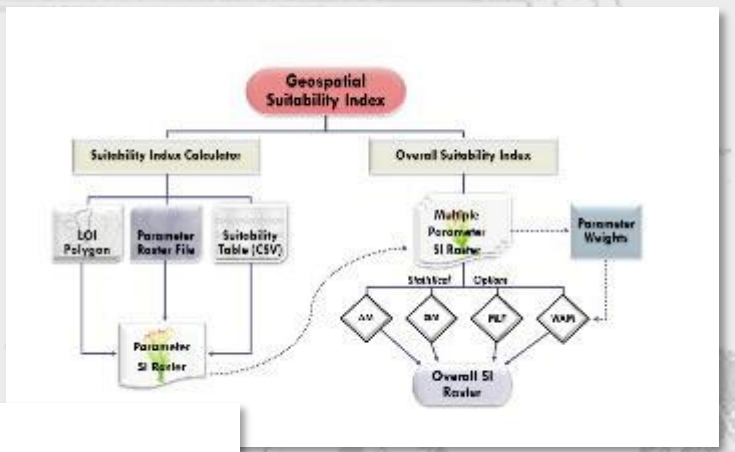
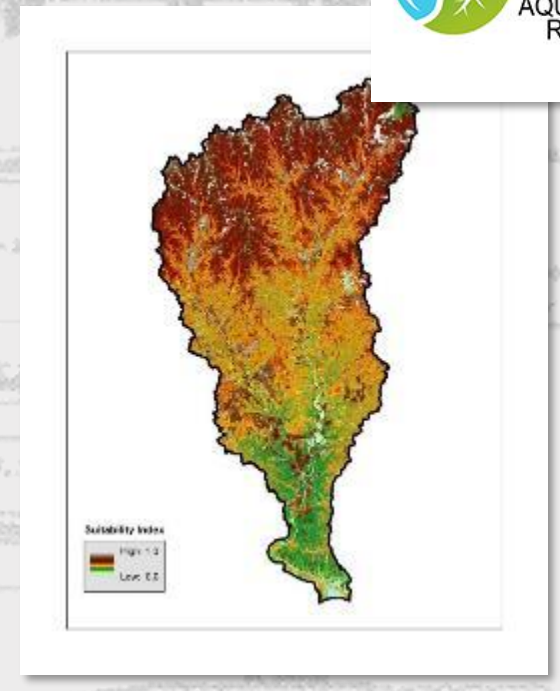
Understanding USACE ERDC's Aquatic Invasive Research Program Opportunities





- Christine VanZomeren, Associate Technical Director
- Jennifer Seiter-Moser, Technical Director
- March 23, 2022

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ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

EL

Webinar Overview

1. Environmental R&D at ERDC
2. APCRP Background
3. APCRP Purpose/Focus Areas
4. Additional Programs Conducting Research Related to Invasive/Nuisance Species
5. How are Projects Funded: Statement of Needs
6. Examples Past and Ongoing Projects
7. Questions

Civil Works Environmental Science & Engineering

Ecosystem Management and Restoration Research Program

Research focus: Aquatic Ecosystem & Floodplain Restoration

- General Investigations (GI) Appropriation
- Focus Areas: Multi-Objective Restoration, Integrity & Sustainability, Inland Resource Management, Coastal, T&E and Invasive Species Management, Modeling and Decision-Making Tools, Ecological Infrastructure

Aquatic Plant Control Research Program

Research focus: biology and ecology of invasive aquatic plants species; technologies to manage invasive aquatic plants

- Construction General (CG) Appropriation
- Focus Areas: Biological Control; Chemical Control; Ecological Assessments; Management Strategies and Applications; Harmful Algae

Aquatic Nuisance Species Research Program

Research focus: on invasive aquatic animals, as well as harmful algal blooms (HABs)

- Operations and Maintenance (O&M) Appropriation
- Focus Areas: invasive fish and mussels. Congressional Interests: HAB Research and Next Generation Ecological Models

Wetlands Regulatory Assistance Program

Research focus: provides science and technology support to the USACE Regulatory Program.

- USACE Regulatory
- Focus Areas: National Plant Wetland List, Ordinary High Water Mark and Stream Science, Wetland Delineation Science and Assessment Methodology

National Impact of Invasive Species

Millions of acres of surface water nationwide are infested with non-indigenous, problem-causing aquatic plants.

The Corps of Engineers manages over 5.5 million surface acres of water at its reservoir projects and significant additional acreage as part of navigation projects.

- Reservoir operations
- Hydropower
- Recreation
- Water supply
- Fish and wildlife
- Human health and safety
- Ecosystem health

Invasive Alligatorweed and Alligatorweed flea beetle

Big Head Carp at Moon Lake, 2015

Aquatic Plant Control Research Program

POC: Jeremy Crossland

https://apcrp.el.erdc.dren.mil

Research focus: **biology and ecology of invasive aquatic plants species; technologies to manage invasive aquatic plants**

- **Construction General (CG) Appropriation**
- **Focus Areas: Biological Control; Chemical Control; Ecological Assessments; Management Strategies and Applications; Harmful Algae**

Ongoing Research:

- **Biocontrol for Hydrilla, Ludwigia, Phragmites, Flowering Rush**
- **Herbicide use for controlling invasive species**
- **Genetic and molecular ecological assessments**
- **Management strategies for specific species**
- **Invasive algae other than HABs**

Future Efforts: **Incorporating terrestrial invasive species for holistic watershed management**

Funding

2022 President's Budget: $0

Final 2022 Appropriation: $30M ($7M for R&D)

Aquatic Plant Control Research Program

POC: Jeremy Crossland

https://apcrp.el.erdc.dren.mil

❖ Authorization:

- The Aquatic Plant Control Program (APC) was authorized by Rivers and Harbors Act of 1958 to support cost shared control of invasive species.
- The 1965 Rivers and Harbors Act expanded the scope of the APC Program to research to support cost effective solutions to invasive species problems.

❖ Invasive Species Leadership Team:

- The Invasive Species Leadership Team is composed of members from each of the MSC, District, HQ, ERDC
- Since 13 July 2005 the ISLT has developed and maintained a Program Management Plan that lays out a national strategy

❖ Civil Works ENV Business Line: Operations and Maintenance (O&M)

- Tara Whitsel – Acting Business Line Manager (HQ)
- Jen Seiter-Moser– Technical Director (CEERD-EL)
- Jeremy Crossland– Acting Program Manager (CEERD-EL)

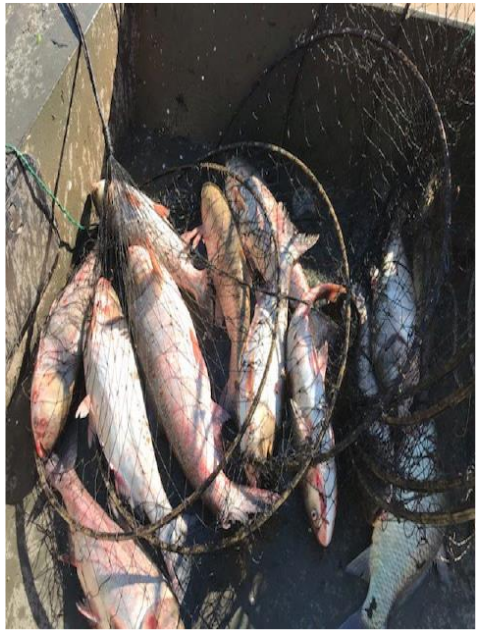
Aquatic Nuisance Species Research Program

POC: Jeremy Crossland

https://ansrp.el.erdc.dren.mil

- **Civil Works ENV Business Line: Operations and Maintenance (O&M)**
  - Joe Wilson– Business Line Manager (HQ)
  - Jen Seiter-Moser– Technical Director (CEERD-EL)
  - Jeremy Crossland– Acting Program Manager (CEERD-EL)

- **Address all invasive aquatic animals**
  - Authorized by the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990; reauthorizes in 1996 with the National Invasive Species Act (NISA)
  - Historically $675K; FY22 $100K
  - Decision/planning support
  - 1-2 Ongoing research projects



Aquatic Nuisance Species Research Program

POC: Jeremy Crossland

https://ansrp.el.erdc.dren.mil

***Research focus*: on invasive aquatic animals, as well as harmful algae blooms (HABs)**

- **Operations and Maintenance (O&M) Appropriation**
- **Congressional Interests: HAB Research and Next Generation Ecological Models**

***Ongoing Research*:**

- **Invasive carp, sea lamprey, mussels (zebra/quagga)**
- **Invasive species costs**
- **Early detection, prevention, management, and scalable technologies for reducing HABs**
- **Next generation ecological models**

***Future Efforts*: 5-year strategic plan for HAB R&D; HAB Demonstration Program**

Funding

2022 President's Budget: $100K

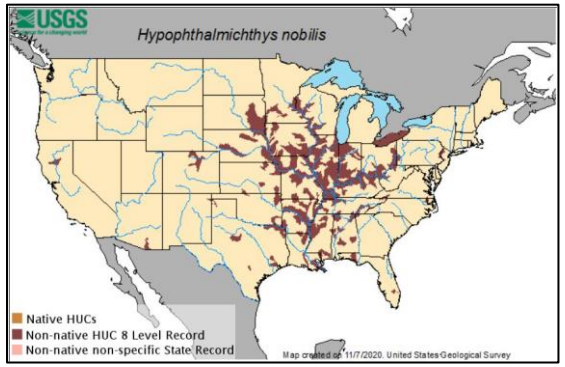
Final 2022 Appropriation: $20.7M ($11M identified for HAB research; $4M HAB Demo; and $5.6M identified for Ecological Modeling)

ANSRP: Dispersal Capabilities of Asian Carp

- **Purpose**
  - To predict and minimize climate related expansion of the distribution of invasive carp species with special emphasis on USACE waters

- **Why Does the USACE Care?**
  - Invasive Species are one of the biggest threats to native water ecosystems
  - Clean Water Act of 1973 states that the USACE is responsible for the spread of aquatic invasive species

- To prevent the accidental spread of Asian carp by understanding their physiological tolerance and dispersal capabilities through laboratory studies and modeling efforts for decision support



HUC 8 dispersal area of bighead carp

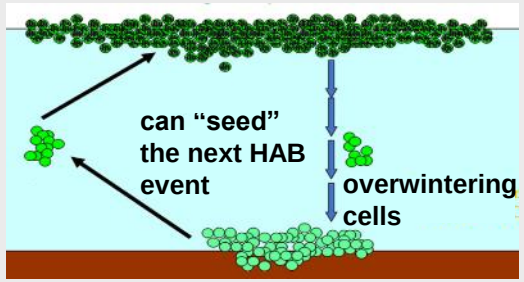
Bighead Carp at Moon Lake 2015

https://ansrp.el.erdc.dren.mil/HAB.html

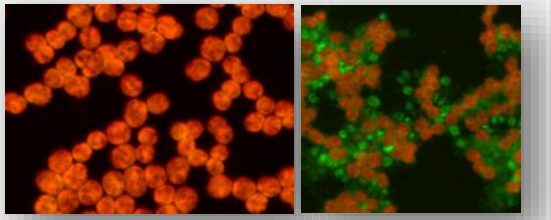
Overview of ERDC-Led HAB R&D Projects

HAB Research Focus Area: Prevention

Reduce biomass and toxicity AND/OR demonstrate reduction in available nutrients feeding the bloom within an aquatic system



Treating cyanobacteria in sediment

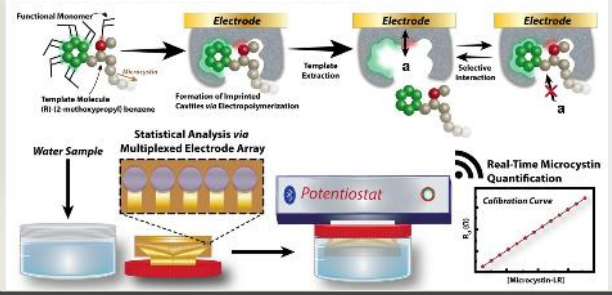


Gene silencing agents for species-specific cyanoHAB control

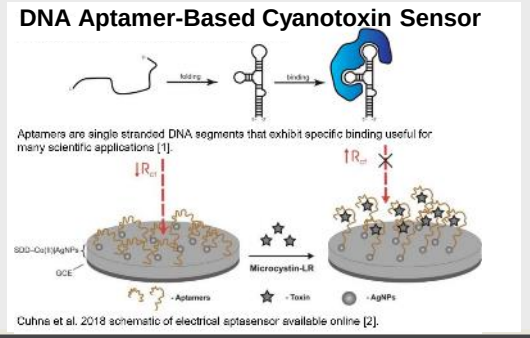
HAB Research Focus Area: Detection

Develop rapid, reliable and cost-effective technologies and standardized approaches for improved HAB monitoring and detection.

Molecular Imprinting-Based Cyanotoxin Sensor



DNA Aptamer-Based Cyanotoxin Sensor



Cuhna et al. 2018 schematic of electrical aptasensor available online [2].

HAB Research Focus Area: Management

Remove or inactivate HAB biomass and toxins through physical, chemical, and/or biological processes

Novel oxidant materials

Algaecide

Cavitation

Flocculation[3]

Floatation Manipulation[4]

HABITATS: HAB Interception, Transformation and Treatment System

2020 USACE Innovation of the Year Award Winner

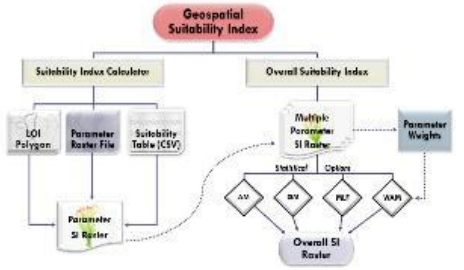
HABITATS permanently removes HAB biomass and associated nutrients, is applicable to freshwater bodies across our Nation, and is scalable can treat millions of gallons of water/day – producing clean water and biofuel.

1. https://www.jneurosci.org/content/37/10/2517; 2. https://www.researchgate.net/profile/Isabel_Cunha4/publication/326519771_Aptamer-Based_Biosensors_to_Detect_Aquatic_Phycotoxins_and_Cyanotoxins/links/5c4640cb458515a4c73766d9/Aptamer-Based-Biosensors-to-Detect-Aquatic-Phycotoxins-and-Cyanotoxins.pdf?origin=publication_detail; 3. https://repository.tudelft.nl/islandora/object/uuid:b0b6e05d-49d8-4cc0-9e28-f510b0a8b215/datastream/OBJ/download; 4. https://ecos.csiro.au/cyanobacteria-responsible-for-january-fish-kill/

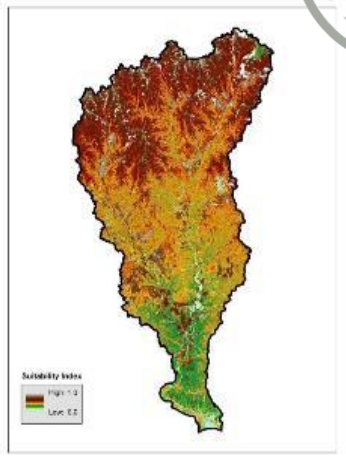
Ecosystem Management and Restoration Research Program

POC: Dr. Brook Herman

https://emrrp.el.erdc.dren.mil



- **Civil Works ENV Business Line: General Investigations (GI)**
  - Mindy Simmons – Business Line Manager (HQ)
  - Jen Seiter-Moser– Technical Director (CEERD-EL)
  - Brook Herman – Program Manager (CEERD-EL)



- **Aquatic and Floodplain Ecosystem Restoration and Management**
  - ±$4M
  - Decision/planning support
  - ~14-20 Ongoing research projects

Ecosystem Management and Restoration Research Program

POC: Dr. Brook Herman

https://emrrp.el.erdc.dren.mil

***Research focus*: Aquatic Ecosystem & Floodplain Restoration**

- **General Investigations (GI) Appropriation**
- **Focus Areas: Multi-Objective Restoration, Integrity & Sustainability, Inland Resource Management, Coastal Resilience and Function, T&E and Invasive Species Management, Modeling and Decision-Making Tools, Ecological Infrastructure**

***Ongoing Research*:**

- **Ecological impacts of dam removal**
- **Watershed planning tools**
- **Water quality and ecological model development**
- **Coastal marsh restoration, SLR and freshwater diversion impacts**
- **Quantifying EGS and OSE in project planning**
- **Natural and Nature Based Features**

- ***Future Efforts*: Addressing the disparity between H&H and Ecological Models, Oyster Restoration & NNBF performance**

- ***Funding***

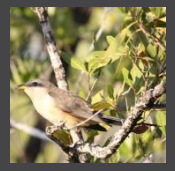
  2022 President's Budget: $4M

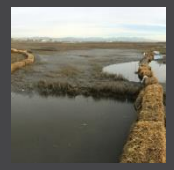
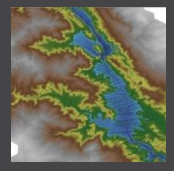
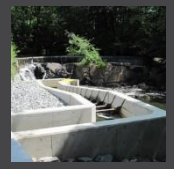
  Final 2022 Appropriation: Budget uncertain at this time ($3M Oyster Restoration)

What is EMRRP?

Aquatic and floodplain ecosystem restoration

Focus areas:

- **Multi-objective Restoration**
- **Integrity & Sustainability**
- **Inland Resource Management**
- **Coastal Resilience & Function**
- **T&E and Invasive Species Management**
- **Modeling & Decision Making Tools**
- **Ecological Infrastructure**

Statement of need (SON) process

❖**Tactical R&D Ideas & Opportunities**
- ❖Ground (bottom) - up
- ❖Short to Mid-Term Needs: 3-5 years
- ❖Submitted to BL: ENV, NAV, FRM
- ❖Reviewed and Ranked
- ❖Project Starts ~2-3 Years

"So – fill me in. Where are you running into a problem? What do you think would really help with that?"

❖The **SON form** is available online, accessible from all three (ENV, FRM, NAV) Gateways
- ❖https://gateway.erdc.dren.mil/son/index.cfm?Cop=Env&Option=Start

❖**FY22 SON DEADLINE DEC 01**
- ❖Update and resubmit SONs annually Dec 01 submission deadline, for reconsideration
- ❖Sometimes highly ranked, but unfunded, SON will be automatically reconsidered next FY.

Environmental BLM Priorities for FY23

1) Bridging the gap between Ecosystem Goods and Services and Other Social Effects research and implementation at the planning level. **-Tactical/Operational/Strategic**

2) Climate resiliency and USACE water resource projects. **-Tactical/Operational/Strategic**

3) Developing regional approaches to ecosystem restoration, determine priorities at large scales and summarizing benefits across a region. **-Tactical/Operational/Strategic**

4) Develop rapid assessment methodologies to quantify and communicate benefits under the four accounts to assist planning studies. **-Tactical/Operational/Strategic**

5) Improve understanding of the principles and practices of monitoring and adaptive management. **-Tactical/Operational/Strategic**

6) *Establish best management practices for emerging invasive species of concern.* ***-Tactical/Operational/Strategic***

Statement of need (SON) process

❖**TIPS and TRICKS**

❖Work with other Districts, Divisions and HQ personnel to fully capture breadth of problem and opportunity.

❖Coordinate with CoP Leads and Research Area Review Group (RARG) Proponents to garner support during review and ranking.

❖Link R&D ideas to multiple regions (e.g., LRD and MVD) or nation-wide application and multiple mission areas. EMRRP – specifically Eco Restoration.

❖**Brief is Best**

❖Accurate title.

❖Description of the problem, including list of applicable or related guidance or policy.

❖Envisioned product.

❖Value Added

❖BL, CoP, Length of Effort, Type of Work (modeling, software, training, physical model, field experiment)

Dredging Operations Technical Support (DOTS)

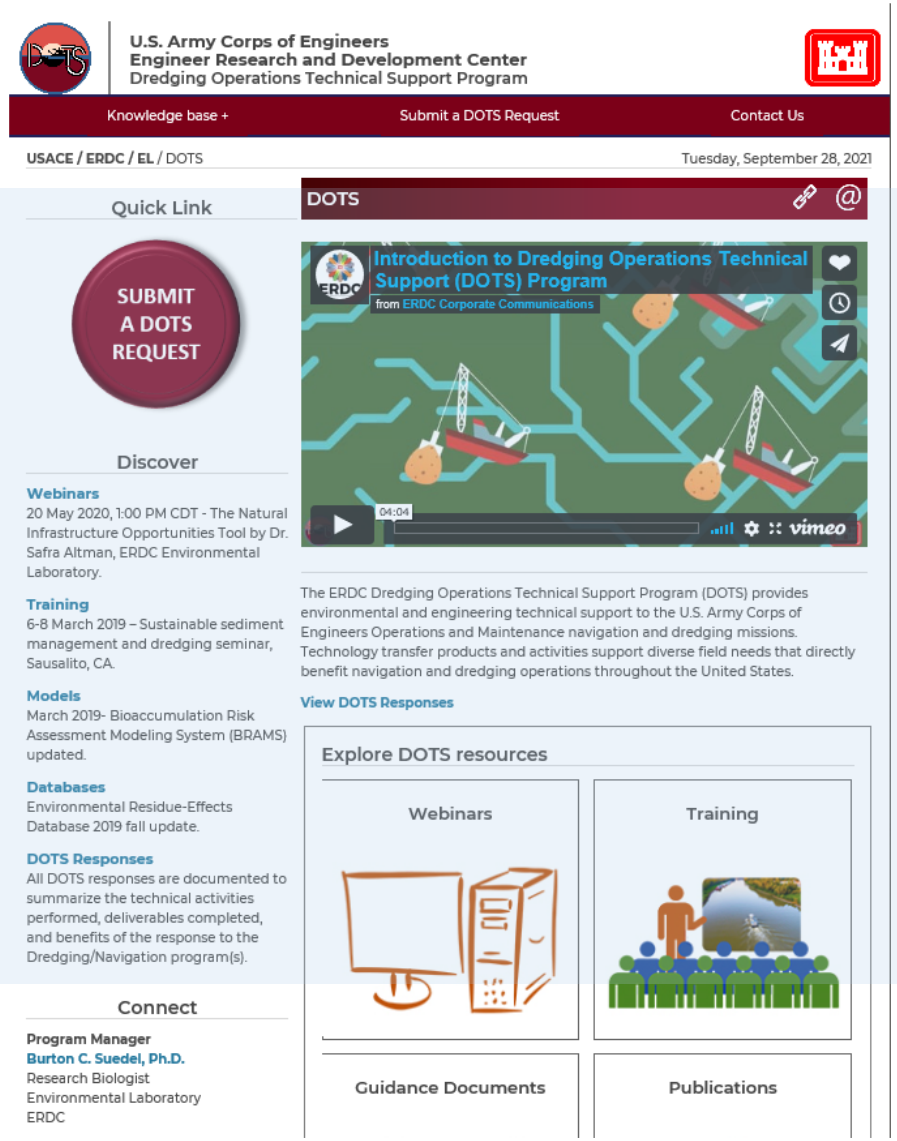
PROGRAM OVERVIEW

- Primary technology transfer mechanism for dredging and navigation since 1978
- Provides “one-door-to-the-Corps” access to comprehensive information on technology related to navigation O&M functions
- Program functions include rapid, short-term technical responses for the field, technology demonstrations, training, database management, publications, and development and dissemination of technical guidance

DOTS Website

https://dots.el.erdc.dren.mil/

- The DOTS program provides website services by mobilizing the right people, skills, and technology that support the USACE navigation mission through improved ERDC communication
- DOTS is committed to transferring knowledge and value generated by the ERDC federal dredging programs and initiatives to our USACE customers and public through a highly usable website
- Short-term, rapid-turnaround technical efforts that address challenges encountered during maintenance and operation of navigable waterways and infrastructure
- 80 hours labor, can include travel



Water Operations Technical Support (WOTS)

Summary

Goal: Identify, develop, and share innovative concepts and technologies that will support sustainable engineering solutions to complex environmental problems at Corps projects nationwide.

Impact to USACE Missions: Provides technology to solve water management and related environmental problems resulting from project operations related to environmental and water management issues.

Army Partners: ERDC Laboratories

Requirement: Technical Support for USACE Division and District Offices.

Technical Approach

How is it done today?

The Corps conveys these concepts and technologies through the best available mechanisms, such as direct technical assistance, specialty workshops, information bulletins, technical notes, executive notes, technical reports, webinars, miscellaneous papers, instruction manuals, videos, meetings, seminars, briefings, and the Internet.

What are the limitations/gaps?

- Incorporates R&D products from other USACE CW Projects and activities.
- No R&D is conducted in the program, can provide new R&D guidance.

What's new in your approach?

The incorporation of all relevant and innovative technology solutions from ERDC to assist USACE Divisions and Districts in solving complex operational problems.

WOTS Contact Information

Dr. Pat Deliman

https://wots.el.erdc.dren.mil/

Progress

What was accomplished in the last 12 months?

- Provided direct technical assistance to USACE Divisions and Districts through:
  - Principal Investigator (PI) responses
  - Workshops
  - Report dissemination
  - Webinars and other virtual communication

WOTS Request: Flowering Rush Management

Trip Report: Flowering Rush Management

Bradley T. Sartain
US Army Engineer Research and Development Center
Vicksburg, MS

Prepared for: US Army Engineer District, Buffalo (LRB), and WOTS Program, ERDC

December 3, 2018

Background

In response to a WOTS request for LRB (Michael Greer), Dr. Bradley Sartain, EE-A, visited with the LRB as well as other researchers, stakeholders, and natural resource managers from the New York Department of Environmental Conservation (NYDEC) and the United States Fish and Wildlife Service (USFWS) at Tonawanda Wildlife Management Area (WMA), Braddock's Bay

Management Options for Flowering Rush at Tonawanda WMA, Braddock's Bay WMA, and Montezuma NWR

Physical/Mechanical Control: Physical removal of flowering rush plants, either by hand or equipment, has historically been used to successfully control small isolated populations in the management areas. Although effective for small infestations of only a few plants, controlling large plant stands would be more labor intensive and likely facilitate spread into other areas by dispersal of bulbils, seeds, and vegetative propagules. It is advantageous that water levels within Tonawanda WMA and Montezuma NWR are capable of being manipulated which provides the option to lower and/or remove water thus making sites more accessible for mechanical means of removal. It should be noted that a single flowering rush plant is capable of producing a large number of bulbils that can be transported to non-infested areas, either by equipment and/or human influence. It is recommended that equipment, footwear, etc. used for and/or during the physical or mechanical removal of flower rush be thoroughly rinsed to decrease the probability of transporting viable bulbils to non-infested areas.

Biological Control: Currently there are no operational biological control tactics for managing flowering rush. Research projects have been initiated by Nathan Harms at ERDC to identify and evaluate an irisect, from the host range in Europe, to selectively control flowering rush. Evaluations to determine efficacy, post-release survival, attack points in the flowering rush life cycle, potential diseases and predation rates, feeding preference against known flowering rush genotypes, and injury to non-target plants must be completed prior to approval by the United States Department of Agriculture (USDA) for release in the US. The timeline for such a candidate insect release can easily exceed 5 years. In addition a white smut (*Doassansia niessii*) fungal agent has been identified in Europe that has a high damage potential and triploid flowering rush from the US has been successfully inoculated with the fungi. This research is still in the developmental stages and if successful will likely require several years before it can be released in the US as a biological control option.

Chemical Control: Currently fifteen herbicides are approved for aquatic use by the United States Environmental Protection Agency (USEPA). Twelve of these have been evaluated as potential management options, either as a submersed, foliar, or bare ground application, for controlling flowering rush. It should be noted that little to no research has been conducted to evaluate the management of diploid flowering rush and herbicide recommendations are largely based off of those implemented for the control of the triploid biotype Foliar applications of imazapyr [1.68 kg acid equivalent (a.e.) ha^{-1}] imazamox [0.56 kg active ingredient (a.i.) ha^{-1}], or a tank mix of 2, 4-D (4.25 kg a.i. ha^{-1}) + triclopyr (3.36 kg a.i. ha^{-1}) with a non-ionic surfactant (1% v/v), when shoot growth is at or near maximum should provide good control of flowering rush. Since the water levels at Tonawanda WMA and Montezuma NWR are capable of being manipulated, de-watering the treatment areas should allow for easier access and increased precision when administering treatments. In-house research has shown increased control with herbicides

Two FY20 Statement of Need Submitted on Invasive Plant: Flowering Rush

STATEMENT OF NEED: 1437

Submitted by: Michael Greer

Job Title: Regional Technical Specialist

Office Symbol: CELRB-PM-PA

Statement Title: Ecology and Chemical Control of Diploid Flowering Rush

Description of the Problem, including list of applicable or related policy or guidance:
Flowering rush (Butomus umbellatus) is an aquatic invasive species that forms large mono- or oligoculture stands along rivers and lakeshores. Potential impacts from flowering rush include: impedes irrigation, promotes deposition of sediment, decreases open water habitat, and decreases abundance and diversity of native plant species. Flowering rush was introduced to the U.S. and Canada around the early1900's. Anecdotal evidence suggests flowering rush populations remained relatively sparse and patchy for many years but have expanded considerably in recent years. The expansion of flowering rush is particularly troublesome for the USACE in regards to ecosystem restoration and natural resource management missions. Research and development of chemical control methods for flowering rush has focused primarily on the infertile (triploid) populations, whereas fertile (diploid) populations are found more frequently in the Great Lakes basin, mid-West, and Northeast. Flowering rush can grow in submerged or emergent habitats, each need different control methods.

Envisioned Product(s):
Mesocosm and field trials that result in technical guidance for the use of herbicides to control diploid flowering rush

.

Value Added:
Restoration practitioners and natural resource managers would have improved methods for the use of herbicides to reduce or eliminate diploid flowering rush resulting in more resilient ecosystems.

STATEMENT OF NEED: 1471

Submitted by: Damian Walter

Job Title: District Wildlife Biologist

Office Symbol: CENWW-OD-t

Statement Title: Ecology and Biology of Flowering Rush.

Description:

Flowering rush (Butomus umbellatus) is an aquatic invasive species that forms large stands along rivers and lakeshores. Potential impacts from flowering rush include: impeded irrigation, increased sedimentation, decreased open water habitat, and decreased abundance and diversity of native plants. Anecdotal evidence suggests flowering rush populations remained relatively sparse and patchy for many years after introduction but have expanded considerably in recent years. The expansion of flowering rush is particularly troublesome for the USACE in regards to ecosystem restoration, natural resource management missions, and recreational navigation.

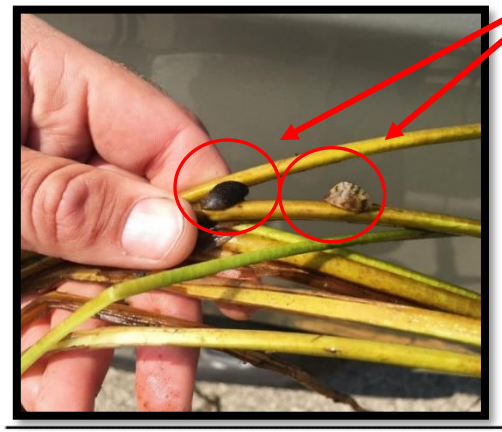
Flowering rush is distributed widely throughout the Northern United States, including Washington, Oregon, Idaho, Montana, Minnesota, Wisconsin, Maine, and New York, and infests multiple CE District projects, or is found within their region in adjacent water bodies. Flowering rush has numerous genotypes and establishes in various types of aquatic systems from shorelines out to deep water (~ 18 ft). It is an extreme threat to native plant communities and associated aquatic animal species by altering if not eliminating native habitats and native species.

Despite the potential problem to multiple CE Districts, how flowering rush establishes and spreads is mostly unknown. Understanding the factors that contribute to spread and successful establishment will allow managers to predict areas that are at risk for impacts and more effectively manage for them. Needed research may include the examination of water depth, nutrient levels, or propagule sizes on establishment, and management (mechanical cutting, herbivory) on spread.

Problem: Flowering rush continuing to expand across the northern U.S. and Southern Canada

Negative impacts to

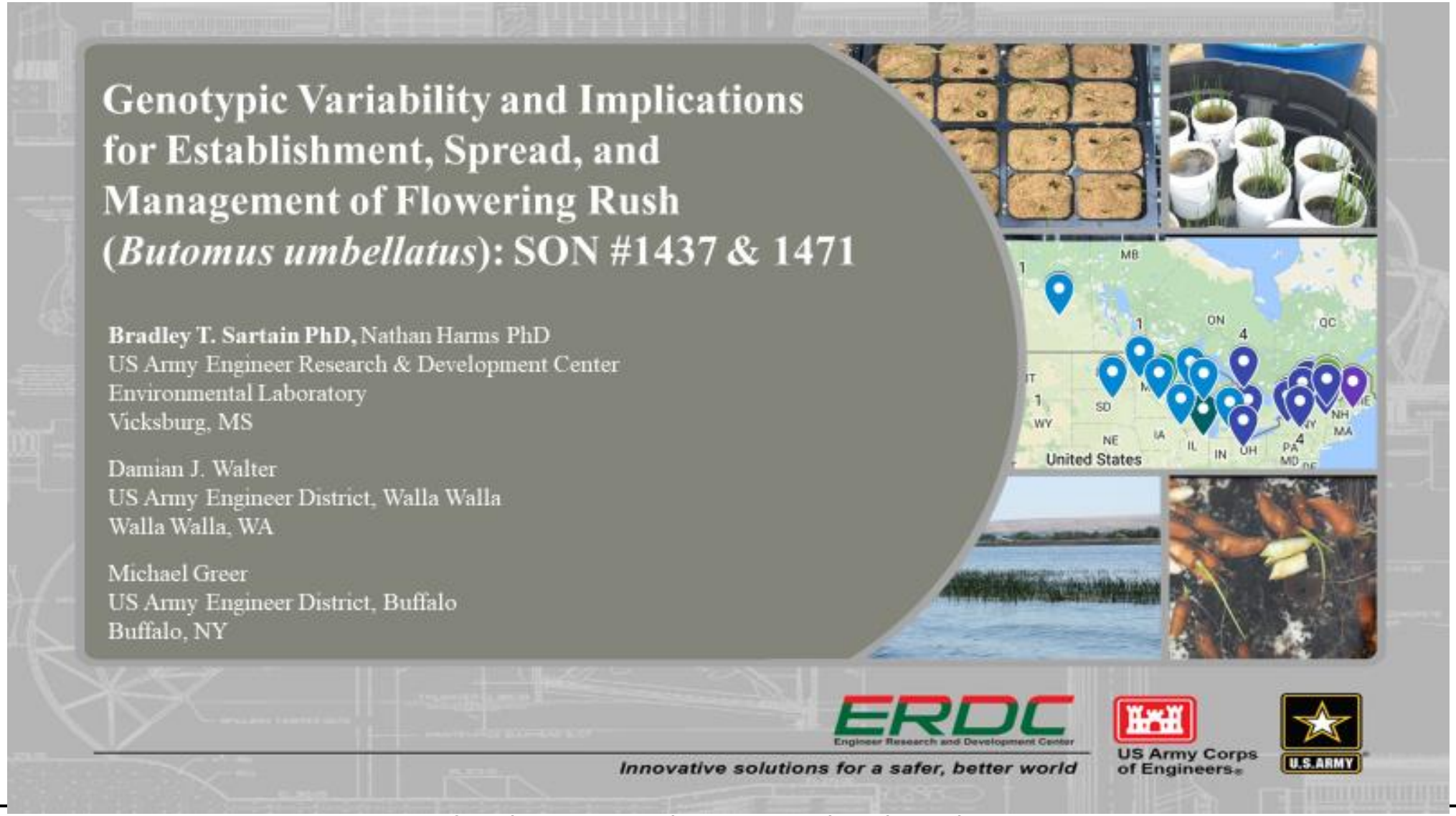
- Native plant communities
- Fish & wildlife habitat
- Water use
- Promote establishment/spread of other invasive species



Increase substrate availability for invasive mussels

Increase invasive fish habitat

Example of an on-going R&D project developed from an SON:



Purpose:

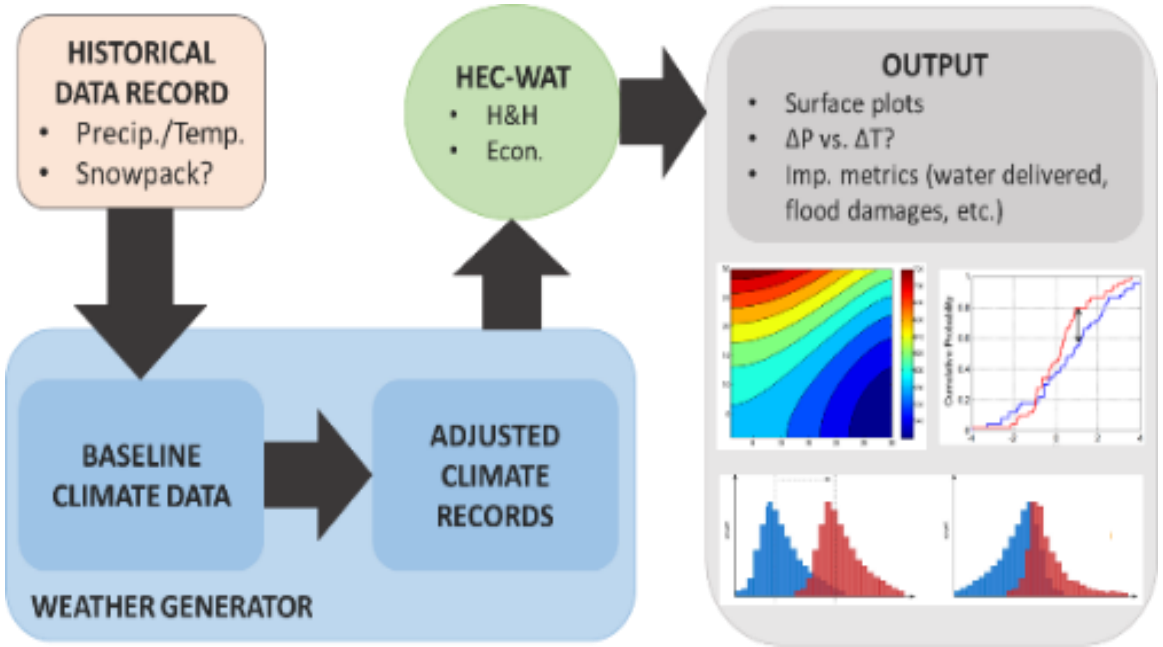
- SON #1437 & 1471: CE Districts LRB & NWW
- Define the factors leading to the successful establishment and spread of cytotype and/or distinct genotype of flowering rush (e.g. propagule buoyancy, water depth, light, temperature, etc.)
- Determine whether each cytotype and/or distinct genotype will show a differential response to management

Recent infestation in Omaha, NE and evidence for importance of bulbils

Questions?

- Christine VanZomeren, PhD.
- Associate Technical Director
- Christine.m.vanzomeren@usace.army.mil
- 601-814-9145

https://emrrp.el.erdc.dren.mil/index.html
https://gateway.erdc.dren.mil/son/index.cfm?Cop=Env&Option=Start



EMRRP