Lakewatch

THE ALBERTA LAKE MANAGEMENT SOCIETY
VOLUNTEER LAKE MONITORING PROGRAM

2012 Mayatan Lake Report

COMPLETED WITH SUPPORT FROM:

Alberta Government

Alberta Lake Management Society's LakeWatch Program

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. LakeWatch Reports are designed to summarize basic lake data in understandable terms for a lay audience and are not meant to be a complete synopsis of information about specific lakes. Additional information is available for many lakes that have been included in LakeWatch and readers requiring more information are encouraged to seek those sources.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health of our environment.

Acknowledgements

The LakeWatch program is made possible through the dedication of its volunteers. We would like to thank everyone from the Mayatan Lake Management Association who assisted us with sampling, including: Tara Doell, Conny Schuster, Alvin and Sandy Steinke, Neil Van den Bussche, Phillip von Roeder, and Frank Skrlj. We would also like to thank Randi Newton and Erin Rodger who were summer technicians with ALMS in 2012. Program Coordinator Bradley Peter was instrumental in planning and organizing the field program. Technologists Trina Ball and Brian Jackson were involved in the training aspects of the program. Lisa Reinbolt was responsible for data management. This report was prepared by Bradley Peter and Arin Dyer. Alberta Environment and the Beaver River Watershed Alliance (BRWA) were major sponsors of the program.

MAYATAN LAKE:

Mayatan Lake is a small lake located 68 km west of the City of Edmonton in the North Saskatchewan River watershed. Mayatan Lake is comprised of two basins joined by a narrow water channel. The west basin is deep, measuring 26.5 m, while the eastern basin is shallow, measuring 6.1 m (Figure 1). On average, Mayatan Lake is 5.7 m deep. In 2011, data collected was compiled from both basins. However, as the two basins are dramatically different, in 2012 they were sampled separately on the same days to provide greater precision. This report presents results from both basins.

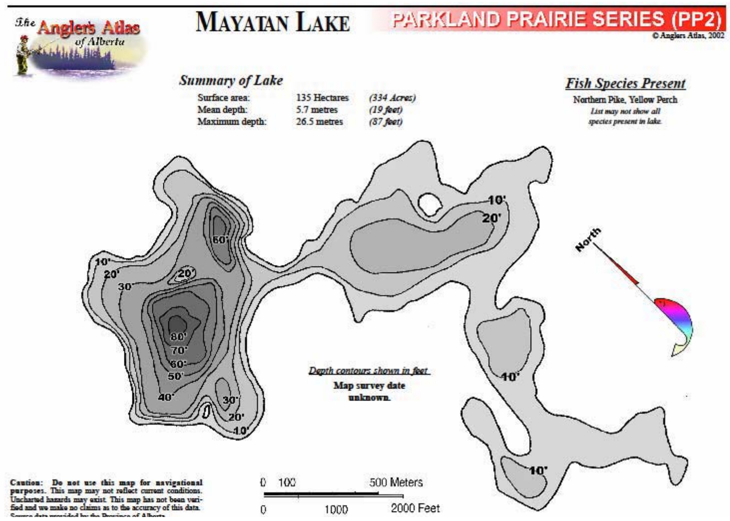

Figure 1 – Bathymetric chart of Mayatan Lake obtained from the Anglers Atlas (http://www.anglersatlas.com/lakes/8412).

According to the 2011 State of the Watershed Report released by the North Saskatchewan Watershed Alliance, Mayatan Lake has a small drainage basin (effective: 4.23 km^2; gross: 13.6 km^2) compared to the lake's surface area (1.38 km^2). This results in an effective drainage basin:surface area ratio of 3.06 km^2. While a small drainage basin:surface area ratio will help to minimize the nutrients entering the lake from the watershed, there is also no outlet channel at the lake, suggesting there is nearly no flushing, and therefore nutrients entering the lake remain there for long periods of time.

After an appeal hearing in November of 2012 with Parkland County, a decision was made to deny the development of a 200 stall RV resort campground on the southeast side of Mayatan Lake.

The 2011 State of the Watershed Report for Mayatan Lake contains more in depth descriptions of the area's land use, climate, topography, geology, and biology. This report can be viewed at http://www.nswa.ab.ca/resources/nswa_publications.

WATER QUANTITY:

There are many factors influencing water quantity. Some of these factors include the size of the lakes drainage basin, precipitation, evaporation, water consumption, ground water influences, and the efficiency of the outlet channel structure at removing water from the lake. Requests for water quantity monitoring should go through Environment and Sustainable Resource Developments Monitoring and Science division.

Currently no long term water quantity data exists for Mayatan Lake. The State of the Watershed Report estimates no net input or output from precipitation, runoff, and evaporation. Ground water input likely plays a large role in maintaining water levels at Mayatan Lake.

WATER CLARITY AND SECCHI DEPTH:

Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi disk depth.

East Basin: Average Secchi disk depth in 2012 was poor at 1.30 m (Table 1). This value changed greatly throughout the summer, measuring 3.25 m on June 16th versus 0.50 m on August 12th. This decrease in Secchi disk depth appeared correlated with large increases in algae/cyanobacteria biomass and total suspended solids (TSS; Table 1). As the east basin is shallow, boats and wind have the potential to stir bottom sediments into the water column; the highest measured concentration of total suspended solids was 19.2 mg/L on August 19th.

West Basin: In contrast to the east basin, average Secchi disk depth measured 4.50 m in the west basin (Table 1). This value ranged between a maximum of 6.00 m on June 16th and a minimum of 3.00 m on July 21st. Concentrations of both algae/cyanobacteria and TSS were low in the west basin; in fact, average TSS in the west basin was 9 times less than the average in the east basin. The depth of the west basin limits the amount of bottom sediment that is stirred into the water column.

WATER TEMPERATURE AND DISSOLVED OXYGEN:

Water temperature and dissolved oxygen profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

East Basin: Throughout the summer, surface water temperature ranged from a minimum of 16.28 °C on September 22nd to a maximum of 24.61 °C on August 12th (Figure 2a). Thermal stratification was observed on the first four sampling trips – by early September, however, the east basin began to turn-over as water temperatures became uniform throughout the water column. The presence of thermal stratification has important implications for dissolved oxygen concentrations.

West Basin: Surface water temperatures in the west basin were very similar to those observed in the east basin (Figure 2b). Thermal stratification in the west basin was much stronger than that observed in the east basin, with a thermocline consistently appearing around 6.00 m. On each sampling trip, water temperatures measured around 5.00 °C for almost half of the water column. Because stratification was strong even in late September it is possible that the west basin of the lake remains stratified all year long with no turn-over events. This pattern of temperature is common in lakes that are small and deep.

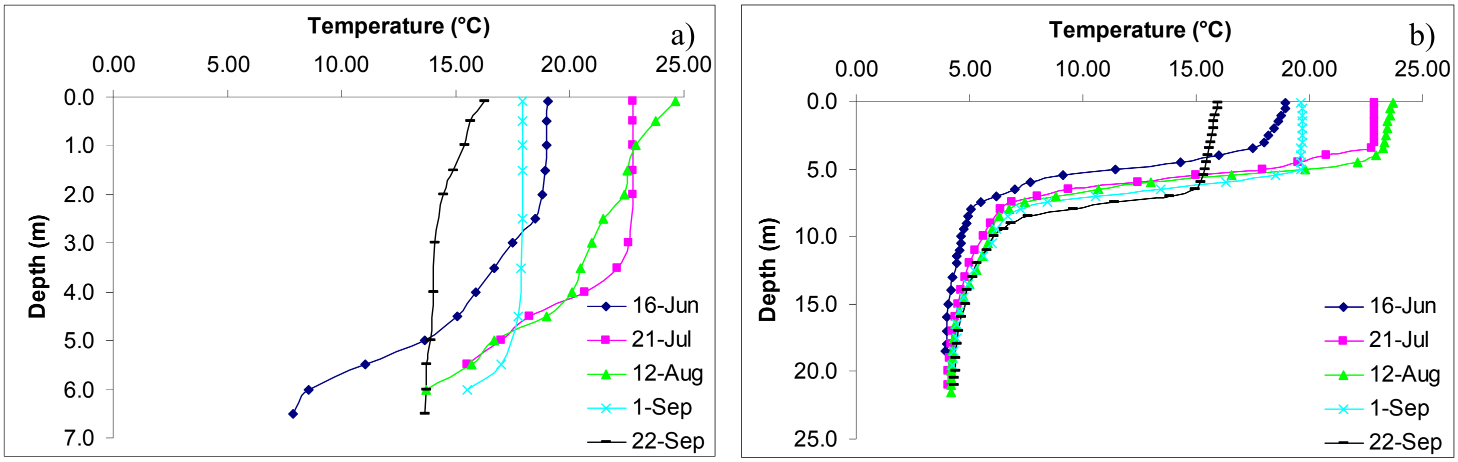

Figure 2 – Temperature (°C) profiles for the a) east and b) west basins of Mayatan Lake measured five times throughout the summer of 2012.

East Basin: Dissolved oxygen concentrations were poor in the east basin of Mayatan Lake (Figure 3a). While dissolved oxygen proceeded towards anoxia on each sampling trip, on both July 21st and September 1st the entire water column fell below the Canadian Council for Ministers of the Environment (CCME) guideline for the Protection of Aquatic Life of 6.5 mg/L. Thermal stratification separates surface waters from deeper waters, restricting the mixing of atmospheric dissolved oxygen to deep waters. In addition, the decomposition of organic matter (ex. algae/cyanobacteria) on the lakebed, an oxygen consuming process, acts to drive down dissolved oxygen concentrations. Low levels of dissolved oxygen near the lakebed may also promote the release of phosphorus from the sediments. When the water column becomes mixed, these released nutrients become available to cyanobacteria/algae near the surface.

West Basin: The west basin remained well oxygenated above the thermocline (Figure 3b). Below the thermocline, however, there were dramatic reductions in dissolved oxygen concentrations, with concentrations consistently proceeding to anoxia around 7.00 m. As with temperature, this pattern is typical of lakes that are small and deep. On July 21st a spike in dissolved oxygen concentrations was observed at ~6.00 m. This is likely oxygen produced from the photosynthesis of a metalimnetic bloom of cyanobacteria/algae – a bloom that sits on top of the thermocline

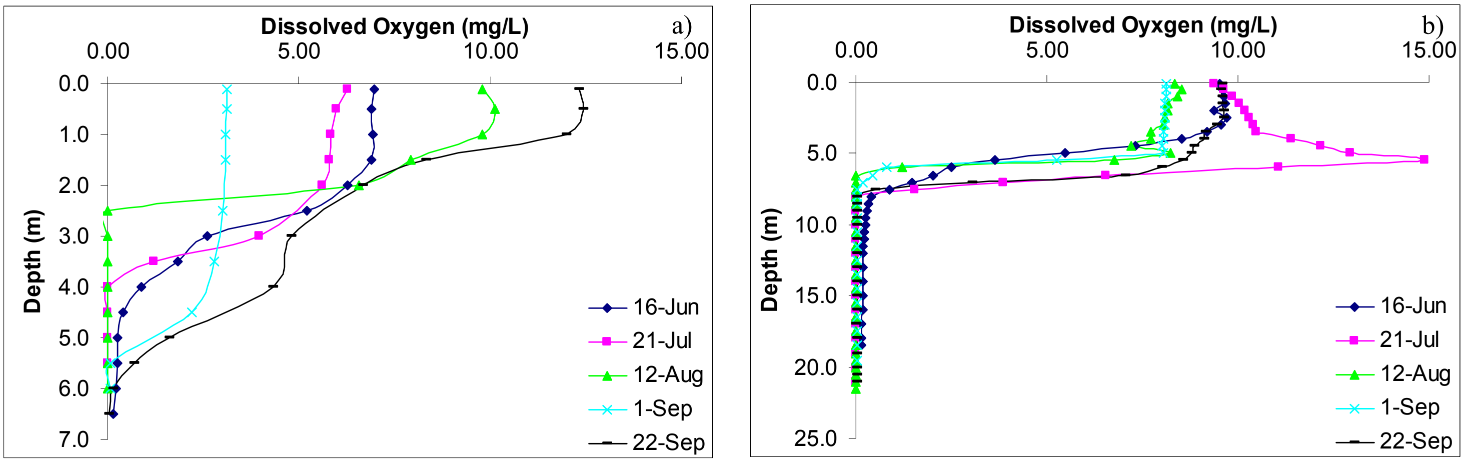

Figure 3 – Dissolved oxygen concentration (mg/L) profiles for the a) east and b) west basins of Mayatan Lake measured five times throughout the summer of 2012.

WATER CHEMISTRY:

ALMS measures a suite of water chemistry parameters. Phosphorus, nitrogen, and chlorophyll-a are important because they are indicators of eutrophication, or excess nutrients, which can lead to harmful algal/cyanobacteria blooms. One direct measure of harmful cyanobacteria blooms are Microcystins, a common group of toxins produced by cyanobacteria. See Table 1 for a complete list of parameters.

Figure 4 – Cyanobacteria collecting on the shore of the east basin of Mayatan Lake. Photo by Erin Rodger, 2012.

East Basin: Average total phosphorus (TP) concentration measured during the summer of 2012 was 88.2 μg/L (Table 1). This value falls well into the eutrophic, or nutrient rich, classification. On two occasions, both August 12th and September 1st, phosphorus levels exceeded the hyper-eutrophic classification limit of 100 μg/L (Figure 5). Total Kjeldahl nitrogen (TKN) levels were similarly high, measuring an average of 2946 μg/L, which falls well into the hypereutrophic classification. Finally, chlorophyll-*a* levels, an indication of algae/cyanobacteria biomass, measured an average of 34.83 μg/L, which falls into the hypereutrophic classification (Figure 4; Table 1). As is typical at most lakes in the province, chlorophyll-*a* concentration peaked in mid-summer when surface water temperatures were highest.

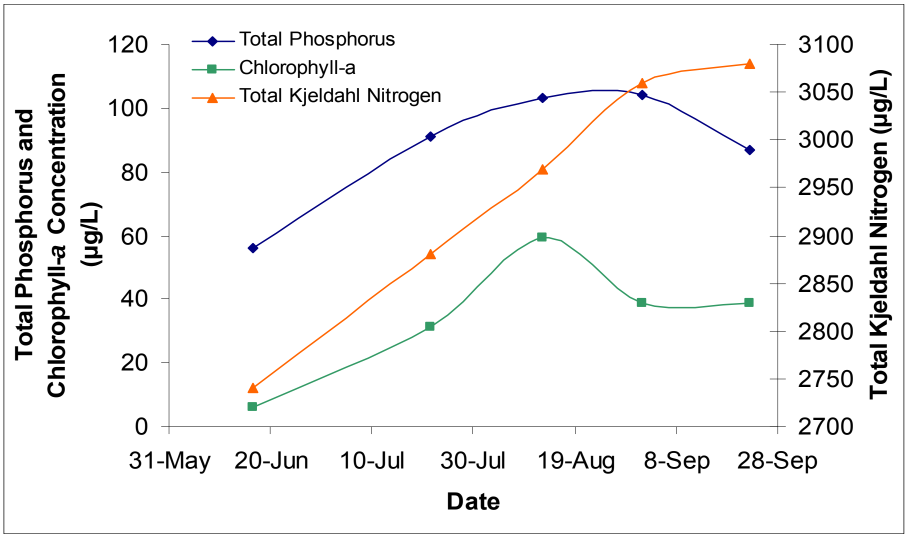

Figure 5 – Total phosphorus (µg/L), chlorophyll-*a* (µg/L), and total Kjeldahl nitrogen (mg/L) concentrations measured five times over the course of the summer of 2012.

West Basin: Average TP measured 35.4 µg/L during the summer of 2012, less than half the concentration in the east basin (Table 1). This value falls into the eutrophic classification, lying just on the cusp between mesotrophic and eutrophic. Similar to the east basin, TKN measured an average of 1424 µg/L, falling into the hypereutrophic classification. Finally, chlorophyll-*a* concentrations were significantly reduced in the west basin compared to the east basin. The west basin measured an average of 6.18 µg/L and fluctuated very little throughout the summer. A value of 6.18 µg/L falls into the mesotrophic, or moderately productive, classification, though, as with TP, lies just on the cusp between mesotrophic and eutrophic.

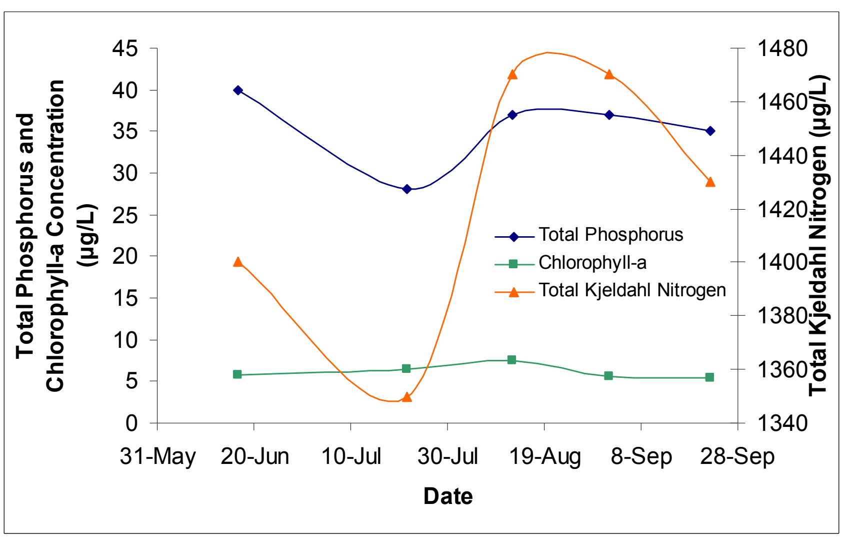

Figure 6 – Total phosphorus (µg/L), chlorophyll-*a* (µg/L) and total Kjeldahl nitrogen (mg/L) concentrations measured five times over the summer of 2012.

East Basin: Average pH measured 8.23 – the alkalinity (211.2 mg/L $CaCO_3$) and bicarbonate concentration (254 mg/L HCO_3) of Mayatan Lake may help to buffer the lake against changes to pH (Table 1). Specific conductivity was high (826.6 µS/cm), with sulphate (233 mg/L) and magnesium (62.9 mg/L) as the dominant ions in the lake. Average microcystin concentration, a liver toxin produced by cyanobacteria, was high compared to other lakes sampled in 2012, measuring 4.95 µg/L, though still fell within the recommended recreational guidelines (20 µg/L). A maximum microcystin concentration of 12.12 ug/L was observed on August 12^{th}. Metal concentrations were measured twice throughout the summer and all values fell within their respective guidelines. Levels of arsenic were close to exceeding the recommended guidelines for the Protection of Aquatic Life of 5.0 µg/L.

West Basin: Average pH measured 8.45 – similar to the east basin, alkalinity (222 mg/L $CaCO_3$) and bicarbonate concentration (256.8 HCO_3) may help to buffer the lake against changes to pH (Table 1). Specific conductivity was high (744.2 µS/cm) with sulphate (186.7 mg/L) and magnesium (63.1 mg/L) as the dominant ions. Unlike the east basin, microcystin concentrations were low in the west basin, measuring 0.067 µg/L. All metals sampled for fell within their respective guidelines (Table 2).

Table 1 – Average Secchi disk depth and water chemistry values for Mayatan Lake. Values from 2011 are a combination of results from both basins. Results from 2012 have been separated by basin.

Parameter	Both Basins 2011	East Basin 2012	West Basin 2012
TP (µg/L)	30.8	88.2	35.4
TDP (µg/L)	12.5	28.4	16.0
Chlorophyll-*a* (µg/L)	4.70	34.80	6.18
Secchi depth (m)	4.3	1.3	4.5
TKN (µg/L)	1488	2946	1424
NO_2 and NO_3 (µg/L)	3	7.1	3.9
NH_3 (µg/L)	34	329	30
DOC (mg/L)	16.1	23.3	15.8
Ca (mg/L)	35.4	46.0	36.9
Mg (mg/L)	67.2	62.9	63.1
Na (mg/L)	21.2	21.6	21.7
K (mg/L)	23.7	27.1	24.1
SO_4^{2-} (mg/L)	185	233	186.7
Cl^- (mg/L)	2.2	2.97	2.3
CO_3 (mg/L)	8.8	2.2	6.7
HCO_3 (mg/L)	244.6	254.0	256.8
pH	8.57	8.23	8.454
Conductivity (µS/cm)	746.8	826.6	744.2
Hardness (mg/L)	365	522	470.3
TDS (mg/L)	464	374	352
TSS (mg/L)	1.54	9.60	1.38
Microcystin (µg/L)	0.0648	4.95	0.067
Total Alkalinity (mg/L $CaCO_3$)	215.0	211.2	222.0

Note: TP = total phosphorus, TDP = total dissolved phosphorus, Chl-*a* = chlorophyll-*a*, TKN = total Kjeldahl nitrogen. NO_{2+3} = nitrate+nitrite, NH_3 = ammonia, Ca = calcium, Mg = magnesium, Na = sodium, K = potassium, SO_4 = sulphate, Cl = chloride, CO_3 = carbonate, HCO_3 = bicarbonate. A forward slash (/) indicates an absence of data.

Table 2 - Concentrations of metals measured in Mayatan Lake on July 11th and August 29th 2011. Values shown for 2012 are an average of those dates. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	**East Basin 2012**	**West Basin 2012**	**Guidelines**
Aluminum µg/L	43.95	7.695	100[a]
Antimony µg/L	0.204	0.10315	6[e]
Arsenic µg/L	4.5	2.48	5
Barium µg/L	70	98.25	1000[e]
Beryllium µg/L	0.0157	0.00885	100[d,f]
Bismuth µg/L	0.0005	0.0005	/
Boron µg/L	108.5	110.5	5000[ef]
Cadmium µg/L	0.0205	0.01715	0.085[b]
Chromium µg/L	0.172	0.1795	/
Cobalt µg/L	0.08095	0.0469	1000[f]
Copper µg/L	0.7685	1.5895	4[c]
Iron µg/L	7.62	1.6	300
Lead µg/L	0.07635	0.10355	7[c]
Lithium µg/L	104.5	108.5	2500[g]
Manganese µg/L	96.05	120.15	200[g]
Molybdenum µg/L	0.1965	0.1044	73[d]
Nickel µg/L	0.0025	0.00725	150[c]
Selenium µg/L	0.05	0.05	1
Silver µg/L	0.00025	0.000725	0.1
Strontium µg/L	377.5	278	/
Thallium µg/L	0.00085	0.00065	0.8
Thorium µg/L	0.00015	0.00015	/
Tin µg/L	0.03115	0.0675	/
Titanium µg/L	1.55	0.4015	/
Uranium µg/L	0.453	0.36	100[e]
Vanadium µg/L	0.6525	0.401	100[f,g]
Zinc µg/L	1.285	1.495	30

Values represent means of total recoverable metal concentrations.
[a] Based on pH ≥ 6.5; calcium ion concentrations [Ca^{+2}] ≥ 4 mg/L; and dissolved organic carbon concentration [DOC] ≥ 2 mg/L.
[b] Based on water Hardness of 300 mg/L (as $CaCO_3$)
[c] Based on water hardness > 180mg/L (as $CaCO_3$)
[d] CCME interim value.
[e] Based on Canadian Drinking Water Quality guideline values.
[f] Based on CCME Guidelines for Agricultural use (Livestock Watering).
[g] Based on CCME Guidelines for Agricultural Use (Irrigation).
A forward slash (/) indicates an absence of data or guidelines.

SOME OF THE OBSERVED WILDLIFE:

Great Blue Heron – *Ardea herodias*. Photo by Jessica Davis, 2011.

Common Loon – *Gavia immer* – Photo by Jessica Davis, 2011.

Wood Frog – *Rana sylvatica* – Photo by Jessica Davis, 2011.

Bald Eagle - *Haliaeetus leucocephalus* – Photo by Jessica Davis, 2011.

Horsehair Worm – Photo by Jessica Davis, 2011.