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# Reclamation Ecological Research Laboratory (Eco Lab) FY19-FY21

**Science and Technology Program  
Research and Development Office  
Final Report No. ST-2021-19214-01  
EcoLab-FA981-2021-06**



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## **Mission Statements**

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The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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# **Reclamation Ecological Research Laboratory (Eco Lab) FY19-FY21**

**Final Report ST-2021-19214-01  
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## Bureau of Reclamation Research and Development Office Science and Technology Program

Final Report ST-2021-19214-01  
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**Reclamation Ecological Research Laboratory (Eco Lab) FY19-FY21**

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# Acronyms and Abbreviations

<b>AIS</b>	<b>Aquatic Invasive Species</b>
<b>ANSTF</b>	<b>Aquatic Nuisance Species Task Force</b>
<b>ASDSO</b>	<b>Association of State Dam Safety Officials</b>
<b>BIA</b>	<b>Bureau of Indian Affairs</b>
<b>BLM</b>	<b>Bureau of Land Management</b>
<b>CPLM</b>	<b>Cross-Polarized Light Microscopy</b>
<b>Eco Lab</b>	<b>Reclamation Detection Laboratory for Exotic Species</b>
<b>eDNA</b>	<b>Environmental DNA</b>
<b>FWS</b>	<b>Fish and Wildlife Service</b>
<b>GPS</b>	<b>Global Positioning System</b>
<b>ICAIS</b>	<b>International Conference on Aquatic Invasive Species</b>
<b>NALMS</b>	<b>North American Lake Management Society</b>
<b>NIST</b>	<b>National Institute of Standards and Technology</b>
<b>NPS</b>	<b>National Park Service</b>
<b>PCR</b>	<b>Polymerase Chain Reaction</b>
<b>QA/QC</b>	<b>Quality Assurance/Quality Control</b>
<b>SNWA</b>	<b>Southern Nevada Water Authority</b>
<b>SOP</b>	<b>Standard Operating Procedure</b>
<b>USACE</b>	<b>United States Army Corps of Engineers</b>
<b>USACE-ERDC</b>	<b>USACE-Engineer Research and Development Center</b>
<b>USGS</b>	<b>United States Geological Survey</b>
<b>UT DWR</b>	<b>Utah Division of Wildlife Resources</b>
<b>WRP</b>	<b>Western Regional Panel</b>

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## Executive Summary

The Reclamation Ecological Research Laboratory (Eco Lab), formerly the Reclamation Detection Laboratory for Exotic Species (RDLES), provides expertise in field sampling, analytical microscopic, and molecular methods for the detection and identification of threatened and invasive species. The Eco Lab provides data that is utilized for environmental compliance and to manage invasive, threatened, and endangered species that impact Reclamation. The laboratory is currently focused on invasive dreissenid mussels and has developed expertise in multiple disciplines of this topic. The Eco Lab provides services to Reclamation regional and area offices, state aquatic invasive species (AIS) programs, water districts, and other agencies with a variety of monitoring and research projects. Over the last three years, as of August 30, 2021, the Eco Lab has received 3,926 samples and received 556 field blank samples. Of these, 176 samples were positive, all from Salt River Project reservoirs in Arizona. In addition, the Eco Lab provides monitoring of sites where mussels are established to assess population dynamics (e.g., Canyon Lake, AZ). Eco Lab staff also undertake public outreach by participating in water festivals for students, and training college and high school students to work in the laboratory. Other laboratories consult with the Eco Lab for training and use the standard operating procedures developed here for their own detection programs.

## Background

Invasive dreissenid mussels (*Dreissena rostriformis bugensis* (quagga) and *Dreissena polymorpha* (zebra)) pose serious risks to Reclamation managed habitat and infrastructure in the United States. The arrival of quagga mussels in Lake Mead in 2007 triggered Reclamation to invest in developing and maintaining the Reclamation Detection Laboratory for Exotic Species (RDLES), now rebranded as the Reclamation Ecological Research Laboratory (Eco Lab). Based upon experience with zebra mussels in the Eastern U.S., if mussels are detected early facility operators may have three to five years to plan, budget, and implement protective measures before mussel populations are large enough to impair generation of hydropower and delivery of water by clogging critical structures such as pipes, water intakes, drains, gates, and trash racks. One of the central goals of the early detection and monitoring effort is to provide Reclamation facility managers the early warning they need to plan for the arrival of invasive mussels. Early actions may also be taken to prevent the spread of mussels to other water bodies. The advantages of an in-house early detection laboratory include customized support for the agency with improved quality control, tailored testing, and cost efficiency. The Eco Lab provides quality sampling and analytical work for the detection of mussels with shorter turn-around times and high Quality Assurance/Quality Control (QA/QC) standards. Reclamation experts can detect sample anomalies that may require additional attention or research. Many state and federal entities are dependent on the Eco Lab for invasive mussel sample analysis and expert guidance in sample analysis. In Fall 2019, the Eco Lab moved from an outdated laboratory space with high cross-contamination concerns to a new, modern space with a dedicated air handler, fume exhaust, and optimized layout.

This report provides the conclusion to the past three years of invasive mussel monitoring conducted by the Eco Lab as well as capacity building in invasive mussels management across the West. It includes an overview of three primary areas: Samples, Collaboration, and Outreach. The section on Samples discusses the methods used in sample collection, the processing procedures followed in the lab, notification procedures for significant findings, and reporting of results. The Collaboration section provides information on the various training aids produced by the Eco Lab, the types of assistance regularly provided, and a synopsis of the working groups the Eco Lab participates in. Finally, the Outreach section discusses the numerous presentations given by lab staff, educational interactions with school-age children, and intern opportunities for high school and college students.

## Samples

### Methods

Water samples are received from various locations across the western United States, from both Reclamation waterbodies and facilities, and state and local agencies. Sampling methods are generally standardized across all agencies. Plankton tow nets (Figure 1) are used to collect several samples,

either vertically or horizontally, at specified locations, usually launches and marinas where there is recreational activity as these areas are often where inoculation occurs.



Figure 1 Plankton tow net with attached cod end

Once the samples are collected the water is placed into clean bottles and buffered with 4M Tris to prevent degradation of mussel shells. Alcohol is also added as a preservative and to kill all living organisms in the sample. At a minimum, the bottle is labeled with the collection date, reservoir name, and the location on the waterbody from which the sample was collected. A Chain of Custody (COC) form was developed to standardize the labeling and data collection (Appendix A). With the introduction of the COC, specific information about each sample, such as tow type (horizontal or vertical), number and length of tows, total depth, and secchi depth is now routinely provided. Other information may also be provided such as sampler names, water volume, water temperature, and Global Positioning System (GPS) points, though this varies widely between locations and/or individuals/agencies. Water quality data is also collected concurrently with plankton tow net sampling, although the amount of information provided again varies. The Eco Lab recommends the use of dedicated nets for each sampled waterbody to minimize the risk of cross-contamination. All nets are decontaminated in 5% acetic acid (vinegar) between sample locations, including multiple locations on the same reservoir. Samples are kept cool after collection and during shipment to the laboratory. In 2020 the Eco Lab introduced the recommendation of collecting a field blank, which is rinsing the plankton tow net and cod end with deionized or purified water, collecting that sample, and following sample preservation techniques. If a sample were to indicate the presence of dreissenid mussels, the field blank can be analyzed to rule out possible contamination from improperly handled field equipment. The Field Sampling Standard Operating Procedure (SOP)

detailing collection methods can be found on the Eco Lab webpage, <https://www.usbr.gov/mussels>.

## Processing



Figure 2 Samples after being logged in

All samples arriving at the laboratory are logged into a central database (Figure 2). During login, all available data is entered, and a unique identifier is created for every sample. Raw water samples are prepared using established protocols, detailed in the Laboratory SOP which can be found on the Eco Lab webpage, <https://www.usbr.gov/mussels>, and microscopic analysis is

completed utilizing cross polarized and regular light microscopy. Briefly, water samples are settled overnight in Imhoff cones (Figure 3).

Figure 3 Samples settling in Imhoff cones prior to analysis



Previous research showed that due to the density of the veliger's hard shell they will fall to the bottom of the settling cone in samples with minimal volumes of zooplankton, algae, or sediment. However, recent studies have indicated that high levels of zooplankton, algae, and sediment may interfere with veliger settling. A proposal has been submitted to further investigate changes that need to be made to the sample settling process. From the cone, the bottom 15 mL of the sample is currently collected and then analyzed by microscopy (Figure 4).



Figure 4 A sample prepared for microscopic analysis

Water samples from non-positive waters in which suspect veligers have been found within the last five years are considered priority samples. In addition to microscopy, they are also analyzed for the presence of quagga and zebra mussel environmental DNA (eDNA) by polymerase chain reaction (PCR) methods. The data and results that are collected are used to further optimize sample

collection and handling methods. Because eDNA analysis provides additional potential to detect mussel populations, the Eco Lab has begun to analyze some samples for eDNA at sites where veligers have never been detected. Analysis for these samples occurs at the request of the client. In addition, in 2019, the Eco Lab started asking clients to provide field blanks for each waterbody that is sampled. This was done to ensure that when a positive eDNA finding is made it was from the waterbody, and not potentially contamination from field equipment.

## Notifications of Findings

Between 2019 and 2021, the Eco Lab had zero first-time findings. A first-time finding is a highly sensitive topic for Reclamation and its partners and stakeholders. These results are communicated directly to Reclamation Regional Offices, the Policy and Programs Office, and the State AIS Coordinator, who follow a strict notification protocol that was developed by Reclamation in 2021. Negative findings and veliger counts from waterbodies known to have mussel infestations are communicated through an access-controlled SharePoint site. Currently, dreissenid mussel data is maintained in a large database that can be utilized for environmental and population data analysis relevant to control activities. This data has been utilized by the United States Army Corps of Engineers (USACE) and the United States Geological Survey (USGS) for various research purposes. Information about Reclamation's early detection program is regularly presented at professional meetings with collaborators and at international conferences. The Eco Lab will continue to modify and update Reclamation's mussel website and produce content such as instructional videos and interactive maps.

## Results

The Eco Lab received an average of 1,398 raw water samples per year between 2019 and 2021. Appendix B lists the waterbodies sampled during that timeframe. Samples were collected from every region in Reclamation by Eco Lab staff, other Reclamation employees, and state employees. Roughly half of the received samples were analyzed by microscopy only. After 2017, FlowCam use was discontinued for samples with veligers and samples were analyzed by counting by microscopy. Samples from Canyon, Apache, and Saguaro Lakes in AZ continued to be limited to veliger counts by microscopy due to continued infestation. Details regarding regional sample numbers and analysis performed are available in Tables 1-3. In all three tables, "Veliger Count" refers to the number of samples where veligers were counted in known positive samples.

All results generated by the Eco Lab are uploaded to a SharePoint site and shared with Federal and State partners. In addition, an internal password protected database of sample results is maintained. All positive findings are reported according to Eco Lab protocols to the appropriate partner. Any follow up tests that the partner requests are carried out to ensure that the findings are validated. Data collection and reporting methods will continue to be optimized. Data from each field season is available to Reclamation researchers for use in research projects such as modeling mussel spread based on habitat suitability, the impacts of sample preservation and holding time on results.

Table 1: Number of Samples Received in 2019 by Region and Analysis Type

Region	Total # Samples Received	Microscopy Only	Microscopy & PCR	Veliger Count
CPN	0	0	0	0
CGB	307	274	33	0
LCB	127	0	54	73
UCB	742	481	261	0
MBART	329	251	78	0
Totals	1505	1006	426	73

Table 2: Number of Samples Received in 2020 by Region and Analysis Type

Region	Total # Samples Received	Microscopy Only	Microscopy & PCR	PCR Only (Field Blanks)	Veliger Count
CPN	40	4	35	1	0
CGB	146	127	7	12	0
LCB	105	17	41	1	46
UCB	824	448	224	152	0
MBART	415	257	60	98	0
Totals	1530	853	367	264	46

Table 3: Number of Samples Received in 2021\* by Region and Analysis Type

Region	Total # Samples Received	Microscopy Only	Microscopy & PCR	PCR Only (Field Blanks)	Veliger Count
CPN	56	0	52	4	0
CGB	231	161	27	42	0
LCB	240	7	82	22	129
UCB	750	378	215	157	0
MBART	308	102	126	81	0
Totals	1585	648	502	306	129

\*Regarding Table 3, data is only complete as of September 2, 2021. Not all samples have been received and analyzed for the fiscal year.

## Collaboration

Eco Lab staff participate in several collaborative efforts with partners to develop, share, and modify standard operating procedures for all stages of analysis, as well as various research projects utilizing invasive mussel population data. Subject matter includes field sampling methods, sample handling, and DNA analysis techniques.

Staff continue to develop and modify SOPs and QA/QC practices based on input from collaborators. A sample collection training video was prepared in 2019 to assist partners with proper sample collection techniques. The video is posted on the Reclamation Mussel Website.

The Eco Lab provides training, follow-up advice, and technical expertise for partners in order to maintain sample QA/QC, as well as for other laboratories establishing their own early detection programs. Both the Field Sampling SOP and the Laboratory SOP have been widely shared with regional and area offices conducting their own sampling efforts. The Eco Lab provides in-person

and virtual training for other labs on analytical methods, as well as providing training materials including veligers, test samples, and identification keys and training for partners who are collecting samples. A flyer has been created (Appendix C) with reminders and tips related to collecting, preserving, and shipping samples.

The Eco Lab routinely answers email and telephone requests for research assistance, and regularly provides regional and area offices with a necessary buffer used in sample collection, veliger samples and sample bottles, as well as information and advice on the purchase of equipment such as water quality measurement devices, plankton tow nets, and sample bottles.

Protocols for innovative technologies such as quantitative PCR and next generation DNA sequencing will continue to be optimized to improve detection methods for invasive mussels.

The Eco Lab participates in working groups organized by the following organizations:

- Western Regional Panel eDNA working group
- DOI Mussel Team
- National Invasive Species Council
- Government eDNA Work Group
- Invasive Mussel Collaborative
- USGS Nonindigenous Aquatic Species database

## **DOI Safeguarding the West from Invasive Species Initiative**

Reclamation and the Eco Lab participated in the Department of the Interior (DOI) Safeguarding the West from Invasive Species Initiative, a multi-agency initiative whose goal was to prevent and contain the spread of invasive mussels. In collaboration with USGS, National Park Service (NPS), Bureau of Indian Affairs (BIA), Fish and Wildlife Service (FWS), the Columbia River Inter-Tribal Fish Commission, Utah Division of Wildlife Resources (UT DWR), AZ Department of Fish and Game, Bureau of Land Management (BLM), Aquatic Nuisance Species Task Force (ANSTF), DOI Policy, Management and Budget, and other Reclamation offices, the Eco Lab committed to providing resources in the areas of Prevention, Early Detection Monitoring, Containment and Control, Prize Competition, and Research. Reclamation fulfilled its commitments, and the Department of Interior announced the final report for the initiative in November 2020. Table 4 outlines the specific Reclamation commitments to which the Eco Lab staff contributed.



Table 4 Commitments to the DOI Safeguarding the West from Invasive Species Initiative that included Eco Lab participation

Category	Commitment Details	Collaborating Agencies
Prevention	Improve predictive models and methodologies for identifying waterbodies at risk of mussel infestation in the West, with a focus on the Columbia and Snake River reservoir systems	USGS/Reclamation/NPS
Prevention	Develop vulnerability assessments for facilities and infrastructure at risk of mussel infestation in the Columbia River Basin	Reclamation
Early-Detection Monitoring	Assess various eDNA methodologies and develop criteria, guidelines, and decision-support tools for using eDNA in concert with other tools to increase the probability of detecting mussel populations	USGS/Reclamation
Early-Detection Monitoring	Assess various eDNA methodologies and develop criteria, guidelines, and decision-support tools for using eDNA in concert with other tools to increase the probability of detecting mussel populations	USGS/ Reclamation
Early-Detection Monitoring	Develop, apply, and evaluate eDNA and microscopy technologies to support sampling and detection efforts	Reclamation
Early-Detection Monitoring	Continue to analyze water samples from across the western United States and provide results to staff and stakeholders	Reclamation

Early-Detection Monitoring	Continue monitoring for mussels in Bureau of Reclamation waters and facilities, as well as connected waters	Reclamation
Containment and Control	Compile best practices, strategies, and technologies used at infested facilities to minimize risks and impacts	Reclamation
Prize Competition	Launch a prize competition to identify innovative concepts to eradicate or prevent mussel infestations in open waters, including large reservoirs and lakes	Reclamation
Research	Continue research on effective technologies for the detection, prevention, control, and management of invasive mussels in lab and field settings	Reclamation

## Outreach

Each year the Eco Lab presents information about the previous sampling season to Regional Coordinators at the Annual Invasive Mussel Task Force Meeting. Updates are presented throughout the year to Reclamation employees that work with invasive species during the Invasive Mussel Task Force Quarterly Open Call. Updates and findings are also presented to Policy and Programs and the Research and Development Office during quarterly meetings. The Eco Lab participates in a variety of outreach activities aimed at sharing knowledge among partners, the research community, and other interested entities. Staff provided over a dozen professional presentations including presentations for the following organizations and groups:

- USACE Engineer Research and Development Center (USACE ERDC)
- Western Regional Panel on Aquatic Invasive Species
- Upper Colorado Basin Region
- Department of the Interior, Office of Policy Analysis Seminar
- American Fisheries Society
- Upper Colorado River Basin Water Forum
- Invasive Mussel Collaborative
- National Invasive Species Council Advanced Biotech Working Group

Additionally, the Eco Lab is included in most TSC facility tours provided to visiting VIPs, school groups, leadership classes, and other interested parties, allowing for widespread education and informative opportunities. Laboratory staff assist in the organization of Reclamation's annual Take-Your-Child-to-Work event, providing input into the format of the event, and giving presentations and hands-on demonstrations of field equipment, sample collection and processing, and microscopy. Each spring, Eco Lab staff participates in several local water festivals for grade school students including the Aurora and Westminster, CO, water festivals, as well as Girls Exploring Science, Technology, Engineering & Math (GESTEM), a day of hands-on workshops presented by area volunteers for 7th grade girls from the Denver Metro Area.

Each summer Eco Lab supports 1-2 college interns, with several high school students interning at various times throughout the year. Interns are fully trained in laboratory and field methods and are provided individual assignments meant to enhance their knowledge of Reclamation and the Eco Lab, while providing practical application of education.

Additional outreach includes maintaining the Reclamation Invasive Mussels webpage yearly with updated sampling maps, and standard operating procedures, as well as any important research findings. An informational sample flyer (Appendix C) was created by Eco Lab staff as a means of passing on critical information to those partners collecting and shipping water samples. The Eco Lab also provides information for congressional briefings, press releases and social media postings.

## **Next Steps**

In the coming years Eco Lab staff will continue to receive and analyze samples from a wide range of waterbodies across the western United States. This work will continue to provide an early warning of mussel activity that will support the decisions that water managers must make. We will continue to provide support and training to our partners in regional and area offices and expect to continue outreach efforts by participating in working groups, presenting at various meetings, sponsoring college and high school interns, and participating in water festivals. Plans are in place to optimize the methods used for sample collection, analysis, and data management. Our SOPs are updated and shared with our partners as they are refined. Data will be collected for use in mussel management, modeling projects, population trend analysis, economic studies, and others. New products such as videos, flyers, posters, and presentations will be created to increase standardization, as well as to provide information and education.



ECOLOGICAL RESEARCH LABORATORY
INVASIVE MUSSELS FIELD SAMPLING LOG

Sample Collector and Agency: \_\_\_\_\_

Net Diameter: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Type and % Alcohol Added: \_\_\_\_\_

Email: \_\_\_\_\_

Baking Soda Added (circle): Y / N | Tris Buffer Added (circle): Y / N

Table with 9 columns: Date Collected, Water Body, Sample Location, Tow Type (V or H), Number of Tows, Length of Tows (M), Total Water Depth (M), Secchi Depth (M), Coordinates (decimal degrees preferred). The table contains 8 empty rows for data entry.

Special Instructions: \_\_\_\_\_

Address to Return Cooler: \_\_\_\_\_

## APPENDIX B - WATERBODIES SAMPLED BETWEEN 2019 AND 2021

AZ	Apache Lake (Horse Mesa Dam)	CO-NM	Navajo Reservoir (Co-Nm)
AZ	Bartlett Lake	ID	Bear Lake
AZ	Canyon Lake (Mormon Flat Dam)	ID	Twin Lakes
AZ	Granite Reef Diversion Dam	KS	Keith Sebelius Reservoir (Norton Reservoir)
AZ	Roosevelt Lake	KS	Kirwin Reservoir
AZ	Saguaro Lake (Stewart Mountain Dam)	KS	Lovewell Reservoir
CA	Boca Reservoir	KS	Webster Reservoir
CA	Boca Reservoir	MT	Bighorn Lake
CA	Cahuilla Lake	MT	Canyon Ferry Lake
CA	Canal at Avenue 56	MT	Clark Canyon Reservoir
CA	Folsom Lake	MT	Fresno Reservoir
CA	Gerber Reservoir	MT	Helena Valley Reservoir
CA	Irrigation Lateral 88.6	MT	Lake Elwell (Tiber Reservoir)
CA	Keyhole Reservoir	MT	Nelson Reservoir
CA	Lake Arrowhead	ND	Edward Arthur Patterson Lake
CA	Lake Berryessa	ND	Jamestown Reservoir
CA	Millerton Lake	ND	Lake Tschida (Heart Butte Reservoir)
CA	New Melones Lake	ND	Mcclusky Canal
CA	Prosser Creek Reservoir	NE	Calamus Reservoir
CA	Shasta Lake	NE	Calamus Reservoir
CA	Stampede Reservoir	NE	Davis Creek Reservoir (Ne)
CA	Stony Gorge Reservoir	NE	Enders Reservoir
CA	Tracy Pp Inlet Channel	NE	Harry Strunk Lake (Medicine Creek Reservoir)
CA	Trinity Lake	NE	Red Willow Reservoir
CA	Tule Lake	NE	Swanson Lake
CA	Whiskeytown Lake	NM	Brantley Reservoir
CO	Bear Lake	NM	Caballo Reservoir
CO	Blue Mesa Reservoir	NM	El Vado Reservoir
CO	Carter Lake Reservoir	NM	Elephant Butte Reservoir
CO	Crystal Reservoir	NM	Farmington Lake
CO	Grand Lake	NM	Heron Reservoir
CO	Green Mountain Reservoir	NM	Sumner Lake
CO	Horsetooth Reservoir	NV	Lahontan Reservoir
CO	Lake Estes	NV	Pyramid Lake
CO	Lake Granby	OK	Arcadia Lake
CO	Mcphee Reservoir	OK	Bell Cow Lake
CO	Meadow Creek Reservoir	OK	Birch Lake
CO	Morrow Point Reservoir	OK	Broken Bow Lake
CO	Pinewood Lake	OK	Copan Lake
CO	Pueblo Reservoir	OK	Dripping Springs
CO	Ruedi Reservoir	OK	Fuqua Lake
CO	Shadow Mountain Lake	OK	Greenleaf Lake
CO	Turquoise Lake	OK	Henryetta
CO	Twin Lakes	OK	Holdenville Lake
CO	Upper Klamath Lake Reservoir		

OK	Hugo Lake	UT	Dougherty Basin Reservoir
OK	Hulah Lake	UT	Duck Fork
OK	Lake Atoka	UT	East Canyon Reservoir
OK	Lake Ellsworth	UT	East Fork Sevier River
OK	Lake Lawtonka	UT	Echo Reservoir (Ut)
OK	Lake Murray	UT	Egan State Fish Hatchery
OK	Lake Tenkiller	UT	Electric Lake
OK	Lake Tschida (Heart Butte Reservoir)	UT	Fairview Lake
OK	Meeker Lake	UT	Ferron Reservoir
OK	Okmulgee City Lake	UT	Fish Creek Reservoir (Ut)
OK	Pine Creek Lake	UT	Fish Lake (Ut)
OK	Sardis Lake	UT	Fisheries Experiment Station
OK	Shawnee Twin Lake	UT	Flaming Gorge Reservoir
OK	Stanley Draper Lake	UT	Forsyth Reservoir
OR	Agency Lake	UT	Fountain Green Fish Hatchery
OR	Clear Lake (Or)	UT	Glenwood State Fish Hatchery
OR	Gerber Reservoir	UT	Grantsville Reservoir
OR	Klamath River	UT	Gunlock Reservoir
OR	Lake Ewauna	UT	Gunnison Bend Reservoir
OR	Upper Klamath Lake Reservoir	UT	Gunnison Reservoir
OR	Wilson Reservoir	UT	Hunter Power Plant (Snow Lake)
SD	Angostura Reservoir	UT	Huntington Lake
SD	Belle Fourche (Orman) Reservoir	UT	Huntington Power Plant Pond
SD	Lake Sharpe/Lower Brule	UT	Hyrum Reservoir
SD	Mni Wiconi Water Treatment Plant	UT	Jackson Flat Reservoir
SD	Pactola Reservoir	UT	Joes Valley Reservoir
SD	Shadehill Reservoir	UT	Johnson Reservoir
UT	Barney Lake	UT	Jones Hole Fish Hatchery
UT	Bear Lake	UT	Jordanelle Reservoir
UT	Beaver Dam Reservoir	UT	Kamas Hatchery
UT	Beaver Quarantine Facility (Ut)	UT	Ken's Lake
UT	Big Sandwash Reservoir	UT	Kents Lake
UT	Big Springs Ute Tribe Hatchery	UT	Kolob Reservoir
UT	Blanding	UT	Koosharem Reservoir
UT	Bottle Hollow Reservoir	UT	Labaron Reservoir
UT	Browne Lake	UT	Lake Boreham (Midview Reservoir)
UT	Bullfrog	UT	Last Chance Lakes
UT	Bullock Draw Reservoir	UT	Lee Kay Center Ponds
UT	Chalk Creek	UT	Little Dell Reservoir
UT	Clear Creek River	UT	Lloyd's Lake
UT	Cleveland Reservoir	UT	Long Park Reservoir
UT	Cook Lake	UT	Lost Creek Reservoir
UT	Corn Creek	UT	Lost Lake (Ut)
UT	Cottonwood Reservoir	UT	Lower Bowns
UT	Currant Creek Reservoir	UT	Lower Box Creek Reservoir
UT	Cutler Reservoir	UT	Lower Enterprise Reservoir
UT	Deer Creek Reservoir	UT	Mammoth Creek State Fish Hatchery
UT	Dmad Reservoir	UT	Mammoth Reservoir

UT	Manning Meadow Reservoir	UT	Springville Hatchery
UT	Mantua Fish Hatchery	UT	Starvation Reservoir
UT	Mantua Reservoir	UT	Stateline Reservoir
UT	Matt Warner Reservoir	UT	Steinaker Reservoir
UT	Midway Fish Hatchery	UT	Strawberry Reservoir
UT	Mill Meadow Reservoir	UT	Strawberry Reservoir 19 (Do Not Use)
UT	Millsite Reservoir	UT	Tall Four Reservoir
UT	Minersville Reservoir	UT	Tibble Fork Reservoir
UT	Moon Lake	UT	Tropic Reservoir
UT	Navajo Lake (Ut)	UT	Upper Box Creek Reservoir
UT	Newcastle Reservoir	UT	Upper Enterprise Reservoir
UT	Newton Reservoir	UT	Upper Klamath Lake Reservoir
UT	Nine Mile Reservoir	UT	Utah Lake
UT	North Creek Reservoir	UT	Virgin River
UT	Oak Creek	UT	Wahweap State Fish Hatchery
UT	Otter Creek Reservoir	UT	White River
UT	Ouray Fish Hatchery	UT	White Rocks Fish Hatchery
UT	Palisade Lake	UT	Wide Hollow Reservoir
UT	Panguitch Lake	UT	Willard Bay Reservoir
UT	Paragonah Reservoir	UT	Yankee Meadow Reservoir
UT	Pelican Lake	UT	Yuba Reservoir
UT	Pine Creek	UT-ID	Bear Lake
UT	Pine Lake	UT-WY	Flaming Gorge Reservoir
UT	Pineview Reservoir	WY	Alcova Reservoir
UT	Piute Reservoir	WY	Bighorn Lake
UT	Porcupine Reservoir	WY	Boysen Reservoir
UT	Quail Creek Reservoir	WY	Buffalo Bill Reservoir
UT	Recapture Reservoir	WY	Deaver Reservoir
UT	Red Fleet Reservoir	WY	Flaming Gorge Reservoir
UT	Redmond Lake	WY	Fontenelle Reservoir
UT	Rockport Lake	WY	Glendo Reservoir
UT	Salina Creek	WY	Guernsey Reservoir
UT	Sand Hollow Reservoir	WY	Jackson Lake
UT	Santa Clara River	WY	Keyhole Reservoir
UT	Scofield Reservoir	WY	Ocean Lake
UT	Settlement Canyon	WY	Pathfinder Reservoir
UT	Sheep Creek Reservoir	WY	Seminole Reservoir
UT	Silver Lake Flat Reservoir	WY-MT	Bighorn Lake
UT	Smith And Morehouse Reservoir		
UT	Springville		

**INVASIVE MUSSEL FIELD SAMPLING METHODS****Secchi Depth Reading & Total Water Depth**

- Lower Secchi disk until black and white marking is indistinguishable and record Secchi Depth.
- Lower disk to bottom of sample site and record Total Depth.

**Sampling**

- Record all sample information on Chain of Custody sheet.
- Collect a field-blank at each new waterbody. See full SOP for details.
- Vertical Tow: Use in water deeper than 4 m. Lower plankton tow net vertically from dock or boat to 1 m above maximum depth, and slowly (~1 m/s) pull up.
- Horizontal Tow: Use for shore sampling or flowing water. Throw net as far as possible and estimate distance. Slowly reel in keeping entire opening of net submerged but not dragging along the bottom.
- Collect 5 tows per Sample Site and put in one bottle. (See “Collected Sample” in figure below).  
  - **Note:** Leave room for alcohol. Sample can be swirled around in cod end to condense.

**Preservation**

- Add 15 drops of Tris buffer per 250-500 mL sample OR 0.2 grams of baking soda per 100 mL sample. **Do not add both!**
- Add volume of alcohol equal to 3x volume of Collected Sample (See Figure).
  - **Note:** The final sample that is mailed should have an alcohol concentration of ~70%.
  - **Do not fill bottle past shoulder!** (See “Max Fill Line” in figure below)

**Bottle Labeling**

- Label bottle with: date collected, water body and sample site, tow type (vertical or horizontal), number of tows, and length of tows (use meters for all measurements).

**Net Hygiene**

- Use dedicated nets for any positive waterbody.
- Ideally every waterbody (positive or not) should have its own net.
- Soak net in vinegar between each site and rinse before next sample.

**Water Quality Data**

- Collect as much water quality data as possible using a multiprobe.
- Email water quality data to: **bor-sha-ecolab@usbr.gov**.

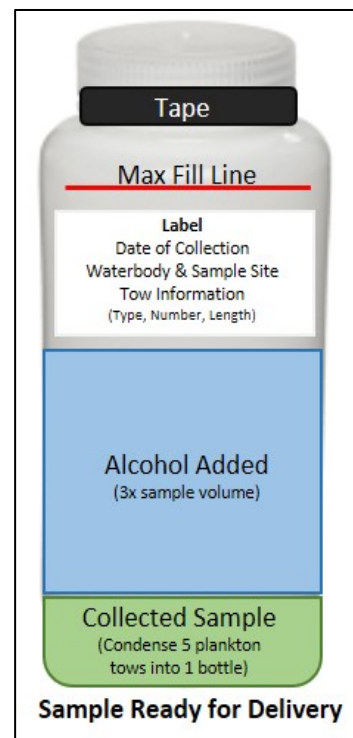
**Shipping**

- Ship samples as soon as possible after collection, ideally within two days of collection.
- Seal bottles with electrical tape and place in a plastic bag.
- Pack sample bottles in a cooler with ice packs, NO WET ICE.

Address: **US Bureau of Reclamation  
Attn: ECOLAB (86-68560)  
1 Denver Federal Center  
Denver, CO 80225**

**Contact Information**

- If you have questions or would like confirmation of cooler arrival email tracking number to: **bor-sha-ecolab@usbr.gov**





Data Sets that Support the Final Report:

- Share Drive folder name and path where data are stored:

[https://doimsp-my.sharepoint.com/:f:/r/personal/jwhitler\\_usbr\\_gov/Documents/FY21%20S%26T%20Research%20Activities/Closeout/Closeout%20for%20Researchers/Project%20Closeout%20Folders/19214?csf=1&web=1&e=mIAhmT](https://doimsp-my.sharepoint.com/:f:/r/personal/jwhitler_usbr_gov/Documents/FY21%20S%26T%20Research%20Activities/Closeout/Closeout%20for%20Researchers/Project%20Closeout%20Folders/19214?csf=1&web=1&e=mIAhmT)

Z:\DO\TSC\Programs\Ecological Research Laboratory\DATA\PROJECTS\Research Office\Eco Lab - FA981 (FY19-21)

- Point of Contact name, email, and phone: Diane Mench, dmench@usbr.gov, 303-445- 2050
- Short description of the data: Pictures, Excel Spreadsheets, Word Documents
- Keywords: Early Detection, Eco Lab, Quagga/Zebra Mussels