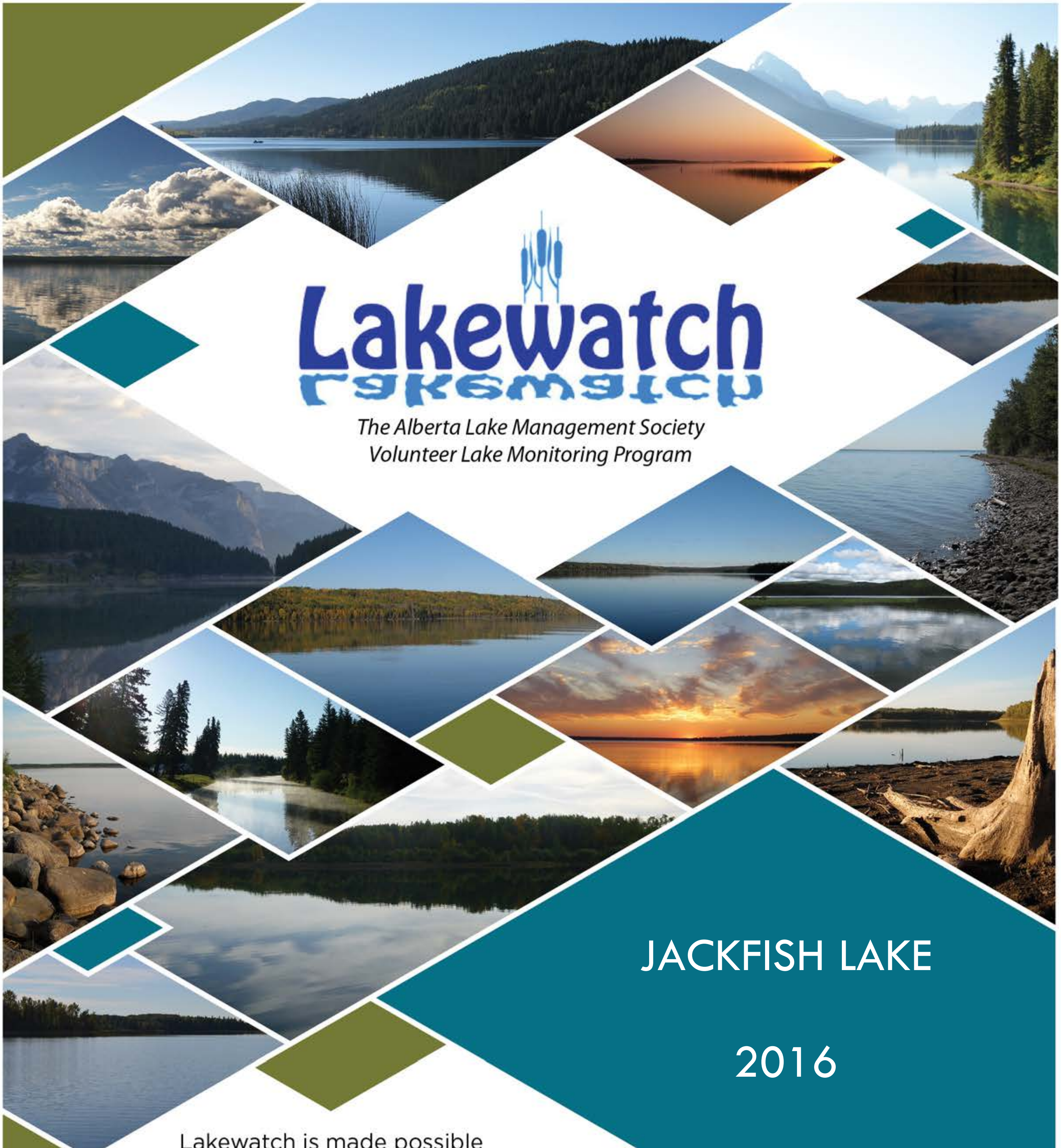


Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

JACKFISH LAKE

2016

Lakewatch is made possible with support from:

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada / Environnement et Changement climatique Canada
Pigeon Lake Watershed Association
Cargill
Alberta Environment and Parks
LICA Lakeland Industry & Community Association
Beaver River Watershed Alliance
Red Deer River Watershed Alliance
MD 61 Wainwright

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.

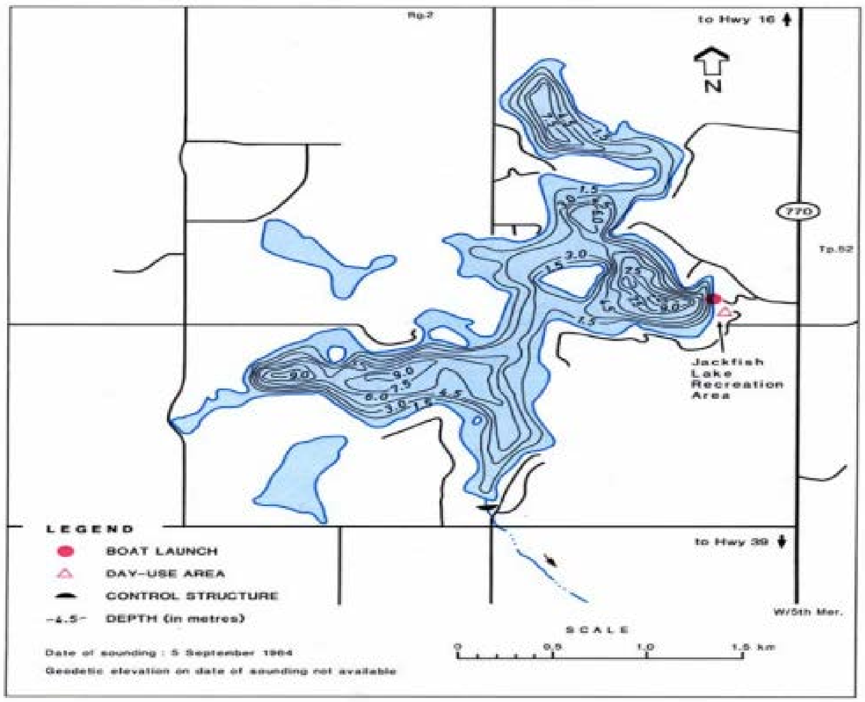
ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health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

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to extend a special thanks to Troy King for his assistance with sampling Jackfish Lake in 2016. We would also like to thank Alicia Kennedy, Ageleky Bouzetos, and Breda Muldoon who were summer technicians in 2016. Executive Director Bradley Peter was instrumental in planning and organizing the field program. Alicia Kennedy was instrumental in report design. This report was prepared by Bradley Peter and Laura Redmond. The Beaver River Watershed, the Lakeland Industry and Community Association, Environment Canada, and Alberta Environment and Parks are major sponsors of the LakeWatch program.

JACKFISH LAKE

Jackfish Lake, likely named so for northern pike which were the target of a sport fishery, is a popular recreational lake in the North Saskatchewan River Basin in the County of Parkland.[1] Approximately 60 km west of the city of Edmonton, Jackfish Lake is small, with a surface area of only 2.39 km^2 , and shallow, with a maximum depth of nine meters.[1] However, due to its irregular shape, the lake has a long, highly developed shoreline of 18.1 km. The drainage basin for Jackfish Lake is small compared to the size of the lake, approximately 12.6 km^2, or five times the size of the lake, and lies in the Moist Mixedwood Subregion of the Boreal Mixedwood Ecoregion[2]. Due to its proximity to both Edmonton and Spruce Grove, Jackfish Lake is heavily used for boating, fishing, and water skiing.



Bathymetric map of Jackfish Lake in 1964 (Source: Alberta Environment)

---

[1] Mitchell, P. and E. Prepas. 1990. Atlas of Alberta Lakes, University of Alberta Press. Retrieved from http://sunsite.ualberta.ca/projects/alberta-lakes/

[2] Nat. Regions Committee. 2006. Nat. Regions and Subregions of AB. Compiled by D.J. Downing and WW Pettapiece. GoA Pub. No. T/852

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 2 for a complete list of parameters.

Total phosphorus (TP) in Jackfish Lake had an average concentration of 37 µg/L in 2016, putting it in the eutrophic trophic classification (Table 2). This is within the range of observed historical concentrations. TP increased over the course of the sampling season, with the maximum concentration of 45 µg/L measured on September 20 (Figure 1).

Chlorophyll-*a* concentrations increased over the course of the summer, with an average concentration of 26.5 µg/L in 2016 (Table 2). This is historically high, and puts Jackfish Lake in the hypereutrophic trophic status class. A maximum concentration of 54 µg/L was reached on September 20 (Figure 1). Chlorophyll-*a* was significantly correlated with TP concentration (r= 0.91, df= 3, p-$value$= 0.03), meaning that nutrient concentrations in Jackfish Lake are associated with algal bloom biomass.

Jackfish Lake had an average TKN concentration of 1.48 mg/L over five sampling dates in 2016 (Table 2). On June 2 and September 20, TKN concentrations were at a seasonal maximum of 1.6 mg/L (Figure 1), although fluctuations occurred throughout the season.

Average pH measured as 8.21 in 2016, buffered by moderate alkalinity (124 mg/L $CaCO_3$) and bicarbonate (150 mg/L HCO_3). Sulphate was the dominant ion contributing to a relatively high conductivity measure of 1200 uS/cm (Table 2). There appears to be a trend toward increasing ion concentrations and conductivity as the lake loses water quantity due to evaporation, though more data is required for a proper analysis.

METALS

Samples were analyzed for metals once throughout the summer (Table 3). In total, 27 metals were sampled for. It should be noted that many metals are naturally present in aquatic environments due to the weathering of rocks and may only become toxic at higher levels.

Metals were measured once at Jackfish Lake and all measured values fell within their respective guidelines (Table 3).

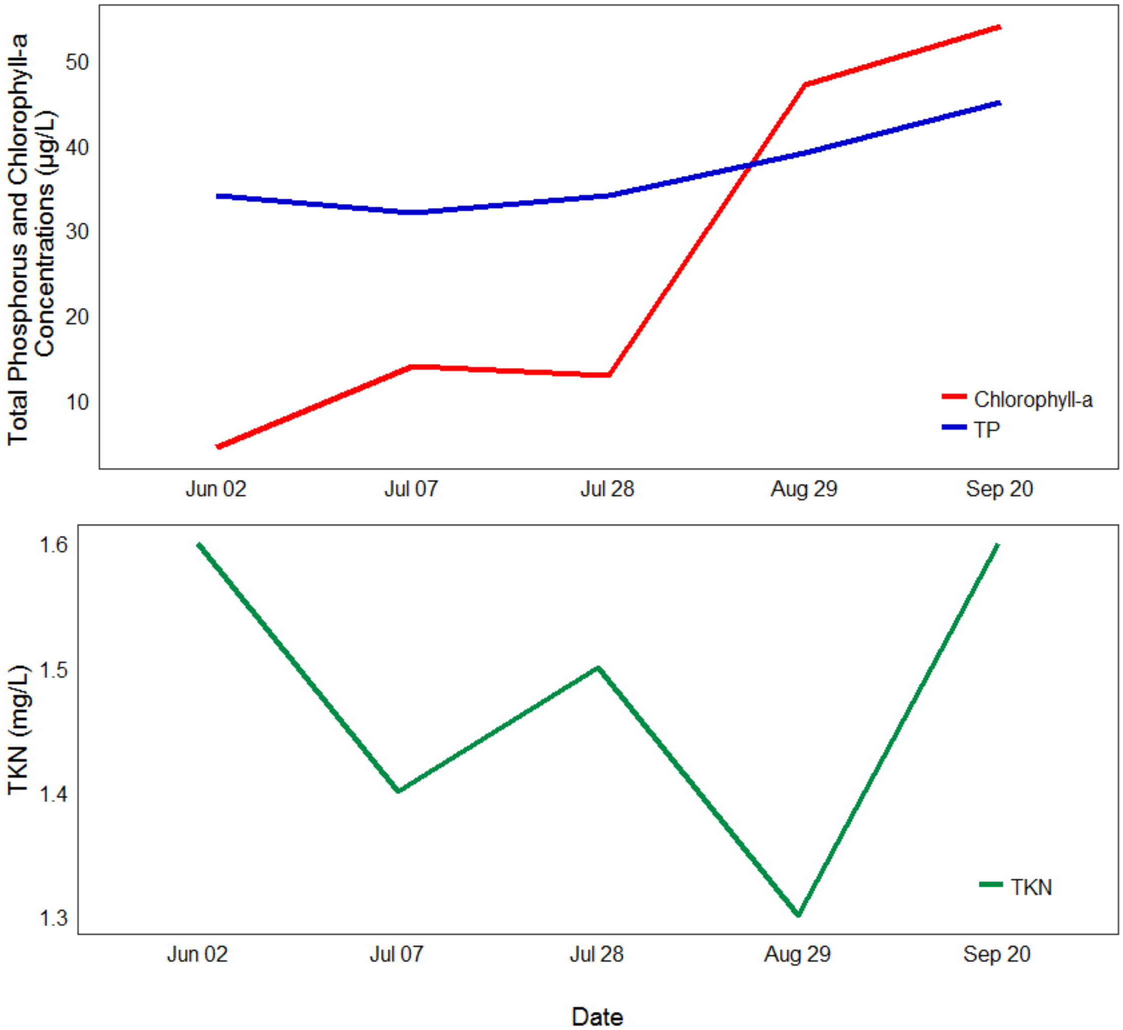


Figure 1- Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Chlorophyll-*a* concentrations measured five times over the course of the summer at Jackfish Lake.

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. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Average Secchi depth in 2016 was 2.50 m, classifying Jackfish Lake as mesotrophic, or moderately productive (Figure 2). A maximum Secchi depth of 6.00 m was recorded on June 2, but decreased significantly over the course of the sampling season. Given that chlorophyll-*a* levels were in the eutrophic or hypereutrophic range on all but one sampling date, it is assumed that low water clarity was associated with high algal biomass as summer warming occurred.

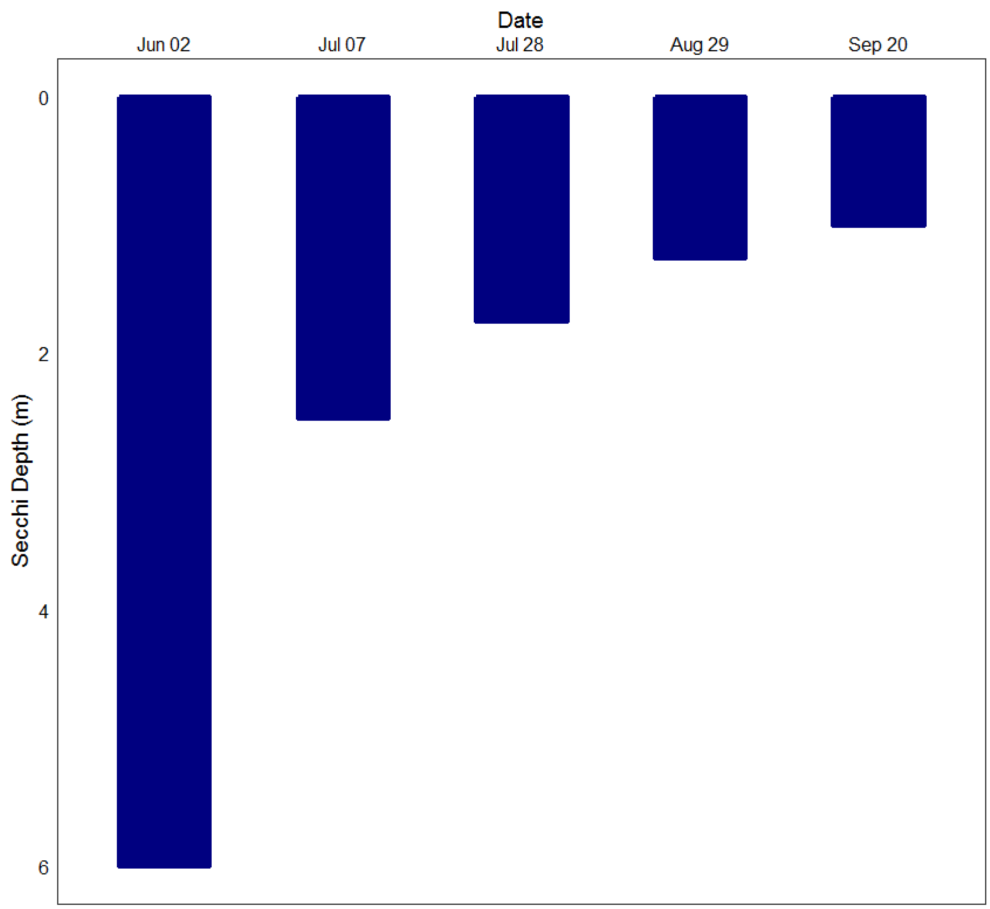


Figure 2 – Secchi depth values measured five times over the course of the summer at Jackfish Lake in 2016.

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.

Jackfish Lake water temperatures varied throughout the summer (Figure 3a). A maximum temperature of 23.27 °C was observed on July 28, and by September 26, the entire water column was approximately 14°C. Given the moderate depth of Jackfish Lake, it never reached full thermal stratification. It was weakly stratified during the warmest visits on July 7 and July 28.

Jackfish Lake remained well oxygenated at the surface throughout the summer, measuring above the Canadian Council for Ministers of the Environment guidelines of 6.5 mg/L for the Protection of Aquatic Life (Figure 3b). Jackfish reached anoxic conditions at the bottom on June 2, July 7 and July 28, but stratification was broken down by August. Anoxia could be due to the separation of atmospheric oxygen from the surface by way of thermal stratification. During the latter half of the summer, the lake was well mixed through the water column.

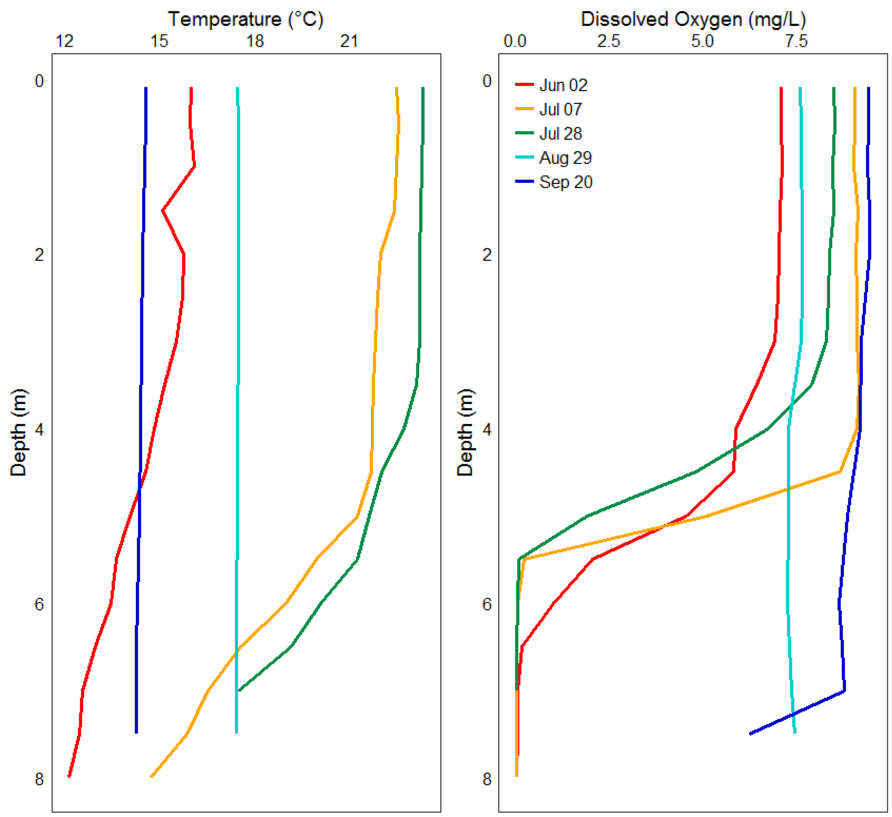


Figure 3 – a) Temperature (°C) and b) dissolved oxygen (mg/L) profiles for Jackfish Lake measured five times over the course of the summer of 2016.

MICROCYSTIN

Microcystins are toxins produced by cyanobacteria (blue-green algae) which, when ingested, can cause severe liver damage. Microcystins are produced by many species of cyanobacteria which are common to Alberta's Lakes, and are thought to be the one of the most common cyanobacteria toxins. In Alberta, recreational guidelines for microcystin are set at 20 µg/L.

Table 1 – Microcystin concentrations measured five times at Jackfish Lake in 2016. All measurements remained well below the recommended limit for recreational use.

Date	Microcystin Concentration (μg/L)
Jun 2	0.05
Jul 7	0.81
Jul 28	0.94
Aug 29	2.15
Sep 20	0.52
Average	0.894

INVASIVE SPECIES MONITORING

Dreissenid mussels pose a significant concern for Alberta because they impair the function of water conveyance infrastructure and adversely impact the aquatic environment. These invasive mussels have been linked to creating toxic algae blooms, decreasing the amount of nutrients needed for fish and other native species, and causing millions of dollars in annual costs for repair and maintenance of water-operated infrastructure and facilities.

Monitoring involved two components: monitoring for juvenile mussel veligers using a plankton net and monitoring for attached adult mussels using substrates installed in each lake. In 2016, no invasive mussels were detected in Jackfish Lake.

WATER LEVELS

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 Alberta Environment and Parks Monitoring and Science division.

Since 1968, Jackfish Lake water levels have fluctuated between 728.3 m asl and 730.1 m asl with a decreasing trend starting in the early 1980’s (Figure 4).

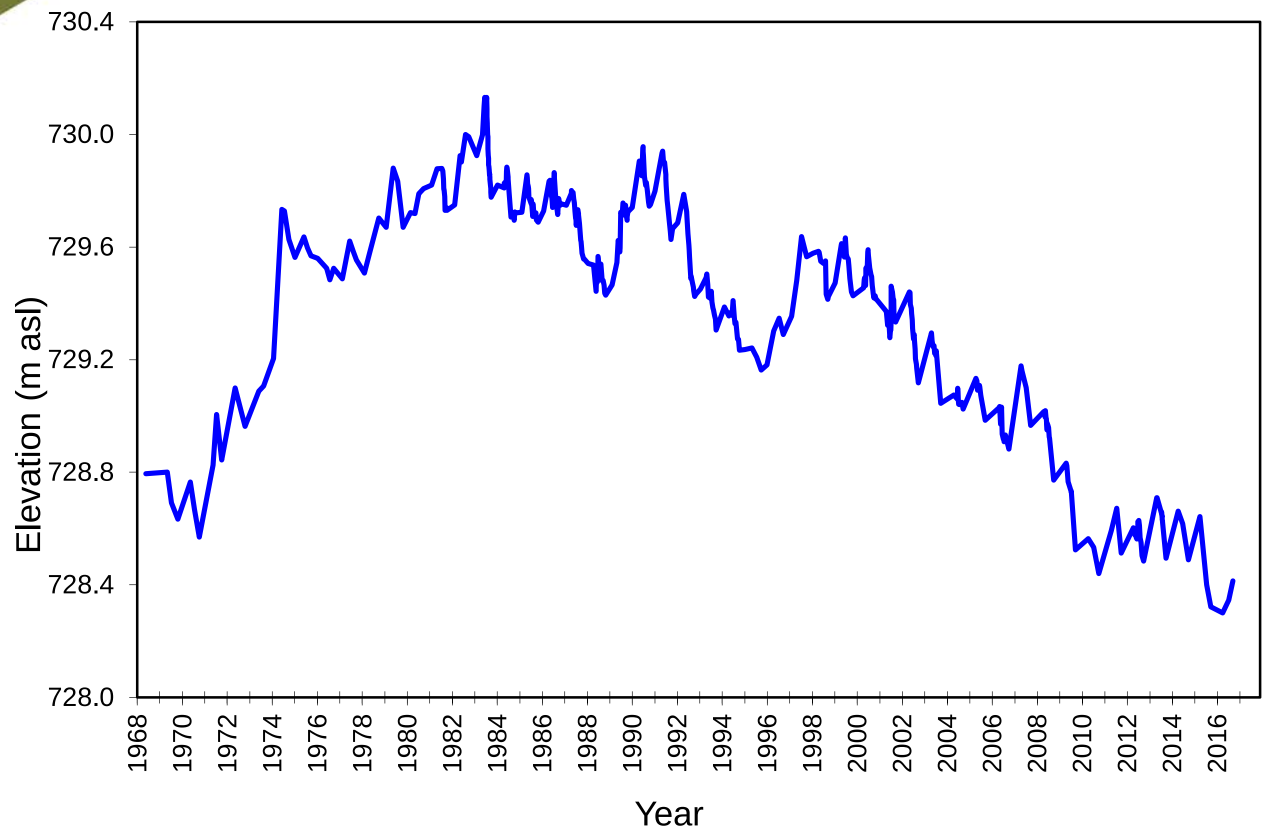


Figure 4- Jackfish lake water levels measured in meters above sea level (m asl) from 1968- 2016. Data retrieved from Alberta Environment.

Table 2: Average Secchi depth and water chemistry values for Jackfish Lake. Historical values are given for reference.

Parameter	1980	1981	2001	2011	2012	2013	2016
TP (µg/L)	/	39	25	44	36	34.4	37
TDP (µg/L)	/	/	/	12.6	14.6	17.4	9
Chlorophyll-*a* (µg/L)	12.6	9.2	12	22.9	12.76	7.39	26.5
Secchi depth (m)	3	2.4	2.73	2.16	2.3	2.84	2.50
TKN (mg/L)	1.259	1.174	/	1.442	1.34	1.202	1.48
NO_2 and NO_3 (µg/L)	<5	<3	5	4.2	10.3	2.5	10.44
NH3 (µg/L)	41	64	45	17.8	75.2	19.4	76
DOC (mg/L)	/	/	/	12.7	13.1	14.07	13.02
Ca (mg/L)	76	/	76	102.1	100.5	104.2	114
Mg (mg/L)	49	/	56	66.8	63.2	67.9	77.8
Na (mg/L)	/	/	22	28.3	27.2	26.8	31.8
K (mg/L)	/	/	20	23.3	24.1	30	26.8
SO_4^{2-} (mg/L)	/	/	392	431.7	461.3	388.7	492
Cl^- (mg/L)	/	/	4	4.97	5.43	5.2	6.06
CO_3 (mg/L)	/	/	/	0.5	0.5	0.5	0.58
HCO_3 (mg/L)	/	/	/	131	145.4	149.2	150
pH	/	/	/	8.12	8.12	8.19	8.21
Conductivity (µS/cm)	/	/	/	1099	1106	1127	1200
Hardness (mg/L)	/	/	/	530	511	539.3	612
TDS (mg/L)	/	/	/	721	753.7	696.7	826
Microcystin (µg/L)	/	/	/	0.081	0.089	0.0302	0.894
Total Alkalinity (mg/L $CaCO_3$)	/	/	77	107.2	119.4	122.6	124

Table 3: Concentrations of metals measured once in Jackfish Lake. The CCME heavy metal Guidelines for the Protection of Freshwater Aquatic Life (unless otherwise indicated) are presented for reference.

Metals (Total Recoverable)	2012	2013	2016	Guidelines
Aluminum µg/L	16.15	22.7	10.6	100[a]
Antimony µg/L	0.115	0.1005	0.159	6[d]
Arsenic µg/L	2.365	1.99	1.93	5
Barium µg/L	81	74.65	95.4	1000[d]
Beryllium µg/L	0.0015	0.00905	0.004	100[c,e]
Bismuth µg/L	0.00325	0.0005	5.00E-04	/
Boron µg/L	159	139	144	1500
Cadmium µg/L	0.00275	0.001	0.001	0.26[b]
Chromium µg/L	0.183	0.2585	0.06	/
Cobalt µg/L	0.01265	0.0505	0.001	1000[e]
Copper µg/L	1.4	1.47	1.64	4[b]
Iron µg/L	24	52.3	26.4	300
Lead µg/L	0.0436	0.0623	0.025	7[b]
Lithium µg/L	111	108.3	113	2500[f]
Manganese µg/L	157.7	73.15	180	200[f]
Molybdenum µg/L	0.1375	0.1305	0.175	73[c]
Nickel µg/L	0.0025	0.37525	0.004	150[b]
Selenium µg/L	0.05	0.0845	0.18	1
Silver µg/L	0.0023	0.04	0.001	0.25
Strontium µg/L	892	1090	1110	/
Thallium µg/L	0.000425	0.000475	0.0019	0.8
Thorium µg/L	0.013525	0.00745	0.0079	/
Tin µg/L	0.04465	0.015	0.019	/
Titanium µg/L	0.6135	1.103	0.81	/
Uranium µg/L	0.455	0.488	0.722	15
Vanadium µg/L	0.2905	0.2185	0.27	100[e,f]
Zinc µg/L	1.79	1.615	2.1	30

Values represent means of total recoverable metal concentrations.

[a] Based on pH ≥ 6.5

[b] Based on water hardness > 180mg/L (as CaCO3)

[c] CCME interim value.

[d] Based on Canadian Drinking Water Quality guideline values.

[e] Based on CCME Guidelines for Agricultural use (Livestock Watering).

[f] Based on CCME Guidelines for Agricultural Use (Irrigation).

A forward slash (/) indicates an absence of data or guidelines.