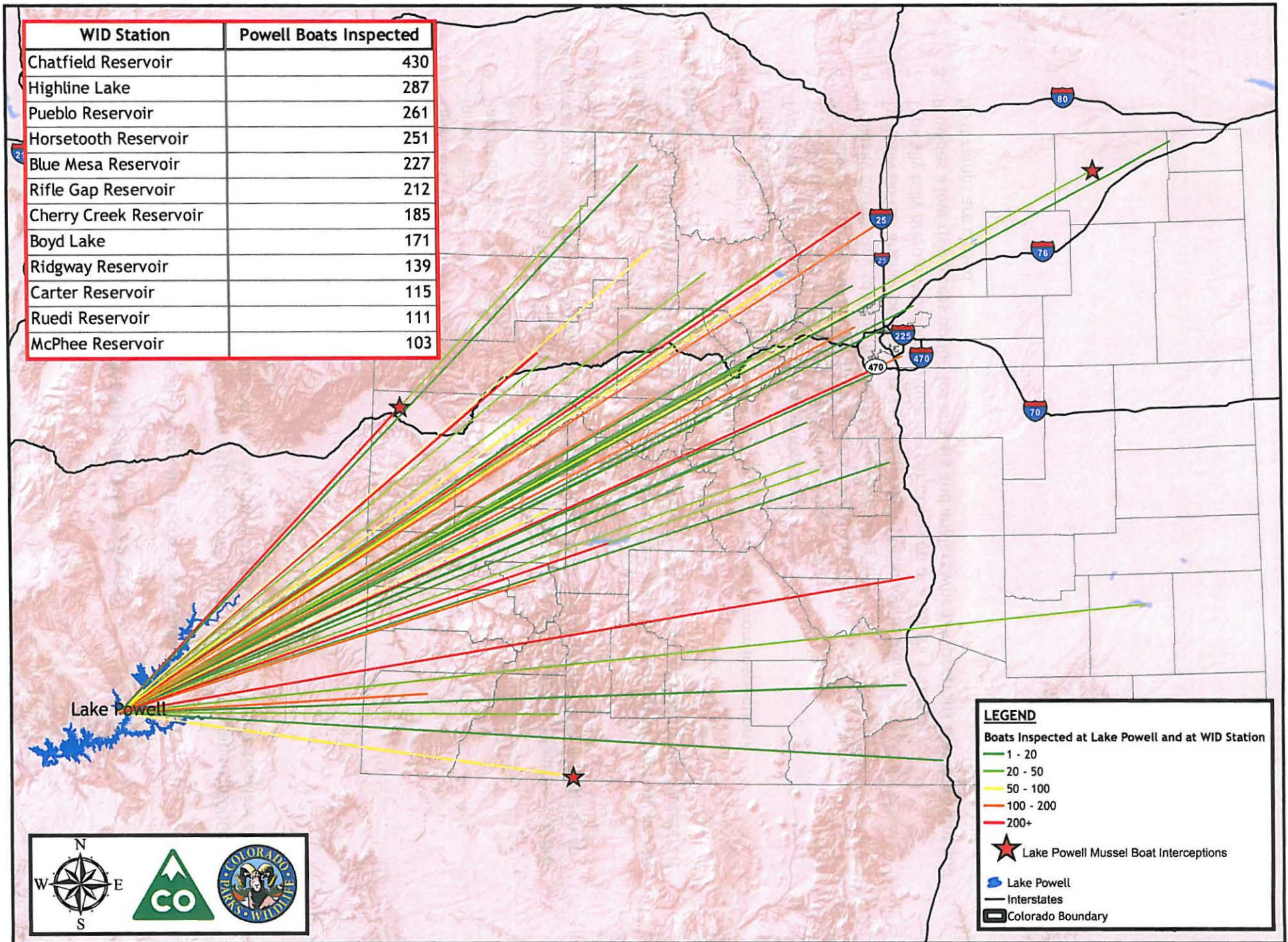


Boats Inspected at Colorado WID Stations That Were Also Inspected at Lake Powell in 2016



Map Produced by:
Colorado Parks and Wildlife Invasive Species Program, December 2016

0 12.5 25 50 75 100 Miles

McPhee Reservoir



Risk of Introduction: **HIGH**

Habitat Suitability

Zebra & Quagga Mussels

VERY HIGH

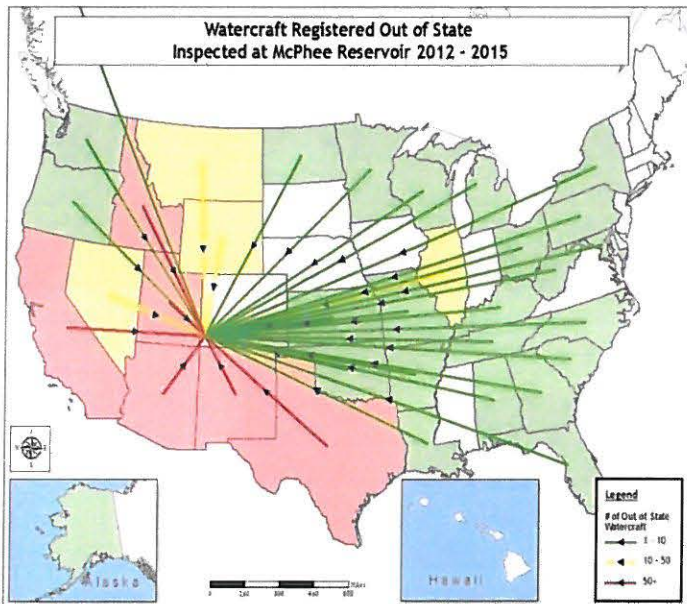
New Zealand Mudsnails

HIGH

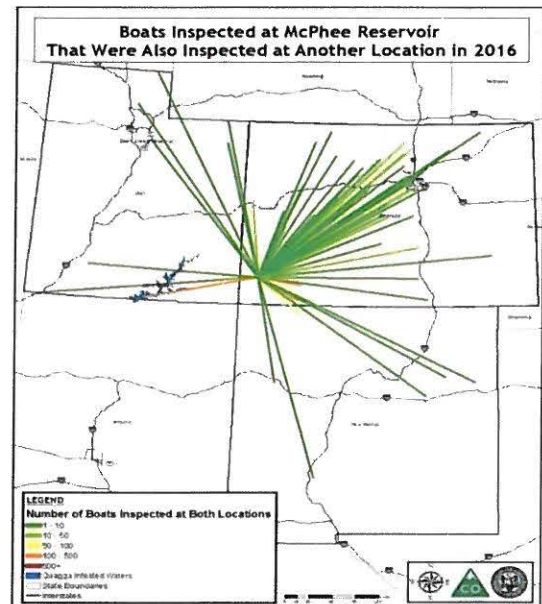
Rusty Crayfish

HIGH

Watercraft Registered Out of State
Inspected at McPhee Reservoir 2012 - 2015



Boats Inspected at McPhee Reservoir
That Were Also Inspected at Another Location in 2016



Inspection Data 2012 - 2015

Incoming Inspections	From Positive / Suspect Waters	Out Of State In Last 30 Days	Out Of State Registrations	Total Decontaminations	Mussel Boat Decontaminations
19753	108	407	1720	521	0

Watercraft Risk Levels





The Cost of Invasion

ZEBRA AND QUAGGA MUSSELS



Industrial Facilities

- \$1.4 million for removal of zebra mussels from 400 cubic yards from one Lake Michigan paper company plant in 1997.¹
- 142 industrial facilities in the Great Lakes, direct operating cost: monitoring and control of zebra mussels \$149 million spent between 1989–1994.⁹
- Industry: intake pipes, water filtration equipment, and power plants operating costs for zebra mussel damages \$3.1 billion dollars spent over 10 years.⁸
- \$200 million annually in the Great Lakes region to raw water users, commercial and sport fishing due to zebra mussels.¹⁵

Water Treatment

- The Metropolitan Water District has spent \$30 million over the last five years to fight the quagga and might be spending \$8 million to \$10 million a year on it into the unfathomable future.²
- Metropolitan Water District of Southern California receives approximately 740,000–800,000 acre-feet of water per year from the Colorado River and will spend \$10–15 million annually in operations and maintenance costs to address quagga mussel infestation in its Colorado River Aqueduct and terminal reservoirs.³



ZEBRA MUSSELS

© PHOTO BY BRAD HENLEY

- “The annual cost to the Southern Nevada Water Authority is about \$200,000. But, Lew said, that doesn’t include additional construction costs for chemical structures that are upwards of \$8 million.”⁴
- Great Lakes water users with intake structures monitoring and control of zebra mussels \$30 million in 1992–1994, and \$120 million in 1989–1994.¹³
- U.S. and Canada water users total economic costs for zebra mussels at \$5 billion for 2000–2010.⁵
- Municipal Water Treatment in the Great Lakes, monitoring and control of zebra mussels \$84,000–\$154,000 in 1993, per plant.¹³
- \$172,600 annually for chlorination additions at Southern Nevada Water Authority: removal of quaggas from one drinking water intake tunnel \$340,000: routine maintenance and removal \$6,000: proposed chemical control \$560,000: research on the invasion \$300,000.¹⁴
- Wichita City water department—\$1.6 million copper ion system at the Cheney Pump Station. 2010.⁶
- \$400,000–\$450,000 per year for municipal water treatment facility in Windsor.⁸
- Buffalo, New York Water Board has signed a \$396,000 contract with Buffalo Industrial Diving Co. to remove an underwater graveyard of mussel shells that has been expanding since the early 1990s. The pile of dead shells, 12 feet long by about 10 feet wide, is 8 feet high in one spot.⁷

Power Generation

- Total estimated costs for invasive mussels in the Eastern United States, including ecological damage, range from \$100 to \$500 million per year. The cost to water conveyance, water treatment, and the power industry has been estimated at \$100 million per year, limited to the Eastern United States. Approximately 1,800 water systems rely on surface water from rivers and lakes west of the 100° Meridian, serving 47.5 million people.⁸

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© PHOTO BY PHILIP MYERS, ANIMAL DIVERSITY WEB

© PHOTO BY U.S. BUREAU OF RECLAMATION

© PHOTO BY GENE SEAGLE

- Wisconsin Power Plants/water utilities- maintenance ZQM \$250,000–\$500,000 per plant/yr in 2001.⁹
- Great Lakes Power Plants (46 power plants) direct operating cost for zebra mussels, costs to power plants range from \$6,700 per hour for a 200-megawatt system to \$127 million annually for U.S. Great Lakes power plants year 1993.⁹ Great Lakes Power Plants (46 power plants) re-design (damages) zebra mussels \$800 million year 1993.³
- Throughout 35 U.S. states and three Canadian provinces surveyed in the Great Lakes Region, 339 facilities reported expenses relating to zebra mussel impacts totaling \$83 million in 1989–1995.¹⁰
- If zebra and quagga mussels invade the Columbia River, they could cost hydroelectric facilities alone up to \$250–300 million annually. This does not include costs associated with environmental damages or increased operating expenses to hatcheries and water diversions.¹¹
- Oregon projected zebra mussel control costs to 13 hydropower facilities \$25.5 million.¹²
- \$150,000 per generator in mitigation strategies with annual maintenance of \$100,000 is the estimated costs to hydroelectric plants for mussel infestation.¹³
- \$1 million per year Hoover Dam annual budget for quagga mussel control.¹³
- An estimated cost for zebra mussel mitigation at a nuclear facility, based on the Entergy owned facility in Oswego NY, is \$467,390, plus annual operating costs of \$109,058.¹⁵
- David Michaud, principal environmental scientist for Wisconsin Electric Power Co: In 1993, the company, which operates six power plants that use Great Lakes water, one of which is in Michigan's Upper Peninsula, spent \$1 million on maintenance alone from zebra mussels, Michaud said.¹⁴
- Ontario Power Generation capital costs (in 1990 U.S. dollars) for installation of a NaOCl system were \$403,000 for Sir Adam Beck (SAB) #1 (470 mw, 10 generators), and \$805,088 for Sir Adam Beck (SAB) #2 (1290 mw, 16 generators). OPG's annual costs for maintaining this system include three technicians at \$65 an hour for four weeks (160 hours) which equals \$31,200.¹⁵

- The mussels clog the utility's two massive water intake pipelines, and if not routinely treated, they could disrupt the flow of 390 million gallons of water a day to the Las Vegas area, Zegers said. The water system spends about \$1 million a year to manage the problem.⁸
- Hydro-electric plant direct operating costs for ZM \$92,000/plant/yr.⁹
- Fossil-Fuel Plant direct operating costs for ZM \$160,000/plant/yr.⁹

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Prioritizing ANS Funding

A SCIENCE BASED DATA DRIVEN APPROACH TO RISK



Risk of Introduction

What is the likelihood that mussels will be introduced via watercraft?



Risk of Establishment

Part 1: What is the likelihood that if introduced, mussels can build shells and survive?



Risk of Establishment

Part 2: What is the likelihood that mussels can grow, reproduce, and establish an invasive population?



Risk of Introduction by Recreational Watercraft

- Primary ranking factor for priority waters.
- Based on boater demographics and more than 1M data points collected at watercraft inspection and decontamination (WID) stations from 2012–2015.
- Five data factors compared among waters with WID stations:
 - Total Incoming Inspections or Total Volume of Boats
 - Boat Origin
 - Local In-State Boat
 - Non-Local In-State Boat
 - Out of State Boat
 - Watercraft Risk Type
 - Number of Boats That Have Been Out of State in the Last 30 Days
 - Last Launch in a Colorado Positive or Suspect Water

Risk of Establishment

- Secondary ranking factor for priority waters.
- Based on ~281,000 water quality data points collected by the ANS Program's sampling and monitoring crews from 2013–2016.
- All waters examined are within suitable habitat ranges despite some being ranked lower than others:

Part 1:

- Primary factor necessary for shell formation and animal viability.
- Represents what a zebra or quagga mussel would need to survive if introduced
- CHALK variables = Calcium, Hardness, Alkalinity, pH

Part 2:

- Secondary factor necessary for long term population survival
- Represents what a zebra or quagga mussel would need to survive, reproduce and establish an invasive population.
- Based on three factors:
 - Chlorophyll
 - Total Phosphorus
 - Total Nitrogen

CPW Zebra and Quagga Mussel Risk Assessment Summary

2016 REVISION UPDATE

Ranked by Risk of Introduction Score First, and Risk of Establishment (Habitat) Score Second.

WID Site Location	Region	² INTRODUCTION RANK	¹ HABITAT RANK
PUEBLO - QM* #	SE	VERY HIGH	VERY HIGH
BOYD LAKE	NE	VERY HIGH	VERY HIGH
CHATFIELD*	NE	VERY HIGH	VERY HIGH
CHERRY CREEK*	NE	VERY HIGH	VERY HIGH
NAVAJO*	SW	VERY HIGH	HIGH
BLUE MESA RESERVOIR* #	SW	VERY HIGH	HIGH
HORSETOOTH LAKE*	NE	VERY HIGH	MEDIUM
CARTER LAKE*	NE	VERY HIGH	MEDIUM
CBT - GRAND, GRANBY*, SHADOW MOUNTAIN* #	NW	VERY HIGH	LOW
ELEVEN MILE*	NE	HIGH	VERY HIGH
JACKSON LAKE*	NE	HIGH	VERY HIGH
MCPHEE RESERVOIR	SW	HIGH	VERY HIGH
NORTH STERLING*	NE	HIGH	VERY HIGH
HIGHLINE LAKE*	NW	HIGH	VERY HIGH
RIDGWAY*	SW	HIGH	VERY HIGH
SPINNEY MOUNTAIN*	NE	HIGH	VERY HIGH
JOHN MARTIN	SE	MEDIUM	VERY HIGH
RIFLE GAP	NW	MEDIUM	VERY HIGH
STAGECOACH	NW	MEDIUM	VERY HIGH
TRINIDAD	SE	MEDIUM	VERY HIGH
JUMBO RESERVOIR #	NE	MEDIUM	VERY HIGH
ANTERO RESERVOIR	NE	MEDIUM	VERY HIGH
LATHROP*	SE	MEDIUM	VERY HIGH
GREEN MOUNTAIN RESERVOIR	NW	MEDIUM	HIGH
ELKHEAD	NW	MEDIUM	HIGH
RUEDI RESERVOIR	NW	MEDIUM	HIGH
TAYLOR PARK RESERVOIR*	SW	MEDIUM	MEDIUM
VALLECITO*	SW	MEDIUM	MEDIUM
CRAWFORD*	SW	LOW	VERY HIGH
VEGA	NW	LOW	HIGH
SWEITZER	SW	LOW	HIGH
STEAMBOAT LAKE	NW	LOW	MEDIUM
CLEAR CREEK RESERVOIR	SE	VERY LOW	MEDIUM
HARVEY GAP	NW	VERY LOW	VERY HIGH
BARR LAKE	NE	VERY LOW	HIGH
TARRYALL RESERVOIR #	NE	VERY LOW	HIGH
MANCOS	SW	VERY LOW	HIGH
PAONIA	SW	VERY LOW	HIGH
WILLIAMS FORK RESERVOIR*	NW	VERY LOW	LOW

¹ Analysis performed by CPW on 2013–2016 data collected by CPW ANS Sampling Crews

² Analysis performed in 2016 based on 2012–2015 average WID data

* indicates a water body that has intercepted one or more infested mussel boats in the past.

indicates a water body which has had a prior detection and has been de-listed for mussels.

COLORADO PARKS AND WILDLIFE ANS PROGRAM, ELIZABETH BROWN & ROBERT WALTERS, JANUARY 12, 2017



ANS Boat Interdictions

ZEBRA AND QUAGGA MUSSELS

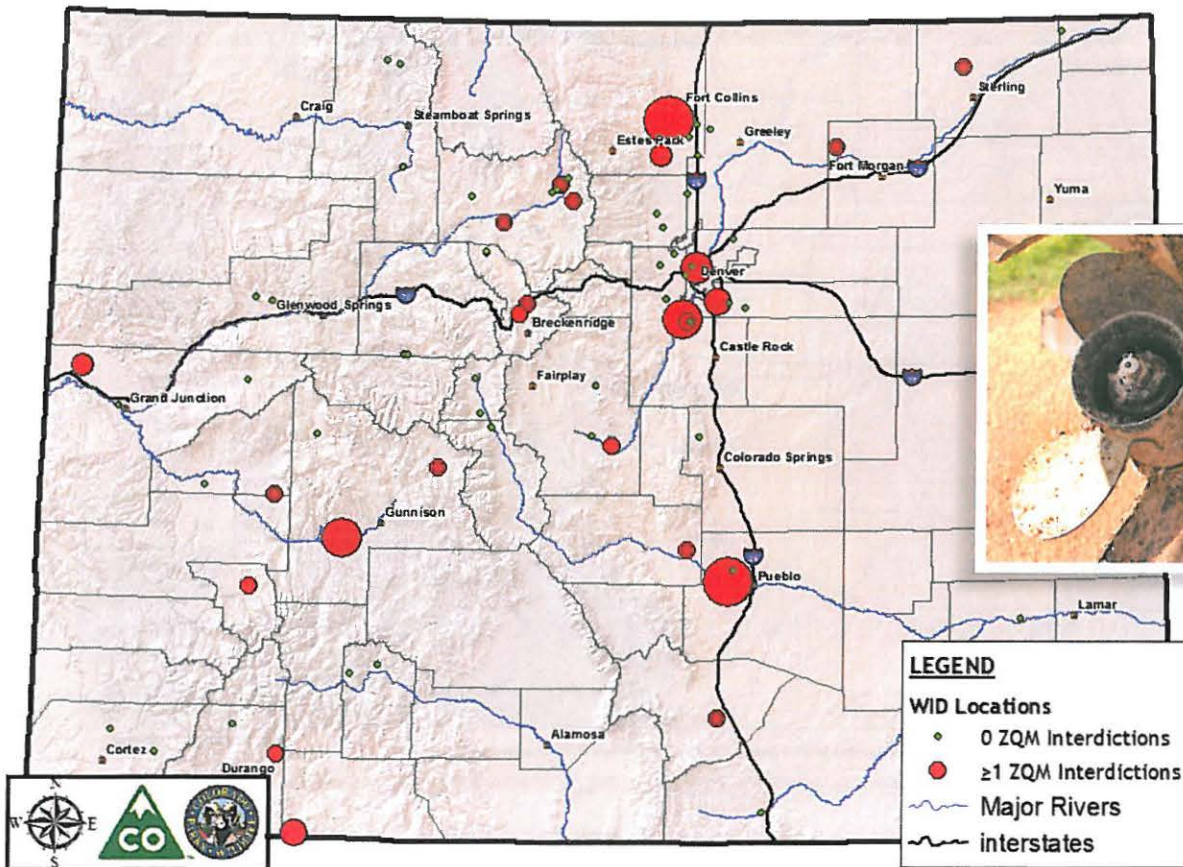


Invasive mussels are being transported on watercraft!

Colorado Parks and Wildlife coordinates a broad multi-jurisdictional watercraft inspection and decontamination network to protect waters from invasive zebra and quagga mussels and other invasive species. Recreational watercraft is the main vector of introduction for this harmful invader. Colorado is a headwater state and there are no mussels upstream. State certified inspectors repeatedly intercept watercraft infested with mussels.

A total of 120 boats with attached adult zebra or quagga mussels have been intercepted coming into Colorado's waters from out of state at watercraft inspection and decontamination stations. The infested watercraft were intercepted at Blue Mesa, Boulder Marine, Canon Marine, Carter, Chatfield, Cherry Creek, Crawford, Denver CPW Office, Dillon Marina, Eleven Mile, Frisco Bay Marina, Granby, Grand Junction CPW Office, Great Lakes Marine, Highline, Horsetooth, Jackson, Lathrop, Navajo, North Sterling, Pueblo, Ridgway, Shadow Mountain, Taylor Park, Turquoise, Vallecito and Williams Fork.

Zebra and Quagga Mussel Positive Interdiction Sites in Colorado



Map Produced by:
Colorado Parks and Wildlife Invasive Species Program, October 2016

0 10 20 40 60 80 Miles

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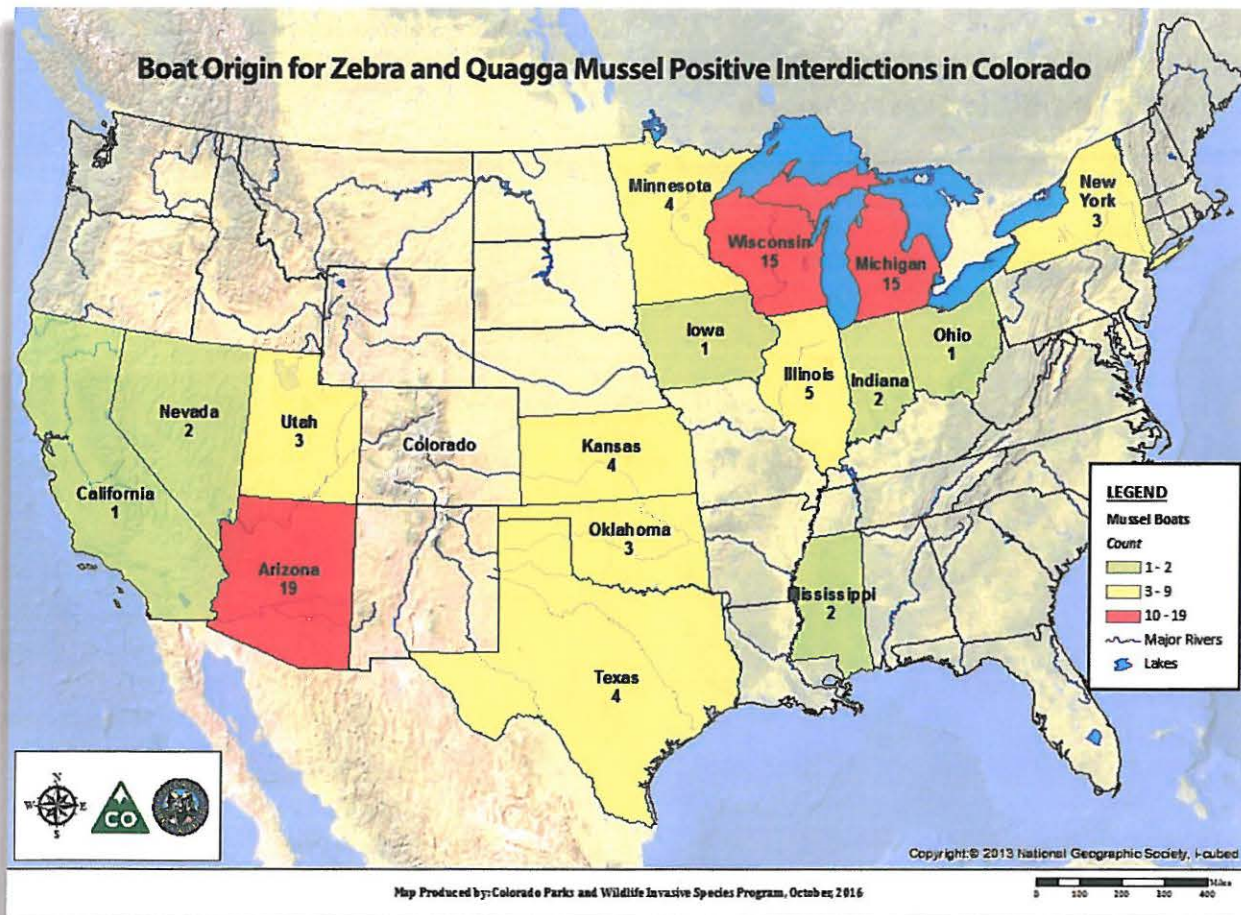


© PHOTO BY MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Where are the infested mussel boats coming from?

It is often difficult to determine the exact location of infestation due to the frequency of boating use. Also, numerous interceptions are used boat purchases in which the previous boating history is not known. For these reasons, the source of infestation for more than twenty interdicted

watercraft is unknown. The remainder of the infested vessels were coming from Arizona, California, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Mississippi, New York, Nevada (Lake Mead), Oklahoma, Ohio, Texas, Utah (Lake Powell), Wisconsin, and the Great Lakes.



2016 ANS Fact Sheet



AQUATIC NUISANCE SPECIES (ANS) PROGRAM OVERVIEW

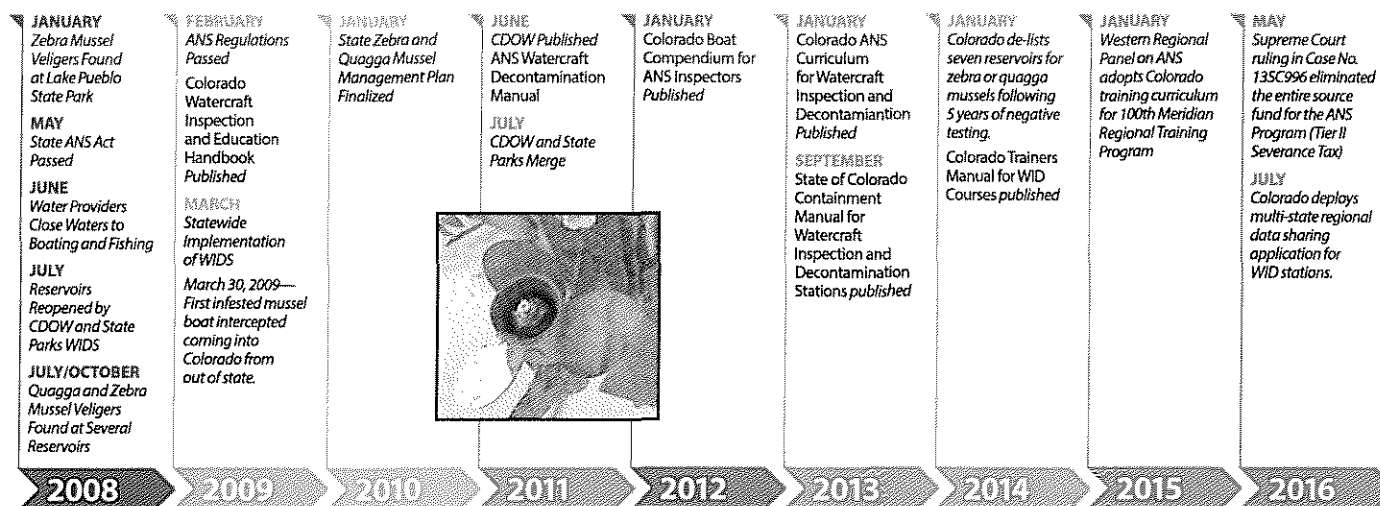
Background

The State Aquatic Nuisance Species (ANS) Act was signed into law May 2008. The Act defines ANS as exotic or nonnative aquatic wildlife or any plant species that have been determined to pose a significant threat to the aquatic resources or water infrastructure of the state. The Parks Board passed regulations required by the Act on February 20, 2009 and updated in 2015 to reflect the CPW merger. The regulations require mandatory watercraft inspection, and if necessary, decontamination of all boats coming from out of state, leaving waters with known ANS and boats entering high-risk waters where inspections are required by the managing entity. The focus of the program is to prevent zebra and quagga mussels and other ANS from infesting Colorado's water resources and threatening our water storage and distribution systems for municipal, industrial and agricultural use. The Colorado ANS Program is highly effective and a model which other states across the nation are learning from.

Program Goal and Successes

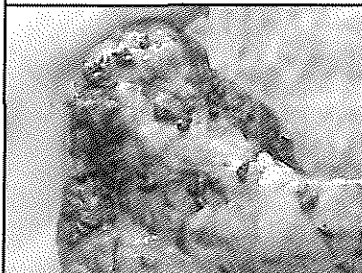
The goal of the program is to protect the state's natural resources, outdoor recreation and water supply infrastructure through the prevention of new introductions of costly invasive species, such as zebra or quagga mussels, in Colorado. Western states such as Kansas, Nebraska, Texas, South Dakota, North Dakota and Arizona, do not have aggressive ANS prevention programs and continue to become infested with zebra or quagga mussels. Colorado has prevented the introduction of these awful invasive species due to the diligent efforts of watercraft inspection and decontamination staff, as well as monitoring, education and enforcement actions.

Pueblo Reservoir is the only water in the state positive for quagga mussel veligers (larvae). There has never been an adult zebra or quagga mussel found in Colorado. All other reservoirs that initially tested positive were de-listed in 2014 after 5 years of negative testing.



Other ANS We Are Most Concerned About

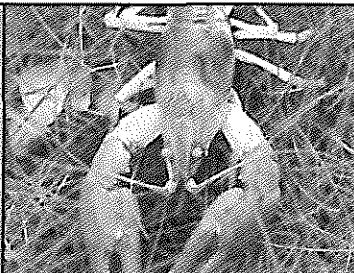
New Zealand Mudsail



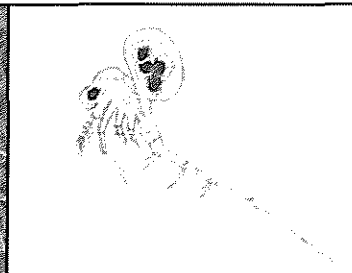
Eurasian Watermilfoil



Rusty Crayfish



Spiny Waterflea



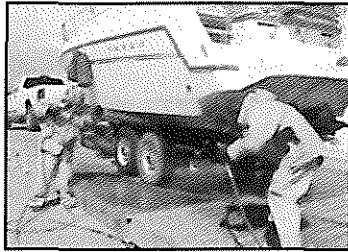
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PHOTO BY PHIL MYERS, MUSEUM OF ZOOLOGY, UNIVERSITY OF MICHIGAN

ILLUSTRATION BY MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

Working Together: Watercraft Inspection and Decontamination (WID)

Watercraft inspection and decontamination is a requirement of the ANS Act and continues to be a key component in preventing the spread of ANS into and within Colorado. CPW coordinates the vast network of WID stations that are operated by CPW, the National Park Service, Larimer County, various municipalities and private industry locations. In total, the state has collectively performed over **3 million inspections and 46,628 decontaminations** since 2008.



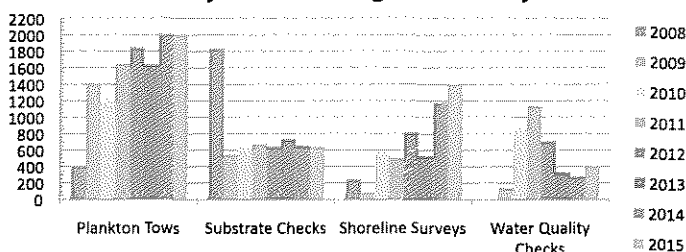
Mussel Boat Interceptions

In total there have been 116 watercraft intercepted with adult zebra or quagga mussels attached since the ANS program began. In 2015, there were 21 watercraft intercepted with zebra or quagga mussels attached, which is more than any year in program history. The majority of the intercepted vessels were coming from Arizona or the Great Lakes. All boats were decontaminated to ensure all mussels were dead, and no mussels were visibly attached.

Sampling and Monitoring

Sampling and monitoring is a key component to the success of the ANS Program. CPW has sampled 584 "at-risk" waters over the last ten years and it was through this sampling program that invasive mussel larvae were first detected in Colorado. While CPW ANS staff monitors the state's public waters for numerous invasive plant and animal species, the focus of sampling is on early detection of zebra and quagga mussels. There are three sampling protocols that target the three life cycles of mussels. CPW also documents native aquatic plants, mollusks and crayfish while performing monitoring activities for invasive species.

Summary of Monitoring Activities by Year



Information and Outreach

CPW and its partner agencies have implemented a comprehensive, multi-faceted invasive species public education campaign. Accomplishments include distribution of tens of thousands of printed rack cards, brochures, handouts, DVDs and posted signage at offices, boat ramps and other public access points. Additionally, a media relations campaign has been launched using web-based, radio, print and television interviews.



Operating and Financials—Where we stand

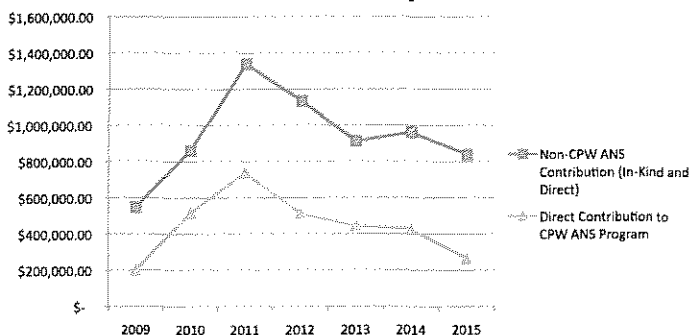
The Supreme Court ruling in case 13SC996 significantly reduced the source fund for the ANS Program (Tier II Severance Tax) as appropriated in the ANS Act. As of July 1st, 2016 the CPW ANS Program is no longer collecting the \$4M appropriation as authorized in the ANS Act. CPW is spending reserve ANS Fund dollars from savings during previous years to complete the 2016 boating season. CPW has engaged a stakeholder process to determine viable long term solutions for stable funding for the ANS Program. Solutions may include funding from federal agencies to operate WIDS at federal impoundments, grants and donations, and legislative remedies.

Prior to the severance tax decision, federal contributions and grants to the ANS Program have been in steady decline. Program expenditures have exceeded the ANS Act allocation as the state is now paying for expenses on federal waters in which previous contributions had evaporated. Future funding for the program is essential, as the cost of operations at a major recreational water body following an infestation could double in order to implement containment measures.

How You Can Help

- Water providers and districts should reach out to their governing boards to consider providing fiscal support to CPW for WID stations and monitoring to prevent an invasion and avoid much more costly management and operational costs.
- Contact U.S. Senators and Representatives and encourage them to continue pursuing an authorization for ANS in the Platte and Arkansas River Basins within the Water Resources Development Act.
- Encourage federal agencies to prioritize funding contributions to CPW for WID and monitoring operations on waters under their ownership and/or management.
- Partners should inform municipal government, county commissioners, state legislators and federal congressional delegates of the potential economic and social impacts that could occur without ANS preventative measures in place. Encourage elected officials to take an active role in securing the ANS program's future for the biosecurity of state waters.
- Participate in stakeholder meetings and informational sessions, as they are announced.

Annual Partnership Funds



The threat of invasion from zebra and quagga mussels is greater than ever due to numerous new infestations in surrounding states such as Arizona, Utah (Lake Powell), Nebraska, Kansas, Oklahoma, Texas and South Dakota.



2016 Fact Sheet



World class recreation and resource management

Economic significance of the outdoors

Accounting for an estimated \$34.5 billion annually in total economic impact, wildlife and outdoor recreation represent important parts of Colorado's heritage, quality of life and economy. Angling, hunting, state park visitation and wildlife viewing contribute roughly \$6.1 billion annually in economic effects statewide. Fishing and hunting have a total combined economic effect in Colorado of more than \$2.8 billion. Colorado Parks and Wildlife (CPW) is playing a pivotal roll in the Governor's Colorado the Beautiful initiative.

Parks offer much more than terrific views

Colorado's 42 state parks protect habitat, provide recreation and many offer hunting and fishing opportunities. Park rangers, volunteers and partners provide classes on safe boating practices, beginning hunting and fishing clinics and wildflower identification to name a few examples. This past year, active duty military and veterans could enter any Colorado state park in August for free. Over 6,600 people took advantage of this exciting opportunity.



Conservation benefits wildlife and habitat

Through ongoing partnerships with other conservation groups and working farms and ranches, strategic planning

and wise resource investments, CPW continues to provide quality wildlife management and outdoor recreation.

CPW manages the largest elk herd in North America, with an estimated population of 264,000 animals. This elk herd provides hunters with healthy locally sourced food. Additionally people from around the world enjoy watching elk in their natural habitat. CPW also stocks more than 90 million fish throughout the state from 19 state fish hatcheries and rearing units. Coloradans have fishing access to over 2,000 natural lakes, 800 reservoirs and 9,500 miles of streams.

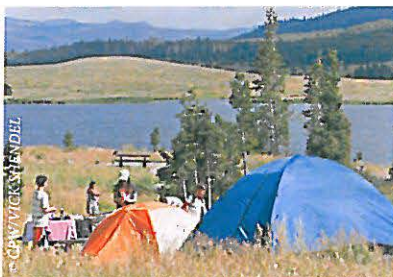


CPW manages over 350 State Wildlife Areas and protects over 900 wildlife species in Colorado. In 2015, CPW protected

31,955 acres of sage-grouse habitat, cooperated on black-footed ferret reintroductions, stocked native fish and managed distribution of native fish across the state.

Outdoor recreation, a native priority

The top reasons Coloradans choose to live here are the state's clean environment, access to public lands and outdoor recreation opportunities and residents' ability to maintain a healthy outdoor lifestyle. Over 80 percent of Coloradans participate in trail-related activities, making these the most popular forms of outdoor recreation.



Economic Significance of Outdoor Recreation

SHOWN IN BILLIONS OF DOLLARS



¹ Source: Economic contributions of Outdoor Recreation in Colorado, 2014, Southwick Associates and CPW.

² Estimated with visitor expenditure data taken from the 2009 State Parks Market Assessment Study (Corona Research) and a conservative industry economic multiplier.

2014 Statewide Outdoor Recreation Activity Days³

SHOWN IN MILLIONS OF DAYS



³ Source: 2014 Statewide Comprehensive Outdoor Recreation Plan (SCORP)

Colorado Parks & Wildlife At-A-Glance

FUNDING SOURCES: \$213.9*

50% \$107.4 • Licenses, Passes, Fees and Permits

18% \$38.5 • Federal, State Grants and Loans

17% \$36.7 • Lottery and Great Outdoors Colorado

7% \$13.7 • Sales, Donations, Interest and Other

4% \$8.8 • Registrations

4% \$8.8 • General Fund and Severance Tax

USE OF FUNDS: \$213.9*

43% \$91.8 • Personnel Services

25% \$53.5 • Operating

12% \$26.0 • Capital Equipment/Improvements

7% \$15.7 • Grants to Others

6% \$13.4 • Payments to Other Agencies

4% \$8.2 • Reserve Fund Increase

3% \$5.3 • Land and Water Acquisitions

*All figures shown in millions



Working Together

Connecting all Coloradans to the outdoors requires a network of committed volunteers and partner organizations working together. Without our 6,000 volunteers, hundreds of partner organizations and friends groups working alongside agency staff, our education and outreach programs would only be able to accomplish a fraction of what we do every day. We engage our partners and volunteers by:

- Hosting the annual Partners in the Outdoors conference
- Providing hundreds of opportunities for volunteer projects
- Training volunteers to represent CPW as certified instructors
- Inviting volunteers to represent CPW at community events and in state parks



CPW Vision Statement

Colorado Parks and Wildlife is a national leader in wildlife management, conservation, and sustainable outdoor recreation for current and future generations.

Employees and Volunteers

Authorized Permanent Employees - 886

Temporary Employees - 1,696

Volunteers: 6,084

Volunteer Hours: 307,080

Volunteer Dollar Equivalent: \$7.1 million

FTE Equivalent: 148



Schools in the Outdoors

CPW connects our youngest citizens to the places they live by connecting students and teachers to outdoor learning resources. We are committed to extending learning beyond the classroom through:

- Schools and Outdoor Learning Environments Program (SOLE)
- Outdoor Understanding for Teachers (OUT), Teaching Environmental Science Naturally (TEN) and other teacher professional development opportunities
- National Archery in the Schools Program
- Field trips to Colorado state parks and state fish hatcheries

For more information on CPW financial sustainability please visit

cpw.state.co.us/financialsustainability