

**Missouri Water Resources Research Center  
University of Missouri-Columbia**

**Annual Technical Report  
2018**

## General Information

### Products

#### Journal Articles

1. Pereira, L.S.F., Andes, L.C., Cox, A.L., and Ghulam, A. (2017). "Measuring Suspended-Sediment Concentration and Turbidity in the Middle Mississippi and Lower Missouri Rivers using Landsat Data." *Journal of the American Water Resources Association*, DOI: 10.1111/1752-1688.12616.
2. J. Dai, and M. Fidalgo de Cortalezzi, Influence of Sample pH, Ionic Strength and Natural Organic Matter Concentration on DNT-MIP Fluorescent Sensor Performance, *Heliyon*, (2019), 5, 6, e01922, ISSN 2405-8440, <https://doi.org/10.1016/j.heliyon.2019.e01922>.
3. J. Kadhem, S. Xiang, S. Nagel, C-H Lin, and M. Fidalgo de Cortalezzi, Photonic Molecularly Imprinted Polymer Film for the Detection of Testosterone in Aqueous Samples, *Polymers*, (2018), 10(4), 349.
4. J. Dai, D. Vu, S. Nagel, C-H Lin, and M. Fidalgo de Cortalezzi, Colloidal crystal templated molecular imprinted polymer for the detection of 2-butoxyethanol in water contaminated by hydraulic fracturing, *Microchimica Acta*, (2018) 185:1-8.
5. J. Dai, X. Dong, and M. Fidalgo de Cortalezzi, Molecularly imprinted polymers labeled with amino-functionalized carbon dots for fluorescent determination of 2,4-dinitrotoluene, *Microchimica Acta*, (2017), 184, 1369–1377.

#### Masters of Science Thesis

1. Pereira, L.S.F. (2016). Landsat Imagery Based Method for Characterization of Suspended-sediment Concentration along the Middle-Mississippi River and Lower Missouri River. M.S. Thesis, Saint Louis University, Department of Civil Engineering, St. Louis, MO.

#### Presentations at Conferences & Symposiums

1. Pereira, L.S.F., Andes, L.C., Cox, A.L., and Ghulam, A. (2016). "Remote Sensing of Suspended Sediment Concentration along the Middle-Mississippi River" Geological Society of America GSA North-Central Section 50th Annual Meeting, presented April 18-19, Champaign, MO.
2. Pereira, L.S.F., Andes, L.C., Cox, A.L., and Ghulam, A. (2016). "Remote Sensing of Suspended Sediment Concentration along the Middle-Mississippi River" 22nd Annual Graduate Student Association Research Symposium, presented April 22, St. Louis, MO.
3. Cox, A.L. (2016). "Use of Remote Sensing to Monitor Suspended Sediment Concentrations in the Middle Mississippi River." presented as a webinar for the St. Louis Chapter of the Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers (ASCE), December 15, St. Louis, MO.
4. Cox, A.L. (2016). "Using Remote Sensing as a Surrogate Method for Suspended Sediment Concentration Measurements along the Middle-Mississippi River."
5. Invited Speaker for the Joint Seminar Series of the University of Mississippi National Center for Computational Hydroscience and Engineering and the U.S. Department of Agriculture – Agricultural Research Service National Sedimentation Laboratory, October 25, Oxford, MS.
6. Cox, A.L. (2017). "Measuring Suspended-Sediment Concentrations and Turbidity in the Middle-Mississippi and Lower-Missouri Rivers using Remote Sensing Technology." Invited Speaker for the Hydrosystems Lab Seminar Series at the University of Illinois, March 3, Urbana, IL.
7. Morales, V., Gaskill, J., Knott, K., O'Hearn, R., Niswonger, D., Argerich, A., North, R. Assessment of Fish Stress in an Agricultural Reservoir. Poster Presentation at: The Undergraduate Research and Creative Achievements Forum;

2019 July 25, Columbia, Missouri.

8. Clinton, M., Gaskill, J., Hagerty, J., Thorpe, A., Obrecht, D., Miller, C., Knott, K., O'Hearn, R., North, R., Argerich, A. Preliminary water quality data on Dairy Farm Lake #1 for fishy bits and algal toxin research. Poster Presentation at: The School of Natural Resources Research Day; 2018 May 3, Columbia, Missouri.

9. A. Kadhem, M. Fidalgo de Cortalezzi, Photonic Molecularly Imprinted Sensor for the Detection of Testosterone, 2019 Institute of Biological Engineering Annual Meeting, St. Louis, MO, April 4th, 2019.

10. M. Fidalgo de Cortalezzi, Molecularly imprinted photonic sensors for environmental monitoring, World water day special event: "Dia mundial del agua: aportes desde la ciencia para su cuidado", Universidad Nacional de La Plata, La Plata, Argentina, March 22nd, 2019 (invited talk).

11. M. Fidalgo de Cortalezzi, Molecularly imprinted photonic sensors for environmental monitoring, USGS Columbia Environmental Research Center, Columbia, MO, March 6th, 2019 (invited talk).

12. A. Kadhem, M. Fidalgo de Cortalezzi, Photonic Sensor Based on Molecularly Imprinting Technology for the Detection of Testosterone in Water, Mid-America Environmental Engineering Conference, Washington University, St. Louis, MO, October 14th, 2017.

13. J. Dai, M. Fidalgo de Cortalezzi, Molecularly Imprinted Polymers Labeled with Amino-functionalized Carbon Dots for Fluorescent Determination of 2,4-Dinitrotoluene, Association of Environmental Engineering & Science Professors 2017 Meeting, University of Michigan, Ann Arbor, MI, June 20th - 22nd, 2017.

## Information Transfer Program

MOWRRC maintained an active information transfer program that included 1) promoting the Water Center, and highlighting 104B research by participating in Booths at the following Missouri statewide conferences: the Missouri Rural Water Association, the Joint Missouri American Water Works Association/Missouri Water Environment Association, and the Missouri Water & Waste Water Conference. Each organization is dedicated to protecting and improving Missouri's water environment. We spoke with operators, vendors, engineering consultants, state agencies, and students with attendance totaling over 1859 people. 2) Coordinated a joint University of Missouri seminar series with Civil & Environmental Engineering & Chemical Engineering throughout the year, and included other special seminars with speakers from out of state and internationally on a variety of topics. 3) Publication of the MOWRRC Newsletter outlining research supported by 104B funds, information transfer activities, and scholarship and fellowship opportunities. 4) Meet with the advisory committee to improve information transfer activities. 5) Travel to strategic meetings with key water scientists including state and federal officials, Missouri universities, private water groups and citizens. 6) In addition, the Director has been serving on the Environmental Protection Agency Science Advisory Board Drinking Water Committee and other national water related organizations, and as the Associate editor of Environmental Engineering Science, a premier peer-reviewed journal in the nation. In the State of Missouri, the Director has been a member of the Missouri Interagency Task Force (IATF) on Missouri Water Plan, a two-year comprehensive effort to plan major water issues in the State for the next 20 years.

## Student Support

Category Section 104 Base Grant  
Undergraduate 12  
Masters 11  
PhD 4  
Post Docs 0  
Total 27

No other students were supported by the NIWR Competitive Grant, NIWR Student Internship or other Coordination Grant Awards.

## **Notable Achievements and Awards**

PhD student Jacob Gaskill received a travel award from the Global Lake Environmental Observatory Network (GLEON) to present the results of this project at an international conference in November, 2019.

## Projects

### **A Novel Artificial Hormone Receptor for the Sensing of Total Endocrine Disruptor Chemicals (EDCs) Concentration in Natural Waters**

**Project Type:** Annual Base Grant **Project ID:** 2017MO154B

**Project Impact:** The goal of this project was to fabricate a sensor based on molecular imprinting technology for detection of total endocrine disrupting chemicals (EDCs) in a water sample, which can be used for field measurements since the reading only required a simple UV-visible spectrophotometer. The focus of this project was an androgenic activity. In order to achieve this goal, the following specific objectives were completed: Objective 1: To fabricate and characterize highly porous MIP films, designed for the capture of androgen receptors (AR) ligands (aMIPs), such as testosterone and flutamide. Objective 2: To determine the binding saturation level for aMIPs, discriminating between specific and non-specific binding. Objective 3: To test the effectiveness of the MIPs to measure ED activity of positive controls and selected agrochemicals through competitive binding experiments in the presence of positive control hormones. Objective 4: To investigate the effect of analogues and potential interference from natural organic matter or dissolved solids in natural waters. Objective 5: To investigate the kinetics of contaminant attachment to the MIP films, as well as the release conditions and mechanisms. Objective 6: To accurately determine contaminant concentration in the film by optical methods. For further information, the full final report is available through the Missouri Water Resources Research Center.

### **Algae, Stench and Death: Are Algal Toxins Present in Missouri Fish?**

**Project Type:** Annual Base Grant **Project ID:** G16AP00066

**Project Impact:** The implications of cyanobacterial harmful algal blooms on fish populations have implications for human health. We collected water and fish samples year-round from an agricultural reservoir to determine if there was a relationship between algal toxins in water and fish. The cyanotoxin microcystin was detectable in 63% of year-round water samples and was above the 1.6  $\mu\text{g L}^{-1}$  unfinished drinking water action level set by the Missouri Department of Health and Senior Services on 3 occasions (June, August, and October). The highest microcystin concentration we observed was 3.82  $\mu\text{g L}^{-1}$ . Additional cyanotoxins, anatoxin and saxitoxin, had maximum concentrations of 0.21  $\mu\text{g L}^{-1}$  and 0.13  $\mu\text{g L}^{-1}$ , and were detectable 6% and 30% of times sampled, respectively. The cyanotoxin cylindrospermopsin was consistently below detectable levels. Procedures for the extraction of cyanotoxins from muscle, liver, and kidney from largemouth bass (*Micropterus salmoides*, n=116) and bluegill (*Lepomis macrochirus*, n=90) are being optimized to improve efficiency and detection using Enzyme Linked Immunosorbent Assays (ELISA). Lactate Dehydrogenase activity in fish blood, a biomarker of cellular damage induced by environmental and biological stressors, was elevated during spring and summer, while body condition as estimated by the percent of lipid in muscle was highest in fall. These data will improve our understanding of the health risks cyanotoxins pose to both fish and humans and will allow for the development of fish advisories in Missouri.

### **Nonpoint Source Pollution Mitigation in an Urban Watershed**

**Project Type:** Annual Base Grant **Project ID:** G16AP00066

**Project Impact:** Floating treatment wetlands (FTWs) are a novel approach to mitigation of stormwater nutrient pollution. While FTWs show promise, results are variable and there are unresolved issues that hinder widespread use. Our research addresses some gaps in the current understanding of how FTWs improve water quality. Two highly impacted ponds near the Missouri S&T campus are the focus of our research. We first characterized stormwater runoff into and pondwater samples from our two research ponds. We sampled approximately 30 storm events, testing stormwater levels of phosphorus and nitrogen, which averaged about 1000  $\mu\text{g/L}$  for nitrate and 100  $\mu\text{g/L}$  for phosphate. Second, we measured nutrient uptake by pond plants and algae in hydroponic microcosms. These 10-L batch experiments were run short-term to evaluate plant uptake of nitrate and phosphate. We have run roughly 30 experiments, with some species showing higher uptake rates than others. Third, we have begun month-long mesocosm-scale batch experiments. Twelve mesocosms (135-L water volume) were set up with four planting schemes using pickerelweed, a native Missouri plant. Nutrients were added weekly and concentrations were

monitored throughout the experiment. Nutrient uptake was consistently observed each week in all mesocosms, regardless of planting scheme; algae seem to be a major factor. We will harvest the pickerelweed near senescence to determine biomass nutrient content. Information gained in this research adds to knowledge on FTWs and will guide stakeholders on best practices regarding stormwater treatment. Our FTW research will serve as a model to Missouri cities for improving surface water resource management.

## **SATELLITE-IMAGERY BASED METHOD FOR WATER-QUALITY MONITORING AND SEDIMENT BUDGETING ALONG THE MIDDLEMISSISSIPPI RIVER AND ITS TRIBUTARIES**

**Project Type:** Annual Base Grant **Project ID:** G16AP00066

**Project Impact:** The project objective was to develop a satellite-imagery based algorithm to monitor suspended sediment concentration (SSC) along the Middle-Mississippi River (MMR) between the Missouri River and Ohio River confluences. The objective was achieved through the following tasks: (1) a critical review of previous work, (2) identification of available data for analysis, (3) methodology development, (4) validation of method transferability, (5) estimation of SSC at unmonitored tributaries along the MMR, (6) development of a local sediment budget, and (7) data preparation for integration into a publicly-available data portal. For further information, the full final report is available through the Missouri Water Resources Research Center.