Minnesota Pollution Control Agency

Prepared in cooperation with the
Minnesota Department of Natural Resources

Elk Lake

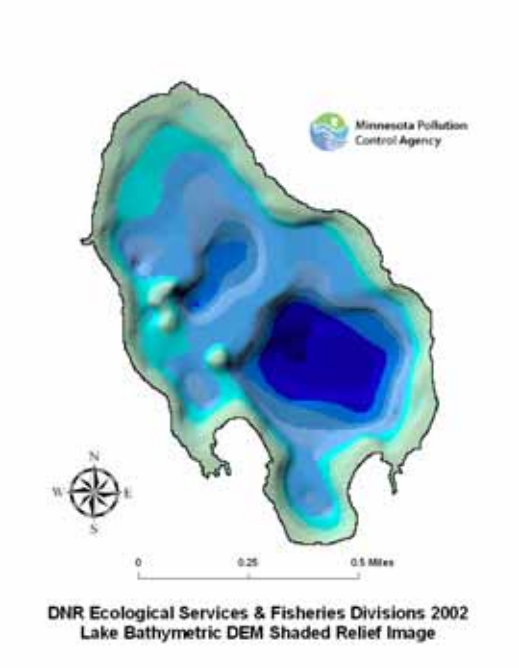
Clearwater County

Sentinel Lakes

Minnesota Lake ID: 15-0010
Area: 271 acres
Watershed Area:1,984 acres
Ecoregion: North Lakes and Forests (NLF)

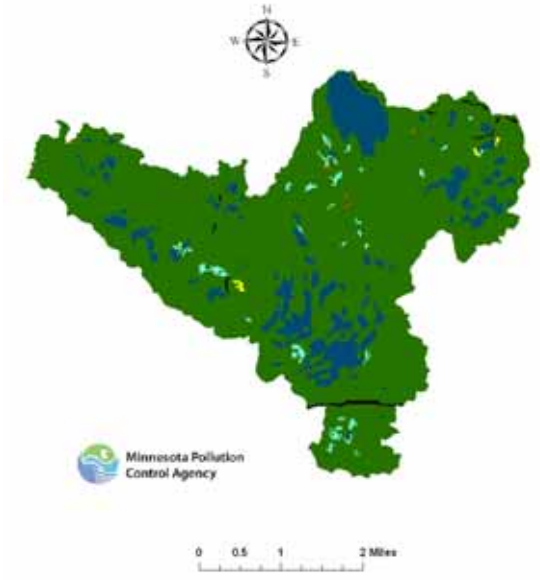
Trophic State: Mesotrophic
Maximum Depth: 93 feet
Mean Depth: 21.8 feet
Mixing Status: Thermally Stratified (Dimictic)

Figure 1. Elk Lake 3D depth contour



DNR Ecological Services & Fisheries Divisions 2002
Lake Bathymetric DEM Shaded Relief Image

Figure 2. Elk Lake Watershed land use



The National Land Cover Database 2001
Multi-Resolution Land Characteristics (MRLC) Consortium

Table 1. Land use compositions

Land use	Elk Lake land use percentage	NLF typical land use percentage
Developed	<1	0 - 7
Cultivated (Ag)	<1	<1
Pasture & Open	<1	0 - 6
Forest	86	54 - 87
Water & Wetland	14	14 - 31
Feedlots (#)	0	

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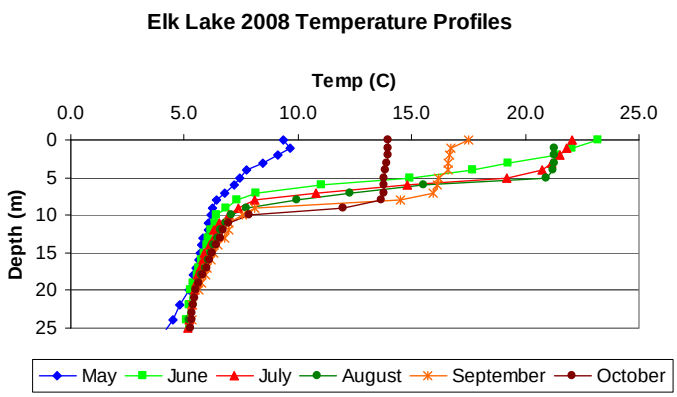
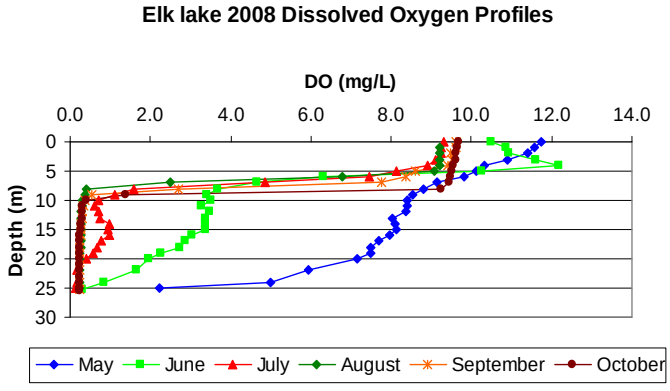
Table 2. Elk Lake summer-mean as compared to typical range for NLF ecoregion reference lakes
MPCA data based on 1985-86 and 2008 sample collections

Parameter	Elk Lake 2008	Elk Lake 1985-86	NLF
Number of reference lakes	-	-	32
Total Phosphorus (µg/L)	21	25	14 – 27
Chlorophyll mean (µg/L)	5	5	4 – 10
Secchi Disk (feet)	9.5	10.8	8 – 15
Secchi Disck (meters)	2.9	3.3	(2.4 – 4.6)
Total Kjeldahl Nitrogen (mg/L)	0.8	0.8	0.4 – 0.75
Alkalinity (mg/L)	160	170	40 – 140
Color (Pt-Co U)	5	5	10 – 35
pH (SU)	8.4		7.2 – 8.3
Chloride (mg/L)	Non-detect	1.0	0.6 – 1.2
Total Suspended Solids (mg/L)	2.2	2.0	<1 – 2
Total Suspended Inorganic Solids (mg/L)	1.1		<1 - 2
Conductivity (umhos/cm)	266	273	50 – 250
TN:TP ratio	38:1	26:1	25:1 - 35:1

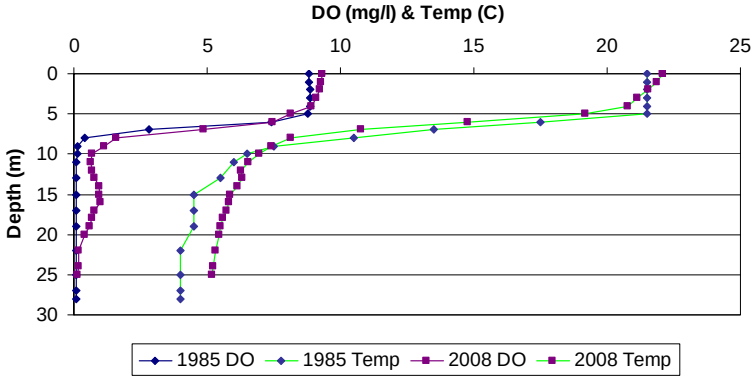
µg/L = micrograms per liter
mg/L = milligrams per liter
umhos/cm = micromhos per centimeter
Pt-Co-U = Platinum Cobalt Units
SU = Standard Units

Figure 3. Elk Lake 2008 temperature and dissolved oxygen (DO) profiles





Elk Lake July Profiles (1985 & 2008)



Watershed, water quality, and fishery summary

Elk Lake is located on the wilderness drive in Itasca State Park. With the exception of a group campsite, there is no development on Elk Lake. In the mid-1980s Elk Lake was selected as a reference lake for the NLF ecoregion and Minnesota Pollution Control Agency (MPCA) collected water quality data and other information on the lake. The historic and more recent data falls within the typical range for NLF lakes (Table 2).

Based on DO and temperature profiles from July 1985 and 2008, a distinct thermocline forms between 5-9 meters while DO falls below 1 mg/L below 10 meters (Figure 4). By mid-summer, most fish would be limited to the upper 6-8 meters in the lake as DO falls below 5 mg/L below this.

The trophic status indicators and other water quality data for Elk Lake fell within the typical range for minimally impacted NLF lakes (Table 2). Total phosphorus (TP) and chlorophyll-a (Chl-a) are high in May as a result of spring overturn. TP declines over the summer as a result of algal uptake and sedimentation. Chl-a remains quite low over the summer and Secchi depth remains between 3-4 m over the summer with a 3.7 m reading in July (Figure 5).

Continuous Secchi disk data are available from 1997-2005. Based on this record, summer-mean Secchi typically ranges between 2.7-3.7 meters, well within the typical range for a NLF ecoregion lake. This limited record suggests a decline in Secchi transparency over time; however this record is very short and should not be viewed as a long-term trend.

Figure 4. Elk Lake Summer-mean Secchi Transparencies

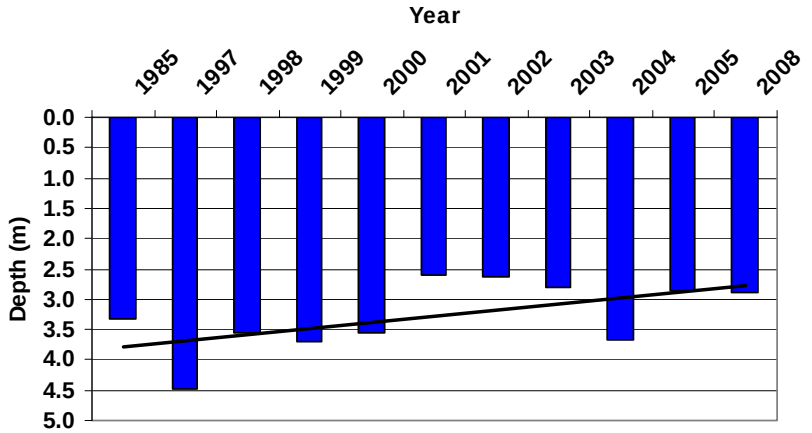
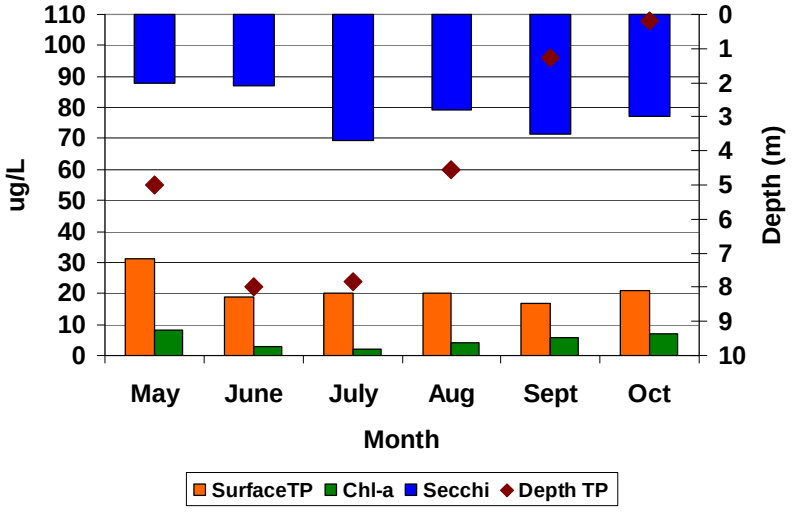


Figure 5. Elk Lake 2008 TP (Surface & Depth), Chl-*a*, and Secchi



Fishery and aquatic plant survey summary

Table 3. Focal species captured during 2008 surveys and their size and abundance compared with other lakes in its lake class.

Species	Stocked	Abundance	Size	Trend
Walleye*	Y	Average-high	Average	Fluctuating abundance
Muskellunge*	Y	High	Large	Stable
Northern Pike*	N	Average	Average	Stable
Yellow perch	N	High	Large	Increasing abundance
Largemouth bass	N	Low	Small	Stable
Bluegill	N	Average	Average-large	Fluctuating abundance
Cisco	N	High	Average	Stable

* Management emphasis on these species (Fisheries Management Plan lists WAE and MUE as primary management species with NOP and centrarchids as secondary species, WAE and MUE are stocked on a regular frequency, Special fishing regulations include catch and release only for MUE and a 40 inch minimum size limit for NOP)

Table 4. Aquatic plant summary

Percent cover of aquatic plants ≤ 15ft	99%
Lake depth beyond which most vegetation disappeared	6.5ft
Number of common species (i.e., ≥ 10% cover)	13
Non-native plant infestation	NA
Frequency of Chara	22%

Narrative

The fish community and habitat of Elk Lake is among the best of all Sentinel Lakes. Elk harbors seven fish species intolerant to disturbance and one species of special concern, the pugnose shiner; however, black crappie, white sucker and yellow bullhead, species typically found in lake class 23 were not sampled in Elk Lake in 2007. Muskellunge were introduced in 1982 (Leech Lake strain) and have been maintained through a high annual stocking rate (the rate has recently been reduced by half but remains on an annual frequency). Musky production (in terms of abundance and size) is among the best in the state compared with other lakes in Elk's lake class, and Elk is used as a brood stock lake for musky egg production. In addition to musky, this small lake supports northern pike, largemouth bass, and stocked walleye populations. Cisco, a fatty cold-water forage fish and yellow perch are abundant in the lake helping to support the high production of predators. Nevertheless, although Elk Lake has a small, forested watershed, the relatively small volume of thermal habitat in this lake coupled with modest nutrient levels makes this lake particularly vulnerable to future increases in water temperature due to climate change. The aquatic plant community of Elk is diverse with a modest contribution of Chara, a structurally complex benthic macroalgae is important for juvenile and non-game fish such as yellow perch, pugnose shiners, and darters. Also, Chara is important for maintaining high water clarity. The "biotic integrity" score for Elk was 130, which is well above average compared with other lakes in its lake class.

Because of the high quality of this lake, its sensitivity to climate change, and partnership opportunities with Itasca State Park and the University of Minnesota Itasca Biological Station, this lake has been targeted for greater meteorological and water quality monitoring with automated sensors built and maintained by the USGS if funding is approved by LCCMR. These data will be housed in a national monitoring database (National Water Inventory System) and used to adapt models to predict the future status of cold-water habitat.