



# **Annual Report:**

## **2021 Dreissenid Mussel Prevention Program**

### **Early Detection Monitoring**

**Lake County Watershed Protection District**  
**Mach 30, 2022**

### **Purpose**

This document summarizes the continued implementation of the Lake County Quagga / Zebra Mussel Prevention Program from January 1, 2021 through December 31, 2021 as a requirement of Title 14 regulations that became effective April 1, 2016. Specifically, section 672.1 requires that any agency with a Prevention Program to submit an annual report that summarizes any changes in the reservoir's vulnerability, monitoring methods and results, and any resulting program conclusions. This report is being submitted by the Lake County Watershed Protection District, herein referred to as "The District" and being submitted to the California Department of Fish and Wildlife (CDFW) Region 2 Office and the Regional Staff Environmental Scientist.

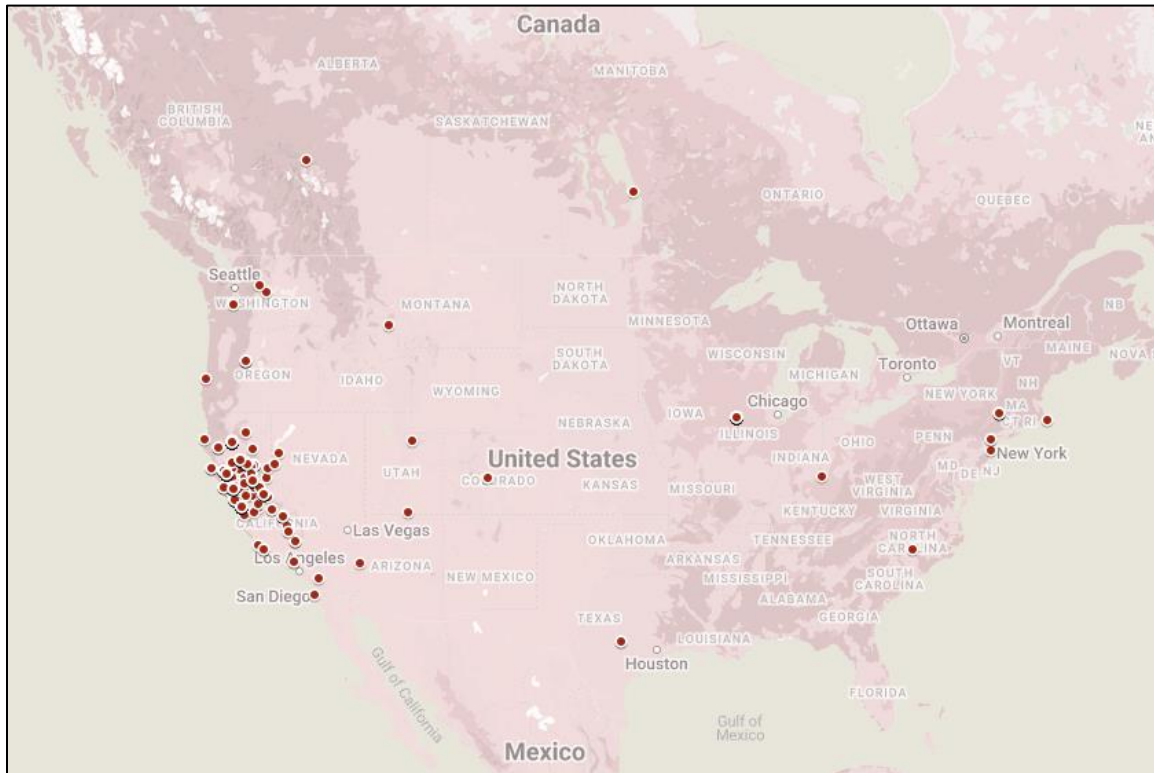
### **Executive Summary**

On January 6, 2007, quagga mussels (*Dreissena rostriformis bugensis*), a type of invasive mussel closely related to invasive zebra mussels (*Dreissena polymorpha*), and often referred to as "dreissenid mussels", were discovered in Lake Mead, Nevada. Since that time, quagga mussel infestations have been discovered in a growing number of western lakes and reservoirs, including [45 locations in California \(CDFW January 2021\)](#). On January 16, 2008, zebra mussels were discovered in San Justo Reservoir, San Benito County, California. Most recently, adult quagga mussels were confirmed in Castaic Lake in August 2021.

Lake County has always been especially susceptible to invasive Quagga / Zebra mussel (herein referred to as "Q/Z") invasion risk because Clear Lake is the largest natural freshwater lake located entirely within California. This lake is a fishing destination, attracting novice and professional bass fishermen from all over the country, and was most recently rated the number one Best Bass Lake of the Decade according to [Bassmaster \(2020\)](#). The lake is also a water recreationists paradise, popular for tubing, swimming, sailing, kayaking, paddle boarding, water skiing, jet skiing, and leisure boating. Due to the popularity of Clear Lake, Lake County receives thousands of visitors -- and their boats -- annually. Even with some travel and gathering restrictions in 2021 due to the COVID-19 novel coronavirus, combined with drought-induced low water levels and public launch closures, at least 8,841 boaters visited Lake County from all over North

*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

America (Figure 1) with about a total of 13,766 boaters using Clear Lake. Because invasive mussels are primarily spread by boaters, the probability of an invasive Q/Z mussel introduction via one of at least 750 public or private boat ramps on the lake is high.



*Figure 1 Distribution of zip codes of boats visiting Clear Lake in 2021 (i.e. locations of last visited water body vessel visited before Clear Lake)*

The most important part of Lake County Q/Z prevention management revolves around the county’s mussel sticker program. Information on this program and the [Lake County Quagga and Zebra Mussel Prevention Plan](#) are available on the Lake County Q/Z mussel –specific website [www.nomussel.com](http://www.nomussel.com). Within the program, every vessel coming into the county has to go through a screening process, where they are deemed low, medium, or high risk, depending on their registered or resident origin and most recently-visited waterbody (high risk locations are provided in an Infested Counties List provided in **Attachment 1**). Once vessels are deemed safe to launch, they are given a resident or visitor-specific hull sticker. This program helps to assure that incoming vessels and other watercraft are mussel-free, which helps to lower vulnerability into Lake County waterbodies. Additional outreach and education efforts are a major influence on the success of this program, as an educated populace can promote and distribute the tenants of a prevention plan and associated programs (more information on sticker sales and education and outreach results and products are available in **Attachment 2**).

*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

One of the greatest tributes of the Lake County Mussel Prevention Program is the outreach and education provided to boaters when they launch from public ramps. Our ramp monitors, as part of Division of Boating and Waterways grant requirements, collect a variety of contact information that is useful for managers to improve the program especially when communicating the important message that mussels need to stay out of Lake County and Clear Lake. This contact information, for the past two years, is provided in **Table 1**. For example, the large reduction in Education provided about AIS and mussels in 2021, led to more in depth training and conversations with program staff so that this number can be improved going into 2022 and the following years. Monitors and program staff also note if the boat and trailer are complying with the local Lake County Sticker rule, if so they are compliant and will be allowed to access the lake and if not, they are not in compliance and will be asked to get a screening and purchase a sticker.

**Table 1. Data collected from contacts between ramp monitors and boaters launching from public ramps in Clear Lake for both 2020 and 2021.**

Contact form Fields	2020	2021	Total
Parking Lot Trailer Stickers	1528	2911	4439
Warning Cards Issued	131	170	301
Vessel Tally: Fishing-Motorized	10116	15573	25689
Vessel Tally: Recreation-Motorized	2771	1941	4712
Vessel Tally: Personal Craft	737	619	1356
Vessel Tally: Kayak, Canoe, Swim	1090	1331	2421
Vessel Tally: Not Specified	2688	1297	3985
Resident Sticker	7932	8437	16369
Visitor Sticker	8359	10941	19300
Sticker Compliant - YES	15384	18261	33645
Sticker Compliant - NO	947	990	1937
Tally-Education-Mussels	1579	26	1605
Tally-Education-AIS	2005	41	2046
Tally-Education-Algae	1509	24	1533

The Q/Z monitoring program was established to detect any known populations of Q/Z mussels in waterbodies vulnerable to invasion in Lake County. Monitoring efforts in Lake County is completed by a partnership between The District and CDFW, where Lake County conducts field sampling and CDFW provides laboratory analysis of collected water samples to determine the presence of juvenile mussels, otherwise known as veligers. The monitoring program also includes artificial substrate monitoring, infrastructure / surface structure surveys, and the aforementioned veliger tows. All monitoring protocols are provided by the CDFW and are available online at:

<https://www.wildlife.ca.gov/Conservation/Invasives/Quagga-Mussels>.

Additionally, in-situ water quality metrics, important for determining habitat suitability for Q/Z mussels, are collected during monthly monitoring events of Clear Lake, during additional sample times when possible, and when sampling in other Lake County water bodies. Historic monthly water quality data (~1968 through 2019) is provided by Department of Water Resources (DWR) [Water Data Library](#), and tracks the relevant parameters to assess Q/Z suitability in this lake. Since 2020, Lake County Water Resources has been conducting the monthly water sampling in Clear Lake.

Based on 2021 monitoring, Clear Lake, Indian Valley Reservoir, Blue Lakes, and Lake Pillsbury, the four most visited lakes in Lake County's waterbodies, with both public and private access, have not had a positive detection of Q/Z mussels. However, 2021 was a very unusual year due to continued restrictions due to COVID-19, as well as low water levels that led to closure of all but two public boat ramps. The two open ramps for the second half of the season were Lakeport 5<sup>th</sup> street and Clearlake Oaks. While the early portion of the year coincided with lower boating activity from residents and visitors, as restrictions lifted, boating and fishing activity increased into spring, then decreased going into late summer and fall. This pattern resulted in overall lower numbers than expected 2021.

## **Monitoring Methods**

The primary agency responsible for managing the Q/Z mussel prevention program in Lake County is the Lake County Watershed Protection District. The District, was originally created as the Lake County Flood Control and Water Conservation District as a political subdivision of the State of California established under the Lake County Flood Control and Water Conservation Act, of the State Water Code in 1951. The District is administered by the Director of Water Resources who reports to the County Board of Supervisors, which acts as the Board of Directors of the Watershed Protection District. The District functions are to plan, manage, maintain, implement, evaluate, and expand all aquatic invasive species programs such as the Aquatic Plant Management Program and the Q/Z Mussel Prevention Program. The District relies on several partners to maintain the Q/Z program. With logistic support from the District, CDFW conducts veliger tows, ideally 3-5 times a year at multiple sites in Lake County including Clear Lake, Blue Lakes, and Indian Valley Reservoir. PG&E conducts tows and monitoring at Lake Pillsbury. The California State Parks Division of Boating and Waterways provides Q/Z grant funds to support the District's boat ramp monitor network for Clear Lake, inspection training and equipment, and all essential educational materials.

The water bodies located within Lake County differ in the types of vessels that can access that waterbody and the type of monitoring that is conducted. **Table 2** summarizes the

water bodies monitored in Lake County and their vessel accessibility type.

**Table 2: Type of watercraft access and monitoring for Lake County waterbodies.**

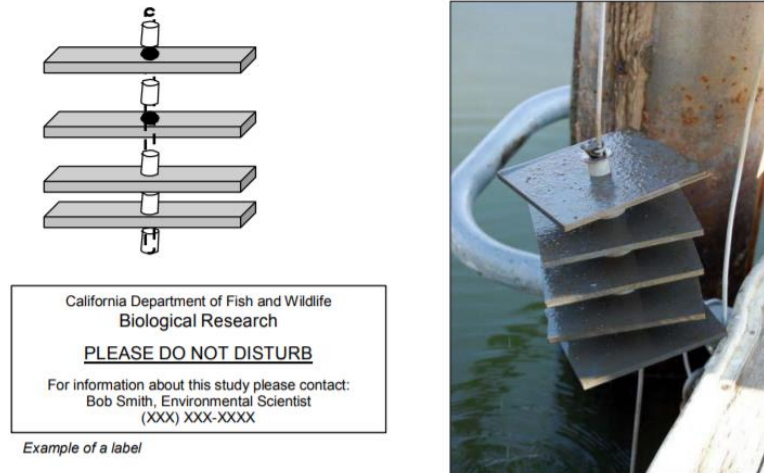
Lake Name	Vessel Accessibility Type (Public vs. Private)	Type of Q/Z Mussel Monitoring		
		Veliger Tows (LCWRD or PG&E)	Artificial Substrate Monitoring Stations (LCWRD)	Infrastructure / Surface Monitoring
Blue Lakes	Private*	✓ (LCWPD)	✓	✓ (LCWPD)
Clear Lake	Public	✓ (LCWPD)	✓	✓
Hidden Valley Lake	Private		✓(Citizen)	
Highland Springs	Public**		✓ (LCWPD)	✓
Indian Valley Reservoir	Public	✓ (LCWPD)	✓	✓ (LCWPD)
Lake Pillsbury	Public	No access 2021	No docks due to low water 2021	✓ (LCWPD)

\*Restricted to 5mph/ non-personal watercraft vessels.

\*\*No motors allowed on boats in this lake.

\*\*\*Q/Z mussel signage was added in 2020 by the beach park and water pump infrastructure is monitored, a permanent substrate monitoring station will be added 2021.

- a) Artificial Substrate Monitoring. The District performs monthly artificial substrate monitoring according to the [methods and procedures provided by the CDFW](#) . Artificial substrates are a series of submerged PVC plates suspended from a dock, bridge, or buoy (**Figure 1**). Placement of these 18 substrates is based on proximity to a potential introduction pathway, mostly located near popular public ramps and access points, but also located in an area where they can remain undisturbed but also easily accessible for monitoring by staff. The District staff monitor and record results of artificial substrates monthly, when able, however the substrates remain in the water year-round. Although not all substrates were checked monthly in 2021 due to low water and the removal of some substrates, results of artificial substrate monitoring that did occur indicate that all substrates were clean and the monitored waterbodies within the county currently do not have any detections of invasive mussels established on artificial substrates (**Table 4**).



***Figure 2 Artificial substrate example provided by the CDFW.***

b) Infrastructure / Surface structure surveys are also performed by the District and citizen monitors at the end of summer season when temporary docks and associated infrastructure are removed from Clear Lake or other water bodies and placed in dry, storage areas. Additional survey inspections have occurred when buoys have been removed from Grebe nesting areas in late summer. During this process, submerged chains and buoy bodies are inspected for any attached mussels.

In 2021, due to low water levels, significant areas of the shoreline were exposed providing additional opportunity to conduct surface surveys of exposed shorelines, sometimes comprised of rocky substrates and woody debris, perfect habitats to identify the presence of adult mussels if they were in our lake. To date, there have been no findings of invasive mussel presence or establishment from any of these surface surveys.

c) In 2021, veliger tows were performed by the District in three water bodies in the County; Clear Lake, Blue Lakes, and Indian Valley Reservoir. CDFW conducts mussel monitoring in some of the high risk regional waterbodies in the State according to the protocols outlined in online at [CDFW Mussel Tow protocols](#). Ideally, in any given normal water year, the District will aim to collect vertical drag tows 3-5 times a year in Indian Valley Reservoir, Upper Blue Lakes and Clear Lake. The veliger monitoring in Lake Pillsbury is completed by PG&E, who own and manage the Scott's dam and reservoir. Water samples from three sites are aggregated into one bottle and sent to the CDFW Shellfish Health Lab (SHL) located in Bodega Bay, CA. Water samples are analyzed for the presence / absence of veligers following a cross-polarized light microscopy (CPLM), based on the methods of Johnson, 1995. Molecular (PCR) methods were not used to analyze the samples. Based on tow data collected during 2021, albeit limited due to some locations being inaccessible due to low water levels, there were no

positive detections for invasive mussel veligers in sampled Lake County waterbodies at this time.

- d) Clear Lake drinking water intake monitoring plans and outreach efforts. Lake County Special Districts operates or oversees approximately three water intakes on Clear Lake of the 18 total public and private water delivery systems on the lake. Because fish screens are at intake sites, and the intake themselves are constructed of materials that pose risk for colonization, a majority of water purveyors are aware of the importance of monitoring Q/Z for maximized aquatic invasive species (AIS) prevention. Each water district has been alerted to the possibility of mussel's introduction and establishment and they monitor for any mussel presence when regular maintenance is performed on inlet pipes, screens and filters. In June 2019, AIS District staff Angela De Palma-Dow, presented on Q/Z and drinking water systems to several drinking water purveyors and the Water Board drinking water division regional engineer at a quarterly meeting in Lakeport, CA. In addition to sharing education and outreach for Q/Z monitoring and prevention, the group decided to create a monitoring and reporting plan for Q/Z drinking water prevention for Clear Lake during 2020. However, due to complications from COVID-19 in both 2020 and 2021, and the additional state order for purveyors to conduct cyanobacteria monitoring, reducing staff and resource availability, this deadline has been extended into 2022 or 2023.

## **Monitoring Results**

Due to low water levels resulting in reduced ramp and site access, reduced veliger tow sampling was conducted by the District in 2021. During this sampling each tow contents was collected into one or more sample jars. For each sampling, in Upper Blue Lakes (n=1), Clear Lake (n=5) sample jars were analyzed and resulted in no positive detections of Q/Z mussel veligers for 2021 (**Table 3**). Sampling was only possible once in Indian Valley in 2021 due to significantly reduced water levels, on May 11<sup>th</sup>, but resulted in no detections of mussels. Artificial substrate monitoring was performed by both Lake County Water Resources staff in Clear Lake (n=11), Blue Lakes (n=3), and by citizen monitors in Hidden Valley Lake (n=6) and results from these surveys resulted in no positive detections of attached adult Q/Z mussels (**Table 4**). Additional infrastructure monitoring in late 2021 of removed docks and exposed shoreline in Clear Lake (n=9), and Indian Valley (n=1), also indicated no presence of settled adult mussels (**Table 5**). Results from all monitoring surveys during 2021 returned no detection of Q/Z in the sampled waterbodies.

In addition, lake water quality conditions, when measured, in Blue Lakes, Indian Valley, Highland Springs, and Clear Lake, such as water temperature, calcium, pH, dissolved oxygen, turbidity, and salinity, are well within the ranges preferred by Q/Z

*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

mussels. (Pucherelli et al. 2016, Whittier et al. 2008; Cohen 2005; 2008) (**Table 6**).

**Table 3: 2021 Results of Veliger Tows in Lake County Waterbodies (aggregated), ND= Non-detection of Q/Z mussel veligers in analyzed samples, NS = not sampled due to drought and lack of access or no water**

Waterbody	Month	Result
Blue Lakes, Upper	May 21	ND
Clear Lake	May 7	ND
	May 26	ND
	October 18	NS
	October 29	ND
	November 10	ND
Indian Valley Reservoir	May 11	ND
	August	NS*
	October	NS*

\*\* Low lake levels prevent launching or sampling

**Table 4: Results of Artificial Substrate Inspections Lake County– 2021. Sample dates for some or all of 2021 sites were April 8-13, May 20, June 9, 23, July 16, 19, 26, August 8, 16, Sept 14, 23, 27, October 29, and November 23.**

Waterbody	Site	Material	2021
Clear Lake	3rd Street, Lakeport	Square plastic plates	Clean
	3rd Street, Lakeport	Concrete discs	Clean
	5th Street, Lakeport	Square plastic plates	Clean
	Redbud Launch ramp	Square plastic plates	Clean
	Redbud Launch ramp	Square plastic plates	Clean
	Clearlake Oaks	Concrete discs	Clean
	Clear Lake State Park	Square plastic plates	Clean
	Clear Lake State Park - new	Square plastic plates	Clean
	Keeling Park	Concrete discs	Clean
	Lakeside Park	Square plastic plates	Clean
	Konocti Vista Casino Resort	Concrete discs	Clean
	Braitto's Marina	Concrete discs	Clean
	Lucerne Harbor	PVC pipe	Clean
Blue Lakes	Narrows Resort	Concrete discs	Clean
Lake Pillsbury	Pillsbury Resort	Square plastic plates	*
	Fullers campground	PVC pipe	*
Hidden Valley	Fishing dock	Square plastic plates	Clean
	Marina	Square plastic plates	Clean
Highland Springs	Floating Buoy by Dam	Square plastic plates	Clean

\*Inaccessible due to low water levels, substrates were removed from infrastructure.



*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

**Table 5: Infrastructure and Surface structure surveys -2021**

<b>Waterbody</b>	<b>Location</b>	<b>Type</b>	<b>Tech</b>	<b>Date</b>	<b>Result</b>
Clear Lake	Library Park	Shoreline, linear	R.Carey	April 30, 2021	Clean
	Rodman Slough	Shoreline, linear	R.Carey J. Beaton E. Belanger	Sept 29, 2021	All Clean
	Holiday Harbor Beach	Shoreline, linear			
	Lucerne Harbor	Point, and shoreline linear			
	Davis Beach	Shoreline, Beach			
	Clear Lake Oaks	Shoreline, Beach			
	Lakeside County Park	Point and shoreline, linear			
	Lakeport, 3 <sup>rd</sup> street	Shoreline, linear			
Indian Valley	Beach on Dam side	Shoreline, linear	W. Fox R. Carey A. DePalma-Dow	May 11, 2021	Clean
Lake Pillsbury	Fuller's Campground Ramp	Point, Visual Dock survey	C. Husted, R. Carey, A. DePalma-Dow	March 8, 2021	Clean

**Table 6: Average water quality measurements from Blue Lakes, Clear Lakes, Highland Springs, and Indian Valley Reservoir (2019) and parameter ranges shown to be suitable for the growth and establishment of (Adult) Q/Z mussels. All WQ sonde samples reported here are collected at same depth as tow (~5m max). Chemical analysis are collected from surface grab at 0.5 m.**

<b>Year, Month</b>	<b>Temp (°C)</b>	<b>Conductivity (uS/cm)</b>	<b>pH*</b>	<b>D.O. (mg/l)</b>	<b>Hardness<sup>1</sup> (mg/L CaCo3)</b>	<b>Salinity (ppm)</b>	<b>Calcium<sup>1</sup> (mg/L)</b>
<b>Blue Lakes - Upper</b>							
2020, Oct 20	19.0	268.3	7.9	8.08	N/A	N/A	N/A
2020, Oct 28	17.9	269.2	8.05	8.05	N/A	N/A	N/A
2021, May	17.4	254.5	9.4	9.48	125	ND**	31
<b>Clear Lake</b>							
2020, Jan	12.3	289	7.8	9.3	114 <sup>1</sup>	N/A	21
2020, June	26.0	312.0	8.8	11.56	N/A	N/A	N/A
2020, Dec	9.3	378.7	7.8	9.24	138	N/A	26
2021, May	19.4	368.6	8.3	7.57	162	N/A	30
2021, June	21.2	376.4	8.4	6.37	N/A	N/A	N/A
2021, Oct	17.0	403.9	8.9	6.92	N/A	N/A	N/A

*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

2021, November	17.6	372.4	8.2	6.22	201	N/A	38
<b>Highland Springs Reservoir</b>							
2021, July	26.8	590	8.0	7.47	N/A	N/A	N/A
<b>Indian Valley Reservoir</b>							
2019, Sept	N/A	N/A	10.0	N/A	N/A	N/A	22.0
2021, May	18.1	343.4	9.8	8.84	156	ND**	25
Preferred Range for Q/Z mussels	6-32 <sup>2</sup>	>22 $\mu$ S/cm <sup>3</sup>	6.5-9.5 <sup>2</sup>	>2-6 <sup>2</sup>	100-420 <sup>2</sup>	0-12 <sup>3</sup>	>12 <sup>2</sup>

\*Where multiple measurements were taken in one month, the pH value reflects an average

\*\* Sampled, non-detect salinity at DL and RL of 2.0 g/kg method SM2520B.

<sup>1</sup> Hardness and Calcium measured in Dissolved Species; Data provided by DWR (Surface 0.5 m, Upper Arm) Water Data Library <http://wdl.water.ca.gov/waterdatalibrary/>

<sup>2</sup> Data provided by *Pucherelli et al. 2016 (BLM)*

<sup>3</sup> Data provided by *Cohen 2005 (prepared for CDWR)*

## **Discussion**

There are several important factors to consider when assessing the vulnerability of a waterbody, or bodies, to the introduction and establishment of invasive mussels. The first factor, which determines the introduction, is the likelihood that a mussel, adult or veliger, could be introduced to the waterbody. Due to the inability of these species to walk, fly, or be transported among non-hydrologically connected waterbodies, the main source of distribution across long, terrestrial distances is through transport on trailers and/or boats or boating equipment (Cohen 1998; Dalton & Cottrell 2013). Additional research by Collas et al. (2021) has found that even when exposed to air and wind speeds over 50km per hour, an adult quagga mussel can survive attached to a boat hull for up to 18 hours. Infested waterbodies exist within that range of Clear Lake, making the likelihood of an introduction via boat likely. The second factor is the probability of the invasive species, once introduced, has suitable habitat to survive, reproduce and become established. Habitat suitability for invasive mussels is based on several specific environmental conditions of the waterbody, such as temperature, conductivity, pH, DO, hardness, salinity, and calcium (Cohen 2005; 2008). Based on the water quality chemical and physical parameters collected from at least four waterbodies in the county, Clear Lake, Upper Blue Lakes, Lake Pillsbury, and Indian Valley Reservoir (**Table 6**) and Highland Springs, contain the appropriate water quality parameters and habitat, year-round, for invasive mussels to survive and become established. The remaining factor, which can most easily be controlled, is the introduction risk by boat or trailers.

The single most important water characteristic that indicates a high risk of colonization is a calcium level of 15 mg/L or greater. Clear Lake has an average 25 mg/L calcium level (DWR Water Data Library 2019 and LCWPD Data). Likewise, other Lake County Water bodies including Indian Valley, Blue Lakes and Pillsbury are all above 15mg/L Ca+.

With preferable environmental conditions well-suited to an invasive mussel establishment, preventing and managing all vulnerable introduction pathways is going to be the best strategy for preventing an invasion.

When considering these two factors together, likelihood for an introduction coupled with the required water quality environment, Clear Lake, the largest waterbody in the county does contain preferable environmental conditions for the establishment of Q/Z mussels. Therefore, because Clear Lake has a high probability of Q/Z introduction, establishment and invasion, monitoring becomes a vital important component of the management and prevention effort in both the lake and throughout the county.

## **References**

California Department of Water Resources (DWR) Water Data Library. Available at: <http://wdl.water.ca.gov/waterdatalibrary/> Accessed January 2019.

Cohen, A.N. (2005). A review of Zebra Mussels' Environmental Requirements. A Report for the California Department of Water Resources. San Francisco Estuary Institute. Accessible: [https://www.sfei.org/sites/default/files/biblio\\_files/No420\\_2005-ZebraMusselRequirements.pdf](https://www.sfei.org/sites/default/files/biblio_files/No420_2005-ZebraMusselRequirements.pdf)

Cohen. (2008). Potential Distribution of Zebra Mussels and Quagga Mussels in California, Phase1 Report Available at: <file:///W:/Quagga%20Mussel%20Program/Literature/Cohen%202008-06-zebra-quagga-ca-distribution.pdf>

Collas, F.P.L., E. Arends, M. Buuts, and R.S.E.W. Leuven. 2021. Effect of airflow on overland transport potential of the invasive quagga mussel (*Dreissena bugensis*). *Management of Biological Invasions* 12(1):165-177. [https://www.reabic.net/journals/mbi/2021/1/MBI\\_2021\\_Collas\\_et al.pdf](https://www.reabic.net/journals/mbi/2021/1/MBI_2021_Collas_et al.pdf)

Dalton, L.B. & S. Cottrell (2013) Quagga and zebra mussel risk via veliger transfer by overland hauled boats. *Management of Biological Invasions* 4(2):129-133 [http://www.reabic.net/journals/mbi/2013/2/MBI\\_2013\\_2\\_Dalton\\_Cottrell.pdf](http://www.reabic.net/journals/mbi/2013/2/MBI_2013_2_Dalton_Cottrell.pdf)

Pucherelli, S., S.O. Meara, K. Bloom, J. Kirsch (2016). Habitat Suitability Parameters for Quagga Mussels in the Lower Colorado River System and at Reclamation Managed Facilities. Final report ST-2015-754F-01. Bureau of Reclamation Research and Development Office. Accessible at: [https://www.usbr.gov/research/projects/download\\_product.cfm?id=1552](https://www.usbr.gov/research/projects/download_product.cfm?id=1552)

*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

Whittier TR, PL Ringold, AT Herlihy, and SM Pierson. 2008. *A Calcium-based invasion risk assessment for zebra and quagga mussels (Dreissena spp)*. *Frontiers in Ecology and the Environment* 2008:6 doi:10.1890/070073.

**Attachment 1. 2021 Infested Counties List updated annually or as needed.**

*Updated Oct 2020*

**MUSSEL  
INFESTED  
COUNTIES  
CALIFORNIA**

**HIGH RISK**

**CALIFORNIA**  
Imperial  
Los Angeles  
Orange  
Riverside  
San Bernardino  
San Diego  
Ventura

**HIGH RISK  
SUSPECTED  
LAKES**

PERRIS  
CASTAIC  
SILVERWOOD  
PYRAMID

**HEAVILY  
INFESTED  
LAKES**

MEAD  
PIRU  
POWELL  
HAVASU  
MOHAVE  
COLORADO RJVER  
SKINNER  
EL CAPITAN  
OTAY  
HODGES

**MUSSEL INFESTED  
COUNTIES in the  
WESTERN STATES**

**HIGH RISK**

**ARIZONA**  
Coconmo  
Gila  
La Paz  
Maricopa  
Mohave  
Yuma

**COLORADO**  
Archuleta  
Grand  
Logan  
Park  
Pueblo

**MONTANA**  
Liberty  
Lewis & Clark  
Broadwater  
Washington

**NEW MEXICO**  
De Baca  
Rio Ariba  
San Juan

**NEVADA**  
Churchill  
Clark  
Elko  
Lyon  
Pershing

**UTAH**  
Emery  
Garfield  
Kane  
San Juan  
Uintah  
Wasatch  
Washington

**TEXAS**

All Vessels Launched in  
Texas in the PAST 30  
Days Must be inspected

**STATES NOT INFESTED**

**LOW RISK**

**Alaska**  
**Florida**  
**Hawaii**  
**Idaho**  
**Maine**  
**New Hampshire**  
**New Jersey**  
**North Carolina**  
**Oregon**  
**Rhode Island**  
**South Carolina**  
**Washington**  
**Wyoming**

## **Attachment 2. Outreach Education products and results 2021.**

Some additional noteworthy results and outcomes from mussel prevention programming in Lake County include the following:

1. 2021 participation in the Lake County Mussel Sticker Program
  - a. Approximately 38 business / vendors / screeners participated in the Sticker program during 2021.
  - b. Sold 4,925 resident stickers, 8,841 visiting monthly stickers, totaling 13,766 in 2021 (compared to 14,273 sold in 2020 and 15,154 stickers during 2019). Lower numbers being sold during the second half of the season were attributed to low water levels reducing the number of open and accessible boat ramps and reduction or cancellation of fishing events and contests.
  - c. During 2021, we conducted 23 vessel inspections (compared to 51 in 2020, and 170 inspections in 2019), and an additional 201 inspections were conducted by Mussel Dogs. Only two (2) of the staff inspections resulted in a spot, partial or went through a full decontamination. This is probably due to state-wide and regional reduction in reservoir or waterbody access due to drought-induced low water levels.
    - i. No adult mussels were found on any vessel in 2021.
  - d. County staff and sheriffs issued 3 citations for non-compliance to visiting boaters launching into Clear Lake without acquiring the required screening and sticker. This is compared to 3 issued in 2020, 6 issued in 2019 and 8 issued in 2018.
    - i. Reduction in citations in 2021 is probably due to overall less lake activity and drought conditions.
2. Outreach and educational efforts improve Q/Z outreach and education

Majority of in-person outreach events were still limited, due to continuing concerns around COVID-19. However, several outreach milestones were accomplished over the 2021 year.

  - a. New road signs were purchased and installed around the County, and this effort is ongoing. The new signs are reflective to be seen at night and inform



*Dreissenid Mussel Prevention Program Annual Report-2021  
Lake County Watershed Protection District*

the public to Clean, Drain, Dry and that it is the law in Lake County to acquire a mussel sticker. The signs were posted at two locations (Hwy 29 and Lakeport Blvd and Rodman Slough).

b.

c. Program sharing at academic conferences. Lake County District staff program Coordinator (Angela D. Dow) presented this program at two venues during 2021 to share with others in aquatic sciences and management how the Clear Lake prevention program works. These presentations are to global audiences and are research, academic, and management focused.

- i. **Event #1:** Presentation in the AIS special session and panel at the Annual Society for Freshwater Science Annual (virtual) meeting. You can view the abstract submission and presentation details here: [https://sfsannualmeeting.org/Schedule/grid\\_details.cfm?aid=14701](https://sfsannualmeeting.org/Schedule/grid_details.cfm?aid=14701)



- ii. **Event #2:** Presentation to the North American Lakes Management Society Annual (virtual) Meeting being held November 15-19, 2021. More information on session details can be found here: <https://www.nalms.org/nalms2021/program/general-sessions/>
- iii.

General Session 3
<b>Invasive Species</b>
Keeping Invasive Q/Z Mussels Out of the America's Favorite Bass Fishing Lake, Clear Lake, California, USA <i>Angela De Palma-Dow, County of Lake Water Resources Department, Lakeport, California</i>
Meet Them Where They're at: An Industry Approach to AIS Prevention <i>Brant Dupree, Big Sky Watershed Member, Missoula, Montana</i>
Baited Box Netting as an Effective and Efficient Way to Selectively Remove Invasive Common Carp <i>M. Vincent Hirt, Carp Solutions LLC, New Brighton, Minnesota</i>
Apparent Eradication of Zebra Mussels ( <i>Dreissena polymorpha</i> ) From an Entire Lake Using Low Doses of EarthTec QZ Ionic Copper <i>David Hammond, Earth Science Laboratories, Inc., Rogers, Arkansas</i>