University of Wisconsin Water Resources Institute
Annual Technical Report
FY 2014

Introduction

The University of Wisconsin Water Resources Institute (WRI) serves as the gateway to federal WRRI grants for all Wisconsin colleges and universities. While the WRI's federal base funding from the U.S. Geological Survey totals less than $100,000 per year, every federal dollar is matched with at least two nonfederal dollars. All WRRI grants are awarded on a competitive, peer-reviewed basis. WRI funds are leveraged with additional funding from the UW System Groundwater Research Program, part of Wisconsin's Groundwater Research and Monitoring Program. Faculty members and research staff who have achieved PI status from any UW System campus are eligible to apply for this funding. Guided by the Wisconsin Groundwater Coordinating Council, this program is the mechanism whereby the UW System and the state departments of Natural Resources, Safety & Professional Services, and Agriculture, Trade & Consumer Protection pool limited state and federal resources to support a coordinated, comprehensive and multidisciplinary response to the state's critical water resource issues. Together, these programs have helped establish the University of Wisconsin as a national leader in groundwater research. The Wisconsin WRI funds an average of 15 short-term research projects of either a fundamental or applied nature that typically involve about 50 faculty, staff and students at a half-dozen campuses around the state each year. By supporting short-term projects, the institute is able to quickly respond to issues as they emerge. WRI annually provides about 30 graduate and undergraduate students in the UW System with opportunities for training and financial support while they work toward their degrees.

WRI research and other water-related information are readily accessible via a Web site (www.wri.wisc.edu) and the Water Resources Library (WRL), a nationally unique collection of documents covering every major water resource topic. The library's catalog is available online and searchable via the Internet, making the WRL a national and global resource. The WRL became the first academic library in the state to make its collection available online to the public when it launched "Wisconsin's Water Library" (www.aqua.wisc.edu/waterlibrary) in 2003. The portal permits Wisconsin residents to check out WRL books and other documents free of charge via their local libraries. WRI also helps organize and cosponsor state and regional conferences on water issues. The WRI is housed in the Aquatic Sciences Center which also houses the UW Sea Grant Institute, part of another federal-state partnership of 30 university programs that promote research, education, and outreach on Great Lakes and ocean resources. This unique administrative union of Wisconsin's federal Water Resources Research Institute and Sea Grant programs enables the UW Aquatic Sciences Center to address the full range of water-related issues in Wisconsin, from surface water to groundwater, from the Mississippi River to the shores of Lakes Michigan and Superior.

Research Program Introduction

As established by Wisconsin's Groundwater Law of 1984, the state provides $250,000 to $300,000 annually to the UW System to support groundwater research and monitoring. In 1989, the WRI became the UW System's lead institution for coordinating the calls for proposals and peer reviews for distribution of the funds. To avoid duplication and better target groundwater research funding, several other state agencies (the departments of Safety & Professional Services, Natural Resources, and Agriculture, Trade and Consumer Protection) agreed to partner with the WRI to establish an annual Joint Solicitation for Groundwater Research and Monitoring. This annual solicitation has funded more than 400 groundwater research and monitoring projects since its inception and has helped establish Wisconsin as a leader in groundwater research. The results of the Wisconsin Groundwater Research and Monitoring Program (WGRMP) are recognized internationally, and WRI plays an important role in coordinating project reporting and making all technical reports available through our institute's library and website.

Our priorities for groundwater research are established annually by the Wisconsin Groundwater Research Advisory Council (GRAC) and are included as part of the Joint Solicitation. The GRAC is our institute's advisory council and also convenes to make project funding decisions. All proposals submitted to the Joint Solicitation receive rigorous external peer review (coordinated by the WRI) and relevancy review by the Research Subcommittee of the state's Groundwater Coordinating Council.

Beginning in 2010, the annual 104(B) allocation was used to expand the scope of the joint solicitation to include research on the effects of climate change on Wisconsin's water resources. Priorities for climate change research were established through a partnership between the WRI and the Wisconsin Initiative on Climate Change Impacts (WICCI). Established in 2007, WICCI is a university-state partnership created to: (a) assess and anticipate the effects of climate change on specific Wisconsin natural resources, ecosystems and regions; (b) evaluate potential effects on industry, agriculture, tourism and other human activities; and (c) develop and recommend adaptation strategies that can be implemented by businesses, farmers, public health officials, municipalities, resource managers and other stakeholders. We believe these partnerships with other state agencies provides WRI with the ability to fund highly relevant research and allows our limited funds for 104(B) to be leveraged to the fullest extent.

Climate Change Impacts on Stream Temperature and Flow: Consequences for Great Lakes Fish Migrations

Basic Information

Title:	Climate Change Impacts on Stream Temperature and Flow: Consequences for Great Lakes Fish Migrations
Project Number:	2011WI267B
Start Date:	3/1/2011
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	WI-2
Research Category:	Climate and Hydrologic Processes
Focus Category:	Climatological Processes, Ecology, None
Descriptors:	
Principal Investigators:	Peter Biek McIntyre

Publications

1. Childress, Evan, J. David Allan, Peter McIntyre; In Press; Nutrient subsidies from native fish migrations enhance productivity in Great Lakes tributaries. Ecosystems Vol. 17. 12 pg.
2. McIntyre PB, C. Reidy Liermann, E. Childress, E.J. Hamann, J. Hogan, S.R. Januchowski-Hartley, A.A. Koning, T.M. Neeson, D.L. Oele, B.M. Pracheil. In Press. Conservation of migratory fishes in freshwater ecosystems. Conservation of Freshwater Fishes
3. Childress, Evan, J. David Allan, Peter McIntyre; In Press; Nutrient subsidies from native fish migrations enhance productivity in Great Lakes tributaries. Ecosystems Vol. 17. 12 pg.
4. McIntyre, PB, C Reidy Liermann, E Childress, EJ Hamann, J Hogan, SR Januchowski-Hartley, AA Koning, TM Neeson, DL Oele, BM Pracheil. 2015. Conservation of migratory fishes in freshwater ecosystems. In: Closs G,Krkosek M, & Olden JD: Conservation of Freshwater Fishes. Cambridge University Press, Cambridge, UK.
5. Childress, E.S. and P.B. McIntyre. 2015. Multiple nutrient subsidy pathways from a migration of iteroparous fishes. Freshwater Biology 60: 490-499.
6. Childress, E.S., R. Papke, and P.B. McIntyre. 2015. Spawning success and early life history of longnose suckers in Great Lakes tributaries. Ecology of Freshwater Fish doi: 10.1111/eff.12220.

Progress Report

Reporting Period: 3/1/2014 - 2/28/2015

Project
WR11R002 - Climate Change Impacts on Stream Temperature and Flow: Consequences for Great Lakes Fish Migrations

Principle Findings and Significance
Objective 1: Quantifying the historical timing of Great Lakes fish migrations in Wisconsin tributaries.

The US Fish and Wildlife Service collected a unique data set as part of their lamprey control program that included data for multiple migratory species over a period of six decades. Our initial analyses indicated that 8 of 13 species showed earlier peak spring migration dates through time. Earlier migration timing is consistent with the hypothesis that ever-warmer spring temperatures are advancing fish spawning phenology.

We are now developing a spatiotemporal Bayesian hierarchical statistical model to quantify shifts in migration timing simultaneously for multiple fish species. We have extracted Julian dates of the first and peak migration for each species in each stream in each year, as well as NOAA's remotely-sensed lake surface temperatures at the mouth of 182 tributaries (1994–2011).

In the past year, our model development has focused on the date of the first fish observation. Rather than relying on a single lake surface temperature measurement, we are defining the cue temperature regime based on the average temperature during 15 days prior to the first migration day. We have extracted that information for white suckers in every stream for 18 years of observations, yielding stream-specific cue regimes of lake surface temperatures. We then use an approach called functional data analysis to identify the time period in each year that most closely resemble the typical temperature cue-regime, and we designate the final day of that period as our estimated Julian date of cue temperature. This approach performs well for most years (see examples in Figure 1).

The analysis reveals a clear trend; the cue temperature regime moves to earlier dates throughout the period from 1995-2011 (Figure 2a). At the same time, the actual migration data indicate earlier onsets over time (Figure 2b). Importantly, merging these two findings shows a statistically significant relationship between the Julian day of actual migration and the Julian day of the cue temperature regime in an individual river (Figure 2c) and across multiple rivers.

We are now working to resolve two additional statistical challenges. First, it is likely that migratory fish are cuing on stream temperatures—for which widespread data since 1950 do not exist—rather than the lake surface temperatures that we have derived from satellite data. Second, the satellite data only cover the period from 1994 to 2012, which excludes much of the available fish migration data. Thus, we have obtained a century-long record of water temperature in the St. Mary's River near the outlet of Lake Superior at Sault St. Marie (SSM), and will create a stream-specific relationship between SSM temperature and our remotely-sensed temperature. That relationship will enable us to estimate the SSM temperature at which the stream-specific cue temperature occurs, and then use

long-term SSM data as a surrogate to estimate the Julian data at which lake surface temperature would cue historical migrations prior to 1994. In this way, we can extend the analysis of migration cue phenology back to 1950, thereby matching the actual records of migration timing. As in Figure 2, this procedure will allow us to test whether phonological shifts are attributable solely to temperature cue timing shifts, or may also reflect other considerations. Moreover, we will then complete the analysis by using Bayesian hierarchical modeling to draw upon the complete space-time mosaic of migration observations to estimate the overall rate of change of migration phenologies in Great Lakes tributaries, and whether it varies systematically in space or across species.

There are no new results from 2014-2015 to report regarding Objectives 2 or 3.

Number of Personnel Involved
2 Participating faculty/staff
1 Supported post-docs

Students Supported

Name
Evan Childress

Affiliation
University of Wisconsin-Madison

Degree
PhD/DSci

Major/Specialization
Freshwater & Marine Science

Graduation
12/2014

Thesis Title
Cross-Ecosystem Delivery of Nutrients to Streams: The Role of Fish Migrations and Landscape Processes

Job Placement
Government

Conference Participation

Title
Society for Conservation Biology

Location
Missoula, MT

Dates
July 2014

Number of supported students attending
1

Presentations by Staff
Conservation in novel aquatic ecosystems. McIntyre, P.B., E.S. Childress & B. Kraemer

Presentations by Students
Conserving fish migrations for the sake of the stream. Childress, E.S. and P.B. McIntyre

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Title
Joint Aquatic Sciences Meeting (SFS & ASLO)

Location
Portland, OR

Dates
May 2014

Number of supported students attending
1

Presentations by Students
Effects of iteroparous fish migrations in streams. Childress, E.S. and P.B. McIntyre

Journal Articles and Other Publications

Title
Conservation of Freshwater Fishes (book)

Type of Publication
Brochure, Fact Sheet or Poster (Peer-reviewed)

Complete Citation
McIntyre PB, Reidy Liermann C, Childress E, Hamann EJ, Hogan J, Januchowski-Hartley SR, Koning AA, Neeson TM, Oele DL, & Pracheil BM. 2015. Conservation of migratory fishes in freshwater ecosystems. In: Closs G, Krkosek M, & Olden JD: Conservation of Freshwater Fishes. Cambridge University Press, Cambridge, UK.

Title
Freshwater Biology

Type of Publication
Book or Monograph (Peer-reviewed)

Complete Citation
Childress, E.S. and P.B. McIntyre. 2015. Multiple nutrient subsidy pathways from a migration of iteroparous fishes. Freshwater Biology 60: 490-499.

Title
Ecology of Freshwater Fish

Type of Publication
Book or Monograph (Peer-reviewed)

Complete Citation
Childress, E.S., R. Papke, and P.B. McIntyre. 2015. Spawning success and early life history of longnose suckers in Great Lakes tributaries. Ecology of Freshwater Fish doi: 10.1111/eff.12220.

Title
Ecology

Type of Publication
Book or Monograph (Peer-reviewed)

Complete Citation
Childress E & McIntyre PB. Life history traits modulate ecosystem-level effects of nutrient subsidies from fish migrations. Ecology, in review.

Title
Transactions of the American Fisheries Society

Type of Publication
Book or Monograph (Peer-reviewed)

Complete Citation
Lyons J, Rypel AL, Rasmussen PW, Burzynski TE, Eggold BT, Myers JT, Paoli TJ, & McIntyre PB. Trends in the reproductive phenology of two Great Lakes fishes. Transactions of the American Fisheries Society, in revision.

Awards and Achievements

Title
Graduate fellowship

Recipient(s)
Evan Childress

Awarded By
NSF IGERT: Conservation in Novel Ecosystems

Type of Award
Research

Description
Evan received a 2-year graduate fellowship to complete his degree as a fellow of the Novel Ecosystems IGERT based in Forest & Wildlife Ecology at UW-Madison

Student Award?
Yes

Number of students receiving award
4

Title
Malueg Award for Graduate Student Excellence

Recipient(s)
Evan Childress

Awarded By
Center for Limnology

Type of Award
Service

Description
This is the annual award for the graduate student in the CFL who best combines research excellence and community citizenship

Student Award?
Yes

Number of students receiving award
1

Research Patent or Copyright
No research patents or copyrights reported.

Uncertainty and Variability of Wisconsin Lakes in Response to Climate Change

Basic Information

Title:	Uncertainty and Variability of Wisconsin Lakes in Response to Climate Change
Project Number:	2011WI268B
Start Date:	3/1/2011
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	WI-2
Research Category:	Climate and Hydrologic Processes
Focus Category:	Climatological Processes, Water Quality, Geochemical Processes
Descriptors:	
Principal Investigators:	Chin H Wu

Publications

1. Magee M, and CH Wu (In Review) Long-term trends and variability in ice cover and thermal structure in three morphometrically different lakes in response to climate change. Limnology and Oceanography
2. Magee M, and CH Wu (In Review) Hanging climate on three lakes with differing morphometry. Water Research

a) A 600-word (or less) annual progress report on principle findings and significance.

Our project investigates the physical responses of ice cover, water temperature, and evaporation in Wisconsin lakes to climate changes. Specifically, our project has (i) improved the 1-D model, DYRESM-I to simulate ice cover and water temperature at sub-hourly time intervals and added a component to simulate dissolved oxygen levels, (ii) improved the 3-D ice/snow/hydrodynamic model (3DHD) that can simulate spatial distribution in ice cover and lake thermal structure, (iii) coupled 3DHD model to DYRESM to simulate DO in three dimensions, (iv) investigated the importance of climate drivers to water temperature and evaporation, (v) performed sensitivity studies analyzing the effects of changing air temperature and wind speed on both ice cover and thermal structure, and (vi) analyzed the effect of climate change on cold-water fish oxythermal stress. New improvements and results for the completed year are detailed below.

Sensitivity of Ice Cover to changes in air temperature and wind speed:

Experiments were conducted to determine the effects of changing the air temperature by increases of 1°C to 10°C and changing the wind speed by changes of ±2%, ±5%, ±8%, and ±8%. Results show that increasing air temperature results in decreasing ice cover duration and decreasing maximum ice thickness. It is apparent that deeper lakes are more prone to experience ice-free conditions, while more shallow lakes may still have ice-cover conditions for short periods (<10 days) even with increase in air temperature of 10°C. In general, lower wind speed results in earlier ice formation and larger ice thicknesses, although there is significant variability due to the timing of air temperatures, which are the main climate driver for ice cover. For instances when air temperature was cold enough for ice cover conditions, ice only was able to form when wind speed was low. If, however, wind speed was low enough for ice cover condition, but air temperature was too warm for ice formation, wind speed did not affect ice cover onset.

Response of thermal structure in two dimictic lakes to climate change:

DYRESM-I was used to simulate the water temperature of Lake Mendota and Fish Lake to determine historical changes in thermal structure and also changes under potential climate scenarios during the open water season. Under the historical scenario, model results indicate earlier stratification onset, later fall overturn, warming epilimnion water, and cooling hypolimnion water. The increasing air temperature and decreasing wind speed have a doubling effect on the longer stratification duration, with wind speed playing a dominant role in determining the stratification onset, stratification overturn, and the hypolimnetic water temperatures. Temperature perturbations indicate that warmer air temperatures lead to earlier stratification onset and later fall overturn for both lakes under all climate scenarios. Decreasing wind speeds lead to earlier stratification onset and later overturn. The magnitude of these changes is larger for each degree or m/s of increase for Fish Lake than for Lake Mendota, indicating that Fish Lake is more susceptible to negative impacts of the changing climate.

Oxythermal stress in a dimictic lake in response to changing climate:

Using DYRESM-I-DO, we studied the effect of changing climate on oxythermal stress of a cisco population in Fish Lake, Wi, USA. A method was developed to quantify the number of days of fish stress per year, and this method applied under the future A1B climate scenario.

Results indicate that under future scenarios, the frequency of fish stress and duration of stress will increase dramatically. Furthermore, we used a state-of-the-art 3D hydrodynamic model coupled with a 1D dissolved oxygen model to simulate the spatial extent of dissolved oxygen stress during the year.

b) Number of personnel involved in the project
2

c) Names and individual information about students supported by the project
First Name: Madeline
Last Name: Magee
Campus: University of Wisconsin-Madison
Advisor First Name: Chin
Advisor Last Name: Wu
Advisor Campus: University of Wisconsin-Madison
Degree/Training *(Masters, PhD, Post-Doc, Expected Masters, Expected PhD, Expected Other, Undergraduate, Other)*: Expected PhD
Graduation Month: December
Graduation Year: 2015
Department: Department of Civil and Environmental Engineering

First Name: Nathan
Last Name: Gerdts
Campus: University of Wisconsin-Madison
Advisor First Name: Chin
Advisor Last Name: Wu
Advisor Campus: University of Wisconsin-Madison
Degree/Training *(Masters, PhD, Post-Doc, Expected Masters, Expected PhD, Expected Other, Undergraduate, Other)*: Expected Masters
Graduation Month: June
Graduation Year: 2015
Department: Department of Civil and Environmental Engineering

d) Conference participation information, including presentations
Title: Oxythermal Stress of a Dimictic Lake n Response to Changing Climate
Presenter(s) : Madeline Magee and Chin Wu
Presentation Type ***Professional Meeting***
Event Name: 39th Annual Meeting of the American Water Resources Associations - Wisconsin Section
Event location: Oconomowoc, Wisconsin
Event Date: 3/5/2015

Target Audience *(Federal Agency, International Organization, K-12 Students, K-12 Teachers, Legislators, Media,* ***Mixed****, Public,* ***Regional Organization****,* ***Scientific Audience****, Service Club, State Government Agency, University Students, Other—please explain)* :
Audience Size: 30
Description:
Survival and growth of fish in lakes is strongly constrained by water temperature and dissolved oxygen. Increasing air temperatures due to global climate warming are projected to significantly alter temperature and dissolved oxygen characteristics in lakes, with these changes leading to significant effects on fish populations and distributions in the USA and Wisconsin in particular. Habitat for coldwater fish may be reduced by both direct warming of water and increased anoxic conditions in the hypolimnion during the stratified season. Understanding how fish habitat and species distribution will change under future climate scenarios is of utmost importance to lake and fish managers throughout the state. However, properly quantifying the oxythermal stress condition is difficult to predict for the future and apply across a large variety of lakes. The common approach in fish niche modeling of defining boundaries and determining layer thickness of useable habitat has not proved accurate in southern Wisconsin lakes. As a result, we have developed a novel metric, temperature dosage, to quantify oxythermal stress of coldwater fish species in Wisconsin lakes. In comparison with conventional methods, this temperature dosage method can reliably quantify oxythermal stress for our study lakes and can be applied across a suite of lakes and for various coldwater fish species of interest.

e) Publications

- Magee, MR, Y-F Hsieh, DM Robertson, RC Lathrop, CH Wu. Influences of air temperature, wind, and water clarity on 100-year trends in ice cover and water temperature in a dimictic lake *submitted to Limnology and Oceanography*
- Magee, MR and CH Wu. Long-term trends and variability of ice cover and thermal structure in three morphometrically different lakes in response to climate change. *in preparation*
- Magee, M.R. and Wu, C.H. Response of Thermal Structure in Two Dimictic Lakes to Changing Climate. *in preparation*
- Magee, MR and Wu, CH. Investigation of ice cover response to changing climate on three lakes with differing morphometry. *in preparation*
- Magee, M.R. and Wu, C.H. Determining cisco stress under historical and future climate scenarios using three oxythermal stress quantifying method. *in preparation*
- Gerdts, N.D., Magee, M.R. and Wu, C.H. Seasonal Evaporation of Two Different Morphometry Lakes Under Changing Climate. *in preparation*

f) Awards and Achievements

g) Research Patent or Copyright

h) **include if applicable**A 600-word (or less) completion/results statement, including discussion and conclusions

Establishing the Long-Term Range of Variability in Drought Conditions for Southwest Wisconsin

Basic Information

Title:	Establishing the Long-Term Range of Variability in Drought Conditions for Southwest Wisconsin
Project Number:	2013WI313B
Start Date:	3/1/2013
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	3rd
Research Category:	Climate and Hydrologic Processes
Focus Category:	Drought, Models, Management and Planning
Descriptors:	None
Principal Investigators:	Evan Reed Larson, Christopher Underwood

Publication

1. Allen, S. and Larson, E.R. 2014. The Driftless Oaks: An environmental history of southwest Wisconsin. Wisconsin Natural Resources 38: 6 7. [available: http://dnr.wi.gov/wnrmag/2014/10/Oak.htm]

Progress Report

Reporting Period: 3/1/2014 - 2/28/2015

Project
WR13R003 - Establishing the long-term range of variability in drought conditions for Southwest Wisconsin

Principle Findings and Significance
The principal findings of our research include a 337-year long tree-ring-width chronology developed from the radial growth patterns of 402 living oak trees sampled at 46 sites and 33 oak timbers in six historic structures across ten counties of southwest Wisconsin. This chronology yielded a robust and skillful 250-year reconstruction of summer drought as represented by the mean May–August Palmer's Drought Severity Index (PDSI). Comparison of our new drought reconstruction to existing records indicates that we have substantially improved representation of drought conditions relevant to the Driftless Area. Analysis of the drought reconstruction indicates that the recent extreme drought of 2012 was the 14th most severe single-year drought in the record. The ten driest years in the reconstruction, listed by increasing drought, include 1791 (10th), 1886, 1936, 1988, 1891, 1772, 1934, 1931, 1800, 1895 (1st). The 1930s represent the driest decade over the past 250 years, followed by the 1800s, 1890s, 1840s, and 1850s. A period of prolonged and sustained drought occurred from 1835 to 1863, with 21 of 29 years being in drought. When compared to the mean PDSI of the instrumental record this ratio increases to 25 of 29 years. The 1900s include six of the ten wettest decades. Overall, the story relayed by this drought reconstruction indicates that while recent extreme droughts have historical precedence, much of the development of modern agriculture in southwest Wisconsin occurred during unusually wet conditions. This suggests that water resource planning should not rely on the instrumental record as being fully representative of the long-term range in hydrologic conditions for the region.

Important findings we achieved in addition to the drought reconstruction include the successful establishment of construction dates for six historic structures across the study area and identification of unprecedented stress signals in the oak trees sampled for this project. Dating the historical structures enabled us to extend our tree-ring chronologies further into the past while improving the known cultural history of the lead mining district of Wisconsin. Structures dated include the oldest schoolhouse in Wisconsin at Shakerag Alley (built in 1828), the structure that houses Brewery Creek in Mineral Point (built in 1852), the Gratiot House (built in 1849) and Barry Tavern (built in 1840) near Shullsburg, a settlement-era horse barn near Stitzer (1854), and the Lie house at the Folklore Village near Dodgeville (1848). The stress signal we observed in our oak tree-ring samples included anomalous wood anatomy. Analysis of the spatial and temporal timing of these features indicated that they occurred during years of extreme drought. Interestingly, the frequency of anomalous rings has increased among young and old trees to an unprecedented rate, suggesting that despite the increasing precipitation shown in instrumental records, oak trees in the Driftless Area are experiencing more frequent drought stress than ever before in their lives. This result supports the idea that increasing temperatures, coupled with rainfall being delivered in extreme events, will produce overall drier conditions in southwest Wisconsin.

In addition to the scientific significance of this research, this project was extremely successful in connecting people with science. Outreach through Wisconsin Public Radio, email, social media, invited lectures, Wisconsin Sea Grant

videos, and an article in the Wisconsin Natural Resources magazine, we were contacted by over 250 landowners to consider sampling oak trees on their property. In May of 2015 we hosted an open house, dinner, and presentation of the findings from this project that was attended by 42 landowners. In addition to landowners, 27 undergraduate students from UW-Platteville contributed to the field and laboratory components of this project and gained research experience vital to their education.

Number of Personnel Involved
2 Participating faculty/staff
0 Supported post-docs

Students Supported

Name
Jaime Teutschmann

Affiliation
University of Wisconsin-Platteville

Degree
BA/BS

Major/Specialization
Biology and Geography double major

Graduation
5/2015

Thesis Title
Ring Anomalies in the Driftless Oaks: A Proxy for Extraordinary Events?

Job Placement
Other

Name
Jamie Jefferson

Affiliation
University of Wisconsin-Platteville

Degree
BA/BS

Major/Specialization
Geography

Graduation
5/2014

Thesis Title
Tales of People and the Land Told Through Tree Rings: Historical Dendroarchaeology of the Gratiot House

Job Placement
Private Non-Profit

Conference Participation

Title
Connections in Nature Student Research Symposium

Location
Riveredge Nature Center, Saukville, Wisconsin

Dates
November 8, 2014

Number of supported students attending
1

Presentations by Staff
Sara Allen and Evan R. Larson. Establishing the long-term range of variability in drought conditions for southwest Wisconsin using oak tree chronologies.

Title
Association of American Geographers Annual Meeting

Location
Tampa, Florida

Dates
April 8-12

Number of supported students attending
2

Presentations by Staff
Sara Allen and Evan R. Larson. Establishing the long-term range of variability in drought conditions for southwest Wisconsin.

Title
Connections in Nature Student Research Symposium

Location
Riveredge Nature Center, Saukville, Wisconsin

Dates
Nvember 9, 2013

Number of supported students attending
1

Presentations by Staff
Sara Allen and Evan R. Larson. Preliminary results from a new project establishing the long-term range of variability

in drought conditions for southwest Wisconsin using oak tree-ring chronologies.

Title
Association of American Geographers Annual Meeting

Location
Chicago, Illinois

Dates
April 20-25, 2015

Number of supported students attending
2

Presentations by Staff
Sara Allen and Evan R. Larson. The Good Oak: Establishing the long-term range of variability in drought conditions for southwest Wisconsin using oak tree chronologies.

Presentations by Students
(1) Jaime A. Teutschmann, Sara Allen, and Evan R. Larson. Ring anomalies in the Driftless Oaks: A proxy for extraordinary events? (2) Jamie Jefferson and Evan R. Larson. The story of land and people through the lens of tree rings: Dendroarchaeology of the Gratiot House, southwest Wisconsin.

Journal Articles and Other Publications

Title
The Driftless Oaks: An environmental history of southwest Wisconsin

Type of Publication
Media Placement, Press Release or Newspaper Story

Complete Citation
Allen, S. and Larson, E.R. 2014. The Driftless Oaks: An environmental history of southwest Wisconsin. Wisconsin Natural Resources 38: 6–7. [available: http://dnr.wi.gov/wnrmag/2014/10/Oak.htm]

Awards and Achievements
No awards and achievements reported.

Research Patent or Copyright
No research patents or copyrights reported.

Impacts of Climatic and Land Use Changes on Streamflow and Water Quality in the Milwaukee River Basin

Basic Information

Title:	Impacts of Climatic and Land Use Changes on Streamflow and Water Quality in the Milwaukee River Basin
Project Number:	2013WI314B
Start Date:	3/1/2013
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	4th
Research Category:	Climate and Hydrologic Processes
Focus Category:	Hydrology, Water Quality, Models
Descriptors:	None
Principal Investigators:	Woonsup Choi, Changshan Wu

Publications

There are no publications.

Progress Report

Reporting Period: 3/1/2014 - 2/28/2015

Project

WR13R004 - Impacts of climatic and land use changes on streamflow and water quality in the Milwaukee River basin.

Principle Findings and Significance

In the watershed modeling phase, we set up the Hydrological Simulation Program-Fortran (HSPF) and calibrated using observed weather data. The HSPF model was set up with 33 subbasins nested in the Milwaukee River basin. Streamflow data from four sites in the Milwaukee River basin, namely Milwaukee, Cedarburg, Menomonee, and Kinnickinnic were used for comparison to the HSPF output. Except for Kinnickinnic, relative errors are within 5%, which is deemed excellent. The Nash-Sutcliffe efficiency values for daily streamflow during the calibration period range from 0.62 (Kinnickinnic) to 0.71 (Milwaukee), and they deteriorate for the validation period across the sites. Overall, the model excellently reproduces the mean streamflow and does a reasonable job with goodness-of-fit.

In sequence, HSPF was forced using statistically downscaled global climate models (GCM) data for the baseline (1961-2000) and future (2046-2065 and 2081-2100) time slices. The statistically downscaled climate dataset was generated by researchers at the University of Wisconsin-Madison, and consists of daily maximum and minimum temperatures and total precipitation from nine global climate models at 0.1° grid spacing. According to the downscaled GCM data, both temperature and precipitation are projected to increase significantly in the future.

Land use change impacts

- We simulated future residential and commercial developments using a cellular automata model, and then with the knowledge of future residential and commercial developments, we developed a linear regression model to predict impervious surface distributions in residential and commercial land uses. The results were compared to those of three conventional approaches, and the comparison indicates that the proposed integrated model performs better than the conventional approaches in predicting urban impervious surface fractions
- The land use change model projects a modest increase in developed land at the expense of forest and shrubland by 2050. In response, annual mean flow is projected to decrease insignificantly when spatially averaged. However, there is much variation by season and location. Flow changes are generally larger in warmer months than cooler months. What is more striking is the variation by location. A few subbasins show quite large increases, whereas a few others show quite large decreases. The reasons for such discrepancy will be further explored in the coming months.

Climate change impacts

- The projected changes in mean annual streamflow are highly variable between the climate models, ranging between increases and decreases almost equally. Unlike in many other studies, there is no dominant direction of change. On the other hand, when the changes are examined by subbasin, downstream subbasins (mostly urban) showed much less variability between the GCMs in annual streamflow changes than upstream ones (mostly rural).
- The changes in mean monthly streamflow for both 2046-2065 and 2081-2100 periods show increases in winter

and spring and decreases in summer. The climate model uncertainty is substantial across the months except summer. Daily flows are projected to become more extreme in most of the models.

- There is very high uncertainty in the projection of summer precipitation, which is reflected on the high uncertainty in the summer streamflow. The smaller uncertainty in the projected spring streamflow reflects the consistent warming and more precipitation projected for winter and spring. Overall, climate change is expected to make the flow regime more volatile, posing increased risks to water resources managers and residents of the basin.

Number of Personnel Involved

2 Participating faculty/staff

0 Supported post-docs

Students Supported

Name
Feng Pan

Affiliation
University of Wisconsin-Milwaukee

Degree
PhD/DSci

Major/Specialization
Geography

Name
Wenliang Li

Affiliation
University of Wisconsin-Milwaukee

Degree
PhD/DSci

Major/Specialization
Geography/GIS

Thesis Title
Large Scale Urban Impervious Surfaces Estimation through Incorporating Temporal and Spatial Information into Spectral Mixture Analysis

Conference Participation

Title
Annual Meeting of the Association of American Geographers

Location
Tampa, Florida

Dates
8-12 April 2014

Number of supported students attending
1

Presentations by Staff
Influence of Different Methods for Estimating Impervious Surface Cover on Model-simulated Streamflow of the Milwaukee River Basin (Feng Pan and Woonsup Choi)

Presentations by Students
Incorporating land use land cover probability information into endmember class selections for temporal mixture analysis (Wenliang Li, Changshan Wu)

Title
AWRA Wisconsin Section 38th Annual Meeting

Location
Wisconsin Dells, WI

Dates
March 13-14, 2014

Number of supported students attending
1

Presentations by Students
The Influence of Different Methods for Estimating Impervious Surface Cover on Model-simulated Streamflow of the Milwaukee River Basin (Feng Pan and Woonsup Choi)

Journal Articles and Other Publications
No journal articles and other publications reported.

Awards and Achievements
No awards and achievements reported.

Research Patent or Copyright
No research patents or copyrights reported.

Recent Advances in Monitoring and Analysis of Trace Metals: A Workshop to Address Applications in the Upper Great Lakes

Basic Information

Title:	Recent Advances in Monitoring and Analysis of Trace Metals: A Workshop to Address Applications in the Upper Great Lakes
Project Number:	2014WI325B
Start Date:	3/1/2014
End Date:	2/28/2015
Funding Source:	104B
Congressional District:	WI 2nd
Research Category:	Water Quality
Focus Category:	Water Quality, Geochemical Processes, Surface Water
Descriptors:	None
Principal Investigators:	Stephen J. Ventura

Publications

There are no publications.

Progress Report

Reporting Period: 3/1/2014 - 2/28/2015

Project
WR14R001 - Recent Advances in Monitoring and Analysis of Trace Metals: A Workshop to Address Applications in the Upper Midwest

Principle Findings and Significance
The objective of this project is to facilitate the sharing of information on current work, methods, and results for the study and monitoring of trace metals and related constituents in the Upper Great Lakes and their watersheds. We expect the project to improve research planning and methods for new projects and increase information sharing and coordination between researchers and managers.

We have conducted preliminary work in preparation for the project and are in the process of scheduling the workshop for the late fall of 2015. The preliminary work has consisted in part of discussions with potential participants and interested resource managers, such as participation by Steve Ventura and Scott Cardiff in a meeting on water quality monitoring in northern Wisconsin in the spring of 2014. In addition, Scott Cardiff has drafted a preliminary summary of previous metals monitoring work in the Upper Great Lakes watershed. This summary has helped to identify potential topics and participants for the 2015 workshop.

We expect to have a tentative schedule and agenda for the workshop compiled by the end of July 2015. At that time we will issue invitations to participants and seek commitments to present. After the workshop, we will compile the workshop information into a white paper. We will provide additional reporting on this grant at that time.

Number of Personnel Involved
3 Participating faculty/staff
0 Supported post-docs

Students Supported

Name
Scott Cardiff

Affiliation
University of Wisconsin-Madison

Degree
PhD/DSci

Major/Specialization
Environment and Resources

Graduation
9/2016

Conference Participation
No conferences reported.

Journal Articles and Other Publications
No journal articles and other publications reported.

Awards and Achievements
No awards and achievements reported.

Research Patent or Copyright
No research patents or copyrights reported.

Quantifying and Communicating Uncertainity in Products of the USGS National Water Census

Basic Information

Title:	Quantifying and Communicating Uncertainity in Products of the USGS National Water Census
Project Number:	2014WI332S
USGS Grant Number:	G14AP00115
Sponsoring Agency:	USGS
Start Date:	7/5/2014
End Date:	10/31/2014
Funding Source:	104S
Congressional District:	
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	None
Principal Investigators:	Kenneth W. Potter

Publications

There are no publications.

Progress Report

Reporting Period: 3/1/2014 - 2/28/2015

Project

WR14R005 - Quantifying and Communicating Uncertainty in Products of the USGS National Water Center

Principle Findings and Significance

Background

The United States Geological Survey (USGS) Water Census Project is an ambitious program that will provide unprecedented information on the availability, movement, and use of water in the United States. This information will make it possible for water managers and users at local, state, regional, and national scales to significantly improve the sustainability of the nation's water resources. To make best use of this information, it is critical that associated uncertainties be quantified and communicated in ways that serve the needs of the users as well as the USGS. This report provides advice on characterizing, quantifying and communicating the uncertainty in Water Census information and in products based on Water Census information

Recommendations

Throughout this report we have made recommendations regarding uncertainty and Water Census products. These are summarized below.

Data with Simple Error Structures

• Use bias, standard deviation and confidence intervals as the primary measures of uncertainty; associate descriptive terms based on confidence limits (e.g., Excellent, Very Good, Fair and Poor)

• Use as much data as possible to "refine" Water Census data and estimate uncertainties

o Conduct annual water budgets for gaged watersheds throughout the U.S. to obtain insight regarding the accuracy of water budget data produced by the Water Census data.

o Consider de-biasing DAYMET precipitation data using the de-biasing methods in the literature.

o Consider using NEXRAD data conjunctively with DAYMET data to refine the DAYMET data for major storms.

o Use flux tower data to develop general estimates of the error bias and standard deviation of Water Census estimates of ET at both monthly and annual time scales.

o Use lysimeter data to investigate biases in flux tower measurements

Data with Complex Error Structures

• Use regional studies such as Farmer et al. (2014) to develop and evaluate the uncertainty in Water Census data using metrics that reflect their most likely uses.

• Consider providing estimates of certain high-demand products based on daily streamflows, such as Q7,10, or flow-duration curves, rather than letting the user extract these products from estimated daily flows.

Communication

• Develop and implement a consistent strategy for communicating the uncertainty associated with each Water Census product.

• Track the use of Water Census products and consider providing assistance (e.g. guidance documents) on the use of uncertainty information in the case of heavily used products.

• Use the tracked information on the use of Water Census data to improve the uncertainty information.

• Specify inappropriate uses of Water Census Data

Number of Personnel Involved
1 Participating faculty/staff
0 Supported post-docs

Students Supported

Name
Zachary Schuster

Affiliation
University of Wisconsin-Madison

Degree
PhD/DSci

Major/Specialization
Environmental Studies

Graduation
5/2016

Conference Participation
No conferences reported.

Journal Articles and Other Publications
No journal articles and other publications reported.

Awards and Achievements
No awards and achievements reported.

Research Patent or Copyright
No research patents or copyrights reported.

Completion Summary
Background
The United States Geological Survey (USGS) Water Census Project is an ambitious program that will provide unprecedented information on the availability, movement, and use of water in the United States. This information will make it possible for water managers and users at local, state, regional, and national scales to significantly improve the sustainability of the nation’s water resources. To make best use of this information, it is critical that

associated uncertainties be quantified and communicated in ways that serve the needs of the users as well as the USGS. This report provides advice on characterizing, quantifying and communicating the uncertainty in Water Census information and in products based on Water Census information

Recommendations

Throughout this report we have made recommendations regarding uncertainty and Water Census products. These are summarized below.

Data with Simple Error Structures

• Use bias, standard deviation and confidence intervals as the primary measures of uncertainty; associate descriptive terms based on confidence limits (e.g., Excellent, Very Good, Fair and Poor)

• Use as much data as possible to “refine” Water Census data and estimate uncertainties

o Conduct annual water budgets for gaged watersheds throughout the U.S. to obtain insight regarding the accuracy of water budget data produced by the Water Census data.

o Consider de-biasing DAYMET precipitation data using the de-biasing methods in the literature.

o Consider using NEXRAD data conjunctively with DAYMET data to refine the DAYMET data for major storms.

o Use flux tower data to develop general estimates of the error bias and standard deviation of Water Census estimates of ET at both monthly and annual time scales.

o Use lysimeter data to investigate biases in flux tower measurements

Data with Complex Error Structures

• Use regional studies such as Farmer et al. (2014) to develop and evaluate the uncertainty in Water Census data using metrics that reflect their most likely uses.

• Consider providing estimates of certain high-demand products based on daily streamflows, such as Q7,10, or flow-duration curves, rather than letting the user extract these products from estimated daily flows.

Communication

• Develop and implement a consistent strategy for communicating the uncertainty associated with each Water Census product.

• Track the use of Water Census products and consider providing assistance (e.g. guidance documents) on the use of uncertainty information in the case of heavily used products.

• Use the tracked information on the use of Water Census data to improve the uncertainty information.

• Specify inappropriate uses of Water Census Data

Information Transfer Program Introduction

None.

University of Wisconsin Water Resources Institute - 5 Year Information Transfer Program

Basic Information

Title:	University of Wisconsin Water Resources Institute - 5 Year Information Transfer Program
Project Number:	2011WI265B
Start Date:	3/1/2013
End Date:	2/29/2016
Funding Source:	104B
Congressional District:	WI-2
Research Category:	Not Applicable
Focus Category:	Education, Climatological Processes, Groundwater
Descriptors:	
Principal Investigators:	Moira Harrington

Publications

1. White, Elizabeth; Carolyn Rumery Betz; Aaron Conklin; Moira Harrington; Ann Moser. 2011, Volume 1 Aquatic Sciences Chronicle 8 pages
2. White, Elizabeth; Carolyn Rumery Betz; Aaron Conklin; Moira Harrington; Ann Moser. 2011, Volume 2 Aquatic Sciences Chronicle 8 pages
3. White, Elizabeth; Carolyn Rumery Betz; Aaron Conklin; Moira Harrington; Ann Moser. 2011, Volume 3 Aquatic Sciences Chronicle 10 pages
4. White, Elizabeth; Carolyn Rumery Betz; Aaron Conklin; Moira Harrington; John Karl; Ann Moser. 2011, Volume 4 Aquatic Sciences Chronicle 12 pages
5. Karl, John Streams Neutralize Nitrates in Groundwater 2011 5:51-minute video
6. Harrington, Moira; Aaron Conklin. wri.wisc.edu program website
7. Moser, Anne; Sarah Leeman. aqua.wisc.edu/waterlibrary program website
8. Conklin, Aaron; Carolyn Rumery Betz; Moira Harrington. facebook.com/UWiscSeaGrant Facebook page for University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute
9. Conklin, Aaron; Carolyn Rumery Betz, Moira Harrington. @UWiscSeaGrant Twitter address for both University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute
10. Rumery Betz, Carolyn; et al. 2011,35th Annual Meeting Program and Abstracts Wisconsin's Role in Great Lakes Restoration, American Water Resources Association, Wisconsin Section. 76 pages
11. Babiarz, Christopher; James P. Hurley; David P. Krabbenhoft; James G. Wiener July, 19, 2011, Wisconsin Leads the World in Mercury Research opinion-page column, 2 pages
12. Rumery Betz, Carolyn; Kevin Masarik.March 7, 2011 Spring is a Good Time to Test Well Water news release, 2 pages
13. Rumery Betz, Carolyn; Kevin Masarik.March 2, 2011 Celebrate Groundwater Awareness Week by Properly Filling and Sealing Unused Wells news release 2 pages
14. Rumery Betz, Carolyn; Kevin Masarik March 1, 2011 Dispelling Groundwater Myths news release 2 pages

15. White, Elizabeth; Aaron Conklin; Moira Harrington; Ann Moser; Marie Zhuikov 2012, Volume 2 Aquatic Sciences Chronicle 12 pages
16. White, Elizabeth;Aaron Conklin; Moira Harrington; Ann Moser; Marie Zhuikov 2012, Volume 3 Aquatic Sciences Chronicle 12 pages
17. White, Elizabeth; Aaron Conklin; Moira Harrington; Ann Moser; Marie Zhuikov 2012, Volume 4 Aquatic Sciences Chronicle 12 pages
18. White, Elizabeth;Aaron Conklin; Moira Harrington; John Karl; Ann Moser; Marie Zhuikov 2013, Volume 1 Aquatic Sciences Chronicle 8 pages
19. Karl, John What's a Spring 2012 27-second video
20. Harrington, Moira; Aaron Conklin; Marie Zhuikov wri.wisc.edu program website
21. Moser, Anne; Peter Rudrud aqua.wisc.edu/waterlibrary program website
22. Moser, Anne water.wisc.edu portal website
23. Conklin, Aaron; Marie Zhuikov; Moira Harrington facebook.com/UWiscSeaGrant Facebook page for University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute
24. Conklin, Aaron; Marie Zhuikov; Moira Harrington @UWiscSeaGrant Twitter handle for both University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute
25. Moser, Anne. @WiscWaterLib Twitter handle for Wisconsin's Water Library
26. Moser, Anne. Facebook page for Wisconsin's Water Library facebook.com/WiscWaterLib
27. White, Elizabeth; et al. 2012,36th Annual Meeting Program and Abstracts Science-Based Policy for Wisconsin's Water Resources, American Water Resources Association, Wisconsin Section. 93 pages
28. Andren, Anders March 7, 2012, Consider the Tide Under Your Feet, opinion-page column, 2 pages
29. Harrington, Moira April 9, 2012 New Director of Sea Grant Institute and Water Resources Institute Chosen news release, 2 pages
30. Zhuikov, Marie January 2, 2013 Study Shows Mercury Deposited Into Lakes Quickly Finds Its Way Into Fish news release, 2 pages
31. Babiarz, Chris; Marie Zhuikov October 2012 Nitrates in Groundwater fact sheet, 4 pages
32. Babiarz, Chris; Marie Zhuikov October 2012 Arsenic in Groundwater fact sheet 4 pages
33. White, Elizabeth; Aaron Conklin; Moira Harrington; Anne Moser; Marie Zhuikov, 2013 Volume 2 Aquatic Science Chronicle, 8 pages
34. White, Elizabeth; Aaron Conklin; Moira Harrington; Anne Moser; Marie Zhuikov, 2013, Volume 3 Aquatic Sciences Chronicle 8 pages
35. White, Elizabeth; Aaron Conklin; Moira Harrington; Anne Moser; Marie Zhuikov, 2013 Volume 4 Aquatic Sciences Chronicle 12 pages
36. White, Elizabeth; Aaron Conklin; Moira Harrington; Anne Moser; Marie Zhuikov, 2014 Volume 1 Aquatic Sciences Chronicle 8 pages
37. Zhuikov, Marie June 13, 2013 Climate Change is Focus of New Water Resources Institute Projects, news release 1 page
38. Harrington, Moira June 26, 2013 Downloadable, Free Resource on Flooding news release 1 page
39. Zhuikov, Marie July 10, 2013 Ancient Oaks Help Scientists Study Climate in Southwestern Wisconsin news release 1 page
40. Zhuikov, Marie January 14, 2014 Researchers Find Strontium in Northeastern Wisconsin Wells news release 2 pages
41. White, Elizabeth; et al. 2013 37th Annual Meeting Program and Abstracts Managing Wisconsin's Urban Water Resources American Water Resources Association, Wisconsin Section, 86 pages
42. Harrington, Moira; Aaron Conklin, Marie Zhuikov wri.wisc.edu program website
43. Moser, Anne; Erin Anthony aqua.wisc.edu/water library program website
44. Moser, Anne water.wisc.edu portal website
45. Conklin, Aaron; Moira Harrington, Marie Zhuikov facebook.com/UWiscSeaGrant Facebook page for the University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute

46. Conklin, Aaron; Moira Harrington, Marie Zhuikov @UWiscSeaGrant Twitter handle for the University of Wisconsin Water Resources Institute and the Wisconsin Sea Grant Institute
47. Conklin, Aaron; Moira Harrington, Marie Zhuikov @UWiscSeaGrant Twitter handle for the University of Wisconsin Water Resources Institute and the Wisconsin Sea Grant Institute
48. Moser, Anne @WiscWaterLib Twitter handle for Wisconsin's Water Library
49. Moser, Anne facebook.com/WiscWaterLib, Facebook page for Wisconsin's Water Library
50. Bocast, Chris February 28, 2014 Groundwater, Soil and Dr. Dirt 22:34 minute audio podcast
51. Bocast, Chris February 28, 2014 Aquifers, Websites and Water Tables 11:15 minute audio podcast
52. Bocast, Chris February 28, 2014 Waters Within Waters - Working With Watersheds 15:33 minute audio podcast
53. Karl, John Look Ma! No Hands! Remote Water Quality Monitoring 25:41 minute video
54. Karl, John Automation for the People: pH, Alkalinity and Conductivity 14:09 minute video
55. Karl, John The Phosphorous (Analysis) Blues 44:58 minute video
56. Karl, John Come On In! The Water’s Fine! Or Is It? (Part One) 18:40 minute video
57. Karl, John Come On In! The Water’s Fine! Or Is It? (Part Two) 40:32 minute video
58. Karl, John Keeping it Clean: Techniques and Laboratory Practices for Mercury Analysis 23:39 minute video
59. Karl, John Toxic and Tricky: Analyzing Methylmercury 19:48 minute video
60. Karl, John Going for the Gold III 21:32 minute video
61. Karl, John Analyzing Water for Organic Chemicals 1:22:37 minute video
62. White, Elizabeth; et al. 2014 38th Annual Meeting Program and Abstracts Mining and Wisconsin and Waters Water Resources Association, Wisconsin Section, 78 pages
63. Harrington, Moira; Aaron Conklin, Marie Zhuikov wri.wisc.edu program website
64. Moser, Anne; Jenna Assmus aqua.wisc.edu/water library program website
65. Moser, Anne water.wisc.edu portal website
66. Conklin, Aaron; Moira Harrington, Marie Zhuikov facebook.com/UWiscSeaGrant Facebook page for the University of Wisconsin Water Resources Institute and University of Wisconsin Sea Grant Institute
67. Moser, Anne @WiscWaterLib Twitter handle for Wisconsin's Water Library
68. Moser, Anne facebook.com/WiscWaterLib, Facebook page for Wisconsin's Water Library
69. Bocast, Chris March 6, 2014 Streams, Snails and Invasive Species 19:01 minute audio podcast
70. Bocast, Chris March 31, 2014 Wisconsin Aquifers: Surficial Groundwater and the Central Sands 20:10 minute audio podcast
71. Bocast, Chris March 31, 2014 Wisconsin Aquifers: Cambrian, Pre-Cambrian and Confined15:40 minute audio podcast
72. Bocast, Chris May 19, 2014 Phosphorous, Outreach and the Fox-Wolf Watershed 24:18 minute audio podcast
73. Bocast, Chris July 2, 2014 Watersheds Past – Oaks, Rings and Answers 21:32 minute audio podcast
74. Karl, John June 16, 2014 Got Oaks? 1:45 minute video
75. Karl, John July 16, 2014 Drought in Southwest Wisconsin As Told By Oaks (And How You Can Help) 3:10 minute video

The University of Wisconsin Water Resources Institute (WRI) Information Transfer Program ensures delivery of education and outreach related to long-term water planning, policy development and resource management to water researchers, professionals and resource managers. Another target audience is broad—members of the general public—so as to deepen knowledge of Wisconsin's water assets and engender greater stewardship. It is an ongoing project.

In this reporting period, the information transfer program produced and distributed publications, social media messages, four issues of a quarterly newsletter and an engaging photography display about Wisconsin water assets and an accompanying handout on additional resources and websites; produced two videos related to a WRI-funded project and completed closed captioning on six videos to increase accessibility; maintained websites; co-sponsored and assisted in planning and conducting a major statewide conference on water resources; and maintained and expanded a library on water resources that also conducts outreach through presentations.

Much of WRI's information is shared via an online publication store, *http://aqua.wisc.edu/publications*. A publication about rain gardens was the most popular WRI download in the publications store. There were about 1,725 downloads in this reporting period. Additional items were distributed through the mail. These included items such as bookmarks, aquatic invasive species watch cards, posters and brochures.

Social media offers the means to communicate in real time and without typical editorial filters. WRI is very active on Facebook and Twitter. Through the Twitter account, for example, one analytical tool shows that WRI has the potential to deliver about 700,000 impressions a week. WRI also uses the social media tools Flickr, YouTube, Pinterest and Sound Cloud.

The Aquatic Sciences Chronicle is published quarterly. It highlights water research and the people who conduct water research and outreach. At *aqua.wisc.edu/chronicle*, all issues of the publication are archived and searchable. This quarterly publication circulates to an audience of roughly 5,700 online and print subscribers, which includes local and state water management agencies, and water-related non-governmental organizations. Readers are found in Wisconsin and across the country. The newsletters are also posted online. There were nearly 322,360 online visitors to the newsletter.

WRI's video catalog includes "What's a Spring," "Streams Neutralize Nitrates in Groundwater," "Testing Well Water for Microorganisms," "A New Measure of Groundwater Flow," "Got Oaks" and "Drought in Southwest Wisconsin as Told by Oaks." Additionally, WRI continued work on a video to explain Wisconsin's Groundwater Monitoring Network, partnering with the state of Wisconsin's Geological and Natural History Survey. When complete, it will be shared through the program's website and its YouTube channel, *http://www.youtube.com/user/UWASC/*.

WRI has also created 11 videos highlighting the protocols of in-laboratory water testing. The video segments were shot at two USGS labs, a regional and a national one; the Wisconsin State Laboratory of Hygiene to focus on algal toxins and metals analysis; and the Racine Public Health Laboratory to explore Great Lakes issues.

WRI's director used the video in classroom instruction and received positive feedback from students. That's important since increasingly restricted budgets mean that some laboratory equipment is not being purchased and used as frequently as in the past. Students may not typically be exposed the equipment and the ways in which it can be used. A video at least allows exposure, just not hands-on interaction.

At *http://itunes.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=430421609*, visitors can download a WRI-sponsored seven-part audio podcast series. "Water, Wisconsin and the Mercury Cycle" details mankind's historic uses of mercury, Wisconsin's water resources and mercury in Wisconsin waters. A major part of the series also focuses on WRI-funded research on mercury. At the iTunes university site, WRI has been able to garner its own artist's page. Pages such as these are reserved only for those who reach a certain threshold of content. The special pages allow for a richer display of water-related content. Moreover, they provide a so-called "sticky" experience where users are attracted to the site and then stick around for additional, related information.

The "Aquifers and Watersheds" audio podcast series was also completed in this reporting period. There are eight episodes in the series, in which experts explain in plain words the foundational ideas underlying the science of hydrology. Episodes are at bit.ly/1e5a1jQ.

The WRI website *http://www.wri.wisc.edu* orients visitors to the Wisconsin program. One of the site's main audiences is researchers. To that end, the site provides a clear navigational path to the WRI project listing, project reports, a groundwater research database, funding opportunities and conference information sections. The areas are updated on a regular basis to ensure currency of information transfer. The WRI site had 133,470 visitors in this reporting period. That is a 32 percent increase in visitors over the previous reporting period.

AWRA 2014 Annual Conference

The Wisconsin Section of the American Water Resources Association conducts an annual meeting. WRI assists with meeting planning and provides material support. WRI joined other conference sponsors—the University of Wisconsin-Stevens Point Center for Watershed Science and Education, Wisconsin Department of Natural Resources, Wisconsin Geological and Natural History Survey and the U.S. Geological Survey's Wisconsin Water Science Center—to stage the event that attracted about 200 people.

Post-Secondary Students Engaged in Water Education

During this reporting period, WRI staff were also integral to the content-population of *http://www.water.wisc.edu*. The site is a portal to the breadth and depth of water-related work on the state's flagship campus, the University of Wisconsin-Madison, and serves as the first stop for anyone interested in water research. Additionally, graduate students can search for departments offering courses and degrees that fit their interests, and staff and faculty can search for colleagues working on topics complementary to their own to facilitate greater interdisciplinary collaboration and exploration. The site had 148,374 visitors in this reporting period. Building off of this website and the collaborative nature of its contributors, this year, WRI staff provided leadership in launching Water@UWMadison – A Wisconsin Idea Symposium, an event designed to bring water researchers and faculty from around the UW-Madison campus

together to build awareness and collaboration. That event happened outside of the reporting dates but its planning was conducted during the period.

Wisconsin's Water Library

Wisconsin's Water Library is a unique resource for researchers, resource managers and all Wisconsin citizens. It contains more 30,000 volumes of water-related information about the Great Lakes and other waters of Wisconsin. The library includes a curricula collection, dozens of educational videos, children's collection, and more than 20 journals and 100 newsletters. Each year, about 1,400 publications circulate among interested users.

Wisconsin's Water Library continues to catalog all groundwater research reports from WRI projects into WorldCat and MadCat, two library-indexing tools that provide both statewide and worldwide access to the science.

In addition to archival benefits, the library provides outreach by answering many in-depth reference questions on a wide range of water-related topics. It provides a water research guide (*http://researchguides.library.wisc.edu/waterresearchguide*). It is active on social media and goes out into the community to offer presentations (more on that below). It prepares recommended reading lists on topics such as climate change, groundwater, water conservation and water supply.

During the reporting period, in partnership with the Wisconsin Department of Natural Resources and the Wisconsin Wastewater Operator's Association (WWOA), the library continued its outreach to current and future wastewater operators of Wisconsin. The library cataloged the essential technical manuals into the library catalog and provided loans to WWOA members around the state in support of their required state license examinations as well as in support of the educational needs of their daily work.

The library maintains several information transfer tools to reach library patrons and the most frequently accessed is the library's website (*http://www.aqua.wisc.edu/waterlibrary*. There were 216,936 visitors.

In addition to its website, Wisconsin's Water Library uses other technology tools to reach library patrons. Using email, the library sends out a bimonthly "Recent Acquisitions List" to roughly 500 contacts. The message also includes recent updates to the library website and contact information for users to ask any water-related question. In addition, the library supports an email account at *askwater@aqua.wisc.edu*, which is monitored daily.

The library uses social media for real-time relationships with interested patrons. It is active on Twitter, Facebook and maintains a blog.

Finally, the library maintains an extensive curriculum collection of guides with innovative approaches and other educational materials for teaching water-related science in K-12 classrooms. The curricula are available for checkout by all teachers and residents in Wisconsin. The librarian also has extensive experience in working with Pre-K children. She is putting that experience to use in developing already field-tested science, technology, engineering, art and math (STE(A)M)curriculum kits. The kits will eventually number 27 on topics such as the water cycle, art and water, and pond science. In this reporting period, a kit related to frogs has been completed and two additional ones—on winter and on buoyancy—are nearly ready for

circulation to age-appropriate audiences. The kits contain several books, tips on a guided water-science experiment and other themed activities. The library also provides checkout of an aquatic invasive species elementary- and middle-school-aged curriculum collection known as an attack pack. Since September 2013, five packs have been checked out more than 20 times to formal and nonformal educators (the maximum checkout period is two months). The packs have been used to educate more than 10,900 people about aquatic invasive species in the waters of Wisconsin. What is also unique about this tool is that in the past it was a problem to circulate packs designed like this. Now, the WRI has devised a distribution system through the public interlibrary loan system.

Outreach Events

To build water literacy, Wisconsin's Water Library staff reached approximately 1,860 Wisconsin residents through nearly 70 events conducted at public libraries, Head Start and other early-childhood programs, and in venues sponsored by the Girl Scouts or as part of other informal learning setups.

One other public outreach event was an interactive map about contaminants found in various Wisconsin counties. The day-long display attracted the interest of about 200 people who stopped to have a conversation at the Wisconsin State Fair. Such an empowering message was helpful to share with people from all over Wisconsin.

Notable Accomplishments

1. WRI created a traveling photography exhibit. Photography is a powerful way to communicate and in this reporting period, WRI produced and then coordinated a traveling photography exhibit along with its sister organization, the University of Wisconsin Sea Grant Institute. Four 24" x 36" double-sided panels depict stunning scenes of Wisconsin's water assets and highlight work that WRI and Sea Grant are doing to promote their sustainable use. The exhibit also invites its viewers to consider how they, too, could act in sustainable ways.

   The exhibit has traveled to public libraries in all corners of the state, with more visits scheduled for the remainder of 2015 and throughout 2016. At each stop, a news release is distributed to local media and local residents are invited to view the exhibit. There are also accompanying handouts to encourage further interaction through websites and tools such as the aquatic invasive species attack pack. WRI staff are offered as speakers for events in conjunction with the exhibit's run at a specific venue.

   WRI created an evaluation tool for the display, and through it, feedback has been positive. Some comments included, "Our library board was very pleased with the display" and "Thanks again for including us in this project. Keep up the good work down there!"

2. The "Aquifers and Watersheds" audio podcast series was completed during this reporting period. There are eight episodes in the series. The series looks at what's

beneath Wisconsinites' feet and what encircles villages, towns and cities—aquifers and watersheds.

WRI's audio specialist sought out USGS, WRI and other academic experts to explain in plain words the foundational concepts underlying the science of hydrology. The series digs into two geologic features that shape the culture and commerce of the state. Episodes are at bit.ly/1e5a1jQ. Audiences can also find the series at *http://itunes.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=430421609*. At the iTunes university site, WRI has been able to garner its own artist's page. Pages such as these are reserved only for those who reach a certain threshold of content. The special pages allow for a richer display of water-related content. Moreover, they provide a so-called "sticky" experience where users are attracted to the site and then stick around for additional, water-related information.

USGS Summer Intern Program

None.

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	3	0	0	0	3
Masters	2	3	0	0	5
Ph.D.	3	0	0	2	5
Post-Doc.	3	0	0	0	3
Total	11	3	0	2	16

Notable Awards and Achievements

Notable Accomplishments1) Beach nowcasting could make issuing beach health advisories and closing notices significantly more efficient-The University of Wisconsin Aquatic Sciences Center is sponsoring a postdoctoral fellow for the first time so that coastal managers will no longer have to rely on frequent but out-of-date water-quality tests to make public health decisions at the state's 120 Great Lakes beaches. Instead, they'll be testing less frequently and using an approach known as "nowcasting" to get more timely and accurate information into the hands of beach managers and the public. Dr. Adam Mednick's primary directive is to expand the reach of the nowcast approach – which relies on real-time computer modeling of bacteria concentrations – to more of Wisconsin's coastal beaches and to help local communities make it a routine practice. Even though the basic nowcasting approach has been around for several years, it represents a seismic shift in beach water-quality monitoring. Typically, beach managers have tracked water quality conditions and issued warnings based on water samples collected and analyzed for bacteria concentrations in a lab. The problem with that approach is that it typically takes 18-to-24 hours to get the results, which means that those advisory decisions made by a local health or parks department are based on the previous day's conditions. Rather than relying entirely on a daily sampling and testing structure, nowcasting uses computerized statistical models to predict the concentration of E. coli bacteria within a beach's nearshore waters, based on environmental conditions that are readily measurable—things like weather conditions, lake currents, wave height and water clarity. The combination of these types of variables can tell us what the likely water quality is, as opposed to having to wait until the next day for lab results. We can, with relative accuracy, predict whether there's a health risk to swimming on a given day.Part of Mednick's role at ASC will be to develop management guidelines for public health departments, to establish a users' group, and to develop online training and help resources so that they can learn to operate nowcasting more efficiently. For more information, please go to:
http://www.seagrant.wisc.edu/Home/AboutUsSection/PressRoom/Details.aspx?PostID=2034.2) University of Wisconsin Water Resources Center plays a key role in understanding effects of climate change on Wisconsin's Water Resources-Beginning with FY11, the WRI's annual 104(B) allocation was used to expand the scope of the Joint Solicitation to include research on the effects of climate change on Wisconsin's water resources. Priorities for climate change research were established through a partnership with the Wisconsin Initiative on Climate Change Impacts (WICCI). Established in 2007, WICCI is a university-state partnership created to:(a) assess and anticipate the effects of climate change on specific Wisconsin natural resources, ecosystems, and regions; (b) evaluate potential effects on industry, agriculture, tourism, and other human activities; and (c) develop and recommend adaptation strategies that can be implemented by businesses, farmers, public health officials, municipalities, resource managers, and other stakeholders. WRI staff serve in leadership roles within WICCI – Director Jim Hurley serves as cochair of WICCI's Science Advisory Board, Jennifer Hauxwell (Assistant Director for Research and Student Engagement) serves as cochair of the Water Resources Working Group, and David Hart (Assistant Director for Extension) serves as chair of the Coastal Communities Working Group. Three climate change projects received continuation funding during FY13 and two new projects based at UW-Milwaukee and UW-Platteville were funded for FY14. 3) Information Transfer Program-WRI created a traveling photography exhibit. Photography is a powerful way to communicate and in this reporting period, WRI produced and then coordinated a traveling photography exhibit along with its sister organization, the University of Wisconsin Sea Grant Institute. Four 24" x 36" double-sided panels depict stunning scenes of Wisconsin's water assets and highlight work that WRI and Sea Grant are doing to promote their sustainable use. The exhibit also invites its viewers to consider how they, too, could act in sustainable ways. The exhibit has traveled to public libraries in all corners of the state, with more visits scheduled for the remainder of 2015 and throughout 2016. At each stop, a news release is distributed to local media and local residents are invited to view the exhibit. There are also accompanying handouts to encourage further interaction through websites and tools such as the aquatic invasive species attack pack. WRI staff are offered as speakers for events in conjunction with the exhibit's run at a specific venue. WRI created an evaluation tool for the display, and through it, feedback has been positive. Some comments included, "Our library board was

very pleased with the display" and "Thanks again for including us in this project. Keep up the good work down there!" -The "Aquifers and Watersheds" audio podcast series was completed during this reporting period. There are eight episodes in the series. The series looks at what's beneath Wisconsinites' feet and what encircles villages, towns and cities—aquifers and watersheds. WRI's audio specialist sought out USGS, WRI and other academic experts to explain in plain words the foundational concepts underlying the science of hydrology.The series digs into two geologic features that shape the culture and commerce of the state. Episodes are at bit.ly/1e5a1jQ. Audiences can also find the series at http://itunes.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=430421609. At the iTunes university site, WRI has been able to garner its own artist's page. Pages such as these are reserved only for those who reach a certain threshold of content. The special pages allow for a richer display of water-related content. Moreover, they provide a so-called "sticky" experience where users are attracted to the site and then stick around for additional, water-related information.