Water Resources Research Institute

Annual Technical Report
2019

Annual Report

General Info

June 18, 2019 – December 31, 2020

This report includes the following research projects:

2019MS144B Dr. James Cizdziel, University of Mississippi

2019MS145B Dr. Gary Ervin and Mr. Gray Turnage, Mississippi State University

Products

Papers:

Scircle, A. and J. Cizdziel. (2019). Detecting and Quantifying Microplastics in Bottled Water using Fluorescence Microscopy: A New Experiment for Instrumental Analysis and Environmental Chemistry Courses," *J. Chem. Ed.* https://pubs.acs.org/doi/abs/10.1021/acs.jchemed.9b00593

Scircle, A., K. Missling, and J. Cizdziel. (2020). "Single-Pot Method for Collection and Preparation of Natural Water for Microplastic Analyses: Microplastics in the Mississippi River System During and After Historic Flooding in 2019," *Environ Toxicol Chem*. https://doi.org/10.1002/etc.4698

Scircle, A. and J. Cizdziel. (2020). "Occurrence of Microplastic Pollution at Oyster Reefs and Other Coastal Sites in the Mississippi Sound, USA: Impacts of Freshwater Inflows from Flooding," Toxics, 8, 35. https://www.mdpi.com/2305-6304/8/2/35

Dissertations:

Scircle, A. "Microplastic pollution in the Mississippi River and the Mississippi Sound Estuary: concentrations, sizes, types, loadings, and method development," University of Mississippi, Dissertation, ProQuest, Nov. 2020.

Turnage Jr., L. G. 2021. Phenology and management of triploid flowering rush (*Butomus umbellatus* L.). PhD Dissertation, 113 pages. Mississippi State University, Mississippi State, Mississippi.

Presentations:

Calhoun, K., G. Turnage, and G.N. Ervin. 2018. Management of problematic native aquatic vegetation to enhance multi-user benefits in southeastern waterbodies. Presented at the Texas Aquatic Plant Management Society annual conference, San Antonio, TX, November 26-27, 2018.

Calhoun, K., G. Turnage, and G.N. Ervin. 2018. Management of problematic native aquatic vegetation to enhance multi-user benefits in southeastern waterbodies. Presented at the Mid-South Aquatic Plant Management Society annual conference, Chattanooga, TN, November 5-7, 2018.

Calhoun, K., G.N. Ervin, and G. Turnage. 2018. Management of problematic native aquatic vegetation to enhance multi-user benefits in southeastern waterbodies. Presented at the Aquatic Plant Management Society annual conference, Buffalo, NY, July 15-18, 2018.

Ervin, G.N. and G. Turnage. 2018. Aquatic Vegetation Management to Enhance Multiple User Benefits of Southeastern Wetlands. Presented at the annual meeting of the Mississippi Water Resources Research Institute in Jackson, MS, April 3 – 4, 2018.

Calhoun, K., G.N. Ervin, and G. Turnage. 2019. Management of problematic native aquatic vegetation to enhance multi-user benefits in southeastern waterbodies. Presented at the Weed Science Society of America annual conference, New Orleans, LA, February 11-14, 2019.

Ervin, G. N. 2019. Wetland plants and ecosystem services – Too much of a good thing? Department of Wildlife, Fisheries, & Aquaculture, Mississippi State University, October 2019.

Ervin, G. N. 2019. Managing Aquatic & Wetland Plants for Ecosystem Services. US Army Corps of Engineers, Engineering Research & Development Center, Vicksburg, MS, June 2019.

Ervin, G. N. and C. Shoemaker. 2019. Wetland vegetation for water quality improvement: Is the simplest advice still the best? Society of Wetland Scientists annual conference, Baltimore, MD, June 2019.

Ervin, G. N., G. Turnage, and K. Calhoun. 2019. Experimental evaluation of herbicides for chemical management of nuisance native aquatic plants. Mississippi Water Resources Conference, Jackson, MS, 03 April, 2019.

Lazaro-Lobo, A., G. Turnage, L. Sanders, A. Ratliff, and G. Ervin. 2019. Response of water quality metrics to foliar herbicide applications and subsequent plant breakdown of American frogsbit. Presented at the Midsouth Aquatic Plant Management Society annual conference, Baton Rouge, LA, November 4-6, 2019.

Ratliff, A., G. Turnage, L. Sanders, A. Lazaro-Lobo, and G. Ervin. 2019. Short and long-term response of fragrant water lily to foliar herbicide applications. Presented at the Midsouth Aquatic Plant Management Society annual conference, Baton Rouge, LA, November 4-6, 2019.

Sanders, L., G. Turnage, A. Ratliff, A. Lazaro-Lobo, and G. Ervin. 2019. Response of water quality metrics to foliar herbicide applications and subsequent plant breakdown of three rooted aquatic plant species. Presented at the Midsouth Aquatic Plant Management Society annual conference, Baton Rouge, LA, November 4-6, 2019.

Scircle, A., and J. Cizdziel. “One “Pot” for collection and Preparation of Water and Sediment Samples for Detection and Characterization of Microplastics,” Society for Environmental Toxicology and chemistry, North America annual meeting, Toronto, Canada, Nov. 2019.

Scircle, A., and J. Cizdziel. “The Occurrence and Distribution of Microplastics in Oysters from the Mississippi Sound,” Bays and Bayous Symposium, Nov. 2020.

Outreach:

Cizdziel, J. “Microplastic Pollution: What’s the BIG deal?” Science Café, Oxford, MS, Octo. 2019.

The Cizdziel group hosted three high school (Oxford) science classes that visited his laboratory to learn about microplastic pollution (Nov. 2019).

The Cizdziel group visited Oxford Middle School to discuss microplastic research with science classes (Dec. 2019).

Information Transfer Program

2019MS145B

A major component of our information transfer on this project involved cooperation with staff of the Sam D. Hamilton Noxubee National Wildlife Refuge (NNWR). During the first 18 months of the project, this went very well, with NNWR staff and our personnel interacting on a regular basis to exchange information and data on the project. This allowed us to tailor the experimental work to fit the specific challenges that NNWR staff were attempting to overcome in managing nuisance vegetation on the refuge. We met with NNWR staff multiple times on the refuge and brought them to campus near the end of the first year of mesocosm herbicide trials to show them the results of the different herbicide treatments. They subsequently used this information to guide their treatment on one of the major lakes at NNWR (Bluff Lake).

About halfway through the second year of the project, the manager of NNWR departed, and a new manager was brought on. At about this same time, the primary NNWR contact for our research collaboration also departed the refuge. These changes resulted in a shift in priorities for the refuge, including the desire to treat the lake on which our field experiment was taking place. At this point, we wrapped up our research, as best we could, and moved on to data entry and analysis.

Other areas of information transfer included presentation of results at regional and national conferences, but this also took a substantial hit when the COVID pandemic broke out near the end of the research. We were able to send students to multiple conferences during the first year of work, and presentations are listed above. One additional route of information transfer was posting of periodic research updates on the PI's web site, at: https://www.garyervin.net/project-pages.

Student Support

2019MS144B and 2019MS009G

Undergraduates: 0

Graduate students: 3

Post-docs: 0

2019MS145B

High School: 1

Undergraduate 10 (from 7 different majors)

Graduate students: 3

Doctoral: 2

Notable Achievements and Awards

2019MS145B

One important outcome from this work is that we were able to leverage the experience of the team assembled for this work to obtain funding from the US Army Corps of Engineers for a three-year study to examine wetland vegetation impacts on nutrient dynamics in river floodplain wetlands.

Additionally, the co-PI for this project (Gray Turnage) completed his doctoral studies and successfully defended his dissertation, thus earning his Ph.D. while supported in part from this funding.

Another notable item is that both of the doctoral students supported on this work were recognized by professional organizations for their work:

Gray Turnage (co-PI) was named the Aquatic Plant Management Society's Outstanding Graduate Student for 2020.

Adrian Lazaro-Lobo received the Weed Science Society of America's award for Outstanding Publication in Invasive Plant Science and Management for 2020.

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104G – G19AC00004

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Products

***Papers*:**

Scircle A. and J. Cizdziel. (2019) "Detecting and Quantifying Microplastics in Bottled Water using Fluorescence Microscopy: A New Experiment for Instrumental Analysis and Environmental Chemistry Courses", J. Chem. Ed. https://doi.org/10.1021/acs.jchemed.9b00593

Scircle A., K. Missling, and J. Cizdziel. (2020) "Single-Pot Method for Collection and Preparation of Natural Water for Microplastic Analyses: Microplastics in the Mississippi River System During and After Historic Flooding in 2019" *Environ Toxicol Chem*. https://doi.org/10.1002/etc.4698

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***Dissertations*:**

Scircle A. "Microplastic pollution in the Mississippi River and the Mississippi Sound Estuary: concentrations, sizes, types, loadings, and method development", University of Mississippi, Dissertation, ProQuest, Nov. 2020.

***Presentations at scientific meetings*:**

Scircle A. and J. Cizdziel. "One "Pot" Method for Collection and Preparation of Water and Sediment Samples for Detection and Characterization of Microplastics", Society for Environmental Toxicology and Chemistry, North America annual meeting, Toronto, Canada, Nov. 2019.

Scircle A. and J. Cizdziel. "The Occurrence and Distribution of Microplastics in Oysters from the Mississippi Sound", Bays and Bayous Symposium, Nov. 2020.

Outreach

Cizdziel J. "Microplastic Pollution: What's the BIG deal?" Science Café, Oxford, MS, Oct. 2019.

The Cizdziel group hosted three high school (Oxford) science classes that visited his laboratory to learn about microplastic pollution (Nov. 2019).

The Cizdziel group visited Oxford Middle School to discuss microplastic research with science classes (Dec. 2019).

Information Transfer Program

None

Student Support

Undergraduates: 0

Graduate students: 3

Post-docs: 0

Notable Achievements and Awards

None

Assessing Microplastic Pollution In The Mississippi River System And At Oyster Reefs In The Mississippi Sound Estuary

Project Type: Competitive Grant

Project ID: G19AC00004

Project Impact:

Much of the seafood that humans consume comes from estuaries and coastal areas where microplastics (MPs) accumulate. As filter-feeders, oysters (*Crassostrea virginica*) are especially vulnerable to MP pollution. We assessed MP pollution in water at four different oyster reefs and six other sites in the Mississippi Sound. Microplastics (>~25 µm–5 mm) were isolated using a single-pot method that we developed and reported on previously. The MPs were quantified using Nile Red fluorescence detection and identified using laser direct infrared analysis, the first application of the analytical technique to MPs in natural waters. Concentrations ranged from ~12 to 381 particles/L, and tended to decrease at sites impacted by major freshwater intrusion. With the Bonnet Carre Spillway spillway open during historic flooding, average MP concentrations were positively correlated with salinity ($r=0.87$, $p=0.05$). However, the dilution effect on MP abundances was temporary and oyster yields suffered from the lower salinity. There were no significant changes in the distribution of MPs during the freshwater intrusions; most of the MPs (>50%) were in the lower size fraction (~25–90 µm), consisted mostly of fragments (~84%), followed by fibers (~11%) and beads (~5%). The most identified plastic was polyester, followed by acrylates/polyurethanes, polyamide, polypropylene, polyethylene, and polyacetal. This work provides much-needed empirical data on the abundances, morphologies, and types of MPs that oysters are exposed to in the Mississippi Sound. We are currently examining the compartmentalization of MPs retained in oysters to provide additional insight into the characteristics of MPs in the Mississippi Sound.

Microplastics in The Mississippi River and Mississippi Sound: Concentrations, Sources, Sizes, Types, And Loadings To The Northern Gulf of Mexico (Year 2)

Project Type: Annual Base Grant

Project ID: 2019MS144B

Project Impact:

We developed a simple single-pot method for collection and preparation of natural water for microplastic (MP) analyses. The method prepares samples in the same vessel (Mason jars) that they are collected in right up until the MPs are transferred onto filters or spectroscopic windows for analyses. The method minimized contamination, degradation, and losses, while increasing recoveries and throughput when compared to conventional sieving. We applied it to surface grab samples collected from the Mississippi River and its major tributaries during and after historic flooding in 2019. Microplastics (>~30 µm) were quantified using Nile Red fluorescence detection, and a subset of samples were identified by micro-Fourier Transform Infrared Imaging spectroscopy. Concentrations were lower during the flooding, likely due to dilution, and ranged from ~14 MPs/L in the Tennessee River during flooding to ~83 in the Ohio River during low-flow (summer) conditions. Loads of MPs tended to increase down river and ranged from ~87 to ~129 trillion MPs/day near New Orleans. Most of the MPs (>60%) were in the lower size fraction (~30–90 µm), consisted primarily of fragments (~85%), followed by fibers (~8%) and beads (~7%), with polyester, polyethylene, polypropylene, and polyacrylate the primary MP type. We demonstrated that our method is effective and versatile, and, because it uses relatively inexpensive and easily assembled materials, it can be adapted for MP surveys worldwide. Analysis of samples from the Mississippi River and Mississippi Sound Estuary is ongoing and will provide additional insight into the characteristics of MP pollution in the region.

Aquatic Vegetation Management To Enhance Multiple-user Benefits Of Southeastern Wetlands (Year 2)

Project Type: Annual Base Grant

Project ID: 2019MS145B

Project Impact:

(A synopsis of primary findings and/or impact (no more than 250 words)

We examined the potential of seven different herbicides labeled for use in aquatic systems to reduce abundance of four key nuisance plant species, while maintaining diversity of desirable species and also minimizing any negative impacts on key water quality parameters (e.g., dissolved oxygen and nitrogen). Three of the tested herbicides (glyphosate, imazamox, and florpyrauxifen-benzyl) provided suppression of two of our three target water lily species (white water lily and water shield), while imazamox and imazapyr provided suppression of the fourth species, American frogbit. None of these chemicals appeared to cause persistent negative impacts on any of the measured water quality parameters.

During this project, we worked directly with habitat managers at the Sam D. Hamilton Noxubee National Wildlife Refuge (NNWR) to identify problematic species and communicate findings of our research. This allowed us to tailor the experimental work to fit the specific challenges that NNWR staff were attempting to overcome in managing nuisance vegetation on the refuge. They used this information, in part, to guide their treatment on one of the major lakes at NNWR (Bluff Lake).

In addition to these research accomplishments, the project helped to train five graduate students, ten undergraduates, and one high school student. Two doctoral students supported on this grant received awards for their work, one earned his dissertation, and several of the students attended scientific conferences to present findings from this project.