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# Studies of Adult and Larval Zebra Mussel Populations in Conesus Lake, NY

Isidro Bosch
*SUNY Geneseo*, Bosch@geneseo.edu

Todd Shuskey
*SUNY Geneseo*

Thomas Collins
*SUNY Geneseo*

Alyssa Smith
*SUNY Geneseo*

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**Report Submitted to**
**The Livingston County Planning Department**

**by**

**Isidro Bosch, Todd Shuskey,**
**Thomas Collins and Alyssa Smith**

**Department of Biology**
**State University of New York at Geneseo**
**1 College Circle, Geneseo NY 14454**

**TABLE OF CONTENTS**

## Executive Summary:

1. In Conesus Lake, NY, adult mussels are abundant in every available hard substrate from the shoreline to a depth of about 8-9 m. Living mussels occupy a layer a few cm thick overlying a much thicker base of dead mussel shell material on the lake bottom.

2. All of more than 750 adult mussels examined were zebra mussels, *Dreissena polymorpha*. No quagga mussels (*Dreissena bugensis*) were found in the seven study sites surveyed.

3. Population densities at depths of 4-9 m ranged from an average low of 6,052 per m$^2$ to a high of 28, 021 per m$^2$. On average these numbers were 15.5 % lower than those reported for Conesus Lake populations in 2000.

4. The density of mussel veliger larvae in the water column ranged from a low of 74 per m$^3$ on June 19 to a peak of 9,750 per m$^3$ on July 10. The peak in larval supply recorded in late June and early July coincided a full moon phase, and with peak chlorophyll concentrations and high turbidity, both indicators that an algal bloom had developed in the water column.

5. For 2013, the average veliger density was 3, 263 per m$^3$, but numbers fluctuated widely over the season. Overall, veliger density was moderate for Conesus Lake compared to the minimum average of 3-6 per m$^3$ reported for 1997 and 1999, and a maximum average of 12, 231 per m$^3$ in 1995.

6. There are still vast numbers of zebra mussels in Conesus Lake and the species continues to be a dominant component of the lake ecosystem.

**Tables**



**Figures**

**Introduction**

The goal of this study was to assess the status of the zebra mussel population (Family Dreissinidae, species *Dreissena polymorpha*) in Conesus Lake by sampling benthic adults and planktonic larvae during the summer reproductive season. Another invasive dreissinid bivalve, the quagga mussel, *D. bugensis*, has firmly established itself in some of the larger Finger Lakes, including Seneca and Canandaigua Lake. Therefore a second goal of this study was to determine if quagga mussels had invaded Conesus Lake.

Since its accidental introduction in 1988, the invasive zebra mussel has had a profound effect on native ecosystems in the Great Lakes system and in other North American inland waters. Populations of mussels that may reach densities of more htan 500 thousand per square meter clear the water of suspended material, alter the nutrient balance (e.g. carbon, phosphorus) between the water column and the benthic compartments of the ecosystem, and outcompete native species for food and habitat. A well known indirect outcome of zebra mussel feeding is an increase in the amount of light penetrating the water and reaching the bottom of the lake. This trend has been correlated with the increased growth of attached algae and macrophytes in the nearshore environment (Skubina *et al.* 1995).

A second but initially poorly known dressinid, the quagga mussel, also invaded the Great Lakes in the early 1990s. Quagga mussels were not recognized as a morphologically and genetically distinct species until 1991 (May and Marsden, 1992). Consequently the exact time or means by which they invaded North American lakes from their native lakes in eastern Europe is unknown. For several years after the introduction of these two species into the Great Lakes system, zebra mussels dominated the benthic macrofauna. However, by 2004 researchers had discovered that the dominance balance had shifted strongly toward the quagga mussel (Ricciardi and Whoriskey 2004), which subsequently replaced the zebra mussel as the dominant species in all but the shallowest lake habitats in the Great Lakes. Quagga mussels have now spread into many of the Finger Lakes including Cayuga, Canandaigua, and especially Seneca, where they make up more than 90% of the combined dreissinid population ( J. Halfman, Finger Lakes Institute unpublished).

Zebra mussel (*Dreissena polymorpha*) larvae were first identified in Conesus lake during the summer of 1992 (J. Makarewicz, unpublished), approximately 6 years after their accidental introduction from Eurasia into the Great Lakes watershed, most likely in the ballast water of a transatlantic cargo ship. By the fall of 1994 large populations of juvenile and adult zebra mussels occupied the whole south basin of Conesus Lake, possibly because they were first introduced near the State Boat launch south of McPherson point in the south basin. From there they spread with the prevailing currents northward into the north basin and by the fall of 1998 occupied every suitable benthic habitat.

In the summer of 2000, our SUNY Geneseo research group carried out the first survey of zebra mussel adult populations in Conesus Lake (Bosch *et al.*, 2001). Population densities at a depth of 8 m ranged from an average low of 12,139 individuals per $m^2$ off Eagle Point to an average high of 50,133 individuals per $m^2$ off Grayshores, a site located in the northern region of the lake. These were moderate values compared to densities of more than 250 thousand per $m^2$ that had been reported for several Great Lakes sites (Bosch *et al*., 2001). No additional lake-wide surveys of adult populations have been undertaken. However, from 1995-1999, and then again in 2004, researchers from SUNY Geneseo monitored veliger larvae populations in an attempt to document seasonal patterns of veliger abundance and to identify environmental cues that might induce gamete release by adult mussels (Makarewricz and Bosch, 2004). An interesting trend that emerged from these plankton studies was that larval densities had declined from an average of 10,000 $\cdot m^{-3}$ in 1995 to less than 3,000 $\cdot m^{-3}$ in 1997 and 1999. However, by 2004 veliger densities had increased to an average of 4, 975 veligers $\cdot m^{-3}$ .

In this report we provide data on population numbers and size distribution of adult zebra mussels and describe temporal patterns of larval density and cohort development. Water quality data for are also provided for a deep-water station where larvae were sampled. Our observations indicate that, while populations of adult mussels have declined by about 20% since the year 2000, adult densities and the supply of larvae are still moderately high and the species seems to be well established in Conesus Lake.

## Procedures and Materials

Adult Zebra Mussel Collections

Adult mussels were collected from seven representative locations distributed throughout the lake (**Figure 1**). Replicate quadrat samples (n=3) were taken by divers using a PVC square with a total sample surface area of 0.125 $m^2$ (0.25 m per side). Mussels were collected by hand and loaded into a 1 L wide mouth jar that was covered on one side with 1mm plastic mesh. Individuals were separated from empty shells in the laboratory and counted. For each quadrat, a representative subsample of more than 100 individuals was weighed to obtain an average weight per animal. The remainder of the bulk sample was weighed and the total number of individuals in a quadrat was estimated by dividing the bulk sample weight by the average weight per individual. The height and length of 100-200 animals from each sampling site were measured to the nearest mm using a small ruler.

Each of the animals measured for height and length we examined the shape of the shell to distinguish between zebra mussels and quagga mussels. Shell morphology is widely used to distinguish the two species and the method seems to be generally reliable and accepted in the scientific literature (May and Mardsen, 1992; USGS Nonindegenous Species Web Site). Overall, quagga mussels are more spatulate (i.e. rounder) while zebra mussels have a more lancelate shape (spear-head). The ventral side of the zebra mussel is flattened, and there is a definite angle between the ventral and dorsal surfaces, whereas the quagga has a more rounded ventral end and the ventral side is convex (USGS Nonindegenous Species Web Site).

At the Grayshores site multiple samples were taken from 4, 6 and 8 m depth, in part to determine the optimal depth for the remaining collections. The 2 m collection depth fell within the marginal band of milfoil. Milfoil plants seem to be a preferred substrate for thousands of very small zebra mussels, which were not considered in our bottom-sampling scheme. Plants were sparse or absent at the 4 m sites but a steep slope at these depths tended to make sampling more difficult. At depths of about 8 m, mussels of all sizes formed a dense carpet over the gradually sloping bottom. Below 10 m the populations were always sparse or absent.  Taking these patterns into consideration we decided to base our survey on populations in the 8 m depth range.

We were unable to obtain samples from Pebble Beach Cove, where we had sampled in 2000.  The benthic layer at 4-8 m offshore from the cove was covered in very loose sediment that was devoid of zebra mussels.  Consequently we sampled a few hundred m to the south along the west shoreline just below the hill where Pebble Beach road turns west to merge with West Lake road.  All other collections were made at the approximate locations sampled in 2000.

## Zebra Mussel Veliger Collections

Our primary sampling site was in the center of the south basin of the lake over a depth of 18-20 m. This open water station has been used extensively for plankton surveys by the Department of Environmental Conservation and by researchers from SUNY Brockport.

Plankton collections were taken in surface waters on a regular (generally weekly) basis from June to Mid-August 2013, during the known reproductive season of zebra mussels in temperate North American lakes.  Two replicate water samples of 57 L were filtered approximately once per week from depths of 1- 4 m using a double action diaphragm pump (gal/min capacity, McMaster Carr # 4325 K18) fitted with 5 m of reinforced tubing.    This depth range corresponded to the major portion of the mixed surface layer of the lake above the thermocline throughout the summer season (**Figure 2**). The plankton concentrated with a 63-µm mesh filter and transferred using a turkey baster into a dark 1 L brown bottle.  Samples from the concentrated plankton collection were sorted live under a stereomicroscope with 50x magnification.  To do so, a small volume placed in a dish was swirled to concentrate larvae in the center.  Larvae were picked individually with very fine tipped glass pipettes.  Sorting of each sample continued until no more larvae were concentrated by swirling of the dish.

A minimum of 60 but typically 100 larvae were set aside for measurements of shell length. Size measurements were made using a compound microscope provided a calibrated ocular micrometer at a magnification of 200x. Our measure of size was defined as the maximum distance along a line parallel to the straight edge of the hinge on the Dshaped larva. This is the longest dimension of the veliger and it is generally referred to as the length of the larva (Sprung 1989).

Water Column Profiles

The station sampled for this study was at a depth of 18 m and corresponds to the DEC station of the South Basin. has been sampled previously in numerous surveys by the DEC, and by SUNY Brockport researchers under the direction of Dr. Makarewicz. Water column data were obtained with a Hydrolab 4a Sonde. The sonde is equipped with sensors that measure temperature (Celsius), photosynthetically active radiation (PAR in micro Einsteins per $m^2$ per $sec^{-1}$ -$\mu E/m^2/sec$- at wavelengths of 400-700 nm), chlorophyll equivalents (Volts), conductivity in microSiemens per cm (μS / cm), dissolved oxygen (as mg/l and % saturation), pH, and redox potential (as milliVolts, mV) relative to depth in meters. Turbidity was measured with a Hach 2100 P turbidimeter for samples collected with Van Dorn water at depths of 3, 9, 12 m and 1 m off the bottom, as appropriate for each station. Turbidity values are reported as nephelometer turbidity units, or NTUs, and water clarity was measured with a secchi disc.

## Results and Discussion

We examined more than 750 individual adults from seven sites in different areas of the lake and determined that they were all zebra mussels. It appears that quagga mussels have not colonized Conesus Lake.

Overall the abundance of zebra mussels in Conesus Lake ranged from an average of just over 6 x $10^3$ individuals per $m^2$ in North Sutton Point to 28 x $10^3$ in Sand Point (**Table 1**). These values are slightly higher than equilibrium values reported for European lakes, but they fall well within the median values reported from the Great Lakes and Saint Lawrence River, the Mississippi River basin, an the Hudson River that are summarized by Riccardi (2003).

Adult density was 15.5% lower (n=7) in 2013 than in 2000. The populations were essentially the same at Eagle Point (-2.3 %), McPherson's Point (-6.3 %) and Sand Point (+4.7 %) but they had decreased in the remaining four sites by an average of 26.4 %. There are no obvious spatial differences that could explain these trends. The sites with essentially no net change were in the central region of the lake, whereas to the north and south populations had declined, but we know of no possible environmental explanation for these trends.

The size frequency distributions were very similar at all the sites with the exception of Pebble Beach, where the median size was close to 1.5 cm compared to 1-1.2 cm elsewhere (**Figure 3**). Densities in Pebble beach were relatively low and that may be due to the larger size, but this is not true for some of the other sites where low densities were recorded. A comparison between 2000 and 2013 data revealed no consistent differences in the size frequency distributions lake wide or between the individual sites.

Bivalve veliger larvae were collected in every sample from early June to mid August (**Figure 4**; August data not shown). The peak in larval supply occurred in late June through the July 10, when densities ranged from 6 to 9.8 x $10^3$ per $m^{3.}$ The lowest densities were in early June. Ranging from 74-1907 per $m^3$. Judging from the size frequency distribution (**Figure 5**) and trends in abundance of larvae, we identified two major spawning events from June to late July. In early June we collected primarily small larvae just a few days old (**Figure 5**, June 7-12) indicating that a spawning event may have occurred between the $7^{th}$ and the $12^{th}$. The small numbers of larvae counted during that time period (**Figure 4**) shows that the spawning may have been limited. Starting with our June 26 collection larval numbers increased significantly and peaked in our July 10 collection, when larval numbers reached their maximum for the study period (**Figure 5**). The beginning of this second mass spawning event coincided with the full moon of June 23 that was notable in being a "supermoon" or "perigee" phase in which the moon was as close as it would come to Earth in 2013. During the same time period the lake reached its peak in epilimnion chlorophyll concentration and turbidity. Consequently, we cannot reject the possibility that spawning was triggered by the onset of algal blooms (See *in vivo* chlorophyll graph, **Figure 6,** epilimnion water column clarity for most of July in **Table 2,** and water column pH, Redox and Conductivity provided for the epi, meta and hypolimnion in **Table 3**).

When averaged out for the whole June - July collection period, the density of veliger larvae for 2013 in Conesus Lake was moderate to high when compared to five previous years, between 1994 and 2004 (**Figure 7,** averages and maxima for each year).

## Conclusions

We found no evidence that quagga mussels had colonized Conesus Lake. The population densities of zebra mussels in 2013 were on average 15.5 % lower than what they were during the summer 2000, approximately 8 years after colonization of the lake. Larval supply was moderate to high, an indication that the population is relatively healthy and productive. The adult densities recorded for Conesus Lake in 2013 are near the median for established populations in the Great Lakes, and the Saint Lawrence and Hudson River systems. The species seems to have established a sustainable equilibrium in Conesus Lake and should be regarded a permanent component of the ecosystem.

**References**

Bosch, I., J.C. Makarewicz, J.P. Emblidge, D.A. Johnson and M.D. Valentino**.** 2001. Population studies of Eurasian watermilfoil (*Myriophyllum spicatum*) and zebra mussels (*Dreissena polymorpha*) in Conesus Lake, N.Y. (Summer 2000). Report to the Livingston County Planning Department. 37 pp.

Makarewicz, J.C. and Bosch I. 2004. Conesus Lake Limnology 2004. Report to the Livingston County Planning Department. 41 pp.

May, B., and Marsden, J.E. 1992. Genetic identification and implications of another invasive dreissinid mussel in the Great Lakes. *Can. J. Fish. Aquat. Sci*. 49: 1501-1506

Riccardi, A. 2003. Predicting the impacts of an introduced species from its invasion history: an empirical approach applied to zebra mussel invasions. *Freshwater Biology* 48:972-981

Skubina, J.P., T.G. Coon & T.R. Batterson. 1995. Increased abundance and depth of submersed macrophytes in response to decreased turbidity in Saginaw Bay, Lake Huron. *J. Great Lakes Res*. 21: 476-478.

Sprung, M. 1989. Field and laboratory observations of *Dreissena polymorpha* larvae: abundance, growth, mortality and food demands. *Arch. Hydrobiol*. 115: 537- 561.

## TABLES

**Table 1**. The abundance of zebra mussels per square meter at our seven sampling locations is shown in absolute numbers and as percent change in comparison to populations in 2000. At the Grayshores site, replicate samples taken at 4, 6, and 8 m showed that mussel density decreased with depth.

| Location | Depth (m) | Number of Quadrats | Density ($mussels \cdot m^{-2}$) | Standard Deviation | % Change from 2000 |
|---|---|---|---|---|---|
| Grayshores | 4 | 3 | 13,278 | 3,965 | -31.6 |
| Grayshores | 6 | 3 | 8,834 | 2,801 | N/A |
| Grayshores | 8 | 3 | 6,052 | 644 | -44.08 |
| Eagle Pt. | 6-7 | 3 | 9,884 | 2,435 | -2.25 |
| McPhersons Pt. | 7 | 3 | 20,647 | 3,175 | -6.2 |
| Sand Pt. West | 6 | 3 | 28,021 | 3,284 | +4.73 |
| Pebble Beach Hill | 8 | 3 | 7,568 | 2,891 | -30.55 |
| Booher Hill | 6-7 | 3 | 7,884 | 1,556 | -21.28 |
| North Sutton Pt. | 6-7 | 3 | 6,166 | 1,168 | -14.89 |

**Table 2.** Water turbidity, secchi depth, attenuation coefficient, and maximum depth of light penetration for surface waters at South Station on dates when zebra mussel larvae were collected during summer of 2013.

| Date | Epilimnion Turbidity (NTU) | Secchi Depth (m) | Average Attenuation Coefficient | Maximum Depth of Light Penetration (m) |
|---|---|---|---|---|
| 6/7/13 | 2.06 | 2.95 | 0.471 | 10.95 |
| 6/12/13 | 1.86 | 2.08 | 0.642 | 13.76 |
| 6/19/13 | 2.05 | 2.6 | 0.255 | 11.58 |
| 6/26/13 | 1.95 | 3.3 | 0.162 | 9.42 |
| 7/10/13 | 3.71 | 1.95 | 0.641 | 10.42 |
| 7/16/13 | 7.58 | 1.54 | 0.763 | 11.07 |
| 7/24/13 | 3.64 | 2 | 0.594 | 10.4 |
| 7/29/13 | 3.43 | 1.5 | 0.647 | 8.23 |
| 8/6/13 | 1.85 | 2.5 | 0.613 | 12.94 |
| 8/17/13 | 1.98 | 2.25 | 0.586 | 9.91 |

**Table 3.** pH, Oxidation-Reduction potential and conductivity of epiliminion (epi), metalimneon (meta) and hypolimnion in Conesus Lake on dates when zebra mussel larvae were collected in 2013.

| Date | Layer of lake (m) | pH (units) | Redox Potential (mV) | Conductivity (µS/cm) |
|---|---|---|---|---|
| 6/7/2013 | epi (0-7) | 7.76 | 140 | 593 |
| | meta (7-12) | 7.57 | 148 | 589 |
| | hypo (12-18) | 7.39 | 162 | 589 |
| 6/12/2013 | epi (0-7) | 7.67 | 146 | 425 |
| | meta (7-10) | 7.40 | 154 | 428 |
| | hypo (10-17) | 7.35 | 165 | 430 |
| 6/19/2013 | epi (0-7) | 7.55 | 101 | 422 |
| | meta (7-12) | 7.40 | 113 | 430 |
| | hypo (12-18) | 7.39 | 111 | 435 |
| 6/26/2013 | epi (0-5.5) | 7.73 | 149 | 405 |
| | meta (5.5- 10.5) | 7.39 | 155 | 429 |
| | hypo (10.5-18) | 7.15 | 172 | 435 |
| 7/10/2013 | epi (0-4.75) | 8.05 | 201 | 411 |
| | meta (4.75-9) | 7.62 | 212 | 435 |
| | hypo (9-18) | 7.55 | 127 | 444 |
| 7/16/2013 | epi (0-5) | 7.65 | 121 | 403 |
| | meta (5-10) | 7.28 | 140 | 443 |
| | hypo (10-18) | 7.38 | 30 | 449 |
| 7/24/2013 | epi (0-7) | 7.12 | 198 | 403 |
| | meta (7-12) | 6.13 | 168 | 452 |
| | hypo (12-18) | 6.48 | -24 | 452 |
| 7/29/2013 | epi (0-6) | 8.01 | 124 | 413 |
| | meta (6-10) | 7.78 | 101 | 447 |
| | hypo (10-18) | 7.69 | -8 | 472 |
| 8/06/13 | epi (0-7) | 7.95 | 165 | 415 |
| | meta (7-10) | 7.76 | 28 | 451 |
| | hypo (10-18) | 7.90 | -119 | 455 |
| 8/17/13 | epi (0-6) | 8.12 | 134 | 415 |
| | meta (6-10) | 7.82 | 147 | 436 |
| | hypo (10-18) | 7.89 | -152 | 456 |

**FIGURES**

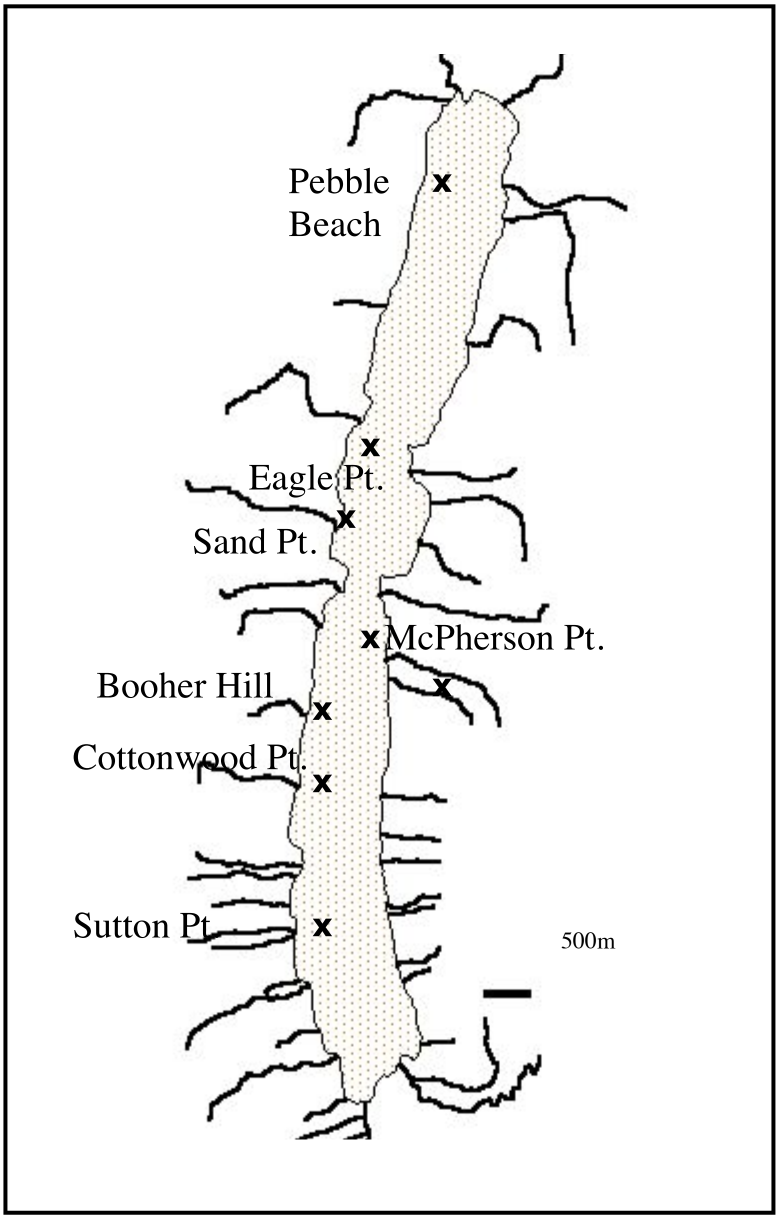


**Figure 1**. Map of Conesus Lake showing approximate locations where quadrat collections of adult zebra mussels were taken.

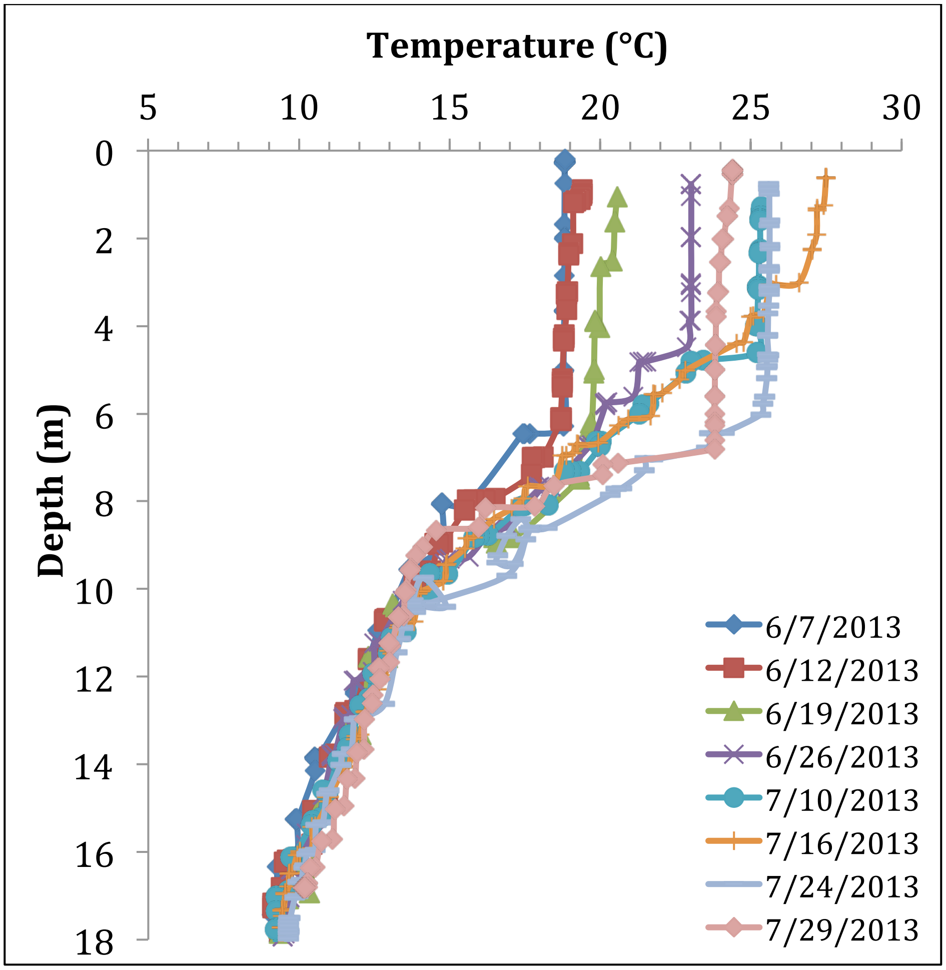


**Figure 2.** Temperature stratification showing the depth of the mixed surface layer (the epilimnion ) at South Station for 2013 veliger collection dates.

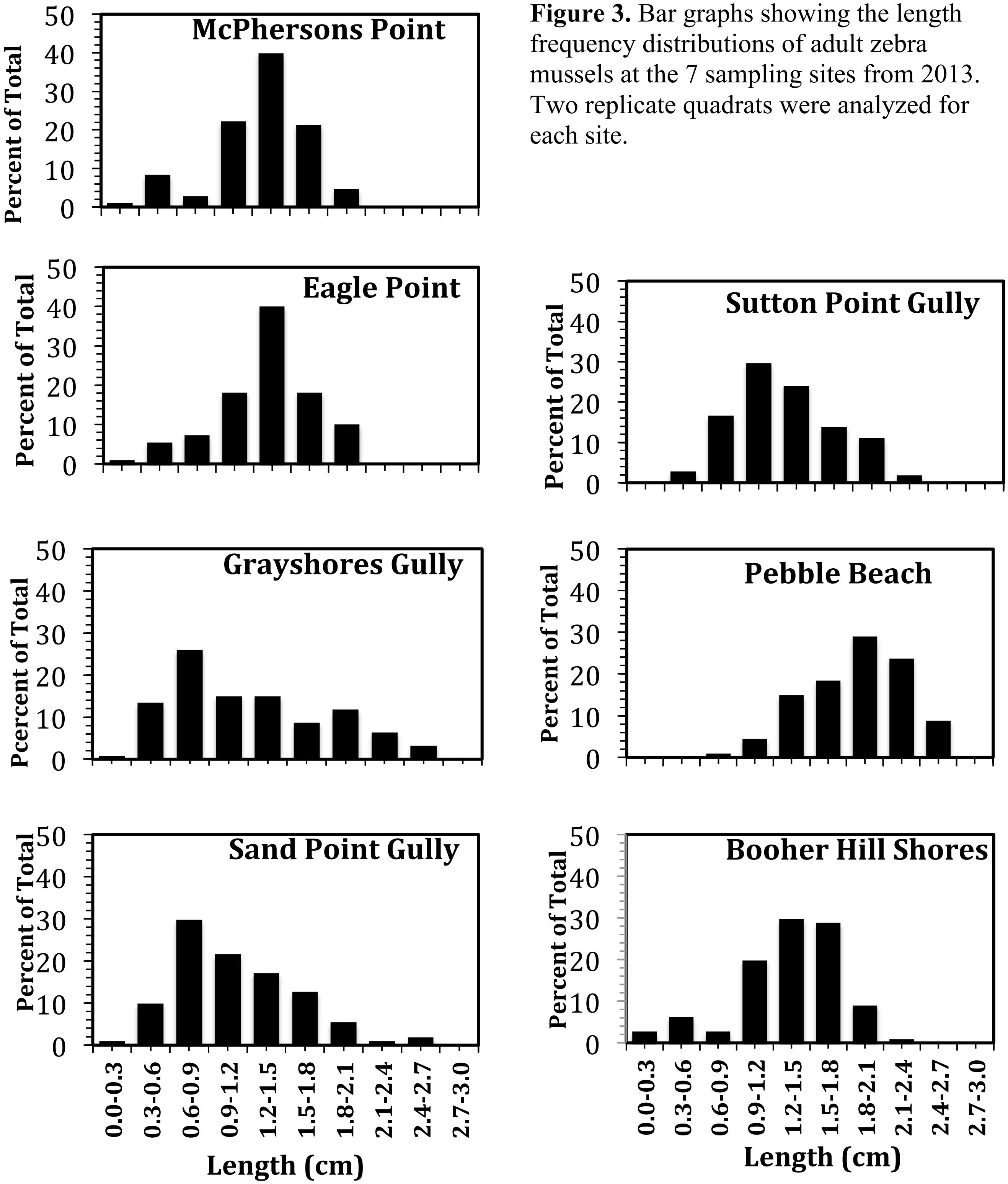


**Figure 3.** Bar graphs showing the length frequency distributions of adult zebra mussels at the 7 sampling sites from 2013. Two replicate quadrats were analyzed for each site.

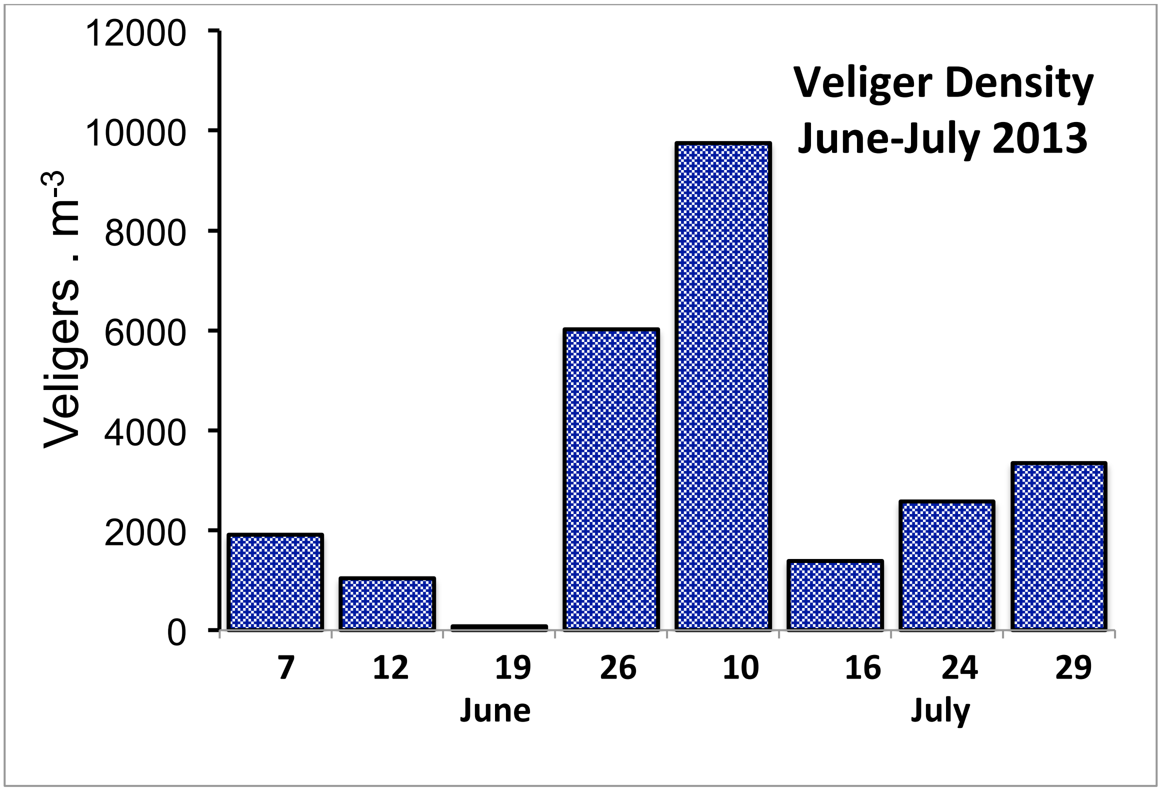


**Figure 4**. This bar chart shows the average density of veliger larvae in the upper 4 m of the water column during sampling dates in June and July.

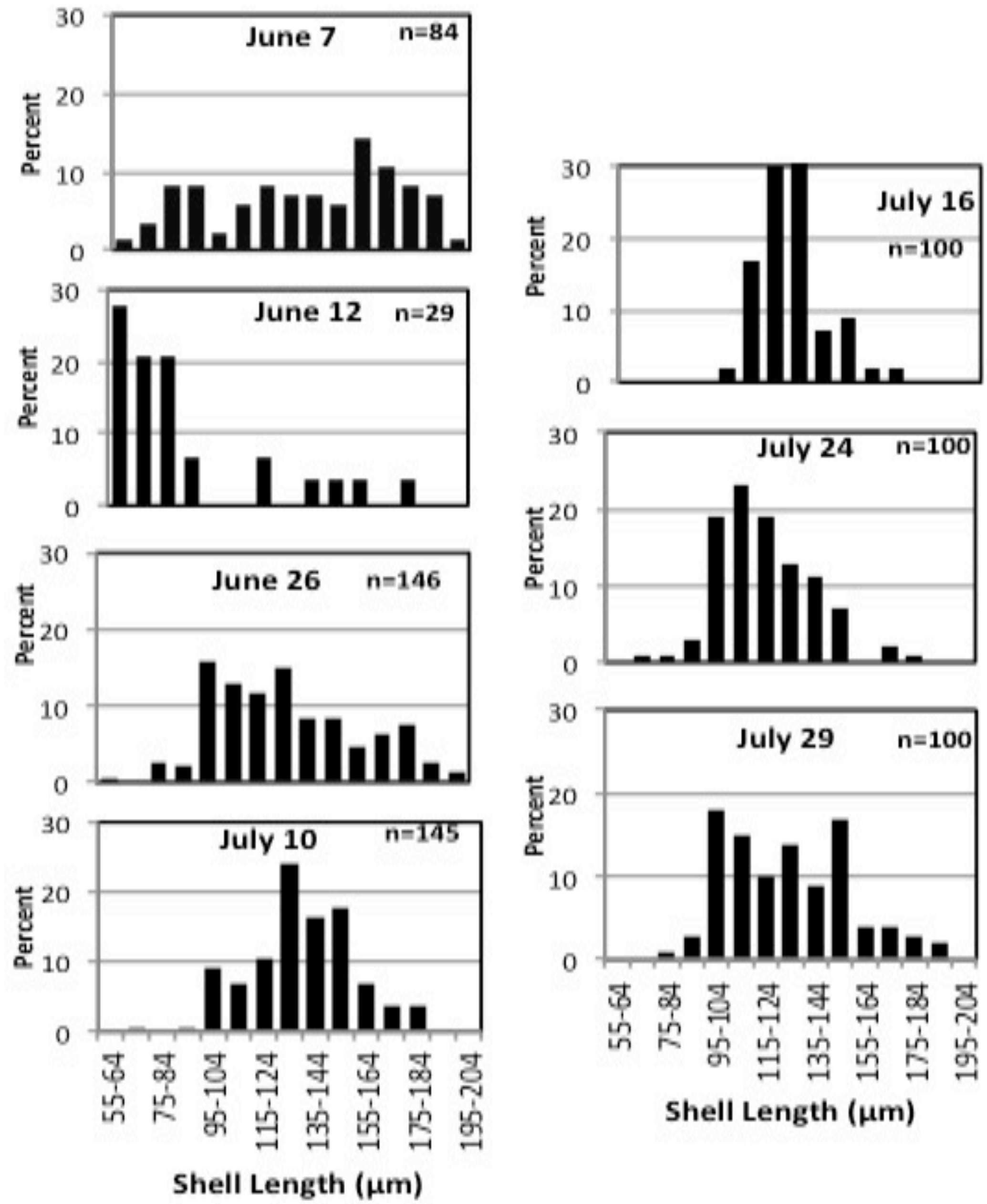


**Figure 5.** Length frequency distributions of zebra mussel veliger larvae collected in net or pump samples from the upper 4 m of the water column.

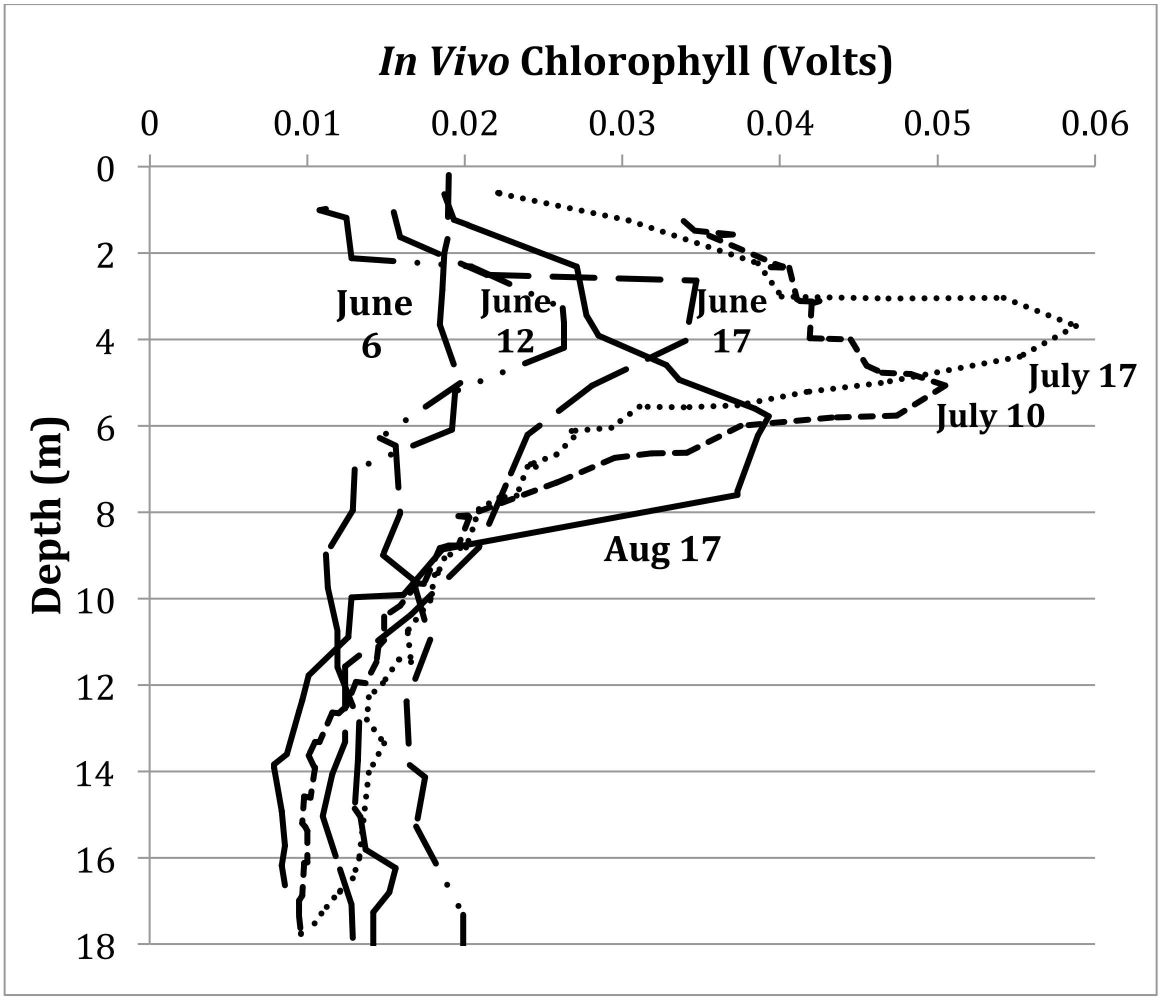


**Figure 6**. Profiles showing the development of the chlorophyll maximum layer at 4-5 m over the growing season. The *in vivo* maximum is first prominent in the June 12 profile and it reaches a maximum on July 17. By August, the chlorophyll maximum has decreased as the lake approaches its August clear phase, and moved downward with the deepening thermocline.

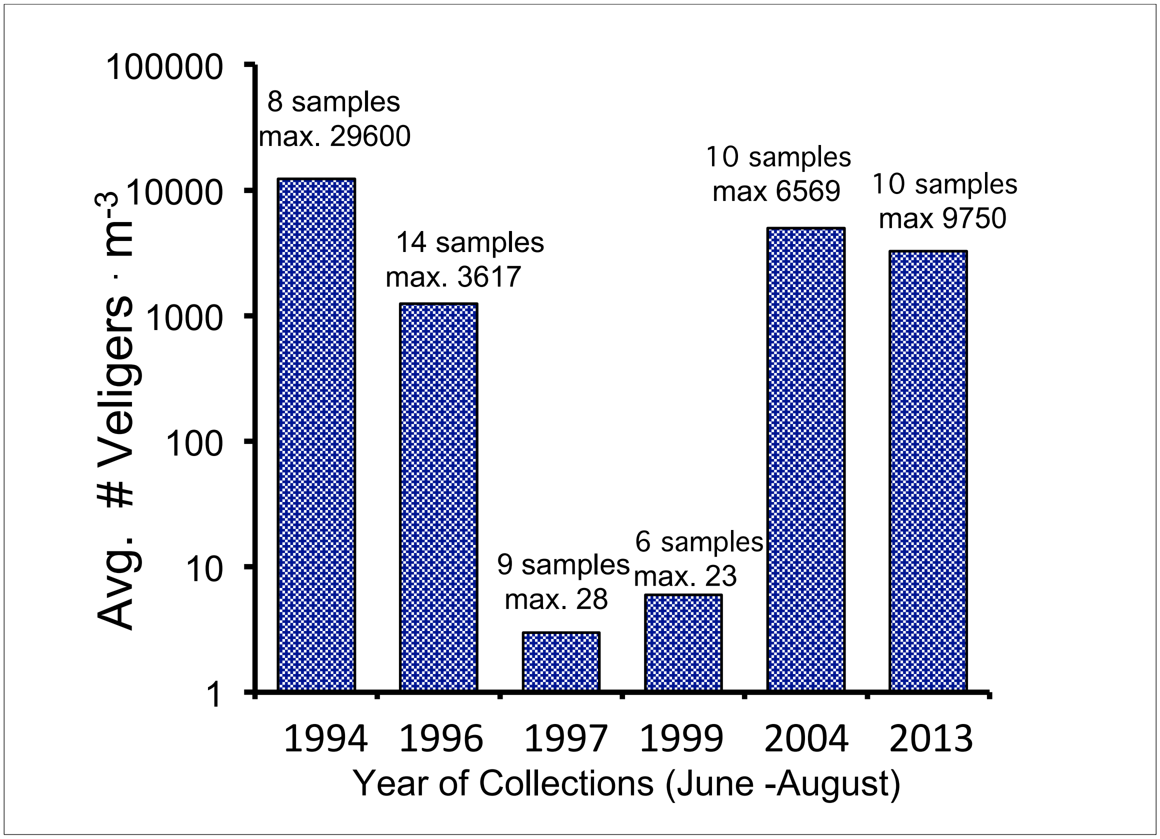


**Figure 7:** Bar chart showing average number of veligers per cubic meter June – August over several years of collection in Conesus Lake. The number of different samples collected as well as the maximum density is reported for each year. The y-axis is on a log scale to allow for comparison between years of high abundance and years of very low abundance.

**Appendix.** Data from water column profiles taken with a Hydrolab 4a multiparameter sonde.

| **7-Jun-13** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | PAR [µE/s/m²] | LDO% [Sat] | LDO [mg/l] | Chloro. [Volts] |
| 0.2 | 18.82 | 7.78 | 139 | 582 | 106.6 | 9.91 | 0.019 |
| 1.68 | 18.81 | 7.77 | 139 | 107 | 106.6 | 9.91 | 0.0189 |
| 2 | 18.81 | 7.78 | 139 | 87 | 106.8 | 9.93 | 0.0187 |
| 2.85 | 18.81 | 7.78 | 139 | 53 | 106.7 | 9.92 | 0.0186 |
| 3.66 | 18.8 | 7.77 | 139 | 41 | 106.5 | 9.91 | 0.0184 |
| 5.02 | 18.78 | 7.78 | 138 | 20 | 106.1 | 9.87 | 0.0197 |
| 6.29 | 18.78 | 7.73 | 139 | 11 | 105.6 | 9.82 | 0.0146 |
| 6.46 | 17.48 | 7.7 | 140 | 11 | 102.4 | 9.78 | 0.0156 |
| 8.03 | 15.63 | 7.61 | 145 | 5 | 89.4 | 8.88 | 0.0159 |
| 9 | 14.72 | 7.58 | 147 | 3 | 79.3 | 8.03 | 0.0148 |
| 9.56 | 13.73 | 7.55 | 149 | 2 | 71.6 | 7.41 | 0.0167 |
| 10.95 | 12.77 | 7.5 | 152 | 1 | 62 | 6.55 | 0.0178 |
| 12.39 | 11.87 | 7.47 | 155 | 0 | 50.8 | 5.48 | 0.0163 |
| 13.86 | 10.64 | 7.44 | 159 | 0 | 46.5 | 5.16 | 0.0165 |
| 14.14 | 10.55 | 7.41 | 161 | 0 | 36.1 | 4.01 | 0.0175 |
| 15.28 | 9.95 | 7.39 | 163 | 0 | 35.3 | 3.99 | 0.0169 |
| 16.31 | 9.33 | 7.33 | 167 | 0 | 22.8 | 2.61 | 0.0232 |
| 17.32 | 9.16 | 7.32 | 167 | 0 | 12.9 | 1.48 | 0.0199 |
| 18.17 | 9.09 | 7.32 | 162 | 0 | 10.4 | 1.2 | 0.0199 |

| 12-Jun-13 Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | SpCond [µS/cm] | PAR [µE/s/m²] | LDO% [Sat] | LDO [mg/l] | Chloro. [volts] |
|---|---|---|---|---|---|---|---|---|
| 0.98 | 19.4 | 7.4 | 150 | 424 | 1412 | 108.2 | 9.94 | 0.0112 |
| 1.02 | 19.38 | 7.57 | 150 | 424 | 1060 | 108.1 | 9.94 | 0.0108 |
| 1.19 | 19.1 | 7.65 | 148 | 424 | 315 | 108.2 | 10.01 | 0.0125 |
| 2.12 | 19.09 | 7.66 | 148 | 423 | 428 | 108.3 | 10.02 | 0.0128 |
| 2.32 | 18.95 | 7.67 | 147 | 424 | 330 | 108.4 | 10.05 | 0.0204 |
| 3.28 | 18.89 | 7.71 | 146 | 424 | 335 | 107.6 | 9.99 | 0.0262 |
| 3.62 | 18.89 | 7.72 | 146 | 424 | 270 | 107.5 | 9.98 | 0.0263 |
| 4.2 | 18.81 | 7.66 | 146 | 425 | 211 | 107.4 | 9.99 | 0.0263 |
| 5.21 | 18.74 | 7.69 | 145 | 425 | 105 | 104.7 | 9.76 | 0.0194 |
| 6.09 | 18.69 | 7.72 | 145 | 425 | 63 | 102.7 | 9.57 | 0.0192 |
| 7.02 | 17.74 | 7.63 | 147 | 428 | 40 | 93.5 | 8.88 | 0.013 |
| 7.96 | 15.6 | 7.54 | 152 | 427 | 25 | 77.9 | 7.74 | 0.0129 |
| 8.99 | 14.62 | 7.49 | 154 | 428 | 16 | 67.3 | 6.84 | 0.0112 |
| 9.75 | 13.91 | 7.3 | 156 | 428 | 12 | 57.7 | 5.95 | 0.0113 |
| 10.74 | 12.85 | 7.34 | 159 | 428 | 8 | 51.5 | 5.44 | 0.0119 |
| 11.59 | 12.31 | 7.33 | 159 | 429 | 6 | 50 | 5.34 | 0.0119 |
| 12.86 | 11.51 | 7.29 | 163 | 429 | 3 | 40.1 | 4.36 | 0.0133 |
| 13.76 | 11.23 | 7.3 | 163 | 427 | 1 | 39 | 4.27 | 0.0132 |
| 14.87 | 10.95 | 7.34 | 164 | 426 | 0 | 35.6 | 3.93 | 0.013 |
| 15.05 | 10.46 | 7.35 | 165 | 428 | 0 | 35.3 | 3.93 | 0.0134 |
| 15.82 | 10.43 | 7.37 | 167 | 427 | 0 | 33.1 | 3.69 | 0.0137 |
| 16.24 | 9.52 | 7.3 | 172 | 433 | 0 | 18.6 | 2.13 | 0.0156 |
| 16.81 | 9.41 | 7.3 | 172 | 432 | 0 | 14.8 | 1.69 | 0.0152 |
| 17.27 | 9.13 | 7.44 | 171 | 434 | 0 | 7.7 | 0.88 | 0.0142 |
| 18.16 | 9.11 | 7.49 | 166 | 433 | 0 | 5.6 | 0.64 | 0.0142 |

| 19-Jun-13<br>Depth<br>[m] | Temp<br>[°C] | pH<br>[Units] | ORP<br>[mV] | SpCond<br>[µS/cm] | PAR<br>[µE/s/m²] | LDO%<br>[Sat] | LDO<br>[mg/l] | Chloro<br>[Volts] |
|---|---|---|---|---|---|---|---|---|
| 1.06 | 20.56 | 7.34 | 102 | 419 | 1567 | 121.9 | 10.95 | 0.0155 |
| 1.63 | 20.48 | 7.45 | 101 | 419 | 1196 | 122.2 | 10.99 | 0.0159 |
| 2.51 | 20.4 | 7.5 | 101 | 418 | 616 | 122.2 | 11.01 | 0.0214 |
| 2.65 | 20.02 | 7.51 | 100 | 419 | 538 | 122.7 | 11.14 | 0.0347 |
| 4.03 | 19.97 | 7.51 | 101 | 420 | 215 | 122.8 | 11.15 | 0.034 |
| 5.07 | 19.79 | 7.6 | 100 | 422 | 109 | 118.8 | 10.83 | 0.0281 |
| 6.21 | 19.67 | 7.64 | 99 | 423 | 40 | 113.5 | 10.37 | 0.024 |
| 7.38 | 19.18 | 7.57 | 101 | 429 | 17 | 112.3 | 10.36 | 0.0226 |
| 8.82 | 17.17 | 7.45 | 107 | 429 | 15 | 93 | 8.95 | 0.0209 |
| 10.37 | 16.05 | 7.39 | 112 | 413 | 3 | 66.5 | 6.55 | 0.0166 |
| 11.58 | 12.94 | 7.38 | 116 | 429 | 1 | 49.4 | 5.21 | 0.0124 |
| 13.32 | 12.06 | 7.41 | 119 | 429 | 0 | 33.9 | 3.65 | 0.0124 |
| 14.07 | 11.26 | 7.43 | 121 | 433 | 0 | 29.1 | 3.18 | 0.0116 |
| 15.04 | 10.71 | 7.37 | 122 | 432 | 0 | 27 | 3 | 0.011 |
| 16.27 | 9.99 | 7.36 | 127 | 438 | 0 | 19.3 | 2.18 | 0.0121 |
| 17.08 | 9.53 | 7.37 | 128 | 438 | 0 | 10.3 | 1.18 | 0.0128 |
| 17.86 | 9.34 | 7.39 | 74 | 438 | 0 | 7 | 0.81 | 0.0129 |
| 18.13 | 9.32 | 7.44 | 9 | 439 | 0 | 4.7 | 0.54 | 0.0467 |

| June 26, 2013<br>Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | SpCond] [µS/cm] | PAR [µE/s/m²] | LDO% [Sat] | LDO [mg/l] | Chloro [Volts] |
|---|---|---|---|---|---|---|---|---|
| 0.76 | 23.02 | 7.69 | 153 | 424 | 257 | 131.2 | 11.24 | 0.0453 |
| 1.04 | 23.02 | 7.72 | 152 | 424 | 182 | 131.3 | 11.25 | 0.0503 |
| 1.98 | 23.02 | 7.74 | 149 | 424 | 112 | 131.9 | 11.29 | 0.0553 |
| 3.07 | 23.02 | 7.76 | 146 | 424 | 60 | 131.9 | 11.3 | 0.0464 |
| 3.23 | 23.02 | 7.77 | 145 | 424 | 52 | 132 | 11.3 | 0.0479 |
| 3.88 | 23.02 | 7.77 | 145 | 422 | 39 | 132 | 11.31 | 0.0504 |
| 4.49 | 22.87 | 7.75 | 145 | 421 | 25 | 131.9 | 11.33 | 0.063 |
| 4.81 | 21.52 | 7.75 | 145 | 423 | 22 | 133 | 11.72 | 0.0705 |
| 5.61 | 21.11 | 7.7 | 146 | 421 | 12 | 132.4 | 11.76 | 0.087 |
| 5.81 | 20.17 | 7.61 | 147 | 426 | 10 | 111.8 | 10.12 | 0.0883 |
| 6.77 | 19.61 | 7.49 | 150 | 427 | 6 | 95.5 | 8.74 | 0.0409 |
| 7.69 | 18.06 | 7.36 | 156 | 430 | 4 | 72.5 | 6.85 | 0.0324 |
| 8.64 | 16.36 | 7.26 | 160 | 431 | 2 | 53 | 5.18 | 0.0262 |
| 9.42 | 14.84 | 7.22 | 163 | 431 | 1 | 38.7 | 3.91 | 0.0206 |
| 10.27 | 13.46 | 7.2 | 166 | 432 | 0 | 31.2 | 3.25 | 0.02 |
| 11.24 | 12.5 | 7.19 | 168 | 432 | 0 | 25.4 | 2.71 | 0.0186 |
| 12.1 | 11.81 | 7.19 | 168 | 431 | 0 | 22.5 | 2.43 | 0.0163 |
| 12.87 | 11.72 | 7.18 | 169 | 430 | 0 | 21.9 | 2.37 | 0.0161 |
| 13.78 | 11.19 | 7.16 | 172 | 432 | 0 | 20.4 | 2.24 | 0.0151 |
| 13.82 | 11.09 | 7.15 | 173 | 433 | 0 | 13.6 | 1.5 | 0.0139 |
| 14.7 | 10.8 | 7.14 | 176 | 437 | 0 | 9.8 | 1.08 | 0.0136 |
| 15.84 | 10.24 | 7.12 | 176 | 435 | 0 | 5.9 | 0.67 | 0.0128 |
| 16.39 | 9.75 | 7.11 | 176 | 439 | 0 | 4.4 | 0.5 | 0.0128 |
| 17.31 | 9.55 | 7.14 | -3 | 441 | 0 | 3.6 | 0.41 | 0.0112 |
| 17.92 | 9.46 | 7.15 | -44 | 441 | 0 | 3.3 | 0.38 | 0.0547 |

| 10-Jul-13<br>Depth<br>[m] | Temp<br>[°C] | pH<br>[Units] | ORP<br>[mV] | SpCond<br>[µS/cm] | PAR<br>[µE/s/m²] | LDO%<br>[Sat] | LDO<br>[mg/l] | Chloro<br>[Volts] |
|---|---|---|---|---|---|---|---|---|
| 1.27 | 25.35 | 8.04 | 212 | 411 | 734 | 129.2 | 10.6 | 0.0339 |
| 1.49 | 25.33 | 8.05 | 210 | 411 | 571 | 128.6 | 10.55 | 0.0346 |
| 1.57 | 25.3 | 8.05 | 207 | 411 | 519 | 128.7 | 10.57 | 0.337 |
| 2.33 | 25.28 | 8.06 | 201 | 411 | 515 | 129.1 | 10.6 | 0.0394 |
| 3.08 | 25.26 | 8.05 | 199 | 411 | 332 | 129.1 | 10.6 | 0.0411 |
| 3.17 | 25.24 | 8.05 | 195 | 411 | 306 | 128.4 | 10.55 | 0.042 |
| 4 | 25.22 | 8.04 | 192 | 411 | 181 | 128.1 | 10.53 | 0.0445 |
| 4.78 | 23.42 | 7.9 | 198 | 424 | 103 | 129.2 | 10.98 | 0.0465 |
| 4.81 | 23.01 | 7.85 | 199 | 426 | 104 | 109 | 9.34 | 0.0483 |
| 5.07 | 22.85 | 7.82 | 200 | 426 | 75 | 94.6 | 8.13 | 0.0505 |
| 5.77 | 21.62 | 7.73 | 205 | 430 | 49 | 90.7 | 7.98 | 0.0474 |
| 5.81 | 21.42 | 7.68 | 207 | 431 | 47 | 79.8 | 7.05 | 0.0433 |
| 6.01 | 21.3 | 7.65 | 208 | 435 | 38 | 76.9 | 6.81 | 0.0375 |
| 6.64 | 19.86 | 7.57 | 213 | 436 | 27 | 63.7 | 5.8 | 0.0318 |
| 6.74 | 20 | 7.56 | 213 | 435 | 24 | 61.2 | 5.56 | 0.0295 |
| 7.31 | 18.81 | 7.54 | 216 | 438 | 17 | 46.3 | 4.31 | 0.0259 |
| 8.13 | 17.37 | 7.52 | 218 | 441 | 11 | 33.7 | 3.23 | 0.0203 |
| 8.83 | 15.8 | 7.52 | 219 | 443 | 7 | 23.7 | 2.35 | 0.0184 |
| 9.65 | 14.34 | 7.53 | 219 | 443 | 5 | 19.3 | 1.97 | 0.017 |
| 10.42 | 13.73 | 7.53 | 220 | 440 | 3 | 16.3 | 1.68 | 0.0149 |
| 11.11 | 13.06 | 7.52 | 221 | 442 | 0 | 16.2 | 1.7 | 0.0145 |
| 11.47 | 12.97 | 7.52 | 221 | 442 | 0 | 12.9 | 1.36 | 0.0144 |
| 11.96 | 12.56 | 7.52 | 221 | 440 | 0 | 10 | 1.06 | 0.0137 |
| 12.66 | 12.05 | 7.52 | 222 | 439 | 0 | 8.4 | 0.9 | 0.012 |
| 13.32 | 11.78 | 7.51 | 223 | 437 | 0 | 6.3 | 0.68 | 0.0108 |
| 13.63 | 11.61 | 7.5 | 223 | 439 | 0 | 5.9 | 0.65 | 0.0101 |
| 13.95 | 11.35 | 7.49 | 223 | 438 | 0 | 5.8 | 0.63 | 0.0105 |
| 14.61 | 10.97 | 7.47 | 224 | 437 | 0 | 4.9 | 0.54 | 0.0102 |
| 15.29 | 10.45 | 7.46 | 227 | 443 | 0 | 3.6 | 0.4 | 0.0099 |
| 16.12 | 9.73 | 7.57 | -1 | 452 | 0 | 3.1 | 0.35 | 0.0098 |
| 17.03 | 9.24 | 7.65 | -104 | 453 | 0 | 2.8 | 0.32 | 0.0095 |
| 17.35 | 9.24 | 7.67 | -114 | 452 | 0 | 2.7 | 0.31 | 0.0095 |
| 17.75 | 9.25 | 7.68 | -124 | 453 | 0 | 2.7 | 0.31 | 0.0096 |

| **16-Jul-13** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | SpCond [µS/cm] | PAR [µE/s/m²] | LDO% [Sat] | LDO [mg/l] | Chloro [Volts] |
| 0.63 | 27.49 | 7.68 | 123 | 397 | 1776 | 138.9 | 10.96 | 0.0222 |
| 1.25 | 27.41 | 7.71 | 121 | 397 | 1759 | 142.4 | 11.23 | 0.0222 |
| 1.92 | 27.18 | 7.75 | 117 | 396 | 911 | 148.7 | 11.8 | 0.0354 |
| 2.24 | 27.02 | 7.75 | 117 | 396 | 510 | 149 | 11.82 | 0.039 |
| 3.06 | 25.84 | 7.68 | 118 | 402 | 178 | 150.1 | 12.03 | 0.0401 |
| 3.7 | 25.42 | 7.64 | 119 | 406 | 168 | 142.8 | 11.65 | 0.0542 |
| 4.4 | 24.53 | 7.5 | 125 | 415 | 52 | 121.8 | 10.1 | 0.0595 |
| 5.02 | 22.83 | 7.37 | 133 | 431 | 28 | 110.0 | 8.85 | 0.0514 |
| 5.53 | 22.06 | 7.31 | 137 | 436 | 22 | 67.7 | 5.84 | 0.0417 |
| 6.27 | 20.62 | 7.27 | 140 | 439 | 11 | 37.7 | 3.36 | 0.0268 |
| 6.67 | 19.93 | 7.27 | 140 | 439 | 9 | 33.1 | 2.96 | 0.0269 |
| 6.96 | 18.75 | 7.26 | 141 | 447 | 5 | 25.1 | 2.34 | 0.0245 |
| 7.62 | 18.44 | 7.26 | 141 | 443 | 5 | 24.1 | 2.24 | 0.024 |
| 7.93 | 17.44 | 7.26 | 141 | 447 | 3 | 23.1 | 2.21 | 0.0222 |
| 8.17 | 17.06 | 7.26 | 142 | 447 | 3 | 22.2 | 2.12 | 0.0209 |
| 8.4 | 16.47 | 7.26 | 142 | 449 | 2 | 19 | 1.83 | 0.0207 |
| 8.82 | 15.79 | 7.26 | 142 | 450 | 2 | 18.2 | 1.77 | 0.0205 |
| 9.07 | 15.51 | 7.27 | 142 | 448 | 2 | 14.3 | 1.43 | 0.0197 |
| 9.42 | 14.91 | 7.28 | 142 | 451 | 1 | 11.5 | 1.14 | 0.0187 |
| 9.82 | 14.8 | 7.28 | 142 | 447 | 0 | 10.3 | 1.04 | 0.0181 |
| 10.11 | 13.94 | 7.3 | 143 | 450 | 0 | 9.3 | 0.96 | 0.017 |
| 10.89 | 13.3 | 7.31 | 144 | 451 | 0 | 6.1 | 0.63 | 0.0166 |
| 11.47 | 13.08 | 7.3 | 144 | 449 | 0 | 5.7 | 0.6 | 0.0171 |
| 11.96 | 12.86 | 7.29 | 144 | 447 | 0 | 4.8 | 0.5 | 0.0158 |
| 12.02 | 12.67 | 7.29 | 144 | 448 | 0 | 4.3 | 0.45 | 0.0148 |
| 12.29 | 12.6 | 7.29 | 144 | 448 | 0 | 4 | 0.42 | 0.014 |
| 12.79 | 12.23 | 7.28 | 144 | 445 | 0 | 3.9 | 0.42 | 0.0139 |
| 13.36 | 11.91 | 7.27 | 145 | 445 | 0 | 3.8 | 0.41 | 0.0143 |
| 13.43 | 11.88 | 7.27 | 145 | 443 | 0 | 3.7 | 0.4 | 0.0149 |
| 14.04 | 11.64 | 7.26 | 146 | 441 | 0 | 3.5 | 0.38 | 0.0145 |
| 15.42 | 10.54 | 7.32 | 31 | 449 | 0 | 3 | 0.33 | 0.011 |
| 15.43 | 10.44 | 7.41 | -20 | 450 | 0 | 2.9 | 0.32 | 0.0115 |
| 15.91 | 10.42 | 7.43 | -49 | 448 | 0 | 2.8 | 0.31 | 0.0122 |
| 16.48 | 9.7 | 7.53 | -119 | 454 | 0 | 2.5 | 0.28 | 0.0129 |
| 16.93 | 9.55 | 7.54 | -147 | 454 | 0 | 2.4 | 0.27 | 0.0121 |
| 16.97 | 9.54 | 7.53 | -155 | 454 | 0 | 2.4 | 0.27 | 0.0117 |
| 17.3 | 9.5 | 7.54 | -164 | 455 | 0 | 2.4 | 0.27 | 0.0114 |
| 17.35 | 9.44 | 7.54 | -173 | 456 | 0 | 2.4 | 0.27 | 0.0104 |
| 17.46 | 9.45 | 7.54 | -177 | 456 | 0 | 2.4 | 0.27 | 0.0102 |
| 17.73 | 9.42 | 7.54 | -182 | 456 | 0 | 2.3 | 0.27 | 0.01 |
| 18.11 | 9.4 | 7.54 | -188 | 456 | 0 | 2.3 | 0.27 | 0.01 |

| **24-Jul-13** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth [m] | Temp [°C] | pH [Units] | ORP [mV] | SpCond [µS/cm] | PAR [µE/s/m²] | LDO %Sat | LDO] [mg/l] | Chloro Volts |
| 1.1 | 24.99 | 7.72 | 80 | 406 | 1915 | 98.6 | 8.14 | 0.0261 |
| 1.08 | 24.99 | 7.74 | 79 | 406 | 1485 | 98.1 | 8.1 | 0.0257 |
| 1.56 | 24.98 | 7.78 | 77 | 406 | 951 | 98.1 | 8.1 | 0.0261 |
| 1.83 | 24.92 | 7.77 | 77 | 406 | 747 | 98 | 8.1 | 0.0594 |
| 2.51 | 24.88 | 7.79 | 75 | 407 | 493 | 96.5 | 7.98 | 0.0417 |
| 3.28 | 24.77 | 7.78 | 75 | 407 | 320 | 93.3 | 7.73 | 0.0468 |
| 4 | 24.76 | 7.78 | 74 | 407 | 192 | 92.1 | 7.64 | 0.0475 |
| 4.44 | 24.75 | 7.79 | 73 | 407 | 123 | 91 | 7.55 | 0.0484 |
| 4.87 | 24.72 | 7.78 | 73 | 407 | 97 | 90.8 | 7.53 | 0.0475 |
| 5.48 | 24.69 | 7.78 | 73 | 407 | 63 | 89.8 | 7.46 | 0.0443 |
| 6.12 | 24.68 | 7.77 | 73 | 406 | 40 | 88.4 | 7.34 | 0.0417 |
| 6.73 | 22.85 | 7.58 | 86 | 434 | 25 | 75.7 | 6.5 | 0.0376 |
| 6.78 | 20.71 | 7.44 | 91 | 449 | 23 | 16 | 1.44 | 0.0171 |
| 6.8 | 20.62 | 7.44 | 90 | 449 | 23 | 12 | 1.08 | 0.0173 |
| 7.37 | 20.41 | 7.45 | 89 | 442 | 15 | 6.8 | 0.61 | 0.0177 |
| 8.04 | 17.31 | 7.48 | 88 | 455 | 11 | 5 | 0.48 | 0.0134 |
| 8.68 | 16.36 | 7.51 | 86 | 451 | 9 | 4.3 | 0.42 | 0.0125 |
| 9.19 | 14.38 | 7.55 | 84 | 455 | 8 | 3.8 | 0.39 | 0.0116 |
| 9.56 | 14.32 | 7.57 | 84 | 454 | 7 | 3.7 | 0.37 | 0.0119 |
| 9.81 | 13.88 | 7.58 | 85 | 455 | 6 | 3.6 | 0.37 | 0.0122 |
| 10.47 | 13.49 | 7.61 | 84 | 449 | 4 | 3.3 | 0.34 | 0.0117 |
| 11.07 | 13.13 | 7.62 | 73 | 451 | 2 | 3 | 0.32 | 0.0113 |
| 11.81 | 13.05 | 7.62 | 72 | 453 | 0 | 2.9 | 0.3 | 0.0106 |
| 12.55 | 12.83 | 7.62 | 71 | 454 | 0 | 2.8 | 0.3 | 0.0103 |
| 13.18 | 12.46 | 7.62 | 71 | 454 | 0 | 2.8 | 0.3 | 0.0097 |
| 13.98 | 12.12 | 7.61 | 73 | 453 | 0 | 2.7 | 0.29 | 0.0092 |
| 14.6 | 11.95 | 7.57 | 73 | 452 | 0 | 2.7 | 0.29 | 0.0092 |
| 15.32 | 11.73 | 7.51 | 73 | 451 | 0 | 2.6 | 0.28 | 0.009 |
| 15.6 | 11.73 | 7.49 | 74 | 451 | 0 | 2.6 | 0.28 | 0.0091 |
| 16.07 | 11.23 | 7.45 | 76 | 447 | 0 | 2.6 | 0.28 | 0.009 |
| 16.66 | 11.04 | 7.29 | 35 | 447 | 0 | 2.5 | 0.28 | 0.009 |
| 16.67 | 10.75 | 7.28 | -81 | 452 | 0 | 2.5 | 0.28 | 0.0132 |
| 17.24 | 10.49 | 7.29 | -141 | 453 | 0 | 2.5 | 0.28 | 0.0128 |
| 17.86 | 10.13 | 7.33 | -183 | 456 | 0 | 2.5 | 0.28 | 0.0117 |
| 17.95 | 10.06 | 7.35 | -191 | 456 | 0 | 2.4 | 0.27 | 0.0113 |
| 18.14 | 10.05 | 7.37 | -203 | 456 | 0 | 2.4 | 0.27 | 0.4375 |

| 29-Jul-13 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | Temp. [°C] | pH | ORP (mvolts) | SpCond [µS/cm] | PAR [µE/s/m²] | LDO [%Sat] | LDO [mg/l] | Chloro. [Volts] |
| 0.52 | 24.41 | 7.76 | 44 | 411 | 543 | 105 | 8.76 | 0.0384 |
| 0.74 | 24.4 | 7.76 | 44 | 412 | 325 | 105.2 | 8.77 | 0.0378 |
| 0.86 | 24.41 | 7.75 | 43 | 411 | 369 | 105.3 | 8.79 | 0.0388 |
| 1.09 | 24.41 | 7.74 | 43 | 411 | 358 | 105.3 | 8.78 | 0.0402 |
| 2.45 | 24 | 7.66 | 46 | 413 | 127 | 105 | 8.83 | 0.0446 |
| 2.5 | 24.01 | 7.66 | 46 | 413 | 126 | 102.9 | 8.65 | 0.0492 |
| 3.17 | 24.01 | 7.63 | 46 | 413 | 68 | 100.4 | 8.44 | 0.0519 |
| 3.96 | 23.84 | 7.59 | 48 | 414 | 44 | 97.6 | 8.23 | 0.0529 |
| 3.91 | 23.84 | 7.58 | 48 | 414 | 48 | 95.1 | 8.02 | 0.0518 |
| 5.28 | 23.8 | 7.54 | 49 | 415 | 17 | 92.8 | 7.83 | 0.0485 |
| 5.29 | 23.78 | 7.52 | 50 | 415 | 17 | 90 | 7.6 | 0.0461 |
| 6.66 | 22.23 | 7.34 | 58 | 440 | 6 | 70.1 | 6.09 | 0.0421 |
| 6.74 | 22.36 | 7.24 | 60 | 435 | 6 | 44.5 | 3.86 | 0.0357 |
| 8.13 | 16.57 | 7.04 | 51 | 463 | 3 | 30 | 2.87 | 0.0276 |
| 8.23 | 16.34 | 6.99 | 43 | 462 | 2 | 19.1 | 1.87 | 0.0105 |
| 9.48 | 14 | 6.9 | 37 | 461 | 0 | 13.6 | 1.4 | 0.0101 |
| 10.82 | 13.18 | 6.84 | 34 | 456 | 0 | 10.7 | 1.12 | 0.0098 |
| 10.86 | 12.92 | 6.85 | 31 | 457 | 0 | 8.3 | 0.87 | 0.0095 |
| 12.3 | 12.44 | 6.88 | 22 | 460 | 0 | 7.7 | 0.82 | 0.009 |
| 12.34 | 12.38 | 6.91 | 24 | 460 | 0 | 5.9 | 0.62 | 0.0085 |
| 13.25 | 12.39 | 6.92 | 26 | 459 | 0 | 5.5 | 0.59 | 0.0082 |
| 13.9 | 11.56 | 6.9 | 28 | 458 | 0 | 5.3 | 0.58 | 0.008 |
| 13.88 | 11.6 | 6.91 | 29 | 461 | 0 | 4.9 | 0.53 | 0.0081 |
| 13.94 | 11.67 | 6.93 | 30 | 455 | 0 | 4.5 | 0.48 | 0.0081 |
| 15.19 | 11.5 | 6.93 | 7 | 452 | 0 | 4.2 | 0.46 | 0.008 |
| 15.33 | 10.92 | 7.21 | -80 | 458 | 0 | 4 | 0.45 | 0.0085 |
| 15.35 | 10.89 | 7.37 | -108 | 458 | 0 | 3.9 | 0.43 | 0.0088 |
| 16.71 | 10.48 | 7.5 | -135 | 459 | 0 | 3.7 | 0.41 | 0.0093 |
| 16.73 | 10.18 | 7.59 | -149 | 463 | 0 | 3.6 | 0.4 | 0.0093 |
| 16.83 | 10.18 | 7.62 | -156 | 462 | 0 | 3.4 | 0.38 | 0.0092 |
| 17.66 | 9.95 | 7.65 | -164 | 465 | 0 | 3.3 | 0.37 | 0.0435 |

| **Aug. 6, 2013** Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | SpCond [µS/cm] | PAR [µE/s/m²] | LDO% [Sat] | LDO [mg/l] | Chloro [Volts] |
|---|---|---|---|---|---|---|---|---|
| 0.95 | 23.39 | 8.04 | 163 | 413 | 1953 | 101.8 | 8.66 | 0.0183 |
| 1.79 | 23.34 | 8.03 | 164 | 413 | 1242 | 102.9 | 8.76 | 0.0184 |
| 3.12 | 23.11 | 7.99 | 164 | 413 | 548 | 101.4 | 8.67 | 0.0402 |
| 4.06 | 23.04 | 7.95 | 164 | 413 | 307 | 100.4 | 8.59 | 0.0372 |
| 5.56 | 22.95 | 7.94 | 164 | 414 | 109 | 96.7 | 8.29 | 0.0431 |
| 6.53 | 22.95 | 7.94 | 164 | 414 | 68 | 95.7 | 8.21 | 0.0444 |
| 7.09 | 22.33 | 7.79 | 170 | 424 | 52 | 82.2 | 7.13 | 0.0408 |
| 8.23 | 19.21 | 7.62 | 182 | 443 | 19 | 53.7 | 4.95 | 0.0314 |
| 8.55 | 16.79 | 7.78 | 9 | 456 | 20 | 14.3 | 1.39 | 0.0141 |
| 9.78 | 16.03 | 7.74 | -24 | 449 | 9 | 11.5 | 1.13 | 0.0137 |
| 10.18 | 14.39 | 7.89 | -54 | 456 | 8 | 7.2 | 0.73 | 0.0128 |
| 10.37 | 14.17 | 7.97 | -80 | 454 | 8 | 6.2 | 0.64 | 0.0115 |
| 11.01 | 13.95 | 7.96 | -92 | 452 | 6 | 5.9 | 0.61 | 0.0114 |
| 12.37 | 12.73 | 7.94 | -111 | 456 | 3 | 4.8 | 0.51 | 0.01 |
| 12.94 | 12.68 | 7.9 | -122 | 456 | 2 | 3.9 | 0.42 | 0.0092 |
| 13.84 | 12.1 | 7.92 | -114 | 456 | 0 | 3.9 | 0.41 | 0.0089 |
| 14.5 | 11.83 | 7.89 | -98 | 452 | 0 | 3.4 | 0.36 | 0.0078 |
| 15.43 | 11.28 | 7.89 | -102 | 450 | 0 | 3.3 | 0.36 | 0.0078 |
| 16.16 | 11.15 | 7.87 | -105 | 449 | 0 | 3 | 0.33 | 0.0082 |
| 16.86 | 10.2 | 7.87 | -134 | 459 | 0 | 3 | 0.34 | 0.0085 |
| 17.27 | 10.19 | 7.87 | -151 | 459 | 0 | 2.8 | 0.32 | 0.0086 |
| 17.93 | 10.04 | 7.84 | -158 | 460 | 0 | 2.8 | 0.31 | 0.0085 |
| 18.03 | 10.04 | 7.89 | -162 | 460 | 0 | 2.7 | 0.31 | 0.0085 |

| Aug. 17, 2013 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | Temp [°C] | pH [Units] | ORP [mV] | SpCond [µS/cm] | PAR [µE/s/m²] | LDO% ] [Sat] | LDO [mg/l] | Chrloro [Volts] |
| 0.64 | 23.6 | 8.08 | 136 | 417 | 646 | 110.3 | 9.35 | 0.0187 |
| 1.23 | 23.46 | 8.1 | 135 | 416 | 469 | 110.4 | 9.38 | 0.0193 |
| 1.36 | 23.37 | 8.08 | 135 | 416 | 449 | 110.6 | 9.41 | 0.0202 |
| 2.32 | 22.44 | 8.13 | 134 | 415 | 235 | 110.7 | 9.58 | 0.0271 |
| 3.44 | 22.33 | 8.15 | 133 | 415 | 122 | 110.4 | 9.58 | 0.0277 |
| 3.91 | 22.3 | 8.15 | 133 | 415 | 75 | 110.5 | 9.6 | 0.0285 |
| 4.6 | 22.07 | 8.15 | 133 | 415 | 59 | 110.6 | 9.65 | 0.3278 |
| 4.94 | 22.06 | 8.15 | 133 | 415 | 43 | 110 | 9.59 | 0.0336 |
| 5.6 | 21.95 | 8.12 | 134 | 416 | 33 | 109.1 | 9.54 | 0.0384 |
| 5.78 | 21.94 | 8.12 | 134 | 416 | 29 | 105.9 | 9.26 | 0.0393 |
| 6.23 | 21.92 | 8.1 | 134 | 416 | 24 | 98 | 8.57 | 0.0386 |
| 7.51 | 21.78 | 8.05 | 136 | 417 | 12 | 98.4 | 8.63 | 0.0373 |
| 7.61 | 21.79 | 8.04 | 136 | 417 | 12 | 96.9 | 8.49 | 0.0373 |
| 8.87 | 17.25 | 7.67 | 159 | 448 | 4 | 30.2 | 2.9 | 0.0186 |
| 9.91 | 16.49 | 7.64 | 162 | 445 | 1 | 8.4 | 0.82 | 0.0161 |
| 9.97 | 14.94 | 7.69 | 142 | 456 | 0 | 5.1 | 0.51 | 0.0128 |
| 10.89 | 13.74 | 7.77 | -14 | 455 | 0 | 5 | 0.52 | 0.0126 |
| 11.79 | 13.05 | 7.91 | -137 | 458 | 0 | 3.7 | 0.39 | 0.0101 |
| 12.36 | 13.07 | 7.91 | -145 | 457 | 0 | 3.6 | 0.37 | 0.0097 |
| 12.62 | 12.74 | 7.93 | -152 | 458 | 0 | 3.5 | 0.37 | 0.0095 |
| 13.6 | 12.32 | 7.95 | -163 | 455 | 0 | 3.2 | 0.34 | 0.0087 |
| 13.85 | 12.18 | 7.94 | -161 | 455 | 0 | 2.9 | 0.31 | 0.0079 |
| 13.92 | 12.18 | 7.93 | -162 | 455 | 0 | 2.9 | 0.31 | 0.0079 |
| 14.93 | 11.75 | 7.9 | -176 | 457 | 0 | 2.8 | 0.3 | 0.0084 |
| 15.73 | 11.39 | 7.87 | -185 | 457 | 0 | 2.6 | 0.29 | 0.0086 |
| 16.19 | 11.3 | 7.84 | -187 | 453 | 0 | 2.6 | 0.28 | 0.0084 |
| 16.64 | 10.91 | 7.81 | -194 | 458 | 0 | 2.6 | 0.28 | 0.0086 |