U.S. Department of the Interior Invasive Mussels Initiative

GLEN CANYON DAM ADAPTIVE MANAGEMENT WORK GROUP

THURSDAY, FEBRUARY 15th, 2018

Presenters:

U.S. Department of the Interior, Bureau of Reclamation, National Park Service, U.S. Geological Survey

Agenda

- **Invasive Mussels Initiative Overview**
  Hilary Smith, USDOI
- **Bureau of Reclamation Activities and Spend Plan**
  Robert Radtke / Lisa Vehmas, Reclamation
- **Watercraft Inspection and Decontamination**
  John Wullschleger, NPS
- **Research, Control and Management**
  Diane Waller, USGS / Sherri Pucherelli, Reclamation
- **Next Steps, Questions and Discussion**
  Hilary Smith, USDOI / All

DOI Invasive Mussels Initiative Overview

Hilary Smith, DOI

Invasive Mussels: High Impact Invaders

Foundational and Ongoing Work

- Aquatic Nuisance Species Task Force
- Western Regional Panel
- Quagga Zebra Mussel Action Plan (QZAP)
- Building Consensus in the West
- 100th Meridian Initiative
- Missouri River Basin Team
- Columbia River Basin Team
- Colorado River Fish and Wildlife Council
- American Boat and Yacht Council partnership
- State Aquatic Nuisance Species Management Plans

…Fall 2016 detection of invasive mussel larvae in Tiber and Canyon Ferry Reservoirs, Montana…

DOI Invasive Mussels Initiative: Purpose and Process

Purpose:

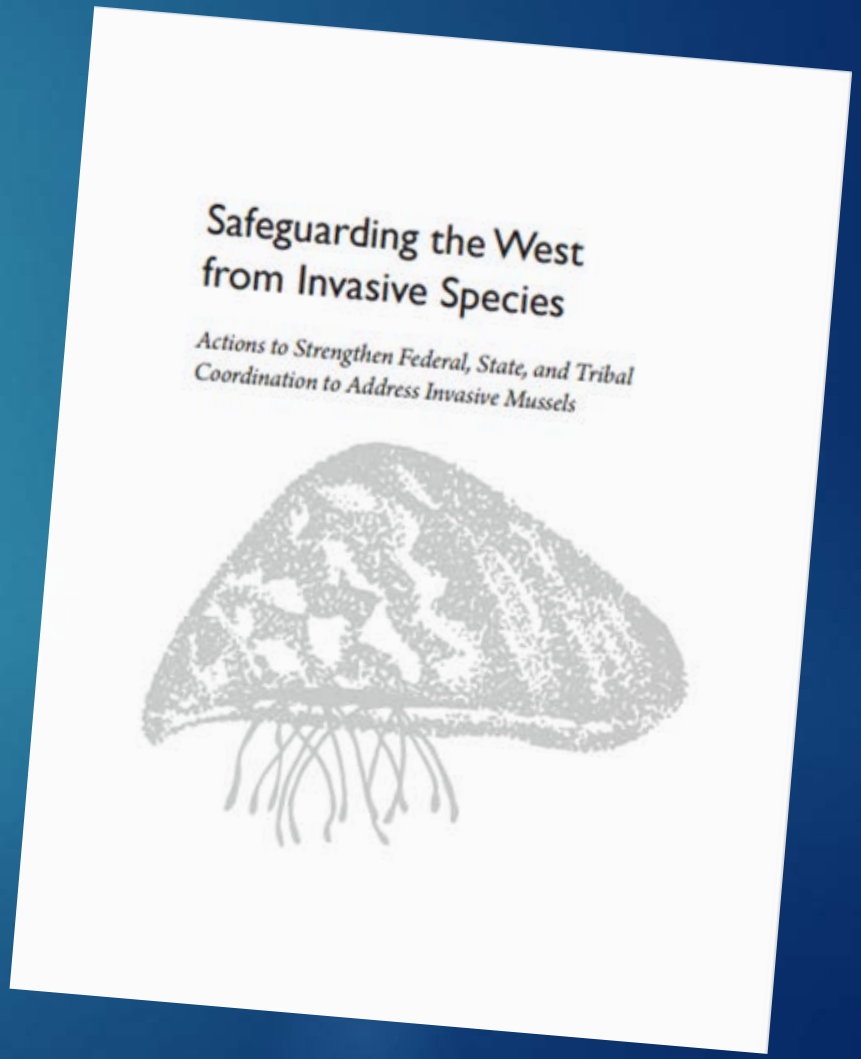
- Identify opportunities for the federal government to strengthen efforts, in coordination with states and tribes, to address invasive mussels in the Columbia River Basin and across the West

Process:

- DOI Leadership Team Initiative, with Western Governors' Association
- Six Intergovernmental Subcommittees
  - Aquatic Infrastructure
  - Inspection and Decontamination
  - Monitoring
  - Research and Innovation
  - Education and Outreach
  - Policy and Coordination
- Proposed Commitments
- Roll out at June 2017 Columbia River Basin Team Meeting

DOI Invasive Mussels Initiative: Action Items

- 40+ Action items
- DOI, BIA, BLM, BOR, NPS, USFWS, USGS
  - in partnership with others
- Short- to Long-term
- Ongoing and New
- Columbia River, Lower Colorado and Beyond
- QZAP Categories
  - Prevention
  - Early Detection Monitoring
  - Rapid Response
  - Containment and Control
  - Outreach and Education
  - Research
  - Increasing Capacity



DOI Invasive Mussels Initiative: Examples

- Develop **vulnerability assessments for facilities and infrastructure** at risk of mussel infestations in the Columbia River Basin (Reclamation)
- Support **watercraft inspection stations and K-9 inspection units on the Blackfeet Indian Reservation**, through BIA project funding (BIA)
- Explore options for sharing **information on trailered boats in regional database** (NPS)
- Explore establishment of **regionally coordinated early detection monitoring program** in the Columbia River Basin (USGS)

DOI Invasive Mussels Initiative: Examples Con't

- Develop **multi-jurisdictional containment strategy from Lake Havasu and downstream** (BLM)
- Maintain or enhance **containment programs at contaminated waters on the Colorado River** (NPS)
- Evaluate **NPS policy on watercraft and inspection** (NPS)
- Complete **Endangered Species Act consultation and reference manual** to facilitate rapid response in the Columbia River Basin (USFWS)

DOI Invasive Mussels Initiative: Implementation and Outreach

- **Implementation**
  - In process
  - Coordination w/existing efforts
  - Tracking progress
  - Monthly calls
  - Preparing progress report

- **Outreach**
  - Western Governors' Association
  - Columbia River Basin Team
  - Western Aquatic Invasive Species Summit
  - Pacific NorthWest Economic Region
  - Pacific Northwest States Council Meetings
  - As requested

DOI rolled out this initiative at the Columbia River Basin Team Meeting in Helena in June.

Bureau of Reclamation Upper Colorado Activities and Spend Plan

Robert Radtke and Lisa Vehmas, Bureau of Reclamation

Upper Colorado Region

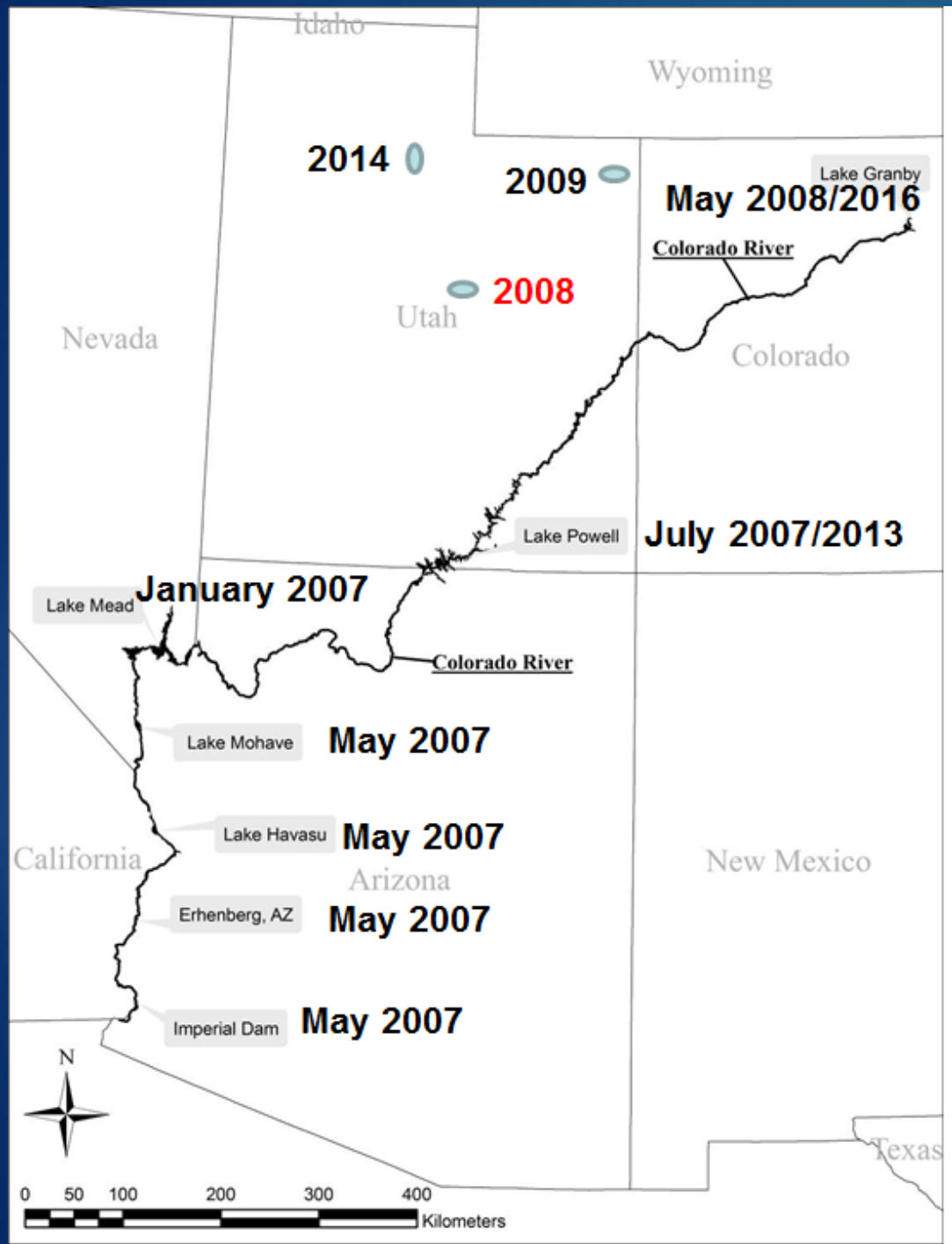
Legend

- UCRegion
- Reservoirs

Conditions in UC regional reservoirs are ideal for mussel habitat

- **Top 20 destinations of Lake Mead boaters**
  - #3 Lake Powell
  - #11 Pineview Reservoir
  - #12 Bear Lake
  - #14 Willard Bay
  - #19 Jordanelle Reservoir

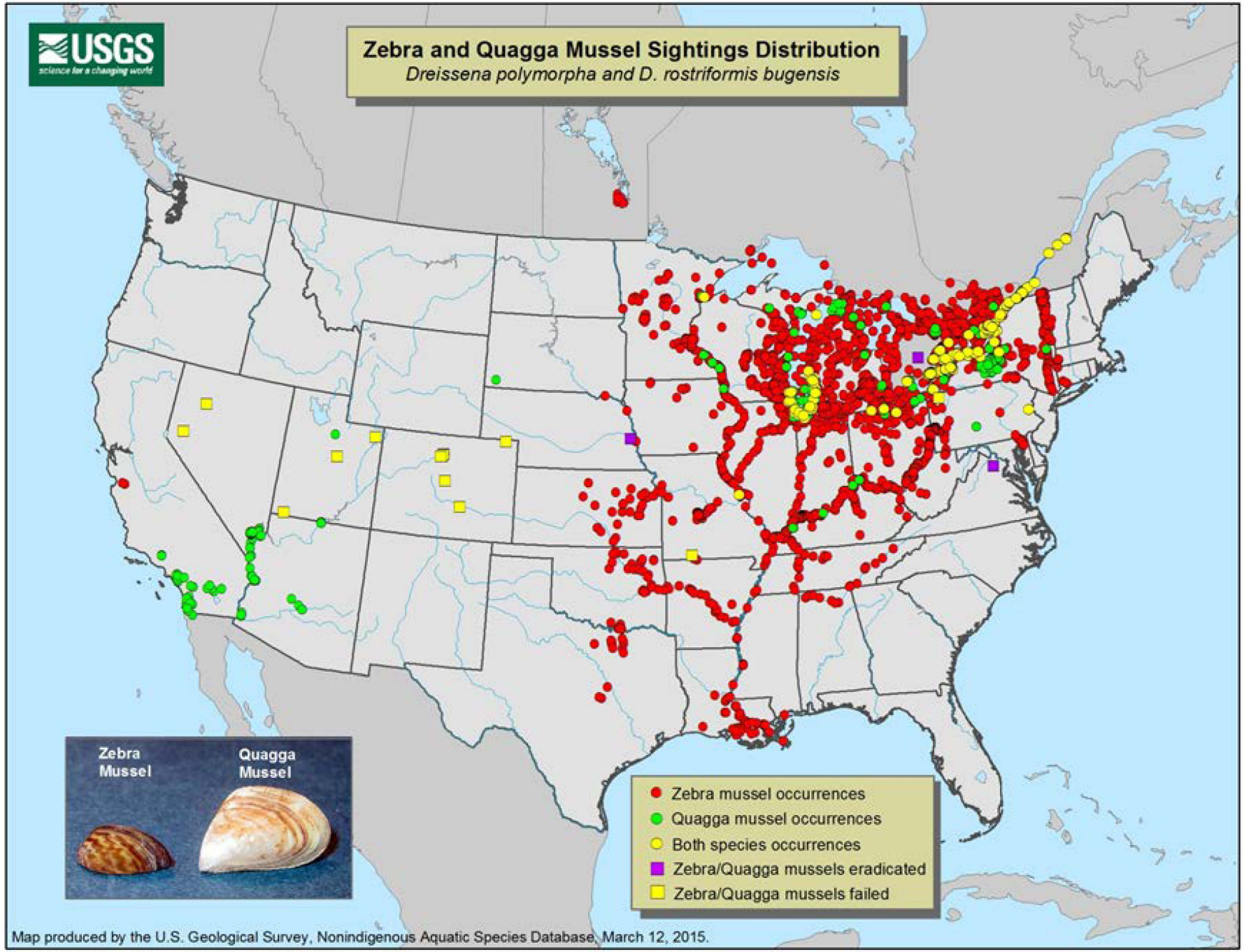
- **I-80 brings eastern boats to Flaming Gorge**



Mussel Findings

Mussels found at:

- Electric Lake, UT Zebra 2008
- Red Fleet Reservoir, UT Quagga 2009
- Deer Creek Reservoir, UT Quagga 2014
- These are now delisted waters, no positive lab results for 3 consecutive years


USGS
science for a changing world
Zebra and Quagga Mussel Sightings Distribution
Dreissena polymorpha and D. rostriformis bugensis
Zebra Mussel
Quagga Mussel
Zebra mussel occurrences
Quagga mussel occurrences
Both species occurrences
Zebra/Quagga mussels eradicated
Zebra/Quagga mussels failed
Map produced by the U.S. Geological Survey, Nonindigenous Aquatic Species Database, March 12, 2015.

Lake Powell

- **Lake Powell was predicted to have first western infestation**
  - Utah Aquatic Nuisance Species Action Team (1998)
- **Adult mussels found in Lake Mead and down CR, Jan 2007**
- **Veligers 1st found in Lake Powell by microscopy (Denver BOR Lab) in Aug 2007**
  - Disagreement about the finding, contending that it was a false positive and could have been Corbicula (Asian clam)
  - Sporadic veliger finding by BOR lab microscopy and PCR since 2007
    - At various times hits might be from individual boat discharge of contaminated water

History at Glen Canyon

- **Mussel DNA detected through sampling for several years.**
- **First adults found in 2013**
  - 40-50 adult mussels found on unit 7 fixed wheel gate in October 2013, some appear to be at least 3 yr old
  - 400-500 adult mussels found on unit 4 fixed wheel gate in early May 2014.
  - Uncountable number of pinhead sized mussels on unit 4 gate.
- **Lake wide 2017**

Regional Mussel Response Plan

- 2009 UC Region developed a Regional Response Plan for Mussels

- Prevention activities
- Early detection activities
- Facility Assessment activities
- Reservoir Rapid response / control

Partnerships

- National Park Service
- Forest Service
- COE
- State of Utah
  - Parks and Recreation
  - Division of Wildlife Resources
- State of Colorado
  - State Parks
  - Division of Wildlife
- State of New Mexico
  - State Parks
  - Game and Fish

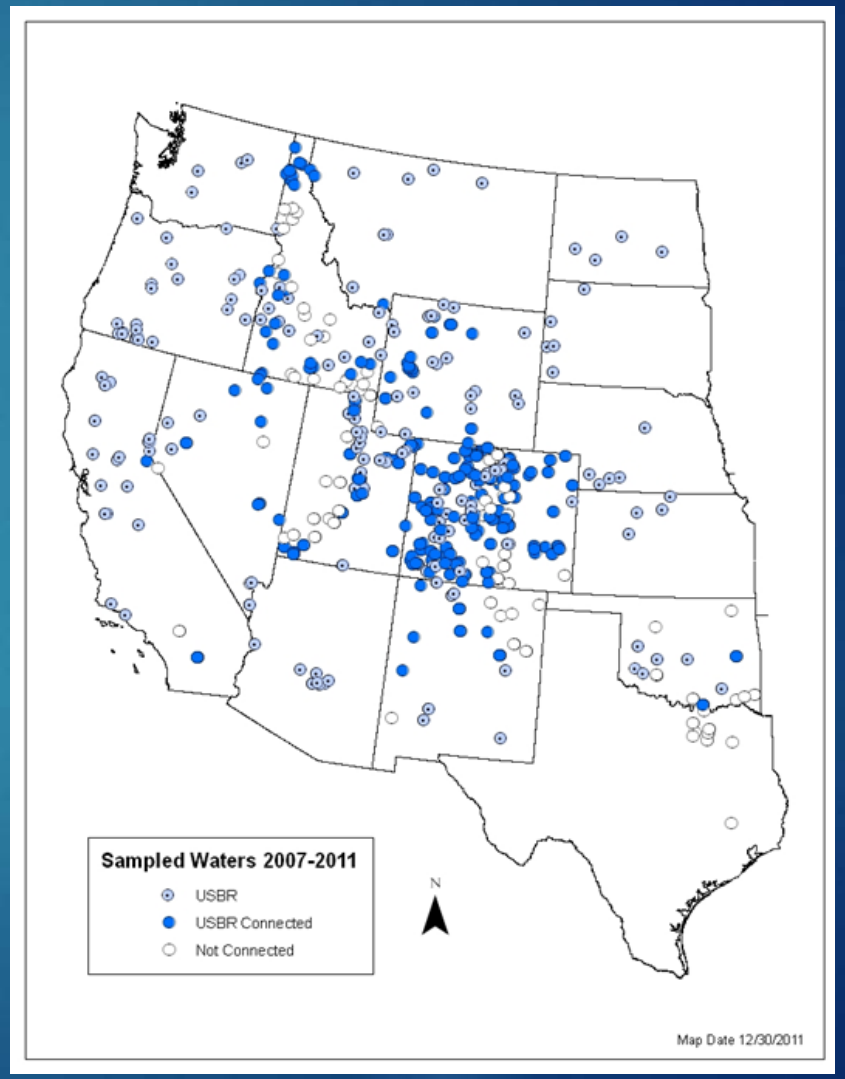
Sampling Locations

2007-2017

425 water bodies sampled by USBR, State and local partners

15 States collaborated in this program in 2011

By 2017 ≈ 18,000 samples analyzed

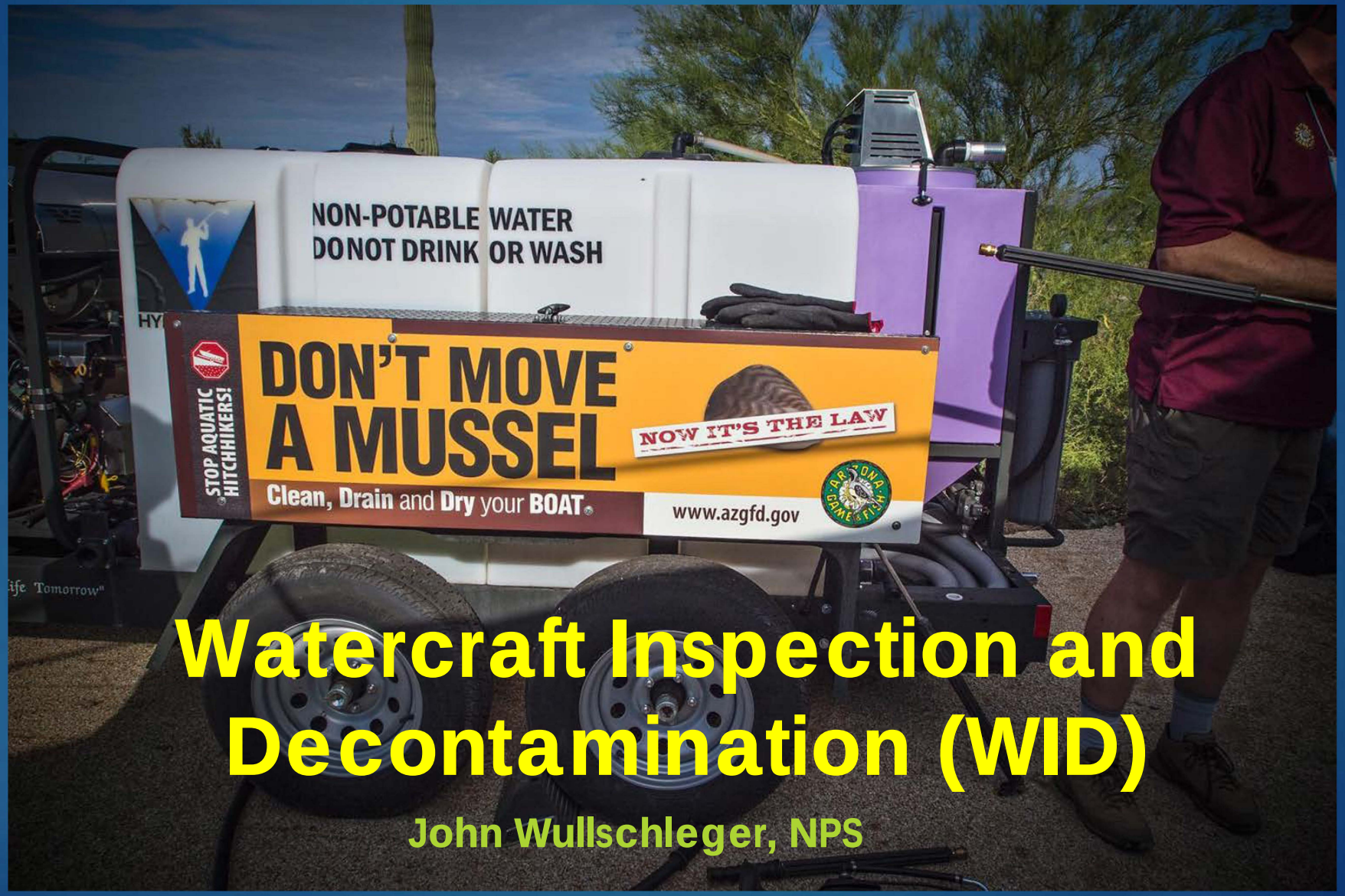


Bureau of Reclamation
2017 and 2018 Spending Plans

In Fiscal Year 2017 (enacted), Reclamation's budget included an increase of $1 million for on-the-ground work for mussel's activities

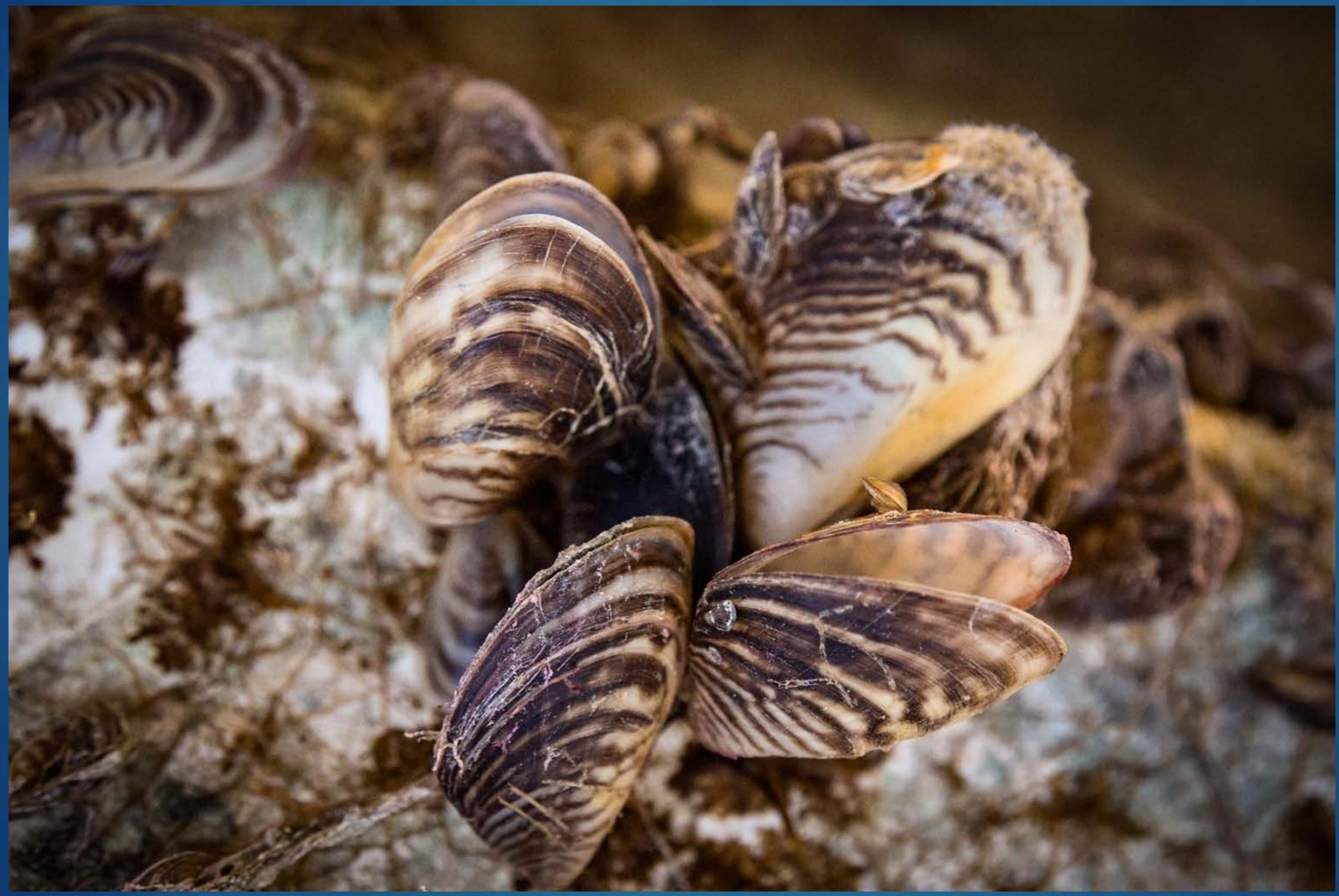
As part of DOI's Mussels Initiative in the West, Reclamation was allocated $4.5M in the proposed FY18 budget for mussels activities

Spend plans were created for both fiscal years: FY17 Complete; FY18 is currently being implemented - under continuing resolution



Watercraft Inspection and Decontamination (WID)

John Wullschleger, NPS



Watercraft Inspection / Decontamination

National Park Service

$2 million annually for WID programs at 9 western parks

- 2 parks focused on containment
- 7 parks focused on prevention
- 4 Columbia River Basin parks
- Overall, at NPS units, state and NPS personnel contacted almost 230,000 boats, of which, 82,000 were inspected and more than 2,600 were decontaminated

Watercraft Inspection / Decontamination

Containment

- Lake Mead NRA is working in cooperation with the Nevada Department of Wildlife and Arizona Game and Fish Department

- Glen Canyon NRA in cooperation with Utah Division of Wildlife Resources and Arizona Game and Fish Department

Watercraft Inspection / Decontamination

Prevention

- Amistad NRA, TX
- Bighorn Canyon NRA, WY / MT
- Curecanti NRA, CO
- Glacier National Park, MT (CRB)
- Grand Teton National Park, WY (CRB)
- Lake Roosevelt NRA, WA (CRB)
- Yellowstone National Park, WY / MT / ID (CRB)

Watercraft Inspection / Decontamination

NPS National Office Efforts

- Regional Data-sharing – we are seeking OMB approval to participate in the Western Regional Panel database for trailered boats that was developed by the State of Colorado

- Regulatory Review – we established a servicewide panel to review NPS regulations that pertain to invasive species and make recommendations for revision or new regulations.

USGS Research

Funding Support - USGS, Great Lakes Restoration Initiative, State of Minnesota - Environmental Trust Funds

Rapid Response and Control Research

Zequanox - Laboratory/mesocosm/field

- Comprehensive evaluation of efficacy, selectivity, application, and impacts
  - Nontarget studies – 10 fishes, 7 native mussels, 2 macroinvertebrates
  - Field applications in open waters to evaluate efficacy, application, and need for containment barriers

USGS Research

Temperature-dependent toxicity of four molluscicides

- Earthtec QZ, Zequanox, Niclosamide, KCl

- Decision-support tool for rapid response eradication treatments at various water temperatures

USGS Research

Efficacy and safety of carbon dioxide for dreissenid control

- Evaluated at 4, 12, and 20°C

- Potential for use in cool waters (<12° C) when other molluscicides are ineffective
  - Can reduce attachment and biofouling
  - Could be combined to increase effectiveness of other treatments

USGS Research

Electrified fields – limited success

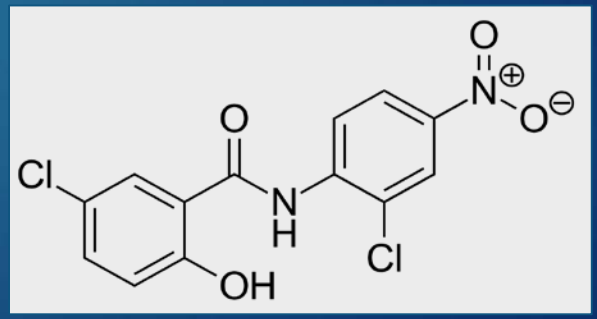
- Potential for use in combination with carbon dioxide to increase effectiveness

Spawning Disruptors

- Identified 6 cyanobacteria (blue-green algae) species that inhibit quagga mussel spawning or fertilization

Salicylanilide (Niclosamide) derivatives

- Initiated synthesis and evaluation of salicylanilide ester derivatives that are toxic to mussels but are less toxic to fish



USGS Research

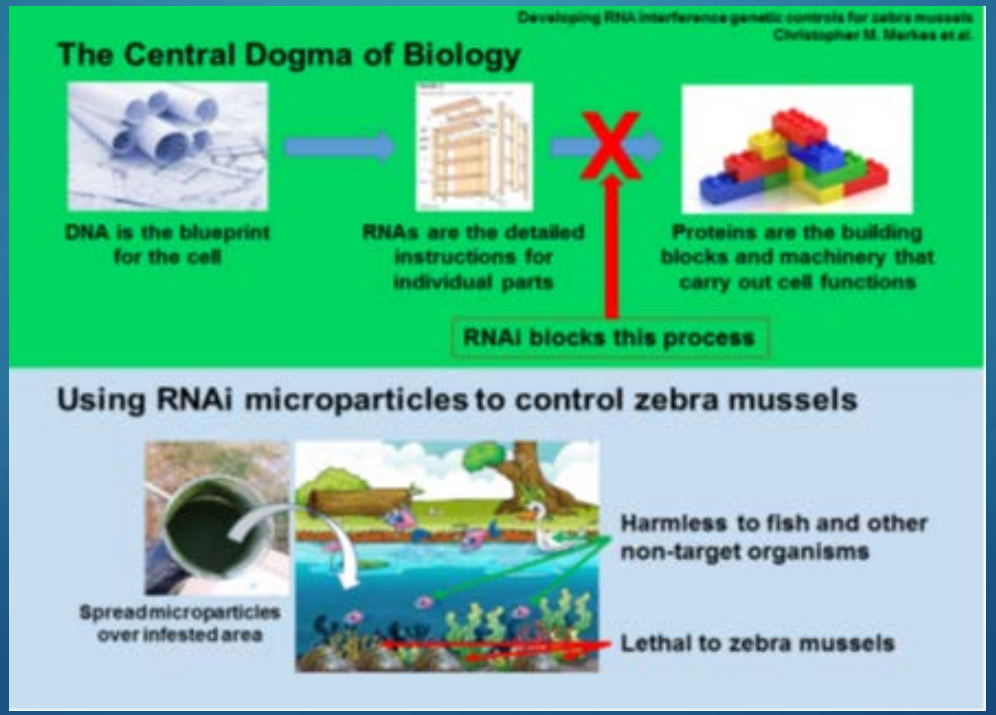
Upcoming Research – Rapid Response and Control

- Initiate open-water trials with carbon dioxide
- Evaluate efficacy and delivery of new niclosamide derivatives
- Isolate/characterize metabolites from cyanobacteria that induce spawning inhibition
- Develop structure-activity relationship models to discover new molluscicides
- Evaluate the use of mixed toxicants for dreissenid control

USGS Research

Upcoming Control Research - Molecular Tools

- Develop RNA interference control for dreissenids
  - Uses gene regulation to eliminate vital gene products
  - Develop microparticles for delivery of toxicants, including RNAi



Research, Control & Management

Sherri Pucherelli, Bureau of Reclamation

Reclamation Research

Prevention of mussel settlement and shell debris removal in facilities

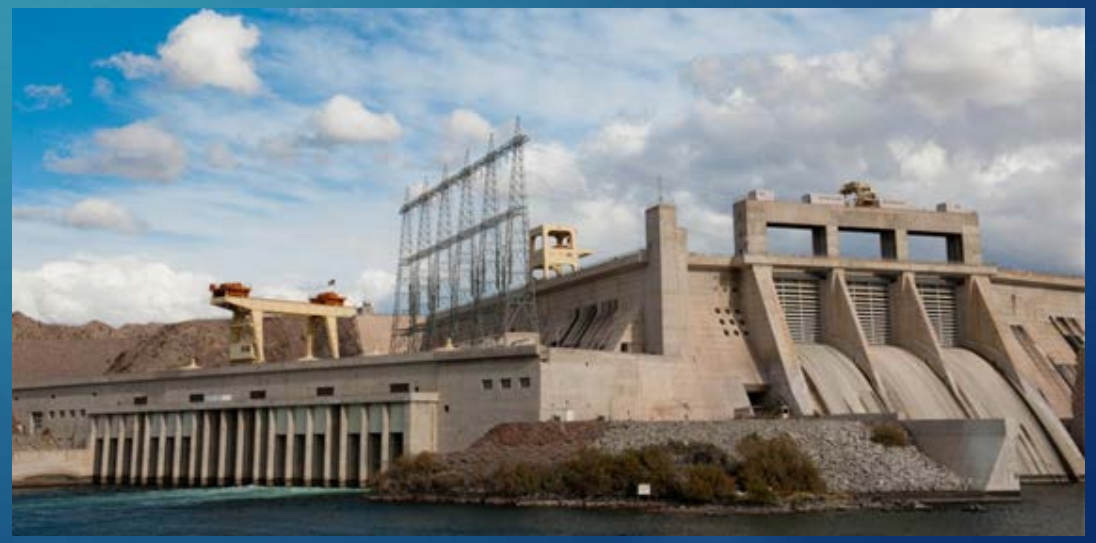
- Cooling water and fire suppression systems
  - Small pipes with low flow
- Trashracks and gates
- Strainers and screens

Reclamation Research

Selected treatments with limited impacts to environment and facility operation

Research conducted at facilities along lower Colorado River

- Davis Dam
- Hoover Dam
- Parker Dam



Reclamation Research

- Zequanox
- Microfiltration, self-cleaning filters
- Copper ion generator
- Turbulence
- Centrifugal separator
- Antifouling and foul release coatings
- Laser pulsed pressure

<u>Implemented</u>

- Ultraviolet light

UV Research

- Cooling water tests at Davis Dam
- Medium pressure UV system
  - Treating 3,500 gallons/min
  - UV doses: 20, 40, 50, 100 mJ/cm²
- Settlement reduced by 88-99%
- Causes delayed larvae mortality
- Effectiveness dependent on….
  - Water clarity
  - Water temperature
  - UV unit and installation location

UV Research

UV has reduced maintenance at Parker Dam

- Prior to UV
  - 16 coolers cleaned per year
    - 640 staff hours= $80,000
- After UV
  - 4 coolers (2016)
    - labor reduced by 75%
    - No units re-packed
    - Less scale on heat exchangers
  - 0 coolers (2017)

Reclamation Mussel Management

- **Early detection and monitoring program**
  - Reclamation Detection Laboratory for Exotic Species (RDLES)
- **Facility vulnerability assessments**
  - Identify hydraulic structures, equipment and systems susceptible to mussel impacts for planning purposes
- **Research for fish management**
  - KCL/formalin and rinse treatment for fish and haul tanks
  - Impact of mussel fouling on fish screen function

Upcoming Reclamation Research

- Carbon dioxide
- Self-cleaning strainers/ filtration
- Hydraulically driven grinders
- Quagga mussel genome sequencing
- Economic evaluation of mussel management activities

- Open water treatments
  - Biocontrol
  - Potash

- Prize Challenge: Eradication of invasive mussels in open water
  - Designed to solicit novel solutions: $100,000 prize for stage 1
  - Closes: February 28th

Next Steps, Questions & Discussion

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