



# **Annual Report:**

## **2018 Dreissenid Mussel Prevention Program**

### **Early Detection Monitoring**

**Lake County Watershed Protection District**  
**April 12, 2019.**

### **Purpose**

This document summarizes the continued implementation of the Lake County Quagga/Zebra Mussel Prevention Program from January 1, 2018 through December 31, 2018 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 submit an annual report that summarizes any changes in the reservoir's vulnerability, monitoring methods and results, and any resulting program conclusions.

### **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 also 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 [43 locations in California \(CDFW January 2019\)](#). On January 16, 2008, zebra mussels were discovered in San Justo Reservoir, San Benito County, California.

Lake County has always been especially susceptible to invasive Quagga / Zebra mussel (herein referred to as "Q/Z") invasion risk because of Clear Lake, the largest natural freshwater lake located entirely within California. This lake is a fishing destination, attracting professional bass fishermen from all over the country, and was rated within the top three best bass fishing lakes in the continental US by Bassmaster Magazine in 2016. 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. Because invasive mussels are primarily spread by boaters, the probability of an Q/Z invasive mussel introduction via one of at least 750 public or private boat ramps on the lake is high.

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](#) available on the counties 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 resident origin and most recently-visited waterbody (High risk locations are provided in a 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 prevention plan and programs (More information on education and outreach results and products is available in **Attachment 2**).

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 the California Department of Fish and Wildlife (CDFW). The monitoring program includes artificial substrate monitoring, infrastructure / surface structure surveys, and 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 by CDFW during lake monitoring. Lake County tracks publically-accessible data through Department of Water Resources (WDR) [Water Data Library](#).

Based on 2018 monitoring, Clear Lake, Indian Valley Reservoir, and Lake Pillsbury, the three largest of Lake County's waterbodies with public access, have not had a positive detection of Q/Z mussels. However, 2018 in Lake County was an especially unusual year, with less boating activity compared to other years due to the Mendocino Complex Wildfire that occurred during July 27<sup>th</sup>, 2018 – September 18<sup>th</sup>. For the majority of this time period, lake communities were evacuated, ramp and lake access was restricted, and significant compromised air quality created conditions unsuitable to boating and fishing.

## **Monitoring Methods**

The primary agency responsible for managing the Q/Z mussel program in Lake County is the Lake County Watershed Protection District ("District"). The Lake County Watershed Protection 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 its Board of Directors. The

District functions 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 program. The California Department of Fish and Wildlife (CDFW) conducts veliger tows 2-3 times a year at multiple sites in Lake County including Clear Lake and Indian Valley Reservoir, with PG&E conducting tows in Lake Pillsbury. The District performs substrate monitoring in Blue Lakes, Lake Pillsbury, and Hidden Valley Lake. The California State Parks Division of Boating and Waterways provides Q/Z grant funds to support the County’s boat ramp monitor network for Clear Lake, inspection training and equipment, and all essential educational materials.

**Table 1 Type of trailered watercraft access and monitoring for selected Lake County waterbodies.**

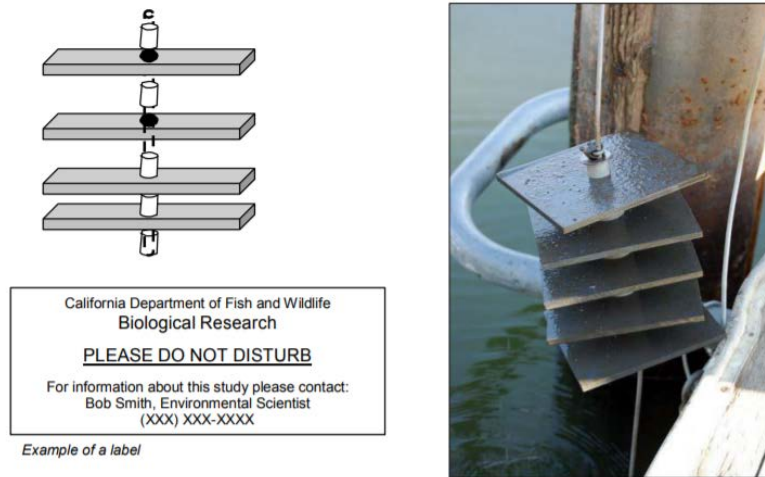
Lake Name	Vessel Accessibility Type (Public vs. Private)	Type of Q/Z Mussel Monitoring			
		Veliger Tows (CDFW or PG&E)	Artificial Substrate Monitoring Stations (LCWRD)	Infrastructure / Surface Monitoring	None
Blue Lakes	Private		✓		
Clear Lake	Public	✓ (CDFW)	✓	✓	
Hidden Valley Lake	Private		✓		
Highland Springs	Public*				✓**
Indian Valley	Public	✓ (CDFW)			
Lake Pillsbury	Public	✓ (PGE)			

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

\*\*Q/Z mussel signage is being added 2019 along with a substrate monitoring station.

- 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 2). Placement of these 18 substrates is based on proximity to a potential introduction pathways, 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, except for the months of December and January, however the substrates remain in the water year round. Current results of artificial substrate monitoring indicate that all

substrates are clean and the county currently does not have any detections of invasive mussels established on artificial substrates (Table 4).



***Figure 1 Artificial substrate example provided by the CDFW.***

- b) Infrastructure / Surface structure surveys are also performed by the District at the end of summer season when temporary docks and associated infrastructure are removed from Clear Lake 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. To date there have been no findings of invasive mussel presence or establishment from these surface surveys. Prior to 2019, the protocol for this monitoring did not follow the [recommended CDFW protocols in regards to Minimum Sample](#) size (page 3), however, starting in 2019, Lake County staff will be implementing a revised surface survey protocol that will match the CDFW requirements.
- c) Veliger tows are performed by CDFW Region 2 regional biologist Angie Montalvo. CDFW conducts mussel monitoring in all high risk water bodies in the state according to the protocols outlined in online at [CDFW Mussel Tow protocols](#). Within Lake County, CDFW collects drag tows 2-3 times a year in Indian Valley Reservoir and Clear Lake. The veliger monitoring in Lake Pillsbury is completed by PG&E, who own and manage the Scott's dam and reservoir. Based on tow data collected during 2018, there are currently no positive detections for invasive mussel veligers in these Lake County waterbodies at this time.
- d) Special Districts Water intake monitoring. Lake County Special Districts operates or oversees approximately 17 water intakes on Clear Lake. Because fish screens in intake sites, and the intake themselves are constructed of materials that pose risk for colonization, Special Districts is aware of the importance of monitoring for maximized

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.

## **Monitoring Results**

Veliger tows were completed by CDFW1-2 times during 2018, in Clear Lake (n=19) and Indian Valley Reservoir (n=2) and resulted in no positive detections of Q/Z mussel veligers (Table 2). Artificial substrate monitoring was performed by both Lake County Water Resources staff in Clear Lake (n=13), Blue Lakes (n=2), Lake Pillsbury (n=2), and by citizen monitors in Hidden Valley Lake (n=2) and results from these surveys resulted in no positive detections of attached adult Q/Z mussels (Table 3). Results from all monitoring surveys during 2018 returned no detection of Q/Z in the sampled water bodies.

In addition, lake water quality conditions in Clear Lake and Indian Valley Reservoir, such as water temperature, calcium, pH, dissolved oxygen, turbidity, and salinity, are well within the ranges preferred by Q/Z mussels. (Pucherelli et al. 2016, Whittier et al. 2008; Cohen 2005;2008) (Table 4).

**Table 2: 2018 Results of Veliger Tows In Lake County Provided by CDFW (site results are aggregated)**

<b>Waterbody</b>	<b>Month</b>	<b>Result</b>
Clear Lake	April	ND
	August	*
	September	ND
Indian Valley Reservoir	August	*
	October	ND

\*No sampling was conducted this month due to the Mendocino Fire Complex

**Table 3: Results of Artificial Substrate Inspections – 2018**

<b>Waterbody</b>	<b>Site</b>	<b>Material</b>	<b>2018</b>
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	Clean
	3rd Street, Lakeport	Concrete discs	Clean
	5th Street, Lakeport - new	Square plastic plates	Clean
	Redbud Launch ramp	Square plastic plates	Clean
	Redbud Launch ramp - new	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

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	Lakeside Park - new	Square plastic plates	Clean
	Konocti Vista Casino Resort	Concrete discs	Clean
	Braitto's Marina	Concrete discs	Clean
	Lucern Harbor	PVC pipe	Clean
Blue Lakes	Narrows Resort	Concrete discs	*
Lake Pillsbury	Pillsbury Resort	Square plastic plates	*
	Fullers campground	PVC pipe	*
Hidden Valley	Fishing dock	Square plastic plates	Clean
	Marina	Square plastic plates	Clean

\*No Access to this site due to the Mendocino Complex Fire Event and resulting closure.

**Table 4 Average water quality measurements from Clear Lake and Indian Valley Reservoir (2016-2018) and parameter ranges shown to be suitable for the growth and establishment of (Adult) Q/Z mussels. All data is provided by A. Montalvo (CDFW) unless otherwise noted.**

Year	Temp (°C)	Conductivity (mS/cm)	pH	D.O. (mg/l)	Total Hardness <sup>1</sup> (mg/L CaCo3)	Salinity (ppm)	Total Calcium <sup>1</sup> (mg/L)
<i>Clear Lake</i>							
2016 May	22.3	0.4	8.7	6.6	173.0	0.2	30.0
2016, Nov	16.7	243.0	9.5	3	131.0	0.1	23.0
2017, April	14.4	0.3	8.3	1.2	113.0	0.1	21.0
2017, July	26.0	263.0	10	7.0	123.0	0.1	22.0
2017, Oct	17.4	257.1	9.1	2.9	127.0	0.1	23.0
2018, April	16.0	243.3	8.6	1.6	N/A	0.1	N/A
2018, Oct	18.5	304.9	7.5	6.2	N/A	0.2	N/A
<i>Indian Valley Reservoir</i>							
2016, Dec	10.7	0.3	7.9	10.1	N/A	0.2	N/A
2017, June	22.8	223.4	8.7	6.9	N/A	0.1	N/A
2017, Oct	18.9	222.5	8.4	3.5	N/A	0.1	N/A
2018, Oct	19.9	253.7	8.1	6.3	N/A	0.1	N/A
Preferred Range for Q/Z mussels	6-32 <sup>2</sup>	>22µS/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>

<sup>1</sup> Data provided by DWR (Surface 0.5 m) 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 considering the vulnerability of a water body, 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 water body. Due to the inability of these species to walk, fly, or be transported among non-hydrologically connected water bodies, the main source of distribution across long, terrestrial distances is through transport on trailers boats (Cohen 1998; Dalton & Cottrell 2013). 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 water body, 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 two waterbodies in the county, Clear Lake and Indian Valley Reservoir (Table 4) contain the appropriate habitat for invasive mussels to survive and become established.

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). 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 water body 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)

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

<u>3/27/2019</u>	<u>MUSSEL INFESTED COUNTIES in the WESTERN STATES</u>	<u>MUSSEL INFESTED COUNTIES in the WESTERN STATES</u>	<u>MUSSEL INFESTED COUNTIES in the WESTERN STATES</u>
<u><b>MUSSEL INFESTED COUNTIES CALIFORNIA</b></u>	<u><b>HIGH RISK</b></u>	<u><b>HIGH RISK</b></u>	<u><b>HIGH RISK</b></u>
<b>CALIFORNIA</b> Imperial Los Angeles Orange Riverside San Bernardino San Diego Ventura	<b>ARIZONA</b> Coconino Gila La Paz Maricopa Mohave Yuma	<b>TEXAS</b>  ALL VESSELS LAUNCHED IN TEXAS IN THE PAST 30 DAYS MUST BE INSPECTED	<b>MONTANA</b> Liberty Lewis & Clark Broadwater Washington
<u><b>NEWLY INFESTED LAKES</b></u>	<b>COLORADO</b>		
PERRIS CASTAIC SILVERWOOD PIRU PYRAMID	Archuleta Grand Logan Park Pueblo		
<u><b>HEAVILY INFESTED LAKES</b></u>	<b>NEW MEXICO</b>		<u><b>STATES NOT MUSSEL INFESTED</b></u>
MEAD POWELL HAVASU MOHAVE COLORADO RIVER SKINNER EL CAPITAN OTAY HODGES	De Baca Rio Arriba San Juan		<u><b>LOW RISK</b></u>
	<b>NEVADA</b> Churchill Clark Elko Lyon Pershing		Alaska Florida Hawaii Idaho Maine New Hampshire New Jersey North Carolina Oregon Rhode Island South Carolina Washington Wyoming
	<b>UTAH</b> Emery Garfield Kane San Juan Uintah Wasatch Washington		

## **Attachment 2. Outreach Education products and results 2018.**

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

1. 2018 participation in the Lake County Mussel Sticker Program
  - a. About 32 business / vendors participated in the Sticker program during 2018.
  - b. Sold 5,849 resident stickers, 7,763 visiting monthly stickers, totaling 13,612 stickers during 2018. Lower numbers sold for 2018 were probably attributed to the Mendocino Complex wildfire that was active and contributed to unfavorable smoky conditions over Clear Lake during July-August, 2018.
  - c. During 2018 about 12,623 vessels were screened, 163 vessels were visually inspected and 29 boats went through decontamination.
  - d. County staff and sheriffs issued 8 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 2017 and 22 issued in 2016.
  
2. Outreach and educational efforts Improve Q/Z outreach and education
  - a. Updated and purchased new educational signage and advertising
    - i. Signage/ kiosks were designed and purchased in 2018 and will be installed during 2019
    - ii. Advertising in the form of educational radio PSAs went into effect during May –October 2018.
    - iii. Increased social media / digital presence by updating and maintaining the Water Resources Department Facebook page. Q/Z mussel prevention program posts have proved to be some of the most popular type of posts. For example a post from December 2018 directing boaters to get their new 2019 mussel sticker reached over 1000 people and received 116 interactive engagements. Additional Social Outreach Q/Z relate posts are provided in Table 4 below.

## April 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	4.5	2011	4/3/2018	no mussels
Clear Lake	3rd Street, Lakeport	Concrete discs	County	39.04396	-122.91301	7	2007	4/3/2018	no mussels
Clear Lake	5th Street, Lakeport	Concrete discs	County	39.04534	-122.91292		2007		missing dock damaged
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	5.5	2011	4/3/2018	no mussels
Clear Lake	Redbud Launch ramp	Concrete discs	County	38.94855	-122.63778	6	2007	4/4/2018	no mussels
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	8	2014	4/4/2018	no mussels
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	7	2007	4/4/2018	no mussels
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327	7	2015	4/3/2018	no mussels
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	5	2011	4/3/2018	no mussels
Clear Lake	Keeling Park	Concrete discs	County	39.12114	-122.8551	7	2007	4/3/2018	no mussels
Clear Lake	Lakeside Park - new	Square plastic plates	County	39.02944	-122.8477	5	2011	4/3/2018	no mussels
Clear Lake	Lakeside Park	PVC pipe	PSU, Oregon	39.012	-122.776	7	2007	4/3/2018	no mussels
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777		2007		access bolcked
Clear Lake	Braitto's Marina	Concrete discs	County			7	2007	4/4/2018	no mussels
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	4	2004	4/3/2018	no mussels
Clear Lake	Lucerne Harbor	Concrete discs	County	39.09046	-122.7972	4	2007	4/4/2018	no mussels
Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586		2010		resort closed no access
Pillsbury	Pillsbury Resort	PVC pipe	F&G Region 2	39.421472	-122.957972		2007		dock removed
Pillsbury	Fullers campground	Square plastic plates	County				2010		dock removed
Hidden Valley	Fishing dock		County			5	2012	4/16/2015	no mussels
Hidden Valley	Marina		County			4	2012	4/16/2015	no mussels

Mussels P/A: present or absent)

Notes: Comments on substrates, e.g., missing, damaged, etc.

## May 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	4.5	2011	4/3/2018	no mussels
Clear Lake	3rd Street, Lakeport	Concrete discs	County	39.04396	-122.91301	7	2007	5/15/2018	no mussels
Clear Lake	5th Street, Lakeport	Concrete discs	County	39.04534	-122.91292		2007		missing dock damaged
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	5.5	2011	5/15/2018	no mussels
Clear Lake	Redbud Launch ramp	Concrete discs	County	38.94855	-122.63778	6	2007	5/17/2018	no mussels
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	8	2014	5/17/2018	substrate was removed from water
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	7	2007	5/17/2018	no mussels
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327	7	2015	5/15/2018	no mussels
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	5	2011	5/15/2018	no mussels
Clear Lake	Keeling Park	Concrete discs	County	39.12114	-122.8551	7	2007	5/17/2018	no mussels
Clear Lake	Lakeside Park - new	Square plastic plates	County	39.02944	-122.8477	5	2011	5/15/2018	no mussels
Clear Lake	Lakeside Park	PVC pipe	PSU, Oregon	39.012	-122.776	7	2007	5/15/2018	no mussels
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777		2007		access blocked
Clear Lake	Braitto's Marina	Concrete discs	County			7	2007	5/15/2018	no mussels
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	4	2004	5/15/2018	no mussels
Clear Lake	Lucerne Harbor	Concrete discs	County	39.09046	-122.7972	4	2007	5/17/2018	no mussels
Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586		2010		resort closed no access
Pillsbury	Pillsbury Resort	PVC pipe	F&G Region 2	39.421472	-122.957972		2007		dock removed
Pillsbury	Fullers campground	Square plastic plates	County				2010		dock removed
Hidden Valley	Fishing dock		County			5	2012	5/12/2018	no mussels
Hidden Valley	Marina		County			4	2012	5/12/2018	no mussels

## June 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	4.5	2011	6/20/2018	Replaced substrate on new dock
Clear Lake	3rd Street, Lakeport	Concrete discs	County	39.04396	-122.91301	7	2007	6/20/2018	no mussels
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	5.5	2011	6/20/2018	no mussels
Clear Lake	Redbud Launch ramp	Concrete discs	County	38.94855	-122.63778	6	2007	6/20/2018	no mussels
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	8	2014	6/20/2018	no mussels
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	7	2007	6/20/2018	no mussels
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327	7	2015	6/20/2018	no mussels
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	5	2011	6/20/2018	no mussels
Clear Lake	Keeling Park	Concrete discs	County	39.12114	-122.8551	7	2007	6/23/2018	no mussels
Clear Lake	Lakeside Park - new	Square plastic plates	County	39.02944	-122.8477	5	2011	6/20/2018	no mussels
Clear Lake	Lakeside Park	PVC pipe	PSU, Oregon	39.012	-122.776	7	2007	6/20/2018	no mussels
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777		2007		access blocked
Clear Lake	Braitto's Marina	Concrete discs	County			7	2007	6/20/2018	no mussels
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	4	2004	6/20/2018	no mussels
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Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586		2010		resort closed no access
Pillsbury	Pillsbury Resort	PVC pipe	F&G Region 2	39.421472	-122.957972	5	2007	5/29/2018	Replaced substrate on new dock
Pillsbury	Fullers campground	Square plastic plates	County			5	2010	5/29/2018	Replaced substrate on new dock
Hidden Valley	Fishing dock		County			5	2012	6/15/2018	no mussels
Hidden Valley	Marina		County			4	2012	6/15/2018	no mussels

## July 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	4	2011	7/20/2018	no mussels
Clear Lake	3rd Street, Lakeport	Concrete discs	County	39.04396	-122.91301	5.5	2007	7/20/2018	no mussels
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	3.5	2011	7/20/2018	no mussels
Clear Lake	Redbud Launch ramp	Concrete discs	County	38.94855	-122.63778	3	2007	0722/2018	no mussels
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	6.5	2014	7/22/2018	no mussels
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	5	2007	7/22/2018	no mussels
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327	4	2015	7/20/2018	no mussels
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	4	2011	7/20/2018	no mussels
Clear Lake	Keeling Park	Concrete discs	County	39.12114	-122.8551	4	2007	7/20/2018	no mussels
Clear Lake	Lakeside Park - new	Square plastic plates	County	39.02944	-122.8477	3	2011	7/20/2018	no mussels
Clear Lake	Lakeside Park	PVC pipe	PSU, Oregon	39.012	-122.776	4	2007	7/20/2018	no mussels
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777	4	2007	7/20/2018	no mussels
Clear Lake	Braitto's Marina	Concrete discs	County			5	2007	7/20/2018	no mussels
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	3.5	2004	7/20/2018	no mussels
Clear Lake	Lucerne Harbor	Concrete discs	County	39.09046	-122.7972	2	2007	7/20/2018	no mussels(low water level)
Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586		2010		no access resort closed
Pillsbury	Pillsbury Resort	Square plastic plates	County	39.421472	-122.957972	4	2017	7/16/2018	no mussels
Pillsbury	Fullers campground	Square plastic plates	County			5	2010	7/16/2018	Missing replaced with new
Hidden Valley	Fishing dock		County				2012		
Hidden Valley	Marina		County				2012		

## Sept 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	3.5	2011	9/13/2018	CLEAN
Clear Lake	3rd Street, Lakeport	Concrete discs	County	39.04396	-122.91301	5	2007	9/13/2018	CLEAN
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	3.5	2011	9/13/2018	CLEAN
Clear Lake	Redbud Launch ramp	Square plastic plates	County	38.94855	-122.63778	3	2018	9/14/2018	replaced concrete with plastic
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	6	2014	9/14/2018	CLEAN
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	4	2007	9/14/2018	CLEAN
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327	4	2015	9/13/2018	CLEAN
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	3.5	2011	0913/2018	CLEAN
Clear Lake	Keeling Park	Concrete discs	County	39.12114	-122.8551	3	2007	9/14/2018	CLEAN
Clear Lake	Lakeside Park - new	Square plastic plates	County	39.02944	-122.8477	3	2011	9/13/2018	CLEAN
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777	4	2007	9/13/2018	CLEAN
Clear Lake	Braitto's Marina	Concrete discs	County			5	2007	9/13/2018	CLEAN
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	3	2004	9/13/2018	CLEAN
Clear Lake	Lucerne Harbor	Concrete discs	County	39.09046	-122.7972	0	2007	9/14/2018	LOW WATER
Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586		2010		NO ACCESS RESORT CLOSED
Pillsbury	Pillsbury Resort	PVC pipe	F&G Region 2	39.421472	-122.957972		2007		NO ACCESS FIRE CLOSURE
Pillsbury	Fullers campground	Square plastic plates	County				2010		NO ACCESS FIRE CLOSURE
Hidden Valley	Fishing dock		County			4	2012	9/20/2018	CLEAN
Hidden Valley	Marina		County			3	2012	9/20/2018	CLEAN

## Oct 2018 - Artificial Substrate Monitoring

Waterbody	Sampling Site	Type	Agency / ownership	Latitude	Longitude	Depth (ft)	Date Installed	Date Inspected	Mussels P/A
Clear Lake	3rd Street, Lakeport - new	Square plastic plates	County	39.04391	-122.91305	3	2011	10/17/2018	CLEANED
Clear Lake	3rd Street, Lakeport	Square plastic plates	County	39.04396	-122.91301	4	2018	10/17/2018	REPLACED WITH PLASTIC/ NO MUSSELS
Clear Lake	5th Street, Lakeport	Concrete discs	County	39.04534	-122.91292	3	2007	10/17/2018	CLEANED
Clear Lake	5th Street, Lakeport - new	Square plastic plates	County	39.04534	-122.91293	3	2011	10/17/2018	CLEANED
Clear Lake	Redbud Launch ramp	Concrete discs	County	38.94855	-122.63778	4	2014	10/18/2018	CLEANED
Clear Lake	Redbud Launch ramp - new	Square plastic plates	County	38.94847	-122.6378	4	2014	10/18/2018	CLEANED
Clear Lake	Clearlake Oaks	Concrete discs	County	39.01923	-122.67408	4	2007	10/18/2018	CLEANED
Clear Lake	Clear Lake State Park	Square plastic plates	County	39.02018	-122.81327		2015	10/17/2018	CLEANED
Clear Lake	Clear Lake State Park - new	Square plastic plates	County	39.02017	122.81323	2.5	2011	10/17/2018	CLEANED
Clear Lake	Keeling Park	Square plastic plates	County	39.12114	-122.8551	2	2007	10/17/2018	REPLACED WITH PLASTIC/ NO MUSSELS
Clear Lake	Lakside County Park	Square plastic plates	County	39.02944	-122.8477	3	2011	10/17/2018	CLEANED
Clear Lake	Konocti Vista Casino Resort	Concrete discs	County	39.02214	-122.88777	2.5	2007	10/17/2018	CLEANED
Clear Lake	Braitto's Marina	Concrete discs	County			4	2007	10/17/2018	CLEANED
Clear Lake	Braitto's Marina	PVC pipe	DWR, Sacto	39.02143	-122.75164	3	2004	10/17/2018	CLEANED
Clear Lake	Lucerne Harbor	Concrete discs	County	39.09046	-122.7972		2007		
Blue Lakes	Narrows Resort	Square plastic plates	County	39.17423	-123.01586			2010	NO ACCESS RESORT CLOSED/ LOCKED
Pillsbury	Pillsbury Resort	PVC pipe	F&G Region 2	39.421472	-122.957972			2007	NO ACCESS ROAD CLOSED DUE TO FIRE
Pillsbury	Fullers campground	Square plastic plates	County					2010	NO ACCESS ROAD CLOSED DUE TO FIRE
Hidden Valley	Fishing dock		County			3.5	2012	10/18/2018	CLEANED
Hidden Valley	Marina		County			3	2012	10/18/2018	CLEANED



## Apr-18 Clear Lake

Waterbody Name	Sample Collection Date/ Time	YSI Multimeter Water Temperature (°C)	Gun Surface Water Temperature (°F)	pH Reading (Field)	DO (mg/L)	DO (% saturation)	Conductivity (corrected cond.)	Salinity (ppt)
<b>MEANS</b>	-	<b>16.02</b>	<b>63.83</b>	<b>8.59</b>	<b>1.63</b>	<b>16.89</b>	<b>243.34</b>	<b>0.10</b>
Clear Lake	4/25/2018 - 0940	16.6	64.2	8.57	2.4	26	240.3	0.1
Clear Lake	4/25/2018 - 0955	15.6	61.3	8.67	2.1	22	236.4	0.1
Clear Lake	4/25/2018 - 1005	15.4	63.8	8.6	2	21	237.1	0.1
Clear Lake	4/25/2018 - 1015	15	63.9	8.59	1.7	18	238.8	0.1
Clear Lake	4/25/2018 - 1025	15.4	62.8	8.57	0.5	5	243.3	0.1
Clear Lake	4/25/2018 - 1040	17.2	63.8	8.18	0.3	3	266.9	0.1
Clear Lake	4/25/2018 - 1058	17	62.6	8.72	1.9	19	247.4	0.1
Clear Lake	4/25/2018 - 1110	16.6	66.3	8.75	1.9	19	242.1	0.1
Clear Lake	4/25/2018 - 1120	15.4	65.8	8.69	1.9	19	237.8	0.1

## Oct-18 Clear Lake

Waterbody Name	Sample Collection Date/ Time	YSI Multimeter Water Temperature (°C)	Gun Surface Water Temperature (°F)	pH Reading (Field)	DO (mg/L)	DO (% saturation)	Conductivity (corrected cond.)	Salinity (ppt)
<b>MEANS</b>	-	<b>18.544</b>	<b>64.444</b>	<b>7.521</b>	<b>6.167</b>	<b>65.000</b>	<b>304.878</b>	<b>0.200</b>
Clear Lake	10/25/2018 - 1126	18.4	63.9	7.78	5.1	58	301.4	0.2
Clear Lake	10/25/2018 - 1137	18.4	65	7.29	5.5	62	302.6	0.2
Clear Lake	10/25/2018 - 1152	18.4	64.5	7.28	5.1	55	302.2	0.2
Clear Lake	10/25/2018 - 1208	18.7	62.4	7.35	5.4	60	309.7	0.2
Clear Lake	10/25/2018 - 1220	18.8	66.8	7.35	5.7	62	308.8	0.2
Clear Lake	10/25/2018 - 1232	18.8	64.6	7.31	5	53	307.6	0.2
Clear Lake	10/25/2018 - 1304	18.2	64.8	7.78	9.6	78	301.5	0.2
Clear Lake	10/25/2018 - 1318	18.2	65.2	7.81	6.5	72	305.8	0.2
Clear Lake	10/25/2018 - 1347	19	62.8	7.74	7.6	85	304.3	0.2

## Oct-18 Indian Valley

Waterbody Name	Sample Collection Date/ Time	YSI Multimeter Water Temperature (°C)	Gun Surface Water Temperature (°F)	pH Reading (Field)	DO (mg/L)	DO (% saturation)	Conductivity (corrected cond.)	Salinity (ppt)
MEANS		19.97	65.11	8.07	6.28	69	253.74	0.1
Indian Valley	10/11/2018 - 1210	19.9	62.8	7.76	6.4	70	252.3	0.1
Indian Valley	10/11/2018 - 1225	19.9	66.2	7.95	6.9	68	252.6	0.1
Indian Valley	10/11/2018 - 1230	19.7	64.9	8.05	7	71	252.9	0.1
Indian Valley	10/11/2018 - 1250	19.8	65.3	8.15	5.4	64	252.7	0.1
Indian Valley	10/11/2018 - 1302	20	66.1	8.23	5.9	66	254.2	0.1
Indian Valley	10/11/2018 - 1307	20.5	66.4	8.3	6.2	73	257.4	0.1
Indian Valley Ca+	10/11/2018 - 1210	19.9	62.8	7.76	6.4	70	252.3	0.1
Indian Valley Ca+	10/11/2018 - 1230	19.7	64.9	8.05	7	71	252.9	0.1
Indian Valley Ca+	10/11/2018 - 1250	19.8	65.3	8.15	5.4	64	252.7	0.1
Indian Valley Ca+	10/11/2018 - 1307	20.5	66.4	8.3	6.2	73	257.4	0.1