Appendix 4. City of San Diego Public Utilities Department Dreissena Mussel 2014 Annual Report

Introduction

In accordance with Fish and Game Code Section 2301, the Draft City of San Diego Public Utilities Department Dreissena Mussel Response and Control Plan was accepted by California Department of Fish and Wildlife (DFW) in early 2012. In fulfillment of the request by DFW to supply all activities related to dreissena mussels, the City is submitting this annual report. It is also the City's expectation that this report will suffice for the reporting requirements of its scientific collection permit.

Monitoring Results

To date, five City of San Diego owned reservoirs that receive water from the Colorado River Aqueduct have been confirmed to contain veligers and adult dreissena mussels. These reservoirs are El Capitan, Miramar, Murray, Otay and San Vicente (Figure 1). Neither veligers nor adult dreissena mussels have yet to be detected in Barrett, Morena and Sutherland Reservoirs, which are not connected to the Aqueduct. Hodges Reservoir, which now receives water from the Colorado River Aqueduct via a new pump station and pipeline that connects it to Olivenhain Reservoir, has tested positive for dreissena veligers. Veliger and adult population monitoring is being conducted on Hodges, Morena and Sutherland which allow private water craft. Since no private water crafts are permitted at Barrett, and the reservoir does not receive Colorado River Aqueduct water, Barrett Reservoir is at minimum risk of being colonized by Dreissenid mussels and is currently only being monitored with substrates. Table 1 identifies the locations of the monitoring substrates within each of the City's reservoirs of the adult monitoring.

Veliger monitoring is conducted with the use of a Wildco Plankton net (conical plankton-tow net, 63 μm pore size, 0.25 m diameter net opening, removable, weighted cod-end piece) which is lowered through the water column and allowed to rest at the desired depth for 60 seconds before it is raised slowly back to the surface. The sample is then condensed and stored in a labeled container and transported back to the City's Laboratory where it undergoes centrifugation. After centrifugation the concentrated sample/pellet at the bottom of the centrifuge tube is removed and placed in a marked 50 milliliter vial. Sub-samples of this sample are then examined using a cross polarizing microscope under 20x magnification.

- Water Quality Profiles
  In addition to monitoring for mussels the City also takes water quality profiles on a bi-weekly basis at most of its reservoirs. Currently the City uses the YSI 6600 data sonde with multiple sensors to collect the following parameters: dissolved oxygen, pH, temperature, depth, conductivity, oxygen reduction potential and chlorophyll pigment readings. Measurements are taken at one meter intervals from the surface of the water to 20 meters deep and every five meters thereafter until the sonde reaches the reservoir bottom. The dissolved oxygen data will be especially useful in determining were dreissena veliger/adults can survive within a water body.

Non-Infested Water bodies

- Barrett Reservoir
  In May of 2009 the City complied with a request by DFW to install a monitoring substrate in Barrett reservoir which is only monitored for adult settlement. Since its deployment, this substrate has been examined monthly with no Dreissena mussels being detected (Table 2).

Table 2 - Barrett Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)	Comments
Barrett	BA_QM_1	1/9/2014	A	
	BA_QM_1	2/6/2014	A	
	BA_QM_1	3/20/2014	A	
	BA_QM_1	4/17/2014	A	
	BA_QM_1	5/8/2014	A	
	BA_QM_1	6/6/2014	A	
	BA_QM_1	7/10/2014	A	
	BA_QM_1	8/21/2014	A	
	BA_QM_1	9/11/2014	A	
	BA_QM_1	10/9/2014	A	
	BA_QM_1	11/6/2014	A	
	BA_QM_1	12/4/2014	A	

A= Absent; NS =Not Sampled

- Hodges Reservoir
  Hodges Reservoir has one monitoring substrate located near the new inlet/outlet structure. The structure transports water to and from Olivenhain Reservoir, which has shown to be infested with dreissena mussels. Monitoring is conducted monthly with no dreissena mussels being detected (Table 4).
- Veliger monitoring was conducted 9 times at Hodges reservoir near the new in/outlet pipe (Station B). A majority of the 9 samples taken from Hodges were split into two subsamples; one which was analyzed by the City and the other was supplied to the San Diego County Water Authority (SDCWA) and analyzed by Scripps Institute of Oceanography. The result of the nine City samples are outlined in Table 3.

Table 3 - Lake Hodges, Morena and Sutherland 2014 Dreissena Veliger Sampling Results

Reservoir	Sample Date	Sample Location	Value (veligers/L)	Comments
Hodges	1/21/2014	Station B (Located near New In/Outlet)	A	2100 Liters sampled
	2/24/2014	Station B (Located near New In/Outlet)	A	2100 Liters sampled
	4/21/2014	Station B (Located near New In/Outlet)	A	2100 Liters sampled
	5/19/2014	Station B (Located near New In/Outlet)	A	2100 liters sampled
	7/21/2014	Station B (Located near New In/Outlet)	A	Heavy algae bloom present; not analyzed
	8/11/2014	Station B (Located near New In/Outlet)	A	Heavy algae bloom present; not analyzed
	10/13/2014	Station B (Located near New In/Outlet)	P	2100 liters sampled; 1 veliger, shell cracked, not active
	11/17/2014	Station B (Located near New In/Outlet)	A	2100 liters sampled
	12/15/2014	Station B (Located near New In/Outlet)	A	2100 Liters sampled
Morena	4/24/2014	Near Public Dock/ Launch Ramp	NA	Heavy algae bloom present; not analyzed
	5/7/2014	Near Public Dock/ Launch Ramp	A	2100 liters sampled
	11/5/2014	Near Public Dock/ Launch Ramp	A	2100 liters sampled
Sutherland	5/5/2014	Near Public Dock/ Launch Ramp	A	2100 Liters sampled
	8/18/2014	Near Public Dock/ Launch Ramp	A	2100 liters sampled
	11/3/2014	Near Public Dock/ Launch Ramp	A	2100 Liters sampled

A= Absent, ND=Non detect, NA=Not Analyzed

Table 4 - Hodges Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)
Hodges	HG_QM_2	1/21/2014	A
	HG_QM_2	2/24/2014	A
	HG_QM_2	3/17/2014	A
	HG_QM_2	4/21/2014	A
	HG_QM_2	5/19/2014	A
	HG_QM_2	6/20/2014	A
	HG_QM_2	7/24/2014	A
	HG_QM_2	8/23/2014	A
	HG_QM_2	9/17/2014	A
	HG_QM_2	10/15/2014	A
	HG_QM_2	11/18/2014	A
	HG_QM_2	12/17/2014	A

A= Absent; NS =Not Sampled

- Morena Reservoir
  Morena Reservoir has one monitoring substrate which is deployed at the end of the public dock. The substrate was visited 12 times in 2014, with all examinations being negative for dreissena mussels (Table 5).
- Morena Reservoir was visited 3 times in 2014 to conduct veliger sampling, however due to large algae blooms the reservoir was only sampled twice, testing negative for presence of Dreissena veligers (Table 3).
- Sutherland Reservoir
  Sutherland Reservoir has one monitoring substrate which is deployed at the end of the public dock. Sutherland was visited monthly with 1 unsuccessful sampling event due to the substrate being missing (Table 6). All examinations produced negative results for the presence of adult dreissena mussels on these substrates.

Veliger monitoring was conducted 3 times at Sutherland Reservoir with all samples testing negative for the presence of Dreissena veligers (Table 3).

Table 5 - Morena Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)
Morena	MO_QM_1	1/8/2014	A
	MO_QM_1	2/5/2014	A
	MO_QM_1	3/5/2014	A
	MO_QM_1	4/16/2014	A
	MO_QM_1	5/7/2014	A
	MO_QM_1	6/4/2014	A
	MO_QM_1	7/9/2014	A
	MO_QM_1	8/20/2014	A
	MO_QM_1	9/10/2014	A
	MO_QM_1	10/8/2014	A
	MO_QM_1	11/5/2014	A
	MO_QM_1	12/3/2014	A

A= Absent; NS =Not Sampled

Table 6 - Sutherland Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)	Comments
Sutherland	SU_QM_1	1/6/2014	A	
	SU_QM_1	2/4/2014	A	
	SU_QM_1	3/4/2014	A	
	SU_QM_1	4/14/2014	A	
	SU_QM_1	5/5/2014	A	
	SU_QM_1	6/2/2014	NS	Substrate Missing
	SU_QM_1	7/7/2014	A	
	SU_QM_1	8/18/2014	A	
	SU_QM_1	9/28/2014	A	
	SU_QM_1	10/6/2014	A	
	SU_QM_1	11/3/2014	A	
	SU_QM_1	12/2/2014	A	

A= Absent; NS =Not Sampled

Infested Water Bodies

- El Capitan Reservoir
  El Capitan Reservoir has one monitoring substrates deployed near the inlet/outlet tower. The substrate was examined 11 times in 2014 and the results are located in Table 7.

Table 7 - El Capitan Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)	Comments
El Capitan	EC_QM_1	1/22/2014	368	
	EC_QM_1	3/19/2014	56	
	EC_QM_1	4/23/2014	3	
	EC_QM_1	5/20/2014	39456	
	EC_QM_1	6/24/2014	18720	
	EC_QM_1	7/23/2014	23	
	EC_QM_1	8/13/2014	5	
	EC_QM_1	9/17/2014	152	
	EC_QM_1	10/15/2014	A	
	EC_QM_1	11/18/2014	6300	
	EC_QM_1	12/17/2014	4800	

A= Absent; NS =Not Sampled

- Miramar Reservoir
  Miramar Reservoir has one monitoring substrates deployed near the inlet/outlet tower. The substrate was examined 12 times in 2014 and the results are located in Table 8.
- Murray Reservoir
  Murray Reservoir has one monitoring substrates deployed near the inlet/outlet tower. The substrate was examined 12 times in 2014 and the results are posted in Table 9.

- Lower Otay Reservoir
  Lower Otay Reservoir has one monitoring substrates deployed near the inlet/outlet tower. The substrate was visited monthly in 2014 with one unsuccessful sampling event due to the substrate being lost. The results of the substrate sampling are located in Table 10.

Table 8 - Miramar Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)	Comments
Miramar	MM_QM_1	1/23/2014	A	
	MM_QM_1	2/19/2014	A	
	MM_QM_1	3/20/2014	7	
	MM_QM_1	4/24/2014	A	
	MM_QM_1	5/21/2014	11	
	MM_QM_1	6/26/2014	6	
	MM_QM_1	7/24/2014	150	
	MM_QM_1	8/14/2014	423	
	MM_QM_1	9/18/2014	696	
	MM_QM_1	10/16/2014	A	
	MM_QM_1	11/19/2014	640	
	MM_QM_1	12/16/2014	3	

A= Absent; NS =Not Sampled

Table 9 - Murray Reservoir 2014 Dreissena Substrate Results

Reservoir	Sample Site	Sample Date	Value (/Ft^2)	Comments
Murray	MU_QM_1	1/23/2014	A	
	MU_QM_1	2/19/2014	A	
	MU_QM_1	3/19/2014	A	
	MU_QM_1	4/23/2014	A	
	MU_QM_1	5/21/2014	113	
	MU_QM_1	6/24/2014	100	
	MU_QM_1	7/23/2014	8	
	MU_QM_1	8/13/2014	4	
	MU_QM_1	9/16/2014	2	
	MU_QM_1	10/14/2014	A	
	MU_QM_1	11/20/2014	736	
	MU_QM_1	12/16/2014	1	

A= Absent; NS =Not Sampled

Table 10 - Otay Reservoir 2014 Dreissena Substrate Results				
Reservoir	**Sample Site**	**Sample Date**	**Value (/Ft^2)**	**Comments**
Otay	OT_QM_1	1/21/2014	864	
	OT_QM_1	2/20/2014	20	
	OT_QM_1	3/17/2014	1	
	OT_QM_1	4/21/2014	A	
	OT_QM_1	5/19/2014	70	
	OT_QM_1	6/23/2014	NA	Lost Substrate
	OT_QM_1	7/21/2014	A	
	OT_QM_1	8/11/2014	25	
	OT_QM_1	9/15/2014	A	
	OT_QM_1	10/16/2014	NA	
	OT_QM_1	11/17/2014	175	
	OT_QM_1	12/5/2014	5400	

A= Absent; NS =Not Sampled

- San Vicente Reservoir
  San Vicente Reservoir has one monitoring substrates deployed near the inlet/outlet tower. Due to construction for the dam raising project access at San Vicente was difficult so the substrate, located near the outlet tower, was only examined 2 times in 2014.

Table 11 - San Vicente Reservoir 2014 Dreissena Substrate Results				
Reservoir	**Sample Site**	**Sample Date**	**Value (/Ft^2)**	**Comments**
San Vicente	SV_QM_1	1/22/2014	1	
	SV_QM_1	11/19/2014	31	

A= Absent; NS =Not Sampled

Observations

Tables 12 and 13 outline yearly averages and totals of dreissena settlement on our substrates. During 2014 the settlement of new dreissena mussels saw increases at El Capitan, Murray and San Vicente reservoirs, Miramar reservoir decreased and settlement values remained constant at Otay reservoir. This statement is supported by settlement data (Tables 12 & 13) diver observations, observations of the shoreline and observations during water drawdown's exposing shoreline and infrastructure.

Table 12 - City of San Diego's Reservoirs Yearly Quagga Mussel Substrate Settlement Averages							
	Average Mussel Settlement/ft^2						
Reservoir	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
El Capitan	0	2	720	3567	10	134	6353
Miramar	0	1	90	13	18	1635	164
Murray	0	0	0	0	0	1	80
Otay	0	2	2472	379	114	557	546
San Vicente	0	0	0	1	0	6	16

Table 13 - City of San Diego's Reservoirs Yearly Quagga Mussel Substrate Settlement Totals							
	Total Mussel Settlement/ ft^2						
Reservoir	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
El Capitan	0	38	16570	82033	194	2812	69883
Miramar	0	37	1804	307	254	19617	1963
Murray	0	8	5	1	5	12	964
Otay	0	43	59340	9107	2519	13356	6555
San Vicente	0	0	0	7	1	70	32

Control and Containment

Boating and Recreational Activities

Private boats are not allowed to moor over night at any City of San Diego reservoir. All owners/operators of private boats are required to remove their vessel from the reservoir at the end of each day. This procedure reduces the likelihood of Dreissena attaching to the outside of any private vessel.

Educational material is provided to the boating community and general public at all pay-stations or entrance booths when operational. Two handouts are given to each vessel operator/owner who enters all recreation areas, a red and white DFW “Boaters Beware” , Figure 2, flyer and a City of San Diego generated flyer called “We Need Your Help To Prevent The Spread” (Figure 3).

- Infested Reservoirs
  During the higher risk (busy) season of June thru September at El Capitan Reservoir, the entrance booth will be staffed on the weekends and holidays. Every vessel owner/operator entering the reservoir will be verbally instructed on dreissena procedures and given the two handouts mentioned above

All launch ramps and pay stations at infested reservoirs are posted with clearly visible signs (Figure 4 & 5) stating that Dreissena mussels have been found in this reservoir and, before leaving, all private boaters must perform the following:

- Empty and dry any buckets. Do not reuse suspect bait.
- Drain any water through the vessel's hull plug and ensure the area is dry.
- Drain all water from ballast tanks.
- Drain and dry all water from lower outboard unit.
- Clean and dry any live-wells aboard the vessel.

Violators will be cited

City Ranger staff will perform random spot checks of boaters at each and every infested City reservoir on a weekly schedule. During the higher risk (busy) season of June thru September, El Capitan Reservoir will be spot checked daily on the weekends and holidays. Any boat owner/operator found not complying with the posted rules will be cited.

- Non-Infested Reservoirs
  Non-infested water bodies of the City's water supply system include Sutherland, Hodges, Morena, Barrett, and Upper Otay Reservoirs. Private boating is not allowed at Barrett or Upper Otay Reservoirs and the County of San Diego is responsible for recreation activities at Morena Reservoir.

Sutherland Reservoir had 106 private boat launches in 2014. Staff completed dreissena inspections on all of the private boats launched for an inspection rate of 100%. Boaters were aware of and very compliant with the Drain, Clean, and Dry rule. No boats had to be turned away in 2014.

Hodges reservoir had 2,828 private boat launches in 2014. Staff completed dreissena inspections on 2,545 of the private boats launched for an inspection rate of 90%. The boaters checked were aware of and very compliant with the Drain, Clean, and Dry rule. Three boats had to be turned away in 2014.

Chemical and Physical Control

To date the City has not implemented chemical control strategies to mitigate the spread of dreissena mussels into its reservoirs or to protect its infrastructure.
The City will use Best Management Practices (BMPs) for release of water from an infested body, pipeline, etc. Currently the City is filtering all discharges whose water could contain veliger.

On September 15 2014 raw water was discharged from sections III and IV of the El Monte Pipeline for the internal inspection. A discharge plan was submitted and approved by DFW prior to the discharge. DFW was also sent a report of this discharge upon completion.
On November 18, 2014 two discharge valves of El Capitan reservoir were exercised in requirement of the Division of Safety of Dams to confirm they remain in operational condition and could be used to release the water from reservoir in case of emergency. A discharge plan was submitted and approved by DFW prior to the discharge.

On December 15, 2014 raw water was discharged from section I of the El Monte Pipeline for the internal inspection. A discharge plan was submitted and approved by DFW prior to the discharge.

Decontamination

The City of San Diego Public Utilities Department has taken numerous precautions to ensure that mussels are not spread as a result of our monitoring activities. All City staff involved with mussels will be formally trained on laboratory procedures and the potential consequences of improper release/disposal of mussels, water or equipment.

All mussels collected on the substrates by the Water Quality Biologists are either returned to the reservoir or transferred to our laboratory for identification and then preserved in a 70% ethanol solution or destroyed with a 1:10 bleach to water solution. Veligers discovered during analysis of our reservoirs and raw water pipelines are destroyed with a 1:10 bleach to water solution after analysis in the laboratory.

Field equipment must be decontaminated to prevent transfer of organisms within and between systems. The plankton net, cod-end piece and affiliated rope are decontaminated by high pressure spraying with freshwater for approximately 2 minutes. The clean sampling equipment is then allowed to air dry at least three days before next use.
All infrastructures removed from City owned water bodies that are known to contain dreissena mussels are cleaned/decontaminated on site and allowed to desiccate for an appropriate period of time before they are transported to other City owned water bodies or disposed of.
The EMTS Laboratory is a 24 hour secured facility. All visitors must check in with a security guard and be issued an access card by one of our staff. All research activities are secured in the Source Water group's work area within the laboratory. Activities involving live mussels are conducted in double contained systems. Once experiments are concluded any specimens, water and equipment are neutralized with 1:10 bleach to water solution for 30 minutes prior to disposal.