are especially effective for metals removal. The reduction of metals is currently a topic of concern for the industrial and power industries as they seek technologies to reduce constituents such as selenium and mercury to extremely low levels.

Westar Energy required further polishing of their flue gas desulfurization (FGD) wastewater stream in order to meet Kansas Antidegradation standards for discharge to the Kansas River. As part of the treatment technology evaluation, Westar opted to engage in a pilot performance study of a CWTS for treatment of a small portion of their FGD wastewater. The design and construction of the pilot was completed in approximately one year, and the pilot operated for the following two years.

The project challenges were twofold in that they included both the innovative design of the pilot project and the extensive water quality modeling to predict the final water quality of a potential full scale CWTS. Successfully moving past these challenges, Westar proceeded with the design and construction of a full scale CWTS for polishing of FGD wastewater. The full scale system was commissioned in the spring of 2014 and is still operating today. This technology has been favorable for Westar in that it was constructed and has been operated with low capital and operating costs, and is effective for removal of metals. Recent performance data will be included as part of this presentation. ■

PRESENTATION 1325
PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION I*, 05/31/2018, 01:00 - 02:50

TRADITIONAL ECOLOGICAL KNOWLEDGE: A PERSPECTIVE FROM THE WORLD OF SCIENCE

LePage, Ben, Pacific Gas and Electric Company, San Ramon, CA
Middleton, Beth, USGS, Lafayette, LA

Understanding ecology is not limited to the world of science, nor should it. Our ancestors survived by learning how

ecosystems worked by observing naturally occurring patterns and being acutely aware of the subtle interplay between the physical and biological world. They passed this invaluable information on to subsequent generations. This Traditional Ecological Knowledge (TEK) has been at the center of human evolution and the development of this planet's diverse cultures. While the process of observation and learning also forms the foundation of science, TEK is not necessarily focused on hypothesis testing, but rather understanding better how these systems function holistically. Living as part of these systems was integral to their management strategies and ultimately the development of their cultures. Science continues to struggle with the details on how these systems function but on some level these systems just exist and we probably need to consider reframing the questions to best understand TEK. TEK has a lot to offer science and the world. Working together, new insights and perspectives on ecosystem functioning and management might just allow the survival and well-being of future generations. ■

PRESENTATION 1405

PRESENTED DURING *RIPARIAN ECOSYSTEMS I: ECOLOGICAL PATTERNS AND EFFECTS*, 05/31/2018, 09:45 - 11:35

DISCERNING THRESHOLDS IN FLOODING THAT ARE MOST CLOSELY ASSOCIATED WITH VEGETATION ZONATION IN RIVER FLOODPLAINS.

Marks, Christian, The Nature Conservancy, Northampton, MA
Atia, Hanna, Mount Holyoke College, South Hadley, MA

The distinct zonation of plant species distributions on microtopographic elevational gradients in river floodplains is a prominent feature of riparian vegetation. A deeper understanding of the causal mechanisms behind this pattern could improve floodplain restoration designs and environmental flow prescriptions for dams. Wetland scientists have long ascribed riparian vegetation zonation to the effects of floods, but it remains unclear which attributes of floods are most directly involved. Field studies offer limited insights because frequency, duration, and depth of flooding are correlated. Instead, we took an experimental approach where potted seedlings of 25 native and non-native woody plant species were subjected to flood treatments of different durations. In the first experiment, flood treatments consisted of clear flowing water where the water surface just covered the surface of the soil. Seedlings had surprisingly high survival rates even after 8 weeks of inundation in all species including ones that are considered flood intolerant. Given that most floods in the field last much less than 8 weeks, this result suggests that the intensity of flood stress may be more important than the extent of exposure. To increase intensity of flood stress in a second experiment, we used stagnant water and increased depth of inundation such that seedlings were completely submerged during flood treatments. Because of the greater intensity of flood stress, half the seedlings of flood intolerant species such as Prunus serotina had died after just 1 week, while none of the seedlings of the most flood tolerant species, Acer saccharinum had died even after 6 weeks. We fit functions to the survival rates of the different species with maximum likelihood methods. The coefficients of the functions representing their experimentally determined flood tolerance were strong predictors of species distributions in the field. These experimental results point to an important role for depth of flooding in explaining riparian vegetation zonation. Future experiments should investigate a wider range of inundation depths to provide stronger support for depth as a key attribute of flooding that determines riparian vegetation zonation. Focusing on depth in restoration plans and environmental flow prescriptions would have the practical advantage that it is easier to calculate and map than duration. ■

PRESENTATION P15

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

SOIL FOOD WEBS OF RIPARIAN FOREST SOILS ON THE OLYMPIC PENINSULA, WA, USA

Kane, Wendal, Eastern Washington University, Cheney, WA
Bastow, Justin, Eastern Washington University, Cheney, WA

The soil food web is an essential component of ecosystem function, as it plays a pivotal role in decomposition and nutrient cycling. Nematodes are often used as surrogates for the soil food web because they occupy many trophic levels, including herbivore, fungivore, bacterivore, omnivore, and predator. Despite their importance, riparian soil food webs are understudied compared to other systems such as forests and grasslands. The aim of this study was to characterize the riparian soil community of three tributaries of the Elwha River. These tributaries were chosen as part of a larger project concerning the return of marine derived nitrogen via anadromous fish in response to dam removal, and represent the lower, middle, and upper Elwha. To assess how the soil food web differs between riparian areas and adjacent upland sites, we sampled soil from ten Acer macrophyllum tree stands at each tributary. Five stands were located at the stream edge, and five were in the upland, greater than 25m from the stream edge. We also sampled soil from five Alnus rubra tree stands at the stream edge to assess how the presence of a nitrogen fixing plant would influence the soil food web. Nematodes were extracted from soil and identified to their functional feeding group. We did not detect any

difference in total nematode abundance between the three tributaries or the three stand types. However, stream side A. rubra stands had more predators (0.269 ± 0.064 individuals per gram of soil, $p < 0.001$), than stream side and upland A. macrophyllum stands (0.087 ± 0.021 and 0.086 ± 0.015 individuals per gram of soil, respectively). A. rubra stands also tended to have more omnivores (0.738 ± 0.138 individuals per gram of soil, $p = 0.068$). This data suggests that A. rubra supports a more complex soil food web in riparian systems. Data collection of other soil characteristics, including soil texture, soil carbon, and soil nitrogen, is ongoing. ■

PRESENTATION 1528
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS I*, 05/30/2018, 01:00 - 02:50

FROM THE OIL FIELD TO THE GREEN FIELD

Tsao, David, BP, Naperville, IL

Onshore oil and gas production, including conventional exploration and production, hydraulic fracturing, oil sands/bitumen, and enhanced oil recovery, results in significant volumes of water co-extracted from the formation or returned as flowback water during the production process. Collectively known as produced water, the composition often includes salts, metals, hydrocarbons, and trace chemicals introduced in the production process. One area actively being studied to treat produced water is the use of constructed wetlands. While the organic constituents (petroleum hydrocarbons, phenols, polycyclic aromatic hydrocarbons, etc.) are often easily addressed in wetland systems, the inorganic constituents (salts, metals, etc.) can result in phytotoxic conditions limited the applicability of treatment wetlands. By far, the largest component of produced water, and thus particularly challenging to effectively treat, is the salt (chloride) content, often exceeding seawater concentrations (~3.5% global average).

Several recent studies have been undertaken to assess the viability of using constructed wetlands to address either individual components of the produced water or the produced water as a whole. Specifically, the degradation of Total Extractable Hydrocarbons by Spartina alterniflora was show in bench-scale studies to be relatively unimpeded for three different crude oils (ºAPI gravities 21, 30, 38) at saline concentrations ranging up to 60 parts per thousand (6.0% salinity). This study also included the simulation of free phase crude being introduced to the wetland plants. Likewise, in a separate field pilot study, C6 to C40 aliphatics and aromatics, polycyclic aromatic hydrocarbons, phenols, and benzene were all reduced between 88.0% and 99.9% from influent concentration by a mixture of Scirpus, Juncus, and Phragmites spp. In addition, As, Fe, and Zn concentrations were reduced in the effluent between 81.4% and 98.5% compared to the influent which consisted of real produced water containing on average 9.2% salinity. The results from both of these studies show promise in evaluating the feasibility of using constructed wetlands to treat highly saline produced water. ■

PRESENTATION 1532
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS II*, 05/30/2018, 03:10 - 05:00

FROM BROWNFIELDS TO GREENS FEES

Tsao, David, BP, Naperville, IL

Former industrial facilities are often left with environmental impacts to the soil and groundwater. In order to return these discontinued properties into productive use, remediation of the impacts can often be done in parallel with redevelopment. This presentation will summarize the remediation results performed by constructed wetlands treating extracted groundwater from beneath former petroleum refinery sites. The two case studies involve the simultaneous redevelopment and remediation approaches designed into a championship 18-hole golf course and a greenspace/nature trail, respectively. The centerpiece of each case study are full scale Constructed Treatment Wetlands designed to treat extracted groundwater, impacted with inorganics and hydrocarbons. These systems initially use a single pumping scheme to send the influent through cascade aerator to knock down the benzene concentrations by passive air stripping. The vapor phase is treated in a subsurface compost biofilters while the effluent streams are then treated by a series of surface and subsurface flow wetlands to meet the final discharge criteria. Primary constituents treated in this system are high natural iron, arsenic, and manganese, and dissolved hydrocarbons and other organics including benzene, toluene, ethylbenzene, xylenes (BTEX), methyl tertiary butyl ether (MTBE), and polycyclic aromatics hydrocarbons (PAHs) in the groundwater. The biofilter and wetlands themselves, as well as vegetative covers and tree hydraulic barriers, are incorporated directly into the design of the golf course,.and nature trail. ■

Education & Communication: Professional Development

PRESENTATION 1047
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION II*, 05/31/2018, 01:00 - 02:50

USING VIDEO TO PROMOTE WETLAND SCIENCE IN THE AGE OF FAKE NEWS

McKee, Karen, U.S. Geological Survey, Lafayette, LA

Scientists are increasingly required to share their work more broadly, not only with other science professionals and students, but with those outside the scientific community. Consequently, in addition to traditional journal articles and conference presentations, scientists must learn to communicate their work using media that are popular sources of information in the 21st century. One of the most popular and effective means of sharing information is video. In this presentation, I'm going to talk specifically about how science professionals are using video to share information in the age of fake news and science skepticism and how wetland scientists can use video to promote their work in a way that is credible and impactful. Video can be used to advance wetland science in a number of ways: to announce an important effort or call to action, to enhance a journal article, to summarize research about a wetland topic for a non-specialist audience, or to create a virtual fieldtrip highlighting an important wetland, to name a few examples. Video is also a great medium for showing not only what scientists do, but who scientists are. For women and minorities, video is particularly effective at overturning negative stereotypes and getting across the message that anyone can be a successful scientist. Videos are especially powerful in terms of showing a scientist's motivation, enthusiasm, and dedication. These are intangible qualities that are often difficult to convey using other types of media, such as text, but come across clearly and convincingly in a video. In addition to these topics, I will also talk about the Society of Wetland Scientists (SWS) new media initiative to solicit wetland videos from members to be featured on the SWS Website and YouTube channel. ■

PRESENTATION 1050
PRESENTED DURING *WORKING IN WETLANDS II*, 05/30/2018, 01:00 - 02:50

OWNING AND OPERATING AN ENVIRONMENTAL CONSULTING BUSINESS

Jecker, Scott, Whitenton Group, Inc., San Marcos, TX

Owning and operating an environmental consulting business can be a challenging and rewarding process. Doing the actual environmental work (desktop reviews, ecological field surveys, inspection, reporting, permitting, consultation, etc) is only part of the job. There are a number of non-environmental tasks that require attention for day to day operation. These tasks include business development, employee management, human resources, budgets, payroll, paying the bills, equipment purchases/maintenance, employee recruitment, and evaluating success or failure and implementing the appropriate changes. There are many important decisions to make on a daily basis to keep the wheels in motion in the right direction. These decisions can prove to be challenging since they have the ability to impact employees and clients. Some of the rewards of owning a small business are being a part of building a team that functions well together and being a part of a team that makes a business a success. ■

PRESENTATION 1079
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION III*, 05/31/2018, 03:10 - 05:00

CREATIVE CAREER SOLUTIONS: SURVIVING AND THRIVING AS A WETLAND SCIENTIST IN AN UNPREDICTABLE TIME

Sutton-Grier, Ariana, Nature Conservancy and University of Maryland, Bethesda, MD

Background, Objectives & Methods

It is a fact that the U.S. is producing many more PhDs each year than there are academic positions to accommodate (including research and liberal arts institutions and community colleges). Depending on the field of science or engineering, there are roughly between 6-19 too many PhDs produced per tenured faculty member over their career to find a replacement tenure-track academic position. This reality means most PhDs will find jobs outside of academia (oft called "alternative" careers but clearly the majority of careers for PhDs). And yet what these other career options are tends to be something that those in school know little about. This presentation will focus on my personal career journey as a wetland scientist who has never had a tenure-

track position to date. In addition to my own career, I will also call upon other examples from the literature and my experiences with colleagues.

Results and Conclusions

For early career scientists still in undergraduate or a Masters programs, it is good to consider whether the PhD is the right choice. For those already in a PhD program or postdoctoral position, it is useful to consider options for additional training beyond research. There are lots of fellowship opportunities including the American Association for the Advancement of Science (AAAS) Science and Technology Policy fellowship, and the Sea Grant, ORISE, and Mendenhall fellowships, and there are numerous science or science policy opportunities in government agencies. There are also opportunities to apply scientific training in non-profits, think tanks, and industry. In order to be successful in these opportunities, it is critical to develop skills beyond traditional research skills including facilitation, negotiation, science translation, and the ability to work with multidisciplinary teams across disciplines. I will explore in more detail some of the opportunities and skills I think are most important for early career scientists who are exploring careers beyond academia with the hope of providing inspiration and guidance to those who are interested in developing other career paths. ■

PRESENTATION 1090
PRESENTED DURING *WORKING IN WETLANDS I*, 05/30/2018, 09:45 - 11:35

WORKING IN WETLANDS - INDUSTRY PERSPECTIVE

Johnston, Christine, Xcel Energy, Denver, CO

The focus of my talk will be on what my position as a Senior Environmental Analyst for a large utility company does when there are projects that may impact wetlands. I will focus on my education, experience, and talk about the skills that I look for when hiring a wetland scientist to assist me with performing delineations and permitting. ■

PRESENTATION 1098
PRESENTED DURING *WORKING IN WETLANDS II*, 05/30/2018, 01:00 - 02:50

JOBS IN ACADEMIA: FROM SCIENCE SUPPORT STAFF TO PROFESSORS

White, John, Louisiana State University, Baton Rouge, LA

Most students are familiar with the academic workplace from the limited viewpoint of student and some consider faculty positions to be the default job position available. The normal progression of Ph.D. student, to post-doc to faculty member is taking longer these days and a discussion as to how the potentially long pathway might be a reason diverting interest away. There are a range of pluses and minuses in all positions, I will review the process of searching and interviewing for a faculty position including the range of faculty position from "all teaching" to "all research" and the hybrid position. I will include the results of an informal survey of wetland scientists as to their reason for seeking their job as well as some assessment as to the best and worst components of their day to day job. In addition, there are a number of science-based positions within academia which are not faculty positions and many do not require a Ph.D.. A brief description of these science support positions at two large, public Land-grant universities will be discussed including the required skill sets and what these job entail. ■

PRESENTATION 1107
PRESENTED DURING *WORKING IN WETLANDS II*, 05/30/2018, 01:00 - 02:50

WORKING IN WETLANDS: MY LIFE AS AN ENVIRONMENTAL CONSULTANT

Robinson, Amber, HDR Engineering, Inc., Lafayette, LA

Are you passionate about protecting wetlands? Does working for a variety of clients on challenging, multi-layered projects sound exciting to you? Do you want to make a career out of helping your clients build important infrastructure projects while reducing impacts to protected environmental resources? If so, a career as an environmental consultant is just right for you.

This presentation will educate young wetland professionals and students on the job requirements, responsibilities and day-to-day operations of an environmental consultant. To illustrate this objective, I will share my real life experiences as an Environmental Scientist working for HDR Engineering, Inc. on a vast array of projects for railroad, industrial, oil and gas and coastal restoration clients along the Gulf Coast. ■

PRESENTATION 1158
PRESENTED DURING *WORKING IN WETLANDS I*, 05/30/2018, 09:45 - 11:35

NAVIGATING THE POST PHD SLUMP

Brumley, Jessica, National Research Council, Ada, OK

Often times, after spending years in higher education earning a doctorate degree, it can feel like you have not been prepared for the job market, which can be frustrating. Academia is the obvious career path for most, but not everyone is looking for a career in research. For those graduates,

there can be a transition period between graduation and finding your niche in local and global the job market.

Using my experiences from the past three years, this presentation will provide PhD graduates with suggestions on building personal brands in the job market and the various career paths that could be pursued following graduation. Additionally, I will address how to best prepare for the job search process after earning a PhD; what attributes to highlight for non-academic jobs; how to get through the post-doctoral application process for fellowships/grants and where to find these opportunities. Various tools are available to support you through your job search, and these will be presented with self-care tips to alleviate the stress while going through this often frustrating but ultimately rewarding process of navigating the Post PhD slump. ■

PRESENTATION 1189

PRESENTED DURING *WORKING IN WETLANDS I*, 05/30/2018, 09:45 - 11:35

LIFE IN MITIGATION BANKING: A REGULATORY PERSPECTIVE FROM THE PRIVATE INDUSTRY

Hammond, Tiffany, Resource Environmental Solutions, LLC, Lafayette, LA

Imagine working in an environment where every day is slightly different, every project is unique and teamwork is the foundation for success. Envision the ultimate opportunity of exponentially expanding your knowledge base by working with professionals with an array of expertise. Then, realize your daily goal at work is to transform anthropogenically impacted land into a natural and self-sustaining ecosystem, in perpetuity! Some have called us Mother Nature's "Super Hero."

The presentation will focus on the Louisiana Regulatory Team at RES and provide you with a glimpse of what it is like to work in the office of a mitigation solution provider and it is anything, but what you would expect. You will be exposed to the various "hats" one can wear daily, some of the challenges we face and how we team together to literally leave the world's ecosystems a little better than we found them. ■

PRESENTATION 1458

PRESENTED DURING *HUMAN DIMENSIONS OF WETLANDS*, 06/01/2018, 09:55 - 11:35

STRATEGIES FOR GETTING A JOB IN YOUR FIELD AND SURVIVING YOUR FIRST YEAR AS A YOUNG WETLAND SCIENTIST

Halpin, KristiLee, AlpineEco, Denver, CO

Graduation and earning a degree is both an exciting and stressful time. While universities do an excellent job providing you with a background in theory and some applicable skills for the workforce, I found there to be limited resources (or unadvertised/not applicable to your field) available that teach you how to get a job. While traditional and obvious paths that lead to employment are readily available, the more uncomfortable (to me) and awkward avenues will likely lead to more interviews and greater opportunity. Once you have a job, be ready to learn more than you thought you needed too, and accept that you will struggle initially and occasionally fail. This talk will focus on tips for getting a job in your field and highlight one of my first projects that I struggled with because of changes from the client, development, and other typical challenges in the field. ■

PRESENTATION 1663

PRESENTED DURING *WORKING IN WETLANDS II*, 05/30/2018, 01:00 - 02:50

WORKING IN WETLANDS: WETLAND SCIENCE IN THE NON-PROFIT WORLD

MacHamer, Maya, Fourmile Watershed Coalition, Boulder, CO

Working in environmental and wetland restoration is a collaborative, multi-faceted and multidisciplinary process. Non-profit organizations like Watershed Coalitions often develop, construct and monitor restoration projects from start to finish. If you are excited about a career in wetland science, but also have other interests or skills that you would like to develop a non-profit organization may be a good fit. Non-profits often work in communities that are deeply connected to the land and passionate about preserving and protecting their communities and are also in need of people with technical knowledge, long-term vision and a holistic understanding of ecosystems. Colorado communities are still recovering from severe wildfire and flood events and Wetland Scientists are a critical part of the restoration teams. Find out what is involved in completing a restoration project, why the non-profit model works and how it can propel your career aspirations in wetland sciences. ■

Education & Communication: Public Outreach and Education

PRESENTATION 1116
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION I*, 05/31/2018, 09:45 - 11:35

A WYOMING CASE STUDY: HOW USING FACEBOOK FOR TRANSPARENT SCICOMM HELPED RESEARCHERS AVOID POLITICIZING MIGRATION RESEARCH AND CONSERVATION

Garramon Merkle, Bethann, University of Wyoming, Laramie, WY

Twice a year in Wyoming, mule deer, elk, pronghorn, and other native ungulates travel epic distances (up to 150 miles one-way) along migration corridors they have used for thousands of years. Research and conservation of this natural heritage could become highly politicized, because the state's economy is strong driven by natural resource extraction (specifically coal and natural gas, along with uranium, etc.) and development that can result in barriers to migration. Through careful messaging on social media and in-person engagement, the Wyoming Migration Initiative* has contributed to a state-wide culture which embraces migration as a shared value among seemingly diverse interest groups. The synergy of WMI's dedicated communications effort and productive research group have resulted in discovery and on-going research of some of North America's longest ungulate migrations. WMI has played a central role in providing research results which state agencies and conservation organizations use to inform and prioritize management efforts that ensure these migrations continue (e.g., conservation easements, fence remediation and removal, and installation of under- and overpasses.) In 2016, the Wyoming Game and Fish Department designated ungulate migration corridors, in addition to key habitats such as bottlenecks and stopover areas, as 'vital habitat' which must be considered when reviewing development and other land-use proposals. This talk will explore how WMI has built a constituency of 11,000+ Facebook followers with high engagement rates by sharing research-in-progress, field notes, live tracking of migrating animals, and profiles of researchers and partners. This talk will also address our social media guiding principles, examples of topics we consider fraught-but-worth-addressing, and examples of in-person engagement efforts with stakeholders. *WMI is a research unit affiliated with the USGS Wyoming Cooperative Fish and Wildlife Research Unit and the department of Zoology & Physiology at the University of Wyoming. ■

PRESENTATION 1234
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION III*, 05/31/2018, 03:10 - 05:00

CROWDFUNDING YOUR WETLAND RESEARCH: CHALLENGES, LIMITATIONS, AND REWARDS

Swartz, Timothy, University of Illinois at Urbana-Champaign, Champaign, IL
Miller, James, University of Illinois at Urbana-Champaign, Urbana, IL

Traditional sources of scientific research funding have continued to decline in recent decades. As a result, some scientists are looking to alternative funding sources to support their research. One emerging option is crowdfunding, a process of raising financial support from a large group of supporters through the internet. In this talk, I will highlight some of the challenges, limitations, and rewards of crowdfunding by outlining the existing research on this approach and describing my own experience using crowdfunding to support my wetland research.

Unlike a conventional grant-writing process, where proposals are tailored to appeal to experts in a field, crowdfunding depends on a broad, non-professional audience. This requires extensive public engagement and outreach, which can be challenging to achieve. To succeed at crowdfunding, scientists must first develop an audience for their research using social media or other tools. Then they must work to make their research accessible and compelling to that audience. As a result, crowdfunding is often a time-intensive process. Furthermore, the financial rewards may be limited. On average, individual contributions to a crowdfunding campaign are small, and successfully raising large sums can be difficult. Because of these limitations, crowdfunding may be best suited to filling in gaps in existing budgets or providing seed money for a pilot study or emerging project. Currently, funding large research projects solely through crowdfunding is uncommon. Nevertheless, crowdfunding is a welcome addition to the research funding landscape. Not only does the process reward scientists with research funds, it also leads to greater public engagement and can help scientists develop a community of supporters who are personally invested in the research. Crowdfunding provides a new platform for wetland scientists to promote the benefits and importance of wetland research. Using crowdfunding to make wetland science approachable and engaging to the public will strengthen our field and advance the cause of wetland science and conservation. ■

PRESENTATION 1270
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION I*, 05/31/2018, 09:45 - 11:35

THE DISTINCTION BETWEEN ADVOCACY VS. SCIENCE TO SUPPORT POLICY: WHY IT MATTERS AND HOW TO ENGAGE

Kenney, Melissa, University of Maryland, College Park, MD

As an environmental decision analyst I am often asked by scientists, "Why do people make "bad" decisions?" or "Why isn't my science being used to inform policymaking?". For such scientists, it is critical to understand that decisions include both science and value judgments. Even if multiple decision makers agree upon the science, it is not uncommon for different decision makers to disagree on the optimal policy because their values cause them to weight the objectives of the decision differently. This is the key distinction -- are you providing facts to support an understanding of the consequences of different actions (i.e., evidence-based policy) or are you endorsing for a particular solution (i.e., advocacy)? Even in a post-truth world, it is essential to have the relevant science present during the decision-making process. This does not mean that one needs to advocate for a particular policy position, but instead means thoughtfully presenting the positive and negative consequences of different policy choices given the current scientific understanding. Thus, it is key to ensure that you are bringing your science to the attention of policymakers in a way that they expect to receive it (e.g., policy briefings, quick pitches, memos). In this talk, I will present several examples and provide a roadmap for how wetland scientists can effectively engage at multiple levels in the policy process. ■

PRESENTATION 1545
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION III*, 05/31/2018, 03:10 - 05:00

BUILDING DIVERSE COMMUNITIES IN THE SWAMMP

Munguia, Steffanie, Middlebury Institute of International Studies, Monterey, CA
Riera, David, Florida International University, Hialeah, FL
Lougheed, Vanessa, UTEP, El Paso, TX

Some of the strongest communities of environmental stewards are colored and diverse. Yet even with such champions, they continue to be directly impacted by environmental pollutants and degradation, as they are excluded from mainstream green movements. In our country's 40 largest environmental not-for-profits, only 27 percent of full-time staff are considered diverse. Diversity itself is a vague term; if used in wetlands, it indicates the multitude of unique species found persisting in a given area. In our case, diversity simply means taking an inclusive approach to the composition of a group of people in wetland science. While many professional and academic programs in the US are dedicated to enhancing minority representation, the word diversity continues to be discussed negatively through issues of racial bias and discrimination. Where employers and institutions have faltered, professional societies are addressing this disparity and changing the narrative. SWaMMP is the SWS multicultural mentoring program, which focuses on the inclusion of students from groups traditionally under-represented in the sciences. This program was piloted by Dr. Frank Day in 2004, and is funded through a collaborative between the SWS Executive Board, several SWS chapters and a NSF grant. The program has produced 15 cohorts, supporting more than 126 students from 80 different colleges and universities, uniting them at the society's annual meeting, where many are presenting their research for the first time. Furthermore, students are paired with mentors who are experienced wetland professionals. The diversity of research interests, career aspirations, and ethnic backgrounds in SWaMMP have led to a richer understanding of private and public pathways and opportunities in wetland science. This provides students with a unique learning experience, allowing many of them to return as program advocates and leaders. SWaMMP is cultivating a new, diverse generation of wetland professionals, growing the society's resilience with each cohort. ■

PRESENTATION 1557
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION II*, 05/31/2018, 01:00 - 02:50

COMMUNICATION TOOLS: SPREADING THE WORD ABOUT WETLANDS

Culver, Denise, Colorado Natural Heritage Prog, Fort Collins, CO

We know how important and irreplaceable wetlands are, but how do we effectively communicate that to the public and to land management officials? The Colorado Natural Heritage Program (CNHP) has been actively working with our partners to address this issue. CNHP has developed a variety of digital field tools, e.g., mobile app, wetland information center, and NWI mapping, which enable a broader segment of the population to easily access important wet-

land information and to use that information in their work and recreation activities. The App format is highly desirable and appeals to a wider range of users than traditional paper based formats. We have consolidated the region's wetland information resources at a single web location that facilitates a greater use of information by wetland professionals, regulators, educators, and the public. CNHP has developed easy-to-use pocket guides to common wetland plants to assist field staff with the correct identification of Colorado's wetland plants. Wetland plant identification workshops have been conducted throughout the State to accompany the release of the field guides. I would like to share our information with SWS, as well as hear about other wetland communication tools. ■

Education & Communication: Teaching Wetland Science

PRESENTATION P18
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

INVESTIGATION OF ECOSYSTEM SERVICES PROVIDED BY SEASONALLY EMERGENT WETLAND BETWEEN AN AGRICULTURAL DRAIN AND IRRIGATION CATCHMENT IN SOUTHWEST IDAHO.

Flock, Rebecca, CWI, Nampa, ID

Non-point source nutrient loading in irrigation returns contribute to water quality impairments in freshwater system. We investigated a seasonally emergent wetland in the transitional zone between the Bernard Drain and Lake Lowell in the lower Boise River watershed, southwest Idaho. We sought to characterize the ecosystem services the wetland zone provides as a means of improving the quality of the water entering the reservoir via run-off. The Bernard Drain returns agricultural irrigation waste water and has been reported to have the highest overall detection of contaminants of the 8 canals and drains entering the catchment. Lake Lowell is an 11,000-acre irrigation catchment and reservoir constructed in 1908 and designated as part of Deer Flat National Wildlife Refuge. The reservoir receives drainage from approximately 40,000 acres and provides multiple secondary services to the surrounding community as an active recreation area, breeding and migratory habitat for birds and mammals, and historic landmark.

Established over a century ago, the aging reservoir has experienced increasingly eutrophic conditions, phosphate and dissolved oxygen impairment, as well as the appearance of harmful algal blooms. Preliminary variations in soil and water quality parameters indicate that the seasonally emergent wetland reduces the transport of nitrate, orthophosphate, and sediment during the irrigation season. Additionally, the wetlands zone provides a cooling effect for the margins of the reservoir, thereby helping to mitigate some aspects of water quality impairment. These findings illustrate the value of identifying management practices that support the ability of the wetlands to continue providing its ecosystem service, especially in transitional zones between agricultural drains and the reservoir. ■

Education & Communication: Wetlands and Society

PRESENTATION 1023
PRESENTED DURING *HUMAN DIMENSIONS OF WETLANDS*, 06/01/2018, 09:55 - 11:35

WATER SECURITY THROUGH REVIVAL OF TRADITIONAL SOURCES OF WATER IN RURAL AREAS OF BHARATPUR (RAJASTHAN, INDIA)

Mehra, SatyaPrakash, Rajputana Society of Natural History, Bharatpur, Rajasthan, India

Bharatpur, the Eastern Gate of Rajasthan, is situated on the confluence of three rivers, viz., Ruparel, Banganga, and Gambhir and together with the stormwater constitute flood drain of River Yamuna during the monsoon period. The region used to hold the natural depressions with the dense thickets of the green cover forming numerously scattered wetlands with woodlands thus, giving the remarkable diversity of habitats. With the pace of development on the name of modernization and urbanization, the area lost almost all the natural depressions except one which serves as wintering ground to the migratory winged guests and was declared World Heritage and Ramsar Site - Keoladeo National Park (KNP).

The region has a history of floods and droughts, the frequency of these has changed over the decades, with a decrease in floods and increase in droughts with the rapid increase in the development in the last decade of 20th century. The conditions further worsened due to erratic rainfall and shortening of the duration with increased intensity. With the onset of the 21st century, the sources of water were almost lost due to anthropogenic activities added to climatic changes in the region. The increased exploitation of the underground water depleted groundwater table resulting in the availability of highly saline water below ground.

The present investigation highlighted the challenges of the area related to water security and mitigating the impact of climate change through traditional knowledge and the customary actions. Based on the traditional knowledge, authors revived the symbiotic relationship between man and nature to cope up the challenges. Through CSR support, initiatives were undertaken for water sustainability through improvement of water conditions in the rural environs. The methodology adopted for the social and structural activities in the period of ten years (2007 - 2017) were briefed in the present work.

The linkage of conservation with income generation was instrumental in the interventions. It was observed that modern conservation actions overlook indigenous eco-centric customs and traditional values, breaking the inter-relationship with their natural set up. The site-specific "Social Model" formed during the interventions, had the global application. It was concluded that sustainability and conservation programs need inclusion of local community which was possible only when the interventions link employment and livelihood. ■

PRESENTATION 1115

PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION I*, 05/31/2018, 01:00 - 02:50

CONTRIBUTION OF TRADITIONAL ECOLOGICAL AND WESTERN SCIENTIFIC KNOWLEDGE SYSTEMS IN ECOL-CULTURAL RESTORATION OF MESOPOTAMIAN MARSHES, IRAQ

Stevens, Michelle, CSU Sacramento, Sacramento, CA

The Mesopotamian marshlands of Iraq were once the largest wetland ecosystem in the Middle East and in Western Eurasia, covering about 20,000 square kilometers and home to 500,000 inhabitants. The Marsh Arabs lived in harmony with their environment for millennia, subsisting almost entirely on foods and materials produced within their ecosystem. For the past four decades, the area has been traumatized by civil unrest, upstream water withdrawal and massive drainage of the marshes. Only a few thousand people remain in the marshes today, struggling to survive on vast tracts of desertified marshland. The magnitude of disturbance within the marshes tests whether either ecological or social systems can adapt and still retain traditional cultural knowledge, biodiversity and functioning ecosystem services. We use both Scientific Ecological Knowledge and Traditional Ecological Knowledge systems to test the hypothesis of whether marsh desiccation results in loss of traditional knowledge of Marsh Arab women.

Traditionally, Marsh Arab women took an active role both inside and outside the home. We conducted semi-structured interviews of Marsh Arab women, examining their use of the environment pre- and post-desiccation. Our research revealed that marsh desiccation caused a drastic change in Marsh Arab women's interaction with their environment, resulting in limitations of women's roles to household domestic activities rather than marsh-dependent activities. With the exception of raising water buffalo and limited horticulture activities, today most Marsh Arab women are losing their ability to utilize traditional knowledge. Furthermore, because women do not use these skills, young women know little about the skills necessary to live off the marsh ecosystem, and this valuable cultural knowledge is being lost. Cultural knowledge restoration must be employed alongside ecosystem restoration in order to preserve indigenous management models and cultural heritage, and to enable Marsh Arabs to make a living off their land once again. ■

PRESENTATION 1173

PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES I*, 06/01/2018, 09:45 - 11:35

FLOATING WETLANDS IN THE URBAN WATERSCAPE / A CASE STUDY REVIEW FOCUSED ON CHALLENGES AND BENEFITS OF FLOATING WETLANDS IN THE URBAN WATERSCAPE.

Fulford, Galen, Biomatrix Water, Forres, Moray, United Kingdom

Due to population growth and increasing urbanization, cityscapes have replaced many riverside and open wetland areas. Often in key locations at river confluences and estuaries. Floating Wetlands offer an important technique allowing wetland habitats to be created in urban areas where land restoration is not possible, such as along sheet pile walls and concrete lined waterways. In the past three years, Biomatrix Water has built over 1,000 Floating Wetland Modules with installation locations ranging from London to Chicago as well as locations in Peru, China, and elsewhere. The objective of this case-study focused presentation is to share some of the challenges and benefits of these installations to better understand the opportunities and constraints in their application.

Five installations are reviewed overall with a focus on two installations:

1. At the BHC site in Manchester, UK, water chemistry was assessed over three years in conjunction with invertebrate studies. Invertebrate samples where over time with a standard D frame net and results were analyzed using Community Conservation Index (CCI). The study results showed a COD

reduction from 40 to 20 mg/L and a BOD reduction from 10 to 1 mg/L. Additionally, the CCI Invertebrate score increased from 1.3 to > 12.

2. At the second focus site in Hastings, UK, water chemistry was assessed through the system over two years by the Environment Agency, with a particular interest in the Wetlands ability to mitigate combined sewer inputs from the watershed by providing a key ecosystems service of water quality management, and protecting the status of the bathing beach downstream. Concentrations of BOD, COD, NH3, and P where reduced by > 60%. However, the most significant and publicized benefit was the reduction in E. coli and Enterococci bacteria. The bacteria reduction helped the bathing beach achieve "good" water quality in the EU assessment system for the first time in several years, and is an excellent example of a direct ecosystems services benefit of significant socio-economic importance.

Challenges encountered in these projects included wetland anchoring and wildfowl grazing during planting. In conclusion, the study results show that Floating Wetlands offer a useful tool for habitat and water quality improvements at locations where original wild wetlands have been lost and where re-instatement if original wild wetlands is not feasible. ■

PRESENTATION 1198

PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION II*, 05/31/2018, 03:10 - 05:00

IDENTIFICATION OF SUSTAINABILITY: TRADITIONAL ECOLOGICAL KNOWLEDGE AND INDIGENOUS SCIENCE BETWEEN HUNTING CULTURE AND RESTORATION IN TAIWAN

Fang, Wei-Ta, National Taiwan Normal University, Taipei, Taiwan

Currently, national conservation policies and faiths of aboriginal tribes produced controversial debates between natural ecological conservation and traditional hunting. This qualitative research, uses visual and dictated information to explore hunting culture, trying to construct self-governing managerial approach for human-nature relationships and their implications. This study has been observed twelve activities of Taiwan aboriginal hunting behaviors from 2012 to 2015, reading hunting photo-voice information, and interviewing fourteen aboriginal hunters. This study, therefore, develops Indigenous managerial approach, according to traditional ecological knowledge (TEK) to lessen the tyrant's domination of mainstream culture and the contradiction of aboriginal self-identification. Study results represent that only if recognizes the value of aboriginal hunting culture, and try to apply aboriginal self-governing management, the sound environmental planning for social and environmental justice can be manifested in aboriginal activities. Using concepts from Traditional Ecological Knowledge (TEK), this study determined how these concepts of social norms became established in the lives of the Tayal people, and how Indigenous Tayal hunters have devoted their skills to maintaining the culture which sustains their resilient landscapes and ecosystems. Through the special cultural connotations of hunting knowledge and specifications, the hunting behavior of Taiwan's Tayal can shape a harmonic balance with river corridors and their ecological richness. ■

PRESENTATION P20

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

LEAD CONCENTRATION IN SYCAMORE TREES OF BIG RIVER GRAVEL BAR

Tran, Trang, Missouri State University, Springfield, MO
Heiman, Jordan, Missouri State University, Springfield, MO
Kissoon-Charles, La Toya, Missouri State University, Springfield, MO

Big River watershed in southeast Missouri is a semi-permanent sediment sink with high levels of residual heavy metal pollution from lead mining operation over the last 200 years. Vegetation on gravel bars created natural buffers from soil erosion and heavy metal movement in sediments. Previous studies focused on sediment contamination and lead concentration in organisms such as birds and fish within the Big River ecosystem. However, there is a gap of knowledge in the movement of lead within the food chain of this system. Plants are at the base of the food chain, thus exploration of heavy metal uptake by vegetation could show the potential circulation of lead in the surrounding ecosystem. We carried out a plant species abundance assessment of vegetation on a lead contaminated gravel bar in Big River, and selected sycamore trees (the most abundant species) to be the subject of study. Samples of leaves, stems, barks and branches were collected from sycamore trees at different locations on the gravel bar under investigation. The same method was applied to sycamore trees located in an of the river upstream of the contamination, which served as a control. Plant samples were dried, crushed, and analyzed for lead concentration to determine the leas content of plants compared to stored lead concentration in the gravel bars. ■

PRESENTATION 1315
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION I,* 05/31/2018, 09:45 - 11:35

MOVING THE NEEDLE: AFFECTING POLICY CHANGE AT THE STATE LEVEL RELATED TO WATER AND WETLANDS IN THE ARID WEST

Endter-Wada, Joanna, Utah State University, Logan, UT

Sometimes scientists have opportunities to help frame issues and affect policy change through their service on various advisory groups or panels. In such situations, it is important that they understand the policy process so they can effectively engage in it. This process includes the dynamics of how issues are framed, how policies are designed, and how policy decisions are translated and experienced by citizens. It also includes interactions between various interest groups, of which those scientists may themselves be members. Drawing upon both policy sciences and personal experiences in the Utah water policy arena, and focusing on the challenges involved in working for wetland and environmental protection, I offer some reflections on ways scientists can help effect policy change. I will highlight the importance of being willing to challenge assumptions and articulate trade-offs, finding creative ways to work within "boxes" that groups may be handed, using the power of collaborative reframing, and recognizing the importance of providing and utilizing public input. I will pay particular attention to how scientists can draw upon and employ their own professional and personal strengths, and to choices they may confront in deciding whether and how to engage in policy processes. Making science relevant to policy is an important and worthwhile undertaking for wetland protection, and the objective of this talk is to contribute to the conversations in this invited symposium. ■

PRESENTATION 1319
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION III*, 05/31/2018, 03:10 - 05:00

THE IMPORTANCE OF GENETIC DIVERSITY: PARALLELS BETWEEN NATURAL ECOSYSTEMS AND HUMAN SYSTEMS

Judd, Gabriela, Utah State University, Logan, UT

In the face of current political discord and manifested skepticism of the scientific community, the need for improved outreach and clear communication is vital to reclaiming the power of scientific understanding within our society. The movement of information infiltrates many mediums that travel among all the walks of life that make up the wide range of experiences. These circumstances make for many different ways of understanding any one thing. As members of the scientific community it would serve us to understand and value these different ways of understanding, as they create differences in interpreting information, and so influence different actions. We can incorporate new strategies and develop more effective ways of being heard to regain trust and create the change we want to see by actively choosing to welcome these differences within the scientific community. These different ways of understanding, interpreting and actions are 1) produced by differences in each individual's collection of experiences and 2) more commonly named as diversity. As wetland scientists that see value in the complexity and balance of ecosystems, there are many thought-provoking parallels between striving for robust genetic diversity within any given population in a natural system and striving for robust genetic diversity within our own human species population in the systems we have constructed and participate in- especially in the face of disturbance. Within natural ecosystems, genetic diversity can be used as a precautionary tool amid unpredictable disturbances like our changing climate; building a large gene pool to select from, increases resilience as there are more traits available to adapt to whatever changes manifest. Similarly, the more perspectives we introduce into science, the more ways of understanding we let influence the scientific processes, the more diverse the scientific community will become allowing for access to novel ideas, creative solutions, and a wider range of outreach. Higher diversity in the scientific community will not only equip us with the tools necessary to overcome current challenges but will also create more elasticity against societal commotion. ■

PRESENTATION 1420
PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION II*, 05/31/2018, 01:00 - 02:50

SHIFTING HOW WE COMMUNICATE ABOUT SCIENCE: HARNESSING THE POWER OF SOCIAL MEDIA

Hager, Rachel, Utah State University, Logan, UT

Science communication has long been a one-way process focused on educating; however, social media is restructuring how we communicate by creating increasingly interactive opportunities for more open science and engagement. Social media facilitates the exchange of knowledge internally within and among scientific communities, as well as exter-

nally for outreach to engage the public. In 2016, 79% of online adults used Facebook, 32% use Instagram, and 24% use Twitter; however, estimates of scientists who use any of these social media platforms for science fall between 2.5 and 15%. Online social media tools such as Twitter or Facebook or personal blogs can be some of the most rewarding and informative resources for scientists – if you know how to use them. This presentation will focus on how scientists can more effectively use a variety of social media platforms especially Twitter to clarify, convince, and converse about science. Twitter, the "awesome-people-you-may-never-meet network" is bustling with enthusiastic scientists just like you, but it can be easy to fall down the rabbit hole of a surplus of information. Used effectively Twitter can broaden your scientific thinking, expand your network, and get an instant sounding board from across the globe. In today's age of scientific skepticism and misinformation, some scientists reflect that it is no longer an option to not engage with others. Rather it is becoming a moral obligation. ■

PRESENTATION 1516
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES I*, 06/01/2018, 09:45 - 11:35

ADVANCING BENEFITS: TECHNOLOGICAL EVOLUTION IN FLOATING WETLAND APPROACHES ON URBAN WATERWAYS

Streb, Christopher, Biohabitats, Baltimore, MD

As urban waterfronts increasingly transform into publicly accessible civic spaces, people are connecting to the natural water bodies that made their city a place. With access comes awareness and a demand for improved water quality along these waterfronts. The role ecosystems play in sustaining water quality is generally not well known. Floating wetlands are akin to ecosystem prosthetics, aimed at restoring a semblance of the ecological functions severed due to urbanization. Floating wetlands cannot compensate for the comprehensive elimination of wetlands along urban waterfronts, but they can be employed to provide worthwhile benefits. In the mid, several generations of floating wetlands have been deployed in tidal waters, each with new adaptations to educate, beautify, provide habitat, improve water quality or study. ■

PRESENTATION 1539
PRESENTED DURING *AFRICAN RIVERS*, 06/01/2018, 01:10 - 02:50

CLIMATE CHANGE ADAPTATION IN THE RIVER GAMBIA ESTUARY: HOW FAR HAVE WE COME?

Ceesay, Adam, Wetlands International Africa, Bremen, Senegal
Villanueva, Maria Ching, Ifremer, Plouzane, France, France
Wolff, Matthias, Leibniz Center for Tropical Marine Research, Bremen, Germany (DEU), Germany

A questionnaire-based study was conducted to assess socio-ecological resilience of different stakeholder groups in the mangroves of Tanbi Wetland National Park (TWNP) in the River Gambia estuary in relation to the political mainstreaming process of Climate Change Adaptation (CCA). Study results reveal that people`s perception about the overall concept of climate change remains high and unaffected by gender. However, perception on economic changes differ significantly between socio-economic groups: 72.7% of the fisher folks, 50.0% of the Oyster collectors, 47.9% of the subsistence (residents), 35.0% of the Farmers and 33.3% of the tourist workers reported a decline in daily earnings over the period of the last thirty years. Economic implications of ecosystem change are strongest for the fisher folks and oyster collectors. Shifting attention from gender to occupation will reduce the disparities in local knowledge and economic well-being between the socio-economic groups. There is a need to create awareness for both the state and the coastal villages and to further diversify alternative livelihoods to ensure equal footing of all occupational groups affected by climate change. ■

Education & Communication: Other

PRESENTATION 1082
PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION I*, 05/31/2018, 01:00 - 02:50

WETLAND IMAGERY IN FICTION AND IMPLICATIONS FOR CONSERVATION

Kiviat, Erik, Hudsonia, Annandale, NY

Wetland landscapes have been important to humans widely through history and around the world. Human exploitation

of wetland resources exposes people to wetland hazards; thus living in or near wetlands is an ecological tradeoff. The ecological characteristics of wetlands are reflected in cultural ecology, i.e., the influences of the landscape that produce cultural and behavioral adaptations of people to wetlands. The cultural ecology of wetlands, in turn, is reflected in the literary representation of wetlands. To explore this nexus, I analyze the relationships of wetland ecology to human cultures in English language fiction. As general principles, wetland environments tend to have water levels near the ground surface and episodic flooding; high humidity, ground fogs, high winds at ground level, and (especially in the North Temperate Zone) seasonal ice; soft (penetrable) fertile soils; complex waterways with sheltered channels and pools; a high level of spatiotemporal heterogeneity; productive, dense, harsh-textured, slow-decomposing vegetation; periodic concentrations of animals; and local abundance of biting flies. As a result, cultures have developed effective travel modes and equipment; emersion of shelter, cultivation, and burial above water; clothing and behavioral protection from vegetation; foraging techniques that exploit high primary and secondary production and animal aggregations; many kinds of protection against insect nuisance and vector-borne diseases; and use of refuges from more powerful populations. Analysis of several hundred novels revealed that fictional imagery of wetlands often incorporates emblems of sex, fertility, and decay; destructive flooding; getting lost; taking refuge from other people (e.g., from social or religious persecution, economic disadvantage, or legal action), and isolated culture complexes. Wetland images are also used as transitions in fiction because they stand out from other landscapes. Fiction helps us understand the ecological duality of the human-wetland relationship. Fiction also reveals temporally changing attitudes towards wetlands. This knowledge is useful in educating the public about wetland resources and avoidance of wetland hazards or stressors. Knowledge of the human relationships to wetlands can also guide more public-friendly conservation and management practices in the face of rising sea levels, as well as assisting archaeological and other disciplinary interpretations. ■

PRESENTATION 1086
PRESENTED DURING *WORKING IN WETLANDS I*, 05/30/2018, 09:45 - 11:35

WHY WOULD A DEPARTMENT OF TRANSPORTATION HIRE BIOLOGISTS?

Pierce, Rebecca, Colorado Department of Transportation, Denver, CO

Fourteen years ago I saw an announcement for a wetland biologist position with the Colorado Department of Transportation (CDOT). Turning to my then coworker, I asked him, "Why would CDOT need a biologist?". My presentation will answer that question by describing a typical work day and elaborating on a few recent projects. I will describe the skills and experience needed to start my job and what could be learned after being hired. Everything during my work day is somehow tied to transportation projects, but my responsibilities and opportunities are surprisingly diverse. My presentation will seek to enlighten young professionals and those looking for a career change on the realities of a wetland career at a state agency that does not manage land or natural resources. ■

PRESENTATION 1226
PRESENTED DURING *WORKING IN WETLANDS II*, 05/30/2018, 01:00 - 02:50

LIFE AFTER SCHOOL: DEVELOPING A PROFESSIONAL ONLINE PRESENCE, LOOKING FOR JOBS, AND WINNING OVER HIRING MANAGERS.

Brumley, Jessica, National Research Council, Ada, OK
Sloey, Taylor, UL Lafayette Institute for Coastal and Water Research, Lafayette, LA

The post-graduation job search can be a daunting experience, from the search, to preparing one's application materials, to the interview. A successful candidate should tailor their approach for each specific job, but knowing where to find opportunities and how to make the best impression can be a steep learning curve. By compiling the experiences of recent graduates in wetland related fields who have found successful employment in academic, private, government, and non-profit fields, we can offer words of wisdom to students and young professionals navigating the job market. This presentation overviews resources to locate jobs, building and using professional networks, developing a professional online presence, tailoring application materials to different positions, preparing for and conducting oneself in an interview, and following up after an interview. Participants will also engage in an exercise to make the most of their networking experience while attending the SWS 2018 Annual Meeting. ■

Global Climate Change: Blue Carbon & Carbon Markets

PRESENTATION 1260
PRESENTED DURING *MEASURING WETLAND GREENHOUSE GAS FLUXES: NOVEL METHODS, EXCHANGING IDEAS, AND INFORMING MANAGEMENT*, 05/30/2018, 03:10 - 05:00

BLUE CARBON - GREENHOUSE GAS FLUXES FROM COASTAL CALIFORNIA RESTORATION PROJECTS

Miller, Haley, Chapman University, Orange, CA
Woerndle, Glenn, Chapman University, Orange, CA
Medvedeff, Cassandra, Chapman University, Orange, CA
Keller, Jason, Chapman University, Orange, CA

Coastal wetlands are incredibly valuable environments due, in part, to their ability to sequester and store carbon over long periods of time. There is a growing interest among coastal managers to capitalize on the carbon storage capacity of these ecosystems, known as "blue carbon", to drive restoration and conservation efforts in the context of emerging carbon markets. While wetlands are extremely efficient carbon sinks, they also have the ability to produce and emit greenhouse gasses such as methane and nitrous oxide. Previous studies suggest that production and emission of methane from coastal wetland ecosystems is suppressed by the availability of sulfate in high salinity, tidally-influenced systems and that nitrous oxide fluxes are minimal in all but the most eutrophic coastal environments. However, these assumptions are rarely tested in blue carbon ecosystems. Our studies used static chambers to measure greenhouse gas fluxes from two regionally-significant coastal restoration projects. We measured methane and nitrous oxide fluxes from a sediment augmentation project at the Seal Beach National Wildlife Preserve (southern California) and methane fluxes from the South Bay Salt Pond Restoration Project (San Francisco Bay, California). Our results demonstrate that while methane fluxes were low in both projects, there were "hot spots" of methane flux, including fluxes from high salinity locations. Nitrous oxide emissions from the Seal Beach project were generally minimal. Fluxes of both gasses were not well explained by basic biogeochemical measurements (e.g. salinity, sulfate availability), suggesting that a better understanding of spatial and temporal variability of greenhouse gas fluxes is necessary to better understand the role that these coastal ecosystems play in emerging carbon markets in California and beyond. ■

PRESENTATION 1430
PRESENTED DURING *PEATLANDS*, 05/30/2018, 03:20 - 05:00

EXTRACTING CARBON CREDITS FROM POCOSIN PEATLANDS IN NORTH CAROLINA: A NEW APPROVED ACR ACCOUNTING METHOD

Richardson, Curtis, Duke University Wetland Center, Durham, NC
Wang, Hongjun, Duke University, Durham, NC
Flanagan, Neal, Duke University, Durham, NC
Ho, Mengchi, Duke University, Durham, NC

Millions of hectares of coastal peatlands in the southeast have been drained and converted to agriculture, exacerbating C loss due to increased greenhouse gas (GHG) losses, increased C export in runoff, reduced C sequestration and uncontrolled deep peat fires. However, shrub dominated southeastern peatlands have been shown to have low levels of C loss compared to other wetland ecosystems even under drainage and extended droughts. The main objective of the study was to provide the scientific data needed to quantify if restoration of natural hydrologic conditions on drained peatlands would result in a net positive C storage balance that could be profitable on the open C market. It was hypothesized that (1) the recalcitrant nature of the peat aromatic C in pocosin peatlands would result in a positive annual C balance, and (2) that hydrologic restoration to natural conditions would enhance C sequestration and reduce GHG fluxes such that restored peatlands provide significant C storage for C credit. An ACR approved dual approach of including both a stock based method and flux based method based on our data are outlined along with a range of potential market C values based on our 5 years of research at Pocosin Lakes Wildlife Refuge in North Carolina, where hydrologic conditions and C fluxes were quantified on reference, restored and drained blocks from (2012-2017). Research to-date has shown that restored farmland NC peatland sites vs drained sites have net C credits of a low of 15 to a high of 27 t CO2 ac-1 yr-1 (tons/acre). These net C credit values will be discussed in terms of developing potential C markets in the future. ■

PRESENTATION 1504
PRESENTED DURING *AFRICAN RIVERS*, 06/01/2018, 01:10 - 02:50

MANGROVE CARBON STOCKS OF THE ZAMBEZI AND RUFIJI RIVER DELTAS

Trettin, Carl, USDA Forest Service, Cordesvilles, SC
Mangora, Mwita, Univ. Dar es Salaam, Zanabar, Zanzibar, Tanzania, United Republic of
Bandiera, Salomao, Univ. Eduardo Mondlane, Maputo, Maputo, Mozambique
Fatoyinbo, Temilola, NASA- GSFC, Greenbelt, MD

Lagomasino, David, NASA/GSFC, Greenbelt, MD
Lee, SeungKuk, NASA/GSFC, Greenbelt, MD
Dai, Zhaohua, Michigan Technological Univ., Houghton, MI
Tang, Wenwu, UNC Charlotte, Charlotte, NC
Simard, Marc, NASA-Jet Propulsion Laboratory, Pasaden, CA
Shapiro, Aurelie, WWF - Germany, Berlin, Berlin, Germany

While mangroves have been shown to contain significant carbon (C) pools, storing up to five times more C than typical upland tropical forests per unit area, there have been few objective inventories which characterize the distribution across large area. Inventories were conducted using a Spatial Decision Support System (SDSS) that provided a framework for detailed logistical planning and field mission implementation to estimate above- and below-ground C stocks of mangroves within the Rufiji and Zambezi River Deltas. The mean carbon content in biomass ranged from 89.6 to 224.9 Mg C ha-1 in Rufiji and 99.2 to 341.3 Mg ha-1 in Zambezi, respectively. Live tree biomass was the dominant biomass C pool, accounted for about 88% in Rufiji and 89% in Zambezi, respectively. Soils C pool in these two Deltas are the largest, containing 213.7 to 359.5 Mg C ha-1 that accounts for 61.5-70.9% of the entire stock with a mean of 64.3% in Rufiji River Delta, and 354.7 to 644.9 Mg ha-1 that comprises 47% to 72% of the entire pool with a mean of 60.8% in Zambezi River Delta. Both soil and biomass C pools in the mangroves in Rufiji River Delta are lower than those in Zambezi River Delta although the deltas have similar land cover and mangrove species. The differences in biomass C stocks are likely related to disturbances, frequent harvesting in Rufiji, less anthropogenic disturbances in Zambezi in recent decades. ■

Global Climate Change: Global Climate Change

PRESENTATION 1051
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES I*, 05/30/2018, 09:45 - 11:35

WETLAND CLIMATE ADAPTATION POLICY: GAPS, NEEDS AND ADEQUACY OF MANAGEMENT APPROACHES

Finlayson, Max, Institute for Land, Water & Society, Albury, NSW, Australia

Options for the adaptation of wetlands to climate change have been considered within the context provided by the Ramsar Convention on Wetlands. While comprehensive guidance has not been provided the basic management approaches that have been adopted by the Convention have been used to provide the following principles. These were developed through expert opinion and then peer reviewed and published.

1. Objectives and targets for wetland management should accommodate and compensate for climate change, rather than accepting or avoiding impacts, especially in early phases of adaptation. This is more likely to be achievable by emphasising the benefits that can accrue by protecting wetland functions and ecosystem services as well as key species.
2. Objectives for wetland management under climate change should include ecological, social and economic targets across multiple scales. Ecological issues that can be considered include representativeness, connectivity and refugial values. Setting objectives and targets will involve significant societal choices and rest on decisions about what should be conserved and at what scale. In some cases, it may be necessary to accept a level of biodiversity loss.
3. Flexible, governance and adaptive co-management frameworks across multiple scales and sectors are essential to managing wetlands under climate change. These frameworks should be specific to a given situation and reflect the diversity and complexity of social ecological systems.
4. Easily reversed, no-regret or low-regret adaptation options with multiple, cross-sectoral benefits should be implemented in the initial phases of adapting wetland management. This should be done with the strengthening of adaptive management frameworks.
5. Long-term management strategies should identify triggers for new actions, including novel or high-risk adaptation options (e.g. species translocations). It may be difficult to identify such triggers, given uncertainties about the rates and directions of climate change as well as the particular responses of wetlands. Conceptual modelling may assist with identifying triggers.
6. Scientific monitoring and evaluation of management strategies are needed to enable decisions to be made about what has been achieved, what changes and trade-offs should be implemented, whether there is a need to modify goals and objectives, and what information is available for sharing with stakeholders. ■

PRESENTATION 1052
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT II*, 05/31/2018, 01:00 - 02:50

INTERNATIONAL WETLAND AND CLIMATE POLICY – THE HUFF, PUFF AND BLUFF AND STORMY TIMES AHEAD?

Finlayson, Max, Institute for Land, Water & Society, Albury, NSW, Australia

Developing guidance for informing wetland conservation and management policies within the context of climate change has been contentious for the Ramsar Convention on Wetlands. This has occurred as various countries have argued that the Convention is not the primary international policy instrument for addressing climate change – that is the role of the UN Framework Convention for Climate Change. Others have argued that as climate change is likely to have a profound impact on the ecological character of wetlands it should be addressed by Ramsar which has a remit to consider the wise use of all wetlands. The latter being all the more important given the state of many wetlands worldwide.

With this in mind the attempts to address climate change through the Convention from 2002 to 2015 are considered and reviewed within the context of the reactions of various countries to the proposals that have been tabled and debated, and generally watered down or significant text removed, in particular that relating to the mitigation of climate change, given the preference to reach consensus rather than majority decisions. At the same time these efforts have been surrounded by successful efforts to provide guidance on other drivers of adverse change in wetlands, and to recognise the interactions that occur between these, and how they impact on people and the important ecosystem services provided by wetlands. At the same time other international conventions have seemingly moved further ahead with their efforts to address climate change and biodiversity. The contradiction in approaches is explored within the context of wetlands being recognised as being impacted by climate change and the absence of comprehensive international guidance for wetland mangers and policy makers. ■

PRESENTATION 1103
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT II*, 05/31/2018, 01:00 - 02:50

WHAT'S A PRACTICING WETLAND SCIENTIST TO DO? POLICY & MANAGEMENT TOOLS, STRATEGIES & BMPS IN LIGHT OF CLIMATE CHANGE

Davies, Gillian, BSC Group, Inc., Acton, MA

As noted earlier in this symposium, we now know much about the relationship between wetlands and climate change relative to the global carbon cycle, climate adaptation/resiliency, and impacts to wetlands. How do we apply this scientific knowledge to our day to day projects? This presentation outlines a number of planning strategies, considerations, and Best Management Practices to adapt wetland management to a world driven by climate change. For instance, increases in extended droughts and floods can lead to temporary shifts in herbaceous vegetation. Wetland delineation criteria can be modified to account for this. The US Army Corps of Engineers North Central and Northeast Region wetland delineation guidance provides an example. Wetland resilience to climate change can be evaluated at local to landscape scales, using The Nature Conservancy's GIS-based mapping tool that identifies and ranks ecologically climate-resilient and connected land in regions of the US and Canada. TNC finds that land with a higher density of wetlands is more climate-resilient than land with lower densities of wetlands. A given wetland's resilience can be linked to the overall resiliency of the land surrounding the wetland, which this evaluative tool identifies. With regard to wetland restoration and creation, specific techniques that preserve and transplant impact area soil structure and vegetation to restoration/creation wetlands appear to protect soil carbon and improve resiliency to drought, while potentially reducing costs and the likelihood of invasive species. Finally, for scientists to communicate effectively with policy makers and the public, we examine research by the Yale Project on Climate Change Communication and others. ■

PRESENTATION 1119
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT I*, 05/31/2018, 09:45 - 11:35

COASTAL WETLANDS AND CLIMATE CHANGE: THREATS, OPPORTUNITIES, AND POLICY RECOMMENDATIONS

Sutton-Grier, Ariana, Nature Conservancy and University of Maryland, Bethesda, MD

Background & Objectives

Coastal wetlands, mangroves, tidal marshes and seagrasses, are very productive ecosystems that take up and store a lot of carbon thus earning them the title coastal "blue carbon wetlands." They also provide many other important benefits to people including providing critical fish nursery habitat and providing risk reduction from flooding and erosion. However, coastal wetlands are threatened by climate change, particularly rising sea levels and changing average temperatures. Sea level rise (SLR) is resulting in some wetlands drowning because they can't keep pace with sea level rise and/or they have no migration corridors to be able to move inland if they are surrounded by human development. Rising temperatures

are changing species composition such as where mangroves are moving into previously salt marsh habitat. These ecosystems are also threatened by other human stressors that are degrading or destroying them and resulting in the loss of all benefits. Because of these serious threats to coastal wetlands, it is important to consider innovative and new policy opportunities to protect and restore coastal wetlands.

Results and Conclusions

The policy world has begun to more explicitly recognize the important role coastal wetlands play in climate change mitigation (via long-term carbon sequestration) and in climate change adaptation (via erosion and flood risk reduction). Including wetlands in national greenhouse gas inventories, which the U.S. did for the first time in April 2017, and into the voluntary carbon market are some of the first successful steps for better accounting for the greenhouse gas implications of wetlands loss or restoration. Additionally, there are efforts to include natural ecosystems or nature-based approaches, such as living shorelines, in coastal resilience efforts so that built approaches that harden coastal shorelines are not the only approaches for making communities more resilient in the face of SLR. By better understanding and quantifying the ecosystem services of coastal wetlands, new policy opportunities are developing to protect and restore coastal wetlands and their suite of benefits. We must recognize, however, that these policy efforts can help slow the loss of coastal wetlands, but climate change is likely to cause the loss of many coastal wetlands around the world. ■

PRESENTATION 1289

PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS I*, 05/31/2018, 09:45 - 11:35

WESTERN WATER, WETLANDS, AND CLIMATE CHANGE

Dettinger, Michael, US Geological Survey, Carson City, NV

The western United States is a region long defined by water challenges. Climate change adds to those historical challenges, but does not, for the most part, introduce entirely new ones. Rather climate change is likely to stress water supplies and resources that have already in many cases been stretched to, or beyond, natural limits. Projections are for continued and, likely, increased warming trends across the region, with a near certainty of continuing changes in seasonality and amounts of available snowmelt and streamflows, and a strong potential for attendant increases in evaporative demands. Projections of annual precipitation are less confident, although likely the northernmost West will see precipitation increases while the southernmost West sees declines. Most of the region lies in a broad area where some climate models project annual-precipitation increases while others project declines. Climate models, nonetheless, consistently project increases in precipitation extremes, with more persistent and pronounced dry spells punctuated by larger storms when storms do occur. Other impacts from climate change (e.g., floods and water-quality changes) are poorly understood and will likely be location dependent.

In this context, western wetlands may be expected to face some difficult future conditions hydrologically and, probably, in terms of water quality. Wetland water availability is likely to change in seasonality and in parsing of inflows between baseflow and flood conditions. Water temperatures are likely to increase, in the absence of heroic management countermeasures. Evaporative demands may increase. In many settings, sea-level rise will add its own challenges. In mSuperposed upon these secular changes, year-to-year variations of inflows, inflow quality, and competition from beyond the wetlands may increase as climate change takes hold. ■

PRESENTATION 1326

PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT I*, 05/31/2018, 09:45 - 11:35

POLAR WETLANDS OF THE PAST AND THEIR UTILITY FOR PREDICTING THE FUTURE

LePage, Ben, Pacific Gas and Electric Company, San Ramon, CA

In the polar regions high-biomass forested wetlands prevailed as far back as 100 million years ago. Today, these regions are treeless, cryic deserts for which there are no modern analogs. Although global climate change is inevitable and the poles will warm to the point of being capable of supporting forest communities, the scientific community really has no idea of the composition or type of vegetation that would be capable of thriving under the unique light regime. While predictions on the timing and magnitude of these changes vary substantially, the plant fossil record provides a perspective on how ancient ecosystems functioned and responded to global-scale climatic and environmental change. These ancient forested wetlands provide a wealth of information that is now being used to consider what the vegetation at the poles could look like. Assuming that the current global wetland area of 12.8 million acres is maintained and 50% of the area currently classified as ice and tundra would become wetlands, the global wetland area would double in size to about 25 million acres and comprise about 18% of the total land area. These emergent wetland ecosystems will have a major role in the evolution of future climate and environment. Although we expect the types of forest communities that evolve in the future to be physically and biologically consistent with that seen in the past, their composition is expected to be new. ■

PRESENTATION P24
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

FORESEEN IMPACTS OF CLIMATE CHANGE ON WETLAND HYDROLOGY IN THE MEDITERRANEAN AREA

Grillas, Patrick, Tour du Valat, Arles, France, France
Lefebvre, Gaetan, Tour du Valat, Arles, France, France
Redmond, Lauren, Tour du Valat, Arles, France, France
Germain, Christophe, Tour du Valat, Arles, France, France
Palazzi, Eliza, Institute of Atmospheric Sciences and Climate (ISAC-CNR), Torino, Italy, Italy
Tergazo, Silvia, Institute of Atmospheric Sciences and Climate (ISAC-CNR), Torino, Italy, Italy
Poulin, Brigitte, Tour du Valat, Arles, France, France

The Mediterranean region has been identified as a climate change hotspot due to water scarcity, concentration of economic activities in coastal areas, and reliance on climate-sensitive agriculture. Hence, wetland managers and policy makers need projection tools to foster adaptation to water shortage and review water allocation strategies. Climate projections based on realistic (RCP 4.5) and pessimistic (RCP 8.5) scenarios for 2050 and 2100 were integrated to a free online interactive software (mar-o-sel.net/) developed to promote adaptive management of semi-permanent Mediterranean marshes. Rossby Centre regional atmospheric model (RCA4) projections were used and bias-corrected over land use areas using the daily gridded observational dataset for precipitation, temperature and sea level pressure in Europe (E-OBS). Simulations were run to estimate how changes in precipitation and evapotranspiration would affect the hydrological functioning of semi-permanent wetlands in 2050 and 2100 for 238 localities spread over 23 countries around the Mediterranean Sea. These localities have currently a water balance varying from +31 mm to -2372 mm for an average value of -1405 mm. Mean water deficit will increase from 2050 (-1489 mm) to 2100 (-1565 mm), especially under the pessimistic scenario (-1757 mm in 2100), with large discrepancies among countries. For each locality, we estimated the size of the catchment area and the depth of the water table needed to currently maintain wetlands in a semi-permanent condition; defined as a minimum of 6 months of flooding and 2 months of dryness during 75% of the years. We simulated how climate change would affect the hydrological functioning of these parameterized wetlands based on current and future climate conditions. Because seasonality of precipitation and evapotranspiration interact with water balance, a higher water deficit does not necessarily result in a shorter hydroperiod of the marsh (increased evapotranspiration has little impact when occurring under dry ground conditions). Projected changes in water balance and wetland hydrology are shown for all 238 localities. This project has received funding from the EU H2020 research and innovation programme (grant No 641762). ■

PRESENTATION P26
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

PONDS IN THE ARCTIC: SOURCES OR SINKS OF CARBON DIOXIDE?

Del Val, Luis, University of Texas at El Paso, El Paso, TX
Lougheed, Vanessa, UTEP, El Paso, TX

Earth is experiencing one of the fastest rates of climate change in its history, with the most extreme change occurring in the Arctic. This is of concern because the tundra houses more than one-third of the world's soil carbon, which may be released into the atmosphere as permafrost thaws due to rising temperatures. Tundra ponds may contribute a substantial amount to the net carbon budget, despite making up a relatively small component of the tundra landscape. The purpose of this study was to examine variation in diurnal carbon dioxide (CO2) flux in tundra ponds near Utqiaġvik (Barrow), Alaska. CO2 concentrations were logged for 48 hours at 8 ponds surveyed over 2 weeks in summer 2018. Average CO2 concentrations within any pond ranged from 311 to 4310 μatm, with an overall average of 1541, indicating that ponds were a source of CO2 to the atmosphere. While clear diurnal trends were obvious in all ponds, with increased CO2 concentrations in the evening, substantial variation was noted. Correlations were done to see the degree of synchrony among ponds. Most ponds followed similar diurnal trends in CO2 ($r>0.55$, $p<0.05$). Variability among ponds could be explained by temporal variability in precipitation and solar radiation, as well as the chemical and physical properties of the ponds. Further research on the ponds is needed in order to determine what controls the CO2 flux in such a delicate ecosystem during a period of changing climate. ■

PRESENTATION 1357
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS II*, 05/31/2018, 01:00 - 02:50

IMPACTS OF VEGETATION TRANSITIONS ON BIOGEOCHEMICAL CYCLING WITHIN COASTAL WETLANDS

Steinmuller, Havalend, University of Central Florida, Orlando, FL
G. Chambers, Lisa, University of Central Florida, Orlando, FL

Coastal wetland vegetation communities are responding to global climate change and associated sea level rise by ecological shifts that include the encroachment of more salt- and inundation tolerant species on existing vegetation throughout the coastal plain. Coastal wetlands within Merritt Island National Wildlife Refuge (MINWR) in east central Florida (USA) are experience two separate transitions: the encroachment of Avicennia germinans (black mangroves) on Distichlis spicata (saltgrass), and the encroachment of Distichlis spicata on Spartina bakeri (cordgrass). Soil cores were collected along a transect capturing the transition to investigate patterns in the perceived drivers of these vegetation shifts (salinity and inundation) and their impacts on biogeochemical cycling, specifically carbon and nitrogen dynamics. Results indicate that the encroachment of black mangroves decreased nitrogen and phosphorus mineralization rates, as well as carbon dioxide emissions. Microbial biomass C was nearly 2x higher within the transition zone and black mangrove zone than within the herbaceous vegetation. Enzyme activity (β-glucosidase, N-acetyl-beta-D-glucosaminidase, alkaline phosphatase, β-xylosidase, β-cellobiosidase, and aryl sulfatase) was consistently lower within the transition zone than at the transect end members, indicating that transitional zones between vegetation communities have decreased rates of biogeochemical cycling. Preliminary results suggest that the encroachment of saltgrass on existing herbaceous vegetation also alters rates of biogeochemical cycling and nutrient availability. Conclusions drawn from this study are directly applicable to determining how coastal wetlands will regulate water quality and carbon sequestration in response to sea level rise and global climate change while informing management of these coastal systems. ■

PRESENTATION 1369
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT I*, 05/31/2018, 09:45 - 11:35

FUTURE OPPORTUNITIES TO INCORPORATE WETLANDS SCIENCE AND POLICY INTO CLIMATE SOLUTIONS

Moomaw, William, Tufts University, Somerville, MA

While the majority of wetland management is on the local level, the consequences of those local decisions have global climate implications. The 1988 scientific report that launched the UN Framework Convention on Climate Change warned of runaway climate change triggered by a warming world from increased emissions by soil organisms. Despite the fact that wetlands (including wetlands underlain with permafrost) are among the largest terrestrial carbon sinks and have the potential to release massive amounts of carbon dioxide and methane as the world warms, these ecosystems have received relatively little attention from the climate change community. Reporting emissions from wetlands is "optional" under IPCC reporting rules, and governments generally do not report them. Of greater concern is that the so called "carbon emission budget" requirements to remain within the Paris temperature limits do not consider the potential emission feedback of a warming world, and hence overestimate the amount of fossil fuels that can be burned without exceeding the 1.5 and 2.0 degrees C limits. This presentation will propose a remedy that requires the transdisciplinary collaboration of atmospheric scientists, climate modelers and wetland scientists and practitioners with climate policy and decision makers to develop wetland based mitigation and adaptation options. A recent paper that involved collaboration among a diverse group of actors can serve as a model and first step towards a comprehensive and collaborative approach among scientists from several disciplines that can result in significant contributions from the wetlands community to simultaneously meet climate policy and wetland protection and restoration goals. The opportunity for the Society of Wetland Scientists to play a role in coordinating wetlands research, policy and practice with climate goals will be described. ■

PRESENTATION 1371
PRESENTED DURING *WETLANDS AND CLIMATE CHANGE*, 05/30/2018, 09:55 - 11:35

A BIOGEOCHEMICAL RECORD OF CLIMATE CHANGE IN NORTHERN ONTARIO RIVERINE MARSHES

Glasauer, Susan, University of Guelph, Guelph, ON, Canada
Smith, Richard, Global Aquatic Research, Sodus, NY
Smith, Peter, University of Guelph, Guelph, Ontario, Canada
Allison, Mead, Tulane University, New Orleans, LA
Wabasse, Harry, Webequie First Nation, Webequie, Ontario, Canada

The Winisk River in northern Ontario traverses the Hudson Bay Lowlands (HBL), a wetland complex, before terminating in Hudson Bay. It drains an area of 67,300 km2, with remote communities that depend on natural resources. The Winisk is a particularly important source of organic carbon (OC) to Hudson Bay. Climate change is of concern because of the impact on species affected in the rivers and marshes of the Winisk system. We investigated biogeochemical parameters on sediment cores sampled from riverine marshes along the Winisk River within the territory of Webequie First Nation (WFN), located on Eastwood Island in Winisk Lake. WFN is the nearest community to a proposed massive development of chromite and other mineral deposits in the HBL. Mine development can be expected to impact water flows, water chemistry, and carbon cycling in the region. The objective of the study was to assess temporal patterns of organic and inorganic markers in advance of development and future climate change.

Water and cores were collected at four marsh sites selected in collaboration with the community to encompass the major water inputs and outputs. Core sections were analyzed for organic C and N; lignin compounds using CuO digestion coupled to GC-MS; stable isotopes (C13/C12; N15/N14) to identify sources of organic matter inputs; and transition metals. Sedimentation rates were determined using Pb210 and Cs137 dating. Water samples were analyzed for pH, alkalinity, conductivity and select metals

Our cores represent around 500 years of deposition. Organic C in the marsh sediments was 10-30% and generally decreased from younger to older sections. The C:N ratio was lowest at the core surface, suggesting more complete degradation in younger material. Lignin analyses indicate that gymnosperm wood and sphagnum peat dominate the OC pool, although the proportions of material derived from specific plants vary between sites. The change in the sphagnum mosses indicates that recent climate change is accelerating terrestrial losses of mosses in particular. Stable isotope analysis suggests that other inputs of OC may be present that are consistent with OM derived from the erosion of older marine sediments. Metal concentrations are consistent with capture of dissolved metals by organic matter rather than metal particulates. The results support that both OC amounts and degradation rates are positively correlated with warming in the region. ■

PRESENTATION 1384
PRESENTED DURING *WETLANDS AND CLIMATE CHANGE*, 05/30/2018, 09:55 - 11:35

THE POTENTIAL LONG-TERM IMPACTS OF CLIMATE CHANGE ON THE HYDROLOGIC REGIMES OF WETLANDS IN NORTH CAROLINA

Kurki-Fox, Jack, NC State University, Raleigh, NC
Burchell, Michael, NC State University, Raleigh, NC
Kamrath, Brock, North Carolina State University, Raleigh, NC

Wetlands are especially at risk due to climate change because of their intermediate landscape position, where small changes in precipitation and/or evapotranspiration can have significant impacts on wetland hydrology. Because hydrology is the primary factor influencing wetland structure and function, the important ecosystem services wetlands provide may be altered or lost as a result of climate change. While there is a great deal of uncertainty associated with the projected impacts of climate change on wetlands, hydrologic models and downscaled climate model projections provide tools to reduce this uncertainty. DRAINMOD is one such process-based hydrologic model that has been successfully adapted to simulate the daily water level fluctuations in natural wetlands. The objective of this project was to determine the range of possible impacts of climate change on the hydrologic regimes of non-riverine Coastal Plain wetlands in North Carolina.

DRAINMOD models were calibrated and validated for two minimally disturbed, natural wetland sites in the Coastal Plain ecoregion of North Carolina using observed water table and local weather data. Downscaled climate projections were obtained from the Bureau of Reclamation. Two relative concentration pathway (RCP) scenarios were evaluated: RCP4.5 and RCP8.5. Model simulations were run from 1986-2099, and results were evaluated by comparing results between the base period (1986-2015) and two future periods: 2040-2069 and 2070-2099. The model simulation results indicate projected mean water table level declines of 25-75 cm by the end of this century (2070-2099) for the RCP8.5 scenario and declines of 20-40 cm for the RCP4.5 scenario. Additional comparisons between the evaluation periods were assessed using mean monthly water levels and empirical cumulative distributions.

In Coastal Plain wetlands, declines in water tables can lead to the subsidence of organic soils, which can lead to

the loss of stored carbon and increased risk of peat fires. Lower mean water levels can also lead to shifts in vegetation community composition, and loss of habitat functions for wetland dependent fauna. These results provide an overview of the potential impacts of climate change on North Carolina wetlands, and provide a range of scenarios to inform and guide possible changes to water management strategies in wetland ecosystems to limit the loss of ecosystem services over the long-term. ■

PRESENTATION P22
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

COMPARISONS OF THE VARIABILITY OF DIURNAL CO2 FLUX IN DIFFERENT AQUATIC ECOSYSTEMS IN BARROW, ALASKA

Uribarri, Fabian, University of Texas at El Paso, El Paso, TX
Lougheed, Vanessa, UTEP, El Paso, TX

The Earth for the last forty years has been warming, on average, to its highest temperatures in recorded history. Global circulation patterns tend to concentrate heat at the poles, making the Arctic one of the fastest warming climates in the world. The Arctic also contains about 33% of the world's total carbon, stored frozen within permafrost; the concern is that warming would allow for the release of carbon and methane, in the form of CO2 or CH4, from the Arctic tundra. Water bodies such as tundra ponds, lakes and streams, may have a significant role in contributing to net carbon flux of tundra systems. The aim of this study was to examine the variations in diurnal carbon dioxide (CO2) flux of three tundra water bodies: a pond, river and a lake. The sites were located in Barrow, Alaska and were monitored continuously using Campbell loggers and Vaisala CO2 sensors over an eight to twelve-day period in 2017. The pond, river, and lake had average CO2 concentrations of 1333 W/m², 1358 W/m², and 512 W/m², respectively; all sites tested had CO2 concentrations greater than atmospheric CO2 (388 W/m²), and can thus be classified as sources of CO2 to the atmosphere. The highest amounts of CO2 (4190 W/m²) were released from the pond, corresponding to relatively high downward total solar irradiance values of 617 W/m². Solar radiation, paired with temperature, explained much of the variability in CO2 within all three water bodies. Accurately recording PAR and temperature at multiple sites with CO2 flux monitoring at each site could give better insight as to the exact effects of solar irradiance on CO2 release in the Arctic. ■

PRESENTATION P25
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

IDENTIFICATION, INVENTORY, AND CHARACTERIZATION OF VERNAL POOLS TO ASSESS VULNERABILITY TO CLIMATE CHANGE

Ortiz-Declet, Nemesis, UW-Madison, Madison, WI

Vernal pools are small and shallow, isolated, ephemeral wetlands that change in volume in response to varying weather patterns. These wetlands are important for maintaining healthy forest ecosystems by providing a critical breeding ground for amphibians, invertebrates and other species. With expected changes in precipitation regimes and temperature trends, vernal pools are at risk of either becoming more established permanent wetlands or drying up. A total of 31 vernal pools previously identified using remote sensing were located, surveyed, and assessed at Indiana Dunes National Lakeshore (INDU) during the summer of 2017. The remote sensing detection method identified 20 potential vernal pools, whereas field surveys identified 31. Data regarding area, depth, percent canopy cover, and presence of invasive species were collected to determine which characteristics make the vernal pools more or less resilient to climate change. The characterization data formed the basis of an initial database that can be used to document the unique features of each vernal pool. Long-term monitoring will provide insight into the resiliency of vernal pools to climate change and inform resource management to promote healthy vernal pools throughout INDU and other Midwestern National Parks. ■

PRESENTATION P23
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

DRIVERS OF CO[SUB]2[/SUB] FLUX FROM OPEN WATER AND VEGETATED MARGINS OF AN ARCTIC TUNDRA POND

Ronquillo, Rocio, The University of Texas at El Paso, El Paso, TX
Lougheed, Vanessa, UTEP, El Paso, TX

Climate change is playing a significant role in the Arctic, with substantial warming over the last 50 years leading to the degradation of permafrost. Much of the Arctic tundra has traditionally been viewed as a net carbon sink; however, the gradual rise in temperature may be causing carbon dioxide (CO2) release at a faster rate from moist and aquatic ecosystems. For this study, CO2 concentrations in the water were monitored continuously over a 14-day period during the last week of July and the first weeks of August 2017

from a single Arctic tundra pond near Utqiaġvik, AK using a CO2 data logger. Climate data was collected from the nearest weather station. The goal was to see how CO2 flux differs among open water and the vegetated margins, and what was the role of climate (temperature, precipitation, and downward total solar irradiance) on these fluxes. Average aquatic CO2 concentrations were highest from the vegetated margins (2729 µatm) than the open water sites (1328 µatm), with both acting as a source of CO2 to the atmosphere. The highest CO2 concentrations at both sites were observed at the start of the study period, during a period of exceptionally warm weather, with a maximum temperature of 20.4 degrees C and a solar irradiance peak of (618 W/m2). The associated implications with high levels of CO2 flux that come with warmer temperatures and from the vegetation margins, which are currently expanding in the region, can affect the balance of carbon flux at the landscape level. ■

PRESENTATION P27
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE PRESENT AND FUTURE DISTRIBUTION OF COTTONWOOD FLOODPLAIN FORESTS IN IDAHO: CONSERVATION AND RESTORATION IN A CHANGING CLIMATE

Murphy, Chris, Idaho Department of Fish and Game, Boise, ID

Once extensive and distinctive of Idaho's river valleys, cottonwood-dominated floodplain forests are now greatly diminished and their long-term viability in question. Historic and on-going impacts, including dams, diversions, and flood control have resulted in relict stands lacking seed-based tree reproduction. Climate-change induced flow alteration is likely to further impact this habitat. Despite the importance of floodplain forests to fish and wildlife (including Threatened yellow-billed cuckoo), and the magnitude of threats, no statewide assessment existed to assist conservation and restoration. The objective was to model cottonwood forest distribution, estimate ecological condition, and predict vulnerability to climate-related hydrologic changes (e.g., snowpack reduction, earlier runoff timing). The distribution of cottonwoods (Populus balsamifera ssp. trichocarpa and P. angustifolia) was estimated by Bayesian hierarchical modeling (JAGS). The distribution output was then filtered to include only floodplains of rivers in minimally confined valleys. These target floodplains were identified, in part, using GIS valley bottom landform models (Utah State University, US Forest Service Rocky Mountain Research Station). The condition of floodplains supporting cottonwood forests was described using existing landscape-integrity model and mapped indicators of hydrologic disturbance. Modeled historic and future river flows for target floodplains were obtained from the Rocky Mountain Research Station (based on Variable Infiltration Capacity model). Current and future (under climate change scenarios) flows were compared to the timing of cottonwood seed dispersal to estimate potential for tree recruitment. Initial results indicate that a majority of natural rivers in western and northern Idaho may experience earlier peak runoff and more rapid flow decline, decreasing the chance of flows coinciding with late-spring cottonwood seed dispersal and seedling growth. In contrast, cottonwood forests may be most viable at higher elevations of eastern Idaho where snowpack supported systems are more likely to persist. Conservation and restoration efforts should focus on river reaches with higher probability of long-term cottonwood reproductive success. Maintenance of undammed rivers is critical to any conservation effort, but simulating natural flows on dam-controlled rivers will be necessary for restoring cottonwood reproduction in many areas. ■

PRESENTATION 1606
PRESENTED DURING *WETLANDS AND CLIMATE CHANGE*, 05/30/2018, 09:55 - 11:35

CLIMATE CHANGE PROJECTIONS OF SEMI-ARID WETLANDS

Halabisky, Meghan, University of Washington, Seattle, WA
Lee, Se-Yeun, University of Washington, Seattle, WA
Hall, Sonia, SAH Ecologia LLC, Seattle, WA
Hamlet, Alan, University of Notre Dame, Notre Dame, IN
Moskal, L Monika, University of Washington, Seattle, WA

Wetland ecosystems are widely considered to be highly sensitive to climate change. However, scientific capacity to model climate impacts to wetlands has been hampered by the lack of accurate maps showing the spatial distribution of wetlands and data on their historical hydrological dynamics. For this project we used object based image analysis and a time series of Landsat satellite imagery to reconstruct hydrographs for thousands of individual wetlands. This remote sensing dataset detected fine scale changes (<30 m) in surface water using a sub-pixel technique called spectral mixture analysis. We then developed wetland specific regression models to understand the relationship between climate and wetland hydrological dynamics by comparing our remotely sensed dataset to soil moisture and groundwater variables simulated by the VIC hydrologic model. We used these regression models to project the impacts of climate change using global climate model scenarios for the 2080s. We found that wetlands within a similar geographic location may have drastically different hydrologic responses under climate change, not only in magnitude, but also in directionality, with some wetlands getting wetter and others getting drier. ■

Global Climate Change: Greenhouse Gas Processes

PRESENTATION 1143
PRESENTED DURING *MONITORING & ASSESSMENT II*, 05/31/2018, 01:10 - 02:50

EFFECTS OF STORAGE TIME AND TEMPERATURE ON GREENHOUSE GAS SAMPLES IN SEPTUM-CAPPED VIALS

Faust, Derek, USDA-Agricultural Research Service, Mandan, ND
Liebig, Mark, USDA-Agricultural Research Service, Mandan, ND

Measurement of greenhouse gas flux occurs in a variety of ecosystems (e.g., wetlands), often with a goal of determining whether an area is a net source or sink of greenhouse gases. Determining gas fluxes using static chamber methods involves collecting samples and injecting them into vials for storage until analysis. In most cases, samples are analyzed immediately following collection. Situations may arise requiring storage of samples in vials until analyses can be completed; yet, few studies have examined impacts of storage time and temperature on greenhouse gas samples. The objective of this study was to determine effects of storage time and temperature on carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). Vials sealed with butyl rubber septa were injected with "low" and "high" CO2, CH4, and N2O concentration National Oceanic and Atmospheric Administration certified standards and stored for 3, 7, 14, 28, and 84 days in four storage areas: room temperature, incubator at 25°C, walk-in refrigerator at 1.67°C, and freezer at -20°C. After the appropriate storage time, vials were removed and analyzed on a gas chromatograph with a thermal conductivity detector for CO2, flame ionization detector for CH4, and electron capture detector for N2O. Preliminary results indicate that the concentration of greenhouse gas samples at low and high concentrations was not impacted by storage of samples for 3 days at any storage temperature. Results from this study will provide researchers that collect and analyze greenhouse gas samples with scientifically supported recommendations for proper storage time and temperature in septum-capped vials. ■

PRESENTATION 1153
PRESENTED DURING *MEASURING WETLAND GREENHOUSE GAS FLUXES: NOVEL METHODS, EXCHANGING IDEAS, AND INFORMING MANAGEMENT*, 05/30/2018, 03:10 - 05:00

DIURNAL PATTERNS OF METHANE FLUX FROM A SEASONAL WETLAND: MECHANISMS AND METHODOLOGY

Bansal, Sheel, U.S. Geological Survey, Jamestown, ND
Tangen, Brian, U.S. Geological Survey, Jamestown, ND
Finocchiaro, Raymond, U.S. Geological Survey, Jamestown, ND

Methane emissions from wetlands are temporally dynamic. Relatively few chamber-based studies have explored diurnal variation in methane flux with high replication across a range of conditions. Using an automated gas-flux sampling system, we measured methane flux every 2.5–4 hours for 205 diel cycles during three growing seasons (2013–2015) from a seasonal wetland in the Prairie Pothole Region of North America. During ponded conditions, fluxes were generally positive (i.e., methanogenesis dominant), with the highest fluxes occurring during late day and lowest at pre-dawn. In contrast, during dry conditions, fluxes were primarily negative (i.e., oxidation dominant), with the highest (least negative) fluxes occurring at pre-dawn and lowest during late day. During semi-saturated conditions, methane fluxes oscillated between positive and negative values (i.e., balance between methanogenesis and methane oxidation) and exhibited no diel pattern. Methane flux was correlated positively with air temperature during ponded conditions (r=0.57) and negatively during dry conditions (r=-0.42). Multiple regression analyses showed that temperature, light and water-filled pore space explained 72% of variation in methane flux. Methane fluxes follow distinct diel patterns dependent on dominant microbial processes, which are influenced by saturation state and temperature. Despite differences in diel patterns, average flux rates generally occurred around midday. ■

PRESENTATION 1379
PRESENTED DURING *MEASURING WETLAND GREENHOUSE GAS FLUXES: NOVEL METHODS, EXCHANGING IDEAS, AND INFORMING MANAGEMENT*, 05/30/2018, 03:10 - 05:00

GEOCHEMICAL CONTROLS ON DIFFUSIVE AND EBULLITIVE METHANE AND CARBON DIOXIDE EMISSIONS FROM PRAIRIE POTHOLE WETLANDS

Mills, Christopher,U.S. Geological Survey, Lakewood, CO
Bansal, Sheel,U.S. Geological Survey, Jamestown, ND
Tangen, Brian, U.S. Geological Survey, Jamestown, ND
Mushet, David, US Geological Survey, Jamestown, ND
Finocchiaro, Raymond, U.S. Geological Survey, Jamestown, ND
Goldhaber, Martin, U.S. Geological Survey, Lakewood, CO
McCleskey, R. Blaine, U.S. Geological Survey, Boulder, CO

The millions of wetlands in the approximately 750,000 km2 North American Prairie Pothole Region have the potential to impact carbon budgets on a continental scale. Quantifying CH4 and CO2 emissions from these wetlands is complicated by the extreme spatial and temporal variability in wetland characteristics that arise from the region's hummocky topography, underlying fine-grained glacial till, and dynamic climate. The major ions SO42-, HCO3-, Ca2+, and Mg2+ are elevated in local groundwater due to interaction with glacial till in which pyrite has been oxidized and the resulting acidity has been neutralized by carbonate dissolution. It is suspected that SO42- exerts a primary control on CH4 emissions as observed for marine systems. We measured major ion concentrations in pond water, CO2 and CH4 flux across the pond water-air interface using static chambers, and dissolved gas concentrations using a novel pumping-induced ebullition device at the Cottonwood Lake Study Area (CLSA) in North Dakota from 2009 through 2016.

The 92 ha CLSA hosts wetlands along a hydrological gradient with [SO42-] ranging from <0.1 mM in recharge wetlands to almost 30 mM in a discharge wetland. Flux rates of CO2 ranged from -115 to 2400 mg CO2 m2 hr-1 and were significantly more positive in recharge and flow-through wetlands than in discharge wetlands. Since 1993, discharge wetlands at the CLSA have contained large expanses of open water and most currently behave like shallow lakes in the region by maintaining alkaline pH and occasionally acting as CO2 sinks despite high concentrations of dissolved inorganic carbon. Recharge and flow-through wetlands are more seasonally flooded with little open water, circumneutral pH, and high dissolved CO2 concentrations. Flux rates of CH4 ranged from -0.3 to 4400 mg CH4 m2 hr-1. Annual growing season fluxes from pond water were negatively correlated with pond water [SO42-] in a relationship similar to salt marshes. We used paired flux measurements and dissolved CO2 concentrations to estimate gas transfer velocities, which were highest for discharge wetlands. Estimates of diffusive CH4 flux were made using gas transfer velocities and dissolved CH4 concentrations and were then compared with flux measurements to estimated ebullitive flux. Ebullition was the dominant CH4 flux pathway from ponded water at the CLSA, but was minimal for wetlands in which [SO42-] was >7 mM. ■

PRESENTATION P28
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ARE METHYLOTROPHIC SUBSTRATES IMPORTANT IN NORTHERN PEATLAND METHANE CYCLING?

Hanna, Emily, Chapman University, Orange, CA
Zalman, Cassandra, Chapman University, Orange, CA
Keller, Jason, Chapman University, Orange, CA

Peatlands are a globally significant source of the potent greenhouse gas methane to the atmosphere annually. In these wetlands, methane is traditionally thought to be produced through two dominant microbial pathways: acetoclastic and hydrogenotrophic methanogenesis. However, prior research shows that methane can also be produced from a variety of methylated substrates, including methanol, dimethylsulfide and trimethylamine (i.e., methylotrophic methanogenesis). The process of methylotrophic methanogenesis has been understudied in peatlands but could be an important source of methane in these globally significant ecosystems.

In order to determine the importance of methylotrophic methanogenesis in northern peatlands, we added 13C-labelled methylated substrates (methanol, dimethylsulfide, and trimethylamine) to soils (0-25, 25-50, 50-75, 100-150, 150-200 cm depths) from three different Sphagnum-dominated peatlands. Over the course of anaerobic laboratory incubations, we traced the production of 13C-methane to quantify the use of the methylated substrates in these soils.

We demonstrated that methylated substrates can be used by peatland methanogens, with methylotrophic methanogenesis occurring in all sites at all depths. Methanol was the favored methylated substrate and was converted to methane in each site at all depths. Overall, dimethylsulfide and trimethylamine were converted to methane primarily in the shallow depths in each site. Preliminary analysis suggests that methanol contributed up to 10% of the total methane produced at depth in only one site, but that the contribution of methylotrophic methanogenesis to overall methane production was minor in surface soils. Ongoing work exploring the concentrations of these methylated substrates in peatlands will help to better describe their importance in methane cycling in northern peatland ecosystems. ■

PRESENTATION 1578
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS II*, 05/31/2018, 01:00 - 02:50

THE ROLE OF PHYSICOCHEMICAL PERTURBATION ON DENITRIFICATION AND NITROUS OXIDE PRODUCTION

Weston, Nathaniel, Villanova University, Villanova, PA
Troy, Cynthia,Villanova University, Villanova, PA
Kearns, Patrick, Michigan State University, East Lansing, MI
Bowen, Jennifer, Northeastern University, Boston, MA
Porubsky, William, Algenol Biofuels, Fort Meyers, FL
Hyacinthe, Christelle, University of Georgia, Athens, GA
Meile, Christof, University of Georgia, Athens, GA
Van Cappellen, Philippe, University of Waterloo, Waterloo, AK, Canada
Joye, Samantha, University of Georgia, Athens, GA

N2O is a potent greenhouse gas and is responsible for significant ozone depletion. Atmospheric concentrations of N2O have risen in response to human activities that have accelerated nitrogen cycling processes globally, such as microbial denitrification in soils and sediments. Substrate availability (NO3- and organic matter) and environmental factors such as oxygen availability, temperature, and soil moisture have been identified as important controls on rates of denitrification, N2O production, and the ratio of N2O to total denitrification (N2O:DNF). In this study, we evaluated the role of physicochemical perturbation, defined as changes to the physical and/or chemical environment, on rates of denitrification and N2O production in soils and sediments. The immediate (<1 day) response of denitrifiers to changes in salinity, temperature, moisture, pH, and zinc was a decline in denitrification but a concomitant increase in N2O:DNF ratios. Net N2O production generally increased under moderate levels of perturbation. We examined the longer-term response of the denitrifying community to physicochemical perturbation through a 1 year incubation of tidal freshwater marsh soils under both freshwater and saline conditions. We found that the microbial community adapted to increased salinity within 3 weeks, beyond which changes back to freshwater conditions exerted a physicochemical perturbation that induced higher N2O production. Higher N2O production was associated with lower nosZ expression, indicating that lack of a functional N2O reductase following perturbation leads to production of N2O as the end-product during microbial denitrification. These results suggest that the denitrifying community has a generalizable short-term response to a broad range of physicochemical perturbations. Increased environmental variability due to land use and climate change may amplify N2O production from soils and sediments, with implications for atmospheric N2O concentrations. ■

Global Climate Change: Sea-Level Rise

PRESENTATION 1041
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS III*, 05/30/2018, 03:20 - 05:00

SOIL AND POREWATER RESPONSE TO SIMULATED SEAWATER INTRUSION IN TIDAL FRESHWATER MARSHES, ALTAMAHA RIVER, GA

Widney, Sarah, Indiana University, Bloomington, IN
Smith, Dontrece, University of Georgia, Darien, GA
Schubauer-Berigan, Joseph, US Environmental Protection Agency, Cincinnati, OH
Elswick, Erika, Indiana University, Bloomington, IN
Craft, Christopher, Indiana University, Bloomington, IN

We experimentally added dilute seawater as Press (continuous) and Pulse (episodic) doses to replicate 2.5 x 2.5 m marsh plots in situ for three years and measured soil attributes, including soil porewater, oxidation-reduction potential, and soil C, N, P, and S content over the course of the study period. Press additions of dilute seawater resulted in increased porewater chloride, sulfate, ammonium, and dissolved reactive phosphorus concentrations, lower soil reduction-oxidation potentials and iron-bound phosphorus, and higher reduced sulfur concentrations relative to control plots. Pulse additions of dilute seawater during typical low flow conditions (Sept.-Oct.) resulted in transient changes in porewater chemistry that returned to baseline conditions once dosing ceased. These biogeochemical changes indicate that persistent saltwater intrusion in freshwater marshes may lead to increased export of N and P from coastal wetlands, potentially exacerbating eutrophication issues. However, marshes show resilience to change in the face of temporary saltwater intrusion. ■

PRESENTATION 1285
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS III*, 05/30/2018, 03:20 - 05:00

INCREASING CARBON STORAGE IN RESPONSE TO HISTORICAL SEA LEVEL RISE, BISCAYNE BAY COASTAL WETLANDS, SOUTHEAST FLORIDA

Meeder, John, Florida International University, edinboro, PA
Parkinson, Randall, Florida International University, Miami, FL
Ross, Michael, Florida International University, Maimi, FL
Castañeda, Santiago,Florida International University, Miami, FL

Coastal wetlands are a major component of the global carbon cycle and historically, under conditions of stable sea

level, were a significant sink. The response of coastal wetlands to future sea level rise is uncertain, as is their role in mitigating greenhouse gas emissions. In southeast Florida, coastal wetlands along the western shore of Biscayne Bay are undergoing rapid change in-state in response to historical sea level rise and associated salt water encroachment. Mangrove communities are migrating inland and into Eleocharis-periphyton and saw grass communities. This has significant implications because each of these plant communities accumulates organic matter – and therefore sequesters carbon – at a different rate. Using Pb210, we quantified wetland accumulation rates of the four sediment types present in the study area. The results are as follows: (1) mangrove peat, 4.1 mm yr-1; (2) mangrove peat marl, 3.2 mm yr-1; (3) marl, 1.25 mm yr-1; (4) saw grass peat marl, 2.3 mm yr-1. These were then converted to total carbon accumulation based on soil organic matter content: (1) mangrove peat, 247 g m2 yr-1; (2) mangrove peat marl, 124 g m2 yr-1; (3) marl, 28 g m2 yr-1; (4) saw grass peat marl, 129 g m2 yr-1. The core transects documented a transgressive stratigraphic succession reflecting the landward migration of coastal wetland. These observations were confirmed by photogrammetric analysis of aerial images acquired for 1938, 1956, 1968 and 2009. These data suggest carbon storage has increased in response to historical sea level rise as mangrove dominated wetlands migrated inland. Future rates of carbon sequestration will depend upon ecosystem response to accelerating rate of sea level rise and freshwater delivery. ■

PRESENTATION 1331
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS II*, 05/31/2018, 01:00 - 02:50

IMPACT OF SEA-LEVEL RISE ON FLORIDA BAY DURING THE HOLOCENE: IMPLICATIONS FOR THE FUTURE

Jones, Miriam, USGS, Reston, VA
Wingard, G. Lynn, U.S. Geological Survey, Reston, VA
Keller, Katherine, Natural Systems Sciences, Reston, VA
Stackhouse, Bethany, U.S. Geological Survey, Reston, VA
Landacre, Bryan,U.S. Geological Survey, Reston, VA

Sea-level rise (SLR) and climate variability have driven environmental changes in south Florida throughout the Holocene. Florida Bay, a shallow carbonate bay located south of the Florida Peninsula, contains carbonate islands and mudbanks that formed as rates of SLR slowed in the mid-Holocene. The islands, often ringed with mangroves, provide wildlife habitat and physical barriers to storm surge, tidal flux, and wave development along South Florida's coastline. With most of South Florida located between 1-2 m above mean sea level, and IPCC AR5 projections of 0.26 to 0.98 m of SLR by 2100 CE, SLR could outpace sediment accretion in the southern freshwater Everglades and Florida Bay islands, impacting wildlife habitat and protection of shorelines from coastal storms. We analyzed sediment cores from four islands in Florida Bay that reached the Plio-Pleistocene limestone bedrock to determine how floral and faunal communities and source carbon (C) change in response to Holocene sea level transgression. We used pollen and mollusk assemblages, δ13C, and C/N ratios, along with radiometric dating, to calculate sediment accumulation rates relative to Holocene rates of sea level rise over the last ~5 kyr. Results show that basal freshwater Everglades peat accreted more slowly than SLR, leading to a transition to Rhizophora (red mangrove) peat 3.5-3 ka and an estuarine environment ~3.2-2.8 ka. As eustatic SLR slowed after 3 ka, mud islands began emerging, as sediment accumulation outpaced SLR. Mud island centers are below sea level and accretion rates over the last 100 years are less than the current rate of SLR. Freshwater Everglades accretion rates over the past 5000 years are too low to outpace current rates of sea level rise. These results suggest that with current rates of accretion and SLR, these islands could disappear in <200 years, impacting the storm surge protection they provide to south Florida. Further, the expansion and persistence of high-accumulating Rhizophora peat is limited by elevated rates of SLR, impacting coastline stability and wildlife habitat. ■

PRESENTATION 1403
PRESENTED DURING *SEA LEVEL RISE*, 05/30/2018, 03:20 - 05:00

RESPONSE OF TIDAL WETLANDS TO RISING SEA LEVEL IN THREE ESTUARIES ALONG THE U.S. SOUTHEAST ATLANTIC COAST

Solohin, Elena, Indiana University, Bloomington, IN
Craft, Christopher, Indiana University, Bloomington, IN

Tidal wetlands are increasingly threatened by global climate change and anthropogenic activities. Future rates of sea level rise (SLR) and altered sediment supply due to land use change may have an impact on future tidal wetland ability to keep pace with rising seas.

We used a combination of soil and plant measurements, and remote sensing to understand how tidal marsh health and resiliency has changed over time along three Southeast estuaries: Cape Fear (NC), Edisto (SC), and Altamaha (GA). Soil accretion and mineral deposition were measured using radiometric dating to determine marsh response to current SLR. Preliminary results revealed that accretion rates for cores collected in GA, NC and SC saltmarshes are on the order of 2-4 mm yr-1, indicating that marshes are keeping pace with

current SLR (2-3.2 mm yr-1). However, remotely sensed time series analysis of tidal marshes biomass and vegetation height reflect regional patterns of vulnerability to SLR, with greatest decline in the health of NC marshes. This is supported by RTK measurements of marsh elevation, which suggest that NC marshes have lower elevation in tidal frame, making them more susceptible to SLR than GA and SC marshes.

Understanding the response of marshes to changes in land use and human disturbances will inform coastal adaptive management in the face of climate change and SLR. ■

PRESENTATION 1480
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS I*, 05/31/2018, 09:45 - 11:35

STORM-DERIVED SEDIMENT PROVIDES ELEVATION CAPITAL IN OTHERWISE SEDIMENT-POOR BRACKISH MARSHES

Cherry, Julia, University of Alabama, Tuscaloosa, AL
Grace, James, U.S. Geological Survey, Lafayette, LA
Vervaeke, William, U.S. Geological Survey, Lafayette, LA

To avoid loss to open water, tidal marshes must maintain surface elevations at rates equal to or exceeding that of relative sea-level rise. Surface elevations are maintained through a combination of both biological and physical processes, with gains from organic matter accumulation and mineral accretion offsetting losses from relative sea-level rise. In sediment-poor marshes, rates of accretion may be insufficient to avoid submergence, resulting in degradation of marsh habitats. To explore the relative importance of surface accretion for elevation maintenance, we monitored patterns of elevation change from 2005 to 2017 using the surface elevation table-marker horizon (SET-MH) approach in two subsiding brackish marshes in southeast Louisiana, USA. Elevation dynamics at the Big Branch Marsh and Pearl River study sites were characterized by periods of organic matter accumulation punctuated by pulses of sediment input during storm events. For example, Hurricane Katrina in 2005 provided 6.3± 0.7 cm and 3.9 ± 0.6 cm in accretion at Big Branch and Pearl River, respectively, with subsequent storms providing smaller pulses of sediment every 3 -5 years. These hurricane-induced sedimentation events offset local subsidence, thereby driving net elevation gains over the 12-year period of 7.2 ± 0.5 cm and 1.6 ± 0.5 cm at Big Branch and Pearl River, respectively. These results underscore the importance of periodic sediment inputs for the successful maintenance of marsh surface elevations. In the absence of regular sediment input, discrete sedimentation events may represent an increasingly important mechanism by which tidal marshes gain elevation capital to keep pace with sea-level rise. ■

Management & Applied Science: Classification

PRESENTATION 1609
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES II*, 06/01/2018, 09:55 - 11:35

PEATLAND TYPES OF WASHINGTON STATE. AN APPROACH BASED ON THE U.S. NATIONAL VEGETATION CLASSIFICATION.

Rocchio, Joe, Washington Dept. of Natural Resources, Olympia, WA

Peatlands are wetlands with a substrate comprised of relatively undecomposed organic material that accumulates due to saturated soil conditions. In Washington, peat origin primarily ranges from peat mosses (Sphagnum species), brown mosses (Amblystegiaceae family), sedges (Cyperaceae family), or woody species. Environmental gradients associated with water source, water chemistry, geological history, and geography result in a wide-range of peatland vegetation types across Washington's landscapes. Because peatlands have high conservation value and because they form over hundreds to thousands of years, numerous regulations and conservation objectives in Washington explicitly address their sensitivity and importance for regional biodiversity. However, most of these efforts use a broad definition of 'bog' when referring to most peatlands. This approach masks important ecological variability which is necessary to understand in order to successfully manage, conserve and regulate impacts to peatlands. To better communicate Washington's peatland diversity, an expert-based, supervised classification was completed using a modification of the U.S. National Vegetation Classification (USNVC). A custom unit, called subgroups, was added to the USNVC hierarchy to describe peatland variability. The subgroup is an aggregation of finer-level units of the USNVC based on shared abiotic characteristics. From 2011 to 2015 data were collected from 304 vegetation relevé plots from 121 different sites. Using field meters, pH was determined from 115 relevé plots and electrical conductivity (EC) from 77 relevé plots. These data were used to validate and modify the expert-defined peatland types. Nonmetric multidimensional scaling ordination was used to explore floristic relationships among expert-defined peatland types. Statistical summaries of pH and EC data assisted in the interpretation of the vegetation data. A total of 18 subgroups, or peatland types, were defined. Phytogeography, pH, EC, and elevation proved to be the most useful criteria for distinguishing subgroups. Relative to the current usage of 'bog' when referring to most peatlands in Washington State, the classification presented here provides a more adequate framework for communicating biodiversity values, distribution patterns, threats, and management needs of Washington's diverse peatland resource. ■

Management & Applied Science: Conservation

PRESENTATION 1025
PRESENTED DURING *CONSERVATION OF WETLANDS*, 05/30/2018, 09:55 - 11:35

MAPPING GROUNDWATER SEEPAGE IN A NORTH DAKOTA FEN USING THERMAL IMAGING

Ozotta, Ogochukwu, University of North Dakota, Grand Forks, ND
Gerla, Phil, University of North Dakota, Grand Forks, ND

Groundwater flow and its dissolved mineral transport plays a fundamental role in the ecology of many wetlands. Installation of equipment to map groundwater seepage, however, is invasive and may damage vegetation and potentially affect biodiversity. By mapping surface temperature remotely in the late summer, when the differential between warm soil and cold groundwater is the greatest, we hypothesize that the temperature patterns will reveal areas of greatest upward gradient and flow.

To test the hypothesis, we monitored the effect that hydraulic gradient has on surface temperatures in a fen located at the north end of the Cherry Lake Aquifer, Eddy County, ND (47.73, -98.66). On-the-ground thermal imaging was used to map seepage, with results compared to conventional method of installing shallow ceramic cup piezometers to measure hydraulic gradient, and flux using Darcy's law. Shallow temperature loggers were installed to characterize soil temperatures at the same sites. The approach was applied at contrasting two locations: an open site in sedge-cattail and a nearby shady willow- cordgrass site.

The open site showed strong upward gradient whereas the brushy site showed variable gradients, perhaps related to greater transpiration. Temperature observations and trends determined from the thermal imagery and thermistors did not show a relationship to hydraulic gradients measured at either site, suggesting variability due to heterogeneity of hydraulic conductivity (K). Thus, application of thermal imaging to map groundwater discharge requires data on soil stratigraphy. Currently, we are using inverse modeling of temperature profiles to better characterize shallow variation of K. ■

PRESENTATION 1045
PRESENTED DURING *CONSERVATION OF WETLANDS*, 05/30/2018, 09:55 - 11:35

BRINGING COWARDIN TO ALASKA: INFERENCE OF WETLAND AND DEEPWATER TYPE FROM LANDCOVER MAPPING.

Steer, Anjanette, University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Flagstad, Lindsey, University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Aisu, Megumi, University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Boucher, Tina, U.S. Forest Service, Anchorage, AK

Here we present the first effort to delineate wetland and deepwater habitat for all of Alaska using the National Wetlands Inventory (NWI) classification system. Although over 40% of Alaska is estimated as wetland, less than 50% of the state has been mapped by the National Wetlands Inventory. Climate change is likely to unbalance Alaska's historic stability of wetland condition, particularly in the Arctic where a warming climate disproportionately effects landscapes underlain by ice-rich permafrost. Here, global sea level rise, warming water and air temperatures, reduction in sea-ice cover and duration, and increased frequency and strength of storms combine to amplify the effects of thermal erosion, salinization and paludification. To provide timely wetland information for the areas lacking a formal NWI map, the Alaska Center for Conservation Science (ACCS) inferred wetland and deepwater type from landcover and hydrologic geospatial data as proxy indicators.

Using a recently-constructed landcover mosaic with 30 m resolution, we assigned the most appropriate wetland or deepwater type to each unique landcover class in accordance with the Cowardin classification system. To give greater resolution to waterbody type (lake, pond, river) and salinity (freshwater, brackish, saltwater), we intersected the landcover mosaic with geospatial information derived from the National Hydrologic Dataset (NHD) and the National Wetland Inventory (NWI) and reclassified types as necessary. The final map includes 2,691 unique landcover classes and approximately 4,600 wetland and deepwater equivalents. Wetland map accuracy was assessed using a set of randomly-selected validation points sourced from NWI Status and Trend plot data as well as stream gauge monitoring sites maintained by the National Water Information System (NWIS). Overall map accuracy was 66%, which suggests fair accuracy.

The statewide wetland map will be available as a geodatabase from the ACCS website and may be explored within an interactive data portal that allows users to display wetland, deepwater, and more general landcover distributions through an intuitive interface. This statewide wetland

map is expected to promote the efficient and effective management of wetland and deepwater habitats by providing a uniform and comprehensive inventory of both common and rare types, from which reference condition may be assessed, future condition may be modeled and, subsequently status and trend may be monitored. ■

PRESENTATION P31

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

MAPPING AND CONSERVATION NEED OF RARE WETLAND ECOSYSTEMS IN ALASKA

Lema, Priscilla,University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Flagstad, Lindsey, University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Steer, Anjanette, University of Alaska Anchorage - Alaska Center for Conservation Science, Anchorage, AK
Boucher, Tina, U.S. Forest Service, Anchorage, AK

Biological conservation is most effective when limited resources can be directed towards the species, habitats, and environmental processes of greatest need. Rare ecosystems, which support unique assemblages of specialized and/or diverse flora and fauna within a small geographic area or restricted range, often represent vulnerable elements of biodiversity. Here, we provide the first comprehensive list of Alaska's rare wetland ecosystems. This list includes rarity rankings and a gap assessment of rarity rankings relative to current level of protection, and will be used to evaluate conservation need. 15 rare wetland ecosystems, representing different levels of biological organization (e.g. the plant association and biophysical setting), geographic scale (e.g. local, intermediate, and coarse), and rarity (e.g. S2 - imperiled, S3 - vulnerable, and S4 - apparently secure) are described and mapped. All 15 ecosystems are considered of conservation concern as their ranking is S4 or greater. Rarity rankings indicate that nine ecosystems are 'apparently secure', five are 'vulnerable', and one is 'imperiled'. Evaluation of current level of protection indicates that only one of 14 mapped wetland ecosystems is adequately protected with at least 50% of its distribution managed for biodiversity. More broadly, designations of wetland ecosystem rarity and level of protection are inconsistently aligned, in so far that imperiled systems are not necessarily well-protected and well-protected systems are not necessarily imperiled. The wetland systems presented here are of conservation concern due to inherent rarity or susceptibility to threats. While some systems owe their rarity to conditions of geomorphology and nutrients, other systems are threatened by our rapidly changing climate and anthropogenic threats. Wetland systems linked to climate change are considered more imperiled than those developing from unique geomorphological or high nutrient conditions. Mapping of these systems will allow further research into the effects of climate change or anthropogenic threats on ecosystem rarity. This assessment of rare wetland ecosystems is expected to promote the efficient and effective management of wetland and deepwater habitats by providing an assessment of current baseline condition and protection status from which reference condition may be assessed, future condition may be modeled, and subsequently, status and trend may be monitored. ■

PRESENTATION 1094

PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED I*, 06/01/2018, 09:45 - 11:35

HOW FAR CAN WE GO WITH SCIENCE AS A BRIDGE?

Wang, Hsiao-Wen, National Cheng Kung University, Tainan, Taiwan
Dodd, Adrienne, National Cheng Kung University, Tainan, Taiwan
Wang, Frank, National Cheng Kung University, Tainan, Taiwan
Kuo, Pin-Han, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA

Creating wise use management plans for a wetland requires an understanding of the functions and ecosystem services that the wetland provides. But such basic processes are being ignored as Taiwan pushes its new green energy policy, pressuring agencies in charge of implementing the wetland act of Taiwan to twist the meaning of wetland wise use to include utility solar. Budai Salt Pan wetland, located on the southwestern coast of Taiwan, is one of the wetlands facing solar development. Through participatory research, 11 ecosystem services were identified in Budai Salt Pan wetland, and through ecological assessments, the wetland was found to hold critical habitat for a diverse array of water birds, including the endangered Black-faced Spoonbill, Great Knot, Baer's pochard, Nordmann's greenshank, and the Far Eastern curlew. Hydraulic surveys, modeling, and experiments showed that flood mitigation and habitat quality in the wetland could both be enhanced through water management, providing the possibility of reducing flood risk in the surrounding communities. Though this research is on hand, these factors were not considered when developing solar development plans in the wetland. In order to protect Taiwan's wetlands, and support a sustainable transition to green energy, we worked with experts to create a holistic framework for finding least conflict siting of solar panels, focusing on mixed use designs in energy centers as oppose to rural coastal wetlands. As wetlands will continue to be considered for solar development in Taiwan, we also cre-

ated a Checklist assessment for the Taiwanese government to follow in order to understand if a wetland is appropriate for solar development, and if so, what regulations should exist to mitigate harm. This assessment requires decision makers to identify and protect critical ecological areas and critical ecosystem services in order to ensure there is at least a minimum level of protection for both the species who require the wetland habitats, and the communities who rely on the wetland ecosystem services. ■

PRESENTATION 1242
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES I*, 05/30/2018, 09:45 - 11:35

INTEGRATING SCIENCE, PRACTICE, AND POLICY IN THE NORTH AMERICAN WATERFOWL MANAGEMENT PLAN

Gammonley, Jim, Colorado Parks and Wildlife, Fort Collins, CO

Since its implementation in 1986, the North American Waterfowl Management Plan (NAWMP) has been a major driver of wetland conservation across the continent. The policy and institutional framework that guides the NAWMP is built around continental-scale conservation objectives and regional-scale, partnership-driven delivery of habitat conservation through Joint Ventures. Critical funding sources are strongly leveraged through a variety of partnerships, and by 2012 NAWMP partners had invested over $4 billion (US) in protection and restoration of over 15.7 million acres of wetlands and associated upland habitats in Canada, the U.S., and Mexico. A strong science foundation facilitates planning, monitoring, and adaptive implementation of conservation. Periodic updates are a key feature of the implementation of the NAWMP, and in 2012 a major revision was completed that added an explicit goal for growing engagement and support from people with wide-ranging conservation interests, complementing existing goals for waterfowl populations sufficient to sustain human use, and sufficient habitat to support waterfowl populations and human desires. To achieve specific objectives associated with these interrelated goals, NAWMP-related activities include waterfowl harvest management, prioritizing landscapes for conservation, habitat conservation delivery, and social science to understand and increase public engagement and broaden support. Although the NAWMP is focused on conservation of waterfowl, public interest in and support for additional ecosystem services provided by waterfowl habitats provides a pathway to broaden and strengthen public support for the NAWMP and engage people in wetland and wildlife conservation. Improved scientific understanding and communication of linkages between waterfowl habitat conservation efforts and other beneficial ecosystem services will help keep the NAWMP relevant and successful. ■

PRESENTATION 1323
PRESENTED DURING *AFRICAN RIVERS*, 06/01/2018, 01:10 - 02:50

BUFFER ZONES - PROTECTING RIVERS, WETLANDS AND ESTUARIES IN SOUTH AFRICA

Bredin, Ian, Institute of Natural Resources, Pietermaritzburg, KwaZulu-Natal, South Africa

To date, good progress has been made to define and delineate wetland and riparian areas. This progress has culminated in the production of useful tools to assist in identifying and delineating wetland and riparian areas. However, limited guidance has been provided for the establishment of buffer zones. The objective was to address this gap by developing a method for determining appropriate buffer zones, which could be consistently applied to guide land use decision making around South Africa's wetland, river and estuarine resources. The method developed included a tiered approach to facilitate decision making. The relationships of the criteria used to model the buffer zone requirements, which include identifying core habitat areas, and the levels of risk associated with the proposed activity on water resources were the primary drivers. Site-based modifiers were developed to address site specific characteristics, which were identified to have either a reduced or enhanced effectiveness on buffer zones. Additionally, alternative mitigating measures, which are more effective at addressing a range of impacts, were investigated to support the development of buffer zones. Ultimately, the method for determining buffer zones aims to help reduce the impacts of adjacent land uses on wetland, river and estuarine resources. ■

PRESENTATION 1352
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS III*, 06/01/2018, 01:10 - 02:50

A HYDROGEOLOGIC APPROACH TO CONSERVATION PLANNING FOR WETLANDS AND THEIR LANDSCAPES

Sherrod, Susan, Biohabitats, Denver, CO
Browne, Claudia, Biohabitats, Denver, CO

Hydrogeologic frameworks, which characterize how water moves within a landscape and supports high ecological resources like wetlands, can be used to identify a network of functional zones that account for (1) multiple scales, (2) ecohydrologic relationships and other ecological features, and (3) community values. Using hydrologic functional zones as the basis for planning and strategy selection helps identify stressors to wetlands as well as their contributions to productivity, water storage, stabilization, and other ecosystem functions. This approach can be used to tailor conservation strategies to specific stakeholder goals that benefit wet-

land resilience, prioritize complementary opportunities for conservation and restoration, and inform decision-makers with alternative climate change and land use scenarios. Our applied ecology approach includes synthesis of soil, geology, land use, hydrology, and habitat maps and other data; identification of needs, opportunities, and constraints including land use and community priorities; using GIS modelling to intersect areas of high ecological value and/or potential with important social variables; and development of management recommendations including an adaptive management program following implementation. Wetlands and floodplains are weighted as a high conservation priority in the sensitivity analysis. We provide examples with disparate management challenges and goals, including one from the greater metro area of Kansas City encompassing urban, suburban, and rural development, and another from a southern Colorado grassland preserve. We have found that using hydrogeologic frameworks not only supports large-scale and long-term ecosystem resilience and reduces ecological risk and maintenance needs, they can also prioritize communities, fortifies partnerships, and aids funding potential. ■

PRESENTATION 1392

PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS III*, 05/31/2018, 03:10 - 05:00

ARID WETLANDS: CHALLENGES AND OPPORTUNITIES

King, Sammy, U.S. Geological Survey, Baton Rouge, LA
Laubhan, Murray, U.S. Fish and Wildlife Service, Stafford, KS
Vradenburg, John, U.S. Fish and Wildlife Service, Tulelake, CA
Henry, Adonia, Scaup & Willet LLC, King Salmon, AK

Arid wetlands are dynamic, extremely productive systems that are highly resilient, adapted to drought, and quick to respond to water availability. Changes in climate pose a potential threat to all arid wetlands, although considerable uncertainty exists in the magnitude and types of changes that may be expected globally. In contrast, water diversions, groundwater pumping, and the general overallocation of water for various uses are negatively impacting arid wetlands now and will certainly impact them in the future. Although these systems are adapted to drought, there are limits to their resiliency. Globally, the socioeconomic pressures that are a primary determinant of water use and development vary among countries due primarily to prevailing economic conditions, food demands, governance type, and cultural values. In the U.S., studies indicate that farm and water subsidies, globalization of agricultural markets, and the lack of local governance can lead to unsustainable water use of many current agricultural systems. Furthermore, these agricultural systems do not provide the suite of services provided by natural arid wetlands nor do they exhibit the same resiliency because sustainability is reliant on artificial subsidy systems that can change quickly over broad scales. However, many such agricultural systems are critical to global food supply and it is expected that water challenges will persist, and even increase in magnitude, into the foreseeable future. In spite of these challenges, several examples indicate that collaborative efforts, particularly when aligned with effective governance structures, can lead to more sustainable water use. ■

PRESENTATION 1404

PRESENTED DURING *CONSERVATION OF WETLANDS*, 05/30/2018, 09:55 - 11:35

GATHERING GLOBAL EVIDENCE ON THE EFFECTS OF INTERVENTIONS TO CONSERVE WETLAND VEGETATION: PEATLANDS AS A FIRST STEP

Taylor, Nigel, Tour du Valat, Arles, France, France
Grillas, Patrick, Tour du Valat, Arles, France, France
Sutherland, William, niversity of Cambridge, Cambridge, United Kingdom

Effective and efficient conservation should be based on scientific evidence. This requires an exchange of expertise between researchers, practitioners and policy makers from all over the world. The Conservation Evidence project facilitates such exchange by providing a free online database of scientific tests of conservation interventions. Users can consult the database when making conservation decisions and/or feed evidence into the database by publishing their own tests of interventions.

Currently, we are expanding the database by collating evidence for the effects of interventions to conserve wetland vegetation. This presentation will give an overview of the wetlands project, with results from the first steps on peatlands.

Wet peatlands (e.g. bogs, fens and peat swamps) harbour unique, and sometimes high, biodiversity. They provide multiple ecosystem services. However, they are threatened by disturbances such as drainage, agriculture and peat extraction. Sometimes, active intervention is needed to protect or restore peatland vegetation.

With a global team of experts, we identified over 120 conservation interventions that might benefit peatland vegetation. Based on systematic literature searches and recommendations from an international advisory board, we collated and summarised over 150 papers and reports that tested the effects of these actions on peatland vegetation.

We captured no published evidence for almost half of the interventions. We found relatively few studies from

Russia, Africa, South America and tropical peat swamps: most studies came from North America and Europe. Rewetting and planting are popular interventions, and the evidence suggests they are generally effective and benefit peatland vegetation. On the other hand, altering disturbance regimes on peatlands (e.g. adding or removing grazing livestock, or using prescribed fire) may be effective and beneficial in certain contexts, but ineffective or harmful in others. Conservation Evidence presents the details of experiments to help peatland conservationists understand the likely outcomes in their circumstances.

Our synopsis of evidence provides a useful overview of peatland conservation interventions and should facilitate the exchange of expertise. Use this evidence, but keep generating more to fill the gaps! ■

PRESENTATION 1422

PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS III*, 05/31/2018, 03:10 - 05:00

COST OF CONSERVATION: TURNING RISKS INTO LEVERAGE POINTS TO SUSTAIN AN OASIS IN JORDAN'S DESERT

Linton, Colette, Methods for Agriculture and Irrigation, University of Jordan, Jordan Enviro Union, Rural Family Soci, Amman, Amman, Jordan

The Azraq Wetland Reserve stands out in the Middle East as a host to numerous migrating birds on their journey along the African-Eurasian flyway, and 27 years ago it was the only spring-fed oasis in the region. Since 1994, it has been artificially supported by pumping groundwater from its own basin into the wetland. This practice aids to superficially sustain about 10 percent (50,000 m2) of the oasis' former expanse. However, the basin's fragile restorative efforts continue to be threatened as the basin below the oasis continues to be a major source of water supplies to Jordan's capital and other municipalities. Due to water demand, agricultural and industry operations, overabstraction from the Azraq Basin represents a drop in the water level between 2-4 meters annually, making the oasis a physical and visual embodiment of the country's severe situation of degraded and decreased available water resources.

Conservation and the adaptive capacity of the Azraq Wetland Reserve is closely tied to local and national policies and initiatives that attempt to secure solutions for food security, population influxes and economic competitiveness. As its continued existence represents the effectiveness of local and national management strategies and policy, this Vulnerability Assessment uses the Azraq Wetland Reserve as a focal point to inform stakeholders of the value of this reputed reserve and, respectively, the cost of preserving it amid the country of Jordan's integrated environmental, social and economic complexities.

This research outlines avenues to meet the cost of conserving the Azraq Wetland Reserve within the local and national context against the backdrop of the expected consequences of climate change. The report also lays the groundwork for integrated impacts modelling to assess the extent of the Azraq Wetland Reserve's sustained status as a site of international ecological and public significance (Ramsar site), wherein scenarios map out a desired outcome for the site against social, environmental and climate consequences. ■

PRESENTATION 1450

PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED II*, 06/01/2018, 01:00 - 02:50

THE ELF OF THE WETLANDS IN TAIWAN—RESTORATION OF TAIPEI GRASS FROG

Liu, Cheng-Hsaing, Taiwan Wetland Resoration Society, Hsinchu County, AK, Taiwan

More than 100 years ago, people in Taoyuan County, Taiwan, built ponds for water storage. Over 10,000 ponds as shiny and beautiful as jade made Taoyuan the area of highest pond density in the world and formed a dense ecological network. After the Kuomintang government retreated to Taiwan in 1949, the Shimen Reservoir was built and ponds have gradually lost their function of water storage. Many people began to drain the ponds and reclaimed the land for housing construction. As a result, the number of ponds decreased sharply and indirectly led to the disappearance of many wetland species. At that time, the cross-strait relations between Taiwan and mainland China were tense. Worrying that Mao Zedong would destroy the Shimen Reservoir, so Jiang Kai Shek connected several ponds in the Yangmei area to form a reserve storage pond for battle readiness, of which No. 731 pond has remained the same for 50 years because of its isolated location, and has become the last habitat of many native species in Taiwan.

Taipei Grass Frog is very small in size and has beautiful golden folding lines on the back. It, elusive like a fairy, appeared and disappeared in the grass by the water, a wetland species in farmland and irrigation canals in western counties of Taiwan. It was first discovered by an American scholar in 1909, who named it Hylarana taipehensis. However, with the destruction of wetlands and the reduction of habitats, there are only totally less than 100 this endangered frogs found in four locations in Taiwan. Due to the demand on

high quality water and environment, the existence of Taipei grass frog reflects the good environmental conditions of wetlands and it becomes an indicator species of Taiwan's wetlands. There were nearly 200 Taipei grass frogs in No. 731 pond according to a survey conducted in 2005, but there were only seven according to a survey conducted a few years later. It is believed that this may resulted from improper management of wetlands and the pollution in the nearby irrigation canals.

Since 2015, the team has found that during the day, the Taipei grass frog likes to stay on the secret berm plants on the bank 10 ~ 35cm away from the water and breeds next to the floating plants at night, and disperses the eggs on the aquatic plants in the area 3 to 5 meters in diameter. As a result, the team succeeded in stabilizing the growth of the population of Taipei grass frogs by growing more aquatic plants, creating habitats for the frogs to forag ■

PRESENTATION P32

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

PRESERVING AND MONITORING LOCALLY IMPERILED SWEETGRASS POPULATIONS ON THE ROCKY BOY INDIAN RESERVATION, MONTANA.

Gopher, Keith, Chippewa Cree Tribe, BoxElder, MT
Luna, Tara, Rocky Mountain Botany, East Glacier Park, MT

Sweetgrass (Hierochloe hirta) is the most important cultural plant of the Chippewa-Cree Tribe and is a cool-season, wetland dependent species occurring in the semi-arid northern Great Plains, Montana. Local populations hold tremendous cultural and historical value to the Tribe as they are the same populations and wetlands that were gathered by previous generations. Only one generation ago (50-60 y), sweetgrass at Rocky Boy was extensive in riparian meadows associated with perennial streams. Today, our populations are locally highly imperiled. Elder knowledge was utilized to map the size, extent, and number of historical populations, locate extant remnant populations, and to determine phenology, growth and cultural practices associated with local sweetgrass populations. We are using traditional picking practices and fencing to sustain local populations. Population trends from our 6 year monitoring study have shown warming temperatures are correlated to leaf stem density decreases at extant sites. Periodic severe drought (2017) resulted in early summer dormancy. We will expand our study to include springs and fens that may support the species in the future. Project work has resulted in cultural springs and wetlands protection regulations within the Tribe. Future work will include development of specific, wetland water quality standards that account for our existing water quality and local geology. These standards will ensure persistence of our local sweetgrass ecotypes, as well as other wetland cultural plants, that are specifically adapted to our waters. ■

PRESENTATION 1553

PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES I*, 05/30/2018, 09:45 - 11:35

RECHARGING A COMMUNITY THROUGH PLAYA CONSERVATION

Bartuszevige, Anne, Playa Lakes Joint Venture, Lafayette, CO
Carter, Michael, Playa Lakes Joint Venture, Lafayette, CO

Playas are small, ephemeral, recharge wetlands, found throughout the shortgrass prairie ecoregion of the Great Plains of the United States. As points of recharge to the High Plains (Ogallala) Aquifer, playas are a primary source of recharge contributing up to 95% of the inflow of water to the aquifer. Playa Lakes Joint Venture (PLJV), is a non-profit whose mission is to conserve playas and grasslands - through partnerships - for birds, other wildlife and people in the western Great Plains. PLJV has invested considerably in science to understand the ecology and hydrology of playas and in human dimension science regarding landowner attitudes towards conservation of playas in the Great Plains. An early landowner survey revealed that landowners are most willing to do conservation that will benefit the High Plains aquifer. Thus, we have spent the last 10+ years educating landowners about the hydrological link between playas and the aquifer. Recently, the city of Clovis, NM contacted the PLJV to help develop a playa conservation strategy for the city and county as part of their Water Assurance Plan. Clovis, NM is a city of approximately 40,000 people in eastern New Mexico. It is supported by an agricultural economy and by nearby Cannon Air Force Base. It is projected there is less than 30 years of water remaining in the aquifer around Clovis; thus water conservation is critical for this community. We will discuss how PLJV is working with Clovis, NM, the science that directed the development of the playa conservation portion of the Water Assurance Plan, and how PLJV is planning to replicate this model in other communities throughout the Great Plains. ■

PRESENTATION 1576
PRESENTED DURING *CONSERVATION OF WETLANDS*, 05/30/2018, 09:55 - 11:35

WETLANDS OF COLORADO'S FRONT RANGE

Giolitto, Marianne, City of Boulder, Boulder, CO

The type and distribution of wetlands along Colorado's Front Range has changed significantly over the past 200 years. The Front Range has seen the same increase in ponded wetlands observed in other parts of the country as development has converted various wetland types, and even upland areas, to stormwater detention basins. But the shift in wetland type and distribution in Colorado, and much of the arid West, began much earlier. As soon as Europeans began to settle in Colorado, they also began to redistribute its water across the landscape. Early European settlers to the Front Range built an extensive system of irrigation ditches and storage reservoirs across the landscape, bringing water to historically dry areas. This irrigation and storage system, built nearly 200 years ago, is still in use today. While water management has driven the loss of riverine wetlands, it has given rise to new wetlands in new locations. In some locations along the Front Range, like on lands managed by the City of Boulder's Open Space and Mountain Parks Department (OSMP), wetlands created or supported by water management account for a large portion of the area's wetland acreage. This talk will provide an overview of the types of wetlands found on OSMP-managed land, including wetlands created or supported by water management, and explore the challenges OSMP faces in trying to conserve these wetlands, while balancing the needs of water users and aquatic habitats from which water has been diverted. ■

Management & Applied Science: Delineation

PRESENTATION 1227
PRESENTED DURING *WETLAND REGULATIONS & DELINEATION*, 05/30/2018, 03:20 - 05:00

A CHALLENGING WETLAND DELINEATION IN RED ALLUVIUM OF THE EASTERN MOUNTAINS: WHEN TO USE RULES AND WHEN TO APPLY ECOLOGICAL PRINCIPLES

Nunley, Janet, Environmental Resources Management, Tampa, FL
Richardson, Travis, T. Richardson Soils & Environmental, LLC, Gainesville, FL

A Nationwide Permit 12 under Section 404 of the Clean Water Act, which allows for less than 0.5 acres if impact per wetland crossing, was submitted for a 170-mile pipeline project in West Virginia. The U.S. Army Corps of Engineers (Corps) reviewed the wetland delineations and questioned a 2.5-acre forested area that was not delineated as wetland. If this area was determined to be wetland it would require an individual permit substantially changing the scope and timeline of the project.

The objective was to evaluate the site characteristics consistent with the Corps wetland delineation manual/regional supplement and to provide sufficient documentation to the Corps to justify the delineation.

Multiple transects were established across the 2.5-acre site to determine the status of hydrology, vegetation, and soils. The initial assessment was completed in fall when the site was dry and included 16 data points. The reevaluation was completed in spring when the site was wet and included 18 additional data points. How the site functioned in the larger ecological landscape was also considered.

The initial impression of vegetation was misleading. Though many upland data points met the wetland vegetation indicator, neither hydrology nor hydric soil indicators consistently occurred. Water stains on trees were present, but represented an aberrant event. Some of the newly delineated wetland areas lacked indicators of hydric soils. Ecological evaluation of site functions was a stronger driver of the wetland determination in these problematic areas than strict adherence to the wetland delineation criteria.

The site represented a challenging wetland delineation that when wet or dry did not meet all criteria for a wetland determination. The Corps' Eastern Mountain and Piedmont Regional Supplement describes areas with red parent material as being particularly problematic and our evaluation was consistent with this issue. When evaluating these areas during the dry season, additional investigation is warranted as evidenced by the results of this study. ■

PRESENTATION 1284
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS I*, 06/01/2018, 01:00 - 02:50

1,000 ACRES: A DELINEATION APPROACH

Thames, Kelly, HDR, Charlotte, NC
Wilk, Rebecca, HDR, Richmond, VA

Delineating a 1,000 acre project area can be challenging, particularly when a site is remote, has rough terrain, and limited access. Regardless of how much preliminary investigation occurs beforehand, each site typically has unique, unexpected obstacles. Experienced delineators have certainly encountered the joys of briars, disturbed areas, sinkholes, agricultural ditches, and pesky ephemeral/intermittent breakpoints, all of which can not only delay the project, but cause frustration,

injury, and lower morale. How does one perform her due diligence when all hope seems lost? This presentation discusses our preparation and delineation of a 1,000 acre site in the Southern Coastal Plain of Mississippi that exhibits characteristics of the Eastern Mountains and Piedmont Region, including plant communities, soils, and topography. Though not all field conditions can be predicted, the desktop analysis and planning stage was crucial. Splitting the project area into subsections based on drainage area, or "sub-watersheds," was a strategy employed to manage the coverage of 1,000 acres. Review of available geographic information system (GIS) files and utilizing ArcPad not only expedited the field work, but allowed delineators to visualize the project and collaborate with other teams on-site. Familiarity with threatened and endangered species in the vicinity of the project facilitated potential habitat evaluation during the delineation. Knowledge of soil textures, typical plant communities, and site-specific drainage patterns provided feature comparisons within each sub-watershed and throughout the entire project area. In accordance with the Clean Water Act (CWA), any on-site wetlands and/or Waters of the United States are regulated by the US Army Corps of Engineers (USACE) and the Mississippi Department of Environmental Quality under Section 404 and Section 401 of the CWA, respectively. Anticipated impacts to these environmentally sensitive areas require delineation confirmation by the USACE and Section 404/401 permit issuance prior to any disturbance. ■

PRESENTATION 1351
PRESENTED DURING *WETLAND REGULATIONS & DELINEATION*, 05/30/2018, 03:20 - 05:00

"THERE ARE NO WETLANDS ON OUR PROJECT, THOSE ARE JUST HIGH ELEVATION MEADOWS" A CASE STUDY

Wilson, Jamie, Stanley Consultants, Centennial, CO
Black, Rick, Stanley Consultants, Murray, UT

Science and policy education within our internal project teams is essential to delivering an on-schedule and within-budget project. Many project engineers have not been trained in identification of sensitive natural resources. If project engineers are not aware of the need to engage wetland scientists early on at project conception, sensitive resources such as wetlands, may be impacted to an excessive degree. Late-hour permitting of resources that could have been avoided can cause project delays which could include budget overrun, and often more importantly, impacts to the schedule.

This case study includes a linear project through a high elevation meadow in Colorado. Natural resource scientists were brought into the project team after the alignment was designed and the construction schedule had been developed. The engineers had no permitting concerns because 'there are no wetlands on our project, those are just high elevation meadows'. Upon preliminary investigation, the wetland scientists recognized the importance of the wetland complex, through which the alignment had been designed. Upon further field analysis, it was confirmed that these 'high elevation meadows' were indeed wetlands, and further they were adjacent to a highly sensitive fen wetland complex.

Lessons learned include the importance of bringing the entire project team, including all resource specialists, on board at the inception of a project. Design engineers and resource specialists together can identify potentially sensitive areas that need to be avoided in design, to reduce permitting costs and time investments. ■

PRESENTATION P33
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ISSUES FOR HYDROPHYTIC VEGETATION DETERMINATION IN WETLAND DELINEATION: UNDERSTANDING THE PREVALENCE INDEX VS. HYDROPHYTIC COVER INDEX

De Steven, Diane, USDA Forest Service, Charleston, SC

The 1987 Wetland Delineation Manual defines vegetation as hydrophytic if it is dominated by hydrophyte species. The Prevalence Index (PI), an abundance-weighted average of species wetland-fidelity ranks, has been shown to be a reliable metric for determining if vegetation is hydrophytic. Under the current criterion (rule) that a determination is positive if the PI value is 3.0 or less, there are occasional discrepancies between the PI result and the relative amount of hydrophyte cover. Consequently, a Hydrophytic Cover Index (HCI) has been proposed as an alternative metric, in part because of a misperception that the PI is biased towards non-hydrophytes. To the contrary, mathematical analysis demonstrates that: 1) the PI and HCI are analogous weighted averages of wetland-indicator ranks, 2) neither index is biased, and 3) the two indices emphasize different aspects of vegetation composition. Empirical data suggest that apparent discrepancies arise not from the PI itself, but from the chosen PI criterion and lack of a "rounding-off" rule for values just above the 3.0 threshold. In comparison, the HCI rule (where > 50% relative cover of hydrophytes is a positive determination) implies a subtle shift in how hydrophytic vegetation is defined. The HCI is insensitive to which types of hydrophytes are present, so the HCI rule could produce more positive determinations than the PI when facultative (FAC) species predominate. In field settings, both indices are still likely to yield some ambiguous

results, owing to the inherent imprecision of any threshold value and to recent changes in the treatment of FAC species. Both methods rely on the ability to obtain consistent and repeatable visual estimates of species cover. ■

Management & Applied Science: Ecosystem Services

PRESENTATION 1055
PRESENTED DURING *RIPARIAN ECOSYSTEMS III: RIVER REGULATION AND RESTORATION*, 05/31/2018, 03:10 - 05:00

EMERGING DELTAS IN REGULATED RIVERS: CONTRIBUTION TO RIPARIAN BIODIVERSITY

Volke, Malia, New Mexico Department of Game and Fish, Santa Fe, NM
Johnson, W. Carter, South Dakota State University, Brookings, SD
Dixon, Mark, University of South Dakota, Vermillion, SD
Scott, Michael, Utah State University, Fort Collins, CO

Sedimentary deltas are forming near tributary and mainstem confluences in most of the world's reservoirs, especially those in dryland climates. Their emergence above reservoir water levels may signal the return of some terrestrial habitats lost when floodplains were permanently flooded. As such, deltas may be contributing passively to ecosystem recovery in regulated rivers as they increase in area and in elevation. This study was conducted on the heavily regulated Missouri River, USA to determine if delta plant communities are comparable to the historically dominant Populus-Salix forests destroyed decades ago by damming and failing to establish under the current flow regime on remnant floodplain sections between reservoirs. Our research focused specifically on the delta forming at the confluence of the sediment-rich White River and Lake Francis Case in South Dakota. Objectives of the research were to: (1) quantify spatial and temporal changes in the channel structure and floodplain vegetation; (2) compare delta vegetation to that of natural stands upstream on the White River and on the Missouri River floodplain; (3) determine if modification of reservoir management could improve forest reproduction on deltas; and (4) identify findings that would assist the recovery of other applicable, regulated rivers. The thalweg of the lower 31 km of the White River channel aggraded by up to 12 m between 1954 and 2011, while the aggraded channel flattened from 0.70 m/km to 0.29 m/km. Riparian Populus-Salix forests increased in area by nearly 50 percent during the post-dam period by colonizing abandoned agricultural land and deltaic deposits. Woody plant biodiversity on the delta was very similar to that in stands on the Missouri and White Rivers not influenced by reservoirs. Woody species sorted along the 120-km long study reach; wetland affiliated species dominated near the reservoir while upland affiliated species dominated upstream of the reservoir influence. The evidence is clear that this delta is supporting vegetation on the decline in the upper Missouri River; deltas managed either passively or actively have considerable potential now and as they expand to assist in the recovery of regulated rivers. ■

PRESENTATION 1202
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS II*, 05/31/2018, 01:00 - 02:50

INFLUENCE OF LAND USE AND THE CONSERVATION RESERVE PROGRAM ON NATIVE INVERTEBRATE POLLINATOR COMMUNITIES IN THE LLANO ESTACADO

Begosh, Angie, Oklahoma State University, Stillwater, OK
Smith, Loren, Oklahoma State University, Stillwater, OK
McMurry, Scott, Oklahoma State University, Stillwater, OK

One of the goals of the White House's Memorandum on Creating a Federal Strategy to Promote the Health of Honeybees and other Pollinators was to increase the value of pollinator habitat in the USDA's Conservation Reserve Program (CRP). The Southern High Plains (SHP) of Texas had one of highest concentrations of CRP contracts in the country and was identified as an area where the availability of pollination service may exceed demand in the future. Our objective was to determine how the predominant land uses in the SHP of Texas (native grassland, Conservation Reserve Program, and cropland) affected invertebrate pollinator abundance, species richness and diversity, and if CRP land hosts a diverse pollinator population given it consists primarily of non-native upland grasses. We also examined how playa wetlands contributed to pollinator habitat. We used blue vane traps placed in the playa basins and adjacent uplands in each land use to compare pollinator diversity, richness, and abundance. We used targeted net collection, where we collected pollinators from the flowers upon which they fed, to allow us to determine what plant species pollinators utilize and the role playa plants serve in invertebrate pollinator habitat. We also evaluated vegetation characteristics of the three primary SHP land uses and their embedded playas to assess the effectiveness of CRP at providing pollinator habitat. CRP was the least abundant, rich and diverse in pollinators of all land uses. There was not a significant difference between uplands and playas. AIC model selection and path analysis showed that percent grass and duff cover within each land use were the primary drivers of pollinator abundance and richness. CRP could be

improved by creating seed mixes that include native grasses and native flowering forbs to replace existing non-native grasses to expand floral resources and enhance availability of nesting sites for solitary bees. Native grasses in CRP uplands will also allow for a more natural hydrology of the embedded playas and encourage growth of wetland plants. ■

PRESENTATION 1215
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY II*, 05/30/2018, 01:00 - 02:50

ESTIMATING ECOSYSTEM SERVICE BENEFITS FROM CRANBERRY BOG RESTORATION

Wildman, Nick, MA Division of Ecological Restoration, Boston, MA

The Massachusetts Division of Ecological Restoration (DER) has a mission to restore and protect the Commonwealth's rivers, wetlands, and watersheds for the benefit of people and the environment. A growing part of the DER's focus is the restoration of cranberry plantations. These project sites range from dozens to a hundred acres in size and involve intensive earthwork and grading to restore ecosystem services including hydrologic retention, nutrient transformation, and habitat diversity. These projects typically require upwards of five years of engineering, design, and permitting followed by an implementation phase and monitoring. Costs for this work are typically supported by a mix of state, federal, NGO, and private entities. In the last five years, the DER has begun to better understand the statewide labor market effects of this work as well as the benefits to ecosystem services experienced within the watersheds where these projects are located. This presentation will describe the DER's understanding of market and non-market benefits of cranberry bog restoration and future steps to frame this restoration work within the benefit-relevant indicators most critical to the people of Massachusetts. ■

PRESENTATION P43
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE POTENTIAL FOR WRACK TO SERVE AS A NUTRIENT SOURCE ON RESTORED LIVING SHORELINES

Mellouli, Tasnim, Aquatic Biogeochemistry Laboratory, University of Central Florida, Orlando, FL
Ho, Janet, Aquatic Biogeochemistry Laboratory, University of Central Florida, Orlando, FL
G. Chambers, Lisa, University of Central Florida, Orlando, FL

Living shorelines rely on natural materials such as sand, rock, or plants to stabilize coastal systems, prevent erosion, promote biodiversity, and sequester carbon. Wrack, a natural and common component of living shorelines, is decomposing marine vegetation that washes up along the shores of coastal systems. The effects of wrack on shoreline vegetation health and nutrient status is unknown. This project focuses on wrack's impact on the growth and production of seedlings on the shoreline by analyzing the nutrient content of the wrack and its ability to leach nutrients into the environment during photodegradation.

This research project took place at living shoreline restoration sites in Canaveral National Seashore (Indian River Lagoon, FL, USA), one of the most biodiverse locations in the United States. Fresh and aged wrack was collected along three living restoration sites of the northern Indian River Lagoon's shoreline. After separating debris and material from the prominent seagrass, Halodule wrightii, total nitrogen (N), total carbon (C), and total phosphorous (P) content were determined on dried and ground subsamples. Fresh and aged wrack did not differ significantly in total C, N, or P. Afterwards, I completed a photodegradation study to understand nutrient loss via leaching from fresh wrack into the water.

This research has revealed important information about the potential for wrack to serve as a nutrient source on living shoreline sites and provide advice to restoration practitioners who are unsure whether to remove wrack or leave it in place on the shore as it decomposes. ■

PRESENTATION 1336
PRESENTED DURING *CONSERVATION OF WETLANDS*, 05/30/2018, 09:55 - 11:35

WILDLIFE USE OF TWO FREE WATER SURFACE CONSTRUCTED WETLANDS IN TEXAS

Mokry, Loretta, Alan Plummer Associates, Inc., College Station, TX

Free water surface (FWS) wetlands mimic natural emergent marshes but are designed (engineered) to optimize a number of natural contaminant removal mechanisms to meet various water quality treatment goals. They can provide tertiary treatment of wastewater and/or polishing treatment for indirect reuse of water to augment potable water supplies. While water quality improvement is the main driver for most constructed wetland applications, several operating systems demonstrate that these systems also provide other benefits to both human and wildlife populations.

The City of Beaumont's Hillebrandt Bayou Water Reclamation Plant includes a conventional plant (trickling

filters and lagoons) which discharges to an approximately 263 hectare (650-acre) constructed wetland (Cattail Marsh) to provide ammonia-nitrogen removal before effluent is discharged to a natural marsh and subsequently to Hillebrandt Bayou. It is located in Jefferson County, Texas within the Great Texas Coastal Birding Trail - Upper Texas Coast region. Another system in Texas, the East Fork Water Reuse Project, is operated by the North Texas Municipal Water District (NTMWD). This system supplements the yield of Lavon Lake by diverting effluent return flows from the East Fork Trinity River and polishing the diverted water through an 809 hectare (2,000 acre) FWS constructed wetland before conveyance back to Lavon Lake for use as water supply. The John Bunker Sands Wetland Center located centrally within the East Fork Wetland provides education and research opportunities pertaining to water conservation, wetland systems and wildlife management.

Data from annual surveys conducted at Beaumont's Cattail Marsh and the NTMWD's East Fork Wetland are used to compare population densities and diversity at these two constructed wetlands with other natural habitats within their vicinity. ■

PRESENTATION 1394

PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS I*, 05/31/2018, 09:45 - 11:35

INNOVATIVE APPROACHES TO WETLAND CONSERVATION IN A WATER-STARVED REGION: KLAMATH BASIN, OREGON

Vradenburg, John, U.S. Fish and Wildlife Service, Tulelake, CA
Taylor, Dustin, U.S. Fish and Wildlife Service, Tulelake, CA
Griggs, Ken, U.S. Fish and Wildlife Service, Tulelake, CA
King, Sammy, U.S. Geological Survey, Baton Rouge, LA

The Klamath Basin was historically the most expansive and diverse wetland habitat in the Pacific Northwest and an integral wetland landscape for waterbirds in the Pacific Flyway. In 1908 President Theodore Roosevelt established Lower Klamath National Wildlife Refuge, importantly the first and largest tract of land at that time in the United States set aside specifically for the purpose of protecting migratory waterbirds. Despite recognition of these key wetlands, rapid landscape alteration and hydrologic development for agriculture and energy resulted in over eighty percent of the wetlands converted to cultivated land and pasture. Continued hydrologic modifications and over allocation of water have contributed to dramatic declines in endemic and anadromous fish. Increased regulations for the recovery of endangered species, Tribal trust resources, and commercial fisheries have created a contentious environment for water use allocations. Unfortunately, wetlands continue to receive little consideration in water discussions. Today, prolonged periods of drought and misaligned timing of water deliveries plague public lands, even when climatic water surpluses occur. The result is declining wetland habitat for waterbirds and timing of availability that does not match the majority of species life cycle needs. These conditions have put wetland managers in a unique position to develop and implement strategies that maximize water availability through creative partnerships with the agricultural community that ensure some wetland habitat is available throughout the Klamath Basin during key periods of the year. Implementation of flood fallow rotations and collaboration with local irrigation districts on agricultural return flows help Refuge staff and the agricultural community incorporate public and private lands into sustainable wetland habitats that support multiple land and water uses. Integrated management that restores historic processes provides water quality benefits to the Klamath River, critical wetland habitat in the Pacific Flyway, and preservation of the agricultural economy of the Upper Klamath Basin. ■

PRESENTATION 1417

PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS II*, 05/30/2018, 03:10 - 05:00

INTEGRATING ECOLOGICAL FUNCTION INTO NATURAL REMEDIATION DESIGNS

Conklin, Karah, LT Environmental, Arvada, CO

Natural treatment technologies -- including constructed treatment wetlands, phytoremediation, and vegetated stabilization -- harness the power of plants to clean up contaminated environments. These technologies have proved successful in remediating a variety of contaminants including organics, heavy metals, petroleum, and pesticides in soils, groundwater and wastewater. While these plant-based solutions provide a more sustainable alternative to conventional technologies, these designs have traditionally been focused on strictly meeting contaminant reduction goals.

As the public and regulators have become more concerned with the ecological impacts and long-term maintenance of remediation projects, designs have advanced to include goals of increasing biodiversity, creating functional habitat and controlling invasive/non-native species. This presentation will examine the technical considerations and challenges for enhancing the ecological impact of remediation projects and discuss lessons learned from the implementation and management of several projects over the last 10 years including:

- Stormwater Wetland and Bioswale System in Iceland;
- Vegetated Shoreline Stabilization and Habitat Restoration in Brooklyn, New York;
- Coal Bed Methane Water Management in Southern Colorado;
- Wildlife Habitat Enhancement at an Inactive Industrial Facility in Williamsburg, Virginia; and
- Landfill Leachate Treatment Wetland in Indiana. ■

PRESENTATION P41

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

MACROINVERTEBRATE COMMUNITY STRUCTURE IN AN URBAN RUNOFF TREATMENT WETLAND IN SOUTHERN CALIFORNIA

Brown, Morgan, Irvine Ranch Water District, Irvine, CA
Lieuw, Jessica, Irvine Ranch Water District, Irvine, CA
Swift, Ian, Irvine Ranch Water District, Irvine, CA

Constructed wetlands have been recognized as an effective and low-cost strategy for treating wastewater and polluted runoff. In addition to improving water quality, treatment wetlands perform other important wetland functions including acting as storm buffers, cycling nutrients, providing recreational value, and providing habitat for wildlife. To accomplish these goals, routine monitoring of water and habitat quality is important. Aquatic macroinvertebrate communities are used to assess habitat quality because they differ in sensitivity to impairment and may respond to impacts that are not reflected by water chemistry. However, few studies have used macroinvertebrate surveys to assess water quality before and after treatment in a constructed wetland. Using D-frame sweep nets and Hester Dendy colonizing plates, we sampled macroinvertebrate community characteristics and water quality parameters at the influent and effluent ponds of the San Joaquin Marsh (SJM) in Orange County, California, in June 2017. Taxa richness and diversity of macroinvertebrates were compared at one point in time, and were low in both ponds. The influent macroinvertebrate community was dominated by oligochaetes, while the effluent was dominated by chironomids. Increased presence of plant matter within SJM could be driving higher proportions of chironomids at the effluent because they have been shown to eat leaf and wood fragments in addition to fine particulate detritus. Both oligochaetes and chironomids are detritivores known to be tolerant of pollution and low oxygen, which characterize urban runoff treatment wetlands like SJM. These data will provide an important baseline for future monitoring and management in SJM and other constructed wetlands in southern California. ■

PRESENTATION 1499

PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED II*, 06/01/2018, 01:00 - 02:50

FUNCTIONAL RESTORATION OF FLOODPLAIN WETLANDS IMPACTED BY TIE-HACKING IN THE EARLY 1900'S IN THE BIGHORN MOUNTAINS OF WYOMING

McEldowney, Richard, Confluence Consulting, Inc., Bozeman, MT

The term 'tie-hacking' refers to the process used in the late 1800's and early to mid-1900's of cutting timber for use as railroad ties. As part of this process timber was cut from the surrounding forest, skidded to a river, and the logs floated down to the railroad under construction. Frequently the rivers were temporarily dammed in order to create enough water to float the logs down the river, the dams were then blown up and the logs and water were swept down river in the resulting torrent. This process had significant impacts to the riverine systems used for this purpose.

Restoration actions were undertaken by the Wyoming Department of Transportation and the U.S. Forest Service (USFS) at Shutts Flats on the South Fork (SF) Tongue River in the Bighorn Mountains, near Burgess Junction, WY. Restoration was intended to serve as compensatory mitigation for impacts associated with roadway improvements on a nearby U.S. Highway 14. Previous impacts to the SF Tongue system resulted in a change of floodplain elevation causing it to be disconnected from the river and diminishing the level of service provided by the floodplain wetlands found along the river.

In one of the first of its kind in the western U.S., compensatory mitigation was based on functional units instead of acres. The project restored over 15 functional units based on MDT's Montana Wetland Assessment Method. Targeted ecosystem functions included flood attenuation, general wildlife habitat, short and long term water storage, sediment/nutrient/toxicant removal, and production export/food chain support. The primary restoration elements included low-flow sedge benches, floodplain reconstruction, development of a wetland swale, and increasing habitat diversity. The project increased palustrine aquatic bed habitat for use by the Columbia spotted frog, a USFS Sensitive Species found in the project area. Approximately 2.5 acres of wetland habitat was directly restored/created, and hydrology was restored to approximately an additional 3 acres of decadent scrub-shrub wetland habitat at the north end of the Flats. The presentation will use the Shutts Flats case study to demonstrate how a functional assessment method can be integrated into the wetland restoration planning process to maximize wetland functions. ■

PRESENTATION 1584
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES I*, 05/30/2018, 09:45 - 11:35

WORKING LAND SOLUTIONS FOR SUSTAINING WATERFOWL IN THE INTERMOUNTAIN WEST

Vest, Josh, Intermountain West Joint Venture, Missoula, MT
Smith, Dave, Intermountain West Joint Venture, Missoula, MT
Petrie, Mark, Ducks Unlimited, Vancouver, WA
Dugger, Bruce, Oregon State University, Corvallis, OR
Colson, Chris, Ducks Unlimited, Boise, ID

Water scarcity and its variability are defining features for much of the Intermountain West. Here waterfowl (and other waterbirds) rely on complexes of publicly and privately managed wetland habitats to meet annual cycle needs. Although public wetlands may be protected and managed for the benefit of wetland birds their long-term viability is tied to their watershed's water-use patterns. Demands for water use efficiencies, changing human demographics, climate variability, and increased water conflicts in the West threaten longstanding land use practices on both public and private lands that are beneficial to waterfowl and other wildlife. Additionally, publicly managed wetlands alone are insufficient to meet the seasonal needs of waterfowl. Nearly 70% of emergent wetland habitat in the Intermountain West occurs on private lands and are typically associated with agricultural irrigation. High private ownership of these resources inextricably links wildlife conservation to working lands. Flood irrigation is a common practice on ranches here where water is diverted onto hay and pasturelands in spring to increase soil moisture and improve forage production. Most of these sites occur within historic wetland basins and riparian floodplains. Water predominately originates as snowmelt and flood irrigation provides seasonal wetland habitats that largely mimic natural floodplain processes associated with spring runoff. Thus, these working wetlands provide important wildlife habitat and socioeconomic value across the region. However, they are frequently undervalued, especially as water conservation is an emphasis by public and private stakeholders. In this presentation we provide a case study of a working wetland conservation initiative in southern Oregon and northeast California (SONEC): one of the most important migration hubs for waterfowl in North America. Here we provide examples of ecological and socio-economic values provided by working wetlands that sustain migratory waterfowl and compliment public land conservation investments. Recognizing and incentivizing farmers and ranchers who provide vital habitat will be crucial for long-term sustainability of waterfowl in the Pacific Flyway. ■

PRESENTATION 1595
PRESENTED DURING *ECOSYSTEM SCIENCE I*, 06/01/2018, 09:55 - 11:35

ECOLOGICAL CHARACTERIZATION OF PERUVIAN HIGH ALTITUDE PEATLANDS (BOFEDALES) AND POTENTIAL SOCIO-ECOLOGICAL TRAJECTORIES UNDER CLIMATE CHANGE

Wardrop, Denice, Penn State University, University Park, PA
Craft, Christopher, Indiana University, Bloomington, IN
Fennessy, M. Siobhan, Kenyon College, Gambier, OH
Nassry, Michael, Penn State, University Park, PA
Sherbine, Kyle, Penn State University, University Park, PA
Kelly, Colin, Penn State University, University Park, PA
Czuprynski, Zachary, Penn State University, University Park, PA

Located in the high-altitude Andes are wetlands, known as bofedales, that cover approximately 0.4% of the landscape in Peru. Although they represent a small portion of total land cover, they are extremely important for regional livelihoods due to the provisions of water supply and livestock forage in the dry season; at a regional/global scale, they may represent a significant carbon storage feature. They are currently at risk from a variety of factors, including warming temperatures, altered hydrology from glacial melting, and water withdrawal for increased agriculture or mining activities. Students from The Center for Advancement of Undergraduate Studies and Experience (CAUSE) program investigated the impacts of climate change on a range of glacially-supported ecosystem services provided by these unique habitats over a two-year period, resulting in a comprehensive ecological characterization of three separate bofedale sites and a basis for postulating the potential fate of these ecosystem services, and related social impacts, under future climate change scenarios. The range of data collected includes: local glacial recession rates, methane flux, soil respiration, plant community characterization, microtopography, peat depth, water source, water quality, hydrologic patterns, and local community resilience. Sampling methodologies included: drone surveys; methane flux chambers; microbial DNA analysis; water quality parameters of pH, temperature, dissolved oxygen, and metals concentrations; water isotope analysis, water level monitoring wells, vegetation characterization, and interviews of community members. A picture emerges of systems under extreme stress from glacial recession, with probable social impacts: local glaciers lost approximately 35% of surface area from 1988 – 2016, while the water isotopes analysis suggest that glacial meltwater is the main water source for these wetland systems during the dry season. Glacial recession may be changing water quality conditions as well, evidenced by increasing metals concentrations. Global and regional ecosystem services may also be under threat: carbon storage rates

were comparable to those of freshwater wetlands. However, the overall role of these systems in global carbon storage is unclear, since methane flux rates exhibited high spatial and temporal variability. Microbial communities may explain some of this spatial variability, since they were related to soil organic carbon. ■

Management & Applied Science: GIS & Remote Sensing

PRESENTATION 1042
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS I*, 06/01/2018, 01:00 - 02:50

IDENTIFICATION OF POTENTIAL CARBON SINKS BY COMBINING REMOTE SENSING, SOIL DATA AND DIGITAL SOIL MAPPING OF WETLANDS

Libohova, Zamir, Soil Survey, Natural Resources Conservation Service, Lincoln, NE
Owens, Phillip, Agricultural Research Service, Booneville, AR

Wetlands are a major component of natural system that perform functions like water cleaning and carbon storage. There are three features present in wetland definitions: (i) shallow water/saturated conditions – topographic wetness index (TWI), (ii) unique soils – poorly and very poorly drained soils (PD&VPD), and (iii) vegetation adapted to wet conditions – Hyperion reflectance. The objective of this study was to use remote sensing in combination with soil information in a Digital Soil Mapping (DSM) platform to (i) identify potential wetlands in the glaciated landscapes of northern Indiana; and (ii) asses their contribution as potential C sink. In this study potential wetlands must meet the first two criteria regardless of their current land use. The study area size was 47 km2 located in Tippecanoe county, Indiana. Based on TWI and PD&VPD, 25% of the area was identified as potential wetlands, while 10% based on Hyperion spectral signature only. The intersection of Hyperion reflectance with TWI and PD&VPD decreased potential wetlands to 2.8 %. According to the National Wetland Inventory (NWI), 9.9% of the area is wetland of which 4.1 % fresh water forest shrubs/emergent vegetation and 0.5% lakes and ponds. Since the objective of our study was identification of potential wetlands, existing lakes, ponds and streams were excluded from the analysis. The spectral reflectance from the vegetation on the edges of these water bodies was included. The addition of Hyperspectral signature was very restrictive. However, its use as a criteria combined with DSM and soil information is promising. The PD&VPD soils (Mollisols) stored 67 Mg ha-1 SOC for the 0-25 cm soil thickness, compared with 32 Mg ha-1 SOC for the surrounding upland (Alfisols). Depressions dominated by Histosols stored 188 Mg ha-1 SOC or 83% and 64% more compared to Alfisols and Mollisols. This represents the potential increase in soil C storage. ■

PRESENTATION 1136
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE I*, 06/01/2018, 09:45 - 11:35

MAPPING FENS ON NATIONAL FOREST LANDS THROUGH AERIAL PHOTO INTERPRETATION

Lemly, Joanna, Colorado Natural Heritage Program, Fort Collins, CO
Smith, Gabrielle, Colorado Natural Heritage Program, Fort Collins, CO

Fens are as groundwater-fed wetlands with organic soils that typically support sedges and low stature shrubs. In the mountain west, organic soil formation can take thousands of years. Long-term maintenance of fens requires protection of both hydrology and plant communities. Given the sensitivity of fens, the U.S. Forest Service (USFS) determined that all fens should be managed for conservation and restoration. However, few National Forests have a complete inventory of fens. To fill this data gap, Colorado Natural Heritage Program (CNHP) began mapping fens on USFS lands through a series of contracts focused on the Rocky Mountain region. To date, fens have been mapped on five National Forests in Colorado, Utah and Idaho, with work underway on five additional Forests. For each project, potential fens are identified from digital aerial photography. Each potential fen polygon is hand-drawn in ArcGIS based on the best estimation of fen boundaries and attributed with a confidence value of 1 (low confidence), 3 (possible fen) or 5 (likely fen). CNHP photo interpreters rely on multiple image sources, as well as ancillary data such as topographic maps and wetland mapping form the National Wetlands Inventory. Fen density is strongly related to elevation and landforms. For most Forests, fens are concentrated between 9,000–12,000 feet in elevation in the subalpine zone. Fens form at the base of slopes, on valley margins, and in old kettle ponds. The geospatial data on fen locations will help USFS avoid potential impacts and target rare plant surveys in these important wetland habitats. ■

PRESENTATION P46
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE USE OF GEOGRAPHIC INFORMATION SYSTEMS TO IDENTIFY AND MAP WETLANDS IN THE PRAIRIE POTHOLE REGION

Hengel, Benjamin, North Dakota State University, Fargo, ND
DeKeyser, Edward, North Dakota State University, Fargo, ND

The National Wetland Inventory (NWI) is a nationwide database managed by the U.S. Fish and Wildlife Service (FWS) aimed at mapping and classifying the nation's wetland and deepwater habitats. The mapping process historically included the use of printed aerial photographs and highly trained image analysts to assess and map wetlands. Since then, accurately identifying and mapping wetlands has become very important in the conservation of these habitats. The evolution of geographic information systems (GIS) has given scientist's cost-effective and accurate software to manage, manipulate, and analyze such data. Through spatial analysis tools and digital elevation models (DEMs), wetlands can be identified and mapped through the ArcGIS software. This study analyzes the National Wetland Inventory and DEMs of a site in North Dakota using ArcGIS to identify potentially overlooked wetlands and analyzing the accuracy of previously mapped wetlands of the National Wetland Inventory. The use of digital elevation models allows spatial tools such as flow direction and flow accumulation to analyze the hydrology at the surface giving potential wetland areas. The analysis and methods used in this study will lead to more accurate mapping of wetlands and aid in identifying important wetlands overlooked by previous mapping techniques. The results suggest that geographic information systems can be a cost-effective method to determining wetland boundaries while furthering wetland conservation efforts. ■

PRESENTATION 1168
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS II*, 06/01/2018, 03:10 - 05:00

IMPROVING WETLAND MAPPING IN WASHINGTON

Yahnke, Amy, WA Dept of Ecology, Olympia, WA

The ability to identify and characterize wetlands is paramount to effectively protect and successfully restore these valuable resources. In Washington, the existing statewide wetland maps (NWI maps) are out of date and inaccurate in many locations. They are based on imagery and data from the 1980's and do not reflect current wetland location and extent. Many wetlands are missing from the NWI maps, including wetlands that were not mapped in agricultural areas. Moreover NWI maps lack abiotic information that can be used to predict functions and, in combination with land uses, condition. In addition to the regulatory and planning needs of local governments and Washington Department of Ecology, several agencies and non-profit organizations rely on wetland maps to identify areas of priority for research, conservation, and restoration. The ever-growing demand for readily accessible information on wetland location and status provides a clear need for Washington to pursue a multi-lateral, phased approach to improving wetland mapping and classification using the latest technology. Inaccuracies and errors of omission are due in part to the difficulty of photo-interpreting certain land cover types (e.g., forested wetlands, wetlands on slopes, and vernal pools). Remote sensing data sources such as LiDAR, high-resolution aerial imagery, Landsat imagery, digital elevation data, hydrography, and updated soil maps provide an opportunity to address these known shortcomings. This presentation will discuss a collaborative project between Washington departments of Ecology and Natural Resources, and the University of Washington to determine what is needed to update wetland maps in Washington. Current uses and status of wetland maps in Washington will be described with an overview of our approach to data verification and crowd sourcing for field data. This project will improve our ability to more efficiently and accurately identify the location, size, and type of Washington's wetland resource. ■

PRESENTATION 1250
PRESENTED DURING *RIPARIAN ECOSYSTEMS I: ECOLOGICAL PATTERNS AND EFFECTS*, 05/31/2018, 09:45 - 11:35

ASSESSING HABITAT QUALITY AND CONNECTIVITY FOR PREBLE'S MEADOW JUMPING MOUSE IN BOULDER COUNTY, COLORADO

Salo, Jessica, University of Northern Colorado, Greeley, CO
Gage, Edward, Colorado State University, Fort Collins, CO
Stoker, Jason, USGS, Fort Collins, CO
Katz, Gabrielle, Metropolitan State University of Denver, Denver, CO

Preble's Meadow Jumping Mouse (PMJM) is a riparian species that occurs in densely vegetated areas near open water in the foothills and plains of the Rocky Mountain Front Range in Colorado and Wyoming. While proximity to streams largely determines potential PMJM habitat at the landscape scale, specific microhabitat conditions within the riparian zone appear to strongly influence actual PMJM occurrence and habitat use. Given the large amount of human

modification and natural dynamics (e.g., floods) of riparian ecosystems along the Front Range and more specifically, in Boulder County, Colorado, understanding habitat location, quality, and connectivity between known populations of PMJM and high quality habitat is important for the conservation and management of this threatened species. To assess the quality and quantity of PMJM habitat in Boulder County, we mapped the extent of the riparian zone, classified riparian zone land cover composition, created a species distribution model, and analyzed connectivity between preferred habitat patches and existing PMJM populations. Using the species distribution model we estimated that there are 973 hectares of suitable PMJM habitat and 252 hectares of known PMJM occupied habitat. Overall, we found limited connectivity between known PMJM populations in different watersheds, as urban development and large expanses of agriculture land disrupt connectivity between drainages. We identified the presence of suitable riparian vegetation along irrigation canals and natural waterways where PMJM may be present. Both the irrigation canals and natural waterways have the ability to increase connectivity between known populations of PMJM. However, additional sampling for the presence of PMJM is essential to understanding if these waterways actually provide this function. ■

PRESENTATION P45
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

EVALUATING MULTI-TEMPORAL, MULTI-SENSOR REMOTE SENSING FOR MAPPING WETLANDS IN THE BAY OF QUINTE

White, Lori, Environment and Climate Change Canada, Ottawa, Ontario, Canada

Research has shown that both optical and synthetic aperture radar (SAR) remote sensing imagery are useful for classifying wetlands. Optical imagery is often preferred when classifying detailed wetland classes; while SAR is more reliable when multi-temporal data is required. Past studies have demonstrated improved wetland classification accuracy when combining optical and SAR data, and also when imagery throughout the growing season is used. For this research we evaluated various combinations of Radarsat-2, TerraSAR-X, ALOS-2, and Landsat-8 imagery from 2016 to classify wetlands in the Bay of Quinte region using the Random Forest classifier, to determine if a multi-sensor and/or multi-temporal approach improved classification accuracy. To assess the multi-sensor method, we compared classification accuracy using imagery from only one satellite to a combination of one or more SAR satellites, and the combination of optical and SAR. To evaluate the multi-temporal method, we compared classification accuracy when using imagery from only one season to using imagery throughout the growing season. Initial results show that overall classification accuracy increased when either a multi-temporal and/or multi-sensor remote sensing approach is used. With the launch of several satellite constellation missions in the near future this approach shows promise for mapping wetlands operationally. ■

PRESENTATION 1305
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS II*, 06/01/2018, 03:10 - 05:00

SPATIAL ANALYSIS AND REMOTE SENSING FOR STAKEHOLDER ENGAGEMENT IN WETLAND FUNCTIONAL ASSESSMENTS: A CASE STUDY IN APPLIED TRANSLATIONAL ECOLOGY

Robertson, Andrew, Saint Mary's University of Minnesota, Winona, MN

Translational Ecology is an approach to decision making in which ecologists, stakeholders and decision makers work together from project inception to develop research and related products that directly address the sociological, ecological and political contexts of an environmental issue. In a variety of montane and rural environments across the United States (New Mexico, Alaska, and Wisconsin) Geo-Spatial Services of Saint Mary's University of Minnesota has been using this approach to develop, refine and implement landscape level wetland functional assessments that directly support stakeholder engagement, strategic planning and policy development. Researchers, planners, stakeholders and land managers have been working together in structured and ad-hoc scenarios to define research questions, identify data needs, develop approaches (including best professional judgment and preponderance of evidence) and assess results for resource management decision support.

Geographic Information System (GIS) technology, remote sensing data and a variety of spatial analysis techniques are being applied to support this approach. This presentation will summarize the spatial data types, tools, techniques and analysis approaches that have been implemented to date. It will also include information on web-based delivery of spatial data and tools, stakeholder engagement, strategies for communication of scientific data, as well as speak to future initiatives. ■

PRESENTATION 1349
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY II*, 05/30/2018, 01:00 - 02:50

BUILDING AND DEPLOYING THE NETWORKED SENSORY LANDSCAPE AT TIDMARSH

Mayton, Brian, MIT Media Lab, Cambridge, MA
Dublon, Gershon, MIT Media Lab, Cambridge, MA
Paradiso, Joseph A., MIT Media Lab, Cambridge, MA

Wireless sensor network technologies provide an opportunity for long-term in-situ monitoring of a remote site. Over the past five years, we have constructed and deployed a large-scale sensor network at the Tidmarsh restored wetland. The network includes custom low-power wireless sensor node hardware with cameras and a large array of microphones to create a permanent installation that captures both sensor data and live multimedia streams, all of which is made available in real time through a public web site and API.

The sensor node platform is a small weatherproof battery-powered device capable of sensing environmental temperature, humidity, atmospheric pressure, sound levels, motion, ultraviolet, infrared, and visible light, and can be expanded through additional analog and digital sensor probes. The sensor node is designed to last for many years and can recharge its battery through an integrated solar cell. A new deployment in the spring of 2018 will add hundreds of our next generation of sensor nodes, many of which will form a transect spanning the site and will include soil moisture probes to measure the effect of microtopographic features on soil hydrology and environmental parameters.

We also use the data from the sensor network to create a multitude of applications and experiences. For example, a virtual reality browser enables remote users to experience Tidmarsh by combining live sensor data with laser-scanned terrain. Users can explore this virtual Tidmarsh while seeing visual representations of sensor data and hearing live spatialized audio and musical compositions driven by the sensor data. On-site visitors can wear an auditory augmented reality device that extends their hearing to include distant sounds captured by the microphones on the site and sonifications of the sensor data as they walk around.

Through these and other applications, we are examining the role of ubiquitous sensing in wetland restoration, both as a tool for ecological research and for delivering unique experiences to remote as well as on-site visitors, bringing them closer to restored wetlands. ■

PRESENTATION 1393
PRESENTED DURING *GIS & REMOTE SENSING*, 05/30/2018, 03:20 - 05:00

MAPPING COASTAL MARSHES BIOMASS WITH COMBINED GROUND, AIRBORNE, AND SPACEBORNE REMOTE SENSING DATA

Mo, Yu, University of Maryland, College Park, MD
Kearney, Michael, University of Maryland, College Park, MD

The importance and vulnerability of coastal marshes necessitate effective ways to closely monitor them. Optical remote sensing is a powerful tool for this task, however, its application to diverse coastal marsh ecosystems consisting of different marsh types is limited. This study combines ground, airborne, and spaceborne remote sensing data to map the biomass of freshwater, intermediate, brackish, and saline marshes in Louisiana. It is found that linear models derived from NDVI and EVI are most favorable for assessing Leaf Area Index (LAI) using multispectral data ($R2 = 0.7$ and 0.67, respectively). The linear models for different satellite sensors, i.e. ASTER, AVHRR, Landsat TM, ETM+, and OLI, MODIS, SENTINEL-2 MSI, and SPOT, are not significantly different, except for the ones for Landsat MSS ($p < 0.0001$). It is also found that marsh type and plant species significantly impact the linear model development ($P < 0.05$ in both cases). The random forest models are most useful in retrieving LAI and Aboveground Green Biomass (AGB) using hyperspectral data ($R2 = 0.91$ and 0.84, respectively). Sensors with coarser spatial resolution yield lower LAI values because the fine water networks are not detected and mixed into the vegetation pixels. The Landsat OLI-derived map shows the LAI of coastal mashes in Louisiana mostly ranges from 0.5 to 3.0, and is highest for freshwater marshes and for marshes in the Atchafalaya Bay delta. This study provides solutions for assessing the biomass of Louisiana's coastal marshes using various optical remote sensing techniques, and highlights the impacts of the marshes' species composition on the model development and the sensors' spatial resolution on biomass mapping, thereby providing useful tools for monitoring the biomass of coastal marshes in Louisiana and diverse coastal marsh ecosystems elsewhere. ■

PRESENTATION 1440
PRESENTED DURING *GIS & REMOTE SENSING*, 05/30/2018, 03:20 - 05:00

REMOTE SENSING INDICATORS FOR THE LANDSCAPE-SCALE ASSESSMENT OF VEGETATION DYNAMICS IN RESTORED WETLANDS

Taddeo, Sophie, University of California at Berkeley, Berkeley, CA
Dronova, Iryna, University of California at Berkeley, Berkeley, CA

Current scientific literature reports significant variability in the outcomes of wetland restoration, with projects sometimes falling short of ecological targets. A consistent monitoring of wetlands could pinpoint the causes of this variability, but is often limited by a lack of funding or difficult field access. To improve this capacity, it is pivotal to identify metrics that show rapid and predictable responses to restoration treatments. Remote sensing can help monitor such metrics at a large scale, high frequency, and low cost, but remains underutilized in wetland monitoring. We leveraged free remote sensing data to monitor changes in the vegetation productivity, distribution, and heterogeneity of 20 restored wetlands in the Sacramento-San Joaquin Delta of California. Using data from NASA's Landsat satellites, we tracked changes in the greenness of these sites over 17 years. For each year of data, we generated a site-level frequency distribution of greenness, which we characterized by mean value, range, and kurtosis. We then used a higher resolution dataset from USDA's National Agricultural Inventory Program to delineate vegetated patches within these sites. From the resulting classification, landscape metrics were generated to relate fluctuations in greenness to changes in geometry amongst vegetated patches. Preliminary results suggest a significant effect of site age, size, and connectivity on vegetation dynamics. More recent sites showed a linear increase in the average and range of their greenness, which correlated to a proliferation of vegetated patches. Sites at an intermediate level of restoration (7-15 years old) showed a greater variability in the range and kurtosis of greenness, but a constant increase in total vegetated extent. Few isolated sites showed significant fluctuations in greenness, but a stabilization or decline in vegetated extent. These results reveal the serious potential of leveraging free remote sensing data to explore patterns of vegetation development. Studying these patterns offers important clues on the effect of landscape dynamics and site characteristics on vegetation recovery. ■

PRESENTATION 1462
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS II*, 06/01/2018, 03:10 - 05:00

REMOTE SENSING IN FOREST MANAGEMENT AND PLANNING

Jacobsen, Nicole, WA Department of Natural Resources, Olympia, WA

Washington State Department of Natural Resources manages 5.6 million acres of forest, range, agricultural, aquatic, and commercial lands for more than $300 million in annual financial benefit for public schools, state institutions, and county services. The Forest Resources Division oversees implementation of a multi-species habitat conservation plan covering 1.9 million acres of forest land within the range of the northern spotted owl. Our forest resource inventory system is now based on remotely-sensed data and validation plots instead of the previous sample plot-only method. With 1-meter LiDAR covering 98 percent of our land base, we are able to more accurately model and map threatened and endangered species' habitat, special ecological features and uncommon habitats, riparian areas, and areas of high probability for cultural resources. High-resolution and thermal imagery collected by unmanned aerial systems is helping to refine these outputs even further. This talk will present a few key projects as well as discuss lessons learned and next steps. ■

PRESENTATION 1474
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS I*, 06/01/2018, 01:00 - 02:50

A DRONE'S-EYE VIEW: A NEW TOOL FOR ASSESSING AND MONITORING MARSH WETLAND CONDITION

Clare, Shari, Fiera Biological Consulting Ltd, Edmonton, Alberta, Canada
Koenig, Shantel, Fiera Biological Consulting Ltd., Edmonton, Alberta, Canada
Danielson, Brad, Fiera Biological Consulting Ltd., Edmonton, Alberta, Canada

In Alberta, Canada, restoring a drained wetland has been a common approach to satisfying wetland compensation obligations since the introduction of habitat offsetting guidelines in the mid-2000s. Historically, there have been no requirements for the design or monitoring of these restored wetlands, and as a result, the success of these restorations is largely unknown. Given the large number of compensatory wetlands on the landscape, a reliable and cost-effective method for quantifying and tracking condition of restored wetlands through time is required. In this study, we assess the efficacy of using multispectral imagery and structure from motion point cloud data obtained from an Unmanned Aerial Vehicle (UAV) platform to map the boundaries and

assess the ecological condition of 20 marsh wetlands that range in restoration age. The objective of this work is to develop an index of wetland condition to assess the rate and trajectory of change of key metrics, such that the condition of restored marsh wetlands can be reliably and cost-effectively tracked through time using remote sensing technology. In this presentation, we outline some of the challenges associated with using UAV data for this application, and will present results from the study to-date. ■

PRESENTATION 1486
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS I*, 06/01/2018, 01:00 - 02:50

ACCURATELY DETERMINING CLEAN WATER ACT PERMITTING JURISDICTION IN CHALLENGING MONTANE ENVIRONMENTS

Marshall, John, Stantec, Anchorage, AK

Montane environments are particularly challenging for accurately determining the jurisdictional extent of wetlands to meet Clean Water Act (CWA) permitting compliance. Montane environments are often poorly represented in the National Wetland Inventory (NWI) mapping and in State-specific wetland mapping often leading to gross underestimates of the extent of CWA jurisdiction by both permit applicants and regulatory authorities during project scoping. These underestimates result in under budgeted permit processes, and unrealistic completion timelines which can cause significant project delays and degrade stakeholder relationships. Moreover, and potentially more importantly, poor information on montane wetlands inhibits proper wetland functional assessments and understandings of the watershed context for projects limiting productive dialogue on wetland impact mitigation solutions. The inclusion of contemporary remote sensed data, such as LiDAR, high-resolution aerial imagery, and satellite imagery, coupled with spatial analyses, are important to implement early in the permitting process to reduce project costs and permitting timelines. However, remote sensed data must be coupled with onsite reconnaissance in many instances to properly document the extent of hydrophytic vegetation, hydric soils, wetland hydrology, and flora and fauna influencing wetland functioning. This talk will provide three examples of large montane CWA jurisdictional wetland mapping projects (Alaska, Washington, and Montana) where it was essential to integrate multiple spatial scales of data collection to properly meet CWA permitting. ■

PRESENTATION P44
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ARE NUTRIENT POLLUTED COASTAL WETLANDS MORE VULNERABLE TO SEA LEVEL RISE?

Krause, Johannes, Drexel University, Philadelphia, PA
Powell, Elisabeth, Academy of Natural Sciences of Drexel University, Philadelphia, PA
Watson, Elizabeth, Academy of Natural Sciences, Philadelphia, PA
Maher, Nicole, The Nature Conservancy Long Island Chapter, Cold Spring Harbor, NY

Forty-five coastal marshes on Long Island, New York, were assessed for evidence of nutrient over-enrichment, indicated by high δ15N of estuarine soils and biota and low C:N ratios of estuarine macrophytes and soils. We coupled these assessments with analysis of marsh vegetation trends and elevation to test for an association between poor water quality and marsh vegetation loss. We find that nutrient enrichment in low elevation, intertidal marsh areas leads to marsh loss, while high marsh vegetation can tolerate higher nutrient levels. ■

PRESENTATION 1558
PRESENTED DURING *ENVIRONMENTAL CHANGE AND THE WETLAND SEDIMENT ARCHIVE*, 05/31/2018, 09:45 - 11:35

WETLAND SEDIMENT RECORDS OF AGRICULTURAL INTENSIFICATION FROM A MONTEREY BAY COASTAL ESTUARY

Watson, Elizabeth, Academy of Natural Sciences, Philadelphia, PA
Woolfolk, Andrea, Elkhorn Slough National Estuarine Research Reserve, Watsonville, CA
Gray, Andrew, University of California Riverside, Riverside, CA
Oczkowski, Autumn, U.S. EPA, Narragansett, RI

Coastal eutrophication is an increasing threat to the healthy functioning of coastal ecosystems globally and is prevalent in the U.S. state of California where development and agricultural practices have dramatically enhanced nutrient inputs to estuaries over the past century. While degraded water quality can be detected by monitoring oxygen, dissolved nutrient concentrations, chlorophyll, and algal abundance, establishing regulatory guidelines for water quality targets can be complicated by a lack of baseline (e.g., pre-Anthropocene) water quality data and the complex nutrient dynamics of coastal lagoons. Here, we use historical carbon and nitrogen isoscapes to reconstruct spatial patterns and temporal changes in macronutrient dynamics at Elkhorn Slough, a Monterey Bay lagoon located in an intensely agricultural

watershed. We found strong contrasts between current sediment stable isotope signatures and those from the recent past, suggesting dramatic increases in macronutrient inputs over the past three decades. Spatial patterns indicate that nitrate sources have shifted from coastal upwelling to agricultural sources over the 20th century, and examination of historic land use, population, and fertilizer application data suggests that an increase in fertilizer application – rather than population growth or increases in the extent of land under cultivation – is chiefly responsible for this shift. Comparisons of contemporary with historical carbon isoscape maps reveal shifts to terrestrial organic matter sources at the head and mouth of the estuary in accordance with agricultural runoff but a shift to algal-dominated sources of estuarine organic matter in the central portion of the lagoon. These results highlight increased inputs of terrestrial organic matter sources near lagoon inputs and the amplification of carbon cycling occurring in the central slough. This study demonstrates the ability of nitrogen and carbon isoscapes to provide important perspectives on long-term shifts in nutrient inputs and processing that can be used to improve management of water quality in estuaries. ■

PRESENTATION 1569
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS I*, 06/01/2018, 01:00 - 02:50

MAPPING ALASKAN WETLANDS IN A DATA DESERT

Bagley, Calvin, Colorado State University, Fort Collins, CO
Tippery, Amy C., U.S. Army Corps of Engineers, Fairbanks, AK
Beattie, Kate, Colorado State University, Fort Wainwright, AK

Fort Wainwright encompasses approximately 1.6 million acres of U.S. Army training lands located in interior Alaska. The vast majority of Fort Wainwright is remote, undeveloped, and not accessible by roads, resulting in a dearth of geospatial wetlands data, soils data, and, until recently, high-quality aerial imagery. Where data is available, the scale and accuracy are inadequate for project planning and regulatory purposes. The lack of data, combined with the inaccessibility of the area, compounds the difficulty encountered when delineating wetlands to U.S. Corp of Engineers' standards. How can we delineate wetlands to modern standards while lacking geospatial data that we have come to expect in the current digital era?

The strategy of CEMML's Fort Wainwright Wetlands Program was to focus initial attention on intense, on-the-ground surveying efforts. We focused on the areas that were easily accessible and strategically sampling remote areas when resources for accessing them were available. A high volume of on-the-ground data points necessitated the development of an efficient system to collect, store and organize the data. CEMML developed a sophisticated wetlands database used to collect and house the profusion of data. To minimize the error and effort inherent in data entry and post processing in the office, data was entered directly into the database, while in the field, using rugged laptops and mobile GIS applications. In 2016, high-quality, color aerial photography for all of Fort Wainwright was acquired, enabling us to relate wetland types queried from the database to various photo-signatures present across the landscape. The correlation between wetland type and photo signature opened up the option to "pre-map" wetlands in areas where on-the-ground surveys have not been initiated.

Beginning in 2018, CEMML's Fort Wainwright Wetlands Program plans to ground truth pre-mapped areas. This data will be used to develop a geospatial model estimating the confidence level with which each ecotype can be delineated without on-the-ground determinations. This will not eliminate the need to do on-the-ground determinations entirely; however, it will allow us to focus efforts more efficiently toward ecotypes that have a low level of mapping confidence. ■

PRESENTATION 1601
PRESENTED DURING *REMOTE SENSING OF WET AREAS IN MOUNTAINOUS REGIONS II*, 06/01/2018, 03:10 - 05:00

A SEMI-AUTOMATED, REMOTE SENSING BASED APPROACH FOR UPDATING THE NATIONAL WETLAND INVENTORY IN WASHINGTON STATE

Halabisky, Meghan, University of Washington, Seattle, WA
Comnick, Jeff, University of Washington, Seattle, WA
Moskal, L Monika, University of Washington, Seattle, WA

In Washington State, the existing statewide wetland maps (National Wetland Inventory) are out of date and inaccurate in many locations. These errors of omission have been recorded to be as high as 50% in some areas, and may be as high as 90% in some forested areas. Inaccuracies and errors of omission are due in part to the difficulty of photo-interpreting certain wetland types (e.g., forested wetlands, wetlands on slopes, and vernal pools), especially when using lower spectral, spatial, and temporal resolution imagery, which was the practice when the NWI were created in Washington (WA) in the 1980s. Also, many wetlands on agricultural lands were not mapped. Recent development of a suite of new remote sensing and computer aided pattern recognition tools has shown an improvement in mapping efforts of wetlands. However, most studies were not tested in complex landscapes like WA, which is composed of rugged and diverse terrain dominated in many areas by evergreen trees.

The goal of our research was to compare the accuracy of two remote sensing classification techniques; Random Forest classification and rule-based classification using object based image analysis in two areas representative of the land use and ecological diversity of WA. We used a wide variety of datasets as inputs into our model. These include; LiDAR-derived datasets, soil and geology layers, high resolution aerial imagery, and hydrologic flow models. We compare the accuracy of these two methods and discuss the strengths and weaknesses of these two different approaches at mapping wetlands in complex and mountainous landscapes. ■

PRESENTATION 1658
PRESENTED DURING *GIS & REMOTE SENSING*, 05/30/2018, 03:20 - 05:00

USE OF UNMANNED AERIAL VEHICLES IN WETLAND RESTORATION MONITORING

Bateman, John, SUNY College at Brockport, Brockport, NY

Recent technological advances have allowed for innovative ways to gather data that in the past may have been cost-prohibitive. The use of unmanned aerial vehicles (UAVs) allows researchers to capture high-resolution photos and videos at their discretion, as opposed to having photos taken by plane. The flexibility of drones allows for imagery to be taken throughout the season and after disturbance events, such as high wave attack, and allows for better assessment of restoration success and wetland function. In addition, UAV imagery can be incorporated into geospatial information systems (GIS) for quantitative measurements to evaluate restoration efforts. UAVs are currently being used in Braddock Bay Wildlife Management Area along Lake Ontario for several restoration projects. Uses of UAVs in these projects include monitoring sediment transport along and on the created barrier at the mouth of the bay, expansion and reduction of cattail mats within the bay, and muskrat house counts. Photographs taken with the UAV are also interpreted in GIS to measure plant community changes in restored areas. While the full potential of UAV use in restoration monitoring has not been realized, they offer a cost-effective way to assess project success both quantitatively and qualitatively. ■

Management & Applied Science: Invasive Species

PRESENTATION 1084
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES I*, 05/31/2018, 03:20 - 05:00

ECOLOGICAL RECOVERY FOLLOWING LARGE-SCALE PHRAGMITES AUSTRALIS CONTROL IN A LAKE ERIE COASTAL MARSH

Rooney, Rebecca, University of Waterloo, Waterloo, Ontario, Canada
Robichaud, Courtney, University of Waterloo, Waterloo, Ontario, Canada

The rapid expansion of invasive Phragmites australis in coastal marsh along the north shore of Lake Erie has displaced resident plants, disrupted ecological processes, and threatens wetland birds, reptiles, and amphibians. Coordinated herbicide-based control efforts covering over 1000 ha were undertaken in 2016 and 2017, aiming to eradicate this aggressive and highly productive grass. We report on the results of a BACI-design monitoring program targeting control efficacy and the integrity of restored marsh. Though combined aerial and ground-based herbicide application was highly successful (>95%) at eradicating P. australis with minimal risk to aquatic biota from herbicide exposure, we have seen reductions in plant diversity and secondary invasion by Hydrocharis morsus-ranae that tempers our optimism about the restoration of ecological integrity in the short term. Neither primary production nor decomposition rates have recovered to reference levels, though unusually high lake levels may play a role in delaying vegetation recovery. Further, we document effects of herbicide exposure on periphyton that may jeopardize wetland food webs. ■

PRESENTATION 1149
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES I*, 05/31/2018, 03:20 - 05:00

EFFECTS OF SOIL FERTILITY AND FLOODING REGIME ON THE GROWTH OF *AMBROSIA TRIFIDA L.*

Park, Hyun Jun, Seoul National University, Seoul, Korea, Republic of
Hong, Mun Gi, Seoul National University, Seoul, Seoul, Korea, Republic of
Kim, Jae Geun, Seoul National University, Seoul, Seoul, Korea, Republic of

Ambrosia trifida L. (giant ragweed), one of the terrestrial invasive plants with tall and dense canopy, generally shows strong competitiveness in bare ground or waterside. To

examine the effects of soil fertility and flooding regime on the growth of A. trifida, we conducted a mesocosm experiment under two levels of soil fertility (high and low) and three types of flooding patterns (non-flooded, periodically-flooded, and flooded). In non-flooded and high fertility condition, shoot height and total dry weight were the highest (shoot height: 154.7 ± 4.4 cm, total dry weight: 13.0 ± 1.4 g), and the ratio of aboveground dry weight to belowground dry weight was the lowest (2.46 ± 0.57). Regardless of soil fertility, the growth of A. trifida was impeded in two flooding conditions, and especially the decrease in the periodically-flooded condition was the largest ($p<0.05$). Despite the impediment, the growth inhibition effect by flooding stress seemed to be decreased by sufficient nutrients in soil. Therefore, A. trifida could survive in riverside or coastline of wetlands though their growth and development are declined by the inundation, and the survival rate of A. trifida could increase even more if their settlement area is eutrophic. To keep A. trifida from invading wetland and riverside ecosystems, it is important to maintain constant or periodic water level and also to prevent excessive nutrients.
This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(No. 2015R1D1A1A01057373). ■

PRESENTATION 1228
PRESENTED DURING *RIPARIAN ECOSYSTEMS II: PHYSICAL AND BIOTIC DRIVERS OF CHANGE*, 05/31/2018, 01:00 - 02:50

DIVERGENT EFFECTS OF LAND-USE, PROPAGULE PRESSURE, AND CLIMATE ON WOODY RIPARIAN INVASION - TAMARISK, RUSSIAN OLIVE, AND SIBERIAN ELM

Perry, Laura, Colorado State University, Fort Collins, CO
Reynolds, Lindsay, U.S. Forest Service, Fort Collins, CO
Shafroth, Patrick, U.S. Geological Survey, Fort Collins, CO

Riparian ecosystems are often heavily invaded by non-native plants, which can impact community composition and ecosystem services. Tamarisk (Tamarix ramosissima, T. chinensis, hybrids) and Russian olive (Elaeagnus angustifolia) are widely recognized riparian invaders in the western USA. Numerous studies have examined effects of climate, streamflow, and streamflow regulation on tamarisk and Russian olive invasion. However, the role of human land-use in riparian plant invasion, including for tamarisk and Russian olive, remains poorly understood. To evaluate the importance of land-use relative to climate, propagule pressure, and resource availability in riparian invasion, we examined occurrence, abundance, and dominance of tamarisk, Russian olive, and a lesser-known invader, Siberian elm (Ulmus pumila), in 238 riparian sites in developed, cultivated, and undeveloped areas of four western USA river basins (281,946 km2). We used conditional inference forests to examine relationships between invasion and urban, suburban, recreational, transportation, and agricultural land-uses, as well as temperature, precipitation, seed sources, streamflow intermittency, streamflow regulation, streambank stabilization, forest cover, and floodplain grazing.

Temperature and propagule pressure largely drove invasive species occurrence, whereas factors likely to affect resource availability, such as land-use, precipitation, and streamflow intermittency, were more important to abundance and dominance. The role and importance of land-use varied among taxa. Urban and suburban land-use increased Siberian elm occurrence, abundance, and dominance, and urban land-use increased Russian olive occurrence, but suburban land-use reduced tamarisk dominance. Urban and suburban land-use, and associated streambank stabilization, were the most important predictors of Siberian elm abundance. Agricultural and recreational land-uses were unimportant to all three taxa. Surprisingly, Siberian elm, which has received scant prior scientific and management attention, occurred as or more frequently than tamarisk and Russian olive (except in undeveloped areas of the Colorado River headwaters), and had higher abundance and dominance than tamarisk and Russian olive in developed areas. More research is needed to understand the ecology and impacts of this largely unrecognized invader on riparian ecosystem services, particularly in urban and suburban areas. ■

PRESENTATION 1235
PRESENTED DURING *RIPARIAN ECOSYSTEMS II: PHYSICAL AND BIOTIC DRIVERS OF CHANGE*, 05/31/2018, 01:00 - 02:50

THE ROLE OF A NON-NATIVE TREE IN LARGE-SCALE RIPARIAN VEGETATION EXPANSION AND CHANNEL NARROWING ALONG A DRYLAND RIVER

Scott, Michael, Utah State University, Fort Collins, CO
Reynolds, Lindsay, U.S. Forest Service, Fort Collins, CO
Shafroth, Patrick, U.S. Geological Survey, Fort Collins, CO
Spence, John, National Park Service, Page, AZ

Along rivers, native and invasive species may establish and persist on active channels as part of a channel narrowing process. We quantified spatial and temporal patterns of vegetation expansion and channel narrowing, including native cottonwood (Populus fremontii) and non-native Russian olive (Elaeagnus angustifolia), along the mostly unregulated Escalante River in Utah, USA. We analyzed historical aerial photography and used dendrochronologic analysis to document changes in channel and vegetation patterns through

time. Russian olive establishment was examined with respect to hydrologic and climatic variables. Channel narrowing along the Escalante River begam during a mid-20th century drought. Pioneer cottonwood rapidly colonized former channel surfaces between the 1950s and 1981. Small numbers of Russian olive stems established during this period when the channel narrowed by nearly 80%. After 1981, there was no apparent cottonwood establishment but channel bars and banks were rapidly colonized by Russian olive. Hydro-climatic predictors were equivocal but exponential growth of this large-seeded, shade-tolerant species lagged its introduction by 30 years, because of delayed reproductive maturity, limited seed availability and perhaps widespread availability of favorable establishment sites following initial channel narrowing. Sediment trapping, levee formation and modification of channel form by bands of dense Russian olive progressively limited creation of new establishment sites and by 2000, recruitment declined sharply. Our results have implications for management of non-native tree invasions along arid-region rivers, including identification of low, moist, active channel bars where the establishment and physical impacts of Russian olive appear to be most pronounced and where focused management efforts should be most cost effective. ■

PRESENTATION 1263
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES I*, 05/31/2018, 03:20 - 05:00

DRIVERS OF INVASIVE PLANT SEVERITY IN PENNSYLVANIA WETLANDS

Mazurczyk, Tara, The Pennsylvania State University, University Park, PA
Backhaus, Peter, Pennsylvania State University, University Park, PA

Freshwater wetlands are particularly vulnerable to the impacts of invasive plants that disrupt geochemical and geophysical processes in the landscape. The threat to ecosystem health and the competitive displacement of native species from non-native species invasions poses great risk. We investigated seventy-seven site variables that impact invasive plant establishment using a community assemblage framework. Using a long-term spatial and temporal dataset, we evaluated the invasibility of 222 temperate, freshwater wetland sites in Pennsylvania. Plot-level characteristics were sampled between 1993 and 2003 and a resample of 66 wetland sites was conducted between 2003 and 2013. Categorized by hydrogeomorphic type, we examined invasive severity using regression tree and Random Forest analyses to develop a mixed effects model based on the predictive power of various environmental, disturbance, biotic, and abiotic factors for a training dataset (first sampling, n=222) and a test dataset (second sampling, n=66). There was significant inconsistency among wetland types and ecoregions. Thus, we developed a prediction model for a subset of invasive vegetation - invasive herbaceous cover - that had the lowest observed error rate of + 10.6% cover. Statistically significant variables of importance included soil organic matter at 5 cm, a disturbance score, elevation, percent forest, and percent herbaceous cover. We found that wetland sites, particularly lacustrine human impounded, had high invasive severity due to a low-lying geographic position, a disturbance score greater than 30, less than 20% soil organic matter at 5cm, and herbaceous cover as the dominant vegetation type. The prediction model we developed is not intended to precisely estimate invasive severity rather, it should be used as a tool to identify wetlands at high risk of invasibility. Overall, the prediction model provides an effective and cost-efficient way of detecting and monitoring plant invasions in the early stages of establishment, focusing conservation and mitigation efforts more pointedly. ■

PRESENTATION 1438
PRESENTED DURING *GIS & REMOTE SENSING*, 05/30/2018, 03:20 - 05:00

USING DRONES TO ASSESS FERAL SWINE DAMAGE IN WETLANDS ACROSS A FLORIDA RANGELAND

Anderson, Wesley, University of Florida, Lake Placid, FL
Wight, Bethany, University of Florida, Ona, FL
Boughton, Raoul, University of Florida, Ona, FL

Drones or Unmanned Aerial Vehicles are rapidly changing how spatial data are collected. One application of this technology is the ability to conduct environmental damage assessments across large areas. Invasive in the United States, feral swine (Sus scrofa) cause extensive damage through their rooting behavior. In wetlands rooting alters water quality and chemistry and can negatively impact species composition and biodiversity. We utilize drone technology and a 12MP camera to assess the rooting damage area caused by feral swine in seasonal wetlands across a Florida rangeland. We survey 36 seasonal wetlands (0.4-1.3ha) four times per year during the dry season. Flights are conducted at a height of 50m with 75% image overlap to capture 2-3cm ground resolution and conduct image analyses for rooting assessment. In our data pipeline we use an online service to mosaic the georeferenced flight images per sample site, align repeat mosaics through the use of deployed ground control points visible within the mosaic, and process each mosaic within ArcGIS using image classification tools. To

classify each image pixel as rooted, non-rooted, or non-classified we train a subset of pixels using the three visible color bands contained within each image, and then apply these trained populations to all other pixels using Maximum Likelihood Classification. The subsequent classified pixels are then grouped and areas of rooting calculated. In this case study we show how manageable spatial data processing has become, explain the methods, the limitations of these methods, and the results from our first several rounds of flights. ■

PRESENTATION 1452
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES IV*, 06/01/2018, 03:20 - 05:00

ADDRESSING PRACTITIONER UNCERTAINTIES IN INVASIVE [I]PHRAGMITES[/I] MANAGEMENT: A FIVE-YEAR STUDY OF VEGETATION AND SEED BANK RESPONSES TO CONTROL

Rohal, Christine, Utah State University, Gainesville, FL
Kettenring, Karin, Utah State University, Logan, UT
Hazelton, Eric, Utah State University, Logan, UT
Sims, Kimberly, University of Tennessee, Knoxville, TN
Ma, Zhao, Purdue University, West Lafayette, IN

Phragmites australis, one of the most widespread and ecologically impactful invasive wetland plants in North America, is heavily managed, but limited scientific evidence is available to inform management decision-making. We surveyed 42 managers throughout the Great Salt Lake (GSL) watershed about management uncertainties and practical constraints to inform our developing Phragmites management research program. Managers expressed uncertainties regarding the timing of herbicide application and the type of herbicide for effective control. Managers believed revegetation was unnecessary following control due to a prolific seed bank, yet this has been unexplored empirically in this region. With manager assistance, we tested six Phragmites control treatments across six GSL sites to address these uncertainties: 1) summer glyphosate spray, followed by a winter mow; 2) summer imazapyr spray, winter mow); 3) fall glyphosate spray, winter mow; 4) summer mow, followed by a fall glyphosate spray; 5) summer mow then cover plots with heavy-duty black plastic (i.e., a solarization treatment); and 6) untreated control. We evaluated treatments for their influence on Phragmites cover, Phragmites inflorescence production, and native plant cover, and assessed plant community trajectories and outcomes in the context of environmental factors. In addition, we sampled the seed bank in consecutive years to evaluate the richness and density of species across sites, and the influence of treatments on seed bank composition. We found that fall herbicide treatments were more effective than summer treatments for Phragmites removal, but native plant recovery was highly variable across sites, predominately due to differences in soil moisture. The seed bank under Phragmites patches differed in composition, richness, and density across sites, which likely contributed to variability in plant community recovery following treatments. Summer herbicide and summer mow treatments strongly limited Phragmites inflorescence production, but this did not result in an immediate decrease in Phragmites presence in the seed bank, perhaps due to propagule pressure from nearby patches. Including managers in research design and implementation made research findings more pertinent to manager needs and trusted by managers. ■

PRESENTATION 1616
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES I*, 05/31/2018, 03:20 - 05:00

COMPARISONS ON GROWTH AND PHYSIOLOGICAL CHARACTERISTICS OF NATIVE AND INTRODUCED POPULATIONS: A COMMON-GARDEN STUDY ON *PHRAGMITES AUSTRALIS*

Xie, Liujuan, Qingdao Institute of Marine Geology, Qingdao, China, China
Ye, Siyuan, QIMG, CGS, Qingdao, Shandong, China
Pei, Lixin, Qingdao Institute of Marine Geology, Qigndao, Shandong, China

Biological invasion is one of the major global environmental problems. Plants have a major impact on physical processes, biological functions and geological evolution of wetlands. As one of the main plant species of coastal wetlands in China, Phragmites australis invasion may threaten the growth status of native populations, thus affecting the ecosystem structure and functions, geomorphology, photosynthetic carbon sequestration, and surface water/groundwater equilibrium prediction in coastal areas. Here, we compared the growth and physiological characteristics of native P. australis collected from the Yellow River Delta (saltmarsh) and inland freshwater areas (freshwater) in China with the introduced P. australis collected from Fast East Australia (FEAU) populations in a common garden experiment, to evaluate the invasive potential of genotypes from FEAU, and to advance the understanding of invasion ecology of P. australis. The results showed that there were significant differences in root and rhizome biomass between different populations. The height, shoot number, specific leaf area, stomatal conductance and total biomass of saltmarsh and freshwater population were significantly higher than those of the FEAU population. This indicates that the native populations are more capable of in-

tercepting light energy and thus accumulate more photosynthetic products with faster growth rates and higher primary productivity. The chlorophyll content of FEAU population is relatively higher, which may be related to the lower specific leaf area. The aboveground/underground biomass ratio of saltmarsh population is similar to that of FEAU population, and show much higher values than that of freshwater population, which might indicate that saltmarsh and FEAU populations distribute relatively little biomass to the ground and more biomass to aboveground parts, thus promotes the spread of the population. The photo response curve of ETR to PAR is fitted to analyze the adaptation and utilization abilities to light energy. The ETRmax and light saturating irradiance values of FEAU population are higher than that of the native populations, indicating that the former has larger utilization range of photosynthetic active radiation than the latter, and the former can adapt to high irradiance. Thus, the FEAU population had a certain degree of invasion risk. Further research is needed to investigate whether FEAU are thriving in wetlands of China based on the long-term growth experiments. ■

PRESENTATION 1647
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES I*, 05/31/2018, 03:20 - 05:00

INVASIVE *TYPHA* SPP. FACILITATES INVASIVE EUROPEAN FROGBIT (*HYDROCHARIS MORSUS-RANAE*) IN GREAT LAKES COASTAL WETLANDS.

Lishawa, Shane, Loyola University Chicago, Chicago, IL
Wellons, Kathryn, Oregon State University, Corvallis, OR
Monks, Andrew, Loyola University Chicago, Chicago, IL
Albert, Dennis, Oregon State University, Corvallis, OR 97331, OR

Plant-to-plant facilitation plays an important role in structuring communities and is a particularly critical factor in high disturbance ecosystems, such as coastal wetlands, where a species may ameliorate an environmental stressor and allow colonization by another less stress tolerant species. Increasingly, facilitation has also been recognized as an important factor in invasion biology.

In Great Lakes coastal wetlands, the aquatic invasive species European frogbit (Hydrocharis morsus-ranae; EFB), a small floating plant, is commonly observed co-occurring with invasive cattail (Typha spp.), a dominant and ubiquitous emergent taxa. We tested the strength of this relationship at a regional scale by evaluating data from a Great Lakes-wide coastal wetland plant monitoring data set; and at the individual wetland scale, by assessing correlations between the two species. Additionally, we conducted a large-scale (60x30m plots) Typha and EFB management study, to evaluate the effects of different treatments on an extant EFB population.

Our Great Lakes-wide analysis revealed that invasive Typha presence was a significant predictor of EFB ($p<0.001$) and as Typha dominance in a wetland increased, the likelihood of EFB occurring in that wetland increased significantly ($p<0.01$). At the wetland scale we documented a positive linear relationship between EFB cover and Typha cover ($p<0.001$). Experimental results indicated that one year following treatments, in plots where Typha cover had been reduced to near one percent (0.74 ± 1.43), EFB cover was nearly an order of magnitude lower 3.62% (± 4.39) than in control plots (EFB cover 28.90% $\pm$ 5.90). Furthermore, a positive linear relationship between EFB and Typha cover persisted within subplots following treatments ($p < 0.001$).

These results support our hypothesis that invasive Typha facilitates EFB in Great Lakes coastal wetlands, likely by ameliorating wave action and wind energy, thereby providing the structure necessary for EFB to persist in these high energy environments. ■

Management & Applied Science: Monitoring & Assessment

PRESENTATION 1069
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS II*, 05/31/2018, 01:00 - 02:50

SAN LUIS VALLEY COLORADO WETLAND AND WILDLIFE CONSERVATION ASSESSMENT

Aloia, Cary, Wetland Dynamics, LLC, Monte Vista, CO

The 'San Luis Valley Wetland and Wildlife Conservation Assessment' is a cooperative effort amongst natural resource agencies and organizations in the San Luis Valley (SLV) of Colorado to evaluate options for monitoring, management, and conservation of wetland and wildlife resources. Wildlife and land managers in the SLV need to better understand the historic and current wetland landscape given the promulgation of new groundwater rules and regulations, initiation of an irrigation season for ground and surface water, a 10+ year drought, and requests from the water users in the SLV for agencies to provide water management plans that account for new constraints and requirements. The SLV is a cold, semi-arid desert at 7600 feet, containing the largest wetland complexes in Colorado. These wetlands are dependent upon annual snowmelt, summer monsoons, and an extensive aquifer system providing groundwater resources. The Intermountain West Joint Venture has completed an analysis of 30 years of

satellite imagery in the SLV, identifying changes in wetland extent and land use. Coupled with identification of limiting habitat resources for 35 priority wetland-associated wildlife species in the SLV, partners will identify and prioritize limiting wetland resources to manage habitats and water more effectively and efficiently. Specifically the Assessment aims to: 1) Develop a framework for natural resource agencies to work cooperatively to provide and monitor limiting habitat resources for wildlife, 2.) Develop priority habitat conservation goals and potential water and wetland infrastructure projects, 3.) Provide a template for other basins to use for prioritizing conservation strategies, and; 4.) Provide fact sheets along with matrices describing habitats and threats for priority species that can be used by a variety of stakeholders to help determine priorities for conservation. The Assessment can be updated in the future as new monitoring information on climate, wetland hydrology, and land use is collected. ■

PRESENTATION P55
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE IMPACT OF TEMPERATURE AND PH ON BLUE CRAB (CALLINECTES SAPIDUS) JUVENILES.

McLean, Josette, St. George's University, Arima, Trinidad and Tobago
Rosa, Patricia, St. George's University
Diaz, Humberto, Duke University, Beaufort, NC

Blue crabs (Callinectes sapidus), are a species of crab found in estuaries and lagoons across the Western Atlantic. They are one of the major products of the fishing industries of New Jersey, Delaware, and the Carolinas. In addition to this, they are a keystone species; and through predation they control the abundance of organisms within their local ecosystems. Recent studies have shown that estuarine habitats are becoming warmer and more acidic due to anthropogenic inputs and climate change. This experiment investigated how variations in pH and temperature affect the molting, survival and growth rates of blue crab juveniles. One hundred and eighty juvenile crabs were collected from the Neuse River in North Carolina, USA. They were then placed into 3" finger bowls; and equally divided into two incubators, one set at 24°C and the other at 28°C. Each incubator contained distinct groups of crabs kept at pHs of 6.5, 7.5 and 8.5. Every day the juveniles were fed with newly hatched brine shrimp nauplii (Artemia sp.) and their water was changed. Their molting rates, number of deaths and carapace widths were also recorded on a daily basis. Then the average growth, growth rate, molting rate, and survival percentage, were calculated for each treatment. Throughout this research, no significant mortality was observed. However, the results did indicate that an increase in temperature increases growth and growth rates, while a decrease in pH increases growth rates but decreases overall growth. These effects can increase blue crab vulnerability to predation and reduce their overall reproductive fitness. Currently, there is a paucity of data on this topic, but this information may be useful in assessing and increasing the resistance and resilience of blue crab populations to climate change. ■

PRESENTATION P53
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

RIPARIAN VEGETATION FUNCTIONAL DIVERSITY ALONG HYDROLOGIC GRADIENTS ON THE SAN MIGUEL AND DOLORES RIVER

Cubley, Erin, Colorado State University, Fort Collins, CO

Future climate change projections, coupled with increased anthropogenic water development, threaten riparian ecosystems by altering flow regimes. Changes in the timing, duration, magnitude, and frequency of streamflow can dramatically alter riparian vegetation and cause shifts in species composition. Numerous studies have examined the response of vegetation composition to hydrologic perturbations along lateral gradients, where vegetation is mainly determined by disturbance frequency and water availability. Changes in flow regimes on many western rivers can be linked to vegetation encroachment in the channel, as well as expansion of xeric or drought tolerant plant communities. More recently, a functional-traits approach has emerged in riparian ecology to analyze the mechanics of vegetation community assembly and examine how shifts in riparian vegetation composition may alter ecosystem functions and services. The aim of our study was to determine how indices of functional diversity relate to the provisioning of terrestrial wildlife habitat across gradients of water availability on the San Miguel and Dolores Rivers in Colorado. We asked the following questions 1) How does functional diversity change along hydrologic gradients? 2) How does functional diversity relate to the habitat quality for terrestrial wildlife? Vegetation surveys, trait measurements, and depth to groundwater data were collected at four river reaches during the summer of 2016. Exceedance probabilities were calculated using daily flow records for the period of record and inundation frequency was calculated for plots using HEC-RAS 1-D hydraulic models. Initial results suggest low functional diversity in plots characterized by high depth to groundwater and low disturbance frequency. Results from this research will demonstrate how river ecosystems could be altered by future changes in flow regimes and inform water managers on flow requirements for riparian vegetation in the Colorado River basin. ■

PRESENTATION 1102
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES I*, 05/30/2018, 09:45 - 11:35

WETLAND SCIENCE INFORMING POLICY AND PRACTICE: WHERE IN THE WORLD DOES WETLAND WISE USE NEED TO IMPROVE MOST?

Davidson, Nick, Nick Davidson Environmental, Wigmore, Herefordshire, United Kingdom

Despite decades of global attention seeking to stem the loss and degradation of wetlands, such loss and degradation has continued, and may even be accelerating. This presentation will bring together and summarise a range of recent reviews of patterns of wetland loss, how much wetland we have left (and where), and what is the current ecological character state and trends in state of these remaining wetlands, including from the 2017 SWS Ramsar Section "citizen-science survey" of the state of the world's wetlands. I will identify in which parts of the world the wetland situation is currently best and worst. Such an increasingly strong science evidence-base is vital to support governments and others in future priority-setting and taking well-informed policy decisions to better manage the world's wetlands. ■

PRESENTATION 1113
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS I*, 06/01/2018, 09:45 - 11:35

USING THE NWCA TO EVALUATE THE PERFORMANCE OF WETLAND COMPENSATORY MITIGATION PROJECTS UNDER THE CLEAN WATER ACT: LAKE ERIE BASIN OF OHIO CASE STUDY

Weaver, Kerryann, EPA, Chicago, IL

In 2011, as field crews sampled natural wetlands across the nation as part of the National Wetland Condition Assessment (NWCA), 60 compensatory wetland mitigation projects in the Lake Erie Basin of Ohio, 30 mitigation bank (MB) and 30 permittee-responsible (PRM) mitigation sites, were also being monitored using customized NWCA monitoring protocols. This EPA funded project was an effort to comprehensively evaluate the ecological success of compensatory mitigation across the basin and to facilitate the development of effective ecological guidelines for designing sustainable mitigation.

To evaluate the wetland ecological condition and success or failure of the mitigation wetlands, the NWCA vegetation data collected was used to calculate Vegetation Index of Biotic Integrity (VIBI) scores (Mack 2004) and Landscape Development Index (LDI) scores (Micacchion et al. 2010). Achieving VIBI scores reflective of at least a "good" level of ecological condition was set as the quantifiable success criteria as this is a universal performance standard used in Ohio for all wetland mitigation projects. Overall, 30% of mitigation bank and 13% of permittee-responsible sites in the GLBECS study were considered successful. In 2017, a follow-up evaluation was conducted at the same 60 wetland mitigation sites to further evaluate ongoing success in meeting performance standards. The results indicate a general improvement in the performance of both MB and PRM sites. A final report on this work is pending.

The Lake Erie Basin studies demonstrated that quantifiable ecological performance standards, developed from NWCA data can be used to determine the success rates for compensatory wetland mitigation. The results highlight the potential for development of wetland assessment tools, like the Ohio VIBI, using the NWCA data to establish measurable wetland ecological performance standards. Recommendations from the studies include general approaches to improve wetland compensatory mitigation. ■

PRESENTATION 1135
PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS I*, 05/30/2018, 01:00 - 02:30

ASSESSING THE CONDITION OF COLORADO'S WETLANDS TO IMPROVE DECISION MAKING

Lemly, Joanna, Colorado Natural Heritage Program, Fort Collins, CO

Colorado is among the fastest growing states in the country, a trend that has major impacts on the State's natural resources base. In the semi-arid West, water is a scarce resource that is front and center in many political debates and major statewide planning efforts. But while water is on the tip of many tongues, few of these conversations include wetlands. Wetlands in Colorado are as diverse as our landscape and are critical for supporting the state's vibrant wildlife and maintaining healthy watersheds. But they cover a small fraction of the land area-less than 2%. With a small land area, wetlands are often overlooked or underappreciated in major planning efforts. For more than 20 years, the Colorado Natural Heritage Program (CNHP) has been on the forefront of research, inventory, and assessment of wetlands in Colorado. Our initial focus was on cataloging the most significant wetlands for preserving biodiversity. Over time, our work has expanded to include mapping the extent of wetlands, assessing their condition in probabilistic random surveys, evaluating the quality of wildlife habitat, analyzing wetland water quality, estimat-

ing wetland functions at the watershed scale, and developing educational resources about wetlands, such as wetland plant field guides and the Colorado Wetlands App. As we look towards the future, a major goal of CNHP is to create tools and resources that facilitate the use of CNHP's rich wetlands data in watershed and statewide planning. These tools include 1) the Colorado Wetland Inventory Website, which hosts a range of important wetland information; 2) the Watershed Toolbox, an interactive website that presents watershed functions and restoration priorities within two target watershed; and 2) a searchable database with raw data from thousands of wetland and riparian sites. We are also undertaking a multi-agency planning process to create a five-year Wetland Program Plan for Colorado. With these tools, we hope that wetlands play a larger role in resources planning in the years to come. ■

PRESENTATION 1150

PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES I*, 05/30/2018, 09:45 - 11:35

WHAT'S DRIVING CONTINUING WETLAND LOSS AND DEGRADATION?

van Dam, Anne, IHE-Delft Institute for Water Education, Delft, Netherlands

Understanding the drivers of wetland loss and degradation is critical because policy and management responses need to be based on changing human-induced drivers or responding to natural drivers. Direct drivers of change in wetlands are presented in four categories (physical regime drivers, extraction, introduction of pollutants or alien species, and structural changes) and in relation to different wetland types. Indirect drivers are discussed in the context of development sectors: water-energy, food-fibre, infrastructure, and tourism. Trends in indirect drivers are presented for different world regions. Finally, some global megatrends with relevance for wetland loss and degradation are discussed. To support policies for protection of wetland ecosystems, a case is made for monitoring of a selection of indicators for key drivers of change from various policy sectors. These key indicators could be part of a regular global wetlands outlook report, which could raise awareness and guide similar monitoring efforts at regional and national levels. ■

PRESENTATION 1154

PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS II*, 05/30/2018, 03:10 - 05:00

DEVELOPING WETLAND ASSESSMENT METHODS FOR WYOMING'S IRRIGATED BASINS: ADDRESSING CONDITION, BIODIVERSITY, AND HABITAT VALUE

Washkoviak, Lindsey, Wyoming Natural Diversity Database, Lander, WY
Tibbets, Teresa, Wyoming Natural Diversity Database, Lander, WY

Wetlands comprise less than 2% of the area in Wyoming, but are one of the habitats most vulnerable to impacts of future development and climate change. Hydrologic modifications and irrigation infrastructure prevalent in watersheds throughout WY have complicated our ability to characterize and understand wetland ecosystems, making it challenging to assess their ecological condition. The Wyoming Natural Diversity Database (WYNDD), in collaboration with The Nature Conservancy (TNC), Wyoming Game and Fish Department (WGFD), and Wyoming Department of Environmental Quality (WYDEQ), have worked together on a multi-year project to assess the condition of wetlands in Wyoming in order to support state priorities for wetland monitoring, protection, and conservation. We will present the results from basin-scale wetland assessments completed throughout Wyoming, evaluating ecological condition and presence of land use stressors identified from field surveys. Results from 353 wetlands sampled across five basins in Wyoming indicate 11% are at or near reference condition, with a majority of wetlands indicating either a slight (56%) or moderate (27%) deviation from reference condition. We estimate that hydrologic modifications are present at 80-90% of wetlands sampled thus far, and up to 46% of those wetlands are supported or created by irrigation infrastructure. Conservation and restoration strategies aimed at protecting wetland acreage will fall short of their intended purpose without an understanding of the role between modified hydrology and wetland area, function, condition, and value. We will discuss the development of assessment methods that address the need to understand the effects of human activities on wetland function, biodiversity, and habitat value in basins influenced by altered hydrology. We will also highlight the development of a user-friendly storyboard that utilizes GIS data layers presented in a format that informs wetland management and other stakeholder priorities. ■

PRESENTATION 1155
PRESENTED DURING *COASTAL HYDROLOGIC RESTORATION: INFORMING PROGRAM MANAGEMENT THROUGH MONITORING*, 06/01/2018, 09:45 - 11:35

RESTORATION ADAPTIVE MANAGEMENT IN PUGET SOUND, WA: SUPPORTING RESEARCH, TOOL DEVELOPMENT AND COMMUNICATION

Conway-Cranos, Tish (Letitia), Washington Department of Fish and Wildlife, Olympia, WA

The Puget Sound nearshore is a complex, dynamic ecosystem that has changed dramatically in the last 150 years and faces a myriad of ongoing anthropogenic influences. Conducting restoration in nearshore habitats is a vital component of Puget Sound ecosystem recovery, yet this cannot be done effectively without applying adaptive and strategic knowledge at both local and regional scales. Nearshore habitats are dynamically influenced by both riverine and marine abiotic and biotic forces such that it can be challenging to disentangle the individual and cumulative effects of restoration projects across environmental gradients acting at multiple spatial and temporal scales. Despite the challenges in accomplishing such efforts, integrating data collection and analysis across local and landscape-level scales is an important aspect of both understanding the relationship between individual restoration efforts and their surrounding ecosystems and in planning and implementing new restoration projects. The Estuary and Salmon Restoration Program (ESRP) seeks to strategically restore and protect nearshore processes in Puget Sound through understanding both the historic and current condition of the landscape and through supporting research to inform restoration. ■

PRESENTATION 1166
PRESENTED DURING *MONITORING & ASSESSMENT II*, 05/31/2018, 01:10 - 02:50

TRENDS IN SURFACE ELEVATION AND ACCRETION WITHIN A RETROGRADING DELTA IN COASTAL MISSISSIPPI, USA

Pitchford, Jonathan, Grand Bay NERR, Moss Point, MS
Cressman, Kimberly, Grand Bay NERR, Moss Point, MS
Cherry, Julia, University of Alabama, Tuscaloosa, AL
McIlwain, Julius, Grand Bay NERR, Moss Point, MS
Archer, Michael, Grand Bay NERR, Moss Point, MS
Underwood, William, Alabama Dept of Natural Resources, Spanish Fort, AL

The Grand Bay estuary is an extensive salt marsh complex in coastal Mississippi that is part of a retrograding deltaic system with no riverine sediment supply. The unique nature of this estuary makes it susceptible to sea level rise and subsequent changes in marsh elevation and vegetation. This study was designed to better understand trends in surface elevation and accretion within this system along a coastal elevation gradient that extends from a *Spartina alterniflora* dominated marsh to an upland slash pine (*Pinus elliottii*) flatwoods. Five sites were selected along the elevation gradient for establishment of Surface Elevation Tables (SETs) and marker horizon (MH) plots to quantify trends in surface elevation and accretion from 2012 – 2016. Preliminary results suggest that three of the five sites (a low marsh, a mid/low-marsh, and an upland site) are keeping pace with sea level rise, but the two other sites (a mid-marsh and a salt panne site) are not keeping pace with increases in sea level. The salt panne and mid-marsh sites are higher in the tidal frame and thus are less frequently inundated, resulting in low potential for accretion of marine-derived sediments. For sites lower in the tidal frame (mid/low marsh and low marsh), frequent inundation, proximity to eroding shorelines, and belowground root production are likely helping the marsh platform to maintain elevation relative to sea level rise. ■

PRESENTATION 1171
PRESENTED DURING *COASTAL HYDROLOGIC RESTORATION: INFORMING PROGRAM MANAGEMENT THROUGH MONITORING*, 06/01/2018, 09:45 - 11:35

ADVANCING RESTORATION SCIENCE THROUGH EFFECTIVENESS MONITORING AT OREGON'S LARGEST TIDAL WETLAND RESTORATION PROJECTS

Brophy, Laura, Estuary Technical Group. Institute for Applied Ecology, Corvallis, OR
Brown, Laura, Confederated Tribes of Siletz Indians, Siletz, OR
Ewald, Michael, Estuary Technical Group, Institute for Applied Ecology, Corvallis, OR
Peck, Erin, Oregon State University, Corvallis, OR
Wheatcroft, Rob, Oregon State University, Corvallis, OR
van de Wetering, Stan, Confederated Tribes of Siletz Indians, Siletz, OR

Effectiveness monitoring at wetland restoration sites has many benefits. It provides data necessary for adaptive management at the restoration site itself; informs other restoration projects; and provides accountability for the restoration investment. Every monitoring program must first address the question, "Did the project meet its goals?" By doing so, the program helps practitioners clearly communicate their results to funders, the scientific community, and the public. Far beyond the site scale, well-designed effectiveness monitoring fills key data gaps and helps answer "burning questions," advancing conservation and restoration science at local, regional, and national scales. To leverage each monitoring project and achieve these high-level results,

careful planning and input from a multidisciplinary team is important. This presentation will provide results from recent monitoring projects that have followed these principles and have greatly advanced our understanding of Pacific Northwest tidal wetland ecology, producing a "multiplier effect" as results have fed into regional improvements in restoration and conservation science. These monitoring programs are based on a simple ecosystem conceptual model. For interpretive power, monitoring includes parameters at multiple levels of the model: key controlling factors, structural characteristics, and biological outcomes that most strongly affect -- and reflect – the sites' valued wetland functions such as fish and wildlife habitat, native vegetation support, nutrient processing, water temperature moderation, sediment detention, and carbon sequestration. The monitoring – along with our monitoring at many other restoration and reference sites – has produced insights that have helped many groups improve their restoration site selection, design, and implementation. ■

PRESENTATION 1203
PRESENTED DURING *HUMAN DIMENSIONS OF WETLANDS*, 06/01/2018, 09:55 - 11:35

WETLAND CAREER CONNECTED LEARNING: A PARTNERSHIP BETWEEN THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION AND THE EVERGREEN STATE COLLEGE

Bush, Tony, Washington State Department of Transportation, Olympia, WA

Background/ Objectives

The National Governors Association has a goal of increasing work-based learning across the US in support of state's goals of workforce development to meet business demands and be more economically viable. While facing a wave of retirement, having a pool of trained and tested candidates is vital for succession.

For 21 years, The Washington State Department of Transportation (WSDOT) and The Evergreen State College (TESC) have partnered to run the Wetland Monitoring Internship. Despite avoidance and minimization, WSDOT has significant mitigation for wetland impacts. This mitigation brings monitoring and reporting. The Internship is 11-weeks to complete quantitative vegetation monitoring and provide quality training and experience to students. WSDOT trains 15-20 graduate and undergraduates per summer. Participants receive a $3,000 payment and college credit.

Methods

To create and sustain a partnership, dedicated staff from both parties are necessary. A detailed written agreement describing the partnership promotes longevity. This allows the partnership to endure staff changes, even if the founders are absent. Initially, this set up requires time and skilled staff. However, once these agreements are in place, all realize benefits of streamlined finances and logistics with clear roles and responsibilities.

Results and Conclusion

For a partnership to last, collaborators must realize clear benefits. WSDOT receives skilled workers at a reasonable cost, and ends up with a trained pool of biologists to compete for agency jobs. TESC is able to offer career connected, field based learning to graduates and undergraduates while increasing summer enrolment. The interns get valuable training and networking, often leading to wetland jobs.

This can serve as a model for connecting academic bodies with outside entities. We are not able to expand this internship; however, the rest of the nation must also comply with Clean Water Act. To WSDOT's knowledge, no other internship exists that links an academic institution to DOT wetland monitoring. Oregon DOT has reached out to explore creating a similar program.

Potential for expansion elsewhere could be high, but attention to building partnerships is crucial. Replicability requires buy-in from the DOT and a willingness to change current practices. A partner academic institution must be open to facilitating work-based learning for credit, and agreeing upon compensation, and clearly defined roles. ■

PRESENTATION P57
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

UNINTENDED BENEFITS OF THE WORLD'S LARGEST WETLAND MONITORING SYSTEM-LOUISIANA'S COASTWIDE REFERENCE MONITORING SYSTEM

Piazza, Sarai, U.S. Geological Survey, Baton Rouge, LA
Sharp, Leigh Anne, Coastal Protection and Restoration Authority of Louisiana, Lafayette, LA
Boshart, William, Coastal Protection and Restoration Authority of Louisiana, New Orleans, LA

Coastal wetlands in Louisiana are expansive measuring approximately 38,000 square kilometers. The coastal zone in Louisiana is larger than the entire state of Maryland. Louisiana's coastal wetlands are considered "at-risk" because approximately a quarter have been lost since 1932. The state of Louisiana has planned for and begun implementation of an extensive coastal restoration program guided by Louisiana's Comprehensive Coastal Master Plan for a Sustainable Coast. One component of the effort to restore Louisiana's coastal habitats is the Coastal Wetlands Planning, Protec-

tion, and Restoration Act (CWPPRA) Program which has been designing, funding, and implementing restoration projects since 1990. The Coastwide Reference Monitoring System (CRMS) is a program funded by CWPPRA to monitor the effectiveness of individual restoration projects while providing data to understand baseline conditions in Louisiana's complex coastal ecosystem. A reference network of 390 CRMS sites was designed to identify ecological change at multiple scales from localized site conditions to coastwide trends. Since 2006, a consistent set of parameters have been measured using standardized operating procedures providing comparable data throughout Louisiana's coastal zone. The CRMS wetland monitoring network is the most extensive of its kind in the world.

CRMS data are hosted in an online database and publicly available through the CRMS website (https://www.lacoast.gov/crms2/home.aspx). As was intended, CRMS data have provided a foundation for CWPPRA project evaluations, improved restoration project planning and design, and provided information on baseline conditions. Beyond the benefits provided to the CWPPRA program CRMS data feed ecological models, have been used in more than one hundred peer reviewed publications, support environmental permitting, used for science communication and education, emergency response, and recreational activities. The program also supports 60 plus employs within federal and state government, private industry, and academia. The program benefits reach far beyond that of restoration project evaluation, such that CRMS has also become a model for ecosystem level monitoring within the Gulf of Mexico. ■

PRESENTATION P54
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE APPLICABILITY OF NATIONAL WETLAND CONDITION ASSESSMENT (NWCA) DATA FOR ABOVEGROUND BIOMASS ESTIMATIONS

Harris, Kendall, ORISE Research Participation Program at US Environmental Protection Agency, Washington, DC
Serenbetz, Gregg, U.S. Environmental Protection Agency, Washington, DC
Rossi, Ann, U.S. Environmental Protection Agency, Washington, DC

Plant communities are a significant component of wetland ecosystems and estimations of their aboveground biomass, along with floristic quality measures, can help measure their impact on wetland health, processes and changes. In this study we first sought to evaluate the accuracy of biomass equations for the purposes of estimating aboveground biomass of live trees from the National Wetland Condition Assessment (NWCA), which records estimated size classes of the DBH of individual trees on a plot. By applying regression equations developed by Chojnacky et al. (2014) to data collected by the NWCA we were able to estimate the aboveground biomass of the majority of live trees on NWCA plots across the country using only their DBH. To verify that these biomass estimates were reliable we used LTER tree plot data to compare biomass estimates calculated from actual vs. size-class DBH measurements. We then looked at how live-tree biomass estimations related to vegetation quality measures that can be gleaned from NWCA data, such as species diversity, FQAI and proportion of invasive species. This poster will demonstrate the applicability of NWCA data for the purposes of estimating aboveground biomass, and how those estimations can be related to floristic quality and overall wetland health. ■

PRESENTATION 1252
PRESENTED DURING *MONITORING & ASSESSMENT I*, 05/31/2018, 09:55 - 11:35

MANGROVE INVENTORY, GROUND BASED METHOD ENHANCEMENT TRIALS IN FLORIDA

Brown, Mark, United States Forest Service, Knoxville, TN

Mangrove forests of the United States are relatively rare yet vital ecosystems invaluable to marine and estuarine environments of the land/sea interface. Their spatial distribution is generally peripherally restricted to the intertidal zones within tropical and subtropical latitudes. Traditional ground inventories collect otherwise difficult to observe detailed information frequently used to monitor forest ecosystems, and to assess tree population numbers, species presence, heights, diameters, growth rates, mortality, ownerships, and natural/anthropogenic damages. However, access to many mangrove sites is difficult and time consuming, leading to many estimates solely derived from remote imagery. Often ground access requires specialized equipment including powered watercraft and kayaks to reach locations. Traversing mangrove forests and data acquisition on foot can be hazardous on these adverse sites as well, due to mud flats, tides, prop roots, and tree population density. To investigate mitigation of these issues and to augment sample acquisition, the Southern Research Station (SRS), Forest Inventory and Analysis (FIA) unit initiated a collaborative study with the Florida Forest Service (FFS) and the National Aeronautics and Space Administration (NASA) to test alternative measurement methods in mangrove plot locations. Consultation with the Mexico Forest Service (CONAFOR) inventory of mangroves provided one of the methods tested. This paper evaluates study findings related to methods adopted

for improved data collection used to support management of this sensitive ecosystem. Three primary enhancements were simultaneously tested with currently existing methods. First, inventory a one point plot design to reduce the degree of traverse involved in the current 4 subplot design used as the national standard by FIA. Second, measure tree diameter at breast height (dbh) at one foot above the highest prop root (for trees with prop roots at or above normal dbh) to alleviate the difficult/hazardous measurement at 4.5 feet above that point under current methods. Third, synchronize NASA flyovers of ground measured mangrove plot locations using global positioning system (GPS) coordinates and Goddard LiDAR Hyperspectral Thermal (G-LiHT) airborne imaging system to test the viability of remotely sensed data in combination with similar ground truth data as a source of data acquisition for the numerous inaccessible mangrove plot locations in south Florida. ■

PRESENTATION 1259
PRESENTED DURING *MONITORING & ASSESSMENT I*, 05/31/2018, 09:55 - 11:35

PERFORMANCE OF FLORISTIC QUALITY ASSESSMENTS IN MASSACHUSETTS FORESTED WETLANDS

Gorss, Carolyn, University of Massachusetts Amherst, Amherst, MA
Jackson, Scott, University of Massachusetts Amherst, Amherst, MA

In order to combat the loss of valuable wetland functions and services, federal and state governments must have the tools to accurately assess and monitor the condition of wetland ecosystems. One particular method of wetland assessment is Floristic Quality Assessment (FQA), which has been growing in popularity throughout the United States since its creation in the 1970s. FQA relies on vegetative indicators of human disturbance to assess the integrity of an ecosystem. FQA calculations are based on coefficients of conservatism, professionally-assigned scores ranging from 0-10 that denote a local species' tolerance to anthropogenic disturbance. Despite increasing interest in the widespread use of FQA, few studies have thoroughly tested the quantitative validity of FQA, especially in New England. We used the Conservation Assessment and Prioritization System (CAPS), a landscape-based, coarse-scale wetland assessment method, as a basis for evaluating FQA's performance in Massachusetts's forested wetlands. Our objective was to understand the relationship and strength of performance of the CAPS Index of Ecological Integrity (IEI) scores (a form of generalized stressor gradient) against a variety of FQA indices (biological condition gradients), using conservatism scores from 7 states in the Northeast, and 2 ecoregions in Massachusetts. Based on our calculations of the correlation coefficient R2, and Spearman's rank analysis, we determined that FQA and coefficients of conservation have a moderate to weak relationship with our index of ecological integrity. Of the 11 different FQA indices we tested, the metric with the strongest relationship to our IEI was a site's mean Coefficient of Conservation value. The results of this research were used to evaluate and identify opportunities to improve FQA for assessing the condition of New England wetlands. ■

PRESENTATION 1264
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES II*, 06/01/2018, 09:55 - 11:35

INTER-OBSERVER ERROR IN WETLAND VEGETATION SURVEYS

Morrison, Lloyd, Missouri State University, Springfield, MO
Bingham, Sonia, National Park Service, Brecksville, OH
Young, Craig, National Park Service, Republic, MO

A recent literature review found observer error to be a pervasive component of vegetation surveys, although only one of the reviewed studies was conducted in a type of wetland (a bog). We evaluated inter-observer error in surveys of wetland vegetation at Cuyahoga Valley National Park in Ohio. Wetlands with emergent, scrub-shrub, and forest vegetation were included. Two observers independently surveyed the vegetation in twenty-four 100 m2 plots within three weeks of each other. Observers recorded species composition, foliar cover within nine cover categories for herbaceous species, and stem counts of woody species. An average of 13 to 14 species (depending on the observer) were missed by one observer but not the other per 100 m2 plot. Most species missed were rare (<1% estimated cover). Pseudoturnover refers to the percentage of species overlooked or misidentified. Pseudoturnover in this study averaged 30% overall: 24% was due to overlooking error (i.e., not observing species actually present) and 6% was due to misidentification error (i.e., not correctly identifying species). Estimation error occurs when abundances are not accurately estimated. Fifty-nine percent of the cover category designations of herbaceous species differed between the two observers, although most were different by only one (39 of the 59%) or two categories (14 of the 59%). Counts of woody plant stems differed by as much as 35% for the smallest stem size, and the differences decreased as stem size increased. Although pseudoturnover between observers was relatively high, the differences had relatively little effect on final scores calculated for most versions of the Vegetation Index of Biotic Integrity (VIBI). The degree of inter-observer error observed was on the high end of such

error documented in a recent literature review. This may be due to greater vegetation diversity and structural complexity in wetlands compared with other habitats (~one-third of the studies reviewed were conducted in habitats described as grassland, rangeland or other arid environments). Observer error should always be quantified and reported in any study of vegetation involving observers. ■

PRESENTATION 1276
PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS II*, 05/30/2018, 03:10 - 05:00

ASSESSING WETLANDS IN UTAH: FOCUS ON AMPHIBIAN HABITAT

Menuz, Diane, Utah Geological Survey, Salt Lake Cty, UT
Sempler, Ryhan, Utah Geological Survey, Salt Lake City, UT

The wetland program at the Utah Geological Survey began with studies on groundwater development in northern Utah and vulnerable groundwater-fed wetlands in Snake Valley, but soon expanded to encompass all wetlands across the state. The program has looked both to states with more developed wetland programs and needs identified by local stakeholders to chart the program's future direction. The current focus of the assessment program is making sure we are collecting the right data (i.e., the data our stakeholders need) and packaging the data appropriately for easier consumption. The Survey's work with amphibians is a good case study on how initial research conducted on the boreal toad to address the needs of state wildlife employees expanded to include non-profit organizations, citizen scientists, and the regulatory community. ■

PRESENTATION 1296
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS I*, 06/01/2018, 09:45 - 11:35

WHERE THE RUBBER HITS THE ROAD: USING THE SCIENCE, TOOLS AND DATA FROM THE NWCA TO MAKE BETTER WETLAND AND WATER RESOURCES DECISIONS

Thiesing, Mary Anne, USEPA Region 10, Seattle, WA
Hayslip, Gretchen, USEPA Region 10, Seattle, WA
Vallette, Yvonne, USEPA Region 10, Portland, OR

The Environmental Protection Agency's (EPA) National Aquatic Resources Survey (NARS) is a 5 year, ongoing cycle of nationwide aquatic resource surveys which provide a report card on the condition of our nation's waters. The surveys are performed using a randomized, statistically valid design and provide statistically valid data which are used to develop the reports, in order to assess how well existing pollution prevention programs are protecting them, and how to better target future protection efforts. This presentation will focus on the results and uses of the 2011 National Wetland Condition Assessment (NWCA) outcomes. Some of the outcomes from the NWCA include:

- Robust multimetric indices used to evaluate condition across varying wetland types, streams and ecoregions and
- Physical, chemical and biological indicators of stress (risk factors) which identify the factors which contribute most to poor condition.
- A wealth of quality-assured, statistically valid data which can be mined to pursue other questions within both regulatory and non-regulatory programs by providing a more robust look at wetland and stream condition.

There are a variety of ways in which knowledge of condition can be used to better evaluate environmental states and inform decision making. Knowledge of risk factors, for example, can be used to prioritize restoration efforts to improve the health of streams and wetlands in poor condition, as well as identify practices to be avoided in reviewing permit applications for work in waters. The use of multimetric plant condition indices could be useful in better identifying achieved "lift" in wetland mitigation banks, as well as provide a more robust measure of mitigation or restoration success. It is our hope to generate some seeds for future thought and discussion on ways in which the products of these NARS surveys can enhance protection and restoration of these aquatic resources. ■

PRESENTATION 1301
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES II*, 05/30/2018, 01:00 - 02:50

WETLAND RECOVERY IN THE NORTHERN TAMPA BAY AREA FOLLOWING GROUNDWATER CUTBACKS: RESULTS FROM THE 2016 WETLAND HEALTH ASSESSMENT STUDY.

Van Fleet, Ronnie, VHB, Sarasota, FL
Keesecker, Doug, Tampa Bay Water, Clearwater, FL
Swindasz, Jaime, Southwest Florida Water Management District, Brooksville, FL

Approximately every five years since 1998, the Southwest Florida Water Management District and/or Tampa Bay Water have funded a regional assessment of wetland health in the Northern Tampa Bay Area (NTBA) as part of a scientific study to examine wetland recovery following cutbacks in

groundwater withdrawal. Groundwater production for Tampa Bay Water's Consolidated Water Use Permit was reduced from an average of 147 MGD (millions of gallons per day) for the period from WY 1993 through WY 2002 to an average of 88 MGD for the cutback period of WY 2003 through WY 2016. Work for the five-year assessments has involved individual scientific evaluations and mapping analyses for approximately 400 wetlands focused on the eleven central system wellfields in the NTBA. Wetland Health Assessment (WHA) scores, and specific assessments of parameters such as canopy cover, treefall and soil subsidence have been used in the establishment of impact and reference groups for metric development, and are used in the recovery assessment for individual wetlands. The 2016 Study included developing a modified, streamlined WHA monitoring protocol; 2) collecting wetland soils, hydrology, vegetation data; 3) creating and implementing a quality-control program for data collection; 4) integrating all data collected into an overall WHA score; 5) conducting GIS and statistical analyses on wetland health changes; and 5) cataloguing all previously collected data and creating a web interface for easy access to previous and current WHA data. The presentation will focus on the first conclusive positive results since groundwater cutbacks started in 2003, and the innovative web-based tool used to present the results and allow the user to do specialized interrogations of historical and current WHA data. This tool included an interactive mapping interface that allowed symbolized data points of wetland scores through the years and included links to historic data, forms, and photos. Analysis tools allowed users to visualize comparisons between years and filter the dataset for specific spatial and non-spatial analyses. A Story Map Journal presented the findings using interactive links to tables, figures, and map extents in an intuitive evolution of the traditional scientific report. ■

PRESENTATION P56

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE OPPOSITE RIVER: ASSESSMENT OF AN ENVIRONMENTAL FLOW REGIME ALONG THE DUNCAN RIVER, BRITISH COLUMBIA, CANADA

Polzin, Mary Louise, VAST Resource Solutions, Cranbrook, British Columbia, Canada

Rood, Stewart, University of Lethbridge, AB, Lethbridge, Alberta, Canada

Herbison, Brenda, N Kootenay Consulting Services Ltd., Argenta, British Columbia, Canada

The Duncan River. flows into Kootenay Lake and was dammed in 1967 as part of the transboundary Columbia River Treaty. The Duncan Dam has no hydroelectric facility and provides flexibility for downstream flow management. A new environmental flow regime was implemented in 2008 under Alternative 73 (Alt73) that was intended to benefit black cottonwood (Populus trichocarpa), riparian woodlands, Gerrard rainbow trout, and Kokanee salmon. To assess responses to river damming and flow manipulation (Alt 73), we reviewed historical air photos and undertook field studies from 2009 through 2014 to investigate channel and riparian responses. We applied a paired-comparison design to contrast hydrology, channel pattern, bank pattern, profile, surface sediment, and vegetation along the regulated lower Duncan R. with the unregulated Lardeau R., which joins the Duncan R. downstream of Duncan Dam.

Post-damming, substantial accumulation of cobbles, gravels, sands, and large woody debris has occurred along the lower Duncan R. This disparity in physical processes below most dams, where sediment and woody debris supply are typically non-existent, is due to sediment and woody debris inputs from the free-flowing Lardeau River; notwithstanding notable differences, the attenuation of high flows from the upper Duncan River has diminished transport capacity below the Duncan Dam and downstream to Kootenay Lake.

To monitor effects of Alt73 on colonization dynamics of riparian vegetation, we established belt transects with sequential quadrats to assess plant occurrence and abundance, with an emphasis on the response of cottonwood seedlings and saplings. Changes were extensive in most years and seasonal patterns were strongly influenced by higher rainfall when compared to observations along with other rivers in drier regions. Seedling survival was strongly impacted by sediment deposition and scour, emphasizing the importance of fluvial geomorphic processes. Moreover, there was a strong relationship between alluvial groundwater and river stage demonstrating a high degree of connectivity within the riparian colonization zones. From these analyses, we are refining hydrogeomorphic models that seek to provide the mechanism between river flow regime, sediment dynamics, and colonization and persistence of riparian vegetation. The Duncan River study provides useful insights towards the development of environmental flow regimes for other regulated rivers of the North American Pacific Northwest. ■

PRESENTATION 1386
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION III*, 05/30/2018, 03:20 - 05:00

VEGETATION RESPONSE TO HISTORIC DITCHING AND RESTORATION AT THE LAKE SUPERIOR WETLAND MITIGATION BANK IN NORTHEAST MINNESOTA

White, Natalie, SEH, Duluth, MN

The Lake Superior Wetland Mitigation Bank is a 20,000+ acre wetland restoration, constructed to provide mitigation credits for work regulated under Section 404 of the Clean Water Act and Minnesota's Wetland Conservation Act. The bank site is a large bog that was originally ditched and partially drained in the early 1900s in an effort to convert the area into farmland. Although drainage for agriculture met with limited success, the ditches remained on the landscape until the present day. Restoration is now underway through filling or blocking some of the site's 72 miles of ditches. Establishment of restoration credit amounts required quantification of the ditches' influence on the surrounding habitat. In part, this effect was quantified by evaluating vegetation in zones surrounding the ditches. Monitoring of vegetation (both baseline and response to restoration) includes Floristic Quality Assessment (FQA) at established sample points throughout the bank. FQA metrics are compared between points by distance from the ditches, levels of disturbance, and over time to identify changes pre- and post- construction. Results to date indicate the most conservative species (i.e., those with the greatest affinity for undisturbed habitats) were found outside the areas influenced by the ditches, but species richness was higher in areas with more historic disturbance. This response to disturbance is consistent with observable changes due to construction, where metrics for individual species conservatism have generally decreased, but overall floristic quality (which considers species richness) has increased. Construction of ditch checks and fill has put the site on a long-term trajectory to restore bog habitat; ongoing monitoring will continue to quantify vegetation response. ■

PRESENTATION 1388
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS III*, 06/01/2018, 03:10 - 05:00

FORGING A STANDARD APPROACH TO LENTIC MONITORING AND ASSESSMENT APPLYING AIM PRINCIPLES

Dickard, Melissa, BLM, Denver, CO
Lemly, Joanna, Colorado Natural Heritage Program, Fort Collins, CO

Monitoring lentic systems is imperative to the Bureau of Land Management (BLM) and US Forest Service's (USFS) multiple-use mandates directing management of watersheds for activities that potentially impact lentic resources, such as livestock grazing, timber harvesting, mining, energy development, and recreation. Consequently, knowing the condition and trend of lentic systems at both targeted sites and broader spatial scales is critical to achieving BLM's mission to "sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations." To more effectively evaluate resource condition across landscapes, and as a result of different management objectives that transcend traditional boundaries, the BLM decided to approach lentic monitoring under the broader Assessment, Inventory and Monitoring (AIM) strategy. To address these needs, an interagency, interdisciplinary working group was formed to established core indicators for lentic systems sampled under the AIM strategy. The selection of lentic indicators is following a process similar to that used to select and validate lotic core indicators for lotic systems, which included internal and external peer review. Lentic core indicators address vegetative cover and composition, plant height, woody species density and age class, and pedestaling. Supplemental indicators, which can be collected in addition to core indicators, include use-based measurements of stubble height and woody species use. This is unique because it is the first AIM protocol to include short-term and use-based indicators, which can tie condition to management. The draft protocol includes methods to evaluate condition and trends across various spatial scales, and multiple transect layouts to accommodate both systematic random sampling and targeted use-based monitoring. The protocol will be tested in the summer of 2018 for feasibility of field use, and research will be needed to validate sample sufficiency and ability to detect change. ■

PRESENTATION 1426
PRESENTED DURING *MONITORING & ASSESSMENT II*, 05/31/2018, 01:10 - 02:50

"VEGETATION DIVERSITY RESPONSES TO ENVIRONMENTAL WATERING IN ICONIC WETLANDS OF THE MURRAY-DARLING BASIN OVER THREE CONTRASTING YEARS."

Capon, Samantha, Griffith University, Nathan, Queensland, Australia

Environmental watering represents the cornerstone of Australia's approach to restoring and protecting iconic wetlands, particularly in catchments under high levels of river regulation. In the Murray-Darling Basin especially, the last decade or so has seen significant political and public com-

mitment to recovering and delivering water to wetlands for a range of objectives including outcomes related to vegetation diversity. To evaluate the effectiveness of environmental watering actions and inform the adaptive management of associated decision making, the Commonwealth Environmental Water Office is supporting an extensive collaborative long-term intervention monitoring program (LTIM) across the basin. To date, vegetation diversity responses (along with hydrology, stream metabolism, fish, ecosystem and generic diversity) have been monitored over a period of three years in six large iconic wetland regions (the Edward-Wakool, Goulburn, Gwydir, Lachlan, Murrumbidgee and Warrego-Darling) in relation to watering actions as well as natural hydrological conditions. Data from this program have been evaluated at both local area and basin scales as well as with respect to annual and cumulative responses to watering. Here, I will synthesize the findings of our first three years of monitoring wetland vegetation diversity in the Murray-Darling Basin and highlight some of the challenges involved in evaluating this data with respect to environmental watering actions and informing adaptive management. Results to date indicate a high degree of compositional differentiation amongst wetland plant assemblages at a basin scale despite a very cosmopolitan species pool. Vegetation responses to watering are also reasonably idiosyncratic across multiple scales although some common trajectories are emerging. Overall, findings support the high value of monitoring data over large spatial and temporal scales for understanding patterns of wetland vegetation diversity and the processes that shape these. ■

PRESENTATION 1461
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES II*, 06/01/2018, 09:55 - 11:35

SEARCHING FOR INDICATOR SPECIES OF WETLAND FLORISTIC QUALITY IN OKLAHOMA

Fouts, Tommi, Northestern State University, Tahlequah, OK
Bried, Jason, Alberta Biodiversity Monitoring Institute, Edmonton, Alberta, Canada
Jog, Suneeti, Northeastern State University, Tahlequah, OK

Floristic quality assessment is a proven method of wetland monitoring and evaluation, but it requires taxonomic expertise and sampling entire plant assemblages. Indicator species can be used to reduce the time and expertise of floristic quality assessments. Proposed indicators may reflect general classes (e.g. high vs. low) of floristic quality if the indicators are sufficiently robust to environmental heterogeneity. In this context, we are searching for plant indicator species of wetland floristic quality classes in Oklahoma, USA while testing the prediction that indicator performance will improve with increasing environmental stratification of sites. So far we have analyzed the vascular plant assemblages of 117 non-forested wetland sites grouped at three levels of stratification: all sites in prairie ecoregions ("least stratified"), depressional sites in prairie ecoregions ("moderately stratified"), depressional sites in a particular prairie ecoregion ("most stratified"). Using indicator species analysis extended for species combinations, we found indicators with higher predictive value and lower false-positive rates at the most stratified level. Final indicators at this level included two single species, six species pairs, and one triplet combination for low floristic quality; two single species and two species pairs for medium floristic quality; and a single species (Heteranthera limosa) for high floristic quality. We additionally extracted indicators under least stratification to facilitate coarse assessments in Oklahoma prairie regions and because indicator performance did not noticeably improve with moderate stratification. Many indicators for least stratified were the same as those for most stratified, and they indicated the same floristic quality classes at both stratification levels, suggesting the indicators are broadly applicable in Oklahoma prairie regions. Our next step is to conduct validations using the current data along with newly sampled wetland sites. ■

PRESENTATION 1464
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES II*, 05/30/2018, 01:00 - 02:50

MACHINE-LEARNING SUPPORT FOR DETERMINATION OF WETLAND HYDROLOGICAL AND ECOLOGICAL RECOVERY AT UNMONITORED SITES

Schmutz, Dan, Greenman-Pedersen, Inc., Orlando, FL
Garvis, Stephanie, Greenman-Pedersen, Inc., Orlando, FL
Goodding, Danny, Greenman-Pedersen, Inc., Orlando, FL
Shea, Christopher, Tampa Bay Water, Clearwater, FL

Tampa Bay Water, Florida's largest wholesale water supplier, is assessing environmental recovery of wetlands and lakes in the Northern Tampa Bay area in response to regional groundwater production cutbacks initiated in 2003 to improve hydroperiods in the region. State law provides guidance for the establishment of hydrologic regimes appropriate to maintain specific types of wetlands and lakes, and these regimes are being used to assess hydrological recovery of more than 400 monitored sites. However, water level data are unavailable for 749 unmonitored sites (8,307 acres) near groundwater wellfields, causing uncertainty regarding the extent to which these areas have recovered. Using R, we

investigated various machine-learning algorithms and best practices to estimate median water levels and ecological conditions at the unmonitored sites for two time periods--prior to and after the production cutbacks. Accuracy of estimates was evaluated using hold-out samples and leave-one-out cross validation. Algorithms investigated included random forest and regression kriging. Predictive variables evaluated and found to be important included xeric ratio (a potential hydrogeologic surrogate based on soils surrounding the site), modeled Surficial Aquifer System drawdown, modeled Upper Floridan Aquifer (UFA) drawdown, elevation difference between the wetland edge and the potentiometric surface of the UFA, and site depth. Surprisingly, the type of wetland (e.g., cypress or marsh) and degree of connectivity (i.e., whether connected to a larger riparian system) were relatively unimportant in predicting recovery. The random forest approach provided high accuracy (e.g., exceeding 85% for classification of out-of-sample sites as ecologically stressed or unstressed) with minimal needs for parameter tuning. Although machine learning techniques have been criticized as "black box" approaches suitable for prediction but not explanation, most provide a means of identifying variable importance and may, therefore, inspire revisions to our conceptual models of what factors are most important in managing surface water resources. Absolute values of estimated hydrological and ecological metrics as well as changes in the metrics between the two time periods allowed us to classify unmonitored wetlands and lakes into recovery assessment categories, identifying recovered sites, those with substantial improvements, and those requiring further study and potential mitigation. ■

PRESENTATION 1487

PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS II*, 06/01/2018, 01:00 - 02:30

LEVERAGING THE NATIONAL WETLAND CONDITION ASSESSMENT DATA FOR VALIDATION OF A STATE-LEVEL RAPID ASSESSMENT METHOD

Clark, Cara, Moss Landing Marine Laboratories, Moss Landing, CA

Pearce, Sarah, San Francisco Estuary Institute, Richmond, CA

The National Wetland Condition Assessment (NWCA) provides a wealth of information on wetlands across the landscape. This data can be used in novel applications at the state level. The California Rapid Assessment Method (CRAM) is a field-based, cost-effective, and scientifically defensible tool for monitoring wetlands. We validated the Slope CRAM module by examining correlations between CRAM data and intensive field measures, including vegetation data and substrate characteristics. We partnered with the US Forest Service (USFS) and National Park Service (NPS) to identify slope wetland sites where previously collected intensive data was available. However, these sites were primarily in the mountainous Sierra Nevada region of California, and a broader geographic scope was desired. Several sites were identified from the 2011 NWCA and used to augment the study. The common metrics of vegetation from the USFS and NPS studies were extracted from the NWCA vegetation data, including percent native cover, percent non-native cover, percent early-, mid-, and late-successional plants, native species richness, non-native species richness, Shannon plant diversity, Shannon evenness, Ratliff vegetation score, percent decreasers (species that are reduced under over-grazing conditions), and percent bare ground. Results show significant correlations between Slope CRAM Index and Attribute scores and vegetation metrics such as percent native cover ($\rho = 0.76$, $p = 0.000$), and the Ratliff Vegetation Score ($\rho = 0.62$, $p = 0.000$). California also opted to augment the 2011 NWCA with an "intensification" study to include additional sites and an additional survey protocol (CRAM). CRAM was compared to NWCA measurements of water quality, vegetation condition, soil condition, and stress. California had high levels of stress, particularly for non-native vegetation, ditching, and damming. The overall CRAM index score for depressional wetlands was significantly negatively correlated with the soil heavy metal index ($p = 0.01$) and total nitrogen ($p = 0.01$). For estuarine wetlands the index score was positively correlated with the total number of non-native species for estuarine wetlands ($p = 0.04$), and negatively correlated with the Vegetation Multi-metric Index score ($p = 0.04$). This study further validated the CRAM approach by showing strong correlations with intensive data, and benefited from the data collected by the NWCA. ■

PRESENTATION 1491

PRESENTED DURING *MONITORING & ASSESSMENT I*, 05/31/2018, 09:55 - 11:35

VALIDATING THE CALIFORNIA RAPID ASSESSMENT METHOD FOR DEPRESSIONAL WETLANDS

Clark, Cara, Moss Landing Marine Laboratories, Moss Landing, CA

Stoner-Duncan, Sarah, Moss Landing Marine Laboratories, Moss Landing, CA

Pearce, Sarah, San Francisco Estuary Institute, Richmond, CA

O'Connor, Kevin, Moss Landing Marine Laboratories, Moss Landing, CA

We developed tools to assess the overall condition of depressional wetlands, consistent with California's Wetland and Riparian Area Monitoring Plan, which calls for map-based landscape inventories, rapid field assessment, and intensive quantitative field measures. The California Rapid Assessment Method (CRAM) is a field-based, cost-effective, and scientifically defensible tool for monitoring wetlands. It is organized to guide the user through the wetland's structure from landscape level to site-specific plant community composition. We validated depressional CRAM by examining correlations between CRAM data and intensive field measures, including macroinvertebrate and algae indices of biotic integrity (IBIs), and water quality. We leveraged data collected in Southern California and the San Francisco Bay Area (15 sites each), and also collected new data with consistent methods at 15 sites in Northern California. Depressional CRAM data was significantly correlated with the macroinvertebrate IBI ($\rho = 0.42$, $p = 0.0036$) and the algae IBI ($\rho = 0.49$, $p = 0.0005$). Results indicate that CRAM is sensitive to some of the same factors that affect macroinvertebrate and algae communities, which validates its effectiveness. CRAM is a powerful tool for assessing the condition of wetlands. ■

PRESENTATION P52

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

OVERWASH EVENTS AND NESTING SUCCESS IN COLONIAL NESTING WATERBIRDS IN COASTAL LOUISIANA, USA

Ritenour, Karis, Louisiana State University, Baton Rouge, LA
Collins, Samantha, Louisiana Department of Wildlife and Fisheries, Grand Chenier, LA
King, Sammy, U.S. Geological Survey, Baton Rouge, LA

Coastal species around the world face habitat loss from accelerated sea level rise, subsidence, and erosion due to wave action. Coastal marsh habitat and barrier islands are already beginning to disappear, and with them prime habitat for colonial nesting waterbirds. Even remaining habitat may not be ideal, with decreasing elevation leading to frequent overwash events which can wipe out whole colonies. We collected data on the location, elevation, primary vegetation type, nest height, and nest success of four species of colonial nesting waterbirds in Coastal Louisiana. Preliminary data show that island overwash is a primary cause of nest loss for all species, especially Forster's Terns (Sterna forsteri), a species of concern in Louisiana. Approximately 30% of the 291 Brown Pelican (Pelecanus occidentalis) nests observed were overwashed, 28% of the 25 Roseate Spoonbill (Platalea ajaja) nests, and 100% of the 149 Forster's Tern nests. Only Tricolored Heron (Egretta tricolor) nests were relatively safe from overwash, although the toll on chicks old enough to leave the nest but not yet fledged was difficult to assess. We also analyzed past data from a nearby NOAA station to model potential flood risk for these colonies with the intention of finding an ideal elevation for a future restoration project. ■

PRESENTATION 1507

PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS II*, 05/30/2018, 03:10 - 05:00

USING WETLANDS MAPPING AND CLASSIFICATION TO PROTECT AND RESTORE NEW MEXICO WETLANDS

Menetrey, Karen, New Mexico Environment Department, Santa Fe, NM

The New Mexico Environment Department Wetlands Program is updating and expanding its current wetlands inventory across the State of New Mexico. Wetlands are being mapped and classified using multiple classification systems: National Wetland Inventory (NWI); Landscape Position, Landform, Water Flow Path, Waterbody Type (LLWW); and Hydrogeomorphic (HGM) systems. In addition, a functional correlation has been developed that relates wetlands to the ecosystem services that they perform.

These wetlands data are used in a variety of ways to protect and restore wetlands. New Mexico Wetlands Rapid Assessment Methods are being developed to rank wetland conditions. Local watershed groups are developing Wetland Action Plans on a watershed basis or by HGM subclass. Through the planning process, local wetlands are inventoried, assessed, and potential protection and restoration actions are documented. Availability of wetlands mapping data also facilitates increased coordination with agencies and non-government organizations about wetlands restoration, regulation, and development of wetlands water quality standards. In the long term, these data provide the baseline for long term monitoring of quantity, distribution, and condition of New Mexico's wetlands. ■

PRESENTATION 1513
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS I*, 05/31/2018, 03:20 - 05:00

CHANGES OVER 55 YEARS IN THE HYDROLOGY OF AN OLD GROWTH CYPRESS SWAMP ON A RAPIDLY DEVELOPING LANDSCAPE AND LIKELY INTERACTING CAUSES

Duever, Michael, Natural Ecosystems, Naples, FL
Clem, Shawn, National Audubon Society, Naples, FL

The old-growth Corkscrew Swamp is located in southwest Florida. Water level monitoring began at Corkscrew Swamp Sanctuary in 1959 when there had been relatively few hydrologic alterations in its watershed. Agricultural and residential development currently dominates the watershed, and a 55-year monitoring record has detected substantial changes in the swamp's hydrology despite rainfall records showing no significant changes from 1960 to 2015. Upland habitat wet season water levels have shown no decadal changes in water levels or hydroperiods across decades. While Corkscrew Swamp dry season water levels went below ground during some individual years, the decadal average daily water levels from Water Years 1960 to 1999 were always above ground. The decadal average water levels from Water Years 2000 to 2015 showed levels going below ground for over two months. Annual hydroperiods in lower elevation habitats decreased across decades by 41% in marshes, 27% in cypress, and 23% in pond habitats. The major change in hydroperiod occurred between the 1990s and 2000s. Likely interacting causes of the hydrologic changes include: 1) lowered upstream water levels associated with agricultural and residential development that currently maintain downstream wet season water levels but eliminate wet season water storage that previously maintained downstream dry season water levels and hydroperiods; 2) population growth and agricultural expansion has required increasingly larger extractions from southwest Florida's freshwater aquifers underlying the swamp; 3) increased downstream drainage for residential development has increased hydrologic gradients, and thus outflows from Corkscrew Swamp; and 4) in undeveloped areas, succession of open pine forests with a dense herbaceous groundcover and herbaceous marsh and wet prairie plant communities to dense, more-deeply rooted, multi-strata shrub and/or hardwood forests due to decades of fire suppression could be increasing evapotranspiration rates. As wetland water levels are lowered and hydroperiods shortened, it is expected that plant communities along south Florida's very low topographic gradient will gradually move downslope, with the partial or complete loss of wetlands depending on their position along the topographic gradient and the severity of drainage. Based on extensive experience in southwest Florida, this can happen slowly over long periods of time or very rapidly due to an altered fire regime on these drained sites. ■

PRESENTATION P51
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

NEW MEXICO RAPID ASSESSMENT METHOD FOR ARID LAND LOWLAND RIVERINE WETLAND ECOSYSTEMS - GILA RIVER BASIN

McGraw, Maryann, Surface Water Quality Bureau, Santa Fe, NM
Muldavin, Esteban, Natural Heritage New Mexico Division, Albuquerque, NM
Milford, Elizabeth, Natural Heritage New Mexico Division, Albuquerque, NM

In the predominantly arid environment of southern New Mexico, arid land wetland ecosystems tend to be isolated - many are concentrated along riverine corridors where water collects, and where, under natural conditions, dynamic and complex fluvial environments support biologically complex floodplain ecological communities. We present our recent development of a Lowland Riverine Wetlands New Mexico Rapid Assessment Method (NMRAM) within the Gila River Basin of New Mexico, one of the last free-flowing river systems in arid southwestern New Mexico. Thirteen ecological condition metrics based on testing of several potential metrics and metric designs, and sampling from twenty-five floodplain sites representing the disturbance gradient are described for Lowland Riverine Wetlands NMRAM. These metrics are grouped into three major attribute classes: Landscape Context (four metrics); Biotic (five metrics); and Abiotic (four metrics). Data collected from Sampling Areas within a Wetland of Interest are given weighted scores, weighted by attribute, and given a final score and rank. The method also includes the completion of four stressor checklists that record the number and intensity of stressors affecting the Sampling Area and a surrounding buffer zone. The stressors, grouped by land use, vegetation, physical structure, and hydrologic modifications, provide information that furthers the understanding of the current wetland condition, but are not used in scoring or ranking the condition of the wetland. Increased size of the river systems and associated floodplains, hydrological and fluvial geomorphic complexity, and scalable vegetation communities led to most modifications of metrics from other riverine wetlands rapid assessments. ■

PRESENTATION 1549
PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS II*, 05/30/2018, 03:10 - 05:00

A COMPARISON OF STREAM AND WETLAND FUNCTIONAL ASSESSMENTS AND THEIR APPLICABILITY TO RESTORATION PROJECTS IN COLORADO

Worah, Moneka, ERO Resources Corporation, Denver, CO

Streams and wetlands are vital resources that provide many ecosystem services and need protection. However, streams and wetlands are often not functioning at their highest capacity largely due to human activities that have degraded their conditions. Stream and wetland restoration projects have become increasingly necessary in restoring wetland ecosystem function. It is important for those completing restoration projects to understand the variables that influence stream and wetland functionality and which variables could use the most improvement to have the highest influence on stream and wetland conditions.

Stream and wetland functional assessments are useful tools to determine how streams and wetlands are functioning and which type of activities could be completed to improve their health. Many functional assessment methods have been created in recent decades, but often it is not clear which method would be most applicable. ERO applies several functional assessment methods to restoration projects along streams and rivers in the Denver Front Range area, including the Functional Assessment of Colorado Wetlands method, Ecological Integrity Assessment for Colorado Wetlands method, Functional Assessment of Colorado Stream method, and Stream Quantification Tool method. In applying these various functional assessment methods, ERO has found that these methods have many similarities, but also several differences, that could affect their applicability on assessing wetland and stream functions for restoration projects. Some methods might be more applicable when assessing different restoration alternatives or in watershed planning, while others might be more applicable to specific stream reaches or wetland areas to determine specific types of variables that need improvement. Practitioners should understand the differences between functional assessment methods and their applicability to gain insight into stream and wetland functionality and which treatments would have the highest influence on stream and wetland conditions. Each functional assessment method will be described, including their similarities and differences, and the types of applications/projects in which ERO has found each method to be most useful and informative. ■

PRESENTATION 1551
PRESENTED DURING *ECOSYSTEM SCIENCE I*, 06/01/2018, 09:55 - 11:35

NEW MEXICO RAPID ASSESSMENT METHOD FOR PLAYA WETLANDS OF THE SOUTHERN HIGH PLAINS

McGraw, Maryann, Surface Water Quality Bureau, Santa Fe, NM
Muldavin, Esteban, Natural Heritage New Mexico Division, Albuquerque, NM
Milford, Elizabeth, Natural Heritage New Mexico Division, Albuquerque, NM

We present our innovative New Mexico Rapid Assessment Method (NMRAM) combining function and condition to the playa subclass of depressional wetlands in the Southern High Plains of New Mexico. Playas are defined as shallow depressional recharge wetlands formed through wind, wave and dissolution processes with each wetland existing in its own watershed (Smith, 2003). Playa wetlands are unique and critical ecological components as the only source of surface water in the arid Southern High Plains. Playas in much of the Southern High Plains in New Mexico have been recently mapped as part of the National Wetlands Inventory (NWI) with current data. Ten ecological condition metrics based on testing of several potential metrics and metric designs, and sampling from 40 playa wetland sites representing the disturbance gradient are described for Playa Wetlands NMRAM. These metrics, using a combination of GIS-based measurements and field surveys are grouped into four major attribute classes: Size (one metric), Landscape Context (two metrics); Biotic (three metrics); and Abiotic (four metrics). Data collected from Sampling Areas within a playa wetland are given weighted scores, weighted by attribute, and given a final score and rank. The method also includes a suite of metrics and provisional scoring when the playa is inundated. Four stressor checklists that record the number and intensity of stressors affecting the Sampling Area and a surrounding buffer zone are included in the method. The stressors, grouped by land use, vegetation, physical structure, and hydrologic modifications, provide information that furthers the understanding of the current wetland condition, but are not used in scoring or ranking the condition of the wetland. ■

PRESENTATION 1556
PRESENTED DURING *MONITORING & ASSESSMENT II*, 05/31/2018, 01:10 - 02:50

SYNTHESIZING FUNCTIONAL ASSESSMENT METHODS: INVENTORYING WETLAND FUNCTIONS IN THE CHOPTANK RIVER WATERSHED

Backhaus, Peter, Pennsylvania State University, University Park, PA
Brooks, Robert, Pennsylvania State University, University Park, PA
Nassry, Michael, Penn State, University Park, PA

As development continues to decrease the area and functional capability of wetlands, it is imperative to inventory these characteristics to understand watershed-scale dynamics and the provisioning of ecosystem services. Characterizing wetlands provides a baseline for future assessments and can be used as a tool to realize the benefits of land management practices and wetland restoration. The cost and time limitations of intensive field assessments prohibit the widespread availability of fine scale data. However, readily-available, coarse scale datasets (e.g., US Fish & Wildlife Service National Wetland Inventory, US Geological Survey National Hydrography Dataset, Natural Resources Conservation Service Web Soil Survey) provide a basis for which relevant water resources can be remotely assessed. This study synthesizes two wetland functional assessment approaches, Watershed-based Preliminary Assessment of Wetland Functions (W-PAWF) and Hydrogeomorphic (HGM) Classification and Functional Assessment, to inventory wetland functions in the Choptank River Watershed. These systems are based in the Cowardin et al. (1979) classification system and are tailored to the region, using characteristics such as landscape position and hydrology to determine wetland functions. The combination of multiple systems allows a more thorough assessment to be conducted than each individually. The study also considers the inclusion of limited field sampling to provide potential ground truth data, reference wetland data, and observation of additional functions not captured by the remote assessments. ■

PRESENTATION P49
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ESTUARINE WETLAND LOSS AND CHANGE DUE TO NATURAL AND ANTHROPOGENIC FORCES OVER TIME ALONG THE DELAWARE COAST

Biddle, Mark, Delaware Department of Natural Resources and Environmental Control, Dover, DE

The State of Delaware has lost more than 50% of original wetlands since the Colonial period. Twenty-five percent of the land area in Delaware is wetlands, and estuarine wetlands comprise 30% of all wetlands. Since the early 1980's, wetland scientists in Delaware have been tracking wetland extent and health and the forces impacting wetlands. Anthropogenic causes have contributed significant harm to palustrine wetlands, but estuarine wetlands have been affected by both anthropogenic and natural forces. Add in an increased rate of sea-level rise and the future of estuarine wetlands in Delaware is questionable. Using both landscape-scale and ground-level monitoring, scientists are currently assembling valuable data and information. Over 60% of estuarine wetlands in Delaware are at least moderately stressed from direct impacts or secondary impacts from surrounding land use or from natural causes. Assessment methods and permanent monitoring stations are tracking wetland surface elevation changes, vegetation, water quality and other metrics. Visible changes are also evident such as increased shoreline erosion, vegetated wetlands changing to open water or mud flat, and colonization of invasive species. To track and plan for future loss and change, priorities need to be established now for managing estuarine wetlands and planning for paths of marsh migration. ■

PRESENTATION 1568
PRESENTED DURING *MONITORING & ASSESSMENT II*, 05/31/2018, 01:10 - 02:50

EVALUATING ASSUMPTIONS OF FLORISTIC QUALITY ASSESSMENT (FQA) USING EMPIRICAL DATA AND LANDSCAPE MODELING IN MASSACHUSETTS

Jackson, Scott, University of Massachusetts Amherst, Amherst, MA
Plunkett, Ethan, University of Massachusetts Amherst, Amherst, MA
Compton, Brad, University of Massachusetts Amherst, Amherst, MA
McGarigal, Kevin, University of Massachusetts Amherst, Amherst, MA

Interest in Floristic Quality Assessment (FQA) has been growing in recent years and several states have expressed interest in adopting the approach for assessing wetland condition. We addressed three key issues of importance to FQA and other Indices of Biological Integrity (IBIs) for assessing wetland condition. First, are the FQA Coefficient of Conservatism (CoC) scores for Massachusetts consistent with empirical data on plant species abundance relative to stressor gradients? Second, how sensitive are IBIs to geographic variability in wetland plant ecology (i.e. does the indicator value of plants vary over space)? Third, can IBIs

(or CoCs) developed in one wetland type be applied to other wetland types? We examined IBI performance and the CoCs developed for FQA in Massachusetts by comparing them with plant community data for 388 forested wetlands and 70 shrub swamps and a generalized stressor gradient represented by the Conservation Assessment and Prioritization System (CAPS) Index of Ecological Integrity (IEI) scores. Our results suggest that it may be possible to create a rapid assessment methodology that uses plants to assess wetlands condition for forested wetlands and shrub swamps. FQA is a framework that might meet the need for an affordable and reliable assessment method. However, our results suggest that more work is needed to test FQA and the assumptions that go into it, in particular, in the assignment of CoCs. The assumption that one CoC will suffice for evaluating condition in all wetlands or all ecosystems should be reconsidered. ■

PRESENTATION 1574

PRESENTED DURING *ECOSYSTEM SCIENCE I*, 06/01/2018, 09:55 - 11:35

A CASE STUDY OF THE EFFECTS OF LAND USE CHANGES ON NATIVE WETLAND ECOSYSTEMS IN PARK COUNTY, COLORADO

Crumb, Esa, ERO Resources Corporation, Denver, CO

The relationship between ongoing irrigation practices and the effects on wetland ecosystems has been extensively evaluated in studies and literature reviews. However, it is less well understood how natural wetland ecosystems are impacted following the cessation of long-term irrigation practices. Many studies have investigated the problems associated with agricultural irrigation on freshwater wetlands including contamination issues and inflow diversions resulting in significant wetland losses. Other studies have shown that agricultural irrigation can create and support wetland ecosystems. These issues are particularly relevant in the Arid West, where the majority of irrigation withdrawls and irrigated acres occur. Moreover, the use of groundwater for irrigation withdrawls has been increasing since the 1950s.

ERO Resources Corporation was contracted by Centennial Water and Sanitation District (Centennial) to conduct monitoring activities in accordance with a Special Development (or 1041) Permit from Park County for the Cline Ranch (Ranch) project. Centennial purchased 90 percent of the water rights associated with the Ranch and the remaining 10 percent were retained by the Ranch owners. The Ranch water rights were historically used to flood irrigate four hay meadows on the Ranch which support natural and potentially irrigation induced freshwater wetland ecosystems. The project resulted in the removal of irrigation from 90 percent of the Ranch lands which had been historically irrigated for more than 100 years. ERO was tasked with monitoring the vegetation, including wetland communities on the Ranch lands that were subject to removal of irrigation water, with the purpose of evaluating the natural successions of plant communities. The monitoring occurred over a 15-year period and demonstrated an expected shift in the species composition in the uplands. Wetland vegetation mapping documented an unexpected fluctuation in the extent of naturally occurring freshwater wetlands within the Ranch lands. These observations indicate that changes in land use practices, including removal of irrigation waters, may result in surface and subsurface fluctuations in hydrology that can influence the size of wetlands year to year. The changes in wetland boundaries from year to year also indicated how climate fluctuations can also affect wetland systems. This analysis raises questions regarding the drivers of the spatial and temporal changes in natural wetlands. ■

PRESENTATION 1591

PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS II*, 05/30/2018, 03:10 - 05:00

ASSESSING INTENSIVELY MANAGED WETLANDS: LINKING CONDITION, HABITAT GOALS, AND WILDLIFE FUNCTIONS

Downard, Becka, Utah Division of Water Quality, Salt Lake City, UT
Kettenring, Karin, Utah State University, Logan, UT
Endter-Wada, Joanna, Utah State University, Logan, UT

Water and wetlands are both scarce in the arid West. The majority of wetlands in Utah are located in large delta complexes around Great Salt Lake (GSL) where decades of intensive water management have protected wetlands and secured water sources to ameliorate threats associated with drought and water diversion. Despite being a widespread historical wetland management strategy, little is known about the ecological impacts of impounded wetland management aside from providing waterfowl habitat. The objective of our research is to bring three datasets together to investigate linkages between condition, management goals, and wildlife functions in GSL wetlands. Over four years, we sampled plant community composition in order to develop a regionally-specific wetland condition index. Simultaneously, we measured growth and seed production of plant species that support migratory wildlife, and conducted semi-structured interviews with wetland managers to better understand management goals and strategies. We found that the impact of impounding wetlands has generally been

positive, as it has extended the hydroperiod of wetlands that would otherwise be dry for long enough in the year to impair condition. Moreover, impounding some wetlands within large delta complexes has increased the diversity of wetland types, thereby potentially supporting a greater diversity of migratory bird species and better meeting the habitat goals of wetland managers. Water management has created a diverse range of environmental conditions, in relation to disturbance, water regime, and soil chemistry, leading to a mosaic of uniquely adapted plant species and associated wildlife functions. However, there was not any significant relationship between wetland condition and potential habitat goals or functions. We hypothesize this result is due to two things: 1) the larger scales that habitat management occurs relative to condition assessments, and 2) the diverse range of environmental drivers plants important to wildlife respond to. Our results can be used to develop management strategies to maximize wildlife functions and wetland condition, namely to utilize water management infrastructure and strategies to maximize habitat diversity within large wetland management complexes. ■

PRESENTATION 1599

PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS I*, 05/30/2018, 01:00 - 02:30

USING WETLAND CHARACTERIZATION TO INFORM LAND MANAGEMENT DECISIONS IN CENTRAL MONTANA

Carpenedo, Stephen, MTDEQ, Helena, MT

Montana Department of Environmental Quality's (MDEQ) Wetland Program has been working on using wetland restoration and protection as one way to meet the objectives of the Clean Water Act and Montana Water Quality Act. In the course of our work partners identified that to be effective in informing land management decisions, wetlands assessments needed done early in the watershed planning process. And recommendations based on our assessment work be provided to partners in conjunction with other water quality planning documents and recommendations. In 2014-2017, we conducted a pilot project to characterize wetland condition, the functions they provide, and the risk of stressors present. And provide this information in conjugation with other water quality monitoring efforts to better protect and restore aquatic resources in one Central Montana watershed.

In 2016 – 2017 we assessed 164 wetlands in the Musselshell watershed in Central Montana. We used a USEPA Level I-II-III Ecological Integrity Assessment approach developed specifically for Montana by the Montana Natural Heritage Program. At each site we collected information on the vegetation, landscape context, physiochemical, soil, and hydrologic properties and stressors present. Our analysis methods were similar to the National Wetland Condition Assessment so that we could identify why which stressors posed the greatest risk to wetland condition and what the most appropriate best management practices would be to address that risk. In the Musselshell watershed, we found that 31.88% of all wetlands were in poor condition. While grazing was by far the most dominant stressor present (52.75% of all sites) we found very little risk of a wetland being in poor condition from grazing. Whereas if hydrologic modifications were present (36.81% of all sites) the risk of a wetland being in poor condition was 17.2 times more likely.

Our pre-project planning and conceptual models hypothesized that grazing posed the greatest risk to the condition of wetlands in the Musselshell. And that if we based our recommendations on this hypothesis they may not be most effective in improving wetland condition. Whereas if we understand and target the greatest risk and communicate that risk to the partners most able to affect positive change. We will be more effective in improving wetland condition and other aquatic resources in the Musselshell watershed. ■

PRESENTATION 1611

PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES II*, 06/01/2018, 09:55 - 11:35

MEASURING WETLAND SUCCESS: A CASE STUDY IN FLORISTIC QUALITY

Stamer, Reid, EarthView Environmental Inc., Coralville, IA

Wetland mitigation sites are a wonderful example of the intersection of policy, research, and practice. Ideally, policy should reflect sound science, implemented through up-to-date practices. However, the question arises: what constitutes a successful mitigations site? From a botany perspective, we want not only to have hydrophytic species present, but to also replace, and if possible, enhance the biological community that was impacted. One method of gauging a newly established plant community is using a Floristic Quality Index to subjectively evaluate a plant community. This presentation will look at the establishment of a constructed urban wetland in Coralville, Iowa. The wetland was constructed in 2011 and planted in 2012. Invasive species have been rigorously managed, allowing a diverse assemblage of native species to establish. A year to year examination of diversity as well as potential factors for differences in floristic quality will be evaluated. ■

PRESENTATION 1632
PRESENTED DURING *MONITORING & ASSESSMENT I*, 05/31/2018, 09:55 - 11:35

OCCURRENCE AND CHARACTERISTICS OF GROUNDWATER-DEPENDENT WETLANDS ON NATIONAL FORESTS: FINDINGS FROM RECENT INVENTORIES

Dwire, Kathleen, USDA Forest Service, Fort Collins, CO
Jones, George, Wyoming Natural Diversity Database, Laramie, WY
Gurrieri, Joseph, USDA Forest Service, Golden, CO
Carlson, Christopher, USDA Forest Service, Washington DC

Over the past decade, inventories of groundwater-dependent ecosystems, primarily springs and wetlands, have been conducted on National Forests throughout the USA to determine their distribution and characteristics. These efforts are frequently collaborative projects among the US Forest Service, state heritage programs, academic institutions, and non-profit organizations, and have utilized established protocols to evaluate a core set of ecological parameters and management indicators at each visited site. The consistent collection of on-site field data provides a valuable baseline for effective management, and allows for comparisons of wetland features among different Forests, ecoregions, and climatic regimes. For groundwater-dependent (GD) wetlands, a primary objective of the inventories is the determination of the occurrence and condition of fens, i.e. those wetlands with a minimum depth of accumulated peat (≥40 cm), which are of high conservation value. Findings from GDE inventories conducted on National Forests in Utah, Wyoming, and Colorado indicate that the distribution of GD wetlands, as well as the range of peat depths that distinguish fens, is related to elevation, precipitation regime, geomorphic land forms, and past glaciation activity. The continuum of measured peat depths across GD wetlands, whether within one Forest or across multiple Forests, suggests that the peat depth required for 'fen designation' is ecologically questionable. GD wetlands provide valued ecosystem services, including water and carbon storage, and habitat for native biota. Their stewardship is improved through increased understanding of their landscape-level distribution and condition, which is being achieved through collaborative inventories. ■

PRESENTATION P50
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

METHYLMERCURY AND DISSOLVED GREENHOUSE GASES IN WETLANDS RECEIVING AGRICULTURAL TILE FLOW

Judge, Casey, Iowa State University, Ames, IA
Crumpton, William, Iowa State University, Ames, IA

Although restored wetlands designed for nutrient reduction in agricultural landscapes have numerous benefits, they are also potential sources of methylmercury and greenhouse gases. We present a case study comparison of two wetlands with different nutrient loading rates and whose contributing watersheds have different drainage characteristics. Both wetlands are located at the headwaters of first order streams and are designed to intercept and treat nutrient loads associated with agricultural tile drainage water. We monitored nitrogen, mercury and greenhouse gas concentrations in the inflows and outflows of each wetland. Total mercury, methylmercury, dissolved methane, and dissolved nitrous oxide concentrations were measured every 2-3 weeks. Additional, close-interval monitoring for nitrate loads and volumetric flow rates was conducted as part of ongoing monitoring of Iowa Conservation Reserve Program Wetlands. We found consistent declines in nitrate concentrations and increases in dissolved methane between wetland inflows and outflows but unclear patterns in methylmercury. Our data suggest that methylmercury was not formed unless total mercury exceeded a certain threshold level and that both the wetlands and their upper lying catchments could be sources of methylmercury and greenhouse gases. Continued research at these and other wetland sites is planned and designed to identify the factors most important relative to production of methylmercury and greenhouse gases in order to inform wetland restoration efforts. ■

PRESENTATION 1639
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS IV*, 05/31/2018, 09:55 - 11:35

LEVELS AND SOURCES OF MERCURY AND METHYLMERCURY ASSOCIATED WITH WETLANDS INTERCEPTING AGRICULTURAL DRAINAGE IN IOWA

Judge, Casey, Iowa State University, Ames, IA
Crumpton, William, Iowa State University, Ames, IA

Based on several decades of monitoring by the Iowa DNR and Des Moines River Water Quality Network, concentrations of inorganic mercury in Iowa surface waters are well below the state's human health criterion. However, Iowa's health criterion limits for mercury in surface water are

orders of magnitude greater than the Great Lakes 1.8 ng/L human health criterion. It is unclear how levels of total mercury in Iowa surface waters compare to other Midwestern states as the most widely used sample analysis methods in Iowa have relatively high detection limits (50-200 ng/L).

During the 2017 field season, we collected surface water samples every 2-3 weeks (April through December) from the inlets and outlets of six restored wetlands on the Des Moines Lobe of Iowa. All six wetlands were located at the headwaters of first order streams and they intercepted widely varying nitrate loads. Water samples were analyzed for concentrations of nitrate, total mercury, and methylmercury. Detection limits for mercury analyses were less than 0.03 ng/L, and measured concentrations were typically less than 5 ng/L for both total and methylmercury. The goal of this analysis was to determine whether or not wetlands intercepting nitrate loads are a significant source of methylmercury, and to what extent nitrate levels impact methylmercury production. Elevated nitrate loads to the wetlands might be expected to inhibit methylmercury production, but the data suggest the importance of other factors. Seasonal trends for the six wetlands suggest that methylmercury formation does not occur with total mercury levels below a certain threshold level. Additionally, data suggest that overall levels of methylmercury tend to increase within the wetlands, but measured total and methylmercury levels have been very low with no direct relationship to nitrate. With limited data on background levels in Iowa streams, it is unclear how much of an impact wetlands may have on methylmercury in Iowa surface waters. To fully address that issue, additional research to monitor the levels of total and methylmercury in the streams these wetlands contribute to is required. ■

PRESENTATION 1643

PRESENTED DURING *COASTAL HYDROLOGIC RESTORATION: INFORMING PROGRAM MANAGEMENT THROUGH MONITORING*, 06/01/2018, 09:45 - 11:35

BALANCING EFFICIENCY AND EFFECTIVENESS-IMPLEMENTING COMPREHENSIVE RESTORATION MONITORING FOR PROGRAM-LEVEL EVALUATION

Dionne, Shannon, NOAA, York, ME

The NOAA Restoration Center funds coastal wetland restoration projects across the US. More recently, the Restoration Center began implementing a framework for monitoring, evaluation, reporting, and feedback for hydrologic reconnection restoration projects, to implement a consistent and cost□effective process for monitoring and evaluating these projects, and to determine the extent to which individual and collective projects have achieved our program goals.

The framework contains a standardized and targeted approach for monitoring and evaluating the performance of restoration projects. The Restoration Center uses a tiered approach that distinguishes between implementation monitoring (Tier I) and effectiveness monitoring (Tier II). Tier I monitoring evaluates whether NOAA and our partners executed a project as designed. This implementation and basic effectiveness monitoring is required for all NOAA grant-funded hydrologic reconnection projects beginning in 2013. It helps assure the public that their tax dollars are being used well. Tier II monitoring investigates more sophisticated ecological, socioeconomic, and/or technique effectiveness questions to forward the science of wetland restoration. In addition, monitoring and evaluation information can be used to improve future projects and ultimately improve the performance of our program.

To introduce this symposium, the NOAA Restoration Center will briefly present our framework, followed by our initial nation-wide results for Tier I monitoring of hydrologic reconnection restoration over the past 5 years. These initial results will include the proportion of projects that met their goals; the number of acres created or functionally restored; how much money has been saved due to reduced maintenance and/or liability costs; and how many and what kind of additional community benefits, such as a civic enhancement project or reduced safety hazard, have been associated with hydrologic reconnection restoration projects. Through this analysis, we identify potential next steps and changes to this framework. ■

PRESENTATION 1644

PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION III*, 05/30/2018, 03:20 - 05:00

INFORMING DECISION-MAKING WITH SEED BANK AND VEGETATION COVER SITE ASSESSMENT IN HERBACEOUS MARSH, LAKE APOPKA NORTH SHORE RESTORATION AREA, FL, USA

Reinhardt Adams, Carrie, University of Florida, Gainesville, FL
Stone, Deborah, Invasive Plant Management, St. Johns River Water Management District, Palatka, FL
Sarchapone, Jennifer, University of Florida, Gainesville, FL
Cobb Lee, Leah, University of Florida- Environmental Horticulture, Gainesville, FL

Wetland managers tasked with controlling invasive plants may not have the institutional framework or resources required for data-intensive restoration site assessment to guide choice of actions, and instead must rely on experi-

ence and anecdotal accounts from restoration outcomes at similar sites. More intensive site assessment is assumed to better guide restoration decisions, because it can more clearly define the alterations in ecosystem structure and function caused by degradation and more effectively guide choices of management actions. A better understanding of the improvement in management gained by data-intensive site assessment could help guide investment of resources in this effort.

We compared restoration decisions based on manager observation with decisions based on intensive site assessment in degraded freshwater herbaceous marsh at the Lake Apopka North Shore Restoration Area. We performed intensive restoration site assessments for several units with varying hydrology, elevation, and soils. Site assessment included a baseline survey of the extant vegetation to estimate presence of both invasive species and desirable vegetation, and a seed bank assay to determine potential emergence from the soil seed bank following control efforts.

Several insights emerged from the site assessments that altered decisions based on visual observation alone. More invasive species emerged from the seedbank in saturated, as opposed to field capacity soil moisture treatments; the decision to modify water storage was recognized to potentially limit invasive species colonization after initial control. Visual observations resulted in more non-specific herbicide application, while consideration of site assessment data led to acknowledgement of mixed (invasive and native species) scenarios with more targeted strategies (e.g. selective herbicide application). Ultimately, utility of the site assessment is a function of progress toward restoration goal achieved resulting from the assessment, and the cost of assessment implementation. ■

PRESENTATION 1656
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS II*, 05/31/2018, 01:00 - 02:50

MANAGING WETLANDS IN THE WEST SONGNEN PLAIN OF NORTHEAST CHINA: CHALLENGES AND OPPORTUNITIES

Jiang, Hongxing, Research Institute of Forest Ecology
Harris, James Thomas, International Crane Foundation, Baraboo, WI
Vradenburg, John, U.S. Fish and Wildlife Service, Tulelake, CA
King, Sammy, U.S. Geological Survey, Baton Rouge, LA

The West Songnen Plain lies in the semi-arid region of northeast China, where precipitation is far less than evaporation. The region serves as an important breeding ground and staging area of waterbirds along East Asian-Australian Flyway. The region is also a nationally important grain production base in China. Agriculture development and water diversions under climatic variations have resulted in the area of wetland loss exceeding 70% from 1954 to 2006. In 2005, the Wetland Protection and Management Center was established under the State Forestry Administration of China and the Chinese Government increased financial investments and support of wetland management. Five National Nature Reserves have been established in the West Songnen Plain to protect wetlands, however, the wetlands in the region are still facing continuous loss and degradation. The tremendous investments have improved wetland protection and management, but the wetland functions and services still cannot meet the needs of biodiversity conservation, especially for the threatened and endangered waterbirds. Agricultural water diversions from river systems have created infrastructure across the landscape that can provide great opportunities for managing the wetland habitats with higher conservation priority and minimizing impact of the diversions. The challenges are a lack of knowledge for science-based management and inadequate water control. We are implementing best management practices at a local scale with the intent of developing expertise and experience to implement successful management techniques at a broader scale. Ultimately, we hope to enhance wetland resilience under the variant water conditions, benefiting the waterbirds and the local communities as well. ■

Management & Applied Science: Restoration, Creation, & Mitigation

PRESENTATION 1027
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION IV*, 05/31/2018, 09:55 - 11:35

THE DEVELOPMENT AND APPLICATION OF UNIFORM HYDROSERES IN RIPARIAN AND WETLAND RESTORATION: AIMS TO IMPROVE DESIGN RESOLUTION AND RESTORATION SUCCESS.

Giordanengo, John, AloTerra Restoration Services, Fort Collins, CO

The distribution of plants across riparian areas is influenced by frequency of flood disturbance, groundwater hydrology, soil conditions, shade, and other variables. The consistency of these variables over space and time can lead to the development of predictable hydroseres (i.e., zones) across floodplains. However, a consistent approach to defining these hydroseres, especially in a restoration setting, is lacking. Hoag and Fripp (2005) defined riparian zones for

southwest riparian systems, based on flood return intervals. Merritt et al. (2010) developed riparian vegetation-flow response, organizing plants into groupings of species with shared traits such as life history, reproductive strategy, morphology, adaptations to fluvial disturbance and adaptations to water availability. Riparian restoration practitioners are tasked to define and communicate riparian hydroseres/zones well for a broad spectrum of stakeholders, and to develop formulaic approaches to prescribing treatments for disturbed ecosystems. Due to the nature of disturbed riparian systems, especially when artificial irrigation is not available during the establishment phase, proper zonation of plant materials is essential to restoration success. Considering also the need for efficient design and construction processes, the use of a riparian zonation system that relates plant palettes and seed mixes to a hydrologic point of reference (i.e., bankfull) has important practical implications. Because floodplain restoration projects include a wide range of elevations, hydrologic conditions, and geomorphological conditions (i.e., cut banks, benches, slope gradients, etc.) across a site, prescribing treatments based on general terms like "riparian", "upper riparian," or "bench", or Zone 1-4, can be misleading, lead to a reduction in the extents of revegetation efforts, and/or result in locating plant materials where they have an increased risk of failure. This talk will present one approach to defining riparian restoration hydroseres for Southern Rocky Mountain streams, explore methods to designing and communicating plant palettes for hydroseres is a formulaic way, and provide a case study. Results of industry surveys generated during the SWS RM region conference and Rocky Mountain Stream Restoration Network Meeting will be presented for the first time. ■

PRESENTATION 1034
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED II*, 06/01/2018, 01:00 - 02:50

RESTORING DIVERSE WETLAND HABITATS ON A PREVIOUSLY CONTAMINATED SITE: SHPACK SUPERFUND SITE WETLAND RESTORATION

Hoffman, Christina, ERM, Boston, MA

After approximately 20 years of investigation, a former landfill, known as the Shpack Landfill Superfund Site, was slated for remediation. The radioactive material was first removed by the U.S. Army Corps of Engineers, and the remaining chemical contamination was remediated by the potentially responsible parties in charge of the clean-up. Several acres of wetlands were delineated at the Site during the investigation phase of the project; therefore, the final remedial design included restoration of these wetland areas, including an increase in the total acreage of wetlands to compensate for the temporal loss of the functions and services of the wetlands since first being impacted. Palustrine emergent and palustrine forested wetlands were the design targets, punctuated with vernal pools and a small stormwater treatment wetland adjacent to the larger wetland complex. Remediation required the excavation and removal of approximately 20,000 cubic yards of soil and underlying sediments in 2014. Due to ample groundwater data collected during the contamination investigations, the wetland design incorporated groundwater as the source of hydrology for the restored wetlands, as opposed to utilizing overland flow. Working with construction contractors to create 5.8 acres of functioning wetland on a former landfill presented challenges due to the nuances of re-creating a natural habitat using widely fluctuating groundwater elevations, engineered topsoil, and wildlife habitat enhancement elements. Guiding equipment operators in the art of installing the various elements and microtopography included in the wetland design was part of the fun. Time of year constraints (early snow in New England) and steep slopes added to the challenges during the construction phase. Many lessons were learned and three years of annual monitoring since construction was completed tells the whole story. ■

PRESENTATION 1035
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES II*, 05/30/2018, 01:00 - 02:50

RESTORING FLOODPLAIN FUNCTION WITHIN A WELLFIELD FOR WETLAND RESTORATION AND FLOOD MITIGATION

Grizzle, Cynthia, HW Lochner, Tampa, FL

After record rainfall from three back to back hurricanes in 2004, the Cypress Creek Wellfield Surface Water Management project was constructed in Pasco County, Florida. This unique project had two objectives, to reduce nuisance flooding and restore wetlands. Ultimately the project was designed to maximize the use of floodplain storage on the wellfield, thereby reducing flooding in adjacent neighborhoods, increasing surface water to wetlands, and allowing for groundwater recharge. The surface water was detained on the wellfield behind an earthen berm and then redistributed through a 600-acre network of target wetlands associated with the Cypress Creek Floodplain. These wetlands were impacted by historic groundwater pumping and were not expected to recover even with significant reductions in pumping. Implementing a construction project within a state-owned preserve presented unique challenges that were overcome by limiting and shifting the construction

footprint as well as utilizing previously disturbed areas. These practical applications reduced ecological impacts and ultimately reduced project cost. After several years of monitoring target wetlands, it became apparent that additional improvements could be made. Therefore, a second phase was designed, permitted and constructed in 2015. As normal rainfall patterns have returned, the project functioned as designed, and the hydrology within the wetlands has improved. Through innovative design, multiple goals were achieved: reduce nuisance flooding and restore wetlands within the floodplain. All this was done while keeping impacts from construction to a minimum. ■

PRESENTATION 1053

PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS I*, 06/01/2018, 09:45 - 11:35

USING A VEGETATION MULTIMETRIC INDEX TO DETERMINE THE CONDITION OF A WETLAND MITIGATION BANK

Whitley, Annie, U.S. Environmental Protection Agency, Seattle, WA

In 2008, the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency jointly promulgated the Compensatory Mitigation for Losses of Aquatic Resources (Final Rule), establishing a preference for mitigation banks over in-lieu-fee programs and permittee-responsible mitigation to compensate for unavoidable impacts to wetlands. Despite scientific evidence used to establish this preference, it remains unclear how banks compare to natural wetlands. To attempt this comparison, a condition assessment was performed on a 20-year-old mitigation bank; Narbeck Wetland Sanctuary Mitigation Bank was established in 1998 through creation, protection and enhancement of wetlands; performance standards were met after 5 consecutive years (2001 to 2006) of 80% native vegetation cover. The current condition of created wetland at Narbeck was evaluated using sampling protocols and condition metrics, including a wetland vegetation multimetric index (VMMI) from the 2011 National Wetland Condition Assessment (NWCA) Manual. The NWCA identified a gradient of condition, classified as good, fair, or poor, using VMMI values for sites both within sampling regions and nationally. When the VMMI was calculated for Narbeck, the condition was poor, largely due to a plant community dominated by highly disturbance-tolerant, though native, plant species. This may result from a preference by the practitioner to install robust, tolerant plants at the mitigation site to ensure rapid, successful establishment of native plant cover, so that performance standards are met. One implication of this study may be that condition assessments may provide a more promising tool to measure the amount of ecological "lift" obtained through wetland mitigation. ■

PRESENTATION 1056

PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES II*, 05/30/2018, 01:00 - 02:50

SUCCESSFUL WETLAND RESTORATION MUST BALANCE BENEFITS TO HUMAN SOCIETIES AND ECOSYSTEMS

Marazzi, Luca, Florida International University, Miami, FL
Finlayson, Max, Institute for Land, Water & Society, Albury, NSW, Australia
Gell, Peter, Federation University Australia, Mt Helen, Victoria, Australia
Julian, Paul, University of Florida, Ft Pierce, FL
Kominoski, John, Florida International University, Miami, FL
Gaiser, Evelyn, Florida International University, Miami, FL

Globally, millions of people and countless species depend on wetlands. People benefit from the ecosystem services provided by wetlands, including clean water and food, recreation, flood protection, and climate regulation. Had humans not destroyed ~ 50-87% of wetland area, today's global wetland extent would have been between 24 and 93 million km2. Uncontrolled development in densely populated areas has caused widespread damage and economic, social, and political pressures that undermine or delay ongoing wetland restoration efforts. To improve and accelerate the rehabilitation of wetlands we assessed restoration progress in two major wetland systems in affluent countries, alongside examples in less affluent regions. Drawing on personal and published accounts, we assessed restoration progress in the Florida Everglades (USA) and the Murray Darling Basin (Australia), where extensive restoration is taking place and many people rely on multiple, often conflicting, ecosystem services, and in coastal wetlands in eastern Africa and northeastern India. We found that: 1) wetland restoration science needs to make use of both contemporary ecological and palaeoecological approaches and be truly integrated with traditional knowledge; 2) wetland restoration projects need to openly and fully address conflicts over competing human and ecosystem demands and thus need stronger involvement of vulnerable groups and social researchers; 3) independent mediators, or restoration brokers, nominated by independent bodies, may help settle conflicts between stakeholders, especially in highly populated regions where vast and contrasting economic interests create social tensions; 4) integrated river basin management and sustainability plans that harness the multiple values of

wetlands can support their conservation and 'wise use'. Optimal restoration success may be best attained when all stakeholders identify priorities and formulate decisions in a transdisciplinary, transparent, and democratic way, thus balancing existing and future societal and environmental needs. Wetland restoration activities must benefit the life and well-being of as many people (indigenous and non-indigenous) and as many species as possible. Trade-offs between ecosystem services and interests should foster environmental and socio-economic sustainability, a challenge for scientists, conservationists, policy makers, businesses, and communities. ■

PRESENTATION 1060
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION I*, 05/30/2018, 09:55 - 11:35

DURATION OF FARMING IS AN INDICATOR OF NATURAL RESTORATION POTENTIAL OF SEDGE MEADOWS

Wang, Guodong, Chinese Academy of Sciences, Changchun, Jilin, China

Soil seed banks can be important components of ecological restoration, particularly if the species remain viable in the soil for long periods of time. A germination experiment was conducted in the greenhouse to determine seed bank viability based on length of time farmed. Soils from sedge meadows farmed between 0 and 50 years were collected in Sanjiang Plain, China. Most dominant sedges (e.g., Carex schmidtii, C. lasiocarpa) and grasses (e.g. Calamagrostis angustifolia) survived as seeds if farmed for less than 5 years, therefore fields farmed for short periods of time are the best candidates for wetland restoration. Certain important structural components (tussock-forming Carex spp.) are not retained in seed banks when farmed for 6-15 years, but the seed banks still contained viable seeds of other important sedge meadow species, which could contribute to the restoration of wetland communities. However, most sedge meadow species were missing in fields farmed for more than 16 years, which make these fields difficult to restore via natural recolonization. We conclude that the duration of farming can be used as a general indicator of the potential of natural restoration for sedge meadows. This information could be used to determine which wetlands might be targeted for restoration. ■

PRESENTATION 1072
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY II*, 05/30/2018, 01:00 - 02:50

WAITING FOR WET: SOIL MOISTURE AND WETLAND FUTURE FOR A CRANBERRY BOG

Hatch, Christine, University of Massachusetts - Amherst, Amherst, MA
McInnis, Luke, University of Massachusetts - Amherst, Amherst, MA
Ito, Erika, University of Massachusetts - Amherst, Amherst, MA
Cosh, Michael, USDA - ARS, Baltimore, MD

The Hydrologic Understory is an integrated research and extension project that explores groundwater flowpaths, surface water mixing, underground thermal regimes and soil moisture monitoring to map out the interconnected web of hydrology and ecology beneath the surface ultimately helping guide management of wetlands, including attracting desirable native species, creating and maintaining habitat for cold water fishes and optimal water quality.

In this cranberry-bog-turned-restored-freshwater-wetland, the largest in Massachusetts, we are exploring first principles measurements of hydrologic parameters to help guide wetland restoration practices and management. One of the most basic, defining metrics of a wetland is, as the name implies, its wetness. The relative water content in the soil can be assessed in a variety of ways, and this quantity alone is important for both wetland establishment and wetland function.

We collected detailed soil moisture data using a field probe along three transects: a control site, one restored site left undisturbed, and another restored site where soil disturbance was used to create hummocks and hollows. It is believed that this practice will mimic naturally-forming features and create variability in micro-topography and associated habitat types. Gravimetric soil moisture measurements were also collected in conjunction with probe measurements at 30 locations both before and after restoration. Statistical analysis of post-restoration probe-based moisture data reveals that variability of moisture is significantly greater at the disturbed site, and that both restored sites are wetter than the reference site. In addition, average moisture across the site is increased from pre- to post-restoration. Continued moisture monitoring coupled with vegetation surveys are required to assess the effectiveness of this disturbance technique for accelerating wetland re-development, but initial results show that if moisture variability is an indicator of wetland health, then this approach is promising.

Future work includes a detailed elevation change analysis of micro-topography, and comparison to other sites where restoration is in the planning stages. We foresee a continued interest in wetland restoration in Massachusetts and predict that measurable metrics to assess the success, or potential for success of such restoration efforts are desired; and feel that moisture variability is an important tool in this toolbox. ■

PRESENTATION P58
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

APPLICATION OF THE GREAT LAKES COASTAL WETLAND MONITORING PROGRAM TO RESTORATION PROJECTS IN LAKE ONTARIO WETLANDS

Wilcox, Douglas, SUNY College at Brockport, Brockport, NY
Bateman, John, SUNY College at Brockport, Brockport, NY
Mudrzynski, Brad, CC Environment and Planning, Batavia, NY
Uzarski, Don, Central Michigan University, Mount Pleasant, MI
Brady, Valerie, University of Minnesota Duluth, Duluth, MN
Cooper, Matthew, Northland College, Ashland, WI

The Great Lakes Coastal Wetlands Consortium developed a basin-wide monitoring plan in 2008 to determine the condition of coastal wetlands, with funding from the Great Lakes Restoration Initiative via USEPA-GLNPO. A second phase of the program was funded for 2016-2020, in which many of the original study sites are being revisited. The program has collected data on vegetation, invertebrates, fish, amphibians, birds, and chemical and physical parameters from randomly selected wetlands across the basin using standardized protocols. Additional wetlands were sampled as benchmarks specific to restoration projects. On Lake Ontario, data collection at benchmark sites in the Rochester Embayment Area of Concern has provided pre-restoration and post-restoration assessments for EPA/GLRI-funded restorations at Buck Pond and Buttonwood Creek; U.S. Army Corps of Engineers/ GLRI restoration at Braddock Bay; and U.S. Fish and Wildlife Service/GLRI restorations at Salmon Creek, Buck Pond, and Long Pond. Pre-restoration data are often not available when funding for restoration is approved, and post-restoration data collection is usually limited to two years. The Coastal Wetland Monitoring Program thus serves an unmet need, as data collection at benchmark sites can potentially continue as needed through the duration of the program. ■

PRESENTATION 1089
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION II*, 05/30/2018, 01:10 - 02:50

GETTING TO SCALE: WETLAND AND RIPARIAN RESTORATION IN THE TUALATIN RIVER WATERSHED, OREGON

Dulin, C. Tracey, Clean Water Services, Hillsboro, OR

Clean Water Services and its partners have engaged in a large-scale landscape conservation strategy aimed at restoring wetland plant communities and ecological functions along the Tualatin River and its tributaries in a changing rural and urban environment. Thus far under the Tree for All program (jointreeforall.org), we have revegetated over 100 miles of stream corridor with wetland and riparian plant communities by adaptively applying a restoration approach known as Rapid Riparian Reforestation (R3) originally developed at Clean Water Services. We have combined this approach with a number of other innovations to build the largest landscape-scale restoration effort on the West Coast. These innovations include no-cost access agreements, collaborative planning, adjusting geographic boundaries to minimize edge effects, comprehensive site preparation, large scale plant materials procurement, development of pool of specialized and experienced contractors, detailed monitoring and analysis of data into adaptive feedback, embracing disturbance or overall site change, and working with beaver for a more passive approach to stream engineering. This presentation will use the 115-acre Portland Community College (PCC) Rock Creek Floodplain Enhancement project as a case study to illustrate how these innovations contribute to cost effective long term management goals that involve the local community and provide connected habitat for wetland, upland and riparian species. ■

PRESENTATION 1099
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES IV*, 06/01/2018, 03:20 - 05:00

EVALUATION OF THE BRADDOCK BAY WETLAND RESTORATION PROJECT ON LAKE ONTARIO

Silva, Alexander, SUNY Brockport, Brewster, NY
Wilcox, Douglas, SUNY College at Brockport, Brockport, NY
Bateman, John, SUNY College at Brockport, Brockport, NY

Braddock Bay is an open embayment wetland on the southern shore of Lake Ontario and is part of the Rochester Embayment Great Lakes Area of Concern. It is partially protected by two spits that are remnants of the protective barrier beach that has slowly been eroded over time. Without the barrier to protect the shoreline within the bay, the coastal wetland has been severely impacted by wave action

from Lake Ontario, leading to loss of wetland area. Erosion of the barrier has been facilitated by water-level regulations implemented in the late 1950s, which resulted in a loss of diversity because the lack of periodic low water levels brought about a cattail monoculture and loss of sedge/grass meadow habitat. Braddock Bay is currently being restored by the U.S. Army Corps of Engineers. The plan includes restoring the barrier beach; restoration of a portion of existing cattail-dominated wetland by cutting cattails when storage carbohydrates in rhizomes are minimized, followed by herbicide treatment of new stems; channeling and potholing to improve wildlife access to the wetland; and the creation of spoil mounds along the channels and potholes to increase the elevation in these areas to discourage the growth of cattail but support the growth of sedge/grass meadow species. Two years of post-restoration vegetation data collection show an increase in an invasive species of concern (purple loosestrife) from year 1 to year 2 across the restoration site, along with an apparent decrease in cattail across the years in both the sedge/grass meadow and the spoil mound habitats. Implementation of a new lake-level regulation plan that includes greater water-level variability will likely increase the diversity of vegetation and wildlife at Braddock Bay and increase the potential for restoration success. ■

PRESENTATION 1104
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION V*, 05/31/2018, 01:10 - 02:50

USING TREATMENT WETLANDS FOR THE PURIFICATION OF SALT-LADEN WASTEWATER: LITERATURE REVIEW, MESOCOSM-SCALE STUDIES, AND SPECULATION FOR THE FUTURE

Zhu, Hui, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin Province, China

Saline wastewater containing high salts and other contaminants can adversely affect both aquatic and terrestrial ecosystems. The treatment of saline wastewater, for both salts and specific contaminant removal, has become a necessary task in many cases. Based upon a literature review, the latest knowledge on the use of constructed wetlands (CWs) for treating saline wastewater was illustrated. In addition to the review study, greenhouse studies for the screening of salt-tolerant plant species were conducted and suitable species for the treatment of saline wastewater were recommended. Furthermore, mesocosm-scale studies for the treatment of saline wastewater containing nutrient, heavy metals, and antibiotic were conducted as considering various influencing factors (e.g., plant species, influent loads, salinity levels, co-existed contaminants, etc). Major findings were as follows: 1) CWs planted with Canna (Canna indica L.) outperformed the CWs planted with all the other tested plant species in the removal of nitrogen. There were no significant differences among plant species in the removal of P and heavy metals. However, considering the better response of growth and physiological characters of Canna to salt and pollutants stress, Canna can still be selected as the optimizing plant species. 2) The removal of N was significantly inhibited ($P < 0.05$) when the EC value increased by 30 mS/cm. While, the change of salinity levels didn't show significant influence on the removal of P. The change of salinity levels didn't significantly affect the removal of most of the heavy metals, either, except for Cd. 3) The removal efficiencies of CWs to some of the targeted contaminants were changed when multiple contaminants were co-existed. In conclusion, CWs showed very promising removal efficiencies of nutrient and heavy metals from the saline wastewater, especially when the EC value of the wastewater was below 15 mS/cm. Future studies are recommended on the removal of different types of target contaminants, strategies for strengthening the purification process, and on conducting large-scale field experiments under real-world conditions. ■

PRESENTATION 1124
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY II*, 05/30/2018, 01:00 - 02:50

LIVING OBSERVATORY: BUILDING A MULTI-DISCIPLINARY LEARNING COLLABORATIVE TO DOCUMENT THE LONG-TERM STORY OF ECOLOGICAL CHANGE ACROSS TIDMARSH

Davenport, Glorianna, Living Observatory, Plymouth, MA

Founded in 2011, Living Observatory (LO) is a multi-disciplinary learning collaborative of scientists, engineers, artists and restoration practitioners who are engaged in telling the long-term story of ecological change across the Tidmarsh landscape. Developed in parallel with the planning and design of the Tidmarsh Restoration Project (2010-2015), the purposes of the collaborative are to advance scientific knowledge, improve the outcome of wetland restoration, and provide experiences that inform public understanding of ecological processes. All of the speakers in this symposium are affiliated with LO, and participate in the shared effort to learn from this restoration project and communicate its outcomes to the public. In this talk, I present the founding principles of LO through a lens of historical land evolution and use; introduce the multi-disciplinary learning community who, individually and collectively, are exploring hypotheses about evolving ecological processes across the Tidmarsh

landscape; and, demonstrate research novel sensory devices and media representations that we have developed to invite the public to explore complex ecological inter-relationships at different temporal and geographical scales. In closing, the talk will summarize opportunities and challenges facing LO as it moves forward as a non-profit organization. ■

PRESENTATION 1160

PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED II*, 06/01/2018, 01:00 - 02:50

DESIGNING CONSTRUCTED WETLANDS TO TREAT STORMWATER IN ARKANSAS: CAN WE ATTAIN LOW PPB LEVELS OF LEAD IN THE FINAL EFFLUENT?

Barber, Tim, ERM, Beachwood, OH
Kafle, Ankit, ERM, Annapolis, MD
Baker, Mark, ERM, Holland, MI
Hosmer, Larry, ERM, Annapolis, MD

Stormwater from a 100-acre chemical manufacturing facility in Arkansas is managed by two retention ponds. Discharge from these ponds is managed under an NPDES permit, and monitoring data indicate exceedances of the lead and zinc water-quality standards. These issues were addressed in a sustainable manner by constructing a wetland downgradient from each pond to provide supplemental treatment and additional storm-surge capacity. The wetlands were sized based on historical discharge records, and will remove lead and zinc through biologically mediated, precipitation reactions that produce insoluble, metal-sulfide complexes. A proof-of-concept study was conducted to demonstrate that water spiked with high concentrations of lead and zinc compounds would be effectively treated. The tests were conducted using four-foot columns filled with wetland media consisting of organic-rich compost mixed with coarse sand. Different mixtures were tested to maximize the organic carbon content while maintaining sufficient hydraulic conductivity to allow for movement of water through the media. Following a 48-hour equilibration period, the porewater became anaerobic, and lead and zinc were effectively removed by running the solution through the column. Initially, discoloration of the elutriate was observed, most likely associated with dissolved organic carbon derived from the compost, but cleared after several rinses. In the final design, water from the ponds is gravity-fed into the wetlands through flow control mechanisms installed at the influent and effluent points to maintain hydraulic control and ensure sufficient water is maintained in the wetlands during the dry season and increased flows can be accommodated during the wet season. Emergent macrophytes were planted in the wetlands to control erosion, filter water that may bypass the media, and replenish organic matter to support sulfate-reducing bacteria in the sediment. The plants are not expected to significantly extract the metals. Construction was completed in the fall of 2017, and an 18-month establishment period is anticipated before performance specifications are fully satisfied. Currently, maintenance and monitoring activities are being conducted to assess the performance of the wetlands and determine if corrective actions or design modifications are required to meet the project objectives. ■

PRESENTATION 1163

PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS I*, 05/30/2018, 01:00 - 02:50

PHYTO-INTEGRATED™ REMEDIATION SYSTEM TO ADDRESS CHLOROBENZENE CONTAMINATED GROUNDWATER IN SAPROLITE AQUIFER IN SOUTH CAROLINA

Hollifield, Edward, ERM, Charlotte, NC

Background - In 2017, a PHYTO-INTEGRATED™ remediation system employing patented TreeWells® was installed to remediate areas of chlorobenzene impacted groundwater and soil from an industrial waste burn-pit. Previous remedial efforts included excavation and in-situ chemical oxidation, but treatment of contaminants in the deeper, partially weathered rock (PWR) did not meet cleanup criteria. Site soils consist of saprolitic silty/sands to approximately 10 feet below ground surface (bgs). Unconsolidated materials are underlain by a 0.5-2.0-foot thick layer of PWR, which is underlain by an additional 20 feet of unconsolidated saprolitic soil. Saturated conditions are encountered at approximately 25-40 feet bgs in increasingly competent bedrock.

Objectives: Remediation via engineered phytoremediation system is designed to decrease chlorobenzene in the source area soil and groundwater and the downgradient portion of the impacted groundwater plume.

Methods: Following the completion of a remedial alternatives evaluation, the engineered phytoremediation system was approved by the State, and in the Spring of 2017, 19 TreeWells® were installed. The TreeWells® were designed to target contaminated unsaturated soils from 5 to 25 feet bgs in the footprint of the burn-pit and groundwater from approximately 25-40 feet bgs. To monitor the hydraulic effects of the TreeWells®, transducers were installed in piezometers located inside selected TreeWells® and existing vicinity monitoring wells. Performance monitoring included collecting groundwater samples from nested piezometers and site monitoring wells. Conductivity sensors installed in selected TreeWells® piezometers were used to monitor changes in groundwater conductivity as proxy for remedial effects.

Results: Based on the preliminary data collected in the Fall of 2017, while historically variable, there were consistent reductions in all monitored wells following the installation of the TreeWell units with significant reductions outside the source area.

Conclusions: Based on the data collected to date, the TreeWells® appear to be effectively reducing contaminant concentrations in this geologically complex site. ■

PRESENTATION 1165
PRESENTED DURING *COASTAL HYDROLOGIC RESTORATION: INFORMING PROGRAM MANAGEMENT THROUGH MONITORING*, 06/01/2018, 09:45 - 11:35

WHEN YOU BUILD IT, WILL THEY COME? ASSESSING FISHERIES USAGE OF NEWLY RESTORED HABITATS THROUGHOUT SAN FRANCISCO BAY

Spenst, Renee, Ducks Unlimited, Inc., Rancho Cordova, CA
Cosentino-Manning, Natalie, NOAA Fisheries Restoration Center, Santa Rosa, CA
Meisler, Julian, Sonoma Land Trust, Santa Rosa, CA

Restoration is a vital step in achieving habitat and species recovery objectives in San Francisco Bay. Much of the recent and planned tidal restoration involves transforming former salt production ponds and hay fields back to tidal marsh and other estuarine habitats through primarily passive restoration methods such as levee breaches. Most restored sites are several feet lower than surrounding marshes, so levee breaches restore a mosaic of habitats that changes through time as sediment accretes and builds marsh. We will use a growing body of monitoring results to examine fisheries use of these restoring habitats, as well as to provide an in-depth examination of an array of habitat types constructed at one newly restored North Bay site, Sears Point, where habitat elements included root wads, sidecast ridges, marsh mounds, vegetated bottom, and open water channel. Ducks Unlimited has worked in close collaboration with NOAA and other project partners and consultants to develop fish monitoring strategies to assess use of these newly restoring habitats. Methodologies included using trawls and seines, deployment of acoustic tags and receiver arrays, and use of Adaptive Resolution Imaging Sonar to investigate usage paired with seining and trawling. Preliminary results illustrate a broad array of fish species utilizing the restored habitats soon after breaching, including Chinook salmon and Pacific herring, California halibut. Native species were both abundant and well distributed through restored habitats. Acoustic arrays were valuable for documenting use by tagged fish, or in combination with tagging. At Sears Point, ARIS surveys were better at detecting pelagic species, while seining and trawls target benthic species. Among habitat features, sidecast ridges were particularly well utilized. ■

PRESENTATION 1188
PRESENTED DURING *WETLANDS IN A CHANGING CLIMATE: SCIENCE, POLICY AND MANAGEMENT II*, 05/31/2018, 01:00 - 02:50

RESTORING COASTAL WETLANDS: A NATURE BASED SOLUTION TO COPE WITH SEA-LEVEL RISE AND ENHANCE BIODIVERSITY. A MEDITERRANEAN EXAMPLE.

Grillas, Patrick, Tour du Valat, Arles, France
Thibault, Marc, Tour du Valat, Arles, France
Boutron, Olivier, Tour du Valat, Arles, France
Campagna, Julie, University of Angers, Angers, France
Davranche, Aurélie, University of Angers, Angers, France
Nicolas, Delphine, Tour du Valat, Arles, France
Willm, Loïc, Tour du Valat, Arles, France
Luna-Laurent, Emilie, Tour du Valat, Arles, France
Poulin, Brigitte, Tour du Valat, Arles, France

Coastal erosion is a major threat in the Rhône delta (Camargue) resulting primarily from the sharp decrease of the coarse sediment load of the Rhône, sea-level rise and sea surges. Large salt pans (15,000 ha) next to sea-dyke were notably directly threatened by sea-level rise and sea surges. 5.400ha of salt pans were progressively (2008 - 2014) bought by the Conservatoire du Littoral to be restored into coastal wetlands. The main of this restoration project was depoldering the site, in order to enable hydrobiological connectivity between the lagoons, with the sea and the peripheral sub-catchments, thus favoring a more flexible management of the coastline. Ancillary objectives were to restore the previous wetland habitats and enhance biodiversity; to design the needed civil engineer works, and to optimize sluice management for breeding colonial waterbirds (Flamingo, Avocet and terns).

Sea-shore line and vegetation were monitored using remote sensing tools. A two dimensional hydrodynamic model was used to calculate water levels, flows and salinities according to different civil works and sluice management options. Fish populations were monitored at 4 stations to assess connectivity and breeding and wintering bird populations were monitored.

During the first years sea-surges resulted in several breeches in the front dyke and internal levees. However the broken front dyke is progressively replaced by a sand levee which is maintained opened by winter sea-surges. The restoration of biodiversity (vegetation, fish, wintering and breeding birds) is fast probably enhanced by the

close vicinity and connectivity with similar habitats. Civil engineer works proved useful to restore connectivity between lagoons and maintain higher water levels around colonial waterbirds islets. However, optimizing water levels for breeding colonial waterbirds (Flamingo) had negative consequences on the flood extent and duration on other lagoons. The restoration of this wetland is the largest restoration project in France and show efficient alternative solution to expensive and unsustainable dyke approach with high biodiversity added value. ■

PRESENTATION 1204
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION I*, 05/30/2018, 09:55 - 11:35

UNDERSTANDING ELEVATION AND EDAPHIC CONTROLS ON THE ESTABLISHMENT OF WETLAND VEGETATION IN CRANBERRY BOGS SLATED FOR RESTORATION IN MASSACHUSETTS

Whittemore, Michael, Woods Hole Research Center, Falmouth, MA
Hoekstra, Ben, Marine Biological Laboratory, Grinnell College, Woods Hole, MA
Maxwell, Marie, Amherst College, Amherst, MA
Neill, Christopher, Woods Hole Research Center, Falmouth, MA

Commercial cranberry bogs have formed a vital part of the economy, landscape and cultural heritage of southeastern Massachusetts for more than a century. Recent market pressures on the cranberry industry have induced farmers to either renovate bogs to increase yields, or retire less productive bogs. Because many cranberry bogs were created on natural peat wetlands, retirement of bogs and more active restoration strategies for discontinued bogs has the potential to restore original wetlands and enhance ecosystem services by increasing wetland area in coastal watersheds. We currently know little about how vegetation develops in retired or actively restored bogs and how vegetation responds to soil conditions. We surveyed plant species composition and plant cover in four bog units in two former cranberry farms slated for future restoration across a gradient of age since retirement. We found that all sites had high plant species richness and more than 90% native species. Vegetation composition was strongly related to soil moisture. The number and cover of wetland species were highest in the wettest sites and the number and cover of non-wetland and woody plant species increased with elevation and years since retirement. Extractable inorganic nitrogen was high in underlying peat compared with surface soils, dominated by ammonium, and was not related to plant species composition. The fate of this nitrogen in future restorations is not known but the stock of this deep nitrogen was about the same magnitude as one year of typical applications of nitrogen fertilizer to active bogs. We plan to resample vegetation after active restoration of these bogs over the next two years. Understanding the relationships of vegetation development in relation to soil characteristics will help to predict vegetation patterns in retired bogs and to develop practices that maximize establishment of desired wetland vegetation during active restoration. ■

PRESENTATION 1225
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED III*, 06/01/2018, 03:10 - 05:00

BALANCING THE NEEDS OF FEDERAL, STATE AND PRIVATE STAKEHOLDERS – THE ECOLOGICAL RESTORATION OF THE ASHTABULA RIVER

Barber, Tim, ERM, Beachwood, OH

The Ashtabula River was impacted by decades of industrial use resulting in a loss of fish and wildlife habitat. Historical channelization, shoreline armoring, and upland development virtually eliminated wetlands and riparian buffers along the lower 2 miles of the River. The Slip 5A peninsula near NS's Ashtabula coal dock is one of three interconnected projects were habitat restoration and enhancement of the biota has recently been completed. Remediation and ecological restoration of the River required understanding and designing for the various and complex biological, chemical, and physical features of the site, and the engagement and involvement of many stakeholders from the local to the state level. The lower 2 miles of the Ashtabula River in Ohio on Lake Erie was designated as a Great Lakes Area of Concern (AOC) in 1985. Initial activities focused on controlling sources of contamination, including the investigation and remediation of the Fields Brook Superfund Site. Under the Great Lakes Legacy Act (GLLA), approximately 500,000 cubic yards of contaminated sediment were removed from the AOC by 2007. For the first of these projects, in Jan. 2010, U.S. EPA/GLNPO completed excavation and construction of approximately 800 linear ft of fish habitat shelf along the northwestern edge of Slip 5A as habitat mitigation under the GLLA sediment remediation project. The project was finalized in the spring of 2010 by topsoil placement and planting of aquatic and upland vegetation. For the second of these projects, in Sept. 2010, Ohio EPA received funding under the Great Lakes Restoration Initiative (GLRI) to complete the remaining 1,400 ft of the habitat restoration on the southwestern edge of the Slip 5A peninsula. Construction began in Aug. 2011 and was completed in Jun. 2012 with installation of aquatic plants on the fish shelf. The third restoration project on the Slip 5A peninsula was

started in Sept. 2013 and completed in Jun. 2014. The project was implemented as part of a natural resource damage settlement. The third project included removal of invasive species, construction of a hydraulic connector and creation of wetland habitat, stabilization of stream bank, and re-grading and re-planting the upland portions of the peninsula with native species. The creation of new habitat is expected to restore degraded populations of benthic organisms, fish, and wildlife in the AOC, and completes a key management action needed for the restoration of the River. ■

PRESENTATION 1231
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION VI*, 05/31/2018, 03:20 - 05:00

INNOVATIVE USE OF SLAMM TO PROJECT WETLAND CHANGES DUE TO TIDAL RESTORATION

Leduc, Elise, Woods Hole Group, East Falmouth, MA

The Herring River Estuary is a 1000+ acre system located on outer Cape Cod. It has been physically separated from Wellfleet Harbor for over a century by a compound dike system, which has dramatically reduced its tidal range and water circulation, and resulted in significant degradation of the ecological functions and values of the marsh. The Herring River Restoration Committee has developed a comprehensive adaptive management strategy to restore this system. As part of that strategy, a targeted ecological modeling effort was undertaken to improve the understanding of how wetland types and vegetation within the system will respond and change to the alterations in tidal regime planned as part of the restoration. Although the Sea Level Affecting Marshes Model (SLAMM) was originally designed to simulate the dominant processes involved with wetland conversions due to sea-level rise, because water level is the driving factor within SLAMM, by specifying the tidal range resulting from various tide gate openings this model could be used in a unique approach to evaluate how the vegetation will respond to changes in water level due to altering man-made structures, rather than the water level increases projected to occur through sea-level rise. Such simulations were completed for 17 different adaptive management gate opening scenarios. Results from these analyses provide restoration managers with the change in total acres of each wetland type, as well as raster-based map outputs to visualize and evaluate site-specific changes for each gate opening scenario. These data will also feed directly into a broader 38-measurement endpoint decision tool to guide adaptive management decisions, which calls for predictions such as habitat areas and viewscapes. Additionally, these results can assist managers in choosing gate openings that produce desirable equilibrium habitat conditions, identifying gate opening scenarios that may require secondary management actions, and eliminating gate opening alternatives that are too small to affect any meaningful change. ■

PRESENTATION 1240
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES III*, 06/01/2018, 03:10 - 05:00

POTENTIAL & PROBLEMS OF FLOATING TREATMENT WETLANDS FOR MITIGATING AGRICULTURAL CONTAMINANTS

White, Sarah A., Clemson University, Clemson, SC
Garcia Chance, Lauren, Clemson University, Anderson, SC

Floating treatments wetlands (FTW) are a young technology used to remove nutrients and metals from wastewater, urban and agricultural runoff. FTWs are a modified constructed wetland technology that can be implemented within existing water infrastructure to manage contaminants. Research documents the efficacy of FTWs to mitigate both metal and nutrient contaminants from runoff. Yet the mechanisms driving removal processes are not well understood. Despite the limited research-based data elucidating the mechanisms by which FTWs function, their rate of adoption as a best management practice to mitigate nutrient and metal contaminants in agricultural runoff has grown and will likely continue to grow at an increasing rate due to their versatility and functionality. Potential factors that influence FTW performance include sizing, contaminant loading rate, the consistency or periodicity of hydraulic loading, plant selection, management strategy, wildlife pressure, climate, and geographic region. We have conducted research with FTWs since 2008 and have evaluated FTW performance as influenced by plant species (Agrostis alba, Andropogon glomeratus, Beta vulgaris, Canna 'Firebird', Canna flaccida, Carex stricta, Iris ensata, Juncus effusus, Ocimum basilicum, and Panicum virgatum), nutrient loading rate, percent surface area covered, planting density, aeration, and hydraulic retention time. Ongoing studies are evaluating changes in pond hydrology as influenced by the presence of FTWs, quantification of how water quality dynamics influence FTW performance, potential for plant disease mitigation, and the economics of FTWs for use alternative production areas for specialty crop growers. Results confirm FTW performance varies by the plant species used, planting density, nutrient loading rate, and hydraulic retention time. Each of these parameters influences contaminant remediation efficacy and utility of FTWs. Gained knowledge related to these parameters informs system design, yet significant gaps remain and need to be addressed. ■

PRESENTATION 1245

PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED I*, 06/01/2018, 09:45 - 11:35

INTEGRATING SURFACE WATER QUALITY IMPROVEMENTS INTO COASTAL RESTORATION – AN URBAN RETROFIT BEST MANAGEMENT PRACTICE (BMP) CASE STUDY

Gruber, Steve, Burns & McDonnell Engineering, La Jolla, CA

Big Canyon is a 1,300 acre coastal watershed in Newport Beach, California that drains to Upper Newport Bay, an important coastal ecological preserve. Big Canyon Creek, which drains the watershed, is a perennial urban stream that is impaired due to elevated levels of selenium, which has been shown to be toxic at high levels to wildlife. As a result, a total maximum daily load (TMDL) has been established for the creek to protect the stream's biota and beneficial uses. Big Canyon Creek also suffers from anthropogenic alterations that have negatively impacted stream hydrology and water quality, as well as riparian vegetation and wildlife habitat. The Big Canyon Restoration and Water Quality Improvement Project (project), located less than a half-mile from the Creek's discharge into Upper Newport Bay, is a multiple benefit project, integrating (a) water quality improvements of dry weather flows, (b) passive treatment of wet weather runoff with wetland creation, (c) flood plain reestablishment with streambed and streambank stabilization, (d) riparian restoration, and (e) enhanced public access. Comprehensive groundwater and surface water investigations, which were conducted to understand the patterns of selenium loading in the creek, identified one reach where groundwater seeps greatly increased selenium levels in creek surface waters. In order to decrease selenium concentrations to meet TMDL requirements, these seeps were isolated and diverted to the sanitary sewer in order to reduce selenium concentrations in dry weather flows. During wet weather, stormwater runoff from a major arterial roadway is captured and treated through subterranean bioretention cells planted with native vegetation and specifically designed to remove a suite of pollutants common to urbanized watersheds (metals, nutrients, organics, and indicator bacteria). Treated water from these storm events then flows into newly created ephemeral wetlands that are hydrologically connected back to the creek. In addition, several elements were integrated into the project to further improve water quality by re-establishing the functionality of Big Canyon Creek. These elements include a re-connection of the creek to a newly restored floodplain, streambed restoration to enhance in-stream habitat, and stream re-alignment and bank stabilization with eco-friendly vegetated soil revetments to reduce erosion, prevent stream incision, and enhance recruitment of native vegetation. ■

PRESENTATION 1256

PRESENTED DURING *COASTAL HYDROLOGIC RESTORATION: INFORMING PROGRAM MANAGEMENT THROUGH MONITORING*, 06/01/2018, 09:45 - 11:35

AVOIDING EMPTY PROMISES: USE OF LONG-TERM AND ADAPTIVE MONITORING TO IMPLEMENT AN ADAPTIVE MANAGEMENT PLAN FOR A SALT MARSH RESTORATION PROJECT

Keer, Georgeann, Commonwealth of Massachusetts, Boston, MA

Across Massachusetts, salt marsh restoration efforts have focused largely on restoring tidal hydrology through undersized culvert replacement toward the goal of restoring more natural tidal hydrology and the associated functions and values historically lost due to significant and prolonged tidal restriction. At the Sesuit Creek Salt Marsh in Dennis, MA, 57 acres of tidally restricted salt marsh was restored in 2008 when a 24-inch culvert was replaced with twin 10-foot by 12-foot culverts. As with many similar restoration efforts, pre- and post-restoration monitoring for the stated purposes of documenting the restoration trajectory and justifying post-restoration adaptive management was incorporated into the restoration plan. Review of longer-term post-restoration data identified significant marsh plain areas that were slow to recover and remained devoid of vegetative cover. Monitoring efforts were adapted to include a closer examination of marsh plain elevations, sediment accretion and soil chemistry characteristics to aid identification of conditions that may be contributing toward slower than anticipated restoration of vegetated marsh plain. Results from the adapted monitoring program suggested that elevations within unvegetated marsh plain areas are appropriate for low marsh establishment, and sediment is generally accreting. In this case-study, both long-term and shorter-term adaptive monitoring data have provided the foundation for implementation of an adaptive management plan focused on use of Spartina alterniflora seedlings to jumpstart reestablishment of vegetated marsh plain across targeted restoration areas. ■

PRESENTATION 1299
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY I*, 05/30/2018, 09:45 - 11:35

UNDERSTANDING NITROGEN AND PHOSPHORUS BALANCES OF ACTIVE CRANBERRY BOGS CAN HELP TO PRIORITIZE FUTURE RESTORATION AT FARM TO WATERSHED SCALES

Neill, Christopher, Woods Hole Research Center, Falmouth, MA
Scott, Lindsay, Woods Hole Research Center, Falmouth, MA
Kennedy, Casey, USDA Agricultural Research Service, East Wareham, MA
Jakuba, Rachel, Buzzards Bay Coalition, New Bedford, MA
DeMoranville, Carolyn, UMass Cranberry Station, West Wareham, MA

Cranberry bogs make up an important part of the landscape, economics, and cultural heritage of Massachusetts. Because cranberry bogs use ponds and rivers as water sources and as discharge points, the control of runoff of both nitrogen (N) and phosphorus (P) to surface waters from cranberry farming is a concern for the health and management of fresh and estuarine waters in watersheds where cranberry bogs occur. Identifying bogs that release high amounts of N and P can be important for prioritizing bogs for restoration. We quantified the movement of N and P into and out of three southeastern Massachusetts cranberry bogs during one water year and annual cropping cycle. We combined measurements of water flow with measurements of dissolved and particulate N and P concentrations in different components of the annual farming cycle to estimate N and P input-output balances. Water budgets varied widely among bogs. Two bogs showed net movement of groundwater into the bog, one of which had very high inflow, and the third bog had net water flow into groundwater. Two bogs exhibited small net N imports (0.1 and 2.0 kg N/ha) in exchanges with surface and ground waters and one bog exported 12.6 kg N/ha. Bogs exported between 2.1 and 4.5 kg P/ha. High variability of net N exchange likely arose from the hydrogeographical setting in which the bogs occurred. The highest N export was associated with the highest groundwater inflow. The variation in the magnitude and direction of P exchanges was much less and depended less on bog setting. An understanding of individual bog contributions to N and P delivered to surface waters at the watershed scale will require estimates of how much N and P are released to streams and rivers from bogs by normal fertilizer and water management, how bog N export is related to the hydrogeographical and soil setting in which bogs occur, and how much N that enters streams either travels downstream or is retained within the river network. This information could be used to prioritize for restoration bogs that currently make the largest nutrient contributions to watersheds. ■

PRESENTATION 1300
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED II*, 06/01/2018, 01:00 - 02:50

INCORPORATING SOIL FUNCTIONS INTO WETLAND RESTORATION/CREATION PROJECTS - LESSONS ACROSS DIVERSE GEOGRAPHIC REGIONS AND WETLAND TYPES

Berkowitz, Jacob, US Army Corps of Engineers, Vicksburg, MS
VanZomeren, Christine, US Army Corps of Engineers, Vicksburg, MS
White, John, Louisiana State University, Baton Rouge, LA

While numerous wetland creation and restoration projects have been implemented in many regions globally few studies evaluate the benefits of soil biogeochemical functions, including those related to denitrification, carbon cycling, and excess nutrient retention. In response, a series of case studies are presented across varying geographic locations, spatial extents, and wetland types. First a small scale, innovative technique for wetland creation demonstrates excess nitrogen reduction potential in the Atchafalaya River, Louisiana; highlighting the importance of developing techniques that mimic natural process to maximize soil functions. Second, large scale (>11,000 ha) restoration efforts in the Mississippi River alluvial valley display significant improvements in carbon cycling and export functions; identifying the role of site selection and ground state conditions in predicting functional outcomes. Third, the capacity for restored/created wetlands to adsorb phosphorus is evaluated across portions of the Midwestern US including areas contributing to harmful algal blooms in the Great Lakes; underscoring the need for tools capable of predicting functional lifespans and end-states. Finally, the potential for rapid changes in soil morphology and chemistry following marsh restoration in coastal New Jersey related to soil biogeochemical reactions are discussed; including development of potential acidity. The case studies emphasize the importance of understanding complex soil processes and interactions related to wetland functions during design, implementation and monitoring of creation/restoration projects. ■

PRESENTATION 1333
PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS I*, 05/30/2018, 01:00 - 02:30

COLORADO'S WATERSHED PLANNING TOOLBOX: BRIDGING THE GAP BETWEEN ECOLOGICAL DATA AND APPLIED RESTORATION AND WATER RESOURCE MANAGEMENT

Marshall, Sarah, Colorado Natural Heritage Program, Fort Collins, CO
Lemly, Joanna, Colorado Natural Heritage Program, Fort Collins, CO

Colorado is one of the fastest-growing states in the U.S., placing increasing demands on limited groundwater and surface water resources and stressing aquatic ecosystems. As resource managers, planners, and restoration practitioners attempt to mitigate for impacts to aquatic ecosystems, there is a growing need for conservation planning tools that help bridge the gap between ecological data collection and applied restoration and water resource management. The Colorado Natural Heritage Program (CNHP) is working to meet this need by developing a suite of online tools to help support conservation efforts in Colorado. One of these tools, the Watershed Planning Toolbox, is an interactive online mapping interface intended to help users visualize wetland and stream distribution, landscape-scale ecological functions, hydrologic modification, stressors, and prioritization for conservation and restoration at the HUC8 subbasin scale. The tool is being piloted in two HUC8 subbasins in central Colorado, the headwaters of both the South Platte and Arkansas Rivers. Likely ecological functions of wetlands are being mapped using the Landscape Position, Landform, Water Flowpath, and Waterbody (LLWW) classification system, which applies hydrogeomorphic attributes to traditional National Wetland Inventory mapping, and ancillary geospatial data. In addition to mapping, the toolbox will provide a gateway to planning resources ranging from funding opportunities to the most current technical guidance for aquatic restoration. This project is intended to help catalyze and improve aquatic restoration activities by providing integral data to streamline restoration planning, increasing the likelihood of successful project implementation, and encouraging planners and restoration practitioners to view conservation and restoration through the lens of cumulative ecological impacts at the landscape scale. ■

PRESENTATION 1341
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES III*, 06/01/2018, 03:10 - 05:00

CONCURRENT REDUCTION IN PHOSPHORUS AND SUSPENDED SEDIMENT CONCENTRATIONS AFTER INSTALLATION OF A FLOATING TREATMENT WETLAND

Chase, Megan, Clemson University, Pendleton, SC
Bell, Natasha, Clemson University, Clemson, SC
Garcia Chance, Lauren, Clemson University, Anderson, SC
White, Sarah A., Clemson University, Clemson, SC

Floating Treatment Wetlands (FTWs) are an emerging treatment option for remediation of contaminated surface waters. FTWs contribute to concurrent reduction in total suspended solids (TSS) and phosphorus. Within FTWs, phosphorus both sorbs to suspended solids within the water column and accumulates within plant tissues. Plant uptake has been shown to be a minor pathway in phosphorus removal, highlighting the importance of sorption processes. FTWs improve water clarity when their dense root system causes water flow to decrease, resulting in sedimentation of suspended solids and corresponding sorbed contaminants. The connection between sedimentation and phosphorus removal is not well characterized within long term assessments of FTW performance, and insight into how they may mitigate risk associated with algal blooms is needed. The goal of this study was to characterize the potential of FTWs to remediate both sediment and phosphorus from agricultural runoff. A field-scale FTW was installed in August 2017 in an irrigation containment pond that receives irrigation runoff from a plant nursery. Water samples were collected 1 to 2 times per month from May 2017 through May 2018. Samples collected during this period encompassed pre-, concurrent-, and post-FTW installation conditions. For each sampling event, 12 paired samples were obtained from the inlet and outlet of the pond during irrigation events, and were compared to water samples collected at a creek located upstream of the plant nursery. Water samples were analyzed for TSS (mg/L) via standard methods, total phosphorus (mg/L) through Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES), and for phosphate (mg/L) through ion chromatography (IC). Additional water quality parameters that were monitored include temperature (˚C), pH, dissolved oxygen (mg/L), and specific conductivity (µS/cm). Sediment and phosphorus results will be presented, with specific focus on correlations between sediment and phosphorus concentrations and loading as influenced by FTW presence. ■

PRESENTATION 1347
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY I*, 05/30/2018, 09:45 - 11:35

ECOLOGICAL RESTORATION OF ABANDONED CRANBERRY FARMS: AN OPPORTUNITY TO RESHAPE A REGION

Hackman, Alex, Massachusetts Department of Fish and Game, Boston, MA

The abandonment of cranberry farmland in southeastern Massachusetts presents an opportunity for wide-scale protection and ecological restoration of coastal wetland systems. Potentially thousands of acres of Massachusetts' historic wetlands are now in transition, and there is a state-level political focus on the plight of the cranberry industry. Meanwhile, a burgeoning ecological restoration practice exists in Massachusetts to leverage this opportunity while

mitigating the risks of inaction - including permanent wetland degradation from legacy agricultural impacts (e.g. fill over native soils, ditching, dams) and other development pressures facing these lands. For the past decade, the Massachusetts Division of Ecological Restoration (DER) and partners have been restoring wetlands in abandoned cranberry fields, affording a vision of what is possible. During that time, we have developed and refined a practical, process-based framework to guide restoration actions, successfully completed several pilot projects (including Tidmarsh Farms, the largest freshwater wetland restoration project to date in Massachusetts), helped transition private farmland to protected open space, and established a learning collaborative to assess outcomes and improve practice over time. This opening talk of our symposium will provide overall context, summarize these developments, and describe the formation a new state program dedicated to this type of wetland restoration work. Finally, it will set the stage for other talks describing our collective restoration practice and associated research now underway. ■

PRESENTATION P63
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

SEED-BASED RESTORATION OF NATIVE PLANT COMMUNITIES FOLLOWING PHRAGMITES CONTROL IN GREAT SALT LAKE WETLANDS

Martin, Emily, Utah State University, Logan, UT
Kettenring, Karin, Utah State University, Logan, UT

While many strategies exist to reestablish wetland plant communities, seed-based restoration offers the advantage of being cheaper and less labor intensive to install. This is especially true when restoring large wetlands, such as those surrounding Utah's Great Salt Lake (GSL). The GSL is threatened by Phragmites australis, an aggressive invasive species. Recent research has highlighted effective control techniques for Phragmites; however, natural recolonization of native vegetation is still limited. Four potential factors that may limit seed-based revegetation are: 1) dense litter that remains after Phragmites control, 2) buoyant seeds floating away from the restoration site, and 3/4) unfavorable moisture and temperature conditions for germination. Tackifier has been proposed as a solution to seed buoyancy, and mulch can potentially retain early spring moisture when added to seeding mixes, thus improving microsite conditions, but their effectiveness for wetland restoration has not been rigorously evaluated. Similarly, few studies have evaluated how different Phragmites litter removal techniques or the timing of seed addition impact seedling recruitment. Therefore, we evaluated the effects of tackifier, mulch addition, litter removal treatments, and seed sowing timing on native species establishment. We conducted a field experiment in GSL wetlands with five replicates (whole plot) each containing two 10m x 30m subplots. In one of the subplots, Phragmites litter was mowed and removed from site. In the second subplot, Phragmites litter was rolled, crushed, and left on site. Within each litter treatment, five seed treatments were applied at various times: one control (no seeds added), and factorial combinations of mulch (+/-), and sowing times (early or late spring). Tackifier was applied in each of the seeding treatments. Percent cover and stem density data were collected throughout the growing season. We found that tackifier was successful at keeping seeds in place, while the mulch addition did not enhance native cover or density. The most important treatment driving plant recovery was the litter treatment-there was higher seedling recruitment in the mow and remove plots. However, this treatment also allowed for more Phragmites seedlings to establish. Our findings provide strategies that land managers can use to enhance seedling recruitment and allow them to weigh the trade-offs between effectiveness and feasibility when restoring wetland ecosystems. ■

PRESENTATION 1359
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION II*, 05/30/2018, 01:10 - 02:50

WETLAND AND ECOLOGICAL RESTORATION ON RENEWABLE ENERGY PROJECTS

Marcus, Mickey, SWCA Environmental Consultants, Amherst, MA

Large commercial solar and wind projects are becoming an increasingly important source of energy production. Siting these projects may require clearing trees, or loss of habitat as a form of ecological trade-off for renewable energy production. This paper describes methods we have used to provide ecological restoration and improved stormwater management on large commercial solar and wind renewable energy projects.

It is desirable to develop new solar projects onto previously developed locations such as building rooftops, paved parking lots, or industrial sites such as airports, gravel pits, quarries and former factory sites and thereby providing additional use for these facilities without degrading habitat or ecological landscape features. Sanitary landfills, and contaminated properties are also examples of siting solar projects in locations which provide renewable energy benefits, without habitat degradation. Within these previously developed sites both internal and external restoration of grasslands and wooded habitat may be incorporated into

the solar landscape plan to improve ecological conditions. For instance, on a solar project built on a former airport, the paved runways were removed, and planted with native grasses, thereby reducing storm water runoff, and improving water quality.

Solar projects constructed on farmlands may be planted with native grasses and forbs to promote pollinators and habitat use by small mammals and birds. Agricultural practices may be compatible with both solar and wind development. Access to solar fields by terrestrial animals (e.g. turtles) may be achieved by raising the elevation of the fencing, and then developing a mowing program which avoids work during the times of the year when animals are active. Wind projects are compatible with livestock grazing and farming activities.

Examples are provided of planting native shrubs and small trees, using native seed mixes as cover crops, planting stream buffers, removing culverts, and restoring degraded habitats in conjunction with large scale renewable energy projects, and providing case studies of the methods used to make green energy greener. ■

PRESENTATION 1364

PRESENTED DURING *RIPARIAN ECOSYSTEMS III: RIVER REGULATION AND RESTORATION*, 05/31/2018, 03:10 - 05:00

A DECISION TREE TO INFORM RESTORATION OF SALICACEAE RIPARIAN FORESTS IN THE NORTHERN HEMISPHERE

Gonzalez, Eduardo, Colorado State University, Fort Collins, CO
Martínez-Fernández, Vanesa, Universidad Politécnica de Madrid, Madrid, Spain
Shafroth, Patrick, U.S. Geological Survey, Fort Collins, CO
Sher, Anna, University of Denver, Denver, CO
Henry, Annie, University of Denver, Denver, CO
Garofano-Gomez, Virginia, Universitat Politecnica de Valencia, Grau de Gandia, Spain
Corenblit, Dov, Universite Clermont Auvergne, Clermont-Ferrand, France

The regeneration of foundation riparian shrub and tree species in the Salicaceae family (Populus and Salix spp.) is frequently impaired by human activities. Salicaceae forest restoration has been traditionally approached from a terrestrial perspective that emphasized planting. More recently, floodplain restoration activities have embraced an aquatic perspective, inspired by the emerging philosophy of environmental flows for river management. However, riparian Salicaceae species occur at the interface of both terrestrial and aquatic ecosystems along watercourses, and their regeneration depends on a complex interaction of hydrologic and geomorphic processes that have shaped key life-cycle requirements for seedling establishment. Ultimately, restoration needs to integrate these concepts to succeed. However, the literature reporting restoration actions on Salicaceae regeneration is scattered, and a specific theoretical framework is still missing. We reviewed 105 published experiences in restoration of Salicaceae forests, including 91 projects in 10 world regions throughout their range across the Northern Hemisphere, to construct a decision tree to inform restoration planning through explicit links between the well-studied biophysical requirements of Salicaceae regeneration and 17 specific restoration actions. Planting (in 55% of the projects), land contouring (30%), competing vegetation removal (30%), site selection (26%), and irrigation (24%) were the most common restoration actions. Environmental flows, including induced large pulse flows (8%), managed recessions (13%), base flows (7%) and flow sequencing (11%) were effective restoration actions in less populated areas. With alternative, innovative and feasible approaches that also incorporate human needs, it could be possible to restore Salicaceae riparian forests to better fit their new hydrologic and fluvial geomorphic situation. ■

PRESENTATION 1367

PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES II*, 05/30/2018, 01:00 - 02:50

WETLAND RESTORATION IN SOUTH FLORIDA URBAN SETTING: A 30 YEAR REVIEW

Carpenter, Cheryl, C&N Environmental Consultants, Inc., Jupiter, FL

Ms. Carpenter has been conducting wetland restoration since 1988 to present. Fifty-five (55) wetland restorations were completed through 2018. She and her team of biologists, botanists, landscape architects/designers, and engineers typically took a parcel of land from pre-purchase, permitting with on-site wetland restoration/mitigation design, project oversight, and plant installations. These wetlands were monitored and maintained for a period of five years. Most of these wetlands were significantly drained or isolated and dominated by exotic vegetation. These wetland restorations were conducted in both freshwater and coastal systems, and numerous creative solutions were implemented when problems were encountered. Most of the wetland restorations were conducted from 1990 through 2008 when mitigation banking became the primary mitigation option, and have not been revisited, much less evaluated for wetland functions and values. The most significant and accessible, restored wetlands will be photographed for comparison to pre-restoration photographs and assessed per the original success parameters as a measure of long term success in highly urbanized settings. ■

PRESENTATION 1382
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION III*, 05/30/2018, 03:20 - 05:00

A GEONARRATIVE AND WEB MAPPING APPLICATIONS TO PRIORITIZE POTENTIAL COASTAL WETLAND RESTORATION SITES IN THE GREAT LAKES

Kowalski, Kurt, U.S. Geological Survey, Ann Arbor, MI
Saarinen, Justin, New College of Florida, Sarasota, FL

The protection, restoration, and enhancement of coastal wetlands were identified as some of the highest priorities of the congressionally supported Great Lakes Restoration Initiative (GLRI). Some degraded areas are more conducive to restoration and enhancement than others given their position in the landscape and land-use history, but the data and decision tools necessary to identify and prioritize those areas at a regional scale are lacking. Therefore, we created a spatially explicit composite index model for restoration to support the identification and prioritization of potentially restorable coastal wetlands (i.e., areas that could be restored to coastal wetland status if hydrologically reconnected to the Great Lakes) from the parcel scale to the landscape scale. This model was created using a geodesign framework that included expert formulation of 6 primary geospatial data layers (water surface/land elevation, hydric soils, flow lines, conservation and recreation lands, impervious surfaces, undeveloped lands). Easy access to the modeled data was required by decision makers, so we developed web-based mapping applications designed specifically to support restoration decisions. Users can query the data set to summarize model results and produce outputs that support prioritization and selection of restoration sites. A geonarrative (https://glcwra.wim.usgs.gov/) was developed to link the individual restoration assessments through a larger story and streamline access to the mapping applications. This work 1) leverages GLRI restoration investments, 2) promotes multi-scale (site to landscape) assessment of the restoration potential, function, and ecosystem services of coastal wetlands, and 3) encourages regional participation in this process. ■

PRESENTATION 1391
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES I*, 05/30/2018, 09:45 - 11:35

TAMPA BAY WATER'S RECOVERY ASSESSMENT PLAN

Hogg, Warren, Tampa Bay Water, Clearwater, FL

Tampa Bay Water, a regional water supply utility, has reduced its historic reliance on groundwater sources, in order to reduce impacts to wetlands and lakes and meet permit-mandated production levels. From a high level of 164 million gallons per day (mgd), or 621 million liters per day, in 2000, annual average production has been cut to consistently less than 90 mgd (341 million liters per day) for the past decade. The Water Use Permit (WUP) for Tampa Bay Water's central system of eleven wellfields requires a Permit Recovery Assessment Plan that evaluates "the recovery of water resource and environmental systems attributable to reduction of..withdrawals..to 90 mgd..". As part of the recovery assessment plan, monitored wetlands (approximately 400 with various periods of record) and lakes (n=138) in the northern Tampa Bay area, and all wetlands within a model-defined surficial aquifer system (SAS) two-foot drawdown zone (n=685), must be assessed for hydrologic and ecologic recovery. The goal is to place wetlands into categories based on recovery, improvement and continued impact, for regulatory purposes. A number of regulatory and technical challenges are being addressed in the recovery assessment plan, including the establishment of "baseline" conditions, the development of recovery metrics for various types of wetlands, and the creation of a wetland functional assessment method for wetlands determined to exhibit continuing adverse impact. The recovery assessment plan will be delivered to the state regulatory agency, the Southwest Florida Water Management District, by the end of 2018, with WUP renewal for the central system scheduled for 2020. ■

PRESENTATION 1414
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES IV*, 06/01/2018, 03:20 - 05:00

HOW DOES INVASIVE PLANT MANAGEMENT AFFECT CARBON CYCLING IN A GREAT LAKES COASTAL WETLAND?

Johnson, Olivia, University of Connecticut, Storrs, CT
Lishawa, Shane, Loyola University Chicago, Chicago, IL
Lawrence, Beth, University of Connecticut, Storrs, CT

Plant-soil feedbacks underlying wetland carbon (C) dynamics are well studied, but little is known about how invasive plant management techniques affect these interactions. We leveraged a large-scale management experiment to quantify how mechanical disturbance to a ubiquitous, Great Lakes region invasive (Typha × glauca) shifts plant-mediated C uptake, cycling, and release. During each growing season from 2015-2017, we harvested (i.e., cut above water surface and removed biomass), and crushed (i.e., ran over biomass), 60 x 60-meter plots of Typha-dominated wetland and compared a suite of C-related parameters with unmanipulated Typha controls (n = 5 per treatment). Preliminary analyses of long-term data indicate both harvest and crush had greater net carbon dioxide uptake than controls, suggesting

these treatments shift the wetland toward greater primary production relative to respiration. Compared to controls, both harvest and crush had decreased Typha stem densities, but no differences in total aboveground biomass. Neither belowground biomass (roots, rhizomes) nor soil pore water dissolved organic carbon (DOC) shifted in response to treatments. Harvest increased surface water DOC one-year post treatment (control = 11.46 ± 3.90 mg/L, harvest = 33.75 ± 9.21 mg/L), but this increase did not persist in year two. Harvest decreased pore water concentrations of acetate, a common substrate for methane-production, (control = 3.11 ± 0.81 mg/L, harvest = 1.02 ± 0.41 mg/L), while initial data analyses suggests a different pattern in methane emission (control = harvest > crush). These results suggest wetland C uptake and release patterns are due to differences in aboveground structural variation among treatments, which may also contribute to the mixed responses of internal C dynamics. Our final analyses will test how abiotic factors (e.g., light penetration and water level variation) interact with mechanical disturbances to affect C-response. Given the critical wetland function of C storage, our results provide data of relevant scale and timeframe to assess consequence of wetland management, and inform land-use decisions. ■

PRESENTATION 1415
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED III*, 06/01/2018, 03:10 - 05:00

A CASE STUDY OF THE KNICKERBOCKER FLOODPLAIN RECONNECTION PROJECT: WETLAND, STREAM AND FLOODPLAIN RESTORATION OF THORNTON CREEK IN AN URBAN WATERSHED

Swaim, Emily, Soundview Consultants LLC, Seattle, WA

The case study of the Knickerbocker floodplain reconnection project examines fifteen individuals associated with ten regulatory agencies and parties by analyzing the complexities associated with a collaborative wetland, stream, and floodplain restoration project within the urbanized South Branch of Thornton Creek in Seattle, Washington. I documented pre-project implementation, design principles, construction activities, wetland and stream restoration and monitoring practices at the South Branch of Thornton Creek by conducting interviews of all parties involved. The purpose of this case study is to provide insight and knowledge of the elements required to design, implement, construct, and complete a hyporheic floodplain expansion of a degraded, urbanized stream and wetland complex as well as evaluate the effectiveness of the restoration project based upon social science data and the collaborative team-playing essential features needed to make it successful.

Methodologies used to collect the interview transcript data included following the Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers (Baxter and Jack, 2008) as well as A Guide for Designing and Conducting a Case Study for Evaluation Input (Palena et.al, 2006) with use of an Olympus Digital Voice tape recorder VN-7200 for personal interviews.

While many challenges are associated with collaborative design principles, the Knickerbocker project was completed on schedule and within budget, while working with over ten different agencies and parties. Lessons learned are to collaborate early and effectively, establish public outreach, encourage public involvement from the beginning, identify all stakeholders, and hire private contractors for specific assignments to control speed and completion of tasks. Challenges included: multiple voices and oppositions, a New Zealand mud snail infestation, and designing a risky, controversial and exploratory "living laboratory". Some individuals associated with Knickerbocker project declined to comment or participate in this qualitative intrinsic case study. Therefore, there are potential data gaps or lost content not collected nor archived.

This study provides collaborative and synergistic context for proposed urban restoration and floodplain reconnection projects in both the public and private sectors and provides insight into the nature of multi-party coordination in a grant-funded urban stream and wetland restoration project. ■

PRESENTATION 1416
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS IV*, 05/31/2018, 09:55 - 11:35

DESIGN CONSIDERATIONS FOR CONSTRUCTED TREATMENT WETLANDS TO MITIGATE NUTRIENT AND SEDIMENT RUNOFF FROM INTENSIVE AGRICULTURE TO SHALLOW PEAT LAKES

Eivers, Rebecca, University of Waikato, Hamilton, Waikato, New Zealand

The expansion and intensification of agriculture has led to widespread degradation of water quality due to increased sediment and nutrient loads. Shallow peat lakes are particularly susceptible to these effects where catchment soils can have high rates of nutrient loss. Constructed treatment wetlands (CTWs) have been implemented as mitigation tools to improve the water quality of inflows to five eutrophic peat lakes in the Waikato region of New Zealand. The objectives of this study were to compare different predictors of CTW performance and determine morphological and environmental variables that may enhance or impede reduction efficiency. Twenty-six CTWs were sampled over five seasons during 2010-11. All CTWs were comprised of a sedimenta-

tion pond 'module', with around half including shallow wetland-modules planted with native species, and three with additional sedimentation pond-modules. The inflows were surface-flow watercourses diverted from modified or artificial drainage networks, and the outflows were either surface-flow (through drainage channels or culverts), or filtration (through vegetated riparian margins). Morphological predictors of CTW performance included area (range 7 – 1950 m²), depth (0.2 – 2.1 m), volume (12 – 2030 m³), Wetland to Catchment Area Ratio (0.01 – 1.18), hydraulic retention time (0.2 – 37.2 h), and hydraulic loading rate (0.4 – 130 m/d). The presence/absence of macrophytes as well as outlet type and the number of CTW modules were included as categorical variables. Reductions in nitrogen (N), phosphorus (P) and suspended sediments (SS) differed considerably across CTWs, driven by varying influent concentrations and dominant forms of N, P, and SS, as well as CTW morphologies. The presence of macrophytes had significant positive effects on the removal performance of nitrate-N and P, whereas filtration outlet types reduced ammonium-N reduction efficiency. CTWs with more than one module generally improved overall removal performance, whilst greater accumulated sediment depths significantly reduced P reduction efficiency. ■

PRESENTATION 1419
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION VI*, 05/31/2018, 03:20 - 05:00

THE ATCHAFALAYA RIVER BASIN INITIATIVE: INTEGRATING SCIENCE, CONSERVATION, AND PARTNERSHIPS TO RESTORE A GREAT AMERICAN FLOODPLAIN

Piazza, Bryan, The Nature Conservancy, Baton Rouge, LA
Baustian, Joseph, The Nature Conservancy, Baton Rouge, LA
Bergan, James, The Nature Conservancy, Baton Rouge, LA
Gautreaux, Karen, The Nature Conservancy, Baton Rouge, LA

Floodplains in the Mississippi River Basin (MRB) have been converted to agricultural, urban, and industrial uses at an unprecedented rate, and the wetlands that remain are often hydrologically altered and fail to provide the same level of ecosystem services they once did. These facts have led to an increased effort to protect and restore floodplains that require partnerships between scientists, practitioners, and policy makers, often from across a geographical region.

The Atchafalaya River Basin (ARB) in Louisiana provides a compelling example. At about 405,000 ha, it contains the largest tract of bottomland forest left in the MRB. Its habitats support high biodiversity and critical natural processes, like nutrient sequestration and carbon storage. It also provides ecosystem services – flood control, nutrient sequestration, carbon storage, navigation, oil and gas resources, forest, fish and wildlife resources – that have been used extensively by humans. As a result, anthropogenic modifications have created largescale changes in the ARB, altering hydrology and reducing the ability of the ARB to provide its full suite of services. These facts have spurred a movement for conservation and restoration of the ARB, focused on science-based solutions and progressive watershed management strategies.

This talk describes the Atchafalaya River Basin Initiative (ARBI), The Nature Conservancy's multi-disciplinary effort to protect and restore the ARB through successful scientific, conservation, and policy partnerships. First, we report on our initial restoration project that will improve water quality and habitat across 2,225 ha by summarizing extensive scientific monitoring and research results. Next, we report on the partnership and stakeholder efforts that are necessary to succeed in this floodplain restoration. Finally, we link the ARBI to larger efforts to reduce nutrient loading in the MRB that contributes to annual hypoxia in the Gulf of Mexico. ■

PRESENTATION 1427
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS I*, 05/31/2018, 03:20 - 05:00

RESTORING MURRAY RIVER FLOODPLAIN WETLANDS. CAN THE SEDIMENT RECORD INFORM ON WATERING REGIME?

Gell, Peter, Federation University Australia, Mt Helen, Victoria, Australia

The floodplain wetlands of the southern Murray Darling Basin have been subject to the impacts of catchment and water resource development for more than a century. The waterways have been in a degraded state for many decades. This largely has been attributed to the regulation of the rivers and abstraction of water volume for irrigation agriculture. The MDB Plan was enacted in 2012 to return at least 2750 GL of flow to the system to restore the natural character of waterways. Considerable recent investment in infrastructure enables water to be released into floodplain wetlands. The proposed annual watering regime is underpinned by hydrological modelling which suggests that, before regulation, overbank flows would have occurred in most years as discharge peaked in winter and spring. Sediment records have been extracted from over fifty floodplain wetlands down the length of the Murray River. The records from several, large meander wavelength billabongs extend for 1000 -5000 years suggesting that these sites were permanently inundated

over that time. Others extend only to 300 years and so are presumed not to have accumulated sediment until then. The records of most wetlands however, only extend to the onset of river regulation in the 1920s, suggesting that, contrary to the modelling, they were not inundated for sufficient duration for net accumulation to occur. Preserved diatoms attest to shallow, plant dominated systems in the past and many have transitioned to deep, turbid water systems today. As the river is identified as a source of sediment influx into wetlands, less regular watering, rather than more, is a viable option in restoring the ecological function of these floodplain wetlands and avoiding rapid sediment infill. ■

PRESENTATION 1429

PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION VI*, 05/31/2018, 03:20 - 05:00

INTERACTIVE EFFECTS OF SEDIMENT AND NITRATE SUBSIDIES ON SURFACE ELEVATION DYNAMICS IN BRACKISH MARSHES

Nugent, Mollie, University of Alabama, Tuscaloosa, AL
Cherry, Julia, University of Alabama, Tuscaloosa, AL

Sediment subsidies to coastal marshes, whether delivered during storm and flood events or via restoration activities (e.g., sediment pumping, dredging or diversions), are critical for marsh elevation maintenance and persistence in the face of sea-level rise. Nitrate concentrations associated with sediment pulses are increasing as a result of anthropogenic sources, thereby altering biological processes that regulate plant health and feedbacks to surface elevation. To examine potential interactive effects of sediment and nitrate additions on marsh elevation dynamics, we conducted a controlled, full-factorial greenhouse experiment using marsh sods exposed to one of three nitrate subsidies (+ 0.01, 0.021, 0.079 gL...-1 KNO...3) and one of five sediment additions [0, 30, 60, 90, 120 mm]. To examine treatment effects on biological feedbacks to elevation, we measured elevation change and plant health throughout the growing season using a modified mini-surface elevation table (SET) and with normalized difference vegetation index (NDVI) using a hyper spectrometer, respectively. Sediment additions initially provided direct elevation capital, but subsequently, the additional weight of added sediment and the lack of immediate biological feedbacks contributed to elevation declines via rapid compaction. However, nitrate and sediment subsidies positively influenced key components of surface elevation dynamics over the growing season. Sods that received the highest sediment application had higher sustained annual elevation gains, and although nitrate addition had minimal effects on elevation, these subsidies did significantly slow rates of surface elevation decline directly following sediment addition. In addition, average NDVI tended to be higher eight months after sediment addition, with negligible effects of nitrate addition on plant health. Evaluating how nitrate and sediment additions interact to influence marsh elevation responses is timely as reintroduction of nutrient-enriched sediment is increasingly utilized as a management tool to promote land-building and as its delivery during flood and storm surge events become more frequent with climate change. ■

PRESENTATION 1434

PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY II*, 05/30/2018, 01:00 - 02:50

APPLIED SCIENCE AND DESIGN STRATEGIES IN CRANBERRY BOG RESTORATION

Nelson, Nicholas, Inter-Fluve, Inc., Cambridge, MA

Appropriately designing the restoration of retired cranberry bogs requires a deep understanding of science, engineering, and construction realities. In cranberry bog stream restoration, the design risks typical of many river restoration projects including velocity, scour, and buoyancy, are minor and non-existent, and instead include ground water vs surface water elevations, wetland inundation, and appropriate planting strategies. The design team must understand the relationship between the groundwater, surface water, and the ground elevation; sand and peat depths; and soil chemistry. Combining the scientific data into functional hydraulic models to propose a designed channel geometry, frequency of wetland inundation, and channel slope is critical to project success. Synthesizing this information into a constructible design package requires creativity and an understanding of the capabilities and limitations of construction equipment in the bog environment. This talk will focus on critical design data needs and lessons learned from engineering and constructing multiple projects. ■

PRESENTATION 1441
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION I*, 05/30/2018, 09:55 - 11:35

EFFECTS OF BURIAL DEPTH AND WATER DEPTH ON SEEDLING EMERGENCE AND EARLY GROWTH OF SCIRPUS PLANICULMIS

Liu, Bo, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin, China

The seed burial and water regime are both crucial factors influencing seedling emergence and plant growth in wetlands and thus exert important effects on ravage in degraded wetlands. We conducted a pot experiment to determine the effects of burial depth and water depth on the seedling emergence and growth of SCI planiculmis Fr. Schmidt. Seeds of S. planiculmis were buried at 0, 0.5, 1 and 2 cm depths in plastic pots with non-sterilized sediment under exposed (-5 cm), waterlogged (0 cm) and submerged (5 and 10 cm water depths relative to sediment surface) water regimes. The results showed that the percentage of seedling emergence at a burial depth of 0 cm was enhanced under 10 cm and 5 cm water depths (78.89% and 81.37%, respectively) in comparison to the results under -5 cm and 0 cm water depths (0 and 2.22%, respectively). Seedlings did not grow through the water to the surface and no tuber formed when covered by 10 cm of water. The total biomass per seedling was generally higher at 0.5 cm or 1 cm burial depths than that at other burial depths. The tuber number per seedling was highest at a 0.5 cm burial depth, while the value was lowest at a 0 cm burial depth. Our results provide valuable guidance for the establishment of S. planiculmis from seeds in wetland revegetation programs. ■

PRESENTATION 1443
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION V*, 05/31/2018, 01:10 - 02:50

RESTORATION AND RECONSTRUCTION OF TYPICAL DEGRADED WETLANDS IN NORTHEAST CHINA: NATIONAL R & D PROGRAM INTEGRATED THEORY TECHNOLOGY AND DEMONSTRATION

Lyu, Xianguo, NEIGAE, changchun, Jilin, China
Zou, Yuanchun, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, changchun, Jilin, China
Wu, Haitao, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, changchun, Jilin, China

China has proposed a national wetland area red line of 53.33 million ha. Northeast China (NC) distributes one-fifth of the national wetlands and one-third of the palustrine wetlands that playing important roles in conserving water sources, providing biological habitats and maintaining biodiversity. Large area of wetland loss and degradation have occurred in NC mainly due to wetland reclamation and draining. In the past 25 years, 72% wetlands in NC have been threatened by various factors and their ecological functions are declining. Therefore, wetland restoration efforts are urgently needed to expand the wetland area. Meanwhile, the implementation of major ecological projects such as "Rivers and Lakes Connection" require supports of restoration techniques.

In July 2016, a national key R& D program of wetland restoration and reconstruction was launched by the Ministry of Science & Technology of China. Led by the Northeast Institute of Geography and Agroecology (IGA), this program proposed1) to systematically study the wetland ecosystem distribution pattern, function evolution and driving mechanisms in NC,2) to develop ecological water replenished and eco-hydrologically regulated techniques, 3) todevelop ecological restoration and reconstruction techniques of dominant plants,4) todevelop function enhanced techniques of important habitats, 5) to develop structural restored and carbon sequestration upgrading techniques in peat wetlands, and 6) to implement comprehensive demonstration of "hydrology-vegetation-habitat" integrated restored and reconstructed techniques in typical degraded wetlands.A technical scheme for wetland restoration and reconstruction framework, a plan for coordination of water conflict betweenwetlands and farmlands and new approaches for the development of wetland ecological industry have being tackled, too.

The outcomesof this program are providing important technical support for wetland ecological management, ecological industry and ecological poverty alleviation in NC so as to realize the comprehensive benefits forregional ecology, economy and society as a whole. ■

PRESENTATION 1444
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION V*, 05/31/2018, 01:10 - 02:50

SPECIES DIVERSITY PERFORMANCE AFTER NATURAL RESTORATION IN RECLAIMED CALAMAGROSTIS ANGUSTIFOLIA WETLAND

Wang, Xuehong, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin, China
Tong, Shouzheng, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin, China

Plant species diversities and composition characteristics of different reclaimed Calamagrostis angustifolia wetlands restored in the natural condition in Sanjiang Plain were studied. The results showed that there was visible community succession. Plant species increased gradually, and

dominant species has changed from Artemisia stolonifera to C. angustifolia with restoration time increasing. Their species composition was also different with each other. Species diversity analysis suggested that Shannon-wiener index (H) decreased while Simpson index (D) decreased firstly and then increased with the increase of restoration time. Compared with natural C. angustifolia wetland, the species composition structure and diversities in restored wetlands were more complex and higher than the former, respectively. Differences of α-diversity among the three communities with different restoration time and natural C.angustifolia wetland were complex. The α-diversity of community with 5-year restoration was significant different with natural community, and the differences reduced with time increasing. There was no significant difference between community with 12-year restoration and the natural. It suggested that vegetation in reclaimed C. angustifolia wetland could be restored naturally, and the time is more than 10 years. That is to say wetland protection is more important. ■

PRESENTATION 1447

PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION V*, 05/31/2018, 01:10 - 02:50

LO'I AS SEDIMENT AND NUTRIENT RETENTION BASINS: A NEW APPROACH TO DESIGNING CONSTRUCTED WETLANDS IN HAWAI'I

Falinski, Kim, The Nature Conservancy, Honolulu, HI

Coastal wetlands provide important ecosystem services and are key buffers to climate change for island ecosystems and communities. Wetlands filter land-based pollutants, mitigate flooding risks, and reduce coral reef vulnerability to climate change. In Hawai'i, management of wetlands historically included intensive integrated crop and freshwater aquaculture production, while also providing for habitat for native fish and bird species.

In the Hawaiian islands today most lowlands have been converted to other forms of agriculture or urban development. Mangrove (Rhizophora mangle), hau (Hibiscus tiliaceus), and guinea grass (Urochloa maxima) thrive in what wetlands remain. In 2007, O'ahu-based non-profit Kāko'o 'Ōiwi partnered with The Nature Conservancy and the Ko'olaupoko Hawaiian Civic Club to restore land in He'eia watershed to taro cultivation for the benefit of both ecosystem and community. In the process, the restoration connects historic irrigation channels and streams from mountain to sea, and removes invasive vegetation that inhibits native birds, fish and vegetation.

Here, we review the tradeoff between employing the taro paddies (lo'i) to function as sediment and nutrient retention ponds, and the agronomic potential of growing taro, banana and other intercrops. Using hydraulic modeling methods and twelve months of in situ sediment and nutrient monitoring, we estimate relative sediment and nutrient retention under different production scenarios that change water depth, fertilization frequency and irrigation channel routing.

We find that restoration provides a suite of environmental and food production benefits. The wetlands currently reduce total nitrogen by approximately 35%, and the additional lo'i have the potential to provide 12 tons per hectare of taro while also reducing overall sediment loads to Kane'ohe Bay. Additionally, the removal of invasive grasses provides habitat for birds, and community benefits. The re-establishment of the 200 acres of traditional agriculture provide a path forward for community-based resilient food production in Hawai'i that comes with environmental benefits. ■

PRESENTATION 1460

PRESENTED DURING *RIPARIAN ECOSYSTEMS III: RIVER REGULATION AND RESTORATION*, 05/31/2018, 03:10 - 05:00

COLLATERAL BENEFITS: RIVER FLOW NORMALIZATION FOR AN ENDANGERED FISH PROMOTES RIPARIAN WOODLANDS

Rood, Stewart, University of Lethbridge, AB, Lethbridge, Alberta, Canada
Gill, Karen, University of Lethbridge, Lethbridge, Alberta, Canada
Anders, Paul, Cramer Fish Sciences, Moscow, ID
Hoffman, Greg, US Army Corps of Engineers, Libby, MT
Merz, Norm, Kootenai Tribe of Idaho, Bonners Ferry, ID
Polzin, Mary Louise, VAST Resource Solutions, Cranbrook, British Columbia, Canada
Benjankar, Rohan, Southern Illinois University, Edwardsville, IL

The Kootenay River originates in the Rocky Mountains of British Columbia and is joined by numerous tributaries as it flows into Montana and Idaho and then back to BC before providing the 2nd largest tributary to the Columbia River. Following the international Columbia River Treaty, the 130 m tall Libby Dam was constructed in Montana and creates the 140 km long Koocanusa Reservoir across the international border. This massive reservoir has attenuated flood flows since 1975 and traps sands and other sediments, leading to coarsening of the channel and banks downstream. Impoundment was followed by expansion of riparian woodlands dominated by black cottonwoods (Populus trichocarpa) into the previously barren zones downstream. Following this initial pulse, woodland colonization and replenishment became limited due to the moderated flows and dampened channel and floodplain dynamics.

Due to river regulation and other impacts including draining and diking of the extensive wetlands upstream from Kootenay Lake, the Kootenai River (US spelling) white sturgeon (Acipenser transmontanus) population declined and was listed under the Endangered Species Act in 1994. Listing prompted recovery measures that included changes in Libby Dam operations in the late 1990s, with higher spring flows in high water years intended to promote white sturgeon spawning. After 2006, flow normalization was more complete, including substantial peak flows and gradual post-peak recession. While the flow changes have not yet increased natural reproduction of the ancient and long-lived fish, these did increase seedling colonization of black cottonwoods and the streamside sandbar willow (Salix exigua). Additionally, in the channelized meander reach through the prior wetland zone, bands of prairie cottonwoods (P. deltoides) have been established and their reproduction has benefited from the normalized flow regime.

The recovering riparian woodlands provide extensive wildlife habitat while benefiting the riverine ecosystem, such as with the foliar inputs that contribute to the aquatic food web, and by reducing erosion in the varial zone. This promising case study demonstrates the common reliance of a long-lived fish and of riparian trees and shrubs on characteristics of the natural flow regime. Consequently, the restoration of more normalized river flow patterns should provide ecological benefits across a broad range of aquatic and riparian organisms along this and other regulated rivers. ■

PRESENTATION P62
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

SPATIAL HETEROGENEITY AND WETLAND-DEPENDENT BIRD USE IN WISCONSIN'S GLACIAL HABITAT RESTORATION AREA

Loken, Zack, University of Wisconsin - Stevens Point, Stevens Point, WI
Schultz, Rachel, University of Wisconsin - Stevens Point, Stevens Point, WI
Straub, Jacob, University of Wisconsin - Stevens Point, Stevens Point, WI

The Glacial Habitat Restoration Area (GHRA) is a 558,879-acre restoration zone in east-central Wisconsin. According to an aerial map inventory, open water, emergent marsh, and shrub wetlands increased by 17,774 acres in the GHRA from 1990 to 2013. We observed and counted all waterbirds on wetland basins from April – May of 2017 using fixed location focal scans. In summer of 2017, we used the Wisconsin Department of Natural Resource's timed-meander sampling protocol for wetland floristic quality assessment to sample wetland plant community condition on 38 randomly selected wetlands within the GHRA. We categorized wetlands into 3 groups based on hydrologic modification: scrape (category A); category A plus wetlands with ditch plug, ditch-fill, and/or tile break (category B); and category B plus berm and/or berm with a water structure (category C); and included two reference groups: Waterfowl Production Areas and unmodified sites without basins. Wetland plant communities were categorized following the Natural Heritage Inventory (NHI) database; mapped using aerial imagery; and field checked for accuracy. Field sampling data was stored in a file geodatabase using ESRI's ArcMap 10.5 software, including relative cover of introduced species and other floristic quality metrics for each property. Habitat heterogeneity was assessed within each wetland property using an interspersion-juxtaposition index (IJI). Greater values of IJI indicated that community types were more evenly dispersed throughout the wetland than areas with large blocks of similar vegetation. Wetlands with diverse habitat types distributed throughout their basins may be more attractive to waterfowl than those with a homogenous composition. Although there was a difference in IJI between sites with and without basins, there was not a statistically significant difference in IJI values among wetlands in different hydrological modification categories. Preliminarily, we did not find a relationship between waterfowl per hectare open water count and IJI; however, this is only the first year of a two-year study. Our results will be used to assess landscape scale factors on dynamics of wetland-dependent bird species as well as provide a spatial representation of plant community characteristics. ■

PRESENTATION 1473
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION VI*, 05/31/2018, 03:20 - 05:00

RESTORATION OF BOREAL FOREST WETLANDS IN SUPERIOR, WISCONSIN: 10-YEARS POST CONSTRUCTION MONITORING.

Staskowski, Nicole, Cardno, Fitchburg, WI
Parrett, Nayo, American Transmission Company, Waukesha, WI

American Transmission Company completed a 120-acre restoration project in compensation for forested wetland conversion impacts along a new transmission line in northwestern Wisconsin. The restoration project activities are three-fold: removal of aggressive woody species, planting of boreal forest tree species and monitoring to assess the success of conversion. The first two activities, the removal of aggressive woody species and planting of appropriate boreal forest species, took place over the first four years of the restoration. Woody vegetation targeted for control as part of

this phase includes Populus tremuloides (trembling aspen), Alnus incana (speckled alder) and various Salix species. Woody removal activities included cut stump treatment, forestry mowing and targeted, herbicide treatment. Native boreal forest species were targeted for planting across the site. In the wetland areas these include Picea mariana (black spruce), Larix laricina(tamarack) and Thuja occidentalis (northern white cedar); in the upland islands these include Picea glauca (white spruce), Pinus strobus (white pine), Abies balsamea (balsam fir) and Thuja occidentalis. Restoration work and monitoring began in 2008 and continued through 2017. The goal of the project is set the successional trajectory of the site to support an assemblage of boreal forest tree species within 10 years. This is largely measured by survival of trees and reduction of invasive species across the site. In addition to the boreal forest conversion monitoring, the project also improved habitat for populations of the State Threatened Petasites sagittatus(arrowhead sweet colt's foot) and Salix planifolia (tea-leaved willow) on the site. The intent of the performance standards were considered met after 10 years of monitoring and the site was release by the U.S. Army Corps of Engineers at the end of 2017. ■

PRESENTATION P59

PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

DEVELOPING TOOLS BASED ON REFERENCE TIDAL WETLAND CONDITIONS TO IMPROVE RESTORATION OUTCOMES

Yepsen, Metthea, New Jersey Deparetment of Environmental Protection, Trenton, NJ
Brooks, Robert, Pennsylvania State University, University Park, PA
Strakosch Walz, Kathleen, New Jersey Deparetment of Environmental Protection, Trenton, NJ

Too often only one or two metrics are used to set wetland restoration goals and determine measures of project success. Restoration may also be conducted without a complete understanding of the reference conditions the project is attempting to duplicate. With the current trend towards tidal wetland restoration focusing on resilience to sea level rise and storm impacts it is even more important for the project to achieve a state most like natural or reference condition for greater resilience. The characterization of reference conditions can be used to refine restoration project goals, improve monitoring, and result in a higher likelihood of attaining goals and objectives. This project, funded by a Wetland Program Development grant from the EPA Region 2, augments an existing publicly accessible, web-based, multi-metric restoration tool (http://wa.cei.psu.edu/wetlands/ the Reference Wetland Database developed by the Riparia at Penn State) specifically for New Jersey's tidal wetlands (USA). Data from extensive wetland monitoring and assessment conducted within New Jersey, including the National Wetland Condition Assessment (NWCA); Mid-Atlantic Coastal Wetland Assessment (MACWA); Ecological Integrity Assessment (EIA); and other research are summarized in the tool, displaying the range in condition for tidally influenced wetlands (freshwater, brackish, saline) across the state. The tool will also display Reference Standard Wetland conditions useful in setting appropriate goals for wetland restoration projects. ■

PRESENTATION 1489

PRESENTED DURING *RIPARIAN ECOSYSTEMS III: RIVER REGULATION AND RESTORATION*, 05/31/2018, 03:10 - 05:00

VEGETATION DYNAMICS FIVE YEARS AFTER LARGE DAM REMOVAL ON THE ELWHA RIVER, WASHINGTON.

Brown, Rebecca, Eastern Washington University, Cheney, WA
Morgan, Olivia, Eastern Washington University, Cheney, WA
Thomas, Cody, Eastern Washington University, Cheney, WA
Cubley, Erin, Colorado State University, Fort Collins, CO
Schuster, Jarrett, Eastern Washington University, Cheney, WA
Clausen, Aaron, Eastern Washington University, Cheney, WA
Shafroth, Patrick, U.S. Geological Survey, Fort Collins, CO

Worldwide, large dams have altered riparian vegetation dynamics due to changes in sediment transport and hydrology. Dams inundate riparian surfaces in the reservoir, alter downstream landforms, and often reduce downstream plant diversity. Now that large dam removal for economic and ecological considerations has become a reality, scientists have the opportunity to assess if dam removal can reverse the ecological impacts of dams. The removal of two dams on the Elwha River, Washington, USA, represents the largest dam removal project to date. Our objectives were to determine: 1) whether Elwha River dam removal increases downstream vegetation diversity to reference levels, and 2) which factors drive vegetation recolonization in drained reservoirs. We sampled vegetation and environmental variables in 100 m^2 plots along 25 transects above, between, within, and below the two reservoirs for two years before (2005 and 2010) and four years after (2013, 2014, 2016, and 2017) dam removal. Variation in species richness among reaches, years, and landforms was analyzed using mixed linear models. Structural equation models were used to relate variables to reservoir vegetation recolonization. Prior to dam removal, native plant species richness was ~45% lower downstream from dams compared to upstream, while exotic species richness was not different. In the first two years since dam removal, the distribution of young landforms increased dramatically downstream from dams due

to increased sediment transport. However, species richness did not immediately increase. By the fifth year after dam removal (2017), there was a pronounced increase in species richness on flooded landforms downstream from dams. After five years of exposure, reservoir species richness and cover were highest in areas with high soil N, K, and organic matter; and exotic species richness and cover were highest close to reservoir edges. Our results suggest that riparian system restoration is possible after dam removal, and that long-term monitoring is essential for understanding the timeline and extent of natural restoration. These results provide a baseline for predicting the effects of future large dam removal projects such as those on the Klamath River in Oregon, USA. ■

PRESENTATION P66
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

URBAN WETLAND RESTORATION: SEDIMENT QUALITY ACTION GOALS FOR SUCCESS

Nixon, Elizabeth, Northgate Environmental Manage, Oakland, CA

Restoring wetlands in historically impacted urban areas typically requires a process that includes applying sediment quality action goals to ensure an ecologically functioning and successful outcome, while satisfying applicable regulatory requirements. Action goals for a restoration project may be based on a combination of Federal, state and regional chemical screening levels, ambient levels, dredge reuse guidelines, and/or site-specific action goals. We review available sources of screening levels and sediment quality and beneficial reuse guidelines, including the National Oceanic and Atmospheric Administration, US Environmental Protection Agency, US Army Corps of Engineers, California State and regional agencies, New Jersey, Florida, and Port of Baltimore sediment criteria among others, as they apply to selected examples of restoration projects in San Francisco Bay. These cases are examples of challenges including beneficially reusing historic impacted fill material, lack of available "clean" sediments, vertical stratification of impacted sediments, limited availability of risk-based levels beyond local and site-specific studies, inconsistent methodologies associated with regulatory permitting and requirements, cost-benefit tradeoffs, and clear metrics for success. Use of regional ambient or lowest value screening levels for project-specific action goals may result in over-conservative sediment quality requirements that may be cost-prohibitive and abort or delay restoration projects, while action goals that are consistent with predictive ecological risk-based values may better optimize beneficial reuse of sediments. Recommendations for working with regulatory agencies and other stakeholders to develop and apply consistent sediment quality action goals that are protective of species composition and functional groups in a local ecosystem are presented in the context of restoration success stories and lessons learned. ■

PRESENTATION 1505
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS IV*, 05/31/2018, 09:55 - 11:35

WATER QUALITY AND CARBON SEQUESTRATION FUNCTIONAL ASSESSMENT OF A CREATED BRACKISH MARSH BUILT ON PRIOR CONVERTED FARMLAND

Burchell, Michael, NC State University, Raleigh, NC
Krauss, Ken, U.S. Geological Survey, Lafayette, LA
Etheridge, Randall, East Carolina University, Greenville, NC
Shiau, Yo-Jin, Academia Sinica, Taipei, Nankang, Taiwan
Birgand, Francois, North Carolina State University, Raleigh, NC

A 14 ha brackish tidal marsh with over 1500 m of tidal stream was constructed in 2006 in eastern NC on a wetland site that had been converted to farmland in the mid- 1970s. This restoration was strategically located between large areas of drained agricultural land and an estuary designated as a primary shell-fishing and fishery nursery area. Following construction, a functional assessment was initiated to evaluate water quality and carbon sequestration ecosystem services provided by the marsh and tidal stream. Removal of nitrate-nitrogen (NO3-N) from surrounding agricultural drainage was a primary focus. Carbon dioxide and methane fluxes, which have not been well studied in natural or created brackish salt marshes with salinity ranges > 10 psu, were measured and coupled with biomass measurements in an attempt to understand the potential for carbon storage at the site.

Continuous high frequency flow and water quality measurements data were used to quantify the NO3-N retention in the marsh and the factors affecting retention. The marsh appeared to be a significant sink for NO3-N during four major rainfall events (18-42% retention) and the majority of the year. NO3-N was exported from the marsh following a hurricane offset that retention, resulting in a net 9% retention during the period of study.

Mean gas fluxes as determined with gas-flux chambers, appeared to be dominated by CO2 rather than CH4 in this hydrologic and salinity regime. Elevated pore water sulfate ($SO4^{2-}$) appeared to create conditions in the created brackish marsh that suppressed microbial production of CH4, and poised soil redox potential above -150 mV. Since CH4 is considered up to 30 times more efficient in trapping heat, low emissions coupled with high biomass production from this created marsh make C sequestration potential for these

system highly likely. Results of this study determined that water quality and carbon sequestration ecosystem services are possible and may be significant in these created brackish marshes. This should lead to important design, management, policy, and economic considerations that may drive decision-making for future created marsh projects. ■

PRESENTATION 1510
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION V*, 05/31/2018, 01:10 - 02:50

EVALUATING THE RESPONSE OF FOREST COMMUNITY VEGETATION TO HYDROLOGIC MANAGEMENT IN THE GREAT DISMAL SWAMP IN VIRGINIA, U.S.A.

Bendele, Stephen, Christopher Newport University, Powhatan, VA
Atkinson, Robert, Christopher Newport University, Newport News, VA

Forested peatlands of the United States such as the Great Dismal Swamp in Virginia and North Carolina were ditched and drained for logging and agriculture beginning in the colonial period. The use of the Dismal Swamp for timber production lead to the construction of a vast system of ditches effectively lowering the water table. As a result, the plant community has shifted in dominance from obligate hydrophyte species such as Atlantic White Cedar (Chamaecyparis thyoides) and Bald Cypress (Taxodium distichum) to facultative hydrophytes including Red Maple (Acer rubrum) and Sweetgum (Liquidambar styraciflua). Increases in water levels occurred following formation of the federally-administered Great Dismal Swamp National Wildlife Refuge in 1974, but two peat burning fires in 2008 and 2011 suggest that further increases in water levels were needed. Two large water control structures (weirs) were installed in September of 2013 with additional smaller structures added at later dates. The purpose of this study was to evaluate depth to water table and vegetation structure pre and post weir installation. Daily depth to water table was monitored from 2013 to 2015 using both manually wells and wells equipped with remote data sensing equipment. Wells were installed in 11 forested stands and vegetation structure was monitored annually in a 10 meter by 10 meter plot adjacent to each well and used to evaluate weighted average and species importance value in the plant community. Following weir installation in 2013, water tables rose approximately 35.5 centimeters, but failed to exhibit a depth to water table of sufficient duration to meet the federal criterion for wetland hydrology. Plant composition exhibited minimal shifts in weighted average and species importance value, further supporting the notion that hydrologic restoration is incomplete. ■

PRESENTATION P65
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE EFFECTS OF FOREST MANAGEMENT ON THE HYDROLOGY OF ISOLATED WETLANDS IN NORTH CENTRAL FLORIDA PINE FLATWOODS.

Henson, Kevin, University of Florida, Gainesville, FL
Kaplan, David, University of Florida, Gainesville, FL

Many of the pine flatwoods in Southeast United States have a mosaic of isolated ephemeral wetlands that can comprise of up to 30% of the total land area. These wetlands are important for flora and fauna that depend on the storage for water use, breeding, and larval development. The hydrology of these wetlands can impact groundwater hydrology and affect fires by providing islands of unburnable area for wildlife to retreat to. This project investigates the effects of two types of commonly used forest management (prescribed burning and selective thinning) on the hydroperiod of isolated wetlands in pine flatwoods (three wetlands per treatment type). We measure pine tree basal area, leaf area index, duff layer thickness, and ground cover percentage before and after the burning and thinning to quantify how much plant material is removed during management. Depth of water and bathymetry of each wetland are used to determine stage and volume measurements before and after the treatments. We use the depth measurement to calculate actual evapotranspiration using White's Method and compare it to potential evaporation from the Penmen-Montieth equation using available Florida Automated Weather Network (FAWN) weather data. We compare these differences in ET between prescribed burning and selective thinning. The results of this study have implications on water conservation, endangered amphibian protection, and future management of pine flatwoods forests. ■

PRESENTATION P64
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE EFFECT OF A SURFACTANT SEED COATING ON ALKALI BULRUSH GERMINATION AND BIOMASS

Hart, Anders, Utah State University, Logan, UT
Martin, Emily, Utah State University, Logan, UT
Kettenring, Karin, Utah State University, Logan, UT

Great Salt Lake (GSL) wetlands provide vital ecosystem services, including habitat for migratory birds. Alkali bulrush (Bolboschoenus maritimus) plays an important role in providing these services, but invasion by Phragmites australis has reduced the extent of alkali bulrush stands in GSL wetlands. Restoring alkali bulrush is a primary goal for GSL

managers following Phragmites removal. However, rising temperatures and changing precipitation patterns with climate change, as well increasing human water demands upstream, may alter the hydropattern of GSL wetlands, thus lowering soil moisture availability and potentially inhibiting alkali bulrush germination and seedling establishment. Surfactant seed coatings have been effective in aiding the germination of seeds in upland restoration sites by reducing soil water repellency, but have not been tested in wetlands. We tested whether the addition of a surfactant seed coating to alkali bulrush seeds improved germination at four water levels in a greenhouse. Water level and seed coating were significantly associated with improved germination. In a second experiment, we tested the effect of the seed coating at a low and high dose and staggered water level drawdowns on seedling height and biomass over six weeks. Seed coating and time of water level drop were not significantly associated with differences in seedling height. The water level decrease may not have been extreme enough to negatively affect seedlings. More research is needed to determine if a surfactant seed coating enhances alkali bulrush germination and growth under less favorable water availability conditions. ■

PRESENTATION 1527
PRESENTED DURING *SEA LEVEL RISE*, 05/30/2018, 03:20 - 05:00

EVALUATION OF A RECENTLY CREATED TIDAL MARSH'S RESILIENCY TO RELATIVE SEA-LEVEL RISE

Kamrath, Brock, North Carolina State University, Raleigh, NC
Burchell, Michael, NC State University, Raleigh, NC
Krauss, Ken, U.S. Geological Survey, Lafayette, LA
Kurki-Fox, Jack, NC State University, Raleigh, NC
Johnson, Darren, Cherokee Nation Technologies, USGS, Lafayette, LA

Tidal marsh restoration and creation efforts have been initiated around the globe to restore ecological functioning to historically degraded coastal ecosystems. An emerging threat to these coastal ecosystems is climate change-induced sea level rise. Within the United States, the southeastern Atlantic coast is experiencing relatively high rates of sea level rise. For example, the Beaufort, North Carolina (NC) NOAA station measured a sea-level rise rate of 3.0 +/- 0.36-mm/yr in 2016. Rising sea levels alter the hydrologic balance of coastal ecosystems. In tidal marshes, sea level rise increases inundation frequency and depth, which can lead to the loss of vegetative cover and eventual conversion to open water. However, conversion is not the only outcome; natural tidal marshes have shown an ability - through complex feedback systems - to gain elevation through vertical accretion in response to higher sea-levels.

This study, of a newly constructed tidal marsh in eastern NC, USA, was conducted to determine if this feedback system is occurring to the same extent in both natural and constructed tidal marshes. To evaluate the resiliency of a constructed tidal marsh on the NC coast, deep rod surface elevation tables (RSETs) and feldspar marker horizons (MHs) were installed on elevation gradients within the marsh to measure surface and subsurface elevation changes. Twelve plots, each consisting of one deep RSET and three MHs, were installed in March 2012 on four elevation gradient transects with three plots along each transect. RSET, MH, and vegetative cover measurements were taken initially and again in December 2012, January 2014, and April 2017. Preliminary analysis indicates that the constructed marsh had a higher rate of net elevation change when compared to the reference marsh, but that only the middle elevation of the constructed marsh has been keeping pace with the local sea level rise rates. Further statistical analyses of these observations are planned. This study will ultimately provide data on the ability of constructed tidal marshes to respond to the changing climate and influence the planning of future restoration and constructed tidal marsh projects. ■

PRESENTATION 1535
PRESENTED DURING *WETLAND REGULATIONS & DELINEATION*, 05/30/2018, 03:20 - 05:00

EVALUATING HYDROLOGIC PERFORMANCE STANDARDS FOR WETLAND MITIGATION

Sueltenfuss, Jeremy, Colorado State University, Fort Collins, CO

Little scientific agreement exists on the definition of success for ecosystem restoration, though it often leads to ecosystems with low ecological integrity. The use of ecological performance standards has been advocated by the scientific community as well as U.S. federal regulatory agencies to increase the ecological outcomes of wetland restoration. Because the water levels are widely acknowledged as a primary control over wetland form and function, the creation of hydrologic performance standards may be an effective way to improve the outcomes of wetland restoration. Hydrologic performance standards should ideally incorporate the need for different monitoring time frames for different wetland types, site specific evaluation rather than regional averages, and metrics that are ecologically relevant. Here we provide a framework for quantitative hydrologic performance standards created using concurrent hydrologic data from mitigation wetlands and project specific reference sites across three different wetland types distributed across the United States. Wetland types include fens and wet meadows

from Colorado, vernal pools from California, and forested wetlands from Virginia and North Carolina. We identify appropriate monitoring timeframes for the three wetland types by evaluating the time required for hydrologic conditions in restored wetlands to match those in reference wetlands. We then identify how vegetation in the restored wetland has developed in response to hydrologic similarity between restored and reference sites to test the ecological relevance of site specific hydrologic performance standards. Each restored wetland type had a distinct hydrologic regime and differed in the number of years between restoration and hydrologic equivalence with their reference sites. Hydrologic similarity between the restoration and reference sites led to increased cover of native species and reduced cover of exotic species in fens and wet meadows, increased cover of native species in vernal pools, and impacted the tree species richness and survival in forested wetlands. Our analysis indicate hydrologic performance standards created from concurrently monitored reference sites are an ecologically relevant way to evaluate restored wetlands. ■

PRESENTATION 1536

PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS II*, 05/31/2018, 01:00 - 02:50

BINATIONAL COLLABORATION TO RECOVER RIPARIAN HABITATS AND BIRDS IN A DROUGHT-STRESSED BASIN: THE CASE OF THE COLORADO RIVER DELTA.

Hinojosa-Huerta, Osvel, Pronatura Noroeste, Ensenada, BC, Mexico
Calvo-Fonseca, Alejandra, Pronatura Noroeste, Ensenada, BC, Mexico
Hernandez-Morlan, Itzel, Pronatura Noroeste, Ensenada, BC, Mexico

After decades of desiccation caused by the construction of large reservoirs and diversion in the Colorado River basin, the floodplain of the river delta in Mexico experienced a recovery in response to inadvertent flows during the 1980s and 1990s. However, the basin has endured a severe drought since 2002, and flows into the delta were curtailed. Since 2012, as a result of a binational agreement between Mexico and the United States known as Minute 319, several restoration projects have been implemented, recovering 540 hectares of native habitats. Furthermore, this agreement allowed for the release of 195 million cubic meters of water for environmental restoration in the delta during a 5-year period (2012-2017), including a pulse flow event in 2014 that helped to reconnect the Colorado River with the Gulf of California for the first time in 20 years. To evaluate the effect of these restoration efforts on birds in the floodplain we conducted variable distance point counts and evaluated habitat characteristics at 160 sites, from 2002 to 2017. We also conducted surveys with the same procedures at 31 sites at the restored areas. Between 2002 and 2013, the diversity of bird per point (N2) decreased 55.8%, while the relative abundance of the 3 dominant species (Red-winged Blackbird, Mourning Dove and White-faced Ibis) increased from 37% in 2002 to 67% in 2013. The community structure changed and 34 species had significant downward trends. Declining species were mostly riparian land birds and breeding waterbirds. After the pulse flow event, bird diversity increased 42%, and the abundance of nesting riparian land birds, nesting waterbirds and migratory waterbirds increased significantly (22%, 81% and 402% respectively). The bird response at the restoration sites has been stronger, where the overall bird diversity and the abundance of nesting riparian land birds has increased 79% and 157% percent respectively in relation to 2013, and are 27% and 81% higher than in the rest of the floodplain in 2017. The drought in the basin resulted in a drastic reduction of flows, causing an important reduction of habitat quality, which in turn is related to a population decline of riparian birds. The efforts supported by binational collaboration to release water for the environment and implement restoration projects are successfully re-establishing riparian habitats, with increased populations of bird species of conservation concern. ■

PRESENTATION 1537

PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION IV*, 05/31/2018, 09:55 - 11:35

U.S. HIGHWAY 36, ENDANGERED SPECIES ACT HABITAT MITIGATION PROJECT: SUCCESS THROUGH COLLABORATION

Hickey, Patrick, Jacobs Engineering, Denver, CO

A mitigation project was initiated in 2014 to compensate for impacts to two federally listed wetland species located within the US 36 Highway corridor in Boulder County, Colorado: the Preble's meadow jumping mouse (Zapus hudsonius preblei) (PMJM), and the Ute ladies'-tresses orchid (Spiranthes diluvialis) (ULTO).

The State Department of Transportation (CDOT) purchased a 21 acre property under pressure of residential development with the primary objective of preserving a large area of floodplain contiguous with PMJM critical habitat and restoring habitat needs of the two species. Site modification involved lowering surface elevations of the mitigation site to achieve groundwater hydrology necessary for the establishment of the competing habitat needs of the two species: riparian shrubland for the PMJM and open wet meadow for the ULTO. The project also addressed significant pre-existing weed infestation and over-grazed non-

native communities. The site was then planted with over 16,000 riparian shrubs and employed innovative methods to transplant 5 orchid plants and over 7,800 square feet of orchid sod.

To date, two of the transplanted orchids re-appeared in the first growing season. A presence/absence survey for PMJM was conducted in 2016 with negative results as expected in these early stages of site establishment.

The project has succeeded in preserving valuable habitat and set in motion additional land preservation and restoration. At maturity the site will offer much higher quality habitat than the narrow roadside strips of habitat affected by the highway improvements. The site will be managed in perpetuity by the City of Boulder Open Space Program as wildlife habitat that precludes human disturbance and promotes species recovery as the primary objective. More broadly, this site presents a unique opportunity to better understand the habitat needs of these two species and inform future restoration efforts.

This project accomplished more than site restoration, it's a model for cooperation between state, federal and municipalities for habitat mitigation. It takes more than science to preserve, protect and restore endangered species and wetlands. ■

PRESENTATION 1540
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS I*, 05/31/2018, 03:20 - 05:00

CREATING A FEN: THE SCIENCE AND THE MAGIC

Brooks, Robert, Pennsylvania State University, University Park, PA

A fen is a specific type of freshwater wetland, with highly alkaline water and soil, supported by permanently flowing groundwater. This project was a combined mitigation and outreach project to replace an isolated depression that was removed in the watershed, and to simulate the hydrology and vegetation of the relatively inaccessible fen within the core conservation area of the Millbrook Marsh Nature Center, located in State College in the Ridge and Valley ecoregion of central Pennsylvania. A diverse public/private partnership formed to complete the project efficiently and effectively. The primary construction objective was to create an emergent and shrub wetland depression of about 0.04 ha (0.10 ac) in area, with flow-through hydrology, and a slight topographic gradient. Attempts to intersect sufficient quantities of alkaline groundwater by excavating were unsuccessful, so a 1-2 % volume withdrawal from an adjacent spring-fed stream was used as the water source. Low-maintenance inlet and outlet controls were installed to allow management of water levels throughout the seasons. Pockets of open water up to 0.5 m deep (covering about 30% of area) and patches of wetland emergent grasses and shrubs are being planted in the interior area and along edges with species that mimic conditions found in the nearby Millbrook fen, which includes several rare species. Permitting and construction occurred over one month in October and November 2016. Planting of wetland shrubs along the periphery took place in late fall 2016 and spring 2017. Site selection, the construction process, costs, and maintenance issues will be outlined and illustrated. Further outreach activities and periodic environmental monitoring are planned for the future. ■

PRESENTATION 1544
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED I*, 06/01/2018, 09:45 - 11:35

IS THERE A SOIL SAMPLING AND ANALYSIS APPROACH THAT PRACTITIONERS AND POLICY MAKERS CAN USE TO IMPROVE SOIL DEVELOPMENT IN RESTORED WETLANDS? PART 2

Baldwin, Andy, University of Maryland, College Park, MD
Herb, Andy, AlpineEco, Denver, CO

The main findings and conclusions from Part 1 will be briefly summarized, and questions will be posed to stimulate discussion. Questions will be solicited in advance from a small panel of wetland restoration practitioners, policy makers, and researchers, who will also participate in the discussion. The discussion will be followed by a brief wrap up and plans for next steps. ■

PRESENTATION 1555
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED I*, 06/01/2018, 09:45 - 11:35

IS THERE A SOIL SAMPLING AND ANALYSIS APPROACH THAT PRACTITIONERS AND POLICY MAKERS CAN USE TO IMPROVE SOIL DEVELOPMENT IN RESTORED WETLANDS? PART 1

Herb, Andy, AlpineEco, Denver, CO
Baldwin, Andy, University of Maryland, College Park, MD

Although there has been a transition over the last 30 years to recognizing that created or restored wetlands should provide similar ecosystem functions to those wetlands they are replacing, success monitoring programs are still mainly focused on the initial establishment of hydrology and vegetation. Assessing soil development, which is key to ecosystem functions such as water quality improvement, is

not required or practicable for most monitoring programs. Studies of restored wetlands of different ages make it increasingly clear that development of soil organic matter and other attributes generally lag decades behind establishment of hydrology and vegetation. Although regulatory agencies may not require it, it may benefit wetland restoration practitioners (or policy makers seeking to improve restoration requirements) to perform focused soil sampling and analysis on projects of varying age or construction method as a means of improving soil development outcomes. To explore the viability of this approach, a practitioner (Herb) and a researcher (Baldwin) will implement a simple, inexpensive soil sampling and analysis program for multiple created and restored wetlands in Colorado and compare them to similar "natural" wetlands. The samples will be analyzed for pH, soil organic matter, cation exchange capacity, percent carbon, percent nitrogen, and other parameters. The presentation will provide a summary of the sites sampled, the sampling results for each of the restored sites as they compare to the natural sites, an evaluation of the cost and utility of the approach and, if warranted, recommendations for practitioners to improve their wetland restoration projects through focused soil sampling and analysis. ■

PRESENTATION P61
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

PLANTING CAREX SCOPULORUM SEEDLINGS FOR SUBALPINE MEADOW RESTORATION

Booher, Melissa, Colorado State University, Fort Collins, CO
Baldwin, Lydia, Colorado State University, Fort Collins, CO
Cooper, David, Colorado State University, Fort Collins, CO
Wolf, Evan, University of California, Davis, Berkeley, CA

Wet meadows are critically altered and at risk ecosystems in the Sierra Nevada. Disturbance related deficiencies in vegetative cover are a restoration priority due to the importance of organic-rich soils for future plant establishment. This research focuses on biomass accumulation, both above and below ground, associated with planted Carex scopulorum seedlings in Tuolumne Meadows, Yosemite National Park, USA. We are testing the suitability of this species for use in future restoration work and assessing the growth strategy of Carex scopulorum to determine: 1) how does cumulative Carex scopulorum biomass production within a growing season compare to that of other dominant species in the community; 2) does the rate at which Carex scopulorum allocates biomass below ground differ from other dominant species in the community. Carex scopulorum productivity and below/above ground biomass allocation ratio were measured at peak standing biomass using corers in planted, unplanted, and reference areas. Samples were washed to remove all loose soil, biomass was separated by species, then above and below ground biomass was separated. After one year of growth, analyses show that seedlings contribute significantly higher amounts of biomass to study plots than other dominant species in our site. These seedlings allocated a greater proportion of their biomass below ground than most other present species. Our results indicate that after one year of growth, Carex scopulorum appears to be an appropriate species for use in restoring biomass inputs, and could be a valuable tool for restoration of other degraded meadows in the Sierra Nevada. ■

PRESENTATION 1567
PRESENTED DURING *WORKING IN WETLANDS I*, 05/30/2018, 09:45 - 11:35

LIFE IN MITIGATION BANKING: THE ROLES AND RESPONSIBILITIES OF A FIELD BIOLOGIST

Heard, Brighton, Resource Environmental Solutions, Baton Rouge, LA

Wetland mitigation is an everyday adventure where your objectives are to restore and enhance historic wetlands, conserve and preserve existing wetlands, and connect adjacent wetland areas to create larger, more ecologically rich ecosystems in perpetuity. The work environment is team oriented and consists of field and office activities. Our mitigation team includes a combination of land managers, wetland delineators, ecologists, hydrologists, geomorphologists, data analysts, scientific communicators, permitting analysts, and GIS specialists, just to name a few.

The team of field biologists at RES are an integral part of the wetland mitigation process. As a field biologist at RES, I aid in selecting, delineating, designing, monitoring, and drafting regulatory documentation for mitigation sites. My presentation will provide a snapshot view of a wetland mitigation professional's roles and responsibilities in the field. ■

PRESENTATION 1580
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES II*, 05/30/2018, 01:00 - 02:50

ADDRESSING SALT MARSH DECLINE IN NEW YORK CITY

Hartig, Ellen, City of New York Parks & Recreation, New York, NY
Haight, Christopher, City of New York Parks & Recreation, New York, NY
Swadek, Rebecca, City of New York Parks & Recreation, New York, NY
Larson, Marit, City of New York Parks & Recreation, New York, NY

New York City's highly urbanized coast contains over 800 kilometers of shoreline. Its remaining salt marshes provide vital habitat for fish, birds and other wildlife, and opportunities for education, research, and passive recreation such as birding, photography, and nature observation. Though protected from development through legislation, remaining salt marshes are in a state of decline due to poor water quality, developmental pressures, sea-level rise, and other stressors. Comparisons of 1974 aerial imagery and 2012 post-Hurricane Sandy imagery show dramatic conversion of historic salt marsh to mudflat or open water with loss at a rate of up to one percent per year. Data collected through the monitoring of eighteen Surface Elevation Tables (SETs) at six marsh complexes throughout NYC indicate significant accretion, but at a rate insufficient to keep pace with the mean sea-level trend of +2.84 mm per year at The Battery in Lower Manhattan. To counter these losses, NYC Parks is taking a multi-faceted approach that includes innovative and traditional salt marsh restoration methods to: 1) restore expanding tidal pools; 2) rebuild marsh waterward to recover former tidal wetland area; 3) elevate drowning marsh surfaces by augmenting them with a thin layer of clean sediment; 4) acquire property where marsh can migrate inland as sea levels rise; and 5) excavate historic fill, where possible, to restore tidal hydrology. These approaches are underway or planned throughout NYC along the Jamaica Bay, Long Island Sound, and Arthur Kill waterways. Both existing and restored salt marshes in NYC will act as a wave buffer to urban coastal communities, increase available fish and wildlife habitat, and serve public education and enjoyment. ■

PRESENTATION P60
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

INTRASPECIFIC VARIATION IN REGENERATION TRAITS: IMPROVING PREDICTABILITY IN *BOLBOSCHOENUS MARITIMUS* REESTABLISHMENT

Judd, Gabriela, Utah State University, Logan, UT
Martin, Emily, Utah State University, Logan, UT
Kettenring, Karin, Utah State University, Logan, UT

Re-establishing foundational plant species supports the functioning and restoration of wetland ecosystem services. However, revegetation outcomes are often unpredictable because the underlying processes driving plant population reestablishment are poorly understood. Specifically, assessing regeneration traits (e.g. dormancy, germination, establishment) that drive recruitment during the most vulnerable part of a plant's life cycle can improve predictability in restoration. The objective of our experiment was to identify factors that drive germination and contribute to successful re-establishment of Bolboschoenus maritimus-an important native bulrush for restoration in the Intermountain West. We used a range of geographically different seed sources-Utah, Nevada and Montana-to understand the role of intraspecific regeneration trait variation in potentially improving plant performance under changing environmental conditions. We measured seed size and seed mass to further explore their contributions to longevity in the seed bank. We also developed a hydrothermal time (HTT) model for B. maritimus that quantifies the interaction between temperature and water potential to better understand how environmental conditions influence germination and establishment. To develop the model, we placed four replicates of 25 seeds in Petri dishes containing germination blotting paper. The dishes were either saturated with water (water potential = 0) or with solutions of polyethelyne glycol 8000 that maintained a specific water potential (-0.5, -1, -1.5, -2, -4 MPa). Replicates experienced four different temperatures (28, 30, 32, 35 deg. C), held constant in separate growth chambers. Germination was recorded over 4 weeks, and germination fractions were corrected for viability. We found significant variation among seed sources for seed mass, size, and HTT. Furthermore, we identified optimal temperature and water potential conditions for B. maritimus germination. Utilizing the HTT model in restoration will increase predictability of species response to changing climate as well as revegetation outcomes to improve wetland restoration. ■

PRESENTATION 1594
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE III*, 06/01/2018, 03:10 - 05:00

MONITORING VEGETATION IN RESTORATION EXPERIMENTS IN THREE ANDEAN WETLANDS OF CORDILLERA BLANCA, PERU

Fuentealba, Beatriz, The Mountain Institute, Huaraz, Ancash, Peru
Mejía, Mayra, The Mountain Institute, Huaraz, Ancash, Peru

In Peru, we called bofedales a many types of wetlands, mainly peatlands and wet meadow. To know better the ecological functions in these ecosystems, in 2015 we established restoration experiments in three Andean wetlands, inside the Huascaran National Park (HNP), Peru. Each wetland has differences in their hydrological and ecological conditions. Two of them were wet meadows (S1 and S2), and cattle grazing were the main problem, so we built four small cattle exclosures (3 x 3 m) in each site. The other site (S3) were a peatland, and we restored a ditch using 24 checkdams to evaluate its impact. During two years, we have monitoring eight vegetation plots in each site, and the results will be showed here.

We fund that cattle exclosures (in S1 and S2) allowed the growth of Calamagrostis heterophylla (Poacaee), a very desirable species for cattle. Plant coverage and native species coverage was higher inside the cattle exclosures than outside. Only in S1 we found less cushion plants and more Poaceae, Cyperaceae and Juncaceae species through the time. In exclosured of S2, plant coverage and Poaceae abundance increased through the time, meanwhile herb abundance decreased.

In S3, we confirm changes in the water level in the restored area; however, we cannot find changes in vegetation. We found that plots in areas with better condition had more cushion plants and mosses than the other areas. Additionally, we found that plant coverage and native species coverage, and Cyperaceae species abundance increased through the time.

This work shows that vegetation in Andean wetlands have a slow response to changes in cattle activity and in water level. Apparently, Poaceae and Cyperaceae species have a faster response compared with cushion species. We also found that cushion plants, Cyperaceae species and mosses are more representative of bofedales en HNP than other kind of species. ■

PRESENTATION 1602
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION VI*, 05/31/2018, 03:20 - 05:00

LANDSCAPE PATTERN EVOLVEMENT OF TUSSOCK WETLAND AND MAIN DIVING MECHANISM--AN EXAMPLE IN SUN ISLAND IN HARBIN

Qi, Qing, Northeast Institution of Geography and Agroecology, Chinese Academy of Sciences, 长春市, Jilin provinve, China
Tong, Shouzheng, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin, China

To identify the the evolvement characteristics of wetland landscape pattern during restoration and explore main diving mechanism, this paper set the Sun Island in Harbin as research site, supported by 3S technology and filed observation, analyzed the characteristics of Carex tussock wetland landscape pattern during Carex appendiculata restoration through typical indices including patch area, expansion rate, patch number, connectivity, direction of expansion and centroid migration. Results suggest: the tussock wetland area increased about 400m2 from 2008 to 2018, with an increase of 40% and an average expansion rate of 40m2/a; both patches number and area increased gradually and a significant expansion was found in adjacent to artificial recovery area. Additionally, landscape connectivity was well developed; low-lying and well-watered area become the key area for outward expansion of tussock wetland, and a significant migration of space center was behaved. This study indicates that hydrology and micro-topography are the main factors that affect the landscape pattern of tussock wetland in Harbin. ■

PRESENTATION 1637
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED III*, 06/01/2018, 03:10 - 05:00

AN EXPERIMENTAL FEN TRANSPLANTATION

Johnson, Brad, Johnson Environmental Consulting, Fort Collins, CO

Fens in the Rocky Mountains have long been subjected to impacts, and future impacts to fens are virtually inevitable as regional population increases. As such, there is an imperative to innovate technical approaches to mitigating fen impacts past, present and future. The US Clean Water Act describes wetland impact mitigation as an iterative process of habitat impact avoidance, minimization and then compensatory mitigation, in the form of restoration or similar approaches. The Rocky Mountain Fen Research Project (RMFRP) has developed and is testing novel approaches

to both mountain fen restoration and ecological salvage. Pairing restoration and salvage when fen impacts are going to occur, is critical since saving irreplaceable resources such as organic soils and plant communities is a means of minimizing those impacts and creation restoration potential where otherwise impossible.

Peat mining of mountain fens has often been cited as their most severe form of impact. This is in large because their irreplaceable organic soils are removed. Peat mining basically removes a vital organ from the wetland. Mined mountain fens have commonly been considered unrestorable, but the RMFRP has attempted a novel transplantation approach to fen restoration. Fen transplantation involves identifying a hydrologically-impaired donor fen retaining intact vegetation and soils and a peat-mined transplantation fen which intact water source. The transplantation site was prepared in the summer of 2016, and the procedure took place in fall 2016 by moving the donor fen soils and vegetation block-by-block from the donor to the transplantation site. Key to the fen transplantation design was the construction of a subterranean groundwater distribution system that mimicked that of natural mountain fens. Completed in the fall of 2016, 2017 represented the first season of recovery. Monitoring of hydrology, vegetation and show extremely promising results thus far. Monitoring will continue for at least the next four years. ■

PRESENTATION 1657

PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES I*, 05/30/2018, 09:45 - 11:35

COMMUNITY ENGAGEMENT AND WETLAND MANAGEMENT TO COUNTER THREATS OF WETLAND DEGRADATION

Simpson, Matthew, WWT Consulting, Slimbridge, Gloucestershire, United Kingdom

Wetland degradation and loss has direct impacts on local communities. Engaging with local communities to address wetland related problems can be difficult so is often avoided. However, with the right approach, significant results can be obtained. The Community Owned Solutions approach was developed with Indigenous communities in the Guiana Shield region of South America but has been adapted to be used to engage communities around the world. The approach helps create an environment of mutual respect that can make stakeholder engagement more effective. It empowers the community to take control of how they wish their community to develop and face up to current and emerging challenges. This approach identifies and shares solutions to sustainability challenges such as climate change adaptation, biodiversity loss, natural resources depletion, lack of governance, health emergencies and cultural loss. The identification of these solutions allows communities to share best practice in how to monitor and manage their natural resources. The approach is fundamentally transdisciplinary and holistic, and has been used by people working in the fields of development, nature conservation, health, natural resource management, social welfare and education. This paper demonstrates through a range of case studies the techniques for successful community engagement in relation to wetland degradation. If done well engaging with communities empowers them to counter threats to wetland degradation through appropriate, community led management approaches. ■

PRESENTATION 1659

PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION II*, 05/31/2018, 01:00 - 02:50

TROUBLED WATERS: RESTORING THE RIVER OF GRASS TO AMERICA'S EVERGLADES

Capp, Cara, National Parks Conservation Association

America's Everglades is a vast and diverse ecosystem. Networks of wetlands, marshes, cypress domes, pine rocklands, and marine habitat meet across the Florida peninsula and out to Florida Bay and the Keys. These natural resources are critical to Florida's way of life – the state's drinking water is supplied by underlying aquifers recharged by the Everglades, and its tourism and fishing economies depend on abundant clean water. Yet the Everglades is an ecosystem in peril. Decades of urban and agricultural development have cost the Everglades over half of its historic habitat footprint, and nearly two-thirds of the water that once flowed in the iconic "River of Grass" described by Marjory Stoneman Douglas decades ago. What remains of the natural Everglades is protected in Everglades National Park and other public lands – but the watershed does not recognize human-drawn boundary lines. Florida is left with a broken water system, one that cannot sustain the Everglades or its growing cities. Efforts to restore the Everglades have been long in the works, but progress is slow. Complex ecological and political obstacles – including competition over land, lack of funds, and changeover in critical leadership – all play a part. This session will give an overview of the challenges and opportunities for restoring the Everglades from both a scientific and policy perspective. To quote the great Marjory Stoneman Douglas – Mother of the Everglades and an iconic woman of the wetlands – "The Everglades is a test. If we pass it, we may get to keep the planet." ■

PRESENTATION 1660
PRESENTED DURING *WETLAND RESTORATION AND CREATION: CASE STUDIES AND LESSONS LEARNED III*, 06/01/2018, 03:10 - 05:00

COASTAL VEGETATIVE WETLAND CREATION PROJECT INTERMEDIATE MARSH

Crystal, Mike, Sevenson Environmental Services, Inc.
Donegan, Tim, Sevenson Environmental Services, Inc,

Background/Objectives: According to the US EPA, aquatic wetlands are some of the most productive ecosystems on earth, comparable to rainforests and coral reefs. Unfortunately, coastal wetlands are disappearing at an alarming rate – thousands of square miles in the last several decades, with one state currently experiencing a football field size loss every hour. Historically, dredge spoils have been placed in sterile upland impoundments, which often destroys riparian habitat, and provides little-to-no ecological benefit. One of the primary project objectives was to beneficially reuse dredge spoils to rehabilitate vegetated coastal wetlands that had eroded and subsided to the point that average water depths were too large to support plant life.

Approach/Activities: Sevenson Environment Services (SES) constructed side-cast and sheet pile containment levees for the purpose of sequestering hydraulically introduced dredge spoils. Levees were topped at +2' local MSL, and contained water control structures to prevent sediment loss, regulate water ingress/egress and control pool elevations. SES also designed and installed a "burrito wrap" which added another foot to the side cast levees. This additional levee height provided protection when the project experienced exceptionally high tides during construction. SES hydraulically introduced dredge spoils at controlled rates of 5-7000 gpm which served to prevent sediment loss and minimized mounding of sediments above initial target elevations, which were +1' local MSL. After introduced sediment settled to final target elevations of 0' local MSL, which is optimum for the viability of the primary vegetative species selected for the project, Spartina alterniflora was hand planted on 5' x 10' centers. Alterniflora plugs were utilized were sediment was walkable, and gallon containers were planted from air boats were sediment strengths were not adequate to support human activity.

Results/Lessons Learned: The project successfully created 200 acres of viable vegetated wetlands. During the first two years, post-construction, alterniflora spread laterally and closed the gaps in the original 5' x 10' planting regimen. The created wetlands are now fully functional, providing habitat for wildlife, including ingress/egress for fish and shellfish; protection from storms, including tropical events; recreational benefits including fishing and birding; and the aesthetic benefits of turning open water/mud flats ■

Management & Applied Science: Toxicology

PRESENTATION P69
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE EFFECTS OF TETRAKIS (HYDROXYMETHYL) PHOSPHONIUM CHLORIDE (THPC) ON LEAF DECOMPOSITION AND MICROBIAL COMMUNITIES

Alemar, Sara, Georgia Southern University, Statesboro, GA

Fire retardant chemicals are purposely sprayed around forests to prevent forest fires. They have little to no impact on terrestrial environments, however, are toxic to aquatic environments. Directly adding these pollutants to freshwater systems can significantly impact consumers negatively, but the effects are temporary. Although the impact of these chemicals is known for consumers, little is known about their effects on microbial communities and ecosystem processes such as litter decomposition. Microbial communities can be important role players in the decomposition of organic matter and their diversity and distribution can regulate the early stages of the decomposition process. We used mesocosms with different concentrations of Tetrakis (hydroxymethyl) phosphonium chloride (THPC) and a control to test its impact on leaf decomposition and microbial communities. Packs of freshly fallen leaves of water oak were placed in tanks 2-weeks prior to adding THPC treatments to allow for conditioning. After 14-d, replicates were removed to assess colonizing microbial communities and leaf decomposition during an initial conditioning period. Remaining replicates were removed after 14 additional days with treatment and processed for decomposition and microbial colonization. We predicted that higher concentrations of THPC would inhibit microbial colonization and consequently impact decomposition rates. Preliminary results indicate that different concentrations of THPC may have differential effects on leaf decomposition with the lowest concentrations yielding faster decomposition rates than the control. However, there were no differences in decomposition rates between control and medium or high concentrations of THPC. ■

PRESENTATION 1589
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES III*, 06/01/2018, 01:10 - 02:50

ATRAZINE AND MACROPHYTE PRESENCE IN WETLANDS IN SOUTHWEST MISSOURI

Cornish, Christine, Missouri State University, Springfield, MO
Kissoon-Charles, La Toya, Missouri State University, Springfield, MO

Agrochemical usage has increased exponentially over the last six decades. It has been long hypothesized that this increased use has resulted in increased transport of these chemicals into wetlands. Terrestrially applied agrochemicals, such as herbicides, are primarily transported into wetlands via runoff and spray drift, and have been detected in surface water, groundwater, soil, and sediment. The persistence and mobility of these chemicals in aquatic systems has been found to negatively impact various aquatic organisms. For example, atrazine, a commonly used herbicide compound, has been shown to have negative effects on aquatic biota at concentrations as low as 0.1 ng/g. However, few studies have reported on the subsequent impacts of atrazine found in sediment on macrophytes. Macrophytes play many crucial roles in aquatic ecosystems, including stabilizing sediment, assimilating and cycling nutrients, providing habitat and food for other organisms, and improving water quality. We measured atrazine concentrations in wetland sediments and investigated how those concentrations may be related to sediment characteristics and macrophyte species abundance and diversity in agricultural, golf course, and conservation wetlands. We hypothesized that atrazine concentrations would vary based on land use (conservation < agricultural < golf course). However, our study found similar concentrations of atrazine in all wetlands sampled (0.34 ng/g). Atrazine concentrations found in our study, could be due to atrazine's extensive use, persistence, and mobility in the environment. Previous studies have reported much higher atrazine concentrations in agricultural wetlands (9.3 ng/g). Lower concentrations of atrazine found in our study could be due to the influence of microbe-macrophyte interactions, as atrazine has the capability to be biodegraded. Preliminary macrophyte results show that total cover was similar for all wetland categories. Lemna minor (common duckweed) and Spirodela polyrhiza (greater duckweed) had significantly greater species cover, composition, and frequency in conservation wetlands; whereas Spirogyra sp. (filamentous green algae) was greater in golf course wetlands. ■

PRESENTATION P68
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

LEMNA MINOR: RESPONSE TO NANOPARTICLE EXPOSURE

Kissoon-Charles, La Toya, Missouri State University, Springfield, MO
Gurski, Madison, Missouri State University, Springfield, MO
Heiman, Jordan, Missouri State University, Springfield, MO

Silver nanoparticles (AgNPs) are the most abundant nanomaterial used in consumer products, such as soaps, shampoos, textiles, and biocidal coatings. These nanomaterials can enter wastewaters and thus have great potential to enter aquatic systems. Toxicity, fate, and transport of AgNPs in the environment is influenced by various transformation processes in aquatic environments. Several studies have reported on the toxic effects of AgNPs on aquatic and terrestrial plants, algae, vertebrates, invertebrates, and microorganisms. Effects include physical damage to cells, declines in growth, decreased chlorophyll production, DNA damage and death. Previous studies reported decreased growth rates of Lemna minor when exposed to AgNPs at low concentrations. L. minor is a fast-growing, free-floating aquatic plant, which can accumulate high concentrations of metals such as zinc, lead, and cadmium. These characteristics make it an excellent candidate for toxicity studies and for use in phytoremediation. We conducted two experiments to investigate the effects of silver nanoparticles on L. minor growth and chlorophyll content. We grew L. minor in nutrient solution with AgNPs at concentrations similar to those used in other studies. In experiment one, we started with 400 mg fresh weight of plants (approximately 260 fronds) grown in nutrient solution with and without AgNPs. Results of experiment one found no differences in chlorophyll content and growth between treatments. Previous studies that reported toxic effects of AgNPs on L. minor, started with about 13 times less plant material (15-20 fronds). To determine if the amount of plant material played a role in the effects of nanoparticle exposure, we conducted a second experiment varying exposure times and the starting amounts of plant fronds. In experiment two, we started with four different amounts of plant material (20, 40, 80, and 160 fronds). Preliminary results indicated no differences in chlorophyll content after seven days of exposure. However, during sample processing we observed that plants exposed to AgNPs appeared to be softer in texture compared to plants that were not exposed to AgNPs. Future research should compare extent of structural and molecular damage when L. minor colonies of different frond numbers are exposed to nanoparticles for different periods of time. ■

Management & Applied Science: Wildlife Management

PRESENTATION 1097
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS II*, 06/01/2018, 01:00 - 02:30

A BIRDS-EYE VIEW OF NATIONAL WETLAND CONDITION

Peragine, Hannah, Graduate Student, Yale School of Forestry and Environmental Studies, New Haven, CT

National surveys such as the National Wetland Inventory and FWS Status and Trends provide important information about wetland type and areal extent. The National Wetland Condition Assessment (NWCA) provides previously absent data on the dimension of ecological condition- information that improves our understanding of wetland habitats, and supports science-based approaches to conservation and management.

In aggregate, the data from the NWCA gives scientists and managers a national-scale perspective that can help us understand trends and assess where we are as a nation.

The thousands of data points that contribute to this national picture can also serve other purposes. These include valuable assessment of wetland condition in geographic areas already defined as important for certain species or uses, and providing a wealth of data about vegetation presence and abundance, biological condition, sources of stress, and other metrics at sites across the country, useful for risk assessment and planning for adaptation.

Because the survey is statistically-based, it is possible to provide extent estimates for wetland condition within spatial units already established for the management of resources, such as Migratory Bird Joint Venture Areas (JVAs), areas deemed especially important for birds, many of which are wetland dependent. Applying data from the NWCA at this scale can reveal sources and levels of stress for wetland habitat in these special areas, and provide an important basis for comparison. For example, at the national level approximately a quarter of wetland area is in high stress due to hydrological alteration from ditching and from surface hardening, but when examined at JVA scale, the Prairie Pothole JVA is revealed to have half or more of its area in high stress due to each of these causes. This type of habitat quality data is particularly valuable because monitoring efforts for migratory birds tend to focus on population counts, rather than habitat quality, in part because of constraints on resources available for in-depth assessment of habitat. The NWCA provides national and regional scale information on wetland condition and stressors that can help address this gap.

Data from the NWCA also has use in improving risk assessment, such as for destructive invasive insects in forested wetlands, understanding sources of stress, and more broadly, to augment the habitat condition data being used to make land management decisions. ■

PRESENTATION P70
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

INTEGRATED WATERBIRD MANAGEMENT AND MONITORING: UNDERSTANDING EFFECTS OF HABITAT MANAGEMENT DURING THE NON-BREEDING SEASON

Newman, Jana, USFWS, Fort Collins, CO
Rice, Mindy, USFWS, Fort Collins, CO
Loges, Brian, USFWS, Brussels, IL

Our mission at FWS is to work with you to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the benefit of this and future generations. As a science-based organization, monitoring data must be directly applicable to local land management decisions, enabling us to fulfill our statutory duty to achieve the congressionally mandated purpose for each Refuge. Wetlands are among the habitats we target for intensive management yet, historically, we rarely conduct monitoring that directly ties habitat management actions to resultant effects on the species of concern. Robust monitoring programs have been established to monitor waterbird populations during the breeding season, but waterbird survival and fecundity is also influenced by the quality and distribution of habitats utilized during the nonbreeding portion of their annual life cycle. In addition many refuges along major migratory routes were established with a primary purpose of providing habitat during non-breeding periods.

We are actively working to promote a more complete approach to full annual life cycle stewardship by promoting data driven management of wetlands managed as nonbreeding habitats. The Integrated Waterbird Management and Monitoring Protocol is an example of how we explicitly link refuge management actions to refuge objectives using bird counts supplemented with rapid habitat assessments. In the case of Mattamuskeet NWR, in coastal NC, using structured decision making, we identified the optimal management approach for integrating the need to obtain the best possible bird use-days for nonbreeding waterfowl coupled with good outcomes for migrating shorebirds that were within operating expense constraints. ■

PRESENTATION P71
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

USING LONG-TERM MONITORING TO GUIDE SPRING WETLAND MANAGEMENT FOR DUCKS IN THE SAN LUIS VALLEY, COLORADO

Gammonley, Jim, Colorado Parks and Wildlife, Fort Collins, CO
Voss, Kristofor, Regis University, Denver, CO
Aloia, Cary, Wetland Dynamics, LLC, Monte Vista, CO
Jenny, Nehring, Wetland Dynamics LLC, Monte Vista, CO

Persistent drought and changes in surface water and groundwater use in the San Luis Valley of Colorado have altered the availability and distribution of wetland habitats for ducks and other wetland birds, particularly during the critical spring migration and pre-breeding period (February-May). Whereas many wetlands in the San Luis Valley are dependent on agricultural irrigation water sources, groundwater sources are available to provide early spring surface water available to waterfowl at Russell Lakes State Wildlife Area (RLSWA), a 4,000-acre managed wetland complex. Managers need information on the timing of duck migration and duck response to wetland management practices. We tracked numbers and distribution of dabbling and diving ducks during Feb-May over 10 years on RLSWA. We also monitored hydrology and vegetation management in wetland units across RLSWA each year, to examine duck density in relation to these management features. Peak numbers of both dabbling and diving ducks at RLSWA occurred about one day earlier per year over the 10 years of monitoring. Duck densities varied on wetland units across RLSWA in relation to dominant vegetation, unit size, and water and vegetation management during the previous year. Our results demonstrate the need for early water availability on public lands to provide crucial habitats for migrating and pre-breeding ducks, months before the irrigation season begins. Natural Resource agencies in the San Luis Valley are working together to try and develop a framework that will allow them to work together to provide these resources while building a case to take to water users for the need to allow for this type of water use earlier in the season on public lands. ■

PRESENTATION 1618
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES II*, 05/30/2018, 01:00 - 02:50

RAPID ASSESSMENT OF WETLAND MANAGEMENT FOR FORAGE PRODUCTION, AVIAN USE, AND CULTURAL ECOSYSTEM SERVICES

Behney, Adam, Colorado Parks and Wildlife, Fort Collins, CO

Habitat management for nonbreeding waterfowl focuses on providing abundant, high quality food. This approach is based on the underlying assumption that food availability is positively correlated with waterfowl use of sites. The specific relationship between food availability and waterfowl use is relatively unknown and there are likely factors other than food availability that contribute to the attractiveness of sites to waterfowl. Furthermore, wetland restoration planning is based primarily on providing sufficient food to meet the energy demands of waterfowl population goals. For this strategy to be employed effectively, planners must have accurate estimates of local food availability. Whereas, food density estimates are available for many regions, little information exists in the western Great Plains. We set out to estimate food density in six types of waterfowl foraging habitats in northeastern Colorado, assess the relationship between food density (and other factors) and waterfowl use of a site, and test a rapid assessment procedure to predict food density and waterfowl use. Over two years during fall, winter, and spring, we collected a total of 1265 wetland core samples across 44 sites to assess food density, counted waterfowl throughout spring, and conducted rapid assessments of habitat quality on each site. Actively managed moist soil impoundments contained the greatest food density in fall (overall mean ± SE, pooled over years = 1478 ± 231 kg/ha) followed closely by passively managed emergent wetlands (1251 ± 122 kg/ha). However, depletion during the fall was substantial in moist soil wetlands, whereas it was almost non-existent in passively managed emergent wetlands. Actively managed moist soil units also had the greatest mean duck density (25 ducks/ha) observed during duck counts whereas passive emergent wetlands had substantially less (17 ducks/ha), consistent with the hypothesis that food is not the only factor driving where ducks choose to feed. The rapid assessment procedure we tested explained 45 and 68 % of the variability in food density and duck density at a site, respectively. Although this may be good enough for broad scale indices of habitat quality, it is likely not good enough for more specific purposes like estimating food availability in the region. Overall, we show that among foraging habitats, actively managed moist soil impoundments appear to hold the greatest value for ducks in northeastern Colorado. ■

PRESENTATION 1625
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS II*, 05/31/2018, 01:00 - 02:50

STATE AND TRANSITION MODEL FOR SEMI-PERMANENTLY FLOODED WETLANDS AND SHALLOW LAKES IN THE INTERMOUNTAIN WEST AND WESTERN PRAIRIE POTHOLE REGION

Henry, Adonia, Scaup & Willet LLC, King Salmon, AK
Warren, Jeffrey, US Fish and Wildlife Service, Lima, MT
Kristof, Andrea, US Fish and Wildlife Service, Hamer, ID

Anthropogenic modifications of wetlands throughout the Intermountain West and western Prairie Pothole Region have altered historical wetland processes and function, requiring management and/or restoration of these processes to support productive biological communities. State and transition models (STMs) depict the current knowledge of ecological dynamics and identify the range of potential vegetation communities that can exist. We developed a STM for semi-permanently flooded wetlands and shallow lakes based on vegetation communities and hydrological conditions. This STM 1) provides a universally-applicable ecological framework to apply across semi-permanently flooded wetlands and shallow lakes in different geomorphic regions; and 2) elucidates common ecological drivers and processes that influence the expression of wetland plants. The STM includes one reference state with seven vegetation community phases encompassing the natural range of variability of vegetation and hydrology for tall emergent and submerged aquatic vegetation communities. Three alternative states were developed where ecological feedback loops prevent vegetation communities from returning to a more desirable vegetation community phase. Data collected from 12 National Wildlife Refuges are being used to develop indicator values and quantify components of the STM. The STM provides a framework to address management and restoration needs to successfully meet habitat objectives and provide resources necessary to support target populations of waterfowl and other waterbirds. ■

PRESENTATION 1641
PRESENTED DURING *WETLANDS MANAGEMENT FOR WATERFOWL & ITS MYRIAD OF ECOSYSTEM SERVICES I*, 05/30/2018, 09:45 - 11:35

MULTI-BENEFICIAL AQUIFER RECHARGE AND STREAMFLOW AUGMENTATION THROUGH MANAGED WETLANDS FOR WATERFOWL

Roudebush, Jason, Ducks Unlimited, Fort Collins, CO

The eastern plains of Colorado average only 15 inches of precipitation annually. The often semi-arid climate characterized by low precipitation, high potential evapotranspiration, and frequent drought periods necessitates prudent water resource management. Therefore, water managers are tasked with strategically balancing variable water supplies against the increasing demands from municipal, agricultural, and industrial users. To meet increasing demands, the conjunctive use of groundwater and surface water in the Lower South Platte Basin has proven to be an effective tool for augmenting streamflow during low flow periods, while innovatively creating and enhancing wetland habitat for waterfowl and other shore birds. While the goal of these managed groundwater recharge systems is to retime flows from times of surplus to times of deficit, the recharge season on the South Platte River aligns with the spring and fall waterfowl migrations, offering critical stopover habitat to and from the northern breeding grounds. In addition to the seasonal nature of the recharge wetlands, which provide diverse and productive sources of forage, the subsurface return flows also significantly modify the hydrology near the river, creating backwater sloughs and wet-meadow habitat critical for all migratory birds. This symbiotic relationship between water resource optimization and wildlife habitat management allows rural communities to prosper and municipalities to grow, and helps to offset the energetic costs of migration for North American waterfowl. ■

PRESENTATION 1651
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS III*, 05/31/2018, 03:10 - 05:00

WETLANDS IN THE MEXICAN HIGHLANDS

Lafon, Alberto, PROFAUNA Mexico, Saltillo, Coahuila, Mexico

The Mexican Highlands located between the Sierra Madre Oriental and Sierra Madre Occidental has great hemispherical value including a diversity of wetlands that support thousands of shorebirds and waterfowl during the autumn and winter. The highlands encompass approximately 25% of the Mexican territory (48.5 million ha) including the states of Chihuahua, Coahuila, Durango, Zacatecas, Aguascalientes and portions of Jalisco, Michoacán, Sonora, Guanajuato and Nuevo Leon states. According to Ducks Unlimited de México the Northern Highlands support 1.3 million ha of wetlands and the Central Highlands support 1.2 million ha of wetlands. The combined 2.5 million ha provide a diverse suite of wetland habitat including large lakes (Chapala, Cuitzeo, Patzcuaro) lagoons (Bustillos, Yuriria), playas or temporal wetlands (El Cuervo, Mayran, Santiaguillo, Babicora), reservoirs or dams (El Palmito, Boquilla, La Amistad) as well as a numerous small ponds and water tanks used for agriculture and cattle. The majority

of these wetlands face different threats that diminish water quality and/or water volume including contamination, overuse of water, deforestation, and poorly designed and maintained water treatment infrastructure. Unfortunately, factors including land use change, overgrazing, erosion, pesticides, and overuse of water are decreasing the number and the quality of wetland habitat throughout the arid lands of the Mexican Highlands. Due to the regional importance of the Mexican Highlands, several action plans have been implemented by the government and non-government organizations to maintain these critical wetlands and their ecological function. Efforts are being made to increase the number of environmentally friendly techniques being implemented where threats to wetlands are occurring including increasing the efficiency of treatment plants, modifying agriculture and cattle production programs, increasing regulations and developing new environmental education programs to diminish current trends in wetland declines and maintain their environmental benefits. ■

Management & Applied Science: Other

PRESENTATION 1049
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS I*, 05/30/2018, 01:00 - 02:50

TREATMENT OF BENZENE CONTAMINATION USING RHIZOREMEDIATION AT A PETROCHEMICAL FACILITY IN BRAZIL

Coelho, Flavio, ERM, Rio de Janeiro, RJ, Brazil

Background: Phytoremediation, the use of plants to degrade toxic contaminants in the environment, involves different number of processes. Rhizoremediation systems rely on a synergistic relationship between suitable plants and their root associated microbial communities, when degradation is facilitated through a rhizosphere effect where plants exude organic compounds through their roots and thereby increase the density and activity of potential hydrocarbon degrading microorganisms in the area surrounding the roots. The chemical facility is located in Rio de Janeiro, at an environmentally protected area. The existing benzene contamination impacts an area of approximately 120,000 sq. meters, in concentrations of up to 900 mg/L. This approach will be used in areas where concentrations are below 10 mg/L, which comprises approximately 90% of the plume area.

Objective: Rhizoremediation is being used to slow down the groundwater flow towards the bay and at the same time provide the ideal rhizosphere to enhance bacterial and fungal activity and degrade the VOCs.

Methods: A bench scale pilot test was performed to determine the potential for in situ bioremediation at the site. The test was designed to evaluate the effectiveness of anaerobic and aerobic ISB to treat the benzene. The test concluded that benzene-degrading bacteria existed at the soil and groundwater at the site, and that oxygenation of the media favored the reduction of the VOCs. Another study was conducted to determine, between the several native plants to the region, which ones would be more efficient on the overall objective of the project.

Results: The treatability tests indicated a removal efficiency 99.8% or higher reductions in benzene and complete reductions of toluene, ethylbenzene, and total xylenes. Oxygenation of the sand soil and groundwater would provide for greater and more rapid reductions in VOCs. Native plants were selected and will be part of the pilot study.

Conclusions: Rhizoremediation is suited for the issue at hand and has already been approved for pilot testing. The pilot test activities will be conducted in the first semester of 2018. Full-scale field work implementation is scheduled to start in November 2018. The paper will also include the environmental agency response to the proposed rhizoremediation technology and the strategy used to convey the technology both to the agency and the communities around the site. ■

PRESENTATION 1073
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS I*, 05/30/2018, 01:00 - 02:50

PHYTOREMEDIATION PILOT STUDY FOR ARSENIC-IMPACTED COASTAL SOILS AND SEDIMENTS IN NORTHERN CALIFORNIA

Wolf, Katie, ERM, Boston, MA
Warner, Jim, ERM, Walnut Creek, CA

A parcel of land approximately 140-acres in size is located down-gradient of an active industrial property. The parcel consists primarily of undeveloped pasture terrain and encompasses seasonal vernal pools and a tidally-influenced flood control canal. Portions of the pasture that are adjacent to the industrial property historically received arsenic-based herbicides as part of weed abatement efforts. As a result, arsenic compounds are present above the associated regulatory screening level in the shallow soils and sediments in the pasture and flood control canal. A pilot study has been implemented within the arsenic-impacted pasture to assess the feasibility of phytoremediation as a means of stabilizing and remediating the arsenic impacted soils. To evaluate phytoremediation as a potential remedial option for the site, two experimental study plots were established within the pasture area where arsenic concentrations in soil were

highest. Baseline soil samples were collected using a multi-incremental sampling approach prior to planting in order to characterize pre-remedial baseline arsenic and agronomic conditions in soil across the plots. Arsenic-accumulating plants, including brake ferns (Pteris spp.), Napier grass (Pennisetum purpureum), and willows (Salix spp.), were subsequently transplanted from an off-site greenhouse into the prepared plots following baseline sampling activities. At the end of the pilot study, soil and plant tissue samples within the pilot study plots were collected using the same multi-incremental sampling approach to identify concentration changes in soil and to document arsenic uptake levels in fern fronds as part of the remedy evaluation. Multiple lines of evidence from the pilot study will be presented to demonstrate the viability of phytoremediation as a remedy at the site to reduce arsenic levels in soil in a safer and more sustainable way. These results will be used to further refine the full-scale remedy and will provide a basis for the forthcoming Corrective Action Plan. ■

PRESENTATION 1159

PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION I*, 05/31/2018, 01:00 - 02:50

NATIONAL AND INTERNATIONAL CONSIDERATIONS OF TRADITIONAL ECOLOGICAL PERSPECTIVES AND PRACTICES IN WETLANDS PROTECTION, WISE USE, AND RESTORATION

Kutschenreuter, Kathleen, Office of Wetlands, Oceans, and Watersheds, Washington, DC

Native Americans may share many attributes in their values, way of life, and historic and present-day circumstances, but each tribe brings unique practices, belief systems, and traditional ecological knowledge to aquatic resource management and restoration practices. There are 567 federally recognized tribes spread throughout the United States covering over 110,000 square miles and responsible for protecting and restoring rivers, streams, and lakes, as well as ground water. EPA strives to protect human health and the environment of all federally recognized tribes by supporting implementation of federal environmental laws consistent with federal trust responsibilities, tribal sovereignty, and EPA's 1984 Indian Policy. Specifically, EPA's National Wetlands and Aquatic Resources Program supports tribes by providing financial and technical assistance to develop wetland and aquatic resource programs. The combination of unique legal status and culture means each tribe brings different perspectives and concerns about issues such as: preserving subsistence ways of living; protecting wetlands and other aquatic resources that are integral to protecting and maintaining treaty reserved rights that support hunting, fishing, gathering and/or cultural uses; protecting cultural information, sacred sites, and other places of cultural significance; and addressing pollution impacts in Indian country. This presentation will explore cultural intricacies of sustainable wetland and aquatic resource protection and restoration by highlighting successful collaboration among indigenous peoples/nations, wetland scientists, and governmental agencies within the U.S. as well as under the International Ramsar Convention/Treaty. EPA's Enhancing State and Tribal Programs initiative is dedicated to fostering dialogue between EPA and tribes and increasing tribal capacity by providing funding and technical assistance for tribes to develop protective regulations, monitoring and assessment programs, voluntary restoration and protection efforts, and water quality standards for wetlands. This presentation affirms EPA's commitment to deepening our awareness and attunement not only to the historical and legal challenges tribes/indigenous peoples face, but also to the diverse and deeply intertwined spiritual and cultural factors fundamentally linked to the viability and integrity of our nation's aquatic resources for generations to come. ■

PRESENTATION 1220

PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS I*, 06/01/2018, 09:45 - 11:35

ESTABLISHING A QUANTITATIVE DEFINITION OF REFERENCE FOR THE USEPA'S NATIONAL WETLAND CONDITION ASSESSMENT

Kentula, Mary, US Environmental Protection Agency, Corvallis, OR
Herlihy, Alan, Oregon State University, Corvallis, OR
Magee, Teresa, US Environmental Protection Agency, Corvallis, OR
Lomnicky, Gregg, CSS Incorporated, Corvallis, OR
Nahlik, Amanda M., US Environmental Protection Agency, Corvallis, OR
Serenbetz, Gregg, U.S. Environmental Protection Agency, Washington, DC

A major challenge when conducting an assessment of natural resources is determining the appropriate standard (i.e., reference) against which to judge ecological condition. The process is complicated by the (1) tremendous natural environmental heterogeneity that exists within a large landscape and (2) variability of wetland quality across and within regions. We describe the process to identify reference sites for the US Environmental Protection Agency's (USEPA) 2011 National Wetland Condition Assessment (NWCA). For the NWCA, reference sites are those with the best

available ecological condition given the current state of the landscape, i.e., least disturbed sites. NWCA 2011 employed a probability design to sample 1138 sites across the contiguous US to make a quantitative assessment of wetland condition. Vegetation data were used to define ten combinations of ecoregions and wetland types (hereafter reporting groups) that minimized within-group natural variability. For each reporting group, all sites were arrayed along a gradient defined by ten measures of disturbance based on land use, hydrologic modifications, soil heavy metals, and alien plants. Disturbance thresholds of least (i.e., reference), intermediate, and most disturbed were established. Ultimately 277 least disturbed reference sites were identified of which 170 qualified as minimally disturbed (i.e., none of the disturbance measures were present). Amount and type of disturbance found in reference sites varied by region and wetland type. An effort to handpick reference sites prior to sampling had a 52% failure rate when evaluated against the quantitative definition developed for reference for the appropriate reporting group. The NWCA provides a unique opportunity to improve our conceptual and technical understanding of how to apply a reference approach to assess the wetland resource across the conterminous US. Moreover, the number of quantitatively defined reference sites will grow with each subsequent NWCA. This abstract does not necessarily reflect USEPA policy. ■

PRESENTATION 1241

PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS II*, 05/30/2018, 03:10 - 05:00

LESSONS LEARNED: APPLICATION OF PHYTOREMEDIATION IN PLACE OF CONVENTIONAL PUMP AND TREAT APPROACH AT A HYDROCARBON-IMPACTED SITE

Searcy, Brent, ETIC, Pleasant Hill, CA
Oram, Douglas, ETIC, Pleasant Hill, CA
Haughy, Ryan, ETIC, Pleasant Hill, CA

A pilot study is in progress to assess the feasibility of enhancing, and potentially replacing, conventional remediation systems with a phytoremediation-based design at a hydrocarbon-impacted site in California's San Joaquin Valley. The existing systems consist of groundwater and soil vapor extraction and treatment. Projected long-term energy and water usage, and air emissions rates for these systems were motivating factors in developing an alternative means to achieve the necessary hydraulic control and degradation of hydrocarbons in soil and groundwater.

A Phase I test plot was installed in the spring of 2017, with planting of 274 immature hybrid poplar whips in 300-millimeter diameter boreholes over a 1,230-square meter grid. Groundwater elevations were monitored continuously within, and outside of, the test plot to assess hydraulic containment developed via uptake of groundwater by poplar trees. Poplar tree health was monitored via trunk diameter and tree height measurements, leaf appearance, and leaf tissue analysis. Soil and groundwater chemistry in the test plot was analyzed for factors that may affect tree health. In addition, a carbon dioxide (CO2) flux survey was conducted using isotopic speciation of CO2 emitted from the plot to assess phytoremediation effectiveness in enhancing the rate of hydrocarbon degradation.

After 9 months of growth, tree health ranged from trees over 4 meters tall with healthy leaf stock, to trees that were no longer viable. The observed mortality rate for Phase I was higher than anticipated. The tree health data collected during this 9-month period has been assessed, and primary and secondary factors in tree mortality have been determined. These include: length of aboveground whip exposure at initial planting, tree planting date, lack of irrigation, boron and salt concentrations within soils and groundwater, hydrocarbon concentrations in shallow soils beneath the test plot, and damage caused by poplar borers and rabbits. Phase II of the pilot study has been initiated with the planting of 273 additional trees in the spring of 2018. Tree mortality factors identified in Phase I will be mitigated in Phase II via a variety of modifications to the tree planting schedule and procedures. ■

PRESENTATION 1246

PRESENTED DURING *FROM MAPPING TO MONITORING: TRACKING WETLAND ACRES, FUNCTIONS, CONDITION, AND SIGNIFICANCE IN THE ROCKY MOUNTAINS I*, 05/30/2018, 01:00 - 02:30

LANDSCAPE-LEVEL WETLAND ASSESSMENT: MONTANA'S MT-NWI++

Chutz, Jennifer, Montana Natural Heritage Program, Helena, MT
Vance, Linda, Montana Natural Heritage Program, Helena, MT

The Montana Natural Heritage Program has been mapping wetland and riparian areas in Montana since 2007 as part of the National Wetlands Inventory. As the mapping nears completion, we have begun incorporating a suite of value-added attributes that enhance user ability to query the mapping to answer questions about habitat values, landscape context, spatial proximity to streams and rivers, and function. We have also developed a GIS approach to identifying wetlands of special significance that can be targeted for additional protection by land and resource managers. Furthermore, we have incorporated some of the threats facing wetlands, including invasion by Russian olive, whether

a site has been affected by fire, and its threat level from future fires. In this session, we will present how we derive wetland functions from wetland mapping, the techniques used to attribute wetlands and riparian areas with this additional information in Montana's MT-NWI++ dataset, and how these attributes are used to identify wetlands of special significance in Montana. ■

PRESENTATION 1335
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION I*, 05/30/2018, 09:55 - 11:35

TACKLING OPERATIONAL CHALLENGES OF CONSTRUCTED WETLANDS

Mokry, Loretta, Alan Plummer Associates, Inc., College Station, TX

The use of constructed wetlands, wetland systems engineered for water quality treatment, has become an accepted, and increasingly utilized, treatment technology. Constructed wetlands are often employed in conjunction with other natural treatment components such as lagoons and ponds or to provide polishing of effluent from traditional sewage plants to meet increasingly stringent discharge permit criteria. They provide a reliable, cost-effective (both in terms of initial capital and long term operations and maintenance) treatment technology for water quality improvement and can provide multiple benefits for a community. However, some understanding of the natural processes and treatment mechanisms is essential to maintain treatment efficiency and high quality effluent. Some operational challenges are also quite different than for mechanical treatment systems.

Critical components of wetland design and operation include optimization of flow distribution to provide the target hydraulic retention time (HRT) for the design flows, establishment and maintenance of a healthy, robust aquatic plant community, and population control of nuisance wildlife including exotic, invasive species such as nutria and feral hogs, which can be destructive and detrimental to the health and functioning of the wetland treatment system.

Operations and maintenance for constructed wetland systems require attention to maintain effective treatment capability. Routine monitoring of vegetative cover and health, water level control structures, and bioturbation impacts is necessary to identify potential problems. Operational control consists mostly of flow control and proportioning through the wetland system, and water depth adjustment to maintain appropriate HRT and promote healthy vegetative cover. Maintenance includes control of bioturbation through timely implementation of control measures to discourage the target wildlife and/or hunting or trapping to remove specific animals from the system, repair of damage to levees or water control structures, remedial plantings where needed to address short-circuiting flow patterns or other impacted areas, and periodic mowing of access areas and roadways. ■

PRESENTATION 1468
PRESENTED DURING *ECOSYSTEM SCIENCE III*, 06/01/2018, 03:20 - 05:00

ESTABLISHING NEW POPULATIONS OF THE COLORADO BUTTERFLY PLANT, A LISTED SPECIES UNDER THE ENDANGERED SPECIES ACT: WETLAND HABITAT REQUIREMENTS

Smith, Peter, Smith Environmental and Engineering, Dacono, CO

The Colorado butterfly plant (CBP) is a member of the evening primrose family and is a short-lived perennial herb with one to several reddish, pubescent stems that are 50-200 centimeters (cm) (2-7 feet) tall. It is a Federally-listed species (threatened) under the Endangered Species Act. Of the known populations of the CBP, the vast majority occur on private lands managed primarily for agriculture and livestock. The species historical range included Colorado, Nebraska, Wyoming. It's wetland indicator status is Facultative Wet. The purpose of this investigation was to develop a better understanding of the characteristics of the habitat supporting re-introduced CBP - the optimal soil, plant, and hydrologic characteristics - to aid in the re-introduction of the species. Twenty potential sites were investigated to identify 16 sites in the Colorado Front Range where the CBP was planted and/or seeded. CBP seeds and plants were obtained from a private CBP nursery in Thornton, Colorado. Pedologic, hydrologic and plant community characteristics were investigated at the 20 sites to screen out wetland areas that were not suitable. Characteristics of unsuitable sites include: frequent (more than once every two years) flooding, soils with coarse surface textures, soils with high salinity (> 8 Ds/m) salinity in the surface horizon, areas with dense stands of cattails and bulrush, and dense, weedy areas. The sites receiving plants and/or seed were monitored for five years. Of the 16 sites seeded and/or planted, five had populations surviving more than one year and four had populations surviving more than four years. Of the 11 sites that did not support CBP populations more than one year, valuable information was obtained to more narrowly define optimal characteristics of re-introduced CBP populations so as to provide greater opportunity for establishment of future populations. ■

PRESENTATION 1531
PRESENTED DURING *HUMAN DIMENSIONS OF WETLANDS*, 06/01/2018, 09:55 - 11:35

THE DECISION FRAMEWORK FOR LOUISIANA'S COASTAL MASTER PLAN

Green, Mandy, CPRA, Baton Rouge, LA

The Coastal Protection and Restoration Authority (CPRA) is charged with coordinating restoration and protection investments through the development and implementation of Louisiana's Comprehensive Master Plan for a Sustainable Coast (Plan). The first coastal master plan was submitted to the Louisiana Legislature in 2007 and is mandated to be updated every five years. The plan's objectives are to reduce economic losses from flooding, promote sustainability by harnessing natural processes, provide habitats for commercial and recreational activities, sustain cultural heritage, and promote a viable working coast. Two goals drive decision making about the appropriate suite of restoration and risk reduction projects to include in the Plan: restore and maintain Louisiana's wetlands and provide flood protection for coastal Louisiana's citizens. As part of the decision making framework, a wide range of metrics are used to understand and evaluate the complex, competing needs of communities, industries, navigation, and fisheries.

The master plan decision making framework includes the identification of individual risk reduction and restoration projects that are evaluated with landscape, storm surge, and risk assessment models and then ranked by how well they perform over time across the set of decision drivers and metrics. High performing projects are assembled into alternatives (suites of projects) constrained by available funding and river resources. The planning process is grounded not only on extensive scientific analysis but also on interdisciplinary collaboration between scientists, engineers, planners, community advocates, and coastal stakeholders, which creates the long-term dialogue and transparency needed for complex environmental planning decisions. It is through this collaboration that recommended alternatives are reviewed and modified to develop each Plan. ■

PRESENTATION 1603
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES I*, 06/01/2018, 09:45 - 11:35

FLOATING WETLAND PERMITTING CHALLENGES AND CREDITING SYSTEMS

Zisette, Rob, Herrera Environmental Consultants, Seattle, WA

Floating wetlands are a cost effective method for improving water quality and habitat functions in impaired waters. While interest and use are increasing in the U.S., they are still a relatively new concept that can create challenges to obtaining permits and credits. The objective of the presentation is to summarize permitting challenges with floating wetlands in Washington State, and describe how permitting requirements vary by the type of water body, regulatory agency, and state. Information provided by a regulatory panel at the 2015 SWS Pacific Northwest Conference is updated with current agency policies and recent examples of permitting requirements for floating wetland projects in Washington State and other states. Another objective of the presentation is to summarize water quality and habitat function credits provided to floating wetland projects. Credit system examples include water quality credits recommended by an expert panel for the Urban Stormwater Working Group of Chesapeake Bay Program, and Chinook salmon habitat credits evaluated by a wetland scientist at the University of Washington. Barriers to permitting and crediting floating wetlands are addressed. ■

Physical Sciences: Geochemistry & Chemistry

PRESENTATION 1121
PRESENTED DURING *ECOSYSTEM SCIENCE III*, 06/01/2018, 03:20 - 05:00

MULTI-ELEMENT FINGERPRINTING TO ASSESS CHEMICAL CONNECTIVITY BETWEEN PRAIRIE POTHOLE WETLAND SOILS ACROSS NORTH DAKOTA, USA

Zhu, Xiaoyan, North Dakota State University, Fargo, ND
Yuan, Yuxiang, Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, Changchun, Jilin, China
Mushet, David, US Geological Survey, Jamestown, ND
Otte, Marinus, North Dakota State University, Fargo, ND

The question of wetland connectivity has been particularly relevant to wetlands in the Prairie Pothole Region (PPR), because they are often considered "isolated wetlands". Current monitoring does not take connectivity other than through surface water into account. In this study, multi-element fingerprinting was used to determine chemical connectivity between PPR wetlands (ten likely connected 'sequences' of at least one of each of recharge, flow-through and discharge wetlands) in North Dakota. The concentrations of 58 elements in the topsoils were determined. Soil pH (explaining 29.1% of variation, P=0.006) and organic matter content (OM, 13.4%, P=0.006) were the most important variables determining variation in element concentrations of all wetlands combined. In recharge wetlands, OM explained 53.8% (P=0.002) and in discharge wetlands 22.7% (P=0.009), while electrical conductivity (EC) did not play an important role. In contrast, in flow-through wetlands, 26.7% of variation was explained by EC (P=0.006), and 25.8% by OM(P=0.006). The fingerprints of three of the ten sequences were different from the others, most likely due to the disturbance from restoration, serious grazing and seeps. At the time of writing, our data analysis suggested that landscape level variation explains more of the variation between multi-element fingerprints of wetland soils than connectivity, but data analysis was ongoing. ■

PRESENTATION 1457
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS IV*, 05/31/2018, 09:55 - 11:35

BIOGEOCHEMICAL CONTROLS ON GEOLOGIC PHOSPHATE DISSOLUTION IN HUMIC WATERS

Phelps, Sara, University of Florida, Gainesville, FL
Osborne, Todd, University of Florida, St. Augustine, FL
Bochnak, Angelique, ECT, Gainesville, FL

Since the establishment of the Clean Water Act, managers have sought to reduce pollutant loads to impaired lakes to reach total maximum daily loads. However, non-point source (NPS) pollution continues to challenge pollutant management. One potential source of NPS pollution is erosion and sediment transport from urban areas with large amounts of concentrated runoff. While erosion and sediment transport is not typically a major NPS pollutant for nutrients, Florida's geology indicates a closer look. The U.S. Geological Survey suggests that geological units with notable amounts of phosphate can be found at or near land surface across 19% of Florida. This estimate does not take into account further exposure by erosion, channelization, and earth moving activities. Therefore, erosion and sediment transport in this geologic setting may be a significant source of phosphorus loading to drainage lakes. Furthermore, changes in the intensity of storm events are likely to further exacerbate this issue. In this study, we examined the biogeochemical factors that dictate geologic phosphate dissolution in humic waters.

Geologic phosphate is often considered stable and relatively innocuous despite high total phosphorus concentrations. However, in humic waters, biogeochemical conditions may create an environment conducive to accelerated geologic phosphate dissolution, thereby increasing concentrations of biologically available phosphorus. Our findings from dissolution experiments in humic waters interacting with the phosphate-rich Hawthorn Group help to understand whether erosion and sediment transport of geologic phosphorus is meaningful to phosphorus loads in such regions. These findings may indicate a new approach to phosphorus management, load estimates, and prioritization for humic waters found in this geologic setting. ■

PRESENTATION P72
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

THE IMPACT OF FREEZE-THAW CYCLING ON THE BIOGEOCHEMISTRY OF COPPER IN PEAT SOIL

Glasauer, Susan, University of Guelph, Guelph, ON, Canada
Chen, Shuo, University of Guelph, Guelph, ON, Canada
Heck, Richard, University of Guelph, Guelph, ON, Canada

Cycling between freezing and thawing conditions is a significant climatic phenomenon in northern peat soils. In recent years, reduced snowpack in some regions is increasing the frequency and amplitude of freeze-thaw (F-T) events, with potential to change the chemical, physical and microbial characteristics of the upper peat layer. We have investigated the impacts of F-T fluctuations and exposure to dissolved copper on the physical and microbial properties of peat to anticipate the future impacts of proposed Cu mining on a northern Ontario peatland.

Experiments were designed to assess how F-T magnitude and rate impact outcomes. Changes to peat structure were quantified as changes in the abundance and size distribution of pores; microbial respiration was determined with incubation experiments as CO2 and CH4 production. Peat was collected from a peat bog at Luther Marsh in Ontario. Large roots were removed, but the peat was otherwise untreated. F-T cycles were repeated 3 times on cores under the following conditions 1) freezing at -20 C and thawing at +20 C, and 2) freezing at -4 C and thawing at +4 C. Changes in porosity were assessed using computed tomography. Microbial respiration was determined using a Challenger respirometer and jar incubation under anaerobic conditions, with analysis for CO2 and CH4 using gas chromatography. Copper was added to the incubation vessels as 20 ppm CuSO4.

F-T cycling at -20/+20 increased porosity (2.78%) relative to the unfrozen control (2.05%), whereas -4/+4 F-T cycling decreased porosity (1.36%). The -20/+20 group had fewer mesopores and more macropores than the -4/+4 treatment; the control had only mesopores or smaller. CO2 production tended to be higher in peat that was not frozen, with and without Cu, than in peat cycled at -4/+4. Methane production was the same after -4/+4 treatment except when Cu was added; Cu essentially eliminated methane production in the -4/+4 treatments. More Cu was released from the soil after F-T cycling in all cases.

Based on our results, F-T cycling near 0 C will decrease soil porosity and release more sorbed Cu to pore water relative to unfrozen peat. F-T cycling reduces microbial respiration overall, but impacts net methane production more than carbon dioxide. Exposure to Cu magnifies the impacts of F-T cycling on methane. The results suggest that anticipated future increases in freeze-thaw cycling will mobilize Cu in peatlands. ■

Physical Sciences: Geomorphology, Hydrology & Watersheds

PRESENTATION 1037
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS II*, 06/01/2018, 09:55 - 11:35

FLUVIAL HAZARD MAPPING AND THE CONNECTION TO PROTECTING AND RECLAIMING FLOODPLAIN WETLANDS

Blazewicz, Michael, Round River Design, Inc, Salida, CO

River change from floods has largely been ignored in floodplain management, which is often focused on inundation risk. Rapid change in stream location and the scour and filling of floodplains with debris is linked to increased habitat complexity in river corridors - including the creation of floodplain wetlands. Post-flood "restoration" activities have ignored river channel change and frequently filled in nascent wetlands. A framework for mapping river-related erosion hazards is being developed for the Colorado Water Conservation Board. The goal of this mapping is to reduce the long-term risk to life and property by educating communities and landowners about the existing risk associated with river channel movement. Fluvial hazard maps used in conjunction with FEMA floodplain inundation maps can further help us understand and define the concept of an active river corridor with the longer term secondary effect of reducing human investment in these high risk areas, protecting riparian and floodplain wetlands from development, and helping us understand the concepts of river channel change as a driver for long-term physical and ecological stability. Future application of fluvial hazard mapping will have the secondary affect of protecting (and passively re-establishing) floodplain wetlands in Colorado and other states adopting similar protocols. The preliminary mapping protocol co-authored by the presenter will be shared along with several case studies with specific emphasis on wetlands. Feedback from SWS members on the use and application will be sought. ■

PRESENTATION 1080
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS III*,
06/01/2018, 01:10 - 02:50

RECONNECTING THE FLOODPLAIN TO RESTORE WETLAND HYDROLOGY AND FLOOD STORAGE: A "DIAGNOSE AND TREAT" APPROACH

Stamer, Reid, EarthView Environmental Inc., Coralville, IA
Joyce, Judith, EarthView Environmental, Inc., Coralville, IA
Cherry, Shane, Shane Cherry Consulting, Inc., Fort Myers, FL

Many Midwest urban streams have been assessed as degraded, entrenched and disconnected from their historic floodplains with relatively low-valued riparian vegetation dominated by highly invasive species. Floodplain reconnection by excavating lower floodplain benches and/or raising the streambed to engage historic floodplain areas can be a primary restoration strategy to restore acre-feet of flood storage per mile of stream length for a stream. Additionally, the increased hydraulic roughness can reduce downstream flood peaks by metering out runoff more slowly. Hydraulic roughness increases with in-stream habitat structures, channel irregularity (e.g. meanders), bank vegetation, and floodplain vegetation. Story County Conservation, partnering with Iowa State University (ISU) Research Park, set out to restore an unnamed stream and develop an outdoor learning and recreation area, named the Tedesco Environmental Learning Corridor, which occupies 30 acres inside the research park. The site's topography and small to non-existent flooding risk for the surrounding research park made it feasible for most of the project site to achieve floodplain reconnection with a combination of filling in and raising the stream bed and excavating the surrounding historic floodplain while also enhancing and modify existing riffles to improve channel stability. Removing riparian trees to emulate the historic prairie landscape provided the appropriate woody material for in-stream structures that provide channel stability and habitat. Temperature benefits may be realized by incorporating connection to shallow groundwater in the hyporheic zone along the channel or by creating stream channel temperature stratification in backwater pools connected to shallow groundwater seeps. The discussion will focus on floodplain reconnection as a primary restoration strategy, demonstrate the "diagnose and treat" approach, highlight and contrast target plant communities. Multiple objectives, in addition to the flood reduction benefits, include: ecological improvement to stream and riparian habitat, bank stabilization to reduce sediment and nutrient loading, aesthetic and experiential benefits to park users, and increased educational and research opportunities. ■

PRESENTATION 1212
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS II*,
06/01/2018, 09:55 - 11:35

CONTROLS ON WETLAND DISTRIBUTION IN SOUTHERN AFRICA: UNDERSTANDING THE ROLE OF GEOMORPHOLOGY

Ellery, William, Rhodes University, Grahamstown, Eastern Cape, South Africa

With an average altitude of approximately 1 000 m, Southern Africa is situated at an unusually high altitude for a subcontinent that has not undergone mountain building for several hundreds of millions of years. Given this, erosion is the dominant geomorphic process at a subcontinental scale. Given that wetlands occur in geomorphological settings that are non-erosional as they are typically characterised by valley-fill sedimentary sequences, it is intriguing that the region contains many wetlands in diverse geomorphic settings. They occupy valleys dominated by meandering floodplain streams in which a resistant lithology limits valley erosion in an upstream direction. Meander migration leads to longitudinal slope reduction and valley widening such that floodplains dominate in this setting. The Klip River wetland in the eastern Free State Province is a good example. The deposition of sediment on trunk valleys may block tributary valleys, giving rise to valley-bottom wetlands at the toe of the tributary valley – as illustrated by the Mkuze wetland in the northern KwaZulu-Natal Province. Alternatively, sediment deposition at the toe of an eroding tributary valley may block the trunk valley, leading to valley-bottom wetlands upstream of the tributary confluence, which is illustrated by the Nylsvlei wetland in Limpopo Province. Repeated cycles of erosion and deposition of valley floors lead to longitudinal slope reduction and valley widening, and the formation of valley-bottom wetlands, as illustrated by the Krom River wetland in the Eastern Cape Province. Localised deflation of the land surface by wind leads to the formation of depression wetlands (pans in the Northern Cape Province), and on ancient erosion surfaces, deep weathering of certain lithologies leads to loss of metals and mineralogical simplification, which together lead to sagging and the formation of depression wetlands (Nyamvubu Vlei in the KwaZulu-Natal Midlands). A broad conceptual model integrating geomorphology and hydrology as key agents of wetland formation, structure and function is presented, which should form an integral part of the development of policy development and management practice regionally and possibly globally. ■

PRESENTATION 1229
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS IV*, 06/01/2018, 03:20 - 05:00

PLACING RECENT VEGETATION, HYDROLOGY, AND FIRE VARIABILITY OF GREAT DISMAL SWAMP INTO A HOLOCENE CONTEXT

Willard, Debra, US Geological Survey, Reston, VA
Jones, Miriam, USGS, Reston, VA
Hoefke, Kristen, US Geological Survey, Reston, VA
Wurster, Fred, US Fish and Wildlife Service, Suffolk, VA

Great Dismal Swamp (GDS) in southeastern Virginia and northeastern North Carolina (USA) covers more than 100,000 acres of forested peatlands. Intensive efforts to drain and log GDS began in the 18th century, significantly altering the hydrology and native vegetation and increasing the frequency and severity of fires. Goals of the GDS National Wildlife Refuge, established in 1974 CE, include restoration and maintenance of the natural biological diversity of the swamp. Reconstruction of past vegetation, hydrology, and fire history from sites throughout the Refuge are providing evidence for natural variability and impacts of land-use history and specific management actions. Pollen, plant macrofossils, microscopic and macroscopic charcoal, and physical properties of sediments were analyzed from two cores collected in a cypress-tupelo swamp and an Atlantic white cedar swamp that was burnt by wildfires in 2008 and 2011 CE. The oldest recovered sediments date to the Younger Dryas (YD, 12.9-11.7 kiloanum, ka), and pollen and plant macrofossil evidence from the basal sediments indicate the presence of cooler vegetation types now found farther north (Fagus, Tsuga). Post-YD, early Holocene floras are characterized by marsh assemblages, which were replaced by forested wetlands between 4.0 – 3.5 ka. Charcoal records indicate that fires occurred primarily in the marsh stage of the early Holocene and were infrequent during most of the forested wetland stage of the mid- to late- Holocene. The highest charcoal concentrations occur after Colonial land clearance, peaking in the uppermost sediments, likely deposited after the 2008 and 2011 CE fires. Abundant Eupatorium pollen and seeds characterize the post-burn assemblages. By providing data on the impacts of land clearance, swamp drainage, and natural climate variability on vegetation, hydrology, and fire frequency, these records are informing managers on rates of change and the response of the wetland community to a range of environmental stressors. ■

PRESENTATION 1254
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS III*, 06/01/2018, 01:10 - 02:50

THE ORIGIN OF BEDROCK DEPRESSION WETLANDS IN THE SOUTHERN CAPE OF SOUTH AFRICA: A CHANGING PERSPECTIVE.

Ellery, Steven, Rhodes University, Grahamstown, Eastern Cape, South Africa
Ellery, William, Rhodes University, Grahamstown, Eastern Cape, South Africa

The predominant theory of the origin of depression wetlands in southern Africa was developed by Goudie and Thomas (1985) and focuses primarily on mechanisms relating to deflation and erosion as the main drivers of wetland formation. This theory is based on wind driven deflation of animal watering areas where heavy grazing and trampling of vegetation promotes removal of sediment over short periods of time by wind, to create local depressions and impoundment of water. However, this theory applies in arid and semi-arid areas where grazing can reduce vegetation sufficiently to lead to deflation, but does not fully explain the origins of depression wetlands that have formed in moist climates or on ancient erosion surfaces such as the Post African Erosion Surface 1 (PAES1). This study investigates the origin of a depression wetland that has formed on sandstone bedrock through weathering and dissolution on the PAES1 in South Africa. Wetlands like this act as groundwater recharge zones such that water flows away from the centre of the depression, taking with it any dissolved solutes derived from weathering of the bed of the depression. Fluctuations between wet and dry periods create both highly reducing conditions (during wet phases) and highly oxidizing conditions (during dry phases) beneath the margins of these depression wetlands. Some of the main constituents of the sandstone in this wetland are iron(III) oxides, which are highly sensitive to redox conditions and have therefore been transported to, and trapped in the margins of the depression. The redistribution of iron(III) oxides from the centre towards the margins of the depression has caused a net volume loss in the centre of the depression, causing sagging, and a net volume gain at the margins of the depression associated with swelling. This process occurs over periods upwards of a million years and explains the presence of depression wetlands in moist climates on ancient erosion surfaces. ■

PRESENTATION 1262
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE III*, 06/01/2018, 03:10 - 05:00

AN APPROXIMATION TO THE HYDROLOGY OF A HIGH-ANDEAN WETLAND ECOSYSTEM *BOFEDAL* IN APURIMAC (PERU), USING MODELED AND IN-SITU COLLECTED DATA.

Baiker, Jan, Asociación para la Conservación y el Estudio de Montañas Andinas-Amazónicas (ACEMAA), Cusco, Cusco, Peru
Andres, Norina, Swiss Federal Research Institute WSL, Birmensdorf, Zurich, Switzerland
Pfeuffer, Carina, Swiss Federal Research Institute WSL, Birmensdorf, Zurich, Switzerland
Zappa, Massimiliano, Swiss Federal Research Institute WSL, Birmensdorf, Zurich, Switzerland
Rohrer, Mario, Meteodat, Zurich, Zurich, Switzerland

Tropical high-Andean wetland ecosystems (bofedales) are a diverse group of semi-aquatic/terrestrial ecosystems, which depend highly on local water regimes. They are found in the high part of watersheds, frequently just below glaciers. Although it is generally recognised that they play an important role in the provision and maintenance of hydrological services (i.e. water storage, retention and buffer), very little data about the hydrology of this ecosystems are available till now. This lack of data about the ecosystem services provided by bofedales makes it difficult to consider these ecosystems in the context of the adaptation to the adverse impacts of climate change. This study intends to reduce this lack of data, by combining two different approaches: 1) hydrological modeling, using the Precipitation-Runnof-Evapotranspiration Hydrotope model (PREVAH), with a compilation of data coming from a gauged watershed in the Swiss Alps, with wich the PREVAH was calibrated; 2) two years of intensive (but not complete) in-situ hydrological monitoring in a formerly ungauged catchment in the Ampay National Sanctuary (Apurimac, Peru). The results show that none of the two approaches - applied individually - is sufficient to understand the hydrology of a bofedal, in regions with a lack of basic hydrological monitoring data, but that the combination of the two approaches allows a significant approximation to the real situation. Based on this analysis, a first calculation of the water storage capacity and the water retention time in the study-bofedal is conducted. ■

PRESENTATION 1274
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE I*, 06/01/2018, 09:45 - 11:35

MAPPING AND CARBON ACCUMULATION OF HIGH ANDEAN WETLANDS IN RIVER-BASIN HEADWATERS OF PERU

Leyva-Molina, Walter-Martín, Centro de Competencias del Agua, Lima, Lima, Peru
Willems, Bram, Centro de Competencias del Agua, Lima, Lima, Peru
Espinoza-Villar, Raúl, Centro de Competencias del Agua, Lima, Lima, Peru
Moreira-Turcq, Patricia, Institut de Recherche pour le Développement, Lima, Lima, Peru
Garcia, Jorge, Centro de Competencias del Agua, Lima, Lima, Peru
Adauto, Maria-Elena, Centro de Competencias del Agua, Lima, Lima, Peru
Huaman, YizetCentro de Competencias del Agua, Lima, Lima, Peru
Llanos, Romina, Centro de Competencias del Agua, Lima, Lima, Peru

High Andean wetlands (HAW) are ecosystems are located in Andean river-basin headwaters. They have capacity to store water coming from rainfall to recharge underground deposits and generate a continuous flow downstream. In addition, its soils composed of peat, capture organic carbon, for that reason are an important component of global carbon cycle. Despite its importance, there are few studies, or they are not detailed knowledge, about their distribution, extension and dynamics along the Tropical Andes, because they are located at high altitudes (> 3000 masl) and in difficult access areas; which, in turn, limits its characterization.

There are works that report HAW mapping methodologies, but due to variation of geographic and meteorological characteristics of Peruvian Andes, it is not possible to use a single methodology for their identification. Besides this, most studies on carbon sequestration in tropical soils have focused on low altitude areas. Given these needs, this research has been carried out in Chancay-Lambayeque (Lambayeque), Chillón (Lima) and Cachi (Ayacucho) basin headwaters in Peru and reports the results of a set of proposed methodologies for mapping and characterization of HAW using image data from TM, ETM+ and OLI sensors of Landsat mission, as well as the application of carbon accumulation techniques and carbon-14 dating.

Data processing for mapping started with the preprocessing of satellite images (radiometric and atmospheric correction) and, once soil reflectance image was obtained, then spectral indices and transformations were calculated according to characteristics of each basin headwater. In Chancay-Lambayeque basin, 759.8 ha of HAW were identified from a total area of 3736.9 ha; in Chillón basin, 1862.5

ha of HAW were obtained from a total area of 71902.45 ha and in Cachi basin, 1850 ha of HAW were identified from a total area of 14374.2 ha. On the other hand, peatland cores were collected from Cachi river basin headwater (> 4000 masl), which were later analyzed in laboratory to estimate carbon accumulation rates and sedimentation rates based on dating with carbon-14. Carbon accumulation rates and sedimentation rates were highly variable over time in the HAW's analyzed, which may be related to climate changes we observed during our recent past, with a direct consequence on carbon accumulation rates. ■

PRESENTATION P73
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ACTUAL EVAPOTRANSPIRATION RATES DIFFER MARKEDLY BETWEEN CYPRESS-MAPLE SWAMPS AND PINE-OAK DUNES, FIRST LANDING STATE PARK, VIRGINIA BEACH, VIRGINIA

Whittecar, G. Richard, Old Dominion University, Norfolk, VA
Shoup, Bryce, Old Dominion University, Norfolk, VA

Evapotranspiration (ET) constitutes a major loss to many wetland water budgets, but is often a difficult value to calculate. Potential ET (PET) can be calculated for regions using local weather data, but Actual ET (AET) loss is more difficult to quantify accurately, in part because it can differ based on vegetation type. On barrier islands with large areas of dune ridges and interdune depressional wetlands, vegetation communities between the two settings may have significantly different ET rates. Previous studies show that long-term differences in groundwater recharge (precipitation minus ET) between the dune ridges and swales can cause changes in the water table elevations and shapes. First Landing State Park, southeastern Virginia, sits on a 4km-wide cuspate foreland – a 10+m-thick sand body formed by a sequence of progradation events – surfaced by alternating dunes, beach ridges, and fresh-water peat-filled swales. Earlier studies indicate the groundwater dome is not symmetric and centered in the middle of the island, but has a crest farther north than expected. To determine if variations in AET influence the shape in the water table mound, seven monitoring wells with pressure transducers were installed throughout the park. Three wells were installed in each of the two major dominant vegetation groups, a Bald Cypress/Swamp Tupelo/Red Maple setting and a Pine/Oak setting, and one well was installed at the crest of the groundwater dome. AET was calculated using a modified version of the White's Method, a calculation that uses nighttime groundwater recovery and multiday drawdown. Preliminary results from the early/mid growing-season months for 2017 suggest that on a given day, the average AET rates in the cypress/gum/maple swales (up to 12.7 mm/day) are approximately twice those of the forested sand ridges (up to 7.9 mm/day), but as the growing season ends differences in the rates diminish. Monthly crop coefficients developed for each vegetative group reflect the average daily ratios of calculated Actual (local White method) and Potential (regional Penman method) ET values. These coefficients can be used to more accurately estimate ET in wetland water budgets and in groundwater flow models. ■

PRESENTATION 1283
PRESENTED DURING *RIPARIAN ECOSYSTEMS III: RIVER REGULATION AND RESTORATION*, 05/31/2018, 03:10 - 05:00

POTENTIAL FOR RIPARIAN RESTORATION ON RIVER-RESERVOIR DELTAS IN THE GREAT PLAINS

Johnson, W. Carter, South Dakota State University, Brookings, SD
Scott, Michael, Utah State University, Fort Collins, CO
Volke, Malia, New Mexico Department of Game and Fish, Santa Fe, NM
Dixon, Mark, University of South Dakota, Vermillion, SD

More riparian forest vegetation was destroyed in the Missouri River Basin due to dam construction than in any other watershed in the Great Plains. Losses of biodiversity in the riparian forests that remain between reservoirs and downstream of the last dam continue due to river regulation that has stopped most flooding, channel movement, and sediment transport. A half-century of published research has identified approaches that could have started the restoration process; however, very little has been implemented except localized sandbar and shallow-water habitat construction designed to assist listed species that inhabit riverine, not riparian, habitats. Prospects continue to be dim for river re-regulation to initiate alluviation and channel movement. The remaining forests dominated by cottonwood and willow, termed "the living dead," are senescing at increasing rates. Recent appearance of young riparian forests associated with deltas emerging in reservoirs caught the attention of our team of riparian ecologists who published a seminal paper on the subject in BioScience in 2015. Evidence provided from one field study and that of aerial images of multiple deltas suggests that river-reservoir deltas could be a "silver lining" in a darkening cloud hanging over the disabled Missouri River. More study of these novel delta environments is needed to determine the magnitude of riparian expansion that can be expected in future decades under existing or more favorable reservoir operational rules. ■

PRESENTATION 1310
PRESENTED DURING *RIPARIAN ECOSYSTEMS II: PHYSICAL AND BIOTIC DRIVERS OF CHANGE*, 05/31/2018, 01:00 - 02:50

RIPARIAN COTTONWOOD DECLINE AND MORTALITY AFTER STREAMFLOW DIVERSION, GREAT BASIN NATIONAL PARK

Schook, Derek, Colorado State University, Fort Collins, CO
Friedman, Jonathan, U.S. Geological Survey, Fort Collins, CO
Cooper, David, Colorado State University, Fort Collins, CO

Water is commonly extracted from rivers to support agriculture, but stream diversions endanger riparian ecosystems dependent on river flows. The largest drainage basin in Nevada's Great Basin National Park forms Snake Creek, a river that supports diverse microhabitats and species in an arid landscape. Snake Creek passes through a 5-km section of porous karst, where some surface water is lost to groundwater recharge. To prevent water loss from the local irrigation supply, a water diversion pipeline was built in 1961 to transport water through the karst reach. This action has left the diverted river reach completely or mostly dry throughout the year. We are using cottonwood (Populus trichocarpa, P. angustifolia, and hybrids) dendrochronology to understand the spatial and temporal patterns of riparian forest declines associated with the diversion pipeline by investigating the dewatered and adjacent reference reaches. Cottonwoods in the dewatered reach and both Snake Creek reference reaches had 80-95% of trees with their first year of growth being from 1870-1935, revealing low regeneration over the last 80 years across reaches. Tree mortality was highest in the dewatered reach (36%) compared to three reference reaches (12-14% mortality at Snake Creek above and below the diversion and at Baker Creek). Cross-dating revealed that 86 of the 110 (78%) sampled dead trees in the dewatered reach died after 2005, a half-century after pipeline installation. Among the living trees, percent live canopy was lowest in the dewatered reach (45%) compared to the three reference reaches (63-76%). Ring width analyses revealed that basal growth in the dewatered reach did not substantially differ from that of reference trees in the first three decades after the diversion was installed; however, over the last two decades dewatered tree ring widths diverged from those in reference reaches and have declined sharply. After the year 2000, ring widths in the dewatered reach resembled trends seen preceding mortality in dead trees, likely foreshadowing additional mortality. Aerial photography and stable isotope analyses are under way to complement tree-ring analysis. ■

PRESENTATION 1348
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS II*, 06/01/2018, 09:55 - 11:35

RIVER CHANNEL MODIFICATION AND EVOLUTION ALTERS HYDRAULIC CONNECTIVITY WITH THE FLOODPLAIN IN THE ATCHAFALAYA RIVER BASIN

Kroes, Daniel, U.S. Geological Survey, Baton Rouge, LA
Allen, Yvonne, FWS, Baton Rouge, LA; Roberts, Steven, USACE, New Orleans, LA
Varisco, Jeffery, USACE, New Orleans, LA

Once part of the vast swamps of the Mississippi River (MR) Valley the Atchafalaya River (AR) Basin is now the largest remaining forested wetland in the lower United States. Many hydrologic changes have occurred in the Basin including the creation of a single continuous channel. Dredging and subsequent erosion of the channel has resulted in dramatic changes in the hydraulic connectivity of this swamp that have not been quantified. In order to examine the changes: 1) Hydrographic surveys from 1962, 1974, 2010 were analyzed; 2) Stage / discharge relationships from 1960-2015 were examined; and 3) Flow distribution through the swamp was compared between synoptic discharge measurements from 1958-1974 and 2001-2015. Analyses indicate that since 1962 the main channel has doubled in cross-sectional area. Half of the doubling occurred between 1962 and 1974 as a result of dredging and erosion. The remaining cross-sectional increases between 1974 and 2010 were caused primarily by erosion. This increase in cross-section lowered the stage of a 1.5 yr-interval flood (11,500 m^3/sec) from 1 m over bank height to 2.4 m below. The AR bankfull discharge has increased from 6,400 m^3/sec in 1960 to greater than 17,500 m^3/sec. The reduction in stage has resulted in a reduction in the percentage of river water leaving the main channel. Flow leaving the river via divergent channels has been reduced by 31% since 1968. Flow leaving the main channel by all pathways has been reduced by 22%. Most of the swamp no longer receives headwater flow (up to downstream), or receives too little flow to alleviate backwater flow conditions and hypoxia at lower stages. Flow is delivered primarily via channel instead of overbank flow resulting in the preferential infilling of open water at the interfaces of channels and lakes. This filling encourages the public perception of too much sediment deposition in the Basin as human access is reduced, while huge areas of swamp drown from subsidence and lack of sediment. Compounding this situation are numerous access and pipeline canal spoil banks which submerged at only high stages due to the incised condition of the river channel and reduced water levels on the floodplain. Restoration efforts must utilize the introduction of headwater flow and reduction of impediments to sheet flow across the floodplain surface. ■

PRESENTATION 1355
PRESENTED DURING *WETLANDS IN THE ANTHROPOCENE: THE RESPONSE OF COASTAL WETLANDS TO GLOBAL AND LOCAL STRESSORS II*, 05/31/2018, 01:00 - 02:50

CHANGES IN SEDIMENT AVAILABILITY ALONG UPPER ESTUARIES CREATE A SEDIMENT SHADOW: CONSEQUENCES FOR TIDAL FRESHWATER WETLAND DYNAMICS

Noe, Greg, USGS, Reston, VA
Ensign, Scott, Aquatic Analysis and Consulting, LLC, Morehead City, NC
Hupp, Cliff, U.S. Geological Survey, Reston, VA
Krauss, Ken, U.S. Geological Survey, Lafayette, LA
Korol, Alicia, George Mason University, Fairfax, VA
Gillespie, Jaimie, U.S. Geological Survey, Reston, VA
Bourg, Norman, USGS, Reston, VA

Sediment transport from watersheds through tidal freshwater rivers to estuaries is an important process for estuarine water quality and the resilience of tidal freshwater wetlands to sea level rise. Recent research along the U.S. Atlantic coast is identifying large rates of sediment trapping in tidal freshwater rivers that meaningfully decreases delivery of watershed sediment downstream to lower tidal rivers and saline estuaries. We call this zone of minimal sediment availability in lower tidal freshwater rivers, where little upstream watershed and downstream estuarine sediment is delivered, the 'Sediment Shadow'. Here we evaluate the impact of the Sediment Shadow phenomenon on the dynamics of tidal freshwater wetlands, including: 1) how widespread is the Sediment Shadow; 2) are sediment loads in coastal rivers changing over time; 3) influence on nutrient and sediment retention; 4) associated changes in biogeochemical cycling; and 5) consequences for resilience to sea level rise. First, we have observed a Sediment Shadow, specifically minimal in-channel suspended sediment concentration or tidal wetland sedimentation rate, at the downstream end of tidal freshwater rivers in 7 of 7 rivers studied from Maryland to Georgia. Second, long-term sediment load (instead of sediment concentration) did not significantly change over time for the 13 examined Coastal Plain nontidal rivers with sufficient long-term data. Third, N and P sedimentation rates were minimal in wetlands along lower tidal rivers, with greater rates both downriver in oligohaline marshes and upriver in tidal freshwater forests near the head of tide. Fourth, soil denitrification enzyme activity and gas efflux of CO2 was greatest, whereas efflux of CH4 was typically lowest, in lower tidal river wetlands compared to upriver tidal and nontidal freshwater wetlands and downriver salt-stressed and oligohaline wetlands. Finally, rates of soil surface elevation change are lower in tidal freshwater wetlands compared to downriver oligohaline marsh, typically due to lower sediment accretion rates, and are often insufficient to keep with recent relative sea level rise. In conclusion, the longitudinal downstream decrease in sediment availability through tidal freshwater rivers (the Sediment Shadow) is widespread and impacts tidal freshwater wetland eco-geomorphology, biogeochemistry, ecosystem services, and resilience to sea level rise. ■

PRESENTATION 1453
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES I*, 05/30/2018, 09:45 - 11:35

TREND ANALYSIS OF RECHARGING AND DISCHARGING GROUNDWATER CONDITIONS BELOW WETLANDS IN NORTHERN TAMPA BAY, FLORIDA

Terrie, Lee, St Petersburg College, Seminole, FL
Fouad, Geoffrey, Monmouth University, West Long Branch, NJ

Wetlands and groundwater are a single resource in the permeable karst terrain of Florida. Depending upon the potentiometric level in the deeper Upper Floridan aquifer, groundwater can discharge upward toward wetlands, or water in wetlands and the shallow aquifer can recharge downward. To assess the hydrologic recovery of wetlands after reductions in municipal groundwater pumping, a mapping time series was developed to quantify recharging and discharging groundwater conditions on a monthly basis for a region of about 600 square miles in and around wellfields in the Northern Tampa Bay area of Florida from 1990-2015. The time series maps the potentiometric elevation of groundwater in the Upper Floridan aquifer above and below land surface, providing a surrogate for the vertical hydraulic head difference term in Darcy's groundwater-flow equation. Recharging and discharging conditions were evaluated at 10,516 wetlands in the National Wetlands Inventory for 12 years before and 14 years after regional pumping cutbacks. Average annual groundwater levels increased below the wetlands following cutbacks (p-value < 0.001). The number of wetlands with discharging groundwater conditions increased from 979 to 1,238 of the total population on an average annual basis, and from 1,158 to 1,990 during the wet season. Recharging conditions were classified, and the greatest recharge class during the dry season decreased after cutbacks from 2,007 to 1,209 wetlands. Monthly wetland groundwater levels rose closer to land surface after cutbacks (p-value $= 0.06$). Similar trends in wetland groundwater conditions were observed for a subset of the wetlands in wellfields. The pumping cutbacks have had a regional effect on wetland groundwater conditions both in and out of wellfields. Future analyses will assess the effects of pumping and larger climatic fluctuations, such as El Niño and La Niña cycles. ■

PRESENTATION 1483
PRESENTED DURING *WETLAND AND FLOODPLAIN PLANT FUNCTIONAL ECOLOGY: APPLICATIONS FOR MITIGATING GLOBAL CHANGE*, 05/31/2018, 03:10 - 05:00

OBSERVATIONS FROM THE FLUME TO THE FIELD ON LINKAGES BETWEEN PLANT RESPONSE AND EFFECT TRAITS IN RIPARIAN ECOSYSTEMS

Bywater-Reyes, Sharon, University of Northern Colorado, Greeley, CO
Diehl, Rebecca M., University of Montana, Missoula, MT
Wilcox, Andrew C., University of Montana, Missoula, MT
Merritt, David, USDA Forest Service, Fort Collins, CO

Woody riparian vegetation is dependent on, and interacts with, flood dynamics, resulting in the coevolution of floodplains and plant communities. A better understanding of ecogeomorphic dynamics can, therefore, inform conservation of riparian corridors. We present a body of research linking functional traits of plants with different morphologies (Tamarix spp. and Populus spp.) to the strength of interactions with river morphodynamics. Field investigations on regulated (Bill Williams River, AZ, Bitterroot River, MT and Green River, CO/UT) and unregulated (Santa Maria River, AZ and Yampa River, CO) systems, provide a variable hydrologic and sedimentologic (sand to gravel bed) template from which we can test mechanisms revealed by flume studies. In ecology, plant traits are linked to ecological response. Many ecological response traits are comparable or correlated to metrics used in hydraulics to predict changes in flow dynamics in the presence of vegetation, known as morphological effect traits. As a result, our field and flume studies documented a unique topographic signature in the presence of plants in general, and specifically depending on plant traits. More rigid plants, or those with a higher flexural rigidity, had greater bed elevation change following floods, and the largest impact in altering morphodynamics. Flexural rigidity correlates to a variety of other ecological and morphological traits. In the literature and other studies by the authors, these metrics have predicted changes in hydraulics and thus morphodynamics across scales (flume to reach scale). Our work collectively allows for linking traits used in ecology to the impact of plants in altering river dynamics. This linkage provides a means to make predictions about the resulting impact of shifts in environmental conditions on riparian ecosystems across spatial and temporal scales. ■

PRESENTATION 1490
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE III*, 06/01/2018, 03:10 - 05:00

DYNAMIC BEAVER POND LEVELS IN MOUNTAIN PEATLANDS PROVIDE TRANSIENT FLOODWATER STORAGE

Westbrook, Cherie, University of Saskatchewan, Saskatoon, SK, Canada
Bedard-Haughn, Angela, University of Saskatchewan, Saskatoon, SK, Canada

There is growing interest in using beaver to help restore ecosystem resilience to floods, especially in mountain environments. The problem with the concept of relying on beaver ponds to attenuate floods is that they, when full, should offer little storage of floodwaters. Beaver commonly live in wetlands situated in valley-bottom positions in the southern Canadian Rocky Mountains where water, once shed from the alpine zone, funnels through before reaching the populated lowlands. A June rainstorm in 2013 triggered the largest recorded flood in the Rockies west of Calgary, Alberta. The valley-bottom wetland we have researching for a decade was hydrometrically instrumented at the time of the flood. Our aim was to opportunistically learn more from the flood about the ways in which valley-bottom mountain wetlands housing beaver ponds affect floodwater conveyance. We found that even though the soils were mostly frozen at the time of the event, floodwaters were transiently detained by the valley-bottom peatland. The four largest beaver ponds in the peatland collectively stored 1.9 x 104 m...3... of water when filled to the top of the dams. However, water levels in the ponds were dynamic during the event, owing to high bed permeability and vertical drainage. The water storage offered by some of the beaver ponds, even ones experiencing breaches, delayed floodwater transmission. Results indicate that beaver dams can offer enhanced hydrological resilience to floods, but that the conditions under which this happens requires further study. ■

PRESENTATION P75
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

HYDROLOGICAL PROCESSES REGULATING ALPINE WETLAND WATER TABLE DYNAMICS

Mercer, Jason, University of Wyoming, Laramie, WY
Westbrook, Cherie, University of Saskatchewan, Saskatoon, SK, Canada

Alpine wetlands are expected to be very sensitive to changes in climate. Increasing temperatures and changing precipitation dynamics will likely reduce snowpack volumes, shift the timing of snowmelt, and increase evapotranspiration amounts resulting in less water availability to high elevation wetlands. However, there is a dearth information related to the hydrology of alpine wetlands, thus limiting our ability to predict how they will actually respond to changes in climate. To address this gap in knowledge, the water table dynamics of three alpine wetlands in Banff National Park, Alberta, Canada were monitored over two growing seasons, subject to very different spring snowmelt conditions. To better infer the hydrological processes associated with the observed moisture dynamics, water table observations were paired with a combination of hydrophysical and hydrochemical techniques, including a water balance, a physically-based 1D water table model, end-member mixing analysis, and groundwater discharge measurements. Results indicate that groundwater is an important source water to at least some alpine wetlands, while snowmelt may play a more indirect role in regulating growing season moisture availability via the recharge of the subsurface hydrological network. These findings suggest that alpine wetlands may be less sensitive to changes in climate than previously thought, as groundwater can, to a degree, act as a buffer to other hydrological changes. This research will be of interest to wetland scientists, hydrologists, soil physicists, and natural resource managers focused on habitat and water availability. ■

PRESENTATION 1575
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS I*, 05/31/2018, 03:20 - 05:00

WETLANDS - PINNACLES OF THE HIDDEN HALF OF THE HYDROLOGICAL CYCLE.

Job, Nancy, South African National Biodiversity Institute, Cape Town, Western Cape, South Africa
le Roux, Pieter, University of the Free State, Bloemfontein, Free State, South Africa

Wetlands are often managed in isolation, however, wetlands are an expression of the hydrology of the broader landscape. Soil is a partitioner of water, giving rise to flowpaths which vary in residence time and capacity. Wetland hydropattern appears to correlate well with the distribution of soils (and resulting flowpaths) in hillslopes, as defined in 6 broad hydrological hillslope classes for South Africa, each with a characteristic predicted response to rain events (Van Tol et al. 2013; le Roux et al. 2015). A wetland soil map can expose signatures of hillslope hydrological response, implying that wetland soil indicators can contribute to a rapid hydrological classification for wetland catchments. ■

PRESENTATION 1592
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS III*, 06/01/2018, 01:10 - 02:50

HYDROLOGY CHARACTERISTICS OF HIGH-ALTITUDE ANDEAN PEATLANDS

Nassry, Michael, Penn State, University Park, PA
Wardrop, Denice, Penn State University, University Park, PA
Czuprynski, Zachary, Penn State University, University Park, PA
Fennessy, M. Siobhan, Kenyon College, Gambier, OH
Cullen, Cecilia, PSU, University Park, PA
Tomko, Sara, Penn State University, University Park, PA
Plumridge, Evan, Penn State University, University Park, PA

The high-altitude peatlands of southern Peru (bofedales) fill deep valleys carved by glaciers in the Andean Plateau. These wetland systems are often located in a series of stepped terraces below receding mountain glaciers and snowfields, where they serve as a source of water for drinking and irrigation, and supply livestock grazing land for rural highland communities. These unique systems buffer local communities from water shortages during the dry season and provide ecosystem services at a larger scale through carbon sequestration in deep layers of peat. This study focuses on characterizing the complex hydrology and source waters supporting these systems and the potential impacts of climate-driven changes to the current hydrologic regime.

The bofedale system studied here, referred to locally as Ampatuni, covers approximately 60 hectares near Ocongate Peru, at an elevation of 4,300 meters above sea level. Upstream, the Paco Pampa glacier is perched above a similar-sized bofedale, while a 25 hectare lake sits at the downstream end of the valley. Glacier meltwater forms the headwaters of a small stream flowing through the center of this wetland system, with meltwater from snowfields and numerous small spring-fed channels also making surface water contributions. Water quality data (dissolved oxygen, temperature, pH, conductivity) were collected across the site and surface water samples were analyzed for nutrients, metals, and stable water isotopes. Results from a synoptic survey of

the main channel and tributaries, as well as isolated surface pools, suggest a spatially heterogeneous hydrology with highly localized water sources driving biogeochemical processes along the length and width of the valley. This initial snapshot of bofedale hydrology during the dry season will be paired with continuous groundwater level measurements to gain a better understanding of the impact climate change driven landscape modifications will have on these wetlands and the ecosystem services they provide. ■

PRESENTATION 1621
PRESENTED DURING *ENVIRONMENTAL CHANGE AND THE WETLAND SEDIMENT ARCHIVE*, 05/31/2018, 09:45 - 11:35

RECONSTRUCTING LATE QUATERNARY ENVIRONMENTAL CHANGE PRESERVED IN WESTERN PEATLANDS

Sullivan, Donald, University of Denver, Denver, CO

Relatively little research has focused on paleoenvironmental reconstructions from midlatitude minerotrophic fens in North America. Stratigraphic, biogeochemical, and peat humification analyses of subalpine fens from a variety of fens in the western U.S. indicate that these sites preserve a unique record of Holocene climate change and ecohydrological feedback. Due to the relatively marginal conditions that allow fens to persist in the region, these peatlands are very sensitive to fluctuations in climate and consequent hydrological responses. Cores recovered from peatlands can be analyzed in the laboratory to reconstruct past climate fluctuations. Changes in temperature are reflected as changes in organic matter as determined by loss on ignition, and ecohydrological changes are evidenced in the results of peat humification analysis. Responses in peatlands to changes in temperature and precipitation are complex, with warmer summers leading to longer growing seasons, and an increase in peat accumulation rates in higher elevation fens. On the other hand, lower water tables resulting from earlier snowmelt during warm summers lead to increased rates of peat decomposition. In lower elevation fens hydrologic responses to changes in summer temperature differ from those in the higher elevation fens. The balance between rates of organic accumulation and peat decomposition and wetland loss depends on the dynamics of the snowpack, and determines the carbon storage in these peatlands. Global climate models forecast warmer summers over the next several decades in the west, which will likely result in earlier, more rapid snowmelt, the subsequent loss of lower elevation fens, and changes in the carbon sequestration of higher elevation fens in the subalpine zone. Reconstructions of stratigraphic changes induced by early Holocene environmental variations yield a sensitive paleoenvironmental record extending over the past 12,000 years. The results of this research indicate that these fens preserve a sensitive record of climate change and ecohydrological conditions and provide potential analogs for the fate of subalpine peatlands under changing climates in the future. ■

PRESENTATION 1628
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS II*, 06/01/2018, 09:55 - 11:35

INTEGRATED DESIGN FOR INTEGRATED SYSTEMS - COMBINING GEOMORPHIC AND ENGINEERING DESIGN TO MAXIMIZE CHANNEL, FLOODPLAIN, AND WETLAND FUNCTIONS

Ash, Julie, Otak, Boulder, CO

Stream corridors are complex, integrated systems. Channels, floodplains, and wetlands are intricately related, working together in healthy systems for maximum function and health. While this may sound like a benign statement that we already know and accept, it isn't when you realize stream restoration has focused on single-thread channels and two-dimensional floodplain connection, overlooking the critical importance of large wood and beaver, and rarely integrating wetland and stream work at meaningful scales. This talk looks at common results of hydraulically-based engineering design and compares a new approach that combines geomorphic and engineering tools for more robust understanding of complex riverine systems. This approach serves dually to increase our motivation to find more and better ways to work with natural processes and to provide designers with tools to navigate the technical and societal challenges that come with use of more natural treatments. Examples include stream restoration designs that propose single-thread channels with floodplain connectivity delivered primarily via bank overtopping and the functional use of large wood. Hydraulic analyses can demonstrate that traditional designs meet allowable thresholds for velocities and shear stresses in critical locations, thereby meeting design goals and seemingly delivering significant increases in stream function and health. However, single-thread channels are appropriate in some systems, but not in others. And significant opportunities can be missed when floodplain connection is delivered only via bank overtopping and when wood is excluded from the system. Adding geomorphic assessment guides designers to consider the integrated system and adds powerful tools to the engineering toolbox for navigating challenges. Stream restoration design always has hurdles. Traditional design focuses on conservatively protective treatments that withstand forces of specific flood events (e.g., 100-year event). Challenges follow the engineered solutions, like chasing bank

stabilization downstream or addressing low quality habitat. Combining geomorphic and engineering design shifts our efforts to the front end. Confident that an integrated design that works with the complex, integrated natural system, almost effortlessly maximizing interrelated channel, floodplain, and wetland functions, we can focus on solving asset protection challenges and navigating societal resistance to the use of more natural treatments. ■

PRESENTATION 1633
PRESENTED *DURING GEOLOGY/HYDROLOGY/WATERSHEDS IV*, 06/01/2018, 03:20 - 05:00

MORPHOLOGY OF DRAINED UPLAND DEPRESSIONS ON THE DES MOINES LOBE OF IOWA

McDeid, Samuel, Iowa State University, Ames, IA
Crumpton, William, Iowa State University, Ames, IA
Green, David, Iowa State University, Ames, IA

There is growing interest in understanding how drained prairie pothole wetlands impact regional hydrology and how they might play a role in wetland restorations within the Iowa Des Moines Lobe. To this end we developed an algorithm, the Surface Depression Morphology Tool (SDMT), which quickly and accurately identifies, delineates and derives the morphology for all drained depressions within any Digital Elevation Model (DEM). We then ran the SDMT on 3m hydrologically corrected DEMs comprising the entire Des Moines Lobe of Iowa (DML-IA). Following automatic and manual filtering, 189,130 upland depression features were found whose cumulative upland depressional area was 6.4% of the total DML-IA land surface. Frequencies of maximum area and volume were found to be reasonably described by a power-law distribution. However, maximum depth was only marginally described by such a distribution. Depressions existing in the northern glacial sub-regions of the DML-IA tend to be larger and have greater storage capacity than the more southern sub-regions. It is difficult to overstate the many applications of data derived from the SDMT that could advance a wide range of fields, such as wetland restoration and hydrologic modeling. ■

PRESENTATION 1640
PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS IV*, 06/01/2018, 03:20 - 05:00

INTENSIVE TIMBER PRODUCTION IN WETLANDS IN THE SOUTHEAST UNITED STATES – DATA GAPS AND OPPORTUNITIES

Stedman, Susan-Marie, NOAA, Silver Spring, MD
Lang, Megan, USFWS, Falls Church, VA
Amatya, Devendra, USDA Forest Service

Data produced by the U.S. Fish and Wildlife Service's Wetlands Status and Trends project for the time period between 1986 and 2009 indicate that a statistically significant percentage of forested wetlands used for intensive timber production (predominantly pine plantations in the southeast United States) changed to upland forested plantations. Although this change affected a minority of the forested wetlands in the conterminous United States during each study period, the fact that it has happened continuously for decades or longer means that the cumulative effects of this wetland loss are important to watershed managers, land owners, forestry commissions, natural resource managers, and other stakeholders in the forestry and wetland communities. Over the past two years federal agency staff have conducted scientific meetings and field trips with silviculture industry professionals, wetland professionals, and forestry researchers to collect existing information on a wide range of topics related to silviculture in wetlands. Existing studies have helped us eliminate the planting, growth, and harvest of trees as causing change from forested wetland to forested upland. However, many unanswered questions remain, including the role of soil type, specific soil characteristics, drainage, landscape position, and climate on the underlying hydrology of wetlands used for intensive timber production. This presentation will summarize the management question(s) we are trying to answer, the available information, and the types of information and/or research needed in the future. ■

PRESENTATION 1649
PRESENTED DURING *RIPARIAN ECOSYSTEMS I: ECOLOGICAL PATTERNS AND EFFECTS*, 05/31/2018, 09:45 - 11:35

THE EFFECTS OF FLOODING AND DAM MANAGEMENT ON ALLUVIAL RIVERS: EVIDENCE FOR AN INTER-DAM SEQUENCE AND ALTERNATIVE STATE

Skalak, Katherine, U.S. Geological Survey, Reston, VA
Benthem, Adam, U.S. Geological Survey, Reston, VA
Nustad, Rochelle, U.S. Geological Survey, Grand Forks, ND
Hupp, Cliff, U.S. Geological Survey, Reston, VA
Galloway, Joel, U.S. Geological Survey, Bismarck, ND

Though the effects of dams and reservoirs are well-documented, their impacts have been studied individually, with relatively little attention paid to any interactions resulting from the sequencing of dams and reservoirs along a river corridor. We demonstrate that the influence of the upstream dam is still a major control of river dynamics when the backwater effects of the downstream reservoir begin. The interaction between two dams in series in alluvial systems creates a distinct landscape with a predictable series of landforms and geomorphic adjustments. Our analysis suggests that more than 400 river reaches have the potential to exhibit this pattern. We also examine how a 500-year event perturbs the geomorphic template created from dam management. Channel cross-section data and aerial imagery before and after the occurrence of a record-breaking flood were compared to historic rates of channel change to assess the relative impact of the flood on the river morphology. Results show that the flood resulted in the initial loss of islands in the reach just below the dam and a gain in island area downstream and that these losses and gains persisted post-flood. Conversely, the thalweg, which has been stable since the mid-1970s, did not migrate. Channel morphology, as defined by a newly developed shoaling metric which quantifies the degree of channel braiding, indicates significant longitudinal variability in response to the flood. We also analyze the newly-created aeolian transport regime and patterns of large wood accumulation post-flood, concluding that dam management created alternate geomorphic and related ecological stable states, which do not revert towards pre-dam conditions in response to the flood of record. This suggests that more active management, which includes management of sediment transport as well as flow modification, is necessary to restore the river towards pre-dam conditions and help create or maintain habitat for endangered species. ■

Physical Sciences: Sedimentation

PRESENTATION 1565
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION II*, 05/30/2018, 01:10 - 02:50

INVESTIGATING RIVERINE SEDIMENT REMOVAL AT A LARGE RESTORED FLOODPLAIN WETLAND, LA GRANGE WETLAND BANK SITE, BROWN COUNTY, ILLINOIS

Carr, Keith, Illinois State Geological Survey, Champaign, IL
Pociask, Geoff, Illinois State Geological Survey, Champaign, IL
Cahill, Richard, Illinois State Geological Survey, Champaign, IL

Restoring wetlands in formerly leveed floodplains requires an understanding of the effects of free access of floodwaters to backwater areas. Possible consequences for wetland vegetation communities and backwater lake ecology must be weighed against the positive implications for the river of reducing flood peaks, turbidity, nutrients and excessive channel sedimentation. We evaluated sediment removal rates at a restored floodplain wetland, a 647-ha (1,600-ac) wetland mitigation bank located at the confluence of the Illinois and LaMoine Rivers. The site, which includes a shallow 60-ha (150-ac) backwater lake, was leveed and pumped for agriculture from about 1915 to 2002. On-site wetland hydrology restoration included ditch filling, tile de-activation, and the re-introduction of the river via natural levee degradation. In all, approximately 400 ha (1,000 ac) of wetlands have been restored.

Site sedimentation rates were measured using data from vibracores, as well as direct sediment deposition monitoring. We measured 137 Cs (Cesium-137) in the cores to determine peak levels, which occurred in 1963 during the peak period of subaerial testing of nuclear weapons, and measured accumulated sediment after that date.

The radiometric data showed agreement from three separate cores establishing an average sedimentation rate of 0.61 cm/yr for the period from 1963 to 2004. If this rate is extended backwards to the early 1900s and compared to grain-size data from the cores, a change in sediment character to a slightly finer-grained depositional regime seems to occur in about 1917. This corresponds to the period when a drainage district was organized and levees were built on site, presumably reducing the delivery of coarser-grained, higher-energy sediments from the river.

From 2002 forward to the present, sedimentation rates were directly measured via a network of concreted steel stakes to determine if the sedimentation rate changed after levee removal. These measurements have shown that a single large flood can deposit 2 to 5 cm of sediment on the site.

However, when averaged over the complete monitoring period since 2002, the annual rates range from 0.55 to 1.80 cm/yr, slightly higher on average than those for the leveed period determined via the radiometric dating. Because the methods differ, current and historical sedimentation rates may not compare without additional study which is ongoing. ■

Physical Sciences: Soils

PRESENTATION 1065
PRESENTED DURING *ECOLOGICAL RESTORATION OF CRANBERRY FARMS IN MASSACHUSETTS - PRACTICE, RESEARCH, AND POLICY I*, 05/30/2018, 09:45 - 11:35

LONG-TERM DEVELOPMENT AND SOIL-BASED ECOSYSTEM FUNCTIONS OF RESTORED WETLANDS

Ballantine, Kate, Mount Holyoke College, South Hadley, MA

Just as principles from ecosystem science inform restoration practice, restoration practice can inform our understanding of ecosystems as well as guide future restoration projects. This presentation will summarize some of the basic and applied research we are doing in restored wetlands to investigate how these systems develop and function under different climatic conditions, and what restoration methodologies may stimulate desirable and undesirable ecosystem processes over the long term. Ongoing projects examine structural and functional development in wetlands ranging from 0 to 75 years since restoration, as well as the effects of soil amendments that range along a gradient of carbon lability (e.g., biochar, topsoil, compost, straw) on vegetative communities, greenhouse gas fluxes, water quality parameters, microbial community structure, and soil cycling of nutrients via soil microbial processes. New projects compare development trajectories in active cranberry farms, abandoned cranberry farms, passively managed cranberry farms, restored cranberry farms, and natural reference systems. Controlled greenhouse experiments and complimentary field-scale manipulations at the Tidmarsh Cranberry Farm Restoration are being implemented to illuminate the impact of climatic variables and soil amendments on development and function over time. Preliminary results will be presented. ■

PRESENTATION 1112
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS III*, 06/01/2018, 03:10 - 05:00

PHOSPHORUS CHARACTERIZATION OF WETLAND SOILS OF THE SOUTHEASTERN UNITED STATES

Williams, Candiss, USDA-NRCS-National Soil Survey Center, Lincoln, NE
Oluwari, Margaret, Tuskegee University, Tuskegee, AL
Ankumah, Ramble, Tuskegee University, Tuskegee, AL
Fall, Souleymane, Tuskegee University, Tuskegee, AL
Essamuah-Quansah, Joseph, Tuskegee University, Tuskegee, AL
Shange, Raymond, Tuskegee University, Tuskegee, AL

Phosphorous (P) is an essential element in the environment for plant life, animal growth, crop management, and livestock production. An excess level of P can cause acceleration of eutrophication. Wetlands are important landscape features that play a vital role in ecosystems and can buffer interaction among uplands and adjacent waterbodies. Wetlands therefore serve as an important feature in conservation management and planning. The objectives of this study were to determine the buffering capacity of wetland surface soils and to evaluate the relationship of wetlands to agricultural landscapes in the southeastern U.S. Soils from 167 wetlands in the southeastern portion of the U.S. were sampled as part of the U.S. Environmental Protection Agency's National Wetland Assessment and analyzed for its buffering capacity and potential as a sink of P from adjacent landscapes. Soils were analyzed for water extractable P, Mehlich-3 Elements (aluminum, calcium, iron, phosphorus, manganese and magnesium), P Sorption Index (PSI), and Double-Point Anion Exchange Resin (DPAER). Water extractable P ranged from 0 to 7.36 mg P kg-1 of soil with an average of 0.36 mg P kg-1. Mehlich-3 extractable P ranged from 4.99 to 245.67 mg P kg-1 of soil with an average of 47.75 mg P kg-1. P sorption Index ranged from 0 to 1031.19 mg P kg-1 of soil with an average of 244.29 mg P kg-1. Double-Point Anion Exchange at 1-hr ranged from 7.37 to 857.36 mg P kg-1 of soil with an average of 106.82 mg P kg-1. Double-Point Anion Exchange at 24-hr ranged from 3.82 to 369.02 mg P kg-1 of soil with an average of 553.04 mg P kg-1. Wetland soils have great potential to sorb additional quantities of P and may serve as a sink of P from adjacent land areas. A conservation management plan that includes wetlands would be beneficial to reducing P; an approach less harmful to the environment. ■

PRESENTATION 1236
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS III*, 06/01/2018, 03:10 - 05:00

USING NWCA AND RACA TO IMPROVE UNDERSTANDING OF SOIL CARBON AND BULK DENSITY

Wills, Skye, Natural Resources Conservation Service, Lincoln, NE
Rossi, Ann, U.S. Environmental Protection Agency, Washington, DC
Roecker, Stephen, USDA, Indianapolis, IN
Vasilas, Lenore, USDA, Beltsville, MD
Williams, Candiss, USDA-NRCS-National Soil Survey Center, Lincoln, NE

The Rapid Assessment of Carbon (RaCA) projects collected thousands of soil pedons in areas that had been poorly represented in many older soil survey activities. Through a probabilistic sampling scheme based on soil survey and land use/cover classes more than 6,000 independent locations were sampled. In wetland land use/land cover classes, there were more than 2,000 locations (with more than 6,000 individual samples collected). While this is a great resource, wetland locations are not differentiated by wetland type nor is there any adequate vegetation or condition to do further explanatory analysis. The National Wetland Condition Assessment (NWCA) soil sampling effort can be used to supplement and inform RaCA information. NWCA and RaCA were collected on different sampling frames and guidance on pedon location and sample collection differed somewhat. This paper presents the initial steps needed to use data from these projects in one coherent soil dataset. Initial evaluations indicate that soil bulk density and soil organic carbon stocks have different distributions in each dataset, indicative of the sample frame and sampling guidelines. Evaluating these differences can help explain variation in soil organic stock estimates and inform future soil carbon and soil survey work. ■

PRESENTATION 1356
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS III*, 05/31/2018, 03:10 - 05:00

EVALUATING ABIOTIC INFLUENCES ON SOIL SALINITY OF INLAND MANAGED WETLANDS AND AGRICULTURAL CROPLANDS IN A SEMI-ARID ENVIRONMENT

Fowler, Drew, University of Missouri, Columbia, MO
King, Sammy, U.S. Geological Survey, Baton Rouge, LA
Weindorf, David, Texas Tech University, Lubbock, TX
Vradenburg, John, U.S. Fish and Wildlife Service, Tulelake, CA

Agriculture and moist-soil management are common techniques used on wildlife refuges to provide adequate energy for migrant waterbirds. In semi-arid systems however, the accumulation of soluble salts throughout the soil profile can limit total production of wetland plants and agronomic crops and thus jeopardize meeting the energetic demands of waterbirds. This study evaluates the effect of distinct hydrologic regimes associated with moist-soil management and agricultural production on salt accumulation in a semi-arid floodplain. We hypothesized that the frequency of flooding and quantity of floodwater in a moist-soil management hydroperiod results in a less saline soil profile compared to profiles under traditional agricultural management. Findings showed that agricultural croplands differed (p-value < 0.001, $df = 9$) in quantities of total soluble salts (TSS) compared to moist-soil impoundments and contained greater concentrations (TSS range = 1160-1750 (mg kg-1)) at depths > 55 cm below the surface of the profile, while moist-soil impoundments contained lower concentrations (TSS range = 307-531 (mg kg-1)) at the same depths. Increased salts in agriculture may be attributed to the lack of leaching afforded by smaller summer irrigations while larger periodic flooding events in winter and summer flood irrigations in moist-soil impoundments may serve as leaching events. Therefore, rotating agricultural production with moist-soil management practices could serve as a mechanism to remediate increasing levels of soluble salts. However, variability across landscapes and soil stratigraphy, as well as the timing and magnitude of flood pulses should be considered for their impact on soil salinization processes. Similar to semi-arid natural wetlands, the wetting and dying cycle of managed wetlands in semi-arid floodplains can alter the function of a wetland from a recharge system to a discharge system and may facilitate the upward movement of soluble salts. ■

PRESENTATION P78
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

QUANTIFICATION OF IRON MONOSULFIDE EXPRESSION IN ARID-LAND WETLANDS

Duball, Chelsea, University of Wyoming, Laramie, WY
Vaughan, Karen, University of Wyoming, Laramie, WY
Vepraskas, Michael, North Carolina State University, Raleigh, NC
Berkowitz, Jacob, US Army Corps of Engineers, Vicksburg, MS
Miller, Aaron, USDA-NRCS, Santa Fe, NM

Biogeochemical cycling of sulfur is of particular concern in wetland ecosystems. Under anaerobic conditions, ferrous iron reacts with sulfide ions to form insoluble, black iron monosulfides (FeS) within the soil. While insoluble FeS concentrations are commonly observed in coastal and estuarine systems, few studies have investigated the formation and effects of FeS in freshwater or saline wetland environments. Because FeS primarily forms under saturated conditions, these soil properties hold significant implications for hydric soil identification and could potentially be used as an indicator of anaerobic conditions. The identification of FeS is not widely understood throughout the literature, nor acknowledged as a formal hydric soil Field Indicator among the soil science community, therefore proper understanding and characterization of FeS within wetland soils is critical. We will investigate anomalous riparian soils containing previously un-identified FeS, on a floodplain in western Nebraska. Representative soil profiles will be described and sampled following standard protocol, and Indicator of Reduction in Soil (IRIS) tubes will be implemented and analyzed to determine the extent and relative abundance of FeS within each soil profile. This study will result in an improved understanding of the formation of FeS, identification of hydric and hydromorphic soils that did not previously meet hydric criteria, and enhanced wetland management efforts. ■

PRESENTATION 1374
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS III*, 06/01/2018, 03:10 - 05:00

EXPLORING RELATIONSHIPS BETWEEN PLANT COMMUNITY CONDITION AND SOIL PHYSICOCHEMISTRY AT NATIONAL WETLAND CONDITION ASSESSMENT SITES IN WISCONSIN

Marti, Aaron, Wisconsin Department of Natural Resources, Madison, WI

The Wisconsin Department of Natural Resources (WDNR) is developing a wetland monitoring and assessment program to evaluate the ecological condition of wetlands in Wisconsin at both site specific and landscape scales, primarily using the Wisconsin Floristic Quality Assessment Method (WFQA). Studies in Wisconsin and the Upper Midwest have identified both landscape-level and within-site human disturbances (e.g. land use intensity, agricultural and urban development) as drivers of declining wetland condition. These metrics (often Best Professional Judgement- or GIS-derived) are arguably broader proxies for changes to quantifiable in-wetland physicochemical variables which may directly affect wetland condition, but most wetland studies/programs rarely obtain physicochemical data due to overriding constraints (e.g. logistical, technical, financial). In 2011-2012, over 70 wetland sites in Wisconsin were assessed as part of the National Wetland Condition Assessment (NWCA) or the Wisconsin NWCA Intensification Study using standard NWCA field and lab methods, which afforded a rare opportunity to investigate disturbance-physicochemistry-condition relationships at both regional and statewide scales. The current study investigated soil physicochemistry and plant community data obtained as part of these efforts to identify potential soil drivers of plant community condition. Plant community condition was evaluated using site Mean Coefficient of Conservatism (Mean C; a WFQA metric), and when available, the NWCA Vegetation Multimetric Index (VMMI), the lone bioindicator of wetland condition in the NWCA. Mean C was generally inversely related to measures of Oxalate-extractable soil P, but had no significant relationships with common measures of plant-available soil P (e.g. Mehlich- and Olsen- Extractable) or Total P (Trace Element Extractable), which was identified as a soil stressor in the NWCA 2011 Final Report. In contrast, VMMI scores were not related to any soil physicochemical variables tested. This suggests that WFQA metrics such as Mean C are appropriate measures of plant community condition at both regional and statewide scales because they respond to quantifiable gradients in wetland physicochemistry (i.e. Oxalate-extractable soil P variables). Additionally, soil physicochemistry may be a useful indicator of wetland disturbance deserving consideration for incorporation into standard practice. Further WDNR research on these topics will also be discussed. ■

PRESENTATION 1520
PRESENTED DURING *MOUNTAIN PEATLANDS - PERSPECTIVES FROM ACROSS THE GLOBE I*, 06/01/2018, 09:45 - 11:35

PEATLANDS OF THE MALOTI MOUNTAINS, LESOTHO

Trettin, Carl, USDA Forest Service, Cordesvilles, SC

Mountain peatlands are a relatively rare occurrence globally, and extremely rare on the African continent. In the Maloti Mountains of Lesotho, peatlands are a common component of the landscape, typically occurring above 2,400 m a.s.l. The Maloti Mountains are formed in a Jurassic period basaltic plateau that has been deeply incised over the millennia. The wetlands occur primarily in first-order watersheds near the valley headwall, they may also exist along the side slope along streams. Abundant rainfall, with the majority falling the summer, is the key factor driving the development of the peatland. Productive grass and sedge communities provide organic matter for peat development. The peat accumulation began to develop 3,500 - 4,500 yr. BP, once the valley side slopes stabilized. The peat typically ranges in thickness from 1 to 2.5 m, on slopes between 5 and 18 percent. Compositionally, the peatlands are a grass-sedge fen, with the organic soil horizon being highly decomposed (sapric); there is evidence of frequent fires in the peat core indicating a historical natural fire regime. Water to support the wetlands is realized primarily as shallow subsurface interflow from the surrounding uplands, although spring may also occur near the valley headwall. Functionally, these wetlands serve to regulate stream flow and peak discharge, provide habitat for a diverse floristic community and biota. Currently, the peatlands are highly degraded, primarily from overgrazing; as a result the functional area of peatlands has diminished. ■

PRESENTATION 1562
PRESENTED DURING *EXPLORING NATIONAL WETLAND CONDITION ASSESSMENT DATA APPLICATIONS IN STATE, TRIBAL, AND FEDERAL PROGRAMS III*, 06/01/2018, 03:10 - 05:00

EXPLORING WETLAND SOIL NUTRIENT RATIOS AND RELATIONSHIPS WITH SITE CHARACTERISTICS

Rossi, Ann, U.S. Environmental Protection Agency, Washington, DC
Marti, Aaron, Wisconsin Department of Natural Resources, Madison, WI
Serenbetz, Gregg, U.S. Environmental Protection Agency, Washington, DC

Wetland soils serve a critical role in nutrient cycling within a watershed and help to maintain water quality by removing or sequestering nutrients. Excessive nutrient loads from anthropogenic sources can lead to eutrophication and degradation of water bodies, including wetlands. Numerous studies have documented relatively well-constrained carbon: nitrogen: phosphorus (C:N:P) ratios in marine and terrestrial ecosystems. Deviations in these ratios reflect nutrient imbalances, which can impact microbial activity and therefore, ecosystem processes. Additionally, indices of phosphorus retention/release have been developed and utilized to understand phosphorus dynamics and inform watershed management decisions and policies aimed at reducing nutrient loads. This preliminary study explores the use of nutrient ratios and phosphorus availability indices as potential indicators of nutrient imbalances in wetland soils. Data from the National Wetland Condition Assessment was used to look at soil nutrients in wetlands nationally and within major ecoregions. This presentation will explore correlations between soil nutrients and other wetland characteristics, including soil properties, vegetation communities, and water chemistry. These biogeochemical indices show promise as a way to identify excess nutrient loads and nutrient imbalances that could impact overall wetland condition and function. However, soil type and hydrology as well as other factors must be considered when interpreting soil nutrient ratios. ■

PRESENTATION P77
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

ANOMALOUS CALCAREOUS HYDROMORPHIC SOILS OF WESTERN WYOMING

King, Matt, University of Wyoming, Laramie, WY
Vaughan, Karen, University of Wyoming, Laramie, WY

Soils comprised of greater than 50% calcium carbonate possess unique problems related to wetland delineation in western Wyoming. These light-colored soils lack traditional field indicators of hydric soil (redoximorphic features and organic C accumulation) indicative of anaerobic conditions despite the presence of hydrophytic vegetation and wetland hydrology. To determine the limiting factor for the lack of redoximorphic feature development, a mesocosm study was conducted using 15 intact soil cores from a representative site. These soil cores inundated with water for 16 weeks and subject to one of three treatments, including the addition of FeCl3, organic C as dextrose, and a combination of both FeCl3 and organic C, as well as a control. Once per week, oxidation-reduction potential and pH were measured within each mesocosm. After the 16-week study duration, the mesocosms were drained and soil cores were disassembled. The abundance, color, distinctness, and type of redoximorphic features were described in 5-cm increments through-

out the cores. The FeCl3 and FeCl3 plus organic C treated mesocosms formed a mean of 21.1% and 22.0% distinct or prominent iron concentrations respectively. In contrast the organic C treated and control mesocosms averaged 0.2% and 0.1% distinct or prominent iron concentrations respectively. Based on these results, Fe appears to be the limiting factor for redoximorphic feature development in these calcareous hydromorphic soils. Future work will explore how these hydric soils can be successfully identified in the field. ■

PRESENTATION 1630
PRESENTED DURING *WETLAND VEGETATION/INVASIVE SPECIES III*, 06/01/2018, 01:10 - 02:50

ROOT ZONE WATER MOVEMENT IN A VERTISOL DOMINATED FORESTED WETLAND: IMPLICATIONS FOR TREE WATER SOURCES

Lemon, Mary Grace, Louisiana State University, Baton Rouge, LA
Keim, Richard, Louisiana State University, Baton Rouge, LA

Bottomland hardwood forests (BLH) are important wetland habitats that provide many ecosystem services and serve as valuable timber resources. This ecosystem is experiencing rapid changes in hydrology due to river engineering and global climate change. Surface flooding regimes have been disrupted across a large majority of the BLH range and precipitation patterns are changing. A thorough understanding of water flow through the heterogeneous deposits of low conductivity Montmorillonite clay and fine grained sand outcrops that dominant large expanses of this forest type is lacking. In order to better predict how changes in hydrology will affect this ecosystem, an improved understanding of root zone water movement is necessary. Therefore, in this study we investigated source water using stable isotopes of precipitation, soil water, tree xylem water, surface flood water, and groundwater at two sites in Louisiana located along the Tensas and Boeuf Rivers and in one site in Texas adjacent to the Sabine River. Preliminary results indicate low vertical connectivity between groundwater and ponded surface water across sites indicated by dissimilar isotope signatures between these source waters. In addition, at the Boeuf site, groundwater isotope time series indicate an interesting spatial separation in isotope signatures between a site located along a sandy ridge and others located in a lower elevation back swamp. Ongoing analysis of soil and xylem water should clarify the relevant pathways of water movement through the root zone of this system and thus help identify how source water varies through time. ■

Physical Sciences: Water Quality, Quantity & Hydraulics

PRESENTATION 1134
PRESENTED DURING *WETLAND RESTORATION/CREATION/MITIGATION II*, 05/30/2018, 01:10 - 02:50

DON'T WAVE THE RIVER RED GUMS GOODBYE. THE ROLE OF ENVIRONMENTAL FLOWS IN RESTORING RIVER WATER QUALITY AND RIPARIAN ZONES ALONG THE WIMMERA RIVER.

Julian, Paul, University of Florida, Ft Pierce, FL
Fletcher, Greg, Wimmera Catchment Management Authorty, Horsham, Victoria, Australia

Alteration to the hydrologic balance of a river ecosystem can have profound effects on its biogeochemistry and subsequent ecology. Land use conversion, changes in water demand for agricultural and domestic uses and alteration of native vegetation are contributing factors to stream and river hydrology and can resulting in changes to regional groundwater elevations. This altered hydrology can result in surface water salinization through the transport of saline groundwater, accumulation of salts in soils, passive run-off and direct discharge of saline groundwater to surface waters. Stratified pools of saline water can occur due to reduced surface water flow in combination with groundwater discharge of saline water resulting in negative ecological impacts. Salinization of freshwater streams and rivers have been observed across the globe, however most notably salt-affect rivers and streams occur throughout large areas of south-eastern Australia especially in the lower plains in northern and western Victoria, Australia.

This study evaluated the change of water management and regional hydrology relative to surface water salinization and its effect on biota and biogeochemistry within the lower Wimmera River. The lower Wimmera River has a high environmental value with large stretches of intact riparian and in-stream vegetation and many threatened fauna species of concern. The rainfall-runoff relationship along different reaches of the lower Wimmera River have changed over time due to changes in climate and flow regulation by dams and weirs. Changes in water management through the provision of environmental flows has significantly reduced the extent and duration of high salinity events at key locations along the lower reaches of the river. Furthermore, concurrent with reduced salinity events, nutrient concentrations within the river have begun to decline. In addition to improve water quality fish and macroinvertebrate communities have rebounded.

Long term ecological monitoring has demonstrated that flow and water quality issues are critical factors that influence the overall ecological integrity of the Wimmera River. While

some argue that environmental flows in lowland rivers are insufficient to adequately reduce harmful ecological impacts, environmental flow management is the central tenant to restoring water quality and ecological health in the River. Since the creation of water savings to be provided as environmental flows in the early 2000's environment ■

PRESENTATION 1142
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS III*, 05/30/2018, 03:20 - 05:00

EFFECTIVENESS OF MANAGEMENT PRACTICES USED FOR NUTRIENT AND SUSPENDED SOLID MITIGATION IN AGRICULTURAL DRAINAGE DITCHES

Faust, Derek, USDA-Agricultural Research Service, Mandan, ND
Kröger, Robert, Covington Civil and Environmental, Gulfport, MS
Moore, Matthew, USDA-Agricultural Research Service, Oxford, MS
Rush, Scott, Mississippi State University, Mississippi State, MS

Agricultural non-point sources of nutrients and sediments have caused eutrophication and other water quality issues in aquatic and marine ecosystems, such as the annual occurrence of hypoxia in the Gulf of Mexico. Management practices have been implemented adjacent to and in agricultural drainage ditches to promote their wetland characteristics and functions such as mitigation of nitrogen, phosphorus, and total suspended solid. Objectives include: 1) Examining effects of management practices in drainage ditches (i.e., riser and slotted pipes, two-stage ditches, vegetated ditches, low-grade weirs, and organic carbon amendments) on nutrient and total suspended solid concentrations and loads with emphasis on the Lower Mississippi Alluvial Valley, 2) quantifying percent change in nutrient and total suspended solid concentrations and loads associated with these management practices and, 3) identifying information gaps regarding water quality associated with these management practices and research needs in this area. Generally, management practices used in drainage ditches at times reduced losses of total suspended solids, N, and P. Mitigation efficiencies of the management practices were variable, at times ranging from an 80% reduction to greater than 200% increase in concentration or load. This variability could often be attributed to ineffectiveness of management practices during storm events that were uncommon and intense in duration and volume. These types of events could increase in frequency and intensity due to climate change, emphasizing the importance of improving mitigation during these events. All management practices examined herein require further research to improve nutrient and suspended solid removal, but riser and slotted pipes, two-stage ditches, and organic carbon amendments are practices with few studies and would benefit from additional investigation. Overall, studies on combined effects of management practices on drainage ditch water quality, along with research towards improved nutrient and sediment reduction efficiency during intense storm events are urgently needed. ■

PRESENTATION 1209
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES III*, 06/01/2018, 03:10 - 05:00

THE USE OF CONSTRUCTED FLOATING WETLAND FOR STORMWATER TREATMENT: RESEARCH FINDINGS FROM SOUTH EAST QUEENSLAND, AUSTRALIA

Schwammberger, Peter, University of the Sunshine Coast, Sippy Downs, Queensland, Australia
Lucke, Terry, University of the Sunshine Coast, Sippy Downs, Queensland, Australia
Walker, Christopher, University of the Sunshine Coast, Sippy Downs, Queensland, Australia

Background: Constructed Floating Wetlands (CFWs) are supported by an artificial floating medium, where plant roots grow directly into the water below. As the roots grow into the water they provide an extensive surface area for biofilm growth on the root hairs. Biofilm coverage is an essential requirement for the sequestration and removal of nutrients from stormwater.

Objectives: Research has demonstrated that CFWs can provide an effective treatment solution for domestic and agricultural wastewater. However, utilizing CFWs to remove pollutants from urban stormwater is a relatively novel approach. Consequently, research findings in this area are limited. In December 2015, two CFW (total area of 2,100m2) were installed within a greenfield development (Parklakes 2) on the Sunshine Coast in Australia. A four-year research study on CFWs commenced in January 2016. The five objectives of the study are: (1) characterise the water quality of runoff from the development during the construction and operational phases; (2) verify the stormwater pollution removal performance of a CFW; (3) characterise the ability of CFWs to manage urban lake health, (4) determine the nutrient uptake of Carex appressa, and (5) identify the microbial biofilm composition within the root-zone of the CFWs.

Methods: Storm-event-based water samples were collected upstream and downstream of the two CFWs to assess event-based pollutant removal. Grab samples were collected monthly to assess the system in the static state. Plant nutrients were analysed by combustion analysis and inductively coupled plasma – atomic emission spectroscopy. The microbial diversity was assessed by 16S microbiome analysis.

Progress: To date, 25 storm events have been captured and are being analysed to determine the event-based pollutant removal performance of the CFWs. Plant nutrients were analysed after 12 and 16-months post-CFW installation. The bacterial community data are currently being analysed. It is anticipated that results will be presented at the conference. ■

PRESENTATION 1258
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES III*, 06/01/2018, 03:10 - 05:00

FLOATING TREATMENT WETLAND INFLUENCES HYDRAULIC PERFORMANCE OF A POND RECEIVING IRRIGATION RUNOFF

Bell, Natasha, Clemson University, Clemson, SC
Strosnider, William H.J, Clemson University, Georgetown, SC
Hitchcock, Daniel, Clemson University, Clemson, SC
White, Sarah, Clemson University, Clemson, SC

Constructed wetlands have been used for decades to remediate contaminants from industrial, domestic, and agricultural wastewaters. One such type of constructed wetland is the floating treatment wetland (FTW). A FTW consists of emergent vegetation established upon a buoyant structure that floats on the water surface. Microbial communities colonize the roots suspended below the FTW. These roots and microbial communities serve as natural filters by processing and taking up nutrients and other pollutants, slowing the flow rate, and enhancing the settling of suspended solids. Though studies have investigated treatment efficacy and mechanisms for pollutant removal of these systems, the hydraulic performance of FTWs and its potential impact on treatment efficacy has not been investigated. The objective of this study was to compare the hydraulic performance of a pond receiving irrigation runoff from a plant nursery with a FTW installed and then without the FTW. The FTW consisted of an equal distribution of a mixture of plants including Canna flaccida, Carex stricta, Panicum virgatum, and Paspalum vaginatum (200 plants of each species), and covered ~10% of the surface area of a 320-square-meter pond with an average depth of 0.7 meters. Tracer tests were performed three times while the FTW was installed and three times after the FTW was removed from the pond from October 2017 to February 2018. Rhodamine WT, a nonreactive fluorescent dye, was used and monitored by YSI 6600 multi-parameter water quality sondes with time step set to one minute. Hydraulic indicators, including hydraulic residence time distributions, effective volume ratio, and moment, short circuiting, and mixing indices, will be calculated to assess hydraulic performance. The presence of a FTW is expected to improve hydraulic performance, resulting in increased mixing and effective volume and decreased short-circuiting. This is the first known tracer study to investigate the hydraulic performance of a FTW receiving agricultural runoff water. ■

PRESENTATION 1342
PRESENTED DURING *BIOGEOCHEMISTRY OF WETLANDS III*, 05/30/2018, 03:20 - 05:00

BEHAVIOR OF METALS IN DECOMPOSING LITTER IN CONTAMINATED WETLANDS

Brumley, Jessica, National Research Council, Ada, OK
Nairn, Robert W., University of Oklahoma, Norman, OK

Six wetlands were examined for litter decomposition rates and metals behavior during decomposition: three metals-contaminated volunteer wetlands in the Tri-State Lead-Zinc Mining District, Ottawa County, Oklahoma, and three ecologically engineered coal mine drainage passive treatment systems in the Arkoma Basin of eastern Oklahoma. Litter bag decomposition experiments were completed using 5-g of dried and homogenized standing dead Typha spp. Replicate bags were placed in different hydrologic zones or treatment process units with replicate plots and were collected five times over 250 days. A single exponential decay model expressed decomposition rates and litter was analyzed for iron, zinc, cadmium, and lead concentrations.

Initial concentrations of iron, zinc, lead, and cadmium in litter were the same in all systems. After decomposition, the concentrations differences between hydrologic zones and process units were significantly different in all systems, except one ($p<0.05$). This suggests that hydrology and metals concentrations in the water could affect litter metal accumulation or loss.

Decay constants (k) were similar to values for other Typha spp. systems ($k = 0.0012\text{-}0.0240$ day-1). Volunteer wetlands showed similar decomposition rates, but greatest litter mass loss was in flooded hydrologic conditions. Iron and zinc concentrations increased in the litter over time, indicating a negative relationship with decomposition; although the lead and cadmium concentrations also increased in the litter over time, changes were not significant ($p<0.05$).

Passive treatment systems had differences in decomposition rates between process units ($p<0.05$). Slowest decomposition rates were found in the initial oxidation cells where iron accumulated on the litter as it precipitates from the water. Iron had a negative relationship with decomposition, increasing significantly in all process units for all systems. Zinc had a positive relationship with decomposition. Water in the treatment wetlands had low zinc concentrations, so zinc in the decomposing litter could possibly be released into the system. Lead and cadmium in the treatment wetlands had varied results with one system showing no difference in concentrations and another with increases. This study suggests that metals behavior in litter during decomposition is dependent on the decomposition rates and on metals concentrations in the wetland. ■

Physical Sciences: Other

PRESENTATION P76
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

NEW MADRID SEISMICITY AND THE LITTLE RIVER DRAINAGE DISTRICT: POTENTIAL ANTHROPOGENIC INFLUENCE ON THE NEW MADRID SEISMIC ZONE

Heuneman, Eric, Southern Illinois University, Cobden, IL

The Little River Drainage District (LRDD) located in southeast Missouri's bootheel began excavation in 1913. It was designed to drain ~4856 km2 of land, allowing agriculture and railroad to utilize a region that once consisted of uninhabitable wetlands. The LRDD is situated in a well studied region of intra-plate seismicity known as the New Madrid Seismic Zone (NMSZ). Historically, the NMSZ has produced some of the largest magnitude (M) intra-plate earthquakes in North America; the 1811 New Madrid earthquakes ~M 6.5 -7.5 , and the 1895 Charleston, MO earthquake ~M 6.2. Presently, high levels of microseismicity are observed within the NMSZ. Average b-values for the NMSZ estimate that earthquakes of ~M 5.1 should occur approximately every 80-100 years. However, since the 1895 earthquakes, there have been no seismic events greater than M 5.1 within the NMSZ.

It has been shown that stress changes of even a few 0.001 MPa are sufficient to affect seismicity in a fault. Intra-plate seismogenesis, as found in the NMSZ, often manifests as shallow seismic events <10 km. At these relatively shallow depths it is possible for interstitial fluid pressure to be sufficient to reduce the critical value of shear stress and potentially induce seismicity. Removal of surface water will have the inverse effect through a reduction of the pore pressure.

When accounting for stresses acting within the NMSZ, the wetlands drained by the LRDD have been overlooked as a possible anthropogenic control on the current state of seismicity in the region. A reduction of surface water in Missouri's bootheel brought about by the LRDD as well as isostatic unloading due to the removal of sediment in the Mississippi River Basin affect seismicity in the NMSZ. We hypothesize that these parameters account for the apparent cessation of earthquakes much larger than M 5.0 in the region through isostatic rebound and pore pressure reduction. Our model uses finite difference methods to demonstrate the stresses and displacements expected through the removal of the wetlands and excavation of earth within the NMSZ based on a simple plain strain equation. When accounting for far-field stresses and orientation, the Mohr-Coulomb failure criterion can be used to verify the present probability of fault failure. The wetland management of the LRDD may be positively affecting seismicity in the NMSZ by reducing the probability of fault failure. ■

PRESENTATION 1650
PRESENTED DURING *PHYTOREMEDIATION OF SOIL AND SEDIMENT IN WETLANDS II*, 05/30/2018, 03:10 - 05:00

CONTAMINANT MITIGATION IN RECEIVING FORESTS: IMPLICATIONS FOR WATER REUSE AND STORAGE

Nichols, Elizabeth, NC State University, Raleigh, NC

This presentation will address how forests mitigate contaminants after twenty years of municipal wastewater inputs that often contribute as much annual hydrological loading as natural rainfall. Since the late 1990s, North Carolina has land-applied municipal wastewater to more than 50 land application sites of which most are forested lands. These sites are important, large scale systems that can provide important field data information for forest health, Ecosystem services, contaminant fate and transport, and water quality in contrast to conventional wastewater discharge to surface waters. The data presented will show how specific targeted chemicals and non-targeted chemicals persist or are mitigated at North Carolina's largest land application forest where 2,000 acres of forest are irrigated on a 6,000 acre footprint. Targeted chemical analysis provides concentrations and mass balances for the system. Non-targeted and suspect screening analyses (NTS/SS) capture the entire chemical profile although most chemicals are not identifiable with 90% certainty to an extensive USEPA chemical database. However, NTS/SS can provide fingerprints of the chemical profile in applied waters, soils, groundwater, and surface waters in this land application watershed. These data are needed to understand the human and ecological risk of potential disaster mitigation lands in order for stakeholders to utilize in future regional-scale stormwater management planning. These findings and how they impact stakeholder perspectives of forest reuse systems will be contextualized for other needed water management systems for temperate southern forests such as large scale stormwater management forests in addition to flood plains. ■

Policy: Ecological Economics

PRESENTATION 1114
PRESENTED DURING *FLOATING WETLANDS: FROM NATURAL TO NOVEL ECOLOGIES II*, 06/01/2018, 01:00 - 02:50

A COST-PROFIT ANALYSIS OF FLOATING TREATMENT WETLANDS AS A REMEDIATION TOOL FOR NURSERY AND GREENHOUSE EFFLUENT

Garcia Chance, Lauren, Clemson University, Anderson, SC
White, Sarah A., Clemson University, Clemson, SC

Research has demonstrated that floating treatment wetlands (FTWs) can efficiently remediate nutrient and metal contaminants. Economic information, providing insight into the costs and potential return on investment from installation of FTWs is needed. Cost analysis of FTW uses beyond remediation should be accounted for. These include (1) opportunities to use FTWs as additional growing space for specialty crop production, (2) water quality trading credits, and (3) ecosystem services. Ecosystem services, while less well defined and characterized than traditional economic indicators, must be considered in any cost analysis of FTWs. To evaluate the economic costs and benefits of FTWs, three components were assessed; (1) the cost of FTW installation, (2) the cost of plant installation and maintenance, and (3) the value of the benefits derived from the FTW installation. All calculations were conducted on a FTW module basis (4'x 8'), which can be extrapolated to predict costs and benefits based on individual installation. The first step consisted of gathering data from previous publications as well as contacting distributors of FTW systems to generate ranges of installation costs for the system. The second component consisted of quantifying the costs of plant installation and maintenance within a FTW. This included sourcing costs for a variety of wetland plant materials from a minimum of twelve growers. Maintenance costs were minimal, however, labor for installation and harvest of plants was considered. The final measure considered possible monetary and ecological gains of the system based on previously conducted research. A statistical model grouping the costs and benefits for each of the three steps into a high, medium, and low category to generate final return ranges based upon combinations across the three steps was developed. All these factors will be addressed to form a complete picture of the costs and possible returns of FTWs. ■

PRESENTATION 1130
PRESENTED DURING *HUMAN DIMENSIONS OF WETLANDS*, 06/01/2018, 09:55 - 11:35

CASE STUDY: WETLAND & RIPARIAN CONSERVATION AT AN URBAN QUARRY

Eicke, Chant, EarthView Environmental Inc., Coralville, IA

Open-pit mining requires massive land use and often necessitates large-scale negative impacts on natural areas including wetlands. This case study looks for common ground between wetland conservation and the commercial needs and realities of this industry.

Recent and ongoing quarry expansion along with associated riparian corridor conservation efforts are outlined for a large limestone quarry in eastern Iowa. Industry costs, benefits, & motivations are summarized and explored.

There will likely not be an end to the inherently conflicting relationship between open-pit mining and the health of local natural systems. Yet, pragmatic consideration of both the needs of industry and the functions and values of local natural systems can provide for astutely focused conservation efforts alongside insightful industry planning.

Early identification of natural resources and consideration in long-term planning helps quarry managers to be cognizant of future permitting pit-falls & mitigation costs, along with the ability for strategic conservation and minimization of impacts to natural areas. ■

PRESENTATION 1182
PRESENTED DURING *AFRICAN RIVERS*, 06/01/2018, 01:10 - 02:50

EFFECTS OF PETROLEUM BUNKERING ACTIVITIES ON THE SOCIO-CULTURAL AND ECO-ECONOMICS OF MAJIDUN RIVER, IKORODU, NIGERIA

Ndimele, Bright Uchenna, University of Lagos, Akoka, Lagos State, Akoka, Lagos, Nigeria

Commercial exploitation of Nigeria oil and gas reserves began in 1956 shortly after discovery of oil at Oloibiri in Bayelsa State. The export of the crude oil accounts for 90% of the country's foreign exchange earnings and more than 70% of its total budget expenditure. Over the years what seems to be a blessing has constituted nuisance leading to environmental degradation, loss of farmlands, fishing grounds, communal clashes, militancy, cultism and total breakdown of moral values in the Niger Delta region. These calamities were totally avoidable had successive governments utilized the wealth of the region in developing it. Crude oil bunkery is huge problem in Nigeria accounting for a loss of about 10% of total crude export in Nigeria. The occurrence of heavy metals (often associated with crude oil

spillage) in water, sediments and a commercially important fish (Clarias gariepinus) from petroleum bunkering sites in Majidun River, Ikorodu, Nigeria were studied in order to assess the impacts of this illegal activity on humans using socio-cultural and eco-economic variables. The study was conducted over a period of 12 months (Jan, 2014 – December, 2014). The data showed high levels of metals (Cu, Zn, Fe, Cd, Pb and Mn) in different compartments of the ecosystem. Metal levels were all above the tolerable limits recommended by regulatory bodies (FAO and WHO). It was discovered that income generated by local fishers has reduced because of petroleum and heavy metal pollution. The study also revealed a drastic reduction in the delivery of such ecosystem services like food, water, socio-cultural festivities etc. Government intervention by enactment/ enforcement of existing laws on crude oil bunkering is important to conserve biodiversity, prevent food insecurity and safe lives. ■

Policy: Federal State Local Initiatives

PRESENTATION 1624
PRESENTED DURING *ARID WETLANDS: CONSERVATION CHALLENGES AND RESEARCH NEEDS III*, 05/31/2018, 03:10 - 05:00

LINKING WETLANDS, WATERBIRDS, AND WATER POLICY IN THE ICONIC GREAT SALT LAKE ECOSYSTEM: CHALLENGES AND OPPORTUNITIES IN A HEAVILY IMPACTED LANDSCAPE

Kettenring, Karin, Utah State University, Logan, UT
Endter-Wada, Joanna, Utah State University, Logan, UT
Downard, Rebekah, Utah State University, Salt Lake City, UT
Vest, Josh, Intermountain West Joint Venture, Missoula, MT

The Great Salt Lake ecosystem provides some of the highest concentrations and diversity of wetlands in the Intermountain West Region. Consequently, the Great Salt Lake comprises one of the most important wetland complexes for migratory waterbirds in North America that supports migration, breeding, and wintering habitat. For at least nine waterbird species, the Great Salt Lake sustains significant proportions (15–60%) of their continental populations. The threats to these iconic wetlands, revealed through recent research advances, are numerous including (1) reduced water availability due to upstream diversions from the rivers that feed these wetlands, (2) changes to the timing and quantity of water delivery due to climate change-driven impacts on snowpack, and (3) rising temperatures that increase evaporative demand in a system that already has limited water supply. Nonetheless, in this highly modified landscape, there are a number of policy solutions and management opportunities that can and are being pursued to address these conservation challenges. For instance, managers currently employ an effective impounded wetland management strategy to capture limited, highly variable, and unpredictable water supplies. They are able to disperse water to their highest priority wetland units to create a diversity of water regimes and habitat types to meet functional goals. Also, policy makers are considering novel pathways to "stretch" limited water supplies to better meet human and environmental (including wetland) needs. Addressing issues related to the Great Salt Lake were elevated in a state water strategy effort undertaken from 2014-2017. In addition, waterbird conservation planners are seeking unlikely partnerships to foster strategic wetland conservation and restoration on working lands. For example, incentives to improve agricultural irrigation efficiencies that are also beneficial to wildlife and fisheries habitat in the upper Great Salt Lake watershed provide system resilience and potential flexibility for downstream water management. We conclude by outlining research needs that will enable policy makers, conservationists, and wetland managers to more fully support these critical wetlands, their overall functioning, and waterbirds into the future. ■

Policy: International

PRESENTATION 1201
PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION II*, 05/31/2018, 03:10 - 05:00

THE ENVIRONMENTAL JUSTICE MOVEMENT FOR STREAM AND FISH PROTECTION: CAPABILITIES OF THE TAYAL INDIGENOUS PEOPLE IN MRQUAN TRIBE

Silan Song, Kuoyung, National Taiwan Normal University, Taipei, Taiwan

Scholars use environmental justice (EJ) as an analytical framework to assess the well-being or social justice of individuals or communities, while others use the Capability Approach (CA) methodology. However, an appeal study from 2016-2017 of the EJ of Indigenous People found a wide range of concerns. Environmental Justice is perhaps the most common issue for Indigenous People living in water-rich areas. Whether conscious or unconscious, examples of EJ issues related to Indigenous People abound temporally and globally and usually based on the rationale that the social and economic needs of the non-indigenous culture outweigh those of the Indigenous People. As such, Indigenous People have always been forced to accept the outcomes and were commonly excluded from participating in the decision making process. Indigenous People have

emerged in the last two decades with a wide range of EJ issues and they concerned how these movements use their traditional knowledge to protect their environment, express their aspirations to understand the process of revitalization of local aboriginal capabilities. This study provided one of the examples from Taiwan's Tayal Indigenous People to illustrate elements of EJ and how the Tayal are working through these issues to preserve their identity, culture, and traditional ways of life. This study reveals that the Tayal demands for EJ go beyond equality of distribution, emphasizing the defense and functioning of the existential value of the indigenous tribes so that they can continue to revive their traditional culture, practice their cosmology, and maintain their eternal life. As such, the capabilities of the Tayal are related to their natural ancestral lands. These cases illustrate the widespread use of the CA in the Tayal movement and the applicability of Capability Theory as a comparative analysis framework. In addition, EJ as it relates to Indigenous People has changed the important element in explaining Capability Theory in practice. This presentation provides an interesting case in the EJ struggles of Taiwan's Indigenous People, which can strengthen the theory of collective CA and help the CA theorists to rethink the theoretical basis of this approach. ■

Policy: Ramsar & International Agreements

PRESENTATION 1178
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES II*, 05/30/2018, 01:00 - 02:50

ASSESSING AND PLANNING FOR MANAGING WETLAND ECOSYSTEM SERVICES AND LOCAL LIVELIHOODS THROUGH WETLAND MANAGER EMPOWERMENT - THE MYANMAR APPROACH

McInnes, Rob, RM Wetlands & Environment, Littleworth, Oxfordshire, United Kingdom

Management planning and the implementation of robust management actions are essential for maintaining the ecological character of Ramsar Sites. However, many management plans fail to define the ecological character of the site and especially with regards to the ecosystem services that are provided. Consequently the failure to define how local and wider communities benefit from the site can result in conflicts, especially where certain livelihood actions are considered to generate negative changes within the site. However, a significant barrier to developing robust management plans which fully consider and integrate livelihoods with the site management planning process is a lack of capacity at both government and site level. Through funding from the Norwegian Government, a novel approach to site management planning and capacity building has been undertaken at the Moeyungyi Wetland Wildlife Sanctuary Ramsar Site in Myanmar. The local site managers have been trained and empowered in order to develop robust ecological character descriptions and to identify and resolve livelihood issues which may impact on the site. This presentation will describe the approach adopted, the outcomes achieved and the lessons learned from this process. ■

PRESENTATION 1238
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES II*, 05/30/2018, 01:00 - 02:50

RAMSAR CONVENTION RESPONSES TO GLOBAL WETLAND DETERIORATION: HOW MUCH, AND HOW SUCCESSFUL?

Gardner, Royal, Stetson University College of Law, Gulfport, FL

At its 13th Conference of the Parties (COP13) in the United Arab Emirates in October 2018, the Ramsar Convention will launch the Global Wetland Outlook: State of the World's Wetlands and their Services to People. The Global Wetland Outlook, the Convention's flagship publication, will examine, inter alia, response actions to continuing wetland losses. This presentation will discuss significant features and response actions of the Ramsar Convention, including the rate of designations of Wetlands of International Importance (Ramsar Sites); the extent to which management plans have been prepared for Ramsar Sites; the rate of Article 3.2 reports of human-induced adverse changes in ecological character at Ramsar Sites; the status of the Montreux Record; and the use of Ramsar Advisory Missions. It will also highlight key issues that will be considered at COP13. ■

PRESENTATION 1338
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES I*, 05/30/2018, 09:45 - 11:35

UPDATE ON THE TRENDS OF MEDITERRANEAN WETLANDS: THE MEDITERRANEAN WETLANDS OUTLOOK 2.

Grillas, Patrick, Tour du Valat, Arles, France, France
Galewski, Thomas, Tour du Valat, Arles, PACA, France
Guelmami, Anis, Tour du Valat, Arles, PACA, France
Perennou, Christian, Tour du Valat, Arles, PACA, France
Chazée, Laurent, Tour du Valat, Arles, PACA, France
Gaget, Elie, Tour du Valat, Arles, PACA, France

Popoff, Nadège, Tour du Valat, Arles, PACA, France
Geijzendorffer, Ilse, Tour du Valat, Arles, PACA, France

Ramsar has contributed considerably to the awareness on the values of Mediterranean wetlands, its biodiversity and the benefits, the ecosystem services they provide to people locally and globally. In a first Mediterranean Wetland Outlook published in 2012 by the Mediterranean Wetlands Observatory, important baselines were set, for instance, for the first time there was a first estimation of the surface area and place of Mediterranean wetlands.

Now in 2018, the second Mediterranean Wetland Outlook is launched, allowing for a better understanding of the trends in Mediterranean wetlands. The results clearly show an increase in both the surface and number of sites that have obtained a Ramsar designation (+6450 sq.km and 52 new sites). Some indicators demonstrate a change in its trend since the Mediterranean wetland Outlook 1, but this is mostly a change in the rate of change than an actual inversion of the trend. The observed changes are likely due to the socio-economic contexts and political unrest in the region rather than overall increased conservation effort. In general indicators have particular geographical patterns, separating between the north and the south of the Mediterranean Basin. However, there are some positive examples with for instance a spectacular recovery of waterbirds in Maghreb since 1990 that could be related to the designation of many new Ramsar sites. Apart from the waterbird species which are generally improving, especially in the Western Mediterranean, all other taxa are decreasing. There is some evidence that large-scale protection such as the European Bird Directive has driven the recovery of waterbirds but conservation efforts have been insufficient to prevent the loss of habitat types crucial for endemic amphibians or freshwater The ecosystem services provided by the habitat types in Mediterranean wetland sites have generally been decreasing over time, due to the land cover transitions that have taken place.

Given the evident need in the Mediterranean basin to make progress towards the Sustainable Development Goals, the Mediterranean Wetland Outlook 2 clearly indicates the potential progress countries can make through the conservation or restoration of Mediterranean wetlands and this could give a new momentum. ■

Policy: Regulation

PRESENTATION P79
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

BE CERTAIN BEFORE YOU ERADICATE: THE MISIDENTIFICATION OF A NATIVE NYMPHOIDES FOR AN EXOTIC SPECIES

Cooper, Eddie, United States Geological Survey, Lafayette, LA
Middleton, Beth, USGS, Lafayette, LA
Anemaet, Evelyn, USGS, Lafayette, LA

In the United States, there are four species of the Nymphoides that are native (n) to the Americas. These include N. aquatica (Gulf Coast to Canada), N. cordata (Gulf Coast to Canada), N. grayana (Central and South America), and N. humboldtiana (Central and South America). There are also three exotic (e) species: N. cristata (tropical Asia), N. indica (tropical latitudes of Africa, Asia, and Australia), and N. peltata (Eurasia). Populations of four species have been confirmed within Florida including N. cristata (e), N. grayana (n), N. humboldtiana (n), and N. indica (e). All four species share morphological similarities. For example, N. indica (e) and N. humboldtiana (n) have morphological similarities and are difficult to distinguish without molecular testing. Recent data from DNA and plasmid testing has confirmed that populations of Nymphoides in Florida previously believed to be N. indica (e) are instead N. humboldtiana (n), which was previously unknown in Florida. Currently in Florida, N. indica is being targeted for control and removal. Due to these problems, it may be necessary to use molecular means to distinguish between N. indica and N. humboldtiana before eradication efforts are undertaken. ■

PRESENTATION 1195
PRESENTED DURING *REGIONAL RECOVERY OF WETLANDS IN THE NORTHERN TAMPA BAY AREA: SCIENTIFIC AND REGULATORY PERSPECTIVES II*, 05/30/2018, 01:00 - 02:50

DEVELOPMENT AND APPLICATION OF WETLAND RECOVERY METRICS

Shea, Christopher, Tampa Bay Water, Clearwater, FL
Kiehn, Whitney, Tampa Bay Water, Clearwater, FL
Schmutz, Dan, Greenman-Pedersen, Inc., Orlando, FL

Establishing the recovery of wetland hydrologic and ecological conditions from a stressor requires developing wetland "health" standards, or at least determining the normal range of conditions present in the absence of the stressor. As part of Tampa Bay Water's Recovery Assessment Plan

(a permit-required study to document the effects of a 40-50% reduction in groundwater production since 2002) wetland recovery metrics have been developed. Metrics were developed for different categories of wetlands, based on habitat type, geographic isolation and surrounding soils. Hydrologic parameters for wetlands with documented ecological impact (e.g. treefall, soil subsidence, upland species encroachment) were compared with reference wetlands of similar type. (This approach was first developed by the Southwest Florida Water Management District in the establishment of minimum levels for palustrine cypress "domes" in the area.) Professional judgment was used to characterize over 300 monitored wetlands in the Northern Tampa Bay area into four types: isolated cypress, isolated marsh, connected wetlands and "other" wetlands (e.g. bay swamps, isolated hardwood swamps). The geographically isolated wetlands were then further distinguished as to occurrence in xeric or mesic landscapes, as surrounding soil type was thought, based on previous studies, to effect wetland hydrologic characteristics. For each category, long-term median wetland water level offsets from standard full-pool elevations were calculated for both impact and reference groups. A nonlinear solver function was then used to identify the median water level offset value associated with minimal misclassification error between groups. Reported misclassification error for the metrics developed and utilized ranged from 5% (isolated cypress) to 19% (isolated wetlands in a xeric landscape). Individual wetlands were then assessed using median water levels from a long-term post-cutback period of near-average rainfall, compared against the appropriate type-specific recovery metric. Post-cutback compliance of study area wetlands with the developed metrics ranged from 68% (isolated wetlands in mesic landscapes, n = 131 wetlands) to 82% (connected wetlands, n = 72 wetlands). ■

PRESENTATION 1239
PRESENTED DURING *STEMMING THE DETERIORATION OF WETLANDS: GOOD PRACTICE POLICY AND MANAGEMENT APPROACHES II*, 05/30/2018, 01:00 - 02:50

THE CHANGING US LEGAL AND POLICY FRAMEWORK FOR WETLAND CONSERVATION: WILL IT LEAD TO MORE DEGRADATION?

Gardner, Royal, Stetson University College of Law, Gulfport, FL
Davies, Gillian, BSC Group, Inc., Acton, MA

The Clean Water Act (CWA) is the primary federal law protecting wetlands in the United States. The geographic jurisdiction of the CWA extends to wetlands that qualify as "waters of the United States," also known as "WOTUS."

The parameters of what constitutes a WOTUS have been refined by litigation, regulation, and agency guidance. In June 2015, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers issued the Clean Water Rule, a regulation that updated the WOTUS definition in light of case law and best available science. Industry groups and many states challenged the Clean Water Rule and the new WOTUS definition in dozens of lawsuits across the country. In October 2015, the Sixth Circuit Court of Appeals issued a nationwide stay on the implementation of the Clean Water Rule. The U.S. Supreme Court is now considering whether the Sixth Circuit is the appropriate court to rule on the issue.

At the same time, the Trump administration has entered the fray, through an Executive Order and a proposal to rescind and replace the Clean Water Rule in a complicated two-step (or perhaps three-step) regulatory process, which could culminate in a very restrictive WOTUS definition.

Many groups-including wetland scientists-have weighed in through amicus briefs and comment letters on the proper scope of WOTUS.

This presentation will provide an update on the current status of WOTUS actions in the courts, agencies, and Congress. It will also highlight the role of the Society of Wetland Scientists in these matters. ■

PRESENTATION 1343
PRESENTED DURING *WETLAND REGULATIONS & DELINEATION*, 05/30/2018, 03:20 - 05:00

UNINTENDED CONSEQUENCES OF DAM REHABILITATION: EXPLORING THE CONFLICTS BETWEEN WETLANDS AND WATER STORAGE

Skigen-Caird, Sarah, GEI Consultants, Inc., Denver, CO
Guth, Daniel, GEI Consultants, Inc., Denver, CO

The aging infrastructure associated with water storage facilities is in a process of renewal across the United States. As a result of recent catastrophic failures in the western United States (e.g., Oroville Dam), there is a particular focus across the Arid and Intermountain West to reconfigure and rehabilitate existing embankment structures that have been largely ignored for decades. Increased funding for infrastructure and questions related to the safety of existing flood control facilities has created a sense of urgency to bring them up to current standards and enhance overall integrity through system-wide improvements. In some cases, these upgraded designs restore flow to downstream intermittent/ephemeral stream systems through improved outlet works and/or spillways, systems that have been disconnected from upstream flow for decades. In other situations, it is evident

that long-term seepage through the dam and/or poorly functioning outlets have led to the creation of well-established networks of palustrine emergent and/or forested wetlands downstream of the dam. Redesign and rehabilitation of the embankment inevitably leads to the unavoidable impact to these systems. While we understand the historical upstream impacts to the riparian corridor and associated wetlands through the initial creation of reservoirs for water storage, the alteration and reconfiguration of the downstream corridor requires further consideration, as we now move through acquisition of permits for the dredge, fill, and dewatering of these systems that have developed over time. The questions become: Are these systems of any unique value, particularly since many are relatively small in acreage? Is a functional assessment necessary in order to properly evaluate the intrinsic value of these systems? Is there potential for ecological lift beyond the baseline that could be the result of dam rehabilitation? Case studies across New Mexico, South Dakota, and California will be presented allowing for various scenarios to be explored. ■

PRESENTATION 1350

PRESENTED DURING *SUSTAINING WETLAND SCIENCE IN A TIME OF POLITICAL DIVISIVENESS AND SCIENTIFIC SKEPTICISM: DIVERSE VOICES, TRANSFORMATIVE CAREERS, AND IMPACTFUL COMMUNICATION I*, 05/31/2018, 09:45 - 11:35

A HITCHHIKER'S GUIDE TO FEDERAL WETLAND POLICY

McCarthy, Julia, USEPA Region 8, Denver, CO

Wetlands are a critical component of our ecosystems. They provide numerous functions including supporting high biodiversity and rare species; capturing flood flows; and contributing to carbon and nutrient cycling. Greater scientific understanding of wetland functions has prompted federal wetland protection policies such as the 1972 Clean Water Act (CWA), and the 1977 Executive Order which directs all federal agencies to avoid long and short term adverse impacts associated with the destruction or modification of wetlands. The CWA program that protects wetlands by regulating the discharge of dredged or fill material into these waters has always been controversial. Under Section 404 of the CWA, the Environmental Protection Agency, along with the U.S. Army Corps of Engineers, establishes environmental standards for reviewing permits for discharges that affect wetlands. The implementation of these environmental standards is supported by numerous policies, decisions, and guidance. In the Section 404 regulatory program, there are many important examples of how the best-available science in wetlands and stream ecosystems has been used to advance the goals of the CWA and contribute to the national goal of no net loss of these important resources. This presentation will describe several case studies that demonstrate how program implementation was improved, e.g., made more clear and consistent, by the use of science to support decision-making. ■

PRESENTATION 1529

PRESENTED DURING *GEOLOGY/HYDROLOGY/WATERSHEDS I*, 05/31/2018, 03:20 - 05:00

ENGINEERING AND SCIENTIFIC APPROACHES FOR EVALUATING THE RELATIVE PERMANENCE OF A HYDROLOGIC CONNECTION

Greenberg, Noah, Wright Water Engineers, Inc., Denver, CO
Jones, Jonathan, Wright Water Engineers, Inc., Denver, CO
Phares, Natalie, Wright Water Engineers, Inc., Denver, CO

The degree of permanence of a surface water that connects upgradient aquatic resources and downstream navigable waters is a central tenet of Federal Clean Water Act jurisdiction since the United State's Supreme Court decision in the consolidated cases of Rapanos v. United States & Carabell v. United States. In this decision, the Supreme Court Justices entered two concurring opinions: Justice Kennedy's opinion which introduced the Significant Nexus Test, and Justice Scalia's opinion which introduced the continuous Relatively Permanent Water Test. While the Significant Nexus Test was the subject of extensive research and technical-legal debate in the 2015 Clean Water Rule proceedings, the Relatively Permanent Water Test was largely overlooked by that rulemaking process.

Looking forward, technical gaps and implementation issues may arise as a result of the 2017 Presidential Executive Order 13778 (EO 13778). EO 13778 encourages the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency's adoption of a rule on the jurisdictional extent of Waters of the United States that is consistent with only Justice Scalia's opinion. If EO 13778 is implemented, Justice Scalia's Relatively Permanent Water Test would likely become the primary test of a non-navigable aquatic resource's status as Waters of the United States.

The authors have used scientific and engineering approaches for evaluating the hydrologic permanence of connecting waterways. These approaches have been used to support litigation matters and in requests for jurisdictional determinations. Employed methods include: 1) Development of hydrographs using pressure transducer-measured water depths; 2) Modeled rainfall-water depth predictions that are calibrated with periodic onsite measurements; 3) Contributing watershed water balance models; and 4) Indirect approaches relying on channel morphology, resident

biological communities, stream gage data from reference waterways, aerial photographs, and interviews with individuals familiar with the connecting waterway.

The authors' experience indicates that reliable determinations are possible when a study is allowed to occur over multiple years and employs multiple independent lines of evidence. Looking forward, successfully implementing a regulatory rule that hinges on the hydrologic permanence of connecting waterways will require development of less time-intensive and more predictable methods for evaluating flow permanence. ■

PRESENTATION P80
PRESENTED DURING POSTER SESSION & SILENT AUCTION RECEPTION, 05/31/2018, 06:30 - 08:30

NAVIGATING REGULATORY COMPLIANCE FOR CONSTRUCTION ACTIVITIES: SECTION 402 & 404 OF THE CLEAN WATER ACT

Maraglia, Drew, Wright Water Engineers, Inc., Denver, CO

As infill development opportunity dwindles in the Denver Metro Area, urban sprawl is expanding into what were previously undesirable development locations. Increasingly, developers are acquiring properties that require a suite of complex water quality permits. Navigating the current regulatory environment can be difficult and costly without a thorough understanding of federal, state, and local permit requirements and potential regulatory "off-ramps". Through a side-by-side comparison of water quality permits commonly required for new development projects, key factors correlated to an increased cost of compliance were identified.

As a case study, an evaluation of cost associated with permits authorized under Section 402 (construction stormwater discharge permits) and Section 404 of the Clean Water Act were conducted. The most significant factors contributing to an increased cost of permit compliance are (1) permit coordination during the initial planning phase, and (2) coordinating the implementation and monitoring of restoration/mitigation requirements. Although these sections of the Clean Water Act regulate different components of water quality and have significant variation in compliance requirements, the cost regulatory compliance can be significantly reduced through coordinating the requirements of each permit. ■

Policy: Other

PRESENTATION 1316
PRESENTED DURING *INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND TRADITIONAL RESOURCE MANAGEMENT APPROACHES IN ECOLOGICAL RESTORATION II*, 05/31/2018, 03:10 - 05:00

INTEGRATING CWA AND TRIBAL REGULATORY PROGRAMS USING TRADITIONAL ECOLOGICAL KNOWLEDGE TO MANAGE AND PROTECT AQUATIC RESOURCES IN THE ROCKY MOUNTAINS

Ott, Toney, USEPA, Denver, CO
Wagner, Gerald, Blackfeet Tribe, Browning, MT

Rocky Mountain Tribes have a wide range of approaches for the management, protection and restoration of their aquatic resources. The Clean Water Act authorizes EPA to treat eligible federally recognized Indian tribes in a similar manner as a state (TAS) for implementing and managing certain water programs such as water quality standards (CWA Section 303) and water quality certifications (CWA Section 401). Four Reservation governments in Montana have applied for and received WQS and WQC authority. These tribal governments are responsible for determining beneficial uses, including cultural, for the aquatic resources within the external boundaries of the Reservation. Many of these governments also have aquatic protection ordinances, general environmental ordinances, and specific protections for cultural resources. Examples of these integrated protection programs that utilize TEK and traditional resource management are Blackfeet, Chippewa Cree, and Northern Cheyenne Nation.

EPA has authority in Indian Country to provide water quality certifications (CWA Section 401) for federal permits that may discharge to waters of the U.S. when the tribal government does not have TAS authority. Region 8 has increased communications to include concerns of tribal Environmental and Cultural protection Programs. This Includes information for mitigation and restoration that respects tribal concerns. The increased communications are between the applicants, EPA and the Tribal Environmental Programs.

Examples of the integrated approaches in Indian Country include those of the Blackfeet, Rocky Boy, and Fort Belknap Tribes whose reservations are all located in Northern Montana. The Blackfeet reservation hosts aquatic resources including headwater, alpine, riverine and prairie pothole wetlands. The Tribe has TAS for water quality standards and water quality certifications, and a strong aquatic protection ordinance. The Blackfeet Reservation's size and spectrum of ecosystems act as critical refugia for species at the edge of their range. Many of these ecosystems and species are culturally significant to the Blackfeet. Their integrated approach to wetland and watershed restoration and management incorporates TEK and TRM. ■

INDEX BY AUTHOR

About *Wetland Science & Practice*

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

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

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

HOW YOU CAN HELP

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

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

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

WSP Manuscript – General Guidelines

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

STYLE: See existing articles from 2014 to more recent years available online at:

http://www.sws.org/category/wetland-science-practice.html

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

FIGURES:
Please include color images and photos of subject wetland(s) as WSP is a full-color e-publication.

Image size should be less than 1MB – 500KB may work best for this e-publication.

REFERENCE CITATION EXAMPLES:

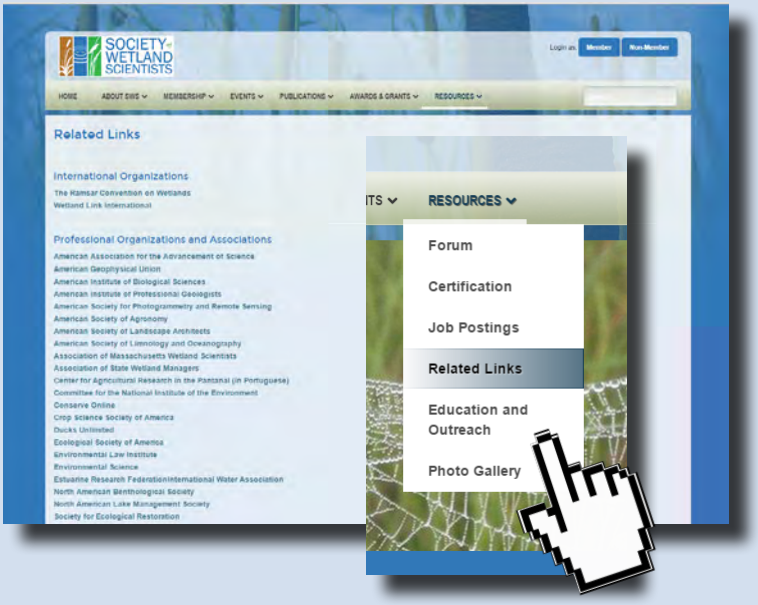
- Claus, S., S. Imgraben, K. Brennan, A. Carthey, B. Daly, R. Blakey, E. Turak, and N. Saintilan. 2011. Assessing the extent and condition of wetlands in NSW: Supporting report A – Conceptual framework, Monitoring, evaluation and reporting program, Technical report series, Office of Environment and Heritage,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

WEB TIP

Resources at your fingertips!

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

Find them on the Related Links page sws.org.



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. ■