

# BIG BEAR LAKE MANAGEMENT OPERATIONS

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Summary of 2011 Activities

November 2011

*“The mission of the Big Bear Municipal Water District is to stabilize the level of the Lake for recreation and wildlife”*

## Big Bear Lake Management Operations

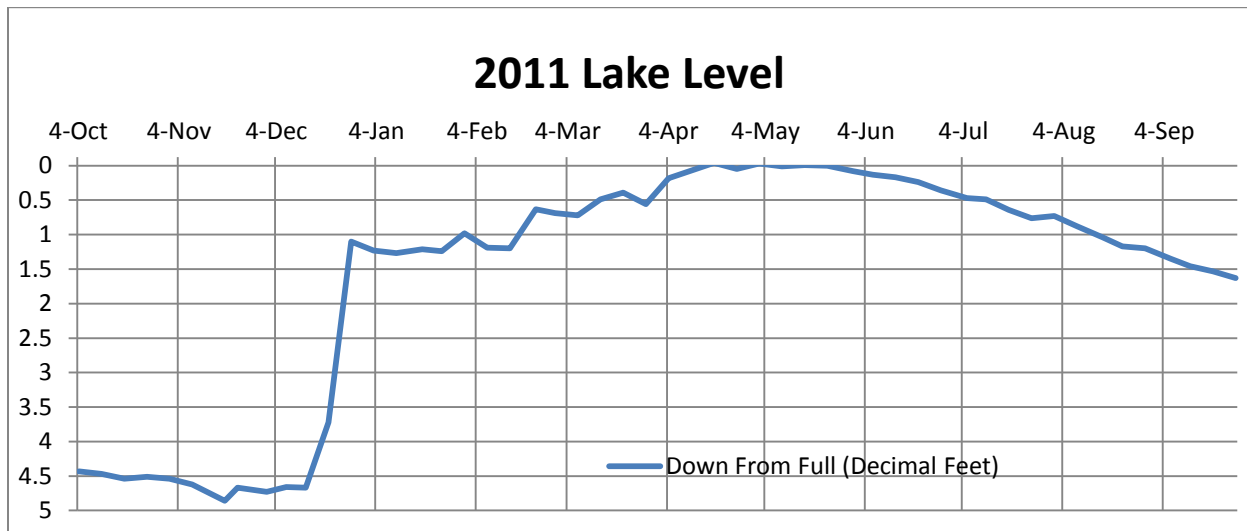
### Summary of 2011 Activities

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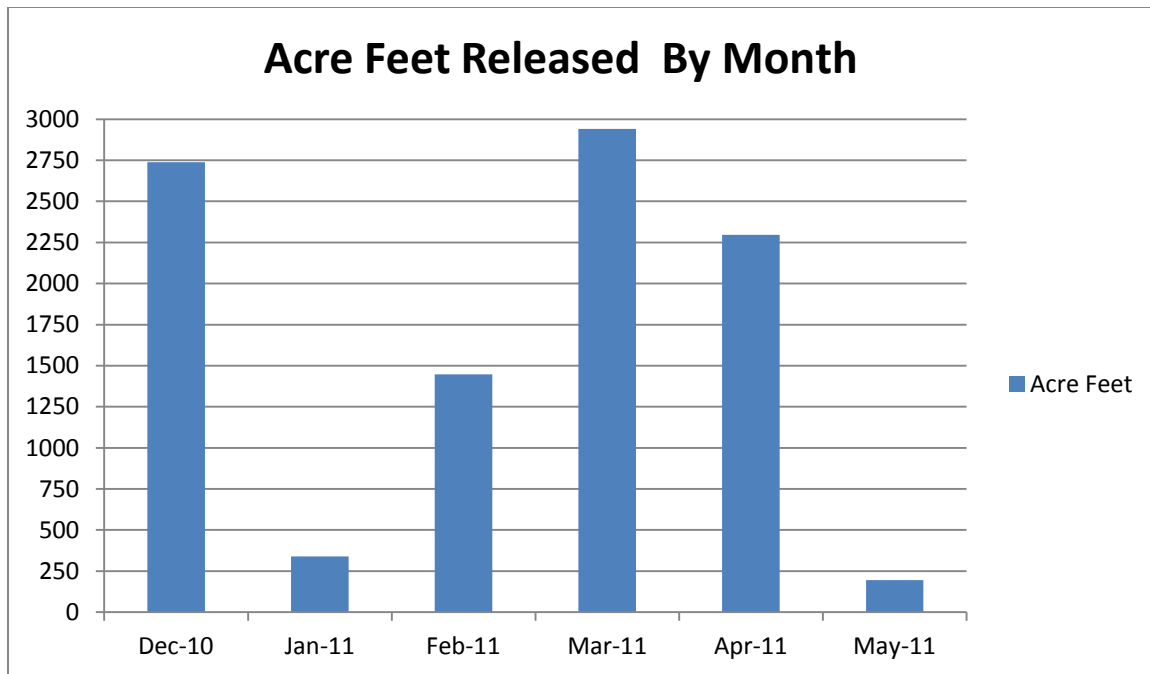
Big Bear Lake management operations, in support of the Districts mission, consist of a multitude of management activities. This document serves as a summary of three broad activities; lake level stabilization, limnological monitoring, and invasive species management.

### **Lake Level Stabilization**

The Lake began the water year, October 1 through September 30 2011, at a level 4.43 feet below full (6738.77 feet elevation) in October 2010. The lowest level was reached the third week of November when the level dropped to 4.86 feet below full (6738.34 feet elevation). The lake recovered to its highest level of -0.04 feet below full (6743.16 feet elevation) during the second week of April. The Lake level ended the year at 1.63 feet below full (6741.57 feet elevation). Lake level improved significantly compared to summer 2010 as a result of 53.09 inches of precipitation (rain and rain equivalent from snow) measured at the Dam. Historical lake levels can be viewed on the District web page.



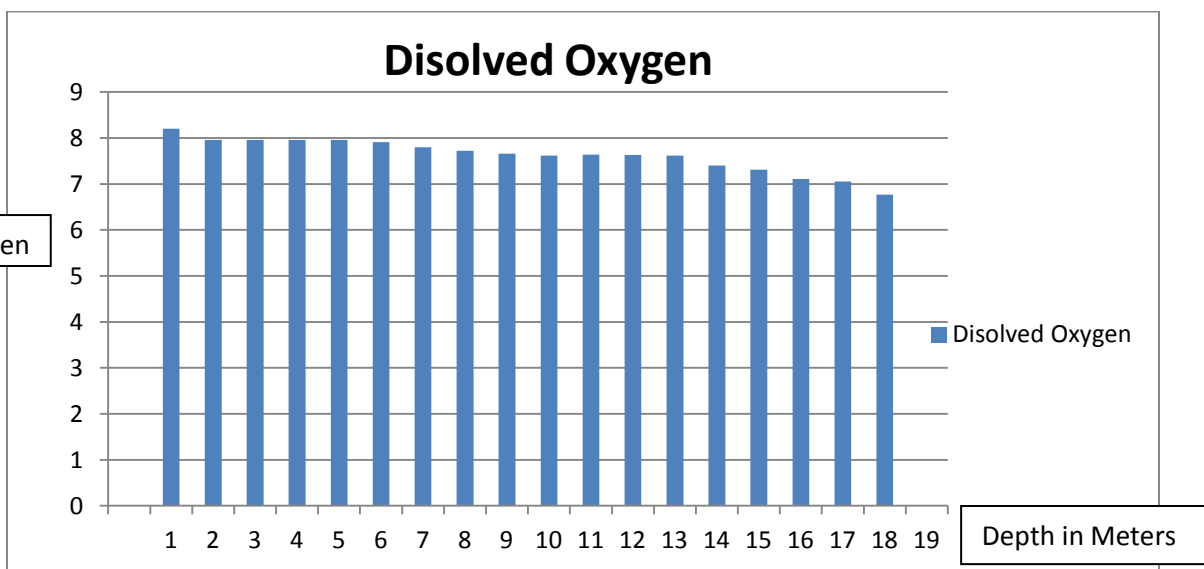
In the month of December 2010, 27.47 inches water equivalent precipitation fell. During a heavy storm, the lake level increased by 12 vertical inches in 12 hours. This resulted in the District conducting a controlled water release to prevent water flowing over the dam. The first release commenced on 12/22/2010 and continued off and on for the majority of the time, through the month of May. This was the first time since 1996 the District conducted such a release. The total amount of water released was 9,962 Acre Feet. The chart below shows by month the amount of water released.



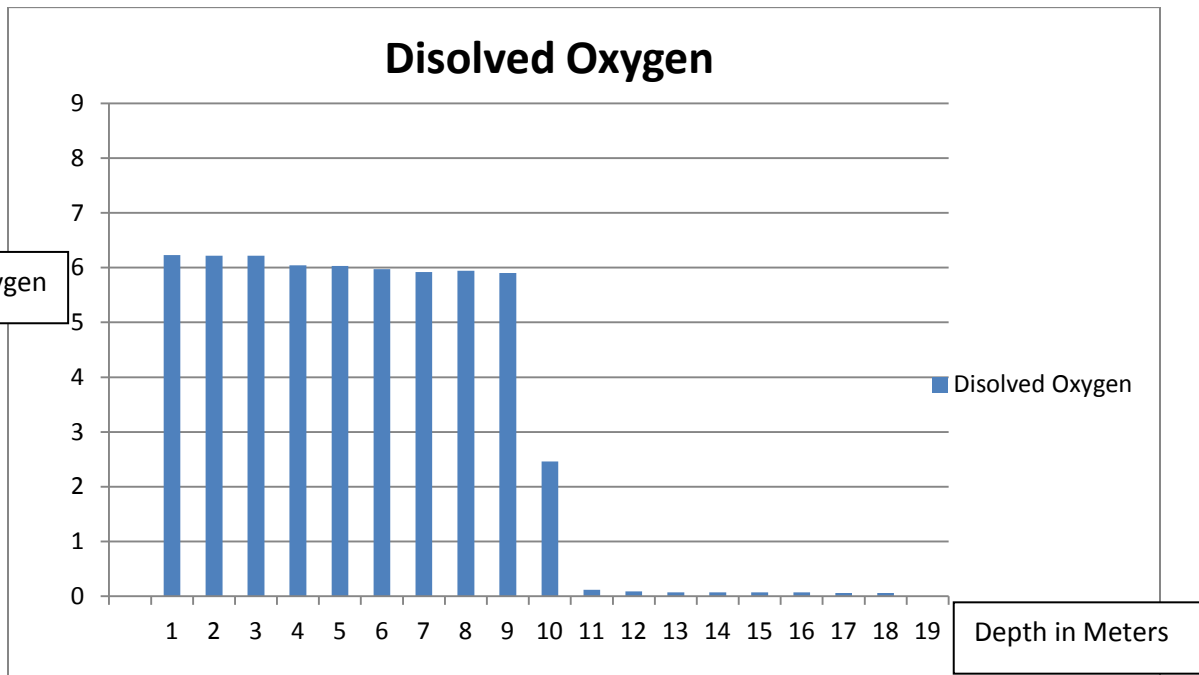
### Limnological Monitoring

District Staff measure the limnological properties of the Lake weekly during the boating season at 5 monitoring stations. Measurements of Lake temperature, dissolved oxygen content and water clarity are collected. The charts below show dissolved oxygen before the Lake stratified, during stratification, and after.

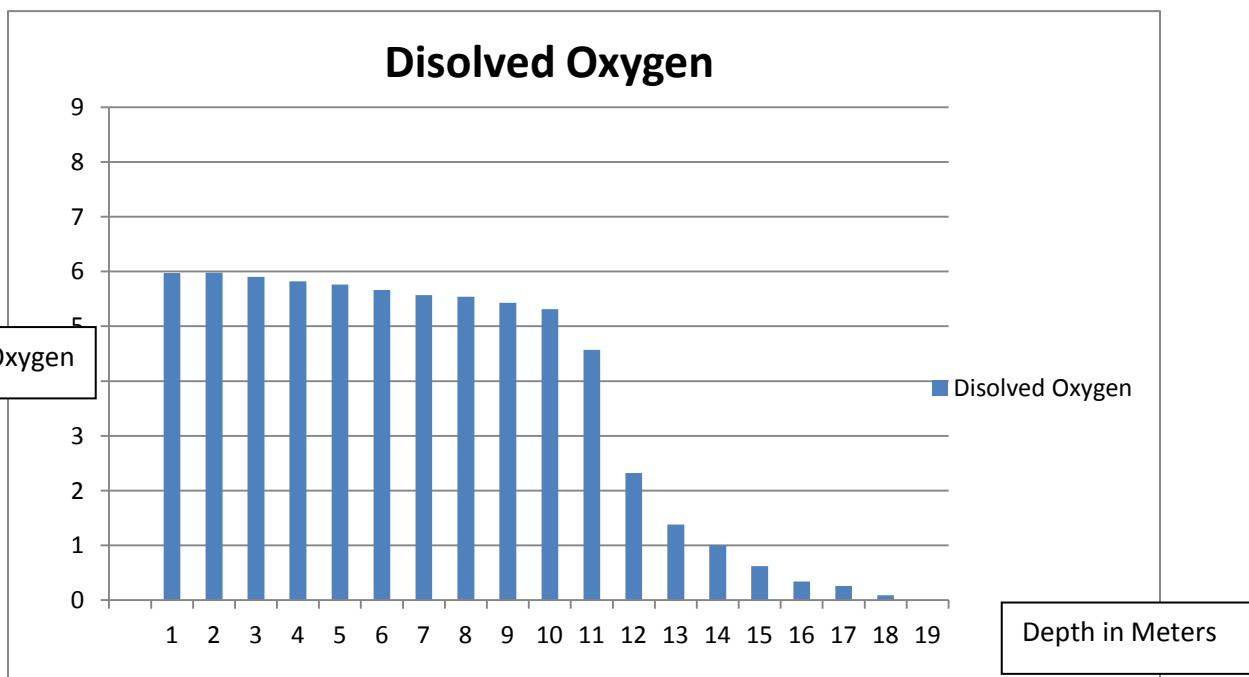
5/24/2011 Dissolved Oxygen Station 1 - Boom Line – Before Stratification



7/26/2011 Dissolved Oxygen Station 1 - Boom Line – During Stratification

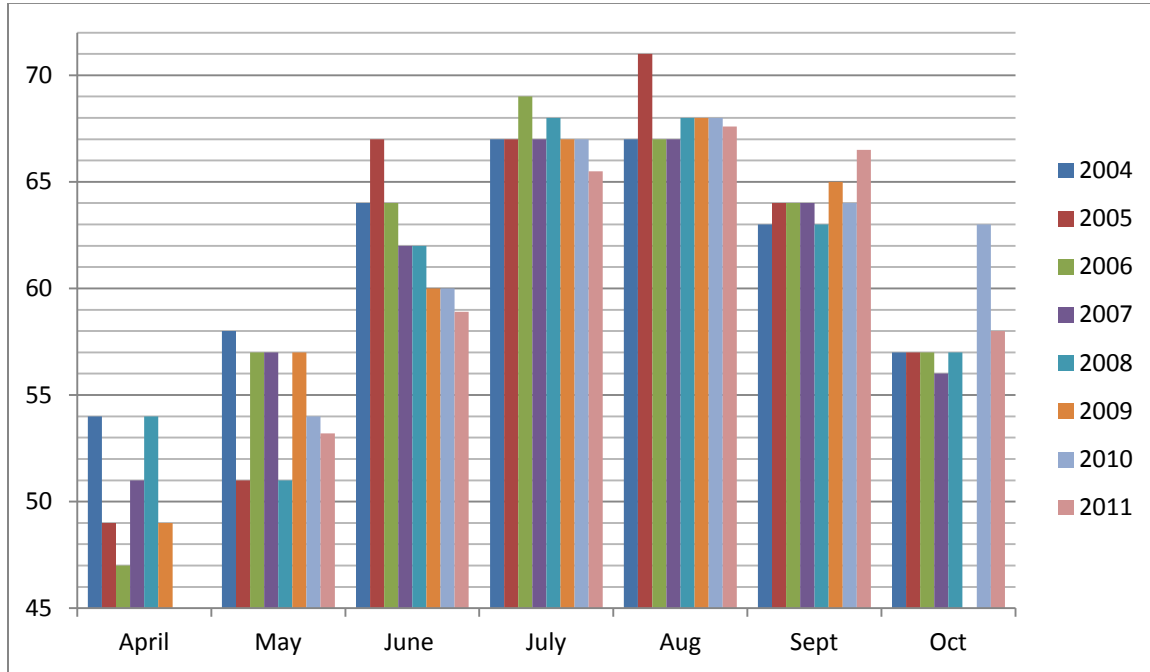


9/06/2011 Dissolved Oxygen Station 1 - Boom Line – After Stratification

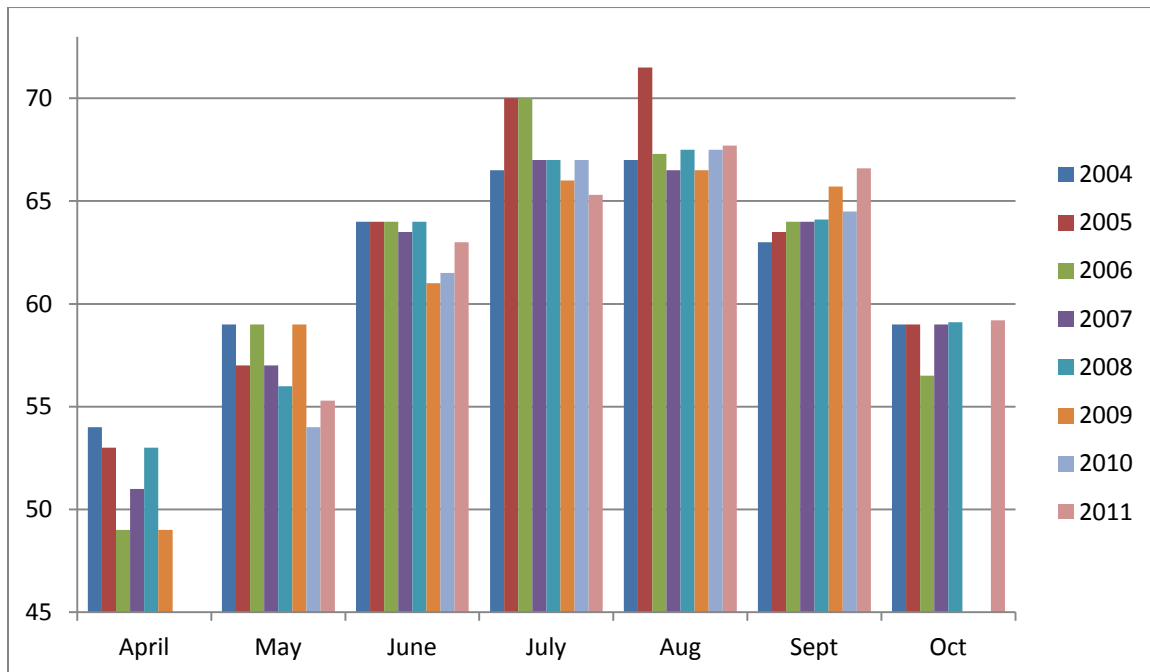


Surface water temperatures peaked in August. The east end of the Lake was 3 to 5 degrees warmer than the west. Summer temperatures reach the high sixties to low seventies.

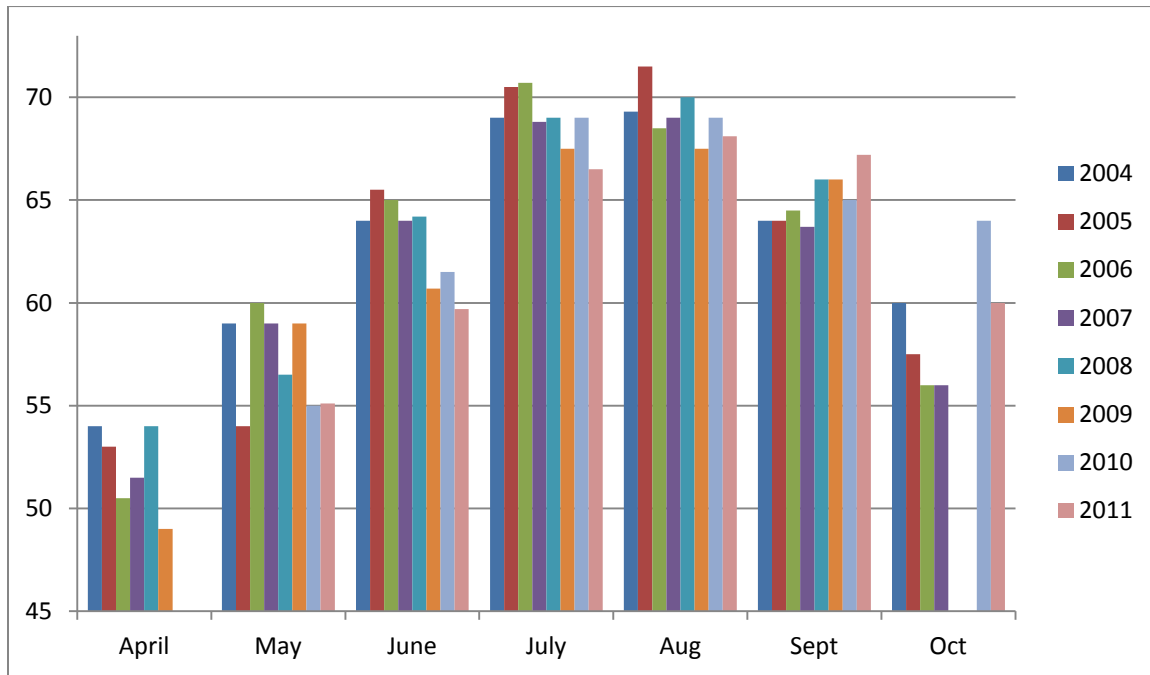
Surface Temperature at Station 1 - Boom-line



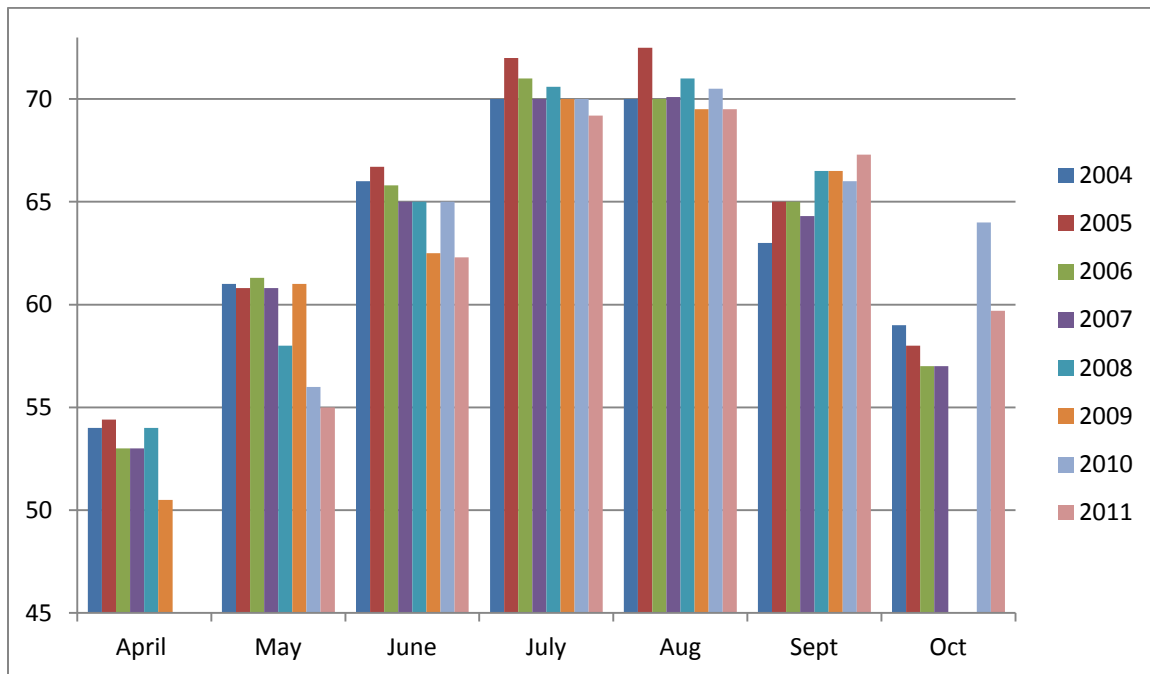
Surface Temperature at Station 2 – Papoose Bay



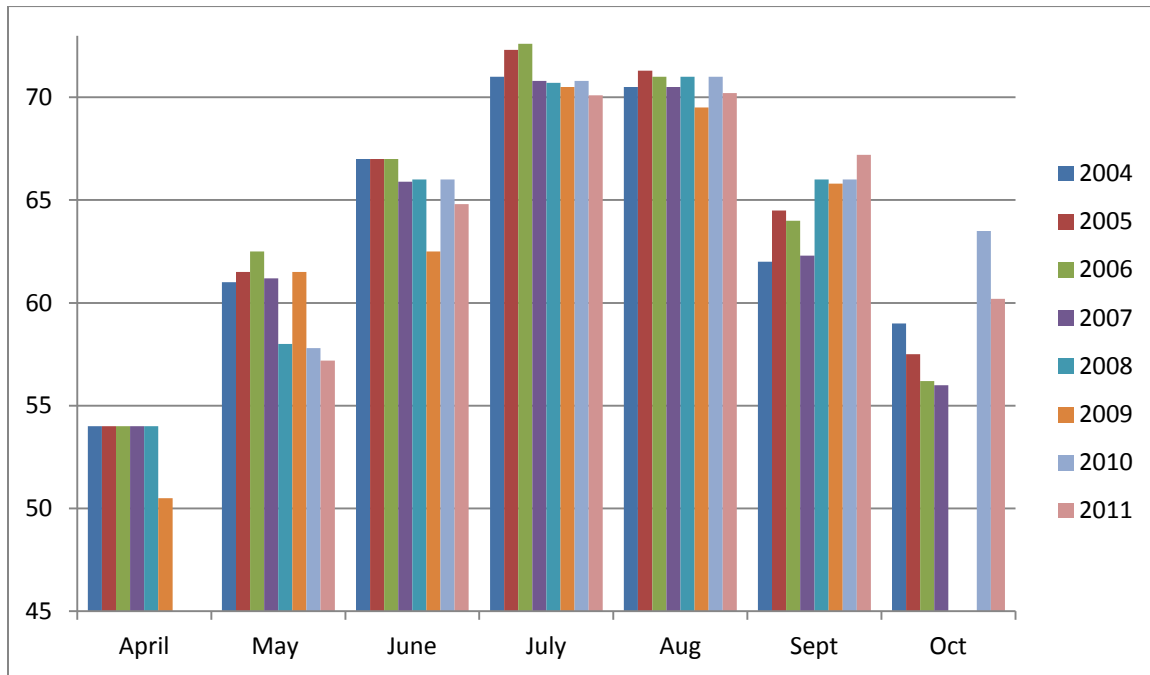
### Surface Temperature at Station 3 – West Ramp



### Surface Temperature at Station 4 – Observatory

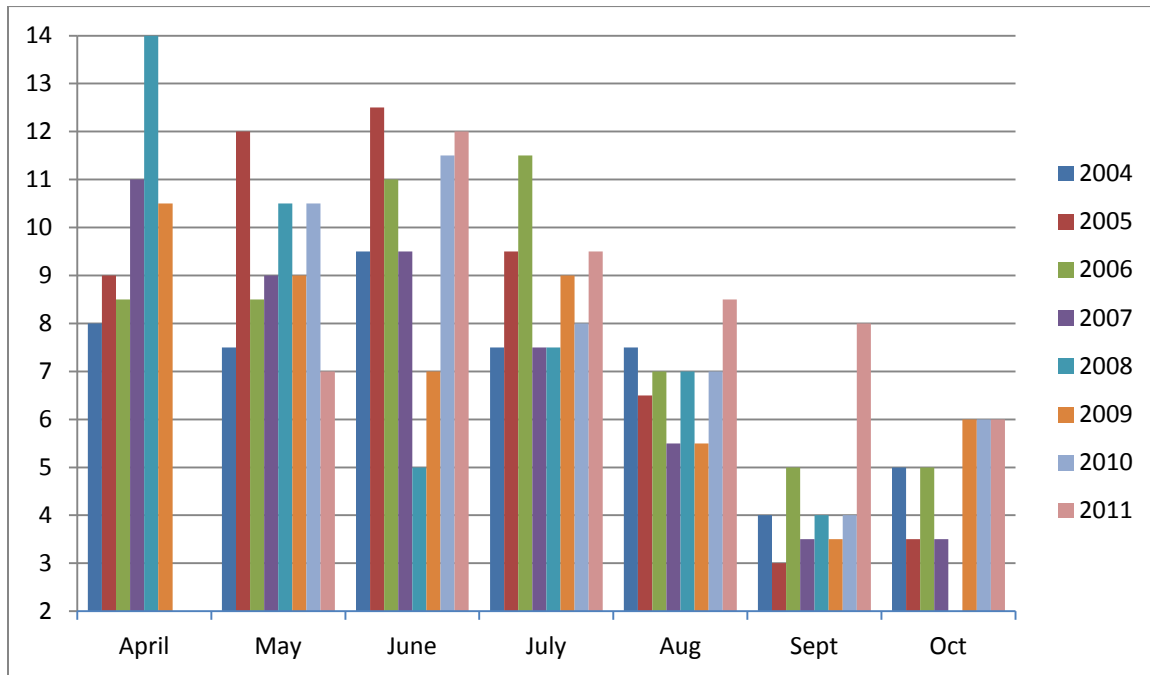


## Surface Temperature Station 5 – Juniper Point

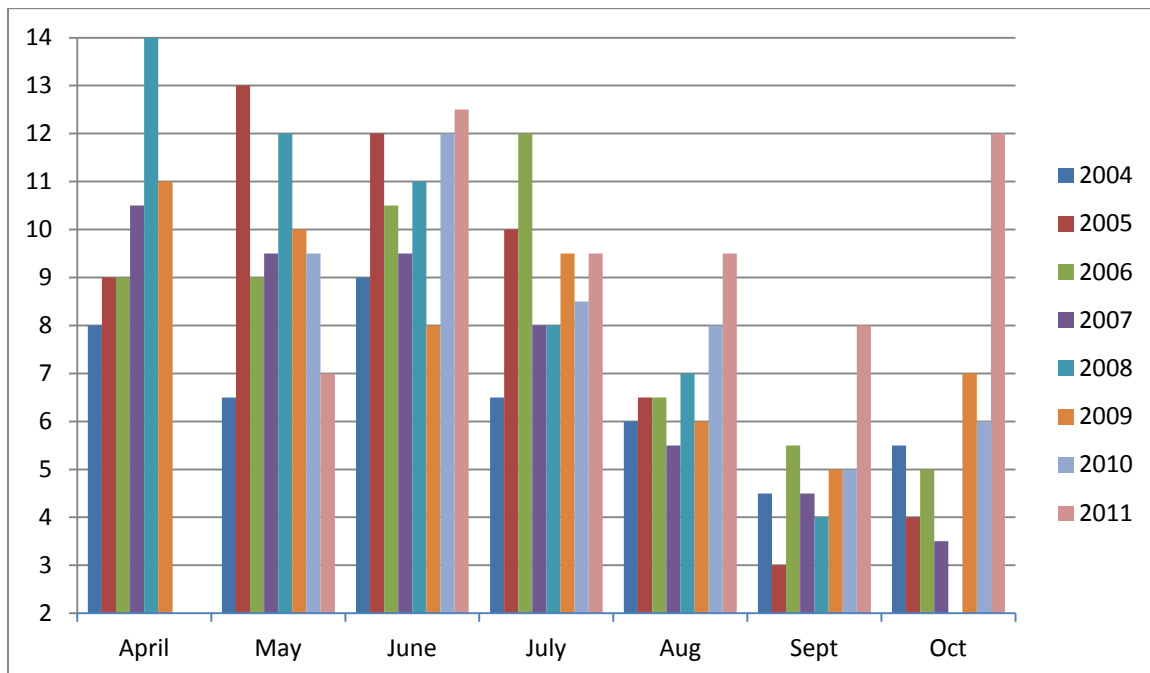


Secchi readings vary widely year to year over the spring and summer months when the Lake is stratified. In 2011 Secchi depths maxed at 12 feet in June in the western part of Lake and 10 feet in the eastern end. By September water clarity is at its worst. In 2011 September readings of 8 feet were recorded in the western end of the lake and 5 feet in the east end. Historically the best water clarity was recorded in May and June, of 2005 when readings of 12.5 feet and 13 feet were measured in the west and 8.5 to 11 feet in the east.

Secchi Monthly Average 2004-2011 - Boom-line

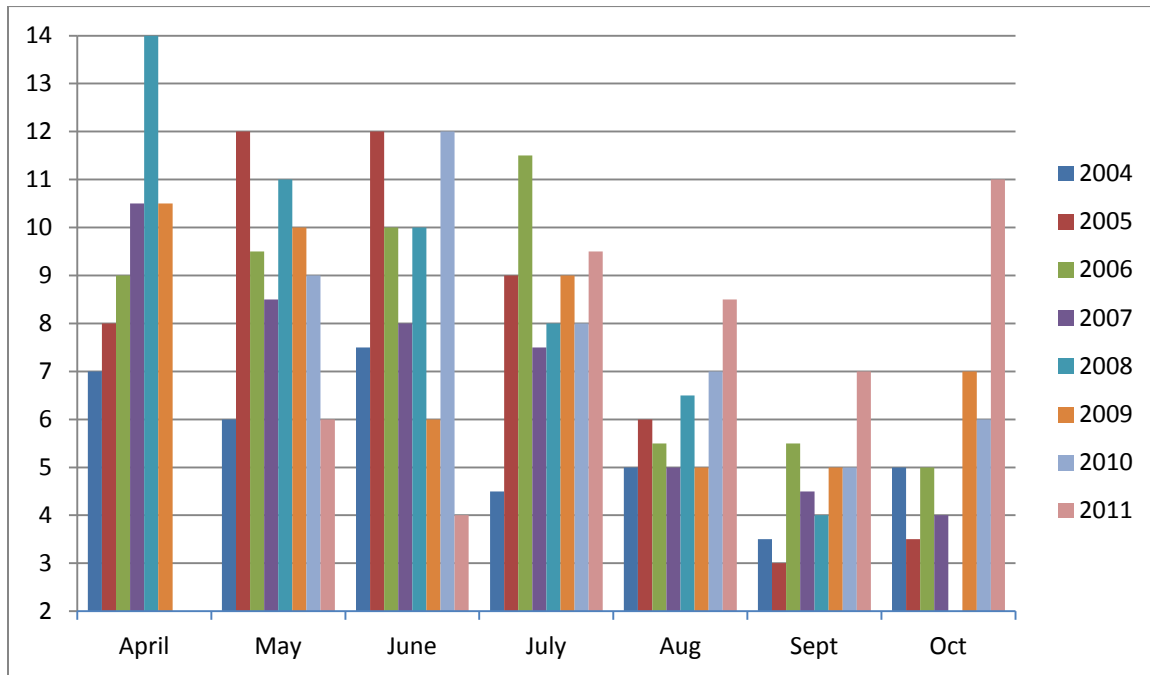


Secchi Monthly Average 2004-2011 – Papoose Bay

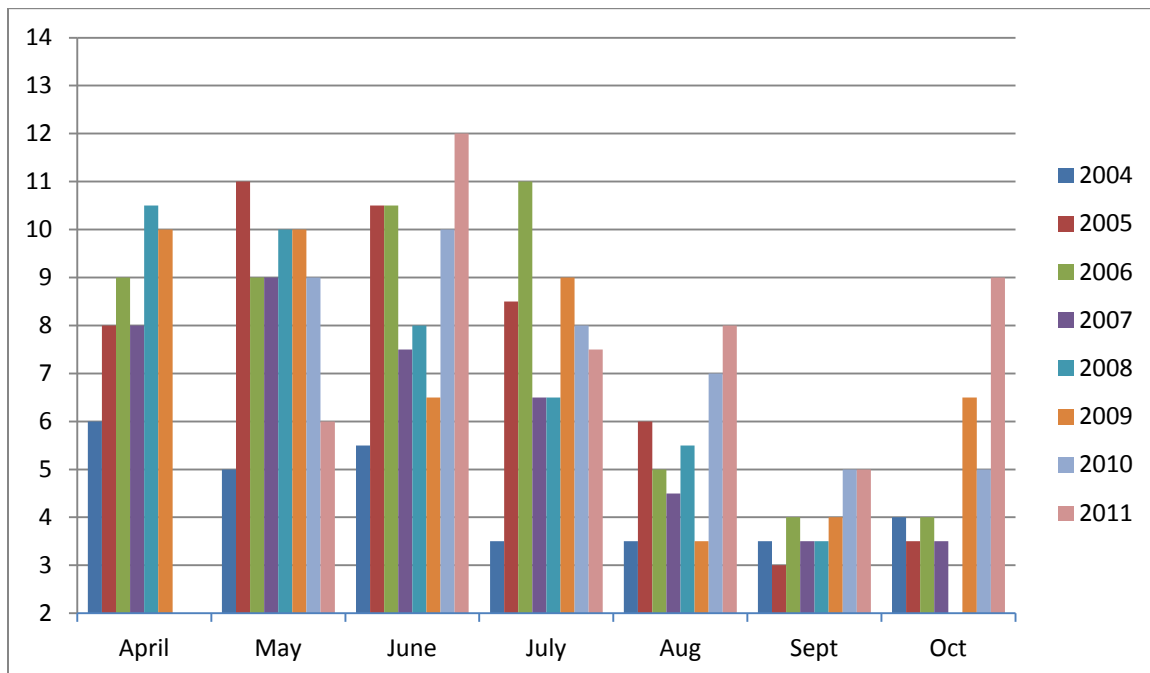




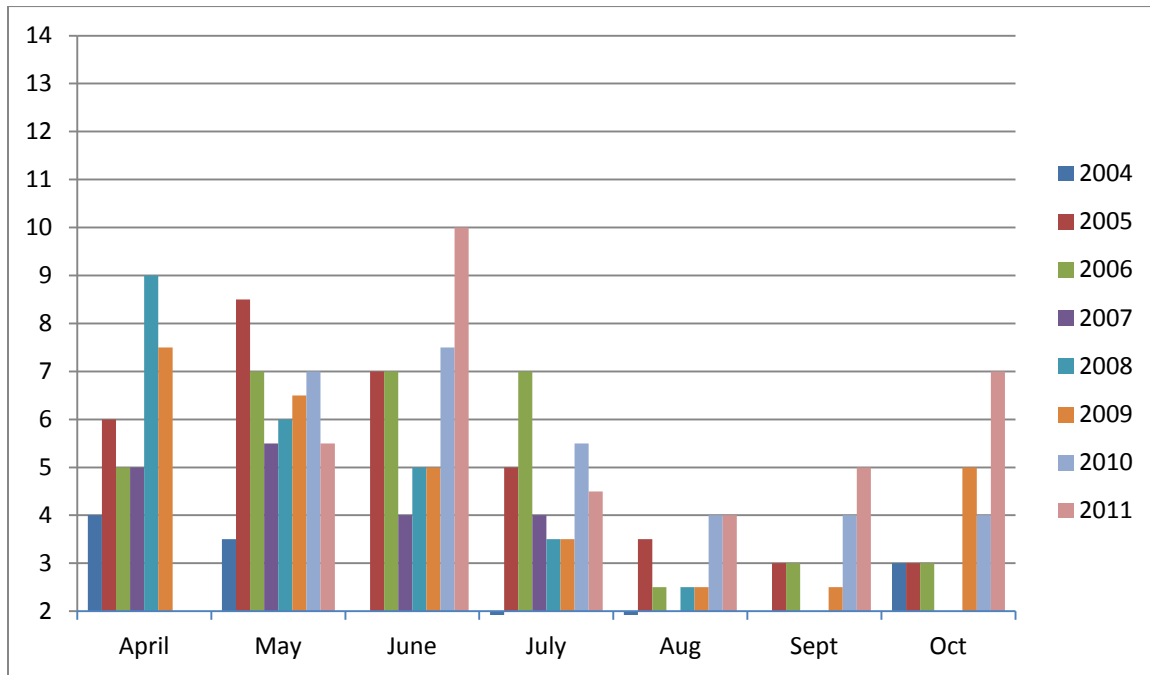
### Secchi Monthly Average 2004-2011 – West Ramp



### Secchi Monthly Average 2004-2011 – Observatory



## Secchi Monthly Average 2004-2011 – Juniper Point



At the beginning of the boating season surface and Lake Bottom water temperatures are similar and the Lake water is mixed. As the surface warms the Lake stratifies with cold, dense oxygen depleted water forming a layer below the relatively warmer, less dense, oxygenated water above. Later in the year surface and bottom water temperatures tend to equilibrate and the waters mix bringing oxygen depleted and nutrient laden water up into the water column to spur algae growth. Water clarity drops dramatically and water column oxygen is also diluted. Over the past 7 years late summer early fall mixing has occurred on the approximate dates as shown below. The Summer of 2011 was unique because the Lake mixed twice. Secchi readings plotted above on graphs clearly show the early fall Lake mixing by a reduction in water clarity.

Year	Date Lake Mixed
2011	<i>September 6</i>
2011	<i>June 7</i>
2010	September 3
2009	June 12 and August 12
2008	August 19
2007	August 20
2006	August 28
2005	September 6
2004	Lake did not stratify

The District installed a Lake aeration system in the summer of 2004. The decision to purchase and install the system was the result of low lake levels, warm water temperature, high concentrations of algae and low dissolved oxygen content when the Lake is stratified. High Lake water temperatures and low dissolved oxygen concentrations stressed trout species, sometimes resulting in fish die off in large numbers. The table below provides a qualitative summary of fish die off prior and subsequent to the installation of the aeration system.

Year	Qualitative Die Off of Trout	Comments
1996	Minor	0-100 per week
1997	Minor	0-100 per week
1998	Minor	0-100 per week
1999	Moderate	100-200 per week
2000	Moderate	100-200 per week
2001	Moderate	100-200 per week
2002	Significant	200-1000 per week
2003	Very Significant	1000-2000 per week
2004	Very Significant	1000-2000 per week
2005	Insignificant	
2006	Insignificant	
2007	Insignificant	
2008	Insignificant	
2009	Insignificant	
2010	Insignificant	
2011	Insignificant	

The system is a stationary floating 25 horse power pump located between the boom line and the dam that draws Lake water and discharges it into the air at the rate of 8600 gallons per minute. The water cools and is oxygenated as it falls through the air before returning to the Lake. The result is an approximate 40 acre oxygenated, cool water refuge for trout fish species. Although the system typically operates during the cooler night and early morning hours, under extreme problematic conditions it is run 24 hours a day. Since installation and operation of the aeration system no massive fish die offs have occurred. However, based on weekly limnological data there remains a significant portion of the Lake during late summer and fall that is nearly inhospitable to cold water fish species.

## **Invasive Species Management**

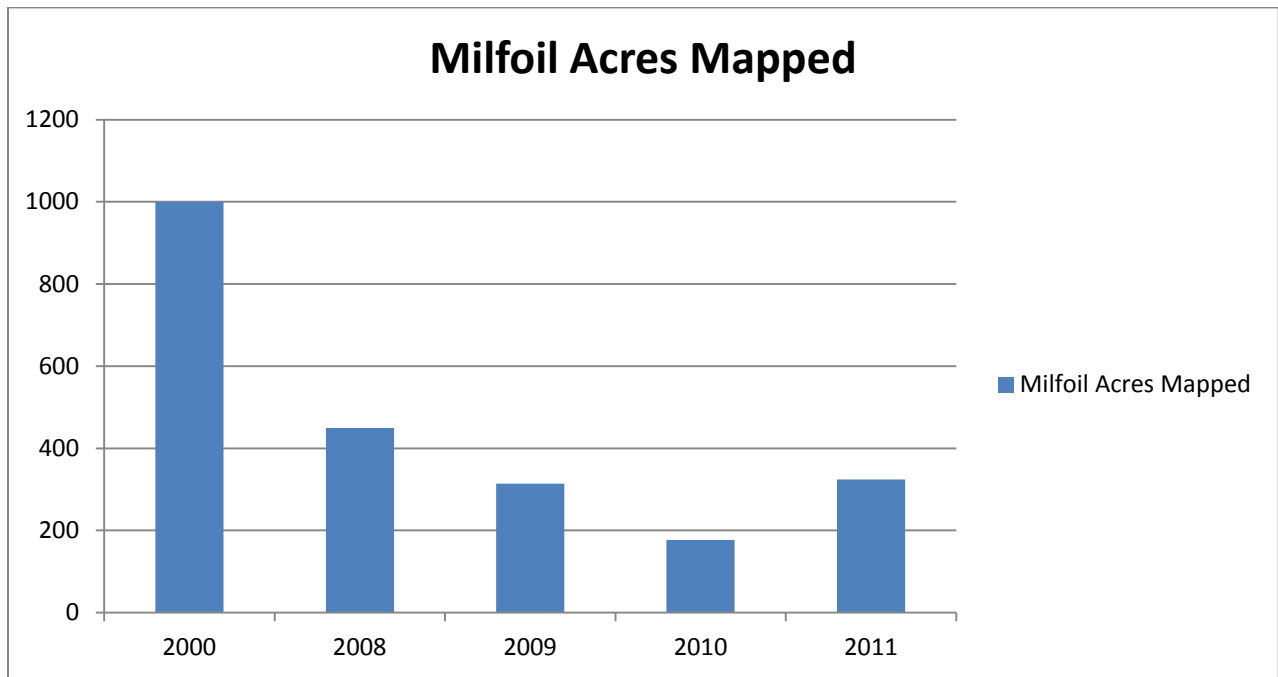
The Invasive species Management program can be broken down into 3 major activities; aquatic plant control, carp removal and quagga mussel prevention program.

### **Aquatic Plant Control**

Activities associated with aquatic plant control have two components. Milfoil specific herbicides are used to treat areas infested with Eurasian Water Milfoil. Native aquatic plant species are typically

controlled mechanically using a harvester. Cuttings are delivered to a composting facility operated by the City of Big Bear Lake. Harvesting operations are used to maintain navigation channels and boat dock lake access.

The District has made considerable progress in reducing the population of milfoil in the Lake compared to the baseline year 2000 when more than 1000 acres of the lake were infested. Below is a chart showing recent Milfoil acres mapped.



## 2011 Milfoil locations



In 2011, 83,000 pounds of the name brand Renovate OTF (Triclopyr 100%) was used to treat 284 acres of milfoil.

Two methods of herbicide application are used. Large areas are treated using the eductor physics of water pumped through a nozzle at pressure to draw dry product from a hopper. Nozzles installed on either side of the back of the weed harvester barge distribute product in swaths 30 feet wide as the barge moves through milfoil infested littoral zone. Metering of product delivery in this unit is based on the known delivery rate of the equipment and the speed of the barge moving through the infested area. The other method employs vortex physics but uses air instead of water. (Typically called the "Vortex.") This method is used for smaller, more pinpoint applications. The unit has a blower that moves air across the bottom opening of a funnel shaped hopper. The air draws the product out of the hopper and is then directed through a hose to a hand held control and nozzle. Metering with this unit is based on an even distribution of a preloaded quantity of product in the hopper and the known area to be treated. In both cases application rates are computed using label instruction for plant species, treatment area and water depth.

Treatment began on June 1 and was completed on July 18, 2011. The prevailing westerly winds moves weed fragments east. The strategy has been to focus the bulk of the treatment in the west so that as

milfoil fragments are carried by wind and currents towards the east they do not take root in areas that are milfoil free.

Herbicide used treating docks and general lake areas totaled \$123,000 and \$265,000 respectively. Employee expenses and fuel for the 2011 program came to \$3,720 for a 2011 total program cost of \$391,720.

In areas where native aquatic plants restrict navigation in and out of private docks and marinas, mechanical means are used to clear paths for vessels. Harvesting efforts began on June 3rd, 2011 and continued through September 15. A total of 53 loads of weeds were removed, during 33 working days, to the City composting facility with a wet weight of about 371,000 pounds or about 185 tons. The dry weight of the material removed is estimated at 37,100 pounds assuming a percent dry weight of 10% for an average load. It should be noted that the total weight of weeds removed was lower this year due to more sporadic harvesting locations and increased travel times of the equipment.

Six 100 gram samples were collected and submitted to Physis Laboratories in Orange County. Two 100 gram samples each of Eurasian Water Milfoil, Common Elodea and Coon Tail were submitted for analysis of total Phosphorous, total Nitrogen and dry weight.

<b>Laboratory Analysis Results</b>	<b>Total Phosphorous (ug/g dry)</b>	<b>Total Nitrogen (ug/g dry)</b>	<b>% Solids</b>
Eurasian Water Milfoil	2999	25,400	9.89
Coontail	3488	24,600	11.52
Common Elodea	3799	20,100	9.83

Using these analyses total weight of Phosphorous and Nitrogen removed from the Lake by the weed harvester is approximately 110 pounds and 930 pounds respectively.

Weed harvesting expenses, excluding depreciation, totaled \$13,005 for 2011.

### **Carp Removal**

After observing the effectiveness of electro-shock fishing for Carp by a District consultant in 2007 the District purchased its own electro-shock boat in 2008 and installed a commercial grinder placed over a sewer manhole in 2009. Shocked carp are netted and after the boat is filled they are ground up and disposed of in the sanitary sewer at the back of the District shop. The Big Bear Area Regional Wastewater Agency (BBARWA) charges the District \$150 for every 1000 pounds of Carp discharged to the sewer.

Electro-shock fishing began June 20 and the efforts ended after 20 work days on October 10, 2011. The annual Carp Round-Up event also removes carp from the lake. Cash and prizes are awarded for winners

in the various divisions. Bow hunters, 96 of them, came from California and the southwest to compete in this District sponsored event on the weekend of June 25-26, 2011.

Including the 11,000 pounds of carp shot during the Carp Round-Up the District electro-shock fishing efforts removed 31,491 pounds of carp during summer 2011.

Excluding depreciation on the electro-shock boat and the grinder, wages, fuel costs and BBARWA charges for carp removal in 2011 totaled \$7,000. Fish surveys conducted by the California Department of Fish and Game indicate that the Districts' carp removal program has dramatically improved game fish populations. Future annual reports will incorporate details from California Department of Fish and Game surveys.

Year	Carp Tournament	Electro Shock Fishing	Total Pounds Removed	Cost (approx.)
2007	6,119	96,000	102,119	\$96,000
2008	4,200	26,000	30,200	\$8,909
2009	6,350	36,000	42,350	\$12,490
2010	10,128	39,350	49,478	\$14,551
2011	11,000	20,491	31,491	\$7,000

### **Quagga Mussel Prevention Program**

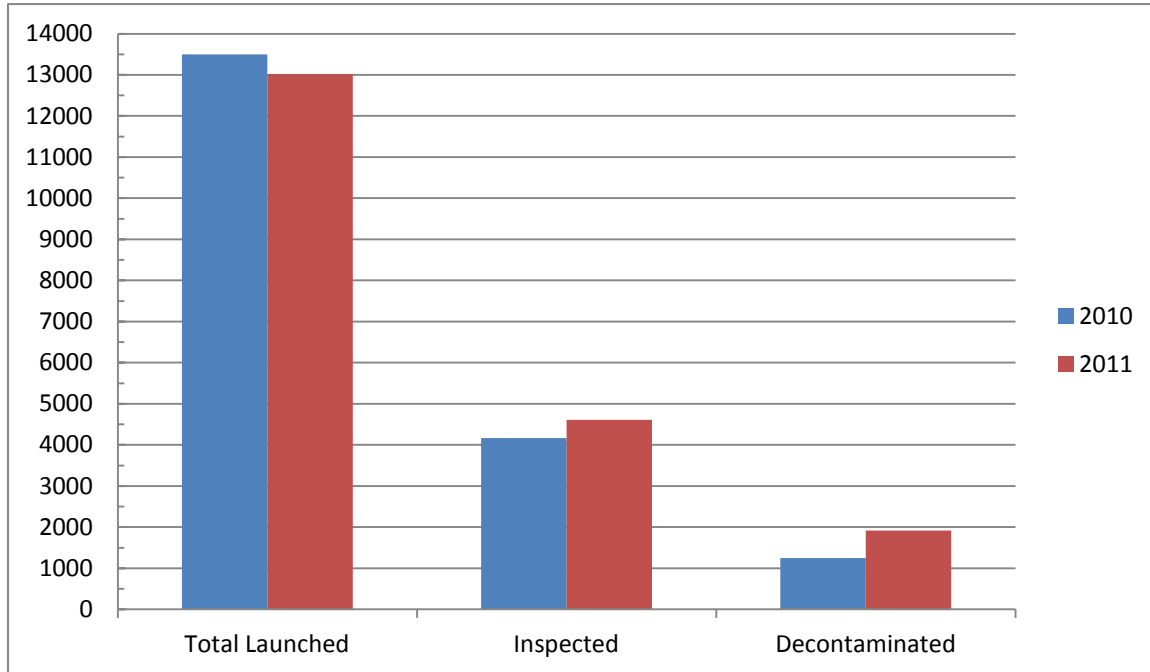
Starting with the boating season of 2008, the district implemented a quagga mussel prevention program aimed at preventing the spread of quagga mussels. The general policy is clean, drained and dry. If a vessel does not meet this criteria, the vessel will be decontaminated at one of our public launch ramps. Private marinas along the lake are required to have a level 1 certified quagga mussel inspector available to inspect boats prior to launch. If they encounter a vessel that does not meet the policy, they are sent to one of the public launch ramps for decontamination.

The District has 3 decontamination stations. The East Ramp and West Ramp handle the bulk of the decontaminations. The third station is located at the District's main office and is only run on holidays or special events. The decontamination is conducted by flushing suspect areas of the vessel with hot water. The entire process can take 5 minutes up to 45 minutes depending on the size of the vessel and level of decontamination.

This year the District sent 3 employees to obtain their level II quagga mussel training certification. This certification is to "train the trainer." The entire United States only has 200 level 2 certified trainers. Currently, the District has 4 staff members trained to this level.

In the Spring of each year, the level II quagga mussel trainers, conduct a level 1 quagga mussel class to certify new and returning inspectors. The class is an all day course thought by district staff that has obtained their level 2 inspector status. This class is offered to marina employees and District employees.

The District employees 7 seasonal ramp attendants whose job is to inspect and decontaminate vessels as they arrive at the public launch ramps. In total, the district inspected 4,613 boats at the public launch ramps. Of this number about 2,696 vessels were clean and no decontamination necessary (58%) and about 1917 vessels were decontaminated. Below is a chart showing 2010 and 2011 decontamination numbers.



**Summary of 2011 Lake Management Operations Expenses**

In Lieu Agreement	\$2,204,220
Herbicide Treatment	\$ 391,720
Weed Harvesting	\$ 13,005
Carp Removal and Disposal	\$ 7,000