Updated Recommendations for the Quagga and Zebra Mussel Action Plan for Western U.S. Waters

(QZAP 2.0)

Zebra mussels
(Dreissena polymorpha)

Quagga mussels
(Dreissena rostriformis bugensis)

September 29, 2020

WESTERN REGIONAL PANEL
ON AQUATIC NUISANCE SPECIES

The Western Regional Panel on Aquatic Nuisance Species

The Western Regional Panel (WRP) on Aquatic Nuisance Species (ANS) was formed in 1997 by a provision in the National Invasive Species Act of 1996 (P.L. 101-636), the amendment to the Nonindigenous Aquatic Nuisance Control and Prevention Act (NANCPA) of 1990. The WRP is an advisory subcommittee of the Aquatic Nuisance Species Task Force and is one of six regional panels on ANS. The WRP is composed of representatives from nineteen western states, four Canadian provinces, federal agencies, tribes, private industries, and non-governmental organizations. The purpose of the WRP is to coordinate ANS efforts in western North America to help limit the introduction, spread, impacts of ANS. The spread of ANS has caused significant economic and ecological problems throughout North America, raising concerns for western aquatic ecosystems and water delivery systems.

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The **Invasive Species Action Network** provides coordination services for the WRP.
Thank you to **Leah Elwell**, Executive Director, and
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The WRP prepared the *Updated Recommendations for the Quagga-Zebra Mussel Action Plan for Western Waters* (QZAP 2.0) to inform ongoing partnership efforts intended to minimize the spread and impacts from zebra and quagga mussels in the western United States. The time, energy, and contributions from the members representing the nineteen western states, four western provinces, federal agencies, private industry, and non-governmental organizations that make up the WRP are invaluable. The original *Quagga Zebra Action Plan for Western U.S.Waters* (QZAP) action items have collectively guided prevention, containment, and management to address the ecological and economic impacts of quagga and zebra mussels since 2009. The accomplishments of the original QZAP are summarized in the *Quagga Zebra Action Plan for Western Waters Status Update Report* (WRP, 2019). The intention of the WRP that drove the creation of the QZAP 2.0 is to provide current detailed and measurable objectives that will further the existing collaborative efforts on invasive mussels and provide a framework to guide WRP members and their partners in decision-making and implementation in the future. The contributors to this document are listed below.

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Introduction

The goal of the WRP is to protect western resources by preventing the introduction and spread of ANS into marine and freshwater systems through coordinated management and research between state, tribal, federal, commercial, environmental, research entities, and the other regional ANS panels.

The WRP is authorized by Congress through NANCPA to be the lead organization for the coordination of ANS efforts in the western United States. Over the last decade, the WRP has facilitated communication and collaboration between jurisdictions across the West to improve the management of invasive zebra and quagga mussels.

The first-time invasive mussels were found west of the 100th Meridian was at Lake Mead National Recreation Area in 2007. Subsequently, in 2008, Senator Dianne Feinstein (CA) requested that the ANS Task Force develop the *Quagga Zebra Action Plan for Western Waters* (QZAP). This task was delegated to the WRP, which created a steering committee and writing committee that collaboratively authored the original QZAP. The ANS Task Force approved it in February 2010.

Figure 1. Geographic scope of the Western Regional Panel on ANS

The QZAP summarized strategies that addressed the zebra and quagga mussel invasion in the West and identified and prioritized specific and comprehensive actions needed to prevent further spread of these mussels, respond to new infestations, and manage existing infestations. The QZAP was to serve as a common set of priorities for water owners, recreational management entities, and their partners.

The WRP has provided opportunities to further the implementation of QZAP. From 2011–2019, the WRP's Building Consensus in the West Workgroup (BC) produced science-based watercraft inspection and decontamination (WID) standards for preventing and containing the overland spread of ANS by recreational watercraft, standards for early detection sampling and monitoring, and laboratory analysis protocols. As part of BC, the National Sea Grant Law Center (NSGLC) and the Association of Fish and Wildlife Agencies (AFWA) published the legal framework for state WID programs. The legal framework includes the Model Legislative Provisions, Model Regulations, Model MOU, and a national comparison report. Members of the WRP and their respective organizations, along with partners of the WRP, have made significant contributions in advancing zebra and quagga mussel management in the West and across the nation.

As more partners engage in the implementation of the QZAP, it continues to be referenced as the "road map" to manage zebra and quagga mussels in the West. After a decade of action, including successes and challenges, it is increasingly important to share past accomplishments to appropriately determine future needs. As such, the WRP published the *Quagga and Zebra Mussel Action Plan for Western Waters: Status Update Report* in 2019. The report compiled relevant information and accomplishments under each original action item and documented the status of progress on each item.

At the same time, the WRP concluded BC and published a final report, *Building Consensus in the West Workgroup: Final Activity Report 2011-2019*. The report details agreements and operational standards produced by western states and federal partners during the decade-long project. The report also references the various legal analyses that were created through partnership.

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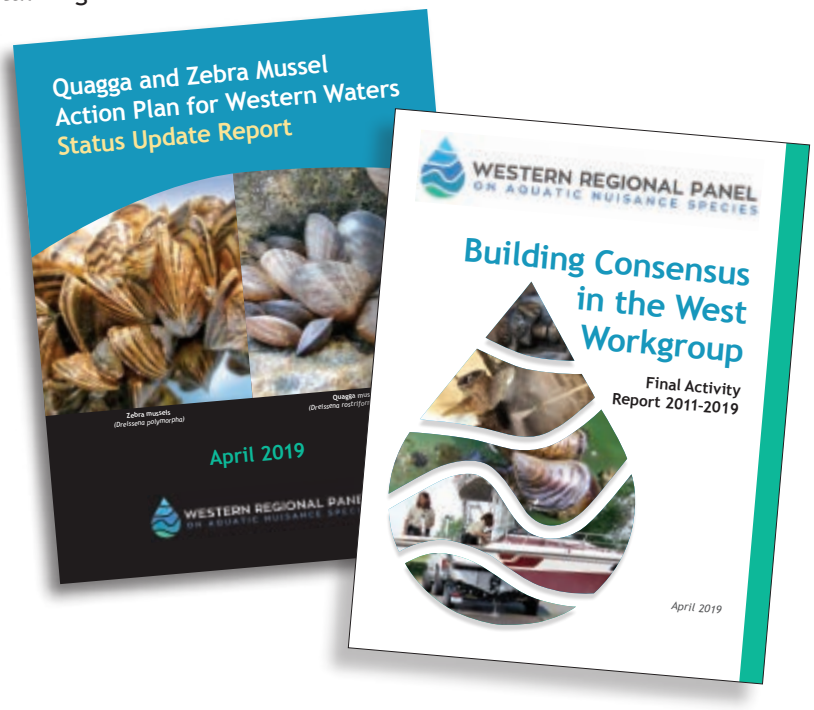
Now is the time for a new road map. By capitalizing on what has been learned, the West must unify under a refined strategic approach so that we may continue to protect the uninfested West from mussels and other invaders. The WRP acknowledges a shared responsibility among jurisdictions for prevention and containment to work in tandem, and the importance of enforcement, rapid response, coordinated monitoring, laboratory quality control, effective communications, and meaningful education and outreach. The QZAP 2.0 documents the unified needs and actions for decision-makers to prioritize resources, increase capacity, and effectively stop the spread of invasive mussels into new waters.



Purpose of the *Updated Recommendations for QZAP* (QZAP 2.0)

The WRP prepared QZAP 2.0 to inform ongoing management and partnership efforts intended to minimize the spread and impacts from zebra and quagga mussels in the western United States.

The original QZAP action items have guided prevention, containment, research, and management to address the ecological and economic impacts of invasive quagga and zebra mussels since 2009. The accomplishments of the original QZAP are summarized in the *Quagga Zebra Action Plan for Western Waters Status Update Report* (WRP, 2019).

The purpose of QZAP 2.0 is to provide a systematic and unified approach to prevent the spread of zebra and quagga mussels into and within the western United States in the future. The urgency and the need for such a coordinated approach remain as important today as ever before. Newly infested waters, increased boating pressure, and gained public and political awareness drove the need for the WRP to acknowledge and learn from the past and set forth a new collective path towards the future. These recommendations are intended to inform decision-making to provide increased capacity and clear direction that empowers the further implementation of a collaborative and coordinated multi-jurisdictional regional strategy to prevent the spread of quagga and zebra mussels in the West.

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The History of QZAP and Related Efforts

In 2007, invasive quagga mussels were detected in Lake Mead National Recreation Area and subsequently in the Colorado River Basin and associated waters. In 2008, Senator Feinstein requested an action plan to identify management options to stop the spread of invasive mussels from the Lower Colorado River into other western waters. The ANS Task Force discussed this request at the Fall 2008 ANS Task Force meeting and decided to delegate plan development to the WRP. The WRP formed two committees, a steering committee and a writing committee, to develop the document over the next year. The WRP submitted the QZAP to the ANS Task Force in October 2009. The document was conditionally approved in November 2009, re-submitted in December 2009, and finalized in February 2010.

The QZAP summarized strategies that addressed the zebra and quagga mussel invasion in the West. The Plan also identified and prioritized specific and comprehensive actions needed to prevent further spread of these mussels, respond to new infestations, and manage existing infestations. New approaches to challenges that zebra and quagga mussels pose in the country were born in the West and have grown into maturity since that time, including watercraft inspection and decontamination, early detection veliger monitoring, and *Clean, Drain, Dry*. These proactive measures have been aimed at stopping the single vector of overland spread by recreational watercraft, alongside a suite of research and control actions. The original QZAP, and now this QZAP 2.0, are intended to serve as the common 'road map' of priorities for water or recreational management entities and their partners.

In 2011, the western state ANS coordinators formed the Western Invasive Species Coordinating Effort (WISCE). The purpose of the WISCE organization is to provide an open dialogue among states regarding ANS management and program implementation. The members coordinate via monthly conference calls and webinars, and at least one in-person meeting each year. They recognize the tremendous distances boaters travel and the value of working together to provide better resource protection against invasive mussels while gaining program efficiencies and maintaining outstanding outdoor recreation opportunities. WISCE's original focus was to engage with and encourage the National Park Service (NPS) to contain quagga mussels at Lake Mead and other infested waters through mandatory WID. This remains a primary focus of WISCE, but has since expanded to encourage all federal agencies that own or manage infested or high priority waters to implement prevention and containment WID.

The WRP members did a comprehensive review of the QZAP in 2013 and determined that the priorities specified in the original document continued to be the highest priorities for western waters and that substantial progress had not yet been achieved. The WRP Chair presented this review to the ANS Task Force, which collectively decided that revising or updating the QZAP was not needed at that time.

The WRP formed its BC Workgroup in 2013 following a workshop held the previous year in Phoenix, Arizona, hosted by NSGLC, Oregon Sea Grant (OSG), the National Association of Attorneys General (NAAG) and the US Fish and Wildlife Service (USFWS). Assistant attorney generals, state law enforcement chiefs, state ANS coordinators, federal agency representatives, and a representative from the Department of the Interior (DOI) Solicitor's Office attended the meeting to better understand legal barriers that were hindering the implementation of mandatory watercraft inspection and decontamination at infested waters per the QZAP.

From 2013 to 2019, WRP's membership engaged in BC, which included extensive facilitated dialogue among state ANS coordinators and the NPS, to develop a model legal framework and science-based standards for implementing state WID programs. In addition to the legal framework, this multifaceted partnership made tremendous progress, including the development of standards for early detection field monitoring, laboratory procedures, WID protocols and procedures, training, quality control, data sharing, and communications. The *Building Consensus in the West Workgroup: Final Activity Report 2011-2019* (WRP, 2019) details the agreements and operational standards produced by western states and partners during the project. The report also references the various legal analyses that were conducted in partnership and provides links to all relevant publications.

The 2014 Water Resources Reform and Development Act (WRRDA) directed the US Army Corp of Engineers (USACE) to engage in the Columbia River Basin (CRB) ANS programs, provided support to existing WID stations, assisted in the development of new WID stations, and established a rapid response fund. This funding also supported ANS monitoring programs in the four Pacific Northwest states. In 2018, Congress expanded the WRRDA authorization to include the Upper Missouri, Upper Colorado, South Platte, and Arkansas River basins.

From 2017–2020, the DOI embarked on its Safeguarding the West (STW) Initiative intended to bolster efforts to combat zebra and quagga mussels in the West and strengthen partnerships between federal, state, and tribal agencies working collectively on invasive mussel prevention and containment. Many WRP members contributed to the six committees that formulated the STW action plan and worked on its implementation.

The Western Governors' Association (WGA) engaged with DOI and the western states on STW and numerous other projects related to invasive species. In 2018, the WGA embarked on its Biosecurity and Invasive Species Initiative, highlighting zebra and quagga mussels as an important threat to western states.

The WRP Executive Committee elected to participate in the development of WGA's Invasive Mussel Leadership Forum and engaged in regular dialogue with WGA and DOI, in addition to providing leadership for the forum's planning committee. The forum was originally planned for January 2019 but was rescheduled because of a partial government shutdown and later held in August 2019 in Las Vegas, Nevada.

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Through these efforts, a long-awaited increase in federal dollars and overall engagement has been realized which has bolstered state invasive mussel activities across the West. Given the numerous partners engaged and to utilize funding to the best extent possible, a strategic federal funding system should be developed in coordination with state agencies to ensure resources are being leveraged efficiently and addressing the highest priorities.

To provide current information relevant to ongoing dialogues with USACE, DOI, WGA, and other partners, the WRP published the *Quagga and Zebra Mussel Action Plan for Western Waters: Status Update Report* in April 2019. The report compiled relevant information and accomplishments under each original action item and documented the status of western progress on each item.

Following the publication of the *Quagga and Zebra Mussel Action Plan for Western Waters: Status Update Report* and *Building Consensus in the West Workgroup: Final Activity Report 2011-2019*, the WRP began working to develop the QZAP 2.0 updated recommendations to inform future management.

Significant Moments in the History of Zebra and Quagga Mussels in the West

- **1993**—Oklahoma reports first zebra mussel infestation in the West.
- **1993**—California makes its first interception of a mussel infested watercraft at the Needles WID Border Protection Station.
- **1997**—The WRP is formed.
- **1999**—The Pacific States Marine Fisheries Commission (PSMFC) begins the ANS Education and Prevention Program.
- **2001**—The first meeting of the 100th Meridian Initiative's Colorado River Basin Team.
- **2003**—The first meeting of the 100th Meridian Initiative's Columbia River Basin (CRB) Team.
- **2003**—Kansas detects infestation of zebra mussels.
- **2004**—The first meeting of the 100th Meridian Initiative's Missouri River Basin Team.
- **2005**—Montana's WID Program begins.
- **2006**—PSMFC begins watercraft inspection training (WIT) at Lake Mead.
- **2007**—Quagga mussels discovered in Lake Mead.
- **2007**—Utah's WID Program begins.
- **2008**—Colorado's WID Program begins.
- **2008**—Zebra mussels discovered in San Justo Reservoir, California.
- **2008**—Senator Feinstein (CA) requests that the ANS Task Force draft the Quagga Zebra Action Plan for Western Waters (QZAP). The WRP was tasked with developing the QZAP and formed a steering committee and writing committee of members to complete the document.
- **2008**—Lake Tahoe WID Program begins.
- **2009**—Wyoming's WID Program begins.
- **February 2009**—Colorado publishes the *ANS Watercraft Inspection and Education Handbook*.
- **September 2009**—PSMFC publishes the *Recommended Uniform Minimum Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States* (UMPS I; Zook and Phillips).
- **November 2009**—The WRP presented the draft QZAP to the ANS Task Force, which was conditionally approved pending incorporation of additional edits requested.
- **February 2010**—The ANS Task Force approves the QZAP.
- **2010**—Congress begins appropriating funding to USFWS for the implementation of the QZAP.
- **June 2011**—Colorado publishes the *ANS Watercraft Decontamination Manual*.
- **September 2011**—WISCE forms to unite states in a common fight against zebra and quagga mussels and to coordinate state programs.
- **October 2011**—The USFWS shifts coordination obligations directly to the WRP. Subsequently, the WRP hires a full-time coordinator.
- **January 2012**—PSMFC publishes the *Uniform Minimum Protocols and Standards for Watercraft Interception Programs for Dreissenid Mussels in the Western United States* (UMPS II; Zook and Phillips).
- **January 2012**—Colorado publishes the *Boat Compendium for ANS Inspectors*.
- **2012**—WISCE scopes out Regional WID Data Sharing System specifications. Colorado Parks and Wildlife (CPW) moves forward with adapting its system for regional use.
- **2012**—WISCE meets jointly with federal partners at WRP in Salt Lake City UT to specifically discuss early detection discrepancies which result in a Reclamation notification policy.
- **August 2012**—The *Legal and Regulatory Efforts to Minimize Expansion of Invasive Mussels through Watercraft Movements—a Co-Learning Workshop* is held in Phoenix, AZ.
- **2013**—New Mexico's WID Program begins.
- **2013**—Quagga mussels are discovered in Lake Powell in Glen Canyon National Recreation Area.
- **August 2013**—The first BC meeting is held in Denver.
- **September 2013**—Colorado publishes the *Containment Manual for WID Stations*.
- **September 2013**—WISCE meets to review BC I agreements (e.g. water body definitions, listing and de-listing standards) at the WRP Annual Meeting in Portland, OR.
- **January 2014**—CO, NM and UT pilot data sharing and use of the new Regional WID Data Sharing System.

- **January 2014**—CO and UT become the first states to de-list waters following five years with no detections according to BC definitions and standards.
- **February 2014**—The second BC meeting is held in Denver.
- **March 2014**—PSMFC's WIT incorporates the *Regional WID Training Curriculum* developed through a BC subcommittee.
- **March 2014**—CPW hosts the first Advanced Decontamination course at Lake Pueblo State Park.
- **April 2014**—CPW hosts the first WID Trainer Training course at Chatfield State Park with PSMFC, AZ, and WY.
- **April 2014**—NSGLC and AFWA publishes the *Model Legislative Provisions to Promote Reciprocity Among State WID Programs*.
- **September 2014**—WISCE dedicates their annual meeting to the BC Workgroup at WRP's Annual Meeting in Houston, TX.
- **October 2014**—Congress passes WRRDA, which authorizes WID in the CRB.
- **January 2015**—The American Boat and Yacht Council (ABYC) and the National Marine Manufacturers' Association (NMMA) host the Industry Summit on ANS and WID in Las Vegas.
- **August 2015**—The National Invasive Species Council (NISC) and the ANS Task Force publish the *Federal Policy Options Addressing the Movement of AIS Onto and Off of Federally Managed Lands and Waters*.
- **October 2015**—WISCE dedicates their annual meeting to the BC workgroup at WRP's Annual Meeting in Lake Tahoe, NV.
- **2016**—Evidence of quagga mussels detected in Tiber and Canyon Ferry Reservoirs in Montana.
- **2016**—The watercraft movement notice is deployed in the *Regional WID Data Sharing System* with AZ and NV participating to alert states that infested watercraft are in transit.
- **2016**—The Tahoe Regional Planning Agency joins the Regional WID Data Sharing System.
- **February 2016**—CPW and PSMFC publish the *Student Training Curriculum for Watercraft Inspectors and Decontaminators* and the *Trainer's Manual for WID Certification Courses*.
- **April 2016**—The third BC meeting is held in Denver.
- **July 2016**—The Western Association of Fish and Wildlife Agencies (WAFWA) passes a resolution recommending states require the removal of water drain plugs and aquatic vegetation from watercraft and conveyances prior to overland transport.
- **August 2016**—PSMFC publishes the *Uniform Minimum Protocols and Standards for Watercraft Inspection and Decontamination* (UMPS III, Elwell and Phillips).
- **September 2016**—Congress reauthorizes WRRDA, adding monitoring and rapid response to WID in the CRB.
- **October 2016**—WISCE meets jointly with WAFWA's Aquatic Invasive Species Workgroup members at WRP's Annual Meeting in Jackson Hole, WY.
- **December 2016**—NSGLC and AFWA publish *Model Regulations for State WID Programs*.
- **January 2017**—The National Wildfire Coordinating Group published the *Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations*.
- **January 2017**—CPW de-lists Lake Pueblo State Park in Colorado, following five years with no detections per BC guidelines.
- **April 2017**—NSGLC published the national legal gap analysis titled *From Theory to Practice: A Comparison of State WID Programs to the Model Legal Framework*.
- **June 2017**—DOI announced its *Safeguarding the West Initiative* to strengthen collaborations with the Western Governors' Association, states, tribes, and other federal agencies to prevent, contain, and control quagga and zebra mussels in western waters.
- **April 2017**—The BC IV meeting is held in Albuquerque, New Mexico.
- **October 2017**—The ANS Task Force and the WRP Annual Meetings are cancelled as a result of the Department of Interior's review of its federal advisory committees.
- **November 2017**—The Advanced Decontamination course is held at Lake Mead.
- **December 2017**—BLM convenes an inter-agency workshop at Lake Havasu in Arizona to develop a multi-jurisdictional strategy for the Lower Colorado River from Lake Havasu downstream.
- **2017-2018**—The USFWS QZAP grant provides funding to CPW for the Regional WID Data Sharing System (current users include AZ, CO, NM, NV, MT, WA, WY, UT, Tahoe, local waters in CA, and several National Parks).

- **May 2018**—PSMFC publishes *A Review of Chemical Use Associated with Watercraft Decontamination to Address Aquatic Invasive Species; A special supplement to UMPS* (Elwell and Phillips, 2018).
- **July 2018**—ABYC publishes the *Technical Information Report on AIS* (T-32).
- **September 2018**—ABYC hosts the 2nd Invasive Mussel Marine Industry Summit in Baltimore, Maryland.
- **July-December 2018**—WGA conducts *Biosecurity and Invasive Species Initiative*.
- **October 2018**—WRP publishes the *Dreissenid Mussel Field Sampling and Monitoring Protocol* and the *Laboratory Standards for Dreissenid Veliger Analysis*.
- **October 2018**—Congress passes the 2018 Water Resources Development Act (WRDA-18) which authorizes WID, monitoring, and rapid response in the Columba, Upper Colorado, South Platte, Upper Missouri, and Arizona [sic] (corrected to Arkansas) river basins.
- **October 2018**—Reclamation funds the Regional WID Data Sharing System for 2019.
- **December 2018**—NSGLC publishes the *Model MOU for WID Programs*.
- **January 2019**—WISCE meets in Denver to develop the *QZAP Status Update Report* and conclude the WRP *Building Consensus in the West Workgroup Final Summary Report*.
- **April 2019**—WRP publishes the *QZAP Status Update Report*.
- **April 2019**—WRP publishes the *Building Consensus in the West Workgroup: Final Activity Report*.
- **April 2019**—WRP publishes standard specifications for *Trailered Mobile Decontamination Units and On-Demand Tankless Water Heater Decontamination Systems*.
- **May 2019**—Lake Tahoe Regional Planning Agency hosts the ANS Task Force spring meeting on behalf of the WRP. The WRP presents the *QZAP Status Update Report* and the *Building Consensus in the West Workgroup: Final Activity Report* and proposes to the ANS Task Force that these *Updated Recommendations for the QZAP* (QZAP 2.0) be completed.

- **August 2019**—WGA holds the Leadership Summit on Zebra and Quagga Mussels in Las Vegas, NV.
- **September 2019**—WRP publishes the *Aquatic Nuisance Species Inspection Procedures for Amphibious Aircraft*.
- **October 2019**—The USFWS QZAP grant funds the Regional WID Data Sharing System for 2020.
- **October 2019**—WRP and WISCE meet in Missoula, MT.
- **December 2019**—NSGLC publishes the *Comparative Analysis of Watercraft Inspection and Decontamination Requirements along the Lower Colorado River*.
- **December 2019**—US Senators Bennet (CO), Daines (MT) and Tester (MT) introduce the *Stop the Spread of Invasive Mussels Act of 2019*.
- **February 2020**—Montana de-lists Canyon Ferry as no evidence of mussels were found per BC guidelines.
- **February 2020**—WISCE meets in Denver, CO to develop this QZAP 2.0.
- **March 2020**—US Representatives McAdams (UT) and Tipton (CO) introduce the *Stop the Spread of Invasive Mussels Act of 2020*.
- **June 2020**—WRP's Executive Committee approved updated WID standard protocols developed by the Decon Think Tank Committee—*Exit Inspection at Containment Waters*, *Exit Inspection at Prevention Waters*, *Incoming Inspections or Roadside Inspections*, and a *COVID Guidance Document for WID Stations*.
- **July 2020**—Alaska's WID program begins at the US-Canadian border after a three-year pilot study.
- **September 2020**—WRP approves updates to the *Dreissenid Mussel Field Sampling and Monitoring Protocol*, the *Laboratory Standards for Dreissenid Veliger Analysis*, and the *Inspection Procedure for Amphibious Aircraft*.
- **September 2020**—WRP publishes this *QZAP 2.0*.

The Problem: Zebra and Quagga Mussels

ANS threaten the diversity and abundance of native species, the ecological stability of infested waters, and water-dependent commercial, agricultural, aquaculture, and recreational activities. The zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena rostriformis bugensis*), collectively referred to as zebra and quagga mussels (ZQM), are among the most devastating ANS to invade North American freshwaters. Once established, these mussels can clog water intake and delivery pipes, infest hydropower infrastructure, adhere to watercraft and pilings, foul recreational beaches, and inflict many other costly problems. As a result, ZQM significantly impacts water supply and distribution infrastructure for municipal, industrial, and agricultural uses, as well as fisheries and all forms of water-based recreation. Their ecological legacy in the East has included competition with native mussels, disruption of food webs, and bioaccumulation of toxins. The invaders are creating similar problems in the western waters where they have become established, putting the long list of imperiled fish and other aquatic life at an even greater risk.

The first zebra mussel detection within the western region was in Oklahoma in 1993, before the WRP was formed in 1997. While Kansas detected zebra mussels in the Missouri River in 2001, it was not until a 2003 infestation in the El Dorado Reservoir that western states took notice.

Quagga

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Zebra

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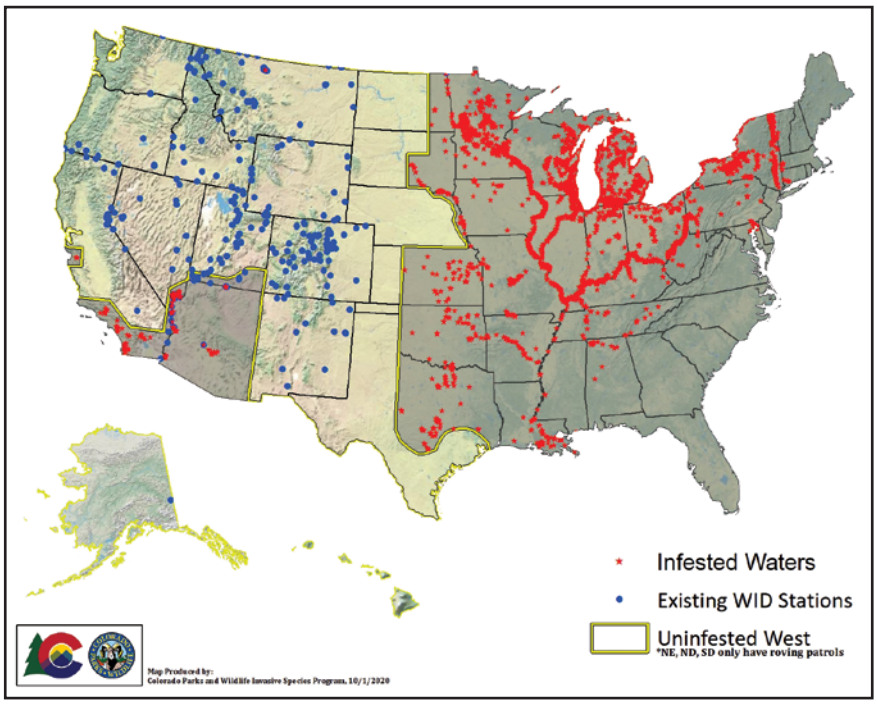
The first coordinated western efforts to prevent ZQM fell under the USFWS's 100th Meridian Initiative, which was endorsed by WRP. Watershed level basin teams for the 100th Meridian Initiative included state, federal, and university partners. The Colorado River Basin Team was the first to form in 2001 but was not supported and is not active today. The Columbia River Basin (CRB) Team and the Missouri River Basin Team were established in 2003 and 2004, respectively. Both are still active today and are coordinated by the PSMFC with funding from the USFWS. Other basin teams were formed over time, but none were sustained.

The USFWS funded 100th the Meridian Initiative activities which included boater surveys conducted by state agencies and enabling the University of Texas-Arlington to develop a national database and website for boater surveys. WRP funding between 2007 and 2011 provided grants which supported boater surveys, the development of state management plans, risk assessments, and other ZQM-related research projects.

Figure 2. The Uninfested West



When quagga mussels were found in Lake Mead in 2007, the West united and mobilized to prevent the introduction and spread of ZQM to additional waters. This unification of effort has been beneficial and continues to be relevant for successful management. ZQM has yet to be detected in the vast majority of western waters, which presents important opportunities to prevent significant damage if greater coordinated action is taken immediately. Without a coordinated multi-jurisdictional strategy, ZQM will cause

The Uninfested West describes efforts to prevent spread of ZQM from infested waters (marked in red) with the use of coordinated prevention and containment WID programs (marked in blue).

irreparable ecological damage to western waters, and costs will be in the billions of dollars.

The WRP places high importance on preventing and controlling ZQM to protect invaluable aquatic resources as well as sustained recreation and tourism industries, water storage and distribution systems, agricultural production, and the West's overall economy. Over the last decade, the WRP has provided a productive forum for communication and collaboration among agencies tasked with preventing the spread of ZQM via recreational activities. The WRP formed a workgroup in 2018 focused on seaplanes and other aquatic aircraft. Members worked alongside seaplane pilots and private industry to develop the ANS Inspection Procedure for Aquatic Aircraft. WRP members are currently engaged in the ANS Task Force's Prevention Subcommittee which is conducting a nationwide risk assessment on seaplanes to better inform inspection and decontamination requirements on aquatic aircraft in the future. WRP members are also collaborating with the boating and marine industry to seek public-private, non-regulatory solutions to mitigate ZQM spread on recreational watercraft, such as utilizing innovations in boat design.

Preventing the spread of ZQM and other ANS requires indefatigable cooperation and coordination between federal, state, county, and municipal governments, districts, marina operators, private entities, and recreationists. There are currently no proven methods to control the downstream movement of ZQM veligers in natural environments. The WRP encourages water providers, including hydroelectric and irrigation facilities, to conduct infrastructure risk assessments and implement preventive measures to reduce the risk of transport through, and invasion of, water distribution systems.

When QZAP was approved by the ANS Task Force in 2010, there were 64 infested waters within the WRP boundary, but by 2020, that number had more than doubled (USGS 2020)[1].). While significant strides have been made, infestations continue to colonize locations that do not have any protections in place. The QZAP 2.0 is a call to all partners to work together across boundaries and coordinate efforts to stop the spread of invasive mussels into new areas.

Due to the multi-jurisdictional nature of western waters, the QZAP 2.0 action items may apply to various organizations; no single entity is responsible for, or capable of, implementing all of the necessary actions needed to protect waters from invasive mussels and other ANS.

1 US Geological Survey Nonindigenous Aquatic Species Database (NAS), Gainesville, FL. http://nas.er.usgs.gov; Accessed September 2020.

Updated Strategies and Action Items for Implementation of QZAP 2.0

The following strategies and action items have been identified by the members of the WRP as priorities to prevent further spread of invasive mussels in the Western United States in the future.

A. Increasing Capacity to Prevent and Manage Zebra and Quagga Mussels

A.1.—Increase funding for the Western Regional Panel on ANS to serve as the main coordinating body for quagga and zebra mussel communication, collaboration, and management in the West; and to create a full-time position to coordinate the implementation of QZAP 2.0 (subject to appropriations and authorities).

A.2.—Establish long-term stable sources of multi-year funding to support the implementation of these recommendations in QZAP 2.0.

A.3.—States should maintain, increase, and/or establish authorities for mandatory WID through the passage of laws and regulations to fill gaps per the **Model Legal Framework** (NSGLC and AFWA, 2019) and associated **Building Consensus** agreements, operational procedures, protocols, and standards (WRP, 2019).

A.4.—States should establish or increase capacity for the implementation of WID and the associated **Building Consensus** operational procedures, protocols, and standards.

A.5.—Federal agencies should resolve gaps in legal authority and consider options to more effectively reduce the movement of aquatic invasive species onto and off of federal water and to more effectively coordinate with state programs." (Federal Policy Options: Addressing the Movement of Aquatic Invasive Species Onto and Off of Federal Lands and Waters, NISC/ANSTF, 2015).

A.6.—Develop a strategic federal funding system (subject to appropriate authorities and appropriations) in coordination with state agencies to ensure resources are being leveraged efficiently and address the highest priorities.

A.7.—Engage with tribal resource managers to build capacity for ZQM management and collaborate with tribes on the implementation of QZAP 2.0.

A.8.—Continue to support and coordinate the Columbia River Basin Team and the Missouri River Basin Team to further the multi-jurisdictional implementation of QZAP 2.0 in those basins.

A.9.—Establish, support, and coordinate new basin teams and plans focused on cross-jurisdictional prevention and containment strategies for the implementation QZAP 2.0.

A.10.—Develop a process and/or mechanism to evaluate and test new technologies related to watercraft inspection and decontamination, boat movement, data sharing, communications, reporting, early detection, control, and management. Create a formalized process for methodologies to gain approval for use.

B. Prevention and Containment

B.1.—Implement or continue implementing mandatory WID for watercraft exiting positive and infested waters following the **WRP inspection protocols for containment**.

B.2.—Establish new or continue existing WID stations on highways to provide a layer of protection between infested waters in the **Colorado River Basin** and the Unifested West.

B.3.—Continue and potentially expand upon the WID strategy in place to protect the **Columbia River Basin**.

B.4.—Protect the Uninfested West through the coordinated implementation of WID stations on highways and at high priority prevention water bodies across the West.

B.5.—Implement mandatory WID at the main points of entry (land, sea, and air) into Alaska as the first line of defense to protect waters in the state.

B.6.—Promote consistent use of the Regional WID Data Sharing System by all jurisdictions conducting WID for data collection and communication between WID stations and ANS managers.

B.7.—Upgrade decontamination units to on-demand hot water systems (where appropriate) per the approved WRP specifications.

B.8.—Adopt the WRP standard watercraft inspection and decontamination protocols among western agencies.

B.9.—Refine existing watercraft and equipment inspection and decontamination protocols and standards, as needed.

B.10.—Implement compatible law enforcement approaches across state, federal, tribal, and local jurisdictions that support mandatory WID and other ANS management efforts.

B.11.—Develop and implement programs to inspect, decontaminate, and intercept contaminated equipment (e.g. barges, dam repair equipment, construction equipment).

B.12.—Develop and implement programs to inspect, decontaminate, and intercept commercially hauled watercraft or conveyances.

B.13.—Ensure quality control at WID stations in accordance with **Building Consensus**.

B.14.—Support the **Regional WID Training Program** administered by the Pacific States Marine Fisheries Commission.

B.15.—Adopt and implement the National Wildfire Coordinating Group protocols within the **Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations**.

B.16.—Continue, expand, and promote partnerships between managing agencies and the marine industry, specifically the National Marine Manufacturers Association, American Boat and Yacht Council, Watersports Industry Association, and BoatUS, to implement the Technical Information Report (T-32) on AIS.

B.17.—Alter and/or improve the design, engineering, and manufacturing of ballast tanks, inboard engines, inboard/outboard engines, and new watercraft to eliminate or reduce the probability of quagga or zebra mussels and other ANS from being transported in recreational watercraft, and to make it easier and safer to inspect and decontaminate watercraft compartments and propulsion systems.

B.18.—Continue, expand, and promote the use of Best Management Practices and Hazardous Analysis and Critical Control Point Planning to reduce the spread of ANS during natural resource management activities.

C. Early-Detection Monitoring for Zebra and Quagga Mussels

C.1.—Adopt WRP *Dreissenid Mussel Field Sampling and Monitoring Protocol* and the *Laboratory Standards for Dreissenid Veliger Analysis*.

C.2.—Expand early-detection monitoring programs to western waters at risk for zebra and quagga mussel introduction, following WRP protocals.

C.3.—Expand laboratory expertise and capacity to provide dreissenid analytical services.

C.4.—Develop field protocols, lab standards, and management support tools for early-detection monitoring using eDNA.

C.5.—Develop and implement a standard training and certification program for field sampling and monitoring staff and laboratory technicians performing early detection analysis for invasive mussels and other ANS.

C.6.—Report dreissenid monitoring results to the USGS NAS database for all agencies/entities collecting data.

C.7.—Create a western sampling location web map and database applicable to all western agencies to promote the coordination of monitoring efforts and early detection surveys.

C.8.—Host an annual monitoring coordination forum to communicate activities, results, and collaborate on priorities to leverage capacity and coverage and avoid duplication.

C.9.—Establish an MOU which clarifies roles and responsibilities between state and federal agencies concerning early detection monitoring results for management; including communications, notifications, public release of information, and online databases, and distinguishes between collections for research versus management purposes.

D. Rapid Response

D.1.—Create and maintain a sustainable rapid response fund (subject to appropriate authorities and appropriations) for zebra and quagga mussels in western states.

D.2.—Develop and maintain rapid response plans for all western states and major basins.

D.3.—Conduct rapid response training in the Arkansas, Upper Colorado, Lower Colorado, Upper Missouri, Platte, and Great Basins, and in Alaska, modeled after the previous CRB trainings.

D.4.—Create an Endangered Species Act (ESA) manual for rapid response in the western basins named in D.3.; modeled after the CRB ESA Manual published in 2019.

E. Research for Control and Management

E.1.—Develop a standardized risk assessment model for invasive mussels in western waters that takes into account both the risk of introduction by watercraft, as well as examines water quality to determine both the probability of establishment and reproduction within the water. Include a decision tree based on risk that helps direct financial resources for management and control.

E.2.—Conduct a western traffic assessment to determine the interstates, highways, roads, or travel corridors that are most commonly used by boaters traveling from infested areas into the uninfested West to inform the strategic placement of roadside WID stations in new basins or areas.

E.3.—Conduct and support social science research to evaluate existing ANS educational campaigns and informational messaging currently in use across the West that target boaters (e.g., Stop Aquatic Hitchhikers, Play Clean Go, Clean Drain Dry, Pull the Plug, and state-specific campaigns) and clearly identify which campaigns, messages, and delivery methods are most effective in both raising initial awareness and achieving subsequent behavior change.

E.4.—Continue to develop and evaluate environmentally friendly and cost-effective tools to manage invasive mussel infestations in open water systems, specifically large reservoirs.

E.5.—Update the research priorities list from *Dreissenid Mussel Research Priorities Workshop* (Portland State University, 2015).

E.6.—Continue to evaluate the impacts (acute and chronic) of control and management tools (e.g. chemical treatments, non-chemical treatments) on non-target organisms, in particular, those listed as threatened or endangered.

E.7.—Conduct research to better understand how human behavior influences the spread of mussels and other invasive species.

E.8.—Coordinate research, control, and management with the ANS Task Force and their Research Subcommittee to meet western priorities.

F. Outreach and Education

F.1.—Following the completion of E.3., promote the use of consistent, effective messaging and enhance coordination of efforts to support the achievement of desired behavior change across the western region.

F.2.—Following the completion of E.3. and E.7., develop (if necessary) or update outreach materials and delivery methods (e.g. print, social media, etc.) and make them available in digital formats that can be tailored to specific jurisdictions.

F.3.—Conduct a standardized, regional, multi-state, survey of motorized boaters in the West to determine if a correlation exists between current WID processes, compliance, and customer experience; make improvements accordingly, evaluate and reassess compliance and customer experience to determine where improvements can be made to incentivize compliance.

F.4.—Develop messaging for states in other regions to communicate western WID requirements and procedures with boaters before they travel to western states.

F.5.—Effectively use and evaluate social and multi-media platforms to share consistent messaging campaigns.

F.6.—Coordinate consistent implementation of the ANS Task Force *Voluntary Guidelines to Prevent the Introduction and Spread of Aquatic Invasive Species: Recreational Activities*.

F.7.—Coordinate information, education, and outreach with the ANS Task Force and their Education Subcommittee to meet western priorities.

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Evaluation

The following evaluation measures will be utilized to determine progress and track the implementation and status of the action items recommended in this document. Historically, the WRP members submit updates annually as a part of the WRP Annual Business Meeting. In the future, members and partners may be asked to provide updates specifically related to achieving these action items.

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QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
Strategy A—Increase Capacity to Prevent and Manage Invasive Mussels		
A.1	Increase funding for the Western Regional Panel on ANS to serve as the main coordinating body for quagga and zebra mussel communication, collaboration, and management in the West; and to create a full-time position to coordinate the implementation of QZAP 2.0 (subject to appropriations and authorities).	Annual funding in FY22 and beyond = $150,000
A.2	Establish long-term stable sources of multi-year funding to support the implementation of these recommendations in QZAP 2.0.	Legislative language or agency policy establishing multi-year agreements to support ongoing operations related to the implementation of QZAP 2.0
A.3	States should maintain, increase, and/or establish authorities for mandatory WID through the passage of laws and regulations to fill gaps per the Model Legal Framework (NSGLC and AFWA, 2019) and associated Building Consensus agreements, operational procedures, protocols, and standards (WRP, 2019).	An increase in the number of states with the authorities outlined in the Building Consensus Model Legal Framework.
A.4	States should establish or increase capacity for the implementation of WID and the associated Building Consensus operational procedures, protocols and standards.	An increase in the number of permanent employees dedicated to ANS, including law enforcement. Increased state budget allocations for WID stations and monitoring with the ability to match federal grants.
A.5	Federal agencies should resolve gaps in legal authority and consider options to more effectively reduce the movement of aquatic invasive species onto and off of federal water and to more effectively coordinate with state programs." (Federal Policy Options: Addressing the Movement of Aquatic Invasive Species Onto and Off of Federal Lands and Waters, NISC/ANSTF, 2015).	Congress passes the Stop the Spread of Invasive Mussels Act or other relevant legislation, regulation, policy, or MOU implemented by the federal government.
A.6	Develop a strategic federal funding system (subject to appropriate authorities and appropriations) in coordination with state agencies to ensure resources are being leveraged efficiently and address the highest priorities.	An established federal funding system developed and implemented cooperatively with states.
A.7	Engage with tribal resource managers to build capacity for ZQM management and collaborate with tribes on the implementation of QZAP 2.0.	An increase in the number of engagement activities with tribes and the number of established partnerships.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
A.8	Continue to support and coordinate the Columbia River Basin Team and the Missouri River Basin Team to further the multi-jurisdictional implementation of the QZAP 2.0 in those basins.	Continuous annual funding of at least $100,000 per basin team to support a minimum of two meetings a year (with full travel support for state participants) and including a monitoring forum. An increase in the number of rapid response exercises.
A.9	Establish, support, and coordinate new basin teams and plans focused on cross-jurisdictional prevention and containment strategies for the implementation QZAP 2.0.	Increased number of basin teams and basin plans (up to the eight major basins). Continuous annual funding of $100,000 per basin team to support coordination, communications, at least one meeting per year, a monitoring forum, rapid response exercises, with full travel support for state participants.
A.10	Develop a process and/or mechanism to evaluate and test new technologies related to watercraft inspection and decontamination, boat movement, data sharing, communications, reporting, early detection, control, and management. Create a formalized process for methodologies to gain approval for use.	Established processes and a formal partnership with a third-party independent testing and certification entity, which includes evaluation criteria and approval mechanisms for broad adoption, evaluation, and improvement over time.
Number	**Action Item**	**Evaluation Measures**
Strategy B—Prevention and Containment		
B.1	Implement or continue implementing mandatory WID for watercraft exiting positive and infested waters following the WRP inspection protocols for containment.	An increase in mandatory WID programs at infested waters; an increase in the number of agencies utilizing the Building Consensus guidance; an increase in the number of agencies following the Regional WID Student Curriculum and approved WRP inspection and decontamination procedures; an increase in the number of agencies following the Regional WID Trainer's Manual; an increase in the number of boats being entered into the Regional WID Data Sharing System from infested waters; an increase in the number of law enforcement contacts at infested waters; and a reduction in the number of mussel-impacted watercraft intercepted at other locations.
B.2	Establish new or continue existing WID stations on highways to provide a layer of protection between infested waters in the Colorado River Basin and the Uninfested West.	An increase in the number of roadside WID stations in the Colorado River Basin; an increase in the number of boats being entered into the Regional WID Data Sharing System; an increase in the number of inspections, decontaminations, and interceptions leaving infested waters; and an increase in the number of law enforcement contacts.
B.3	Continue and potentially expand upon the WID strategy in place to protect the Columbia River Basin.	WID station network remains in place at 2020 levels or expanded as directed by the states.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
B.4	Protect the uninfested West through the coordinated implementation of WIDS on highways and at high priority prevention water bodies across the West.	An increase in the number of mandatory WID programs; an increase in the number of agencies utilizing the Building Consensus guidance; an increase in the number of agencies following the Regional WID Student Curriculum and approved WRP inspection and decontamination procedures; an increase in the number of agencies following the Regional WID Trainer's Manual; an increase in the number of boats being entered into the Regional WID Data Sharing System; an increase in the number of law enforcement contacts at infested waters; and a reduction of the number of mussel-impacted watercraft intercepted at other locations.
B.5	Implement mandatory WID at the main points of entry (land, sea, and air) into Alaska as a first line of defense to protect waters in the state.	An increase in the number of WID stations, inspections, decontaminations, and interceptions entering Alaska. An increase in agencies in Alaska using the Regional WID Data Sharing System.
B.6	Promote consistent use of the Regional WID Data Sharing System by all jurisdictions for data collection and communication between WID stations and ANS managers.	Maintain continued funding and uninterrupted operations over time. Increase in the number of users until all WID stations fully use the system regardless of jurisdiction. An increase in the number of data points per year for inspection/decontamination/interception.
B.7	Upgrade decontamination units to on-demand hot water systems where appropriate per the approved WRP specifications.	An increase in the number of hot water decontamination units upgraded or purchased new in accordance with WRP decontamination unit specifications (2019).
B.8	Adopt the WRP standard watercraft inspection and decontamination protocols among western agencies.	An increased number of agencies conducting WID following WRP standards and the regional training program.
B.9	Refine existing watercraft and equipment inspection and decontamination protocols and standards, as needed.	The WRP maintains an engaged and active Decon Think Tank committee for discussions on new watercraft and refinement of procedures as needed.
B.10	Implement compatible law enforcement approaches across state, federal, tribal, and local jurisdictions that support mandatory WID and other ANS management efforts.	An increase in the number of citations issued; an increase in the number of warnings issued; an increase in the number of law enforcement hours spent on ANS; an increase in the number of law enforcement contacts with members of the public regarding ANS.
B.11	Develop and implement programs to inspect, decontaminate, and intercept contaminated equipment (e.g. barges, dam repair equipment, construction equipment).	The development of programming intended to intercept contaminated equipment. An increase in the number of outreach events to related industries. Increased numbers of equipment inspected and/or decontaminated.

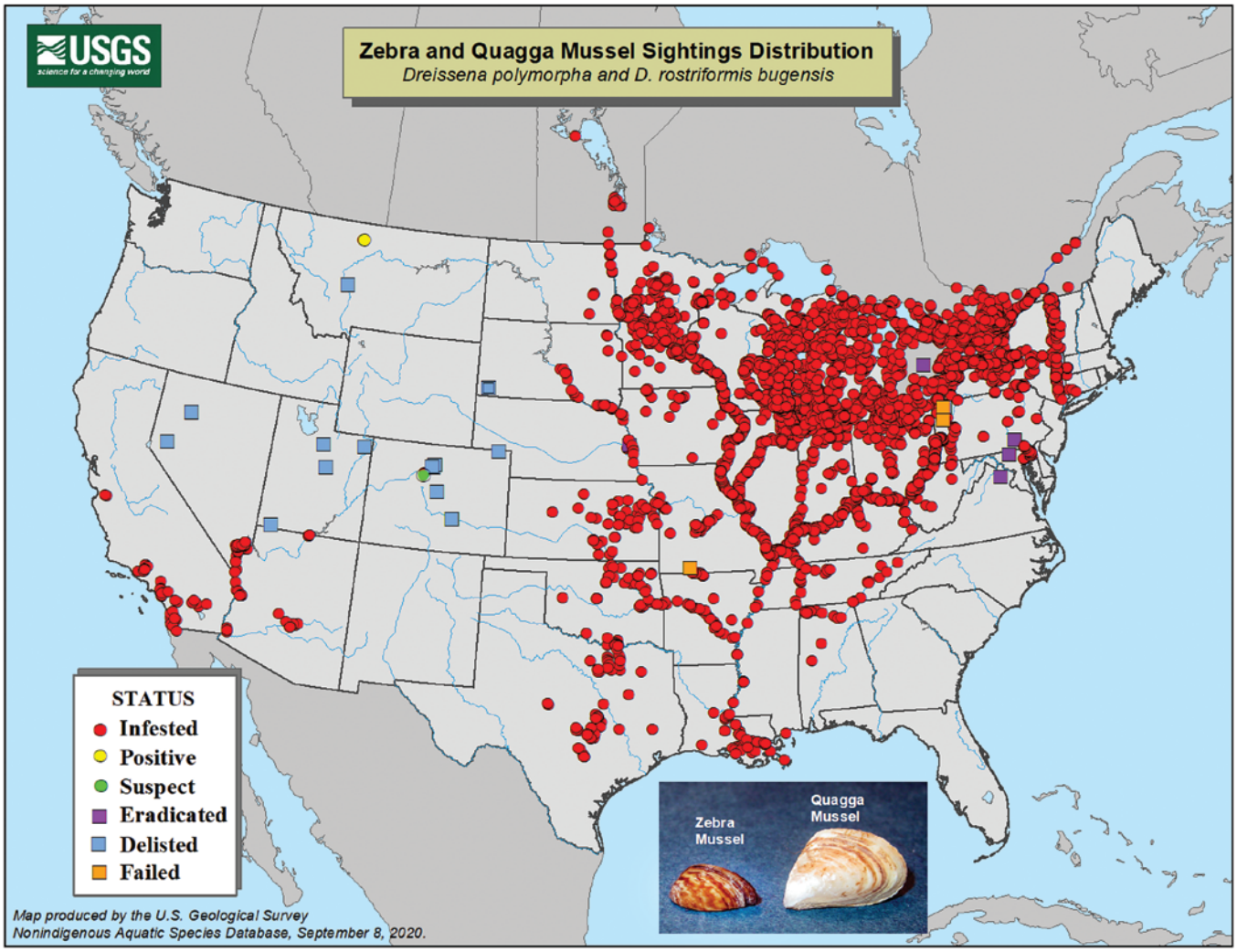
QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
B.12	Develop and implement programs to inspect, decontaminate, and intercept commercially hauled watercraft or conveyances.	The development of programming intended to intercept commercially hauled conveyances. Increased number of commercially hauled craft intercepted, inspected, and/or decontamination; increased number of outreach events to commercial haulers and related industries; the creation and implementation of training for commercial haulers; an increase in the number of certified inspectors working on commercially hauled conveyances.
B.13	Ensure quality control at WID stations in accordance with Building Consensus.	The number of quality control evaluations conducted and subsequent corrective actions or training as appropriate.
B.14	Support the Regional WID Training Program administered by the Pacific States Marine Fisheries Commission.	Maintain and/or increase the number of courses taught; the number of students certified at each level. Maintain stable funding annually.
B.15	Adopt and implement the National Wildfire Coordinating Group protocols within the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations.	An increase in the number of entities that adopt and implement the protocol. Completion of the WRP Fire Equipment Protocol to aid in the adoption of the national standard.
B.16	Continue, expand, and promote partnerships between managing agencies and the marine industry, specifically the National Marine Manufacturers Association, American Boat and Yacht Council, Watersports Industry Association, and BoatUS, to implement the Technical Information Report (T-32) on AIS.	An increase in the number of engagements with the marine industry. A published ANS standard for all NMMA certified boats to prevent/eliminate the movement of ANS on watercraft and to improve decontamination efficacy and safety.
B.17	Alter and/or improve the design, engineering, and manufacturing of ballast tanks, inboard engines, inboard/outboard engines, and new watercraft to eliminate or reduce the probability of quagga or zebra mussels and other ANS from being transported in recreational watercraft, and to make it easier and safer to inspect and decontaminate watercraft compartments and propulsion systems.	Establish a process for new marine technologies to be tested by independent third-party vendors, approved, and released into manufacturing. An increase in the number of marine manufacturers actively engineering new boat designs to reduce the spread of ANS. Effective solutions for ballast tanks, engines, bilge, and other water-holding compartments to prevent ANS are industry standard in marine manufacturing.
B.18	Continue, expand, and promote the use of Best Management Practices and Hazardous Analysis and Critical Control Point Planning to reduce the spread of ANS during natural resource management activities.	Maintain and/or increase the number of HACCP courses and corresponding numbers of certifications issued for trainers and students. An increase in the number of new organizations practicing HACCP in government and industry.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
Strategy C—Detection Monitoring for Zebra and Quagga Mussels		
C.1	Adopt the WRP Dreissenid Mussel Field Sampling and Monitoring Protocol and the Laboratory Standards for Dreissenid Veliger Analysis.	An increased number of organizations that are conducting early detection veliger monitoring and following the Building Consensus guidelines and the WRP field sampling and lab protocols.
C.2	Expand early-detection monitoring programs to western waters at risk for zebra and quagga mussel introduction, following WRP protocols.	Increased number of unique water bodies monitored per the WRP field sampling protocol. Increased number of sampling locations. Increased number of plankton tows for veligers. Increased number of shoreline surveys for mussels. Increased number of artificial substrate deployments and checks for mussels. The number of sampling visits per site.
C.3	Expand laboratory expertise and capacity to provide Dreissenid analytical services.	An increased number of laboratories that provide Dreissenid analytical services. An increase in the number of samples analyzed according to WRP lab protocols.
C.4	Develop field protocols, lab standards, and management support tools for early-detection monitoring using eDNA.	Published and accepted standards for eDNA field sampling protocol and eDNA lab protocol for early detection of zebra and quagga mussels with companion support tools for mangers and decision makers.
C.5	Develop and implement a standard training and certification program for field sampling and monitoring staff and laboratory technicians performing early detection analysis for invasive mussels and other ANS.	The development and implementation of two training certification programs - one program for field sampling and monitoring staff and one for laboratory staff - that align with WRP standards.
C.6	Report Dreissenid monitoring results to the USGS NAS database for all agencies/entities collecting data.	An increase in the number of states reporting all stages of detection per Building Consensus guidelines.
C.7	Create a western sampling location web map and database applicable to all western agencies to promote the coordination of monitoring efforts and early detection surveys.	The development and implementation of an online map and corresponding database is complete including query search functionality and reporting capacities for effective information sharing related to sampling and monitoring activities within the WRP.
C.8	Host an annual monitoring coordination forum to communicate activities, results, and collaborate on priorities to leverage capacity and coverage and avoid duplication.	The annual monitoring forum is established and takes place each year with engagement from WRP membership, partners, and experts.
C.9	Establish an MOU which clarifies roles and responsibilities between state and federal agencies concerning early detection monitoring results for management; including communications, notifications, public release of information, and online databases, and distinguishes between collections for research versus management purposes.	The MOU is established.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
Strategy D—Rapid Response		
D.1	Create and maintain a sustainable rapid response fund (subject to appropriate authorities and appropriations) for zebra and quagga mussels in western states.	Establishment of a stable fund for rapid response for zebra or quagga mussels in the West.
D.2	Develop and maintain rapid response plans for all western states and major basins.	An increase in the number of basin rapid response plans and an increase in the number of state, federal, local, or tribal rapid response plans for zebra and quagga mussels.
D.3	Conduct rapid response training in the Arkansas, Upper Colorado, Lower Colorado, Upper Missouri, Platte, and Great Basins, and in Alaska, modeled after the CRB trainings.	Rapid Response training exercises are conducted with at least one exercise held in a new basin each year.
D.4	Create an Endangered Species Act (ESA) manual for rapid response in the western basins named in D.3.; modeled after the CRB ESA Manual published in 2019.	ESA manual for rapid response published for each basin named in D.3.
Number	**Action Item**	**Evaluation Measures**
Strategy E—Research for Control and Management		
E.1	Develop a standardized risk assessment model for invasive mussels in western waters that takes into account both the risk of introduction by watercraft, as well as examines water quality to determine both the probability of establishment and reproduction within the water. Include a decision tree based on risk that helps direct financial resources for management and control.	Completion of a west-wide waterbody risk assessment with inclusion, at a minimum, of the risk of introduction by watercraft, the risk of establishment (chalk variables) and the risk of invasive reproduction (trophic variables) within the water plus a companion decision tree.
E.2	Conduct a western traffic assessment to determine the interstates, highways, roads, or travel corridors that are most commonly used by boaters traveling from infested areas into the uninfested West to inform the strategic placement of roadside WID stations in new basins or areas.	Completion of a west-wide traffic assessment that provides recommendations for the most effective placement of roadside WID stations to intercept watercraft moving from infested areas into the uninfested West.
E.3	Conduct and support social science research to evaluate existing ANS educational campaigns and informational messaging currently in use across the West that target boaters (e.g., Stop Aquatic Hitchhikers, Play Clean Go, Clean Drain Dry, Pull the Plug, and state-specific campaigns) and clearly identify which campaigns, messages, and delivery methods are most effective in both raising initial awareness and achieving subsequent behavior change.	Published research that evaluates existing ANS educational campaigns and informational messaging related to changing the behavior of boaters and potentially other users to stop the spread of ZQM and other ANS.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
E.4	Continue to develop and evaluate environmentally friendly and cost-effective tools to manage invasive mussel infestations in open water systems, specifically large reservoirs.	Increased number of usable, proven, cost-effective, and environmentally friendly control method that are tested, approved, permitted as appropriate, and widely accepted for use.
E.5	Update the research priorities list from Dreissenid Mussel Research Priorities Workshop (Portland State University, 2015).	The research priorities document is updated and published.
E.6	Continue to evaluate the impacts (acute and chronic) of control and management tools (e.g. chemical treatments, non-chemical treatments) on non-target organisms, in particular, those listed as threatened or endangered.	Increased number of evaluations of the impacts of control and management tools on non-target organisms.
E.7	Conduct research to better understand how human behavior influences the spread of mussels and other invasive species.	Increased number of published studies on human behavior related to preventing the spread of ZQM and other ANS.
E.8	Coordinate research, control, and management with the ANS Task Force and their Research Committee to meet western priorities.	An increase in the number of WRP members on the ANS Task Force Research Subcommittee. An increase in the number of western research priorities completed in partnership with the ANS Task Force.
Number	**Action Item**	**Evaluation Measures**
Strategy F—Outreach and Education		
F.1	Following the completion of E.3, promote the use of consistent, effective messaging and enhance coordination of efforts to support the achievement of desired behavior change across the western region.	To be determined pending the results of E.2.
F.2	Following the completion of E.3 and E.7, develop (if necessary) or update outreach materials and delivery methods (e.g. print, social media, etc.) and make them available in digital formats that can be tailored to specific jurisdictions.	To be determined pending the results of E.2, E.6, and F.1.
F.3	Conduct a standardized, regional, multi-state, survey of motorized boaters in the West to determine if a correlation exists between current WID processes, compliance, and customer experience; make improvements accordingly, evaluate and reassess compliance and customer experience to determine where improvements can be made to incentivize compliance.	Boater survey completed and report issued.
F.4	Develop messaging for states in other regions to communicate western WID requirements and procedures with boaters before they travel to western states.	An increase in partnerships east of the WRP; an increase in the number of engagement activities east of the WRP; an increase in the number of organizations east of the WRP distributing western information resources.

QZAP 2.0—EVALUATION MEASURES FOR ACTION ITEMS		
Number	**Action Item**	**Evaluation Measures**
F.5	Effectively use and evaluate social and multi-media platforms to share consistent messaging campaigns.	Completion of a coordinated social media strategy and evaluation criteria. Increased number of organizations utilizing the social media strategy and implementing it. Increased number of social media posts and post engagement.
F.6	Coordinate consistent implementation of the ANS Task Force Voluntary Guidelines to Prevent the Introduction and Spread of Aquatic Invasive Species: Recreational Activities.	An increase in the number of WRP members and partners utilizing and promoting the guidelines.
F.7	Coordinate information, education, and outreach with the ANS Task Force and their Education Committee to meet western priorities.	An increase in the number of WRP members on the ANS Task Force Education and Outreach Subcommittee. An increase in the number of recommended WRP priorities completed through the ANS Task Force.



Conclusion

Substantial strides have been made in the last decade to stop the spread of zebra and quagga mussels in the western US. The WRP has facilitated a common language for ANS managers and standards for watercraft inspection, decontamination, training, quality control, field monitoring, and laboratory analyses. The NSGLC and AFWA published a legal framework for WID programs. The CPW manages the Regional WID Data Sharing System that is used by almost all western states. The CRB banded together in perimeter defense of waters in a basin that is not yet infested by ZQM. The boating industry came together with the ANS community for five years and published the T-32 Technical Information Report on ANS for Boat Manufacturers. Reclamation, USGS, and USACE continue to expand our understanding of invasive mussels through research and control testing.

Despite this significant progress, many of the same problems that prompted the development of the original QZAP still exist today. There are varying degrees of containment at different locations in the lower Colorado River basin. Some locations have very robust programs with good containment and education. However, infested areas from Lake Havasu downstream in the lower Colorado River basin, shared by Arizona and California, along with infestations in Arizona's Lake Pleasant and Tonto National Forest remain uncontrolled with no containment in place, posing a serious threat to the rest of the West. Similarly, ZQM populations in North Dakota, South Dakota, Kansas, Oklahoma, Texas, and the eastern US continue to spread unchecked, putting more pressure on those states trying to prevent further invasion. As a result, an increasing number of mussel-infested boats arrive at uninfested western waters and the burden to prevent invasion falls to the receiving state.

The risk is growing every year as mussels spread and increase the threat to the uninfested west. Just within the western nineteen states, the number of infested waters has more than doubled in the last 10 years, growing to 172 sites in 2020. The rapid expansion of the mussel population throughout Lake Powell (Glen Canyon National Recreation Area) has increased the workload for western ANS managers as the boats disperse to other waters and need to be inspected after departing this popular boating destination. While the Utah Division of Wildlife Resources, in partnership with the NPS and State of Arizona, has implemented a WID containment program at Lake Powell since 2013, additional actions are needed to reduce the number of boats leaving infested waters with mussels onboard.

Other reservoirs such as Lewis and Clark Lake (Nebraska-South Dakota) and numerous water bodies in Kansas and Texas have advanced mussel populations that pose a serious threat to the west. Unfortunately, like many waters, these lakes did not have a prevention program in place to protect against invasion and do not have a mandatory WID containment program in place to protect other waters. There is a shared responsibility among owners and managers to do no harm and that includes preventing a harmful invasive species from leaving an infested facility and causing irreversible damage to your neighbor's natural resources and water infrastructure.

Zebra mussels
(Dreissena polymorpha)

Quagga mussels
(Dreissena rostriformis bugensis)

The WRP will continue to provide a forum for dialogue on invasive mussel management as western partners adopt the model legal provisions and corresponding operational protocols and guidance. The WRP encourages all members and partners to work collaboratively to stop the spread of invasive mussels, making wise use of mandatory WID programs, early detection monitoring, research, and control innovations. The largest barrier to implementation remains the challenge for agencies to establish the permanent staff and fiscal capacity to implement WID and early detection monitoring programs.

Federal agencies should work in tandem with states and other agencies for compatible and coordinated approaches that result in enforcement of state statutes and regulations, ensuring WID inspections are occurring at critical locations on local, state and federally managed properties, providing long-term funding agreements for WID programs at those critical locations and developing comprehensive strategies for regional containment and prevention.

It is time for all western partners to join together systematically with a unified approach to prevent the spread of zebra and quagga mussels into the Uninfested West. There are many opportunities to capitalize on lessons learned and progress made over the last decade to improve resource protection in the future if we choose to act together and similarly implement these recommendations across boundaries. The recommendations in this document illuminate the need for informed decision making that results in increased capacity and clear direction which empowers the implementation of a collaborative multi-jurisdictional regional network of WID stations, alongside monitoring, rapid response, education, enforcement, and research, which stops the spread of quagga and zebra mussels in the West.

Participants from a diverse array of organizations in front of an infested mussel boat at Lake Mead National Recreation Area during the WGA Invasive Mussel Leadership Forum in August 2019.

© Lake Mead National Recreation Area

Acronyms

ABYC—American Boat and Yacht Council

AFWA—Association of Fish and Wildlife Agencies

ANS—Aquatic Nuisance Species

ANS Task Force—Aquatic Nuisance Species Task Force

APHIS—Animal and Plant Health Inspection Service

AZGFD—Arizona Game and Fish Department

BC—Building Consensus in the West Workgroup

CPW—Colorado Parks and Wildlife

CRB—Columbia River Basin

eDNA—Environmental deoxyribonucleic acid

DOI—Department of the Interior

HACCP—Hazard Analysis and Critical Control Points

ISAN—Invasive Species Action Network

NANCPA—Nonindigenous Aquatic Nuisance Control and Prevention Act of 1990

NAS—Nonindigenous Aquatic Species Database

NDOW—Nevada Department of Wildlife

NISA—National Invasive Species Act of 1996

NISC—National Invasive Species Council

NPS—National Park Service

NSGLC—National Sea Grant Law Center

OSG—Oregon Sea Grant

PSMFC—Pacific States Marine Fisheries Commission

QZAP—Quagga Zebra Mussel Action Plan for Western Waters

QZAP 2.0—Updated Recommendations for the Quagga Zebra Mussel Action Plan for Western Waters

Reclamation—US Bureau of Reclamation

STW—Safeguarding the West

USACE—US Army Corp of Engineers

USFS—US Forest Service

USFWS—US Fish and Wildlife Service

USGS—US Geological Survey

WAFWA—Western Association of Fish and Wildlife Agencies

WID—Watercraft Inspection and Decontamination

WISCE—Western Invasive Species Coordinating Effort

WGA—Western Governors Association

WRP—Western Regional Panel on Aquatic Invasive Species

ZQM—Zebra and Quagga Mussels

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