A 250-Year Assessment of Human Impacts on Lake Superior: An Updated Paleolimnological Perspective

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Victoria Lindsay Shaw Chraïbi

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Victoria Chraïbi

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Dedication

I dedicate this work to my parents and sisters for their love and support of my career goals and my frequent moves. Thank you for the long phone calls and for visiting me at the lake. I dedicate this work to my husband for his love and support; thank you for moving to Duluth, making a new career, and learning to drive on ice.

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In memory of Dr. Daryl R. Karns, an excellent scientist and professor gone too soon. For six years, his thoughtful and thought-provoking guidance helped me turn Plan B research topics into key career moves, progress in research after college, and graduate with my Master's from his Alma Mater. He taught me that the trick to being an effective ecologist is to specialize in one field while remaining interested in everything.

Abstract

To understand environmental conditions in Lake Superior over the last two centuries, we conducted a paleolimnological study on two sediment cores collected in the eastern and western regions of the lake. We examined the diatom community assemblages, trace metals, sediment characteristics, and GIS-reconstructed human land use to evaluate the historical impacts of human activities. During European settlement and agricultural development, there is clear indication the diatom community reorganized due to nutrient enrichment. Trace metal profiles tracked a period of mining and ore processing which temporarily increased metal loads to the lake in the mid- to late-20th century. In recent decades, more oligotrophic diatom species were favored, suggesting nutrient decreases associated with remedial activities. The diatom community has reorganized to be dominated by *Cyclotella* species, providing evidence that water quality changes are being influenced by atmospheric nitrogen deposition and changes in the lake's physical and chemical processes associated with climate change.

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Introduction

Lake Superior is the largest freshwater lake in the world by surface area and the third largest by volume, storing 10% of the world's available fresh water (Kalff, 2003). Lake Superior offers various natural resources and economic opportunities in its basin including fisheries, agriculture, shipping, tourism, and industry such as pulp and paper mills, timber logging, and mining (LakeNet, 2004; GLIN, 2012; Minnesota Sea Grant, 2012). These activities warrant interest in preserving the lake's high water quality.

Lake Superior is the first in the chain of the Laurentian Great Lakes. During the last century, the lower Great Lakes experienced varied anthropogenic and environmental stressors. For example, Lakes Michigan, Ontario and Erie underwent dramatic eutrophication events, helping to spur the creation of the federal Water Quality Act in 1972, commonly referred to as The Clean Water Act (Sweeney, 1993; Schelske and Hodell, 1995). Lake Superior has not faced the intensity of stressors encountered in the lower Great Lakes. Due to its relatively small watershed population of approximately 400,000 people, it has received comparatively less polluted runoff from its catchment (Urban, 2009). Unlike the downstream Great Lakes, Lake Superior did not eutrophy lakewide in the 1960s and 1970s, and has always been classified as oligotrophic (Dobiesz et al., 2009), though one study found evidence of nutrient enrichment in a fluvial lake downstream of Lake Superior (Reavie et al., 2005).

Despite its relatively high water quality, monitoring during the last thirty years provides evidence of changes in Lake Superior's processes. Spring lake concentrations of nitrates increased five-fold over the last century, likely due to increased atmospheric deposition (Bennett, 1986). Regardless of recent declines in atmospheric deposition due to regulated emissions, in-lake nitrate concentrations continue to increase at a slow but steady rate (Bennett, 1986; Sterner et al., 2007; Dobiesz et al., 2009). Open water surveys by the EPA Great Lakes National Program Office (GLNPO, 2010) indicate that phosphorus has been decreasing since 2000 (Gorman and Hoff, 2003). These data are consistent with data showing an increasing nitrate-to-phosphorus ratio, which is among the highest of the world's large lakes (Guildford and Hecky, 2000; Sterner et al., 2007).

Based on models using monitoring data, total phosphorus (TP) loads to Lake Superior have remained well below the maximum levels set by the Great Lakes Water Quality Agreement (Dolan and Chapra, 2012). In addition, though phosphorus remains at consistently low concentrations, ionic concentrations (e.g. chloride) and turbidity in the water column have been increasing over the last few decades, with a marked jump in turbidity in 2004 (Gorman and Hoff, 2003; Urban, 2009; Osantowski et al., 2010). These recent nutrient trends in Lake Superior raise questions about the lake's internal and external drivers. The alterations of the chemical, physical and biological properties of Lake Superior are poorly understood in the context of natural variability within the lake.

Climate change is also impacting Lake Superior. Over the last century, the open water summer temperature increased 3.5° C; during the same time, temporally averaged winter ice cover decreased 12-23% (Austin and Colman, 2008). Such changes in the temperature regime have affected the mixing regime of the lake. The stratified season increased from 145 days to 170 days, and begins earlier in spring (Austin and Colman, 2008). Over the last few decades, wind speed increased 5% per decade, creating a positive feedback loop with warming surface waters so that the water temperature is warming faster than the ambient air temperature (Desai et al., 2009). Climate change will likely continue to influence Lake Superior's temperature regime, the effects of which on lake biology and water quality are not well understood.

Understanding the recent and continuing stressors on Lake Superior is necessary for its proper management to preserve ecological and economic viability. Monitoring is doubtless a vital asset to research pursuits. However, monitoring programs are limited by short duration, varying protocol among monitoring parties, and a "snapshot" view of the lake's processes which is usually limited to seasonal sampling as well as relatively modern data (Smol, 2002). Paleolimnological methods are likely to contribute a useful component to the understanding of Lake Superior's long-term, holistic process through the use of integrative data in the forms of physical and chemical information and microfossil assemblages (Reavie and Allinger, 2011). Lake sediments have been shown to reflect detailed, long-term ecological conditions created by natural and anthropogenic drivers.

Diatom algae (division Bacillariophyta) provide a reliable ecological indicator because they are primary producers which respond rapidly to environmental change and remain in lake sediments as floristic fossils due to their siliceous cell walls (Vinebrooke, 1996; Hall and Smol, 1999). Abundance of diatom community assemblages has been shown to track stressor impacts on water quality in the Great Lakes (Reavie et al., 2006). Diatoms can reflect stressors like climate change (e.g. Gregory-Eaves et al., 1999), nutrient enrichment (e.g. Yurista and Kelly, 2007), and other anthropogenic activities. Lake Superior's biological community is organized into a food web consisting of four trophic levels, which is based on carbon fixed by a phytoplankton community dominated by diatoms and cyanobacteria (Keough et al., 1996; Kitchell et al., 2000). As such, shifts in the phytoplankton assemblage and abundance can impact other biological functions of Lake Superior, and the historical record of their remains may provide clues to changes in the larger lake community.

Former paleolimnological investigations in Lake Superior have yielded somewhat conflicting results. The support for human impacts on water quality is based on sediment core analyses from the eastern region of Lake Superior [collected in 1979 by Stoermer et al. (1985)]. The diatom assemblage shifted to planktonic species such as *Aulacoseira* (previously identified as *Melosira*) in response to human settlement effects between ca. 1850 and 1900, and further increased in response to nutrient loading beginning ca. 1950. Other research proposed human impact was less likely, as well as highlighted the challenges using sedimentary diatoms in Lake Superior. Thayer et al. (1983a,b) analyzed 170 short cores collected from Lake Superior and found only four with well-preserved diatoms. They suggested that paleolimnological investigations in the lake require spatial considerations; namely, accounting for irregular deposition patterns of diatoms and potential preferable dissolution of more lightly-silicified species in lower sedimentation areas that could result in skewed species representation in fossil assemblages. Thayer et al. (1983a) estimated that *Aulacoseira* increased before the *Ambrosia* pollen horizon (which signals initial landscape development) and therefore proposed that the inferred nutrient increase could not be associated with settlement effects, unlike the paleolimnological findings of Stoermer et al. (1985). Instead, Thayer et al. (1983a) suggested the increase of *Aulacoseira* was due to factors other than nutrient increases. Unfortunately, neither investigation benefitted from more refined sediment dating technologies and other detailed analysis such as sedimentary metals characterization that exist today, so uncertainties remain in the timing and meaning of these trends.

No integrated paleolimnological study has been undertaken in decades, during some of Lake Superior's most dramatic changes. This study aimed to fill the data gap in paleolimnological studies and to gain a better understanding of human impact on the lake in hopes to better understand modern changes seen in the monitoring data. In an effort to clarify apparent conflicts among past paleoecological data, this study employed new indicators and research methods compared to the previous studies, such as stratigraphic ^{210}Pb dating, trace metals analysis, detailed TP modeling based on modern species-environment relationships, and comparison with quantified human activities in the watershed acquired from historical records.

Methods

Sediment core sampling

To overcome the difficulties of sampling sediment in Lake Superior, we carefully selected coring sites using sonar and the knowledge of scientists researching Lake Superior's sedimentation patterns. In the field, an echo sounder targeted areas with high sedimentation rates. Two sites were sampled, one from the eastern trenches (8 April 2010, Research Vessel *Lake Guardian*, Lat. 47.188°, Long. -85.116°) and one off the coast of Isle Royale (10 June 2010, Research Vessel *Blue Heron*, Lat. 47.973°, Long. -88.466°) (Fig 1). The eastern site targeted a high sedimentation area northwest of Whitefish Point using GPS coordinates to correspond with a historical core collected in 1979 (Stoermer et al., 1985). The sediment was collected at a depth of 213 m using an Ocean Instruments model 750 box corer (30 cm x 30 cm x 90 cm), from which two 6.5-

cm internal diameter cylindrical cores were sub-sampled. Two cores from the western location were collected at a depth of 234 m with an Ocean Instruments model MC-400 multi-corer (9.4 cm diameter). At each location one core was extruded at 0.25-cm intervals for the first 20 cm, then at 0.5 cm from 20-30 cm, and 1 cm intervals to the bottom of the core. Another core was used for ^{210}Pb dating (at 0.5-cm intervals the first 20 cm, and 1-cm intervals to the bottom of the core). The surface sediment in the western cores was stabilized using Zorbitrol polymer gel to minimize disturbance prior to extruding (Tomkins et al., 2008).

Sediment dating

Freeze-dried subsamples from the cores were ^{210}Pb-dated based on methods presented by Appleby (2001). Sediment subsamples were analyzed for excess ^{210}Pb activity to determine age and sediment accumulation rates for the past ~150 years. ^{210}Pb was measured at 15-20 depth intervals in each core through its granddaughter product ^{210}Po, with ^{209}Po added as an internal yield tracer. The polonium isotopes were dissolved from 0.5-1.0 g dry sediment at 550 °C following pretreatment with concentrated hydrochloric acid (HCl) and evaporated directly onto silver planchets from a 0.5 N HCl solution (modified from Eakins and Morrison, 1978). Activity was measured for 1-6 x 10^5 s with ion-implanted surface barrier detectors and an Ortec alpha spectroscopy system. Unsupported ^{210}Pb was calculated by subtracting supported activity from the total activity measured at each level; supported ^{210}Pb was estimated from the asymptotic activity at depth (the mean of the lowermost samples in a core). Dates and sedimentation rates were determined according to the constant rate of supply model (Appleby and Oldfield, 1978) with confidence intervals calculated by first-order error analysis of counting uncertainty (Binford, 1990). Raw data are in Appendix 1.

Diatom processing

Diatom frustules were cleaned of organic material by digestion to allow identification of diatom species. Weighed sediment subsamples (~0.5 wet g) were diluted with 130 mL deionized water and treated with 20 mL concentrated nitric acid on a hot plate. Samples were heated at approximately 100 °C until 20 mL remained. Then, 25 mL hydrogen peroxide (30% solution) was added using a catalyst of potassium dichromate and again heated until 10-15 mL remained. Samples were rinsed eight times in centrifuge tubes by diluting and spinning down the samples at 2000 rpm. Coverslips were prepared using the Battarbee (1986) method, preparing 2 slides per sample interval by adhesion with Naphrax® mountant.

Diatoms were identified and enumerated using an Olympus BH-2 microscope at 1000x magnification with oil immersion. At least 400 diatom valves were counted per slide. Diatom taxon codes and raw counts are in Appendices 2 and 3. The valve sizes (length, width, diameter and/or depth) of the first ten encountered valves of each taxon were measured to determine average valve dimensions in each sediment interval (Reavie et al., 2010) for subsequent biovolume calculations. Diatom size data are in Appendix 4. To allow for discussion and taxonomic refinement, representative specimens were photographed with a Lumenera Infinity 2 digital camera. Many of the long (e.g. *Synedra*, *Asterionella*), thinly silicified (*e.g. Nitzschia*), and large (e.g. *Stephanodiscus niagarae*) frustules were broken. For this reason, we counted fragments identified to the best of our knowledge in order to preserve the actual diversity and abundances in the diatom assemblage. Fragments were counted as a fraction (1/8 or greater) of whole valves and later totaled for each taxon.

Diatom taxonomy and enumeration techniques were practiced and an initial taxonomic photo database was created to aid in consistent diatom identification. Diatom identification was based on USEPA photographic records and plates (contact Reavie for details), publications by Krammer and Lange Bertalot (1986-1991), Patrick and Reimer (1966, 1975), and publications specific to Lake Superior (e.g. Theriot and Stoermer 1984). Species lists of diatoms found in the Great Lakes compiled during the USEPA's Great Lakes National Program Office monitoring program (GLNPO, 2010) were also used for guidance. Plates of dominant diatom taxa are in Appendix 5.

Pollen

Pollen analysis (Maher, 1977) was used to verify ^{210}Pb results and the timing of European settlement in the western core. Pollen preparation and assessment methods were similar to Faegeri and Iverson (1989) with modifications by Heck (2010). After sediment dating, fourteen samples were chosen from the western core to target the area around the suspected *Ambrosia* horizon, determined to start around 1890 in Lake Superior (Maher, 1977). *Ambrosia* pollen is well-known to increase in sediments following European settlement and deforestation activities in North America.

For each sample, ~1 g wet sediment was diluted with 30 mL high purity water in 40 mL glass centrifuge tubes, centrifuged at 2000 rpm and decanted. Then, 30 mL of 10% HCl was added to each sample and tubes were placed in a 90 ºC hot water bath for 30 minutes. Decanting and washing with 30 mL water and centrifuging were repeated until the sample pH was greater than 6. Thirty mL of 10 % KOH was added to each sample followed by another 30 minutes in the water bath. Centrifuging, decanting and washing were repeated until the samples were clear. Samples were poured through an 80-µm sieve and the >80 µm fraction was transferred to a 0.5 dram glass vial. The <80 µm filtrate was poured through a 20 µm sieve and the >20 µm material was transferred to a 40-mL test tube. These samples were treated with 15 mL 2.5% sodium hypochlorite and placed in the water bath for ~3 minutes. These samples were centrifuged and decanted, followed by addition of 6 mL 10% HCL to each sample and placing in the hot water bath for 10 minutes. As above, samples were centrifuged, decanted and washed until the pH was greater than 6. Pollen material in these samples were recombined with the >80 µm fraction in 0.5 dram vial. Enough silicone oil was added to each vial to cover the sample. A known stock of 20-µm polyvinyl beads in silicone oil was added to each sample for quantitative assessment.

For pollen counting, a glass stirring rod was used to remove a small amount of oiled pollen from a vial and make a “smear” slide for analysis. A coverslip covered the subsample. *Ambrosia* pollen and other entities (beads, other pollen species and spores) were counted along transects until a total of 300 pollen and/or spore entities were encountered. The depth interval containing increasing abundance of *Ambrosia* pollen was identified as the post-settlement horizon. Pollen data are in Appendix 6.

Loss-on-ignition (LOI)

Organic and inorganic LOI analyses followed Dean (1974). Sediment water content was determined from weight lost following oven drying of sediments at 100 ºC for 24 hours. Weight loss after firing at 550 ºC for two hours was used as an estimate of organic content. Weight loss after firing the remaining material for 2 hours at 1000 ºC provided an estimate of carbonate content that is used to reflect inorganic carbonates (largely calcium carbonate) (Boyle, 2001). LOI data are in Appendix 7.

Trace metals

A rapid, low-cost analysis for trace metals was performed to provide stratigraphic surrogates for human activities such as mining and tailings disposal. For each sample, sediment subsamples were freeze-dried and 0.25 ± 0.02 g of dry sediment were added to a 50-mL centrifuge tube. To this, 25 mL 0.5 N HCl was added and samples were heated at 80-85 °C in a hot-water bath for 30 minutes. Vials were transferred to an ice-water bath and allowed to cool for 5 minutes. Samples were centrifuged at 2000 rpm for 10 minutes, and then 10.0 mL of the supernatant was moved to 125-mL acid-washed poly-bottles. Each sample was diluted with 40 ± 0.5 g deionized water. Samples were assessed using inductively coupled plasma mass spectrometry (ICP-MS), which is capable of the determination of a range of metals and several non-metals (B’Hymer et al., 2000; Jarvis et al., 1992). These analyses were performed by personnel at the University of Minnesota Department of Earth Sciences, Analytical Geochemistry Laboratory. Trace metal data are in Appendix 8.

Biogenic Silica (BSi)

The BSi procedure was developed by Keith Sturgeon and Yvonne Chan following techniques described by Mann and Gieskes (1975) and DeMaster (1979). Subsamples of

0.03 g of freeze-dried sediment from selected core intervals were finely ground with a mortar and pestle and added to 40% sodium hydroxide in an 85 °C water bath. At time steps of 5, 15, 30, 60, 90, 120, and 200 minutes, a 1-mL aliquot was subsampled into plastic vials with 1 mL water. A 0.5 mL of the aliquot was subsampled to a separate vial and treated with 2 mL molybdate solution, 4 mL deionized water, and 3 mL reducing solution. After three hours, the biogenic silica concentration was measured by a UV-1800 Shimadzu System version 1.10 spectrophotometer and recorded by the software program UV Probe version 2.33. The spectrophotometer readings of sample absorption were plotted versus time. The initial steep slope is due to actual biogenic silica; this slope was normalized, and this normalized value was put in place of the x variable of the standard curve's equation. The resulting y value in the equation is the BSi concentration in micro-moles per liter. BSi data are in Appendix 9.

Historical Stressor Data

Spatial and temporal dynamics of land use patterns were collected from historical records. A database was populated with information from various internet and GIS resources, which were tracked to provide metadata and documentation for each value. Land use included in this study are agriculture (USBC, 1850-2010, 1925-1987, 1992-2007; CCO, 1880-2006; CDBS, 1871-2011), population (USBC,1850-2010, 1990-2010; CDBS, 1871-2011), and mining (USGS, 1844-2012).Transcribed records combined a date, the land use in question (agriculture, mining, human population), the level of the land use (acres, people, mines) and the spatial distribution of the land use (points, lines, and polygons, stationary or moving over time). Historical items were placed on a timeline with annual time-steps from 1700 to 2020. The level associated with each record was rendered into a GIS raster grid specific to each land use type. The level of each land use was summarized within 15 watersheds covering the Lake Superior basin (Fig 2), each watershed of approximately equal area. Post-processing of results allowed reporting of land-use levels for a particular date and/or changes in land-use levels for a particular range of years. Historical land use data could be generated for all watershed groups combined, or for selected subsets of watershed groups (e.g., only eastern or western watersheds). The land use dataset continues to be developed for additional land use variables, but at this time the compiled results provide a clear picture of historical activities around Lake Superior. For this manuscript we employed the database to describe long-term population dynamics and agricultural and mining activities, and we summarized stressor data separately for western, eastern and all watersheds (Fig 2). Land use data are in Appendix 10.

Data analysis

Sum diatom counts (valves and fragments) were converted into percent relative abundance. Diatom species that were greater than 5% of the relative abundance in at least one sample interval in either core were selected for further analysis. Some biostratigraphies were plotted using C2 version 1.2.7 (Juggins, 2007). Biovolume was calculated for all taxa using sample measurements of length, width, diameter, and depth. Biovolume calculations followed the standard operating procedure of the USEPA (2010).

The statistical computer program R version 2.15.1 (R Development Core Team, 2010) was used to create stratigraphic plots for diatoms and other indicators, mainly using the package rioja version 0.7-3 (Juggins, 2012). Depth-constrained cluster analysis with a broken stick model was applied to diatom relative abundance stratigraphies using the “chclust” and “bstick” functions in rioja. The significant zones revealed by this model were used to infer temporal reorganization by the diatom community in response to changing environmental conditions. The broken stick model was also applied to the trace metal stratigraphies to highlight significant shifts in Lake Superior geochemistry.

Twice yearly, the U.S. EPA conducts phytoplankton monitoring of the offshore waters of the Great Lakes to fulfill provisions of the Great Lakes Water Quality Agreement (1978, 2009). The planktonic diatom and nutrient samples from spring and summer cruises in 2007 and 2008 were used to develop a novel diatom-based transfer function to infer total phosphorus (TP) concentrations from sedimentary assemblages. This model was previously developed and evaluated by Reavie and Juggins (2011), and in this study we evaluated the suitability of applying this transfer function to Lake Superior sedimentary assemblages using analogue and fit-to-TP analyses, and comparisons to Lake Superior nutrient monitoring data.

Weighted averaging (WA) calibration and regression were used to derive a diatom-based model using R and the package rioja. Rioja quantitatively reconstructs environmental variables using weighted averaging of the diatom species and their associated environmental optima and tolerances. The diatom transfer function was derived by relating diatom species assemblages in the training set of phytoplankton samples to measured TP. Past TP concentrations were inferred from the fossil diatom assemblages using the transfer function, which estimates TP based on the TP optima of the fossil taxa, weighted by their relative abundance. The full model is known to have good performance statistics (Reavie and Juggins, 2011), but this is the first time it has been applied to fossil data. Details of diatom-based transfer function development and application are provided by Juggins and Birks (2012).

Analog analysis was performed using the R package analogue (Simpson and Oksanen, 2011). Analog analysis implemented matching of assemblages among modern (302 samples) spring and summer diatom plankton samples from the Great Lakes monitoring program and fossil (downcore) diatom assemblages from this study, following Flower et al. (1997) and Simpson et al. (2005). The method identifies the closest analogs of fossil samples from the modern training set to assess the reliability of diatom-inferred data. The R script generates a pairwise dissimilarity matrix for the modern training set, and a second matrix containing the pairwise dissimilarities between each fossil sample and each sample in the training set. Analogs were determined using Bray-Curtis dissimilarity (Bray and Curtis, 1957). Dissimilarities of the ten “closest” modern assemblages to each fossil assemblage were compiled to assess how well each fossil assemblage was represented in modern collections.

A canonical correspondence analysis (CCA) constrained to TP was used to evaluate relationships between fossil samples and the modern TP gradient. The residual distance of fossil diatom assemblages to the TP axis provided a measure to assess “lack of fit” to TP. First, using the R package vegan (Oksanen et al., 2011), CCA determined extreme residual distances from the TP axis (i.e. axis 1) by using modern samples. Fossil samples were then run passively in CCA using the “timetrack” function in the R package analogue (Simpson and Oksanen, 2011). Fossil samples were positioned, by means of transition formulae, with respect to the TP axis. Fossil samples with residual distances greater than the 95% confidence limits of the training set were considered to have poor fits to TP, and so inferred TP from those assemblages would be considered unreliable.

Results

Land Use History

Native North Americans occupied the Lake Superior watershed before European settlement. Records reflecting European settlement began ca. 1850. Beginning in the 1850s, human population increased rapidly concurrent with increasing agriculture and mining development until the early 1900s, when both decreased sharply when competition from more arable regions caused a reduction in agricultural activities (Fig 2). Population remained stable through the rest of the 20th century while agricultural acres continued to decrease. Since the early 1900s, agricultural activities and population in the western watershed were about twice that in the eastern watershed. Currently, agriculture and a few small cities characterize the eastern watershed, while the western watershed houses the larger cities of Duluth, Superior, and Thunder Bay. Nonferrous (e.g. copper, gold, silver, uranium, lead, lithium, zinc) mines began operation early, starting just before 1850 in the western watershed, where the number of mines peaked in the 1870s. Nonferrous mining began ca. 1880 in the eastern watershed and persisted until approximately the 1980s. Ferrous mining activity increased slowly from ca. 1850 through 1890 in the eastern watershed, whereas in the western watershed it started ca. 1880, peaked ca. 1930, and then subsequently decreased.

A pulse in taconite processing occurred from ca. 1960 through the 1970s, corresponding with taconite processing and discharge activities near Silver Bay, Minnesota (Minnesota Historical Society, 2012). It is noteworthy that the timber industry was also a historically important activity around Lake Superior, but to date we have not compiled sufficient historical data to adequately track its activity. It is likely that the intensity of deforestation activities followed periods of initial population increase.

Dating

The date-depth model constructed using ^{210}Pb showed a trend of decreasing ^{210}Pb activity with depth (Fig 3). A marked *Ambrosia* horizon, representing 38.5% of total pollen, appeared in the western core ca. 1888, coinciding with historical records of increased settlement of the north shore of Lake Superior. The pollen assemblage was dominated (often >70%) by *Pinus* throughout the core (results not shown).

Sedimentation Rates

Eastern Core

Sediment accumulation rate increased after 1870 and peaked just before 1900 (Fig 4a). Afterwards, the sediment accumulation rate followed a decreasing trend, particularly after ~1950, to resemble pre-settlement sediment accumulation rates by the 1990s. Organics content increased after approximately 1910 until 2010. Carbonates displayed some variation around a mean value of ~2% dry weight of sediment through the core.

Western Core

Sediment accumulation rate increased from 1850 to peak in 1875, and then decreased until 1910, at which point it increased again to the highest historical peak in 1965 (Fig 4b). Sediment accumulation rate subsequently decreased to a low point in 1988 before increasing through 2010. As for the eastern core, organics displayed a slow increase from ca. 1900 to 2010. Carbonates peaked ca. 1920, then subsequently fluctuated around an average of ~2.5% dry weight.

Trace metals and nutrients

We quantified eleven elements (Al, Ba, Ca, Fe, K, Mg, Mn, Na, P, Si, Sr) and their accumulation rates in each sediment core. In both cores, most shifts in the chemical trends occurred during the peak mining era of the last ~60 years.

Eastern Core

Broken stick analysis identified six significant zones in the metal accumulation trends of the eastern core (Fig 5a). Zone A covers the pre-1900 portion of the core, when most of the metals were at their lowest accumulation rates. Zone B covers post-settlement through ca. 1952, when all metals increased in concordance with higher overall mining activity (Fig 2). The other zones follow in increasingly rapid succession within the last 60 years; Zone C (1952-1990), a period of gradual decline in metals; Zone D (1990-1994), a brief period of peak Fe and P, which may be related to greater non-ferrous mining in the eastern watersheds since ca. 1950; Zone E (1994-2003), a brief period containing a Mn peak; and Zone F (2003-2010), the recent, brief period of lower Fe, Mn and P, corresponding with lower overall mining activity.

Phosphorus notably followed different trends than the other trace metals, with the possible exception of Fe. P slowly increased through Zones A and B while other trace metals were accumulating at more rapid rates. Towards the end of Zone B (ca. 1935), P increased more rapidly, peaking in Zone C (ca. 1950) and again in Zone D (ca. 1994). After this peak, P declined rapidly to maintain a low, stable accumulation rate in Zone F. Fe also displayed somewhat different trends than the other trace metals, often mirrored at a diminished scale by Mn. Fe and Mn increased after 1900 along with the other metals, similarly declining in the late 20th century. Both metals had their greatest peaks recently (Zones E and F), with the Fe peak offset a few years earlier than Mn, and other metals (Al, K, Mg, Na) dipping temporarily during these peaks.

Western Core

Broken stick analysis identified five zones in the western core record of trace metal accumulation rates (Fig 5b): Zone A (pre-1955), a long period of stable trace metal concentrations, ending with an increase in all analytes; Zone B (1955-1967), a period with peaks in Al, Ba, Fe, P, Si and Sr, corresponding with the brief period of taconite processing waste discharge near Silver Bay, MN (Fig 2); Zone C (1967-1982), a period with peaks in Al, K, Mg and Mn, in addition to still relatively high concentrations of metals that peaked in Zone B; Zone D (1982-1988), a very brief period of declining metal concentrations, except for a peak in Mn; and Zone E (1988-2010), a recent period of lower overall metal concentrations with the exception of a peak in Na in the top two sample intervals, which is attributed to trace amounts of sodium in the Zorbitrol gel used for surface sediment stabilization.

Most trace metals had low accumulation rates that first increased substantially ca. 1930. Most metals reached a peak ca. 1960 (Ba, Ca, Fe, P, Si, Sr) or ca. 1972 (Al, K, Mg). By 1972, most trace metals began to decline, and continued to decrease through 1990. No events are known to relate to the peak of Mn ca. 1982. Beginning in 1990, most trace metals increased slightly at variable rates.

Biogenic Silica (BSi) and Total Diatoms

Eastern Core

Overall, BSi concentration and accumulation rate showed some increase since ca. 1870 (Fig 6a). BSi accumulation rate in the sediment was erratic, but in general was elevated between the 1880s and 1950s; The 1925 peak in BSi accumulation corresponded with the peaks in diatom cell density and biovolume accumulation rates. The last decade had the highest BSi levels, and levels and concentrations in the sediments remain higher than pre-settlement conditions. Density and biovolume of diatoms were very low through the 1990s and early 2000s, but current levels are only slightly higher than pre-settlement levels.

Western Core

BSi accumulation in the sediment had a brief peak ca. 1850, then followed a variable increasing trend since ca. 1935 (Fig 6b). The BSi trends do not reflect trends in the diatom stratigraphy, such as the diatom peak ca. 1960. Since 1960, continuing high levels of BSi accumulation are not reflected in diatom cell density and biovolume accumulation data, which show lower diatom abundance during this time (Fig 10).

Diatoms

A total of 112 species from 28 genera were identified in the two cores from Lake Superior. Most of the species were planktonic, belonging to the genera *Aulacoseira*, *Cyclotella*, *Discostella*, *Stephanodiscus* and *Synedra*. Benthic taxa were rare. Thirteen dominant taxa that displayed greater than 5% abundance in at least one sample in either core are summarized. Most of the species presented were dominant in both core assemblages, and many of these species exhibited similar temporal trends in both cores.

Eastern Core

A total of 95 species from 28 genera were identified in the eastern core. Clustering of diatom assemblages (% relative abundance) identified four significant stratigraphic zones (Fig 7). Zone A (pre-1927) characterized pre-settlement conditions (1750-1850), which was dominated by *Cyclotella ocellata* Pantocsek and *Discostella pseudostelligera* (Hustedt) Houk & Kell. *C. ocellata* remained most dominant at a stable relative abundance for most of the zone, though *D. pseudostelligera* increased to become the most abundant by 1900. In ca. 1904, *D. pseudostelligera*, *C. ocellata* and *Cyclotella atomus* Hustedt (including a poorly-defined “fine form”) decreased to be replaced by *Aulacoseira islandica* (O. Müller) Simonsen. *Discostella stelligera* (Cleve & Grunow) Houk & Klee and *Fragilaria crotonensis* Kitton also increased slightly in the most recent years of Zone A.

In Zone B (1927-1975), *A. islandica* dominated the community assemblage with ~40% relative abundance. *A. islandica* was recognized by Stoermer et al. (1985) as a taxon that increased in Lake Superior due to nutrient enrichment. *A. islandica* broadly peaked as the dominant species throughout Zone B, and began to decline ca. 1971. During *A. islandica*’s peak, the previously dominant species *C. ocellata* and *D. pseudostelligera* declined to relative abundances similar to pre-settlement conditions and appeared to fluctuate throughout the zone relative to *A. islandica’s* abundance. Most other species also decreased during *A. islandica*'s peak, with the exception of *Cyclotella bodanica* Grunow, which doubled its previous relative abundance, and *Stephanodiscus conspicueporus* Stoermer, Håkansson & Theriot, which remained relatively constant. The period of decrease in *A. islandica* was further characterized by increases in *F. crotonensis* and *Tabellaria flocculosa* (Roth) Kützing str. IIIP sensu Koppen.

Zone C (1975-1983) was a narrow zone characterized by a decline in *A. islandica* to a low relative abundance similar to pre-settlement conditions. *F. crotonensis* and *T. flocculosa* also declined, meanwhile *C. ocellata* and *D. pseudostelligera* peaked in relative abundance to values similar to those observed in the early 1900s. *S. conspicueporus*, which was present at low relative abundance throughout the previous zones, began to decline in Zone C.

Increasing relative abundance of *Cyclotella comensis* variety "rough center with process" (hereafter RCWP; a taxon similar in appearance to *Cyclotella delicatula* Hustedt), characterized Zone D (1983-2010); it began to increase ca. 1980 and peaked at ~25% relative abundance. *Cyclotella comensis* Grunow and *Synedra filiformis* Carter & Denny also increased compared to their previous relative abundances. At the top of the core, *A. islandica*, *C. ocellata*, and *D. pseudostelligera* displayed relative abundances similar to pre-settlement conditions. *D. stelligera* and *S. conspicueporus*, species that were present throughout the core in low abundances, decreased to relative abundances similar to or lower than pre-settlement conditions.

Displaying trends by biovolume accumulation rate accentuated productivity trends for the species (Fig 8). For instance, the biovolume accumulation rate emphasized the period of *A. islandica* dominance in Zone B. It also highlighted species abundance trends that are underrepresented in relative abundance analysis due to size differences. For example, the large diatom *C. bodanica* behaved more dynamically in terms of its biovolume accumulation rate than its relative abundance, notably at the beginning of Zone B. Additionally, *C. ocellata* displayed a relatively constant relative abundance up to Zone C, but strong trends in biovolume documented its importance in Zones A and B. During that time, *C. ocellata* had a high biovolume accumulation rate, in concordance with many other taxa whose accumulation peaked during that time, such as *D. pseudostelligera*, *T. flocculosa*, *S. conspicueporus* and *F. crotonensis*. Overall, biovolume data emphasize the magnitude of the productivity increase that occurred during the late 1800s through ca. 1970.

Western Core

We identified a total of 86 species from 24 genera in the western core. The most distinct difference from the eastern core is that *A. islandica* had an earlier peak, at a lower relative abundance, than the eastern location.

Cluster analysis identified four zones with high orders of differentiation (Fig 9). Zone A (pre-1850) defines the lower portion of the core. *C. ocellata* dominated the community assemblage with ~40% relative abundance. *D. pseudostelligera* and *S. conspicueporus* were also prevalent in the community assemblage with ~10% relative abundance each. Other members of *Cyclotella* each comprised less than 10% of the community assemblage.

Zone B (1847-1944) is characterized by a broad peak in *A. islandica* that began in the late 1800s, with a maximum of ~25% of the community assemblage ca. 1897. This peak in *A. islandica* was observed ~40 years earlier than that observed in the eastern core. The preliminary increase in *A. islandica* corresponded with declines in the other dominant species with the exception of *D. pseudostelligera*, which increased into Zone C. *A. islandica* rapidly declined after 1930 and continued to decline throughout Zone C (1944-1988), as did *S. conspicueporus*. *D. pseudostelligera* increased in Zone C to dominate the community assemblage with ~30% relative abundance, peaking ca. 1965. Other *Cyclotella* species showed slight abundance increases compared to previous times throughout Zone C, except for *C. ocellata*, which remained relatively stable at about half its pre-settlement relative abundance through most recent samples.

Cyclotella dominated in Zone D (1988-2010), with most notable increases in *C. comensis* RCWP (~25%), which approximately quadrupled its pre-settlement relative abundance. *C. comensis* and *S. filiformis* also increased. *A. islandica* decreased to approximate its relative abundance in pre-settlement conditions. *S. conspicueporus* declined to a small percentage (~2%) of the community composition, lower than any previous time.

As for the eastern core, biovolume accumulation rates (Fig 10) for the dominant species highlight some trends not evident in the relative abundance stratigraphy of the western core. Zone B had higher than pre-settlement accumulation rates of *A. islandica*, *S. conspicueporus*, *F. crotonensis*, and *T. flocculosa*. Notably, a peak biovolume accumulation rate occurred for every species in Zone C (ca. 1965), indicating a short period of greater total diatom accumulation at that time. Zone D was characterized by rapidly declining accumulation rates, starting ca. 1975, and a short-lived peak in biovolume accumulation rate in 2007, particularly of the *Cyclotella* species, *F. crotonensis* and *S. filiformis*.

Diatom-inferred total phosphorus (DI-TP)

Analog analysis indicated that the number of closest training set samples (i.e. the number of modern Great Lakes samples with high similarity to each fossil sample; $P < 0.05$) was higher in more recent assemblages (Fig 11). That usually more than 30 modern samples in the training set had high similarity to fossil assemblages indicates good comparability between modern and fossil data. Higher numbers of close samples in upper intervals indicates that that older samples have assemblage characteristics that are not as well represented in modern collections. Not surprisingly, lower interval assemblages tended to have higher dissimilarities, based on dissimilarities of the ten most similar (closest) modern samples. However, dissimilarities of these closest samples always fell within the significantly low dissimilarity threshold generated from the full training set.

Trends in fit-to-TP comparisons are also apparent with depth, but most importantly, all fits were well within 95% confidence intervals for the training set, indicating “good” fit to the phosphorus data (Fig 11).

Pre-settlement TP was inferred to be ~2.5-3.0 µg/L (Fig 11). In the eastern core, DI-TP peaked broadly from ca. 1930 to ca. 1965 at a maximum of 6.0 µg/L. In the western core, the DI-TP had a more subdued peak between ca. 1860 and 1930, reaching

4.0 µg/L in ~1890. Modern DI-TP was similar to pre-settlement concentrations. DI-TP appears to satisfactorily track measured TP collected around Lake Superior as part of the GLNPO monitoring program since 1996.

Discussion

Sedimentary indicators provide a record of ecological change in Lake Superior and potential drivers of change over the last ~250 years. Overall, Lake Superior's pelagic condition has responded to both chemical and physical anthropogenic stressors. Early shifts in the diatom communities occurred likely in response to nutrient enrichment by human activities such as agriculture and sewage disposal. Metals deposition tracked mining activities in the 20th century. The diatom communities also tracked shifts in the last ~30 years, which may be related to changing physical and chemical characteristics of the lake influenced by atmospheric stressors.

Both core stratigraphies suggest a community productivity response to P enrichment from the late 1800s through ca. 1970. The community response was mainly characterized by dominance of *A. islandica* as well as increased biovolume accumulation rates for most species and increased BSi accumulation rates. *A. islandica* is a heavily silicified diatom that grows in single cells or filamentous colonies under the winter ice, and then increases during the spring mixing period until silica is depleted and the lake stratifies (Jewson, 1992). Following Tilman's resource-ratio hypothesis, *Aulacoseira* is observed to become dominant in an assemblage at high Si:light ratios, even when Si:P are low, meaning that *Aulacoseira* fares well in moderate nutrient supply and low light availability during a deep mixing event, which is needed to keep a heavily silicified diatom in suspension (Tilman, 1981; Makulla and Sommer, 1993). Stoermer (1993) lists *A. islandica* as a meso-eutrophic diatom in the Laurentian Great Lakes that competes well in moderately-high nutrients and limited light because of its ability to use nutrients during winter while minimizing silica requirements through morphological plasticity. The species responds to moderate nutrient enrichment, but is disadvantaged by further enrichment that would lead to a eutrophic state (Gibson et al., 2003).

The increased P load to the lake around the turn of the century that favored an increase in *A. islandica* likely came from land clearance, agriculture and sewage discharge. Phosphorus sources through the mid-1900s included agriculture; although the total acres of agriculture decreased around that time, the introduction of phosphate-rich fertilizer ca. 1935 and its widespread application through the 1950s may have introduced more P to the lake through runoff. Also, prior to technologies to treat discharge water in urban areas, large amounts of P would have come from untreated discharges such as P detergents and sewage. Increases in *A. islandica* to these types of P sources have been observed in other lakes (Canter and Haworth, 2010). The initial decrease of DI-TP in the late 1970s may have been in response to new policies instituted under the Clean Water Act (1972) and Great Lakes Water Quality Agreement (1978) managing for lower levels of phosphates, and the installation of sewage treatment plants, to which the diatom community responded by favoring species with lower P requirements. However, earlier declines in P inferred from the western core were likely due to passive remediation; i.e., the widespread withdrawal of agricultural activities.

In addition to agricultural and urban P loads, iron mining likely altered trace metal loads to the lake through the erosion of tailings waste, as well as by discarding tailings directly into the lake, as happened in Silver Bay in the 1960s. Geochemical analyses show that P closely tracks Fe; Fe concentrations can partially govern P concentrations because of the tendency for P to adsorb onto hydrated ferric oxides and undergo subsequent sediment burial (Engstrom and Wright, 1984). However, it has also been observed that in oligotrophic lakes, sedimentary P is more often correlated with primary production than Fe concentrations (Engstrom and Wright, 1984). It is therefore possible that inorganic P reflects regulation by the presence of Fe, and organic P reflects biotic activity. We do not have data to address these detailed aspects of P sources to the sediment record; but it is apparent in our data that geochemical P levels do not reflect productivity, so we rely more on the algal indicators to track historical pelagic P concentrations. This approach takes into consideration the high mobility and biological reactivity of P in sediment, and the resulting difficulty in correlating sedimentary P with environmental timelines of open-water P concentrations (Ginn et al., 2012).The nutrient reconstructions based on the diatom-based transfer function revealed strong stratigraphic trends in DI-TP, tracking the eutrophication event from ca. 1930 through ca. 1972 that has been noted in other studies (e.g. Schelske et al., 2006, Stoermer et al., 1985) as well as matching the open-water monitoring record beginning in 1996.

BSi and diatom abundance data appeared to track increased productivity in the 20th century, similar to that noted by Schelske et al. (2006). However, in our data, BSi is poorly correlated with diatom abundance data in both cores. There are a few possible reasons for this incongruity which further research could address, such as issues of dissolution skewing the diatom abundance record, or an incongruity with diatom size. Although the BSi sampling protocol generally followed Conley and Schelske (2001), some deviations from the protocol, such as using conical centrifuge tubes instead of flat-bottomed tubes, and a small storage container instead of a shaking water bath, may have introduced some measurement error. With this in mind, we are more confident in the trends displayed by the diatom assemblage data than the BSi data. Although BSi may give evidence of changes in productivity in many cases, reconstructing community shifts by diatom counts and identification may provide better details of algal responses to environmental changes for some lakes.

The two cores shared similar diatom assemblages. Most of these species had similar trends over time in both cores, suggesting certain whole-lake processes elicited similar responses from diatom assemblages in different areas of the lake. The species that displayed the most dissimilar trend between cores was *A. islandica*. While it appeared to track a discrete eutrophication event, the timing of the events differed between locations. Both core dating models performed well, so issues with core dating creating this incongruity is unlikely.

The western location tracked an earlier, longer and less intense eutrophication event, whereas the eastern location tracked a more recent and more intense event. Complex circulation patterns in Lake Superior make it difficult to confirm reasons for these differences (e.g. Lien and Hoopes, 1978). It appears that the eastern core revealed the predominant eutrophication impacts on the lake, whereas the western location captured more localized impacts around the north shore. Assemblages in both cores, however, appear to have responded to P enrichment that reached those areas of the lake at different times and possibly from different sources. It may be that the earlier diatom shift in the western location was due to activities associated with non-ferrous mining, such as land clearance and settlement, which intensified much earlier in the western watersheds (Berndt 2003) (Fig 2). The later diatom shift in the eastern location was more likely related to agricultural activities in the southeastern watershed. The differences in *A. islandica* suggest that in addition to whole-lake signals registered by other species, localized effects influenced trends in *Aulacoseira*.

In the last ~15 years, trace metals in Lake Superior displayed rapid changes. The general trend revealed decreasing metals, suggesting a gradual recovery from mining-related inputs. There has been a concurrent shift in both core assemblages to dominance by *Cyclotella* species beginning in 1995, and further increasing as of 2010. There have also been increases in *S. filiformis* in both and *F. crotonensis* in the western core. All of these species frequent the deep chlorophyll layer, a nutrient-rich area just at the thermocline of Lake Superior during the summer (Fahnenstiel and Glime, 1983). A possible reason for the recent increases in these diatoms is the increasing nitrate concentration in Lake Superior. Lake Superior nitrified over the last century due to atmospheric inputs created by agricultural fertilizer and industrial emissions (Bennett, 1986). The atmospheric nitrogen deposition to Lake Superior continues on an increasing trend (Dobiesz et al., 2009), and algal monitoring data confirm the continued dominance of *Cyclotella* in the phytoplankton assemblage.

The sources and cycling of nitrates in Lake Superior are still under investigation. There are indications that nitrogen is primarily supplied by atmospheric deposition, and consequently accumulates as nitrates due to in-lake nitrification without equivalent rates of denitrification and sediment burial (Sterner et al., 2007; Finlay et al., 2007). The high N:P ratio in Lake Superior is moving away from the Redfield ratio, and will likely continue as long as P and carbon remain limiting in the Lake Superior system, affecting phytoplankton ability to uptake nitrogen (Guildford and Hecky, 2000; Hecky, 2000; Sterner et al., 2007). *F. crotonensis* has been observed to respond strongly to additions of atmospheric N when Si and P are in low to moderate concentrations in an oligotrophic lake, as well as during rapid changes in ecological conditions (Stoermer, 1978; Saros et al., 2005). *S. filiformis* competes well in low to moderate Si and P concentrations (Tilman, 1981). *Cyclotella* also competes well in situations of high N and low Si (Stoermer and Kreis, 1980). Although there appears to be no silica limitation in Lake Superior, the main dominants, i.e. *Cyclotella* species, in the current diatom assemblage may be present because they function well in oligotrophic, nitrogen-rich waters.

In terms of relative abundance, most of the currently dominant *Cyclotella* species, with the exception of *C. ocellata*, were not dominant previously in the cores, indicating a notable shift in the primary producers of Lake Superior. *Cyclotella* increases have appeared in records of about 200 other lakes in the high northern latitudes that have otherwise not been impacted by nutrient enrichment (Rühland et al., 2008). In these lakes, the shifts to *Cyclotella* dominance were better explained by increasing ice-free period length and air temperature than by atmospheric nitrogen deposition. The mechanism of this influence may be warmer winter temperatures, resulting in earlier springs with deeper mixing, followed by longer periods of summer stratification and warmer surface water temperatures (Winder and Schindler, 2004; Rühland et al., 2008; Saros et al., 2012). Climatic changes resulting in changes in the mixing level have been recently noted in a lake on Isle Royale, Lake Superior’s largest island (Saros et al., 2012). Changes in these physical properties of a lake in turn affect water column mixing, nutrient distribution, and light availability. The *C. comensis* complex has been observed to fare well in longer ice-free periods that provide stable light and thermal stratification with somewhat elevated nutrient concentrations, which may amplify the duration and nutrient availability of the deep chlorophyll layer (Fahnenstiel and Glime, 1983; Rühland et al., 2008; Thackeray et al., 2008).

Lake Superior’s physical properties appear to be changing along a trajectory favoring optimal conditions for *Cyclotella*. Average ice cover has decreased 12-23% over the last century, and because of increasing wind speed, the water temperature has been increasing faster than the ambient air temperature (Austin and Colman, 2008; Desai et al., 2009). Thermal stratification has increased from 145 days to 170 days in the last century, beginning earlier in spring, possibly supporting *Cyclotella* over other planktonic diatoms, particularly species which frequent the deep chlorophyll layer (Fahnenstiel and Glime, 1983). The effects of a warming climate on the recent diatom assemblage are further supported by the decline of *Aulacoseira*, which has a low temperature optimum and is usually restricted to conditions of winter circulation (Stoermer and Ladewski, 1976; Rühland et al., 2008).

Vollenweider (1975) suggested that lake size does not necessarily reduce a lake's vulnerability to stressors. This appears to be the case for Lake Superior in its response to nutrient enrichment. Also, Lake Superior seems to be responding to climate change in the same manner and over the same general time period as other smaller oligotrophic northern temperate lakes. Considering its size, there does not appear to be much refuge from climatic variables, particularly when lake size is dominated by surface area and therefore more prone to interact with the atmosphere. Rühland et al. (2008) indicated the current rate of temperature change in the lakes they studied occurred at half of the rate of the changes projected for the next 50 years. Because of Lake Superior's large surface area, it is possible that the rate of change will be equivalent or greater in Lake Superior. Also, the large size of Lake Superior may impede the lake's recovery because of physical characteristics like long water residence times and gigantothermy, which has led to the lake warming faster than the atmosphere over the last century and longer ice-free periods (Vollenweider, 1975; Austin and Coleman, 2008). It is likely Lake Superior's biological structure will continue to change in the near future in response to climatic variables.

The results from our eastern core largely agree with the results of the study conducted by Stoermer et al. (1985) at a nearby coring site. The two studies found many of the same species to be dominant in the eastern core assemblage, with some variation in taxonomic identifications, most likely due to changing taxonomy. The overall *Cyclotella* trends agree between the cores. Stoermer et al. noted a beginning rise in *Cyclotella* at the top of their core. In the absence of sediment dating, Stoermer et al. estimated major diatom community shifts to occur in 1870 and 1950 and indicated the need for better dates. With ^{210}Pb dating on our core, we identified diatom assemblage shifts occurring in the late 1800s. Our study supports the Stoermer et al. disagreement with findings by Thayer et al. (1983). Our analysis found the *Ambrosia* horizon dating to 1888, well before *A. islandica* peaked in our cores. We therefore disagree with Thayer et al. that increases in *A. islandica* occurred before European settlement, but instead that *A. islandica* is a consistent indicator of anthropogenic nutrient enrichment in Lake Superior. Also, unlike Thayer's observation that community assemblages did not correlate well among their cores, many of the diatom assemblage shifts in our cores were concordant, with the exception of *A. islandica*.

Thayer et al. (1983) raised several questions about the capacity of Lake Superior diatom assemblages to indicate temperature change associated with climate. Stoermer et al. (1985) provided a response to this in a careful analysis of many of the species' ecological preferences. Many of Stoermer et al.'s conclusions in this matter are further supported by the diatom assemblage in the past ~15 years, characterized by the increase of warm-temperature species such as *Cyclotella* and *Synedra* and the decrease of colder-temperature species such as *Aulacoseira* and *Stephanodiscus* (Stoermer, 1993). We therefore agree that climate change has had an influence on the recent diatom assemblage of Lake Superior.

Conclusions

Lake Superior's water quality and biological communities have undergone several shifts in the last ~250 years. Many diatom species were affected similarly between the basins, suggesting whole-lake responses to certain environmental parameters. Additionally, some species responded to basin-specific stressors such as nutrients. In the late 1800s and throughout the 1900s, Lake Superior's pelagic water mass was mainly influenced by human activities such as agriculture and mining. Since the 1980s, it appears that the lake has been increasingly influenced by environmental stressors originating outside the catchment and being delivered by interactions with the atmosphere, including nitrogen deposition and shifts in temperature and seasonality.

Better taxonomic knowledge of Lake Superior diatoms, ^{210}Pb dating and trace metal analysis advanced knowledge of paleolimnological trends in Lake Superior. Future research would lend more information to the potential impacts of changing water quality (e.g. trends of increasing chloride) on primary producers, the exact relationship between Lake Superior diatoms and nutrients, and the continuing influence of atmospheric nitrogen deposition and global climate warming. To achieve this, research on other cores around the lake, particularly the western region, would give a better idea of chemical and biological shifts through time.

Lake Superior is a water body that is sensitive to change. Considering its importance as a major economical freshwater resource, careful attention should be paid to these changes. Nutrient management strategies were apparently warranted and have been effective. However, recent trends indicate a new set of challenges presented by atmospheric drivers. The impact of these external stressors on Lake Superior's physical, chemical, and biological processes should be further researched and considered when determining management plans.

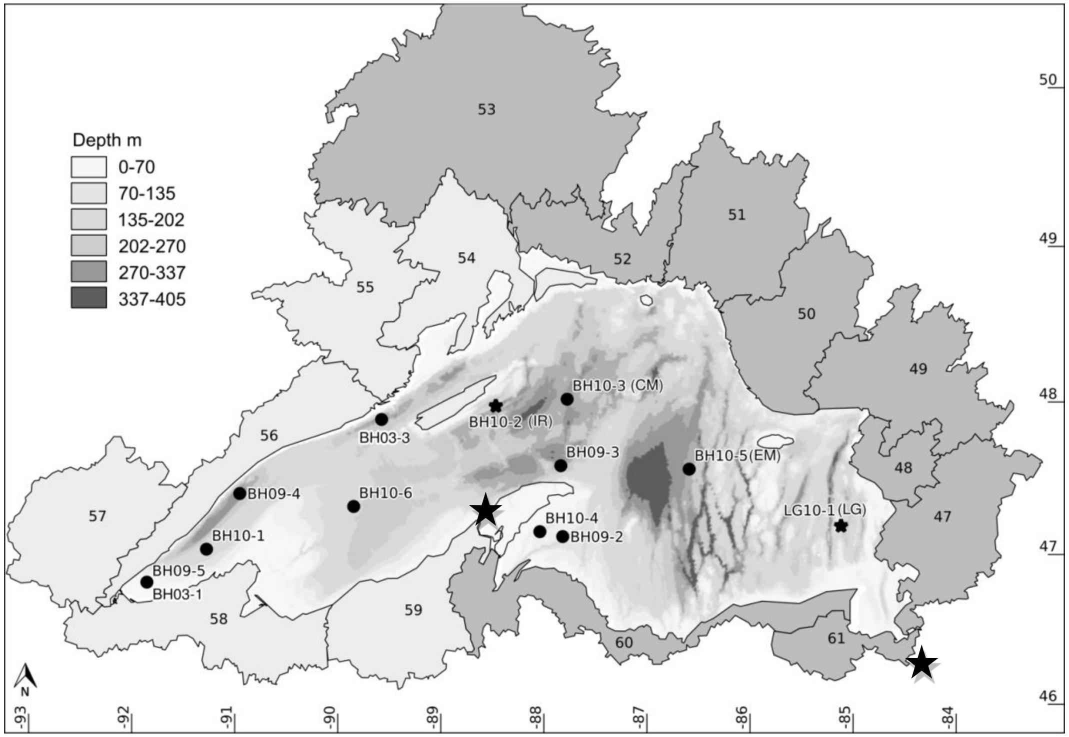


Figure 1. Lake Superior bathymetric map with surrounding watershed. X and Y axes are latitude and longitude. Increasing lake depth is indicated by darker shading. Stars represent coring sites used in this study (LG10-1 (LG) = eastern core and BH10-2 (IR) = western core); circles are other cores sampled in the last decade. Although only two cores were studied in this article, additional core identifications are provided to harmonize with other studies and manuscripts in which they appear. Surrounding watershed boundaries are indicated using arbitrary identification numbers used in the stressor database. Watersheds draining to the eastern side of the lake, represented by the eastern core (LG), are shaded dark; watersheds draining to the western half of the lake, represented by the western core (IR), are shaded light.

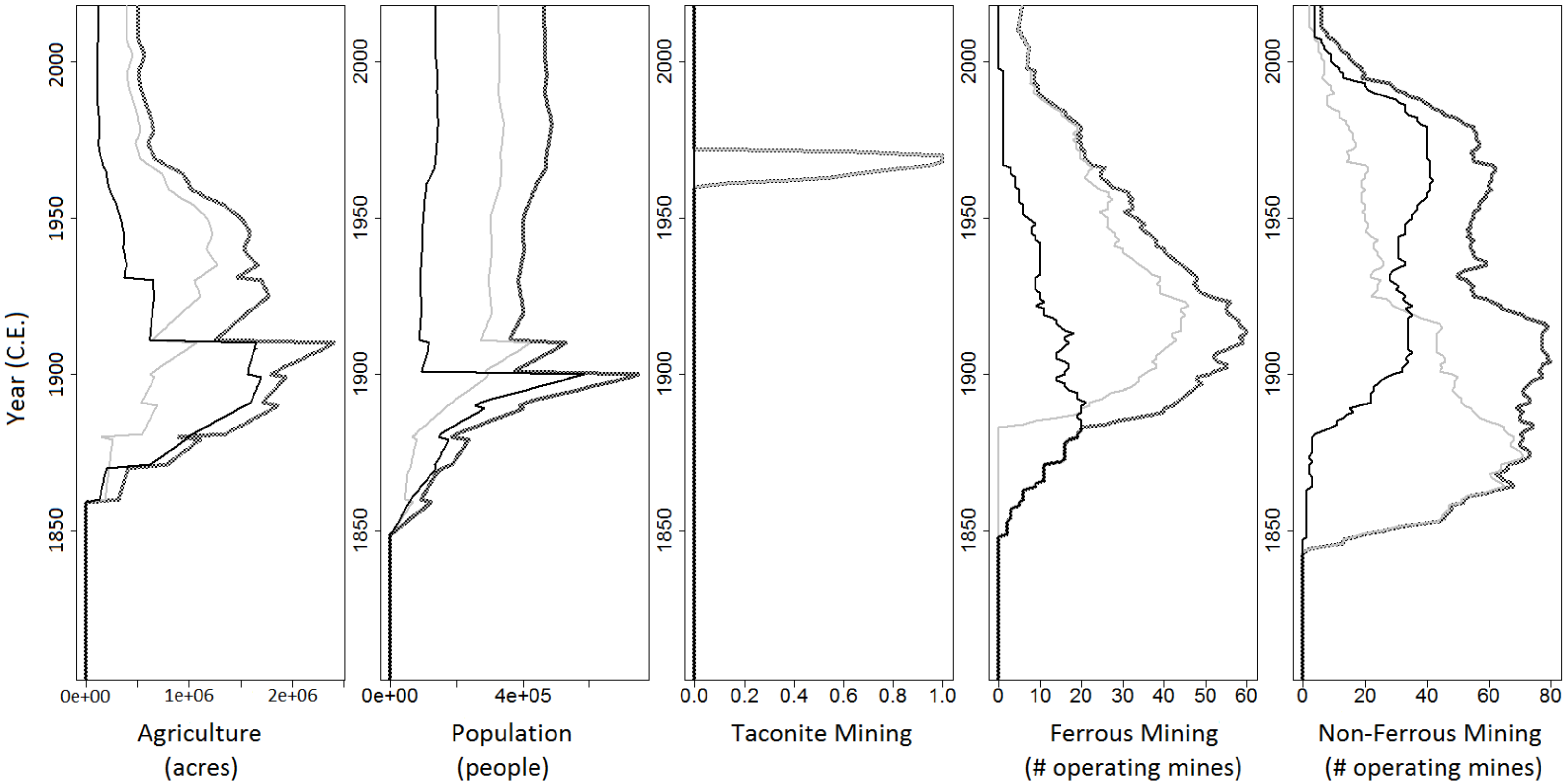


Figure 2. Land use stressors in the Lake Superior watershed over the past ~200 years. Historic land use activities include agricultural activity (acres), human population (number of people), taconite mining waste dumping (arbitrary scale in which 1.0 represents maximum processing output), ferrous mining (number of operating mines), and non-ferrous mining (number of operating mines). The dotted line represents the entire watershed, black line represents the eastern watershed and the grey line represents the western watershed.

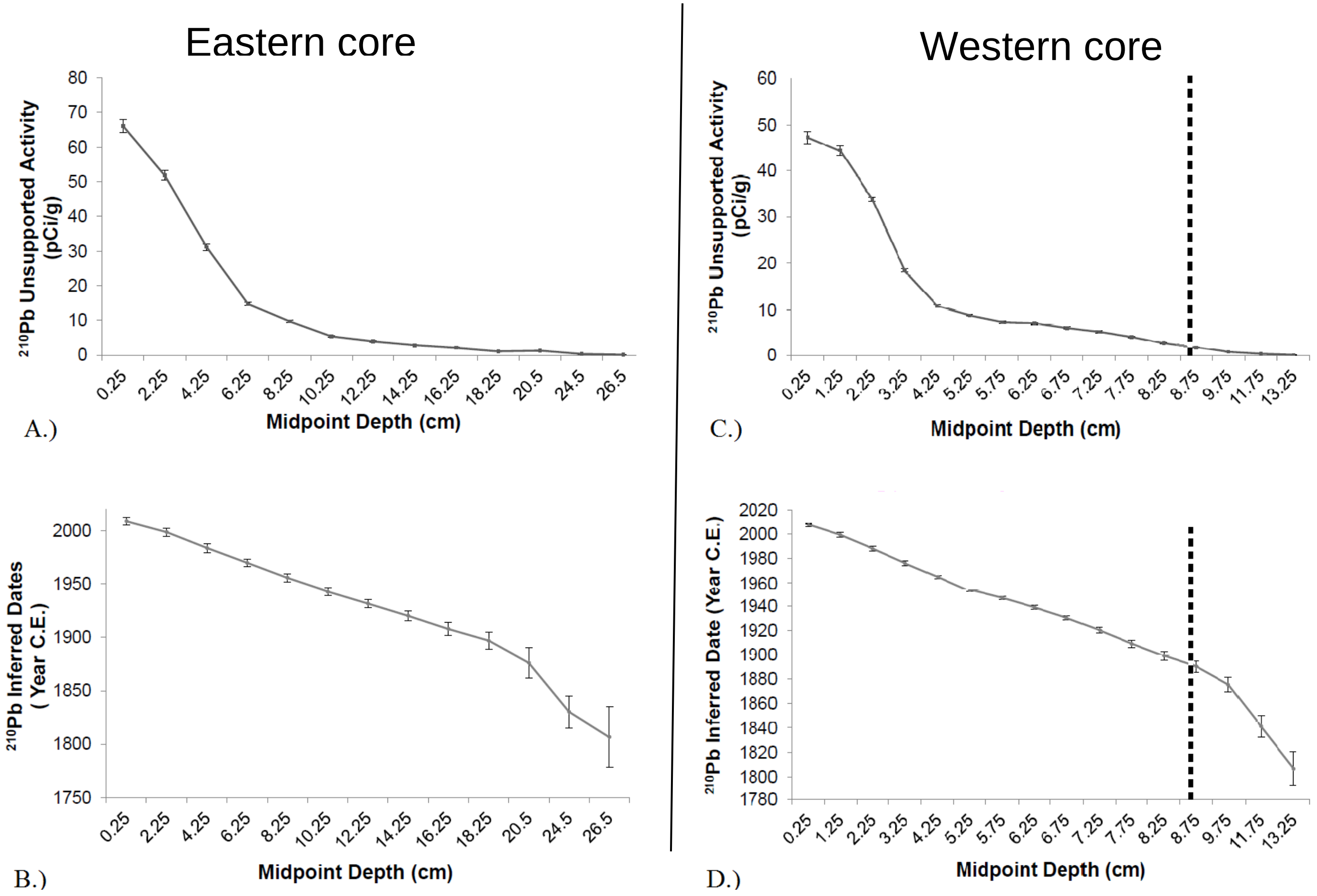
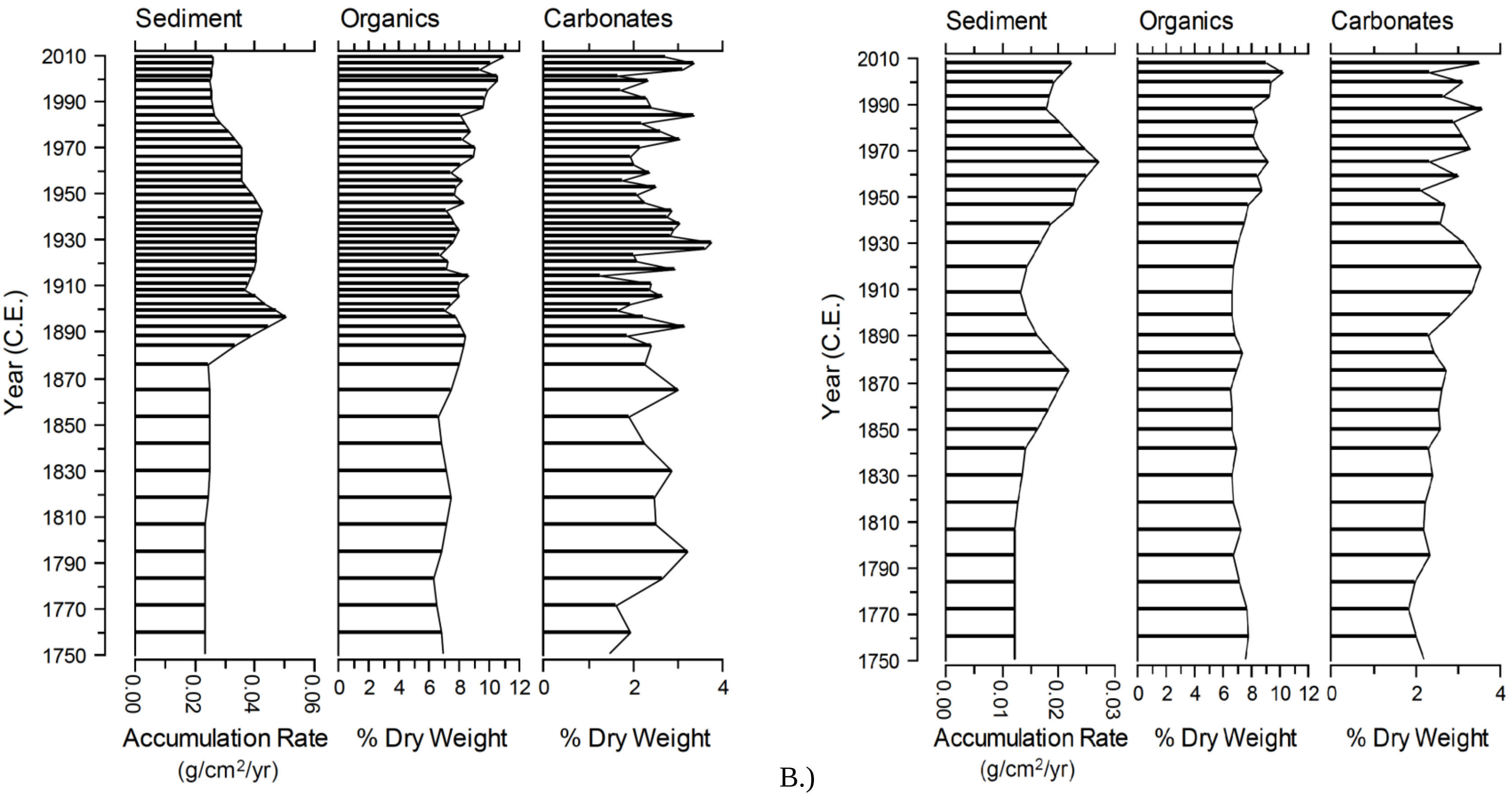


Figure 3. A.) Profile of ^{210}Pb unsupported activity (pCi/g) of the eastern core, with standard deviation. B.) Profile of dates inferred from ^{210}Pb activity in the eastern core, with standard deviation. C.) Profile of ^{210}Pb unsupported activity (pCi/g) of the western core, with standard deviation. The dashed line indicates *Ambrosia* pollen horizon. D.) Profile of dates inferred from ^{210}Pb activity in the western core, with standard deviation. The dashed line indicates the *Ambrosia* pollen horizon.



A.)

B.)

Figure 4. Sediment accumulation rate, organics and carbonate content of sediments of A.) eastern core and B.) western core of Lake Superior.

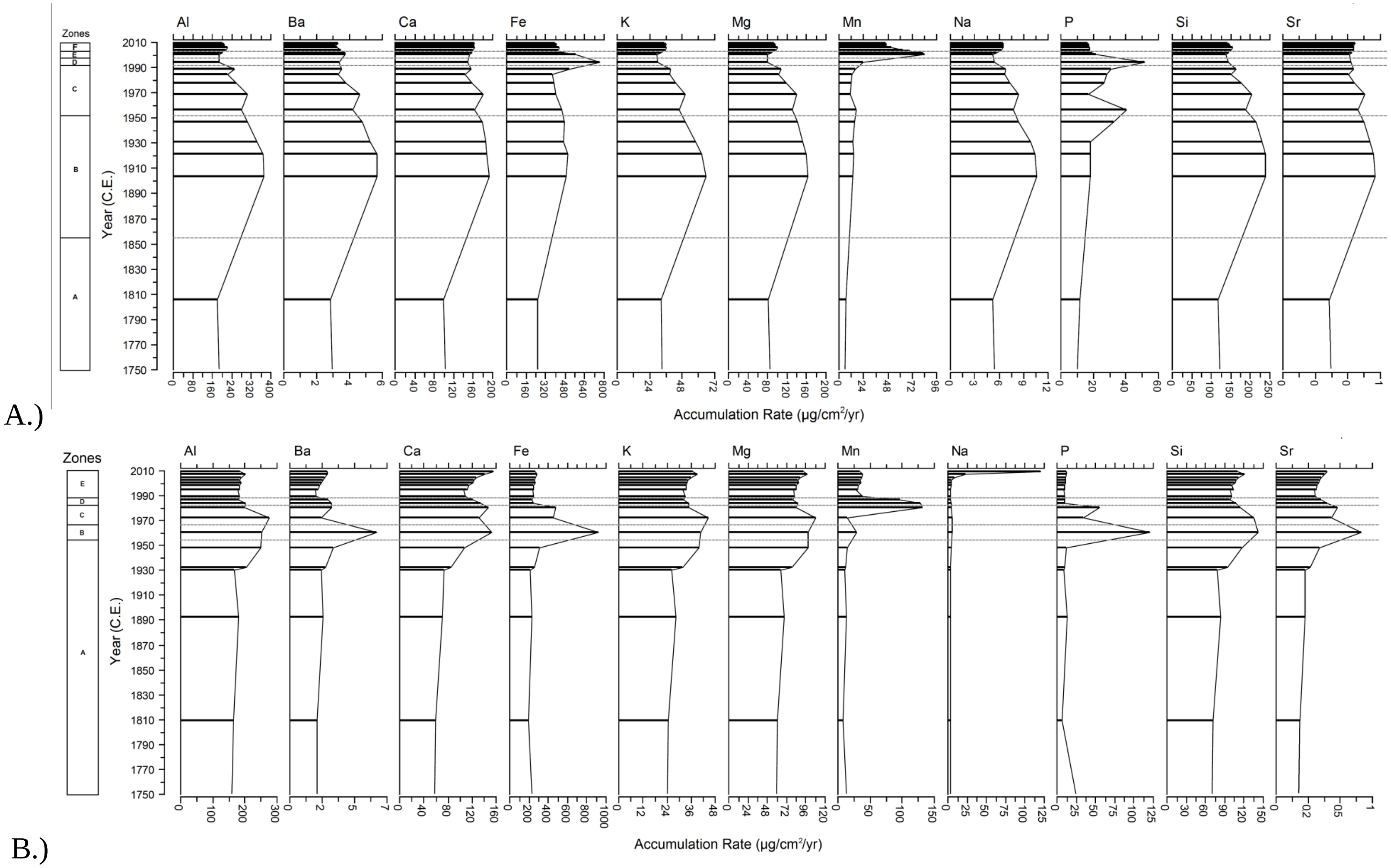


Figure 5. Trace metal accumulation rates (µg/cm^2/yr) in sediment of A.) eastern core and B.) western core of Lake Superior over the last ~260 years. Dotted lines represent significant zones of change derived from cluster analysis with broken stick analysis.

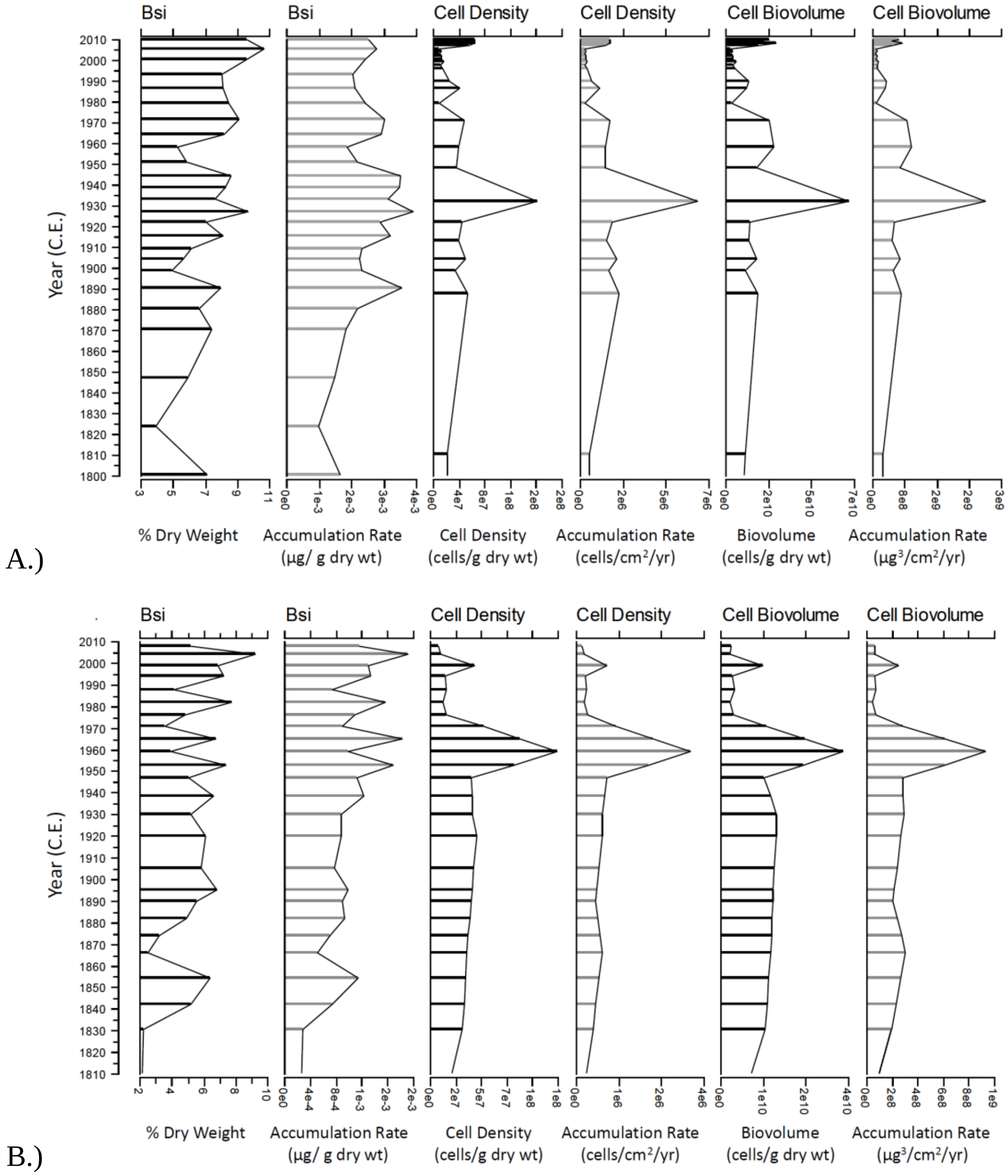


Figure 6. Biogenic silica, diatom cell density and diatom biovolume trends over the last ~200 years in A.) eastern core and B.) western core of Lake Superior. Black bars represent cells/g dry weight; grey bars represent accumulation rate.

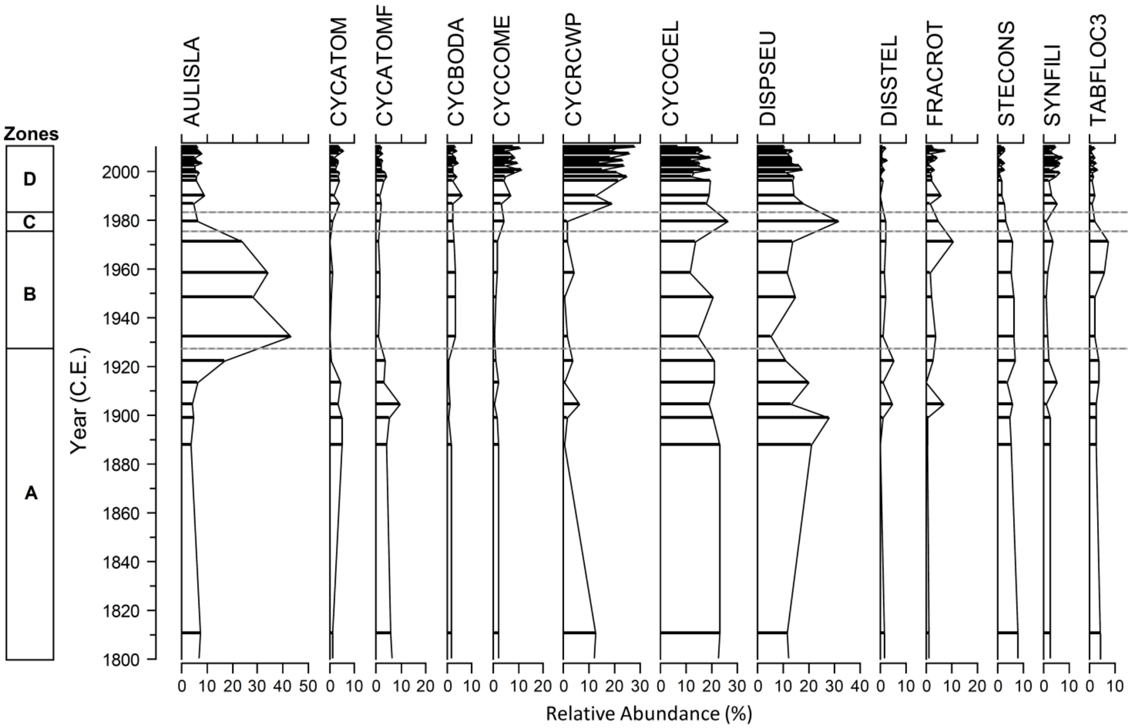


Figure 7. Dominant diatom species (>5% relative abundance in either core) for the eastern core of Lake Superior over the last 260 years shown in terms of relative abundance (%). Dotted lines represent zones of dissimilarity derived from cluster analysis of diatom relative abundance. Taxon codes: AULISLA = *Aulacoseira islandica*; CYCATOM = *Cyclotella atomus*; CYCATOMF = *Cyclotella atomus* “fine form”; CYCBODA = *Cyclotella bodanica*; CYCCOME = *Cyclotella comensis*; CYCRCWP = *Cyclotella comensis* var. rough center with process; CYCOCEL = *Cyclotella ocellata*; DISPSEU = *Discostella pseudostelligera*; DISSTEL = *Discostella stelligera*; FRACROT = *Fragilaria crotonensis*; STECONS = *Stephanodiscus conspicueporus*; SYNFILI = *Synedra filiformis*; TABFLOC3 = *Tabellaria flocculosa* str. IIIP.

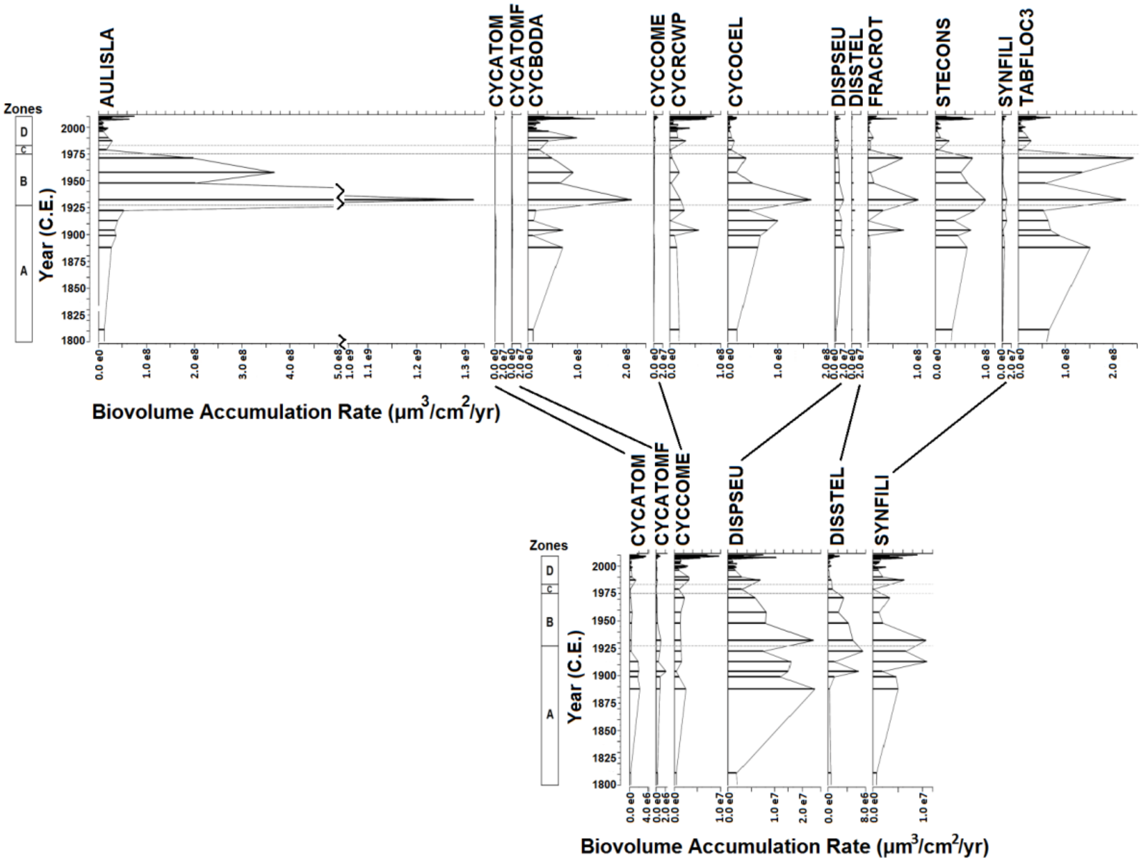


Figure 8. Dominant diatom species (>5% relative abundance in either core) for the eastern core of Lake Superior over the last 210 years shown in terms of biovolume accumulation rate (µm^3/cm^2/yr). Horizontal dotted lines represent zones of dissimilarity derived from cluster analysis of diatom relative abundance. The lower plots display species with lower accumulation rates in order to emphasize trends.

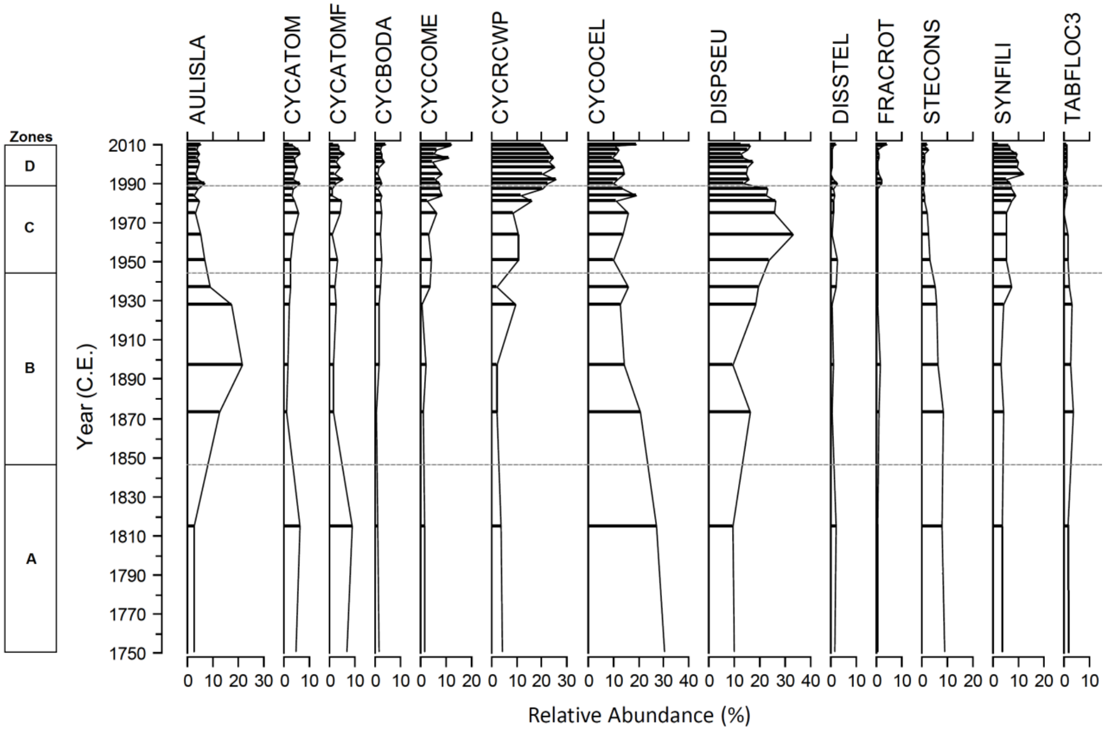


Figure 9. Dominant diatom species (>5% relative abundance in either core) for the western core of Lake Superior over the last ~250 years shown in terms of relative abundance (%). Dotted lines represent zones of dissimilarity derived from cluster analysis of diatom relative abundance. Taxon codes: AULISLA = *Aulacoseira islandica*; CYCATOM = *Cyclotella atomus*; CYCATOMF = *Cyclotella atomus* “fine form”; CYCBODA = *Cyclotella bodanica*; CYCCOME = *Cyclotella comensis*; CYCRCWP = *Cyclotella comensis* var. rough center with process; CYCOCEL = *Cyclotella ocellata*; DISPSEU = *Discostella pseudostelligera*; DISSTEL = *Discostella stelligera*; FRACROT = *Fragilaria crotonensis*; STECONS = *Stephanodiscus conspicueporus*; SYNFILI = *Synedra filiformis*; TABFLOC3 = *Tabellaria flocculosa* strain 3p.

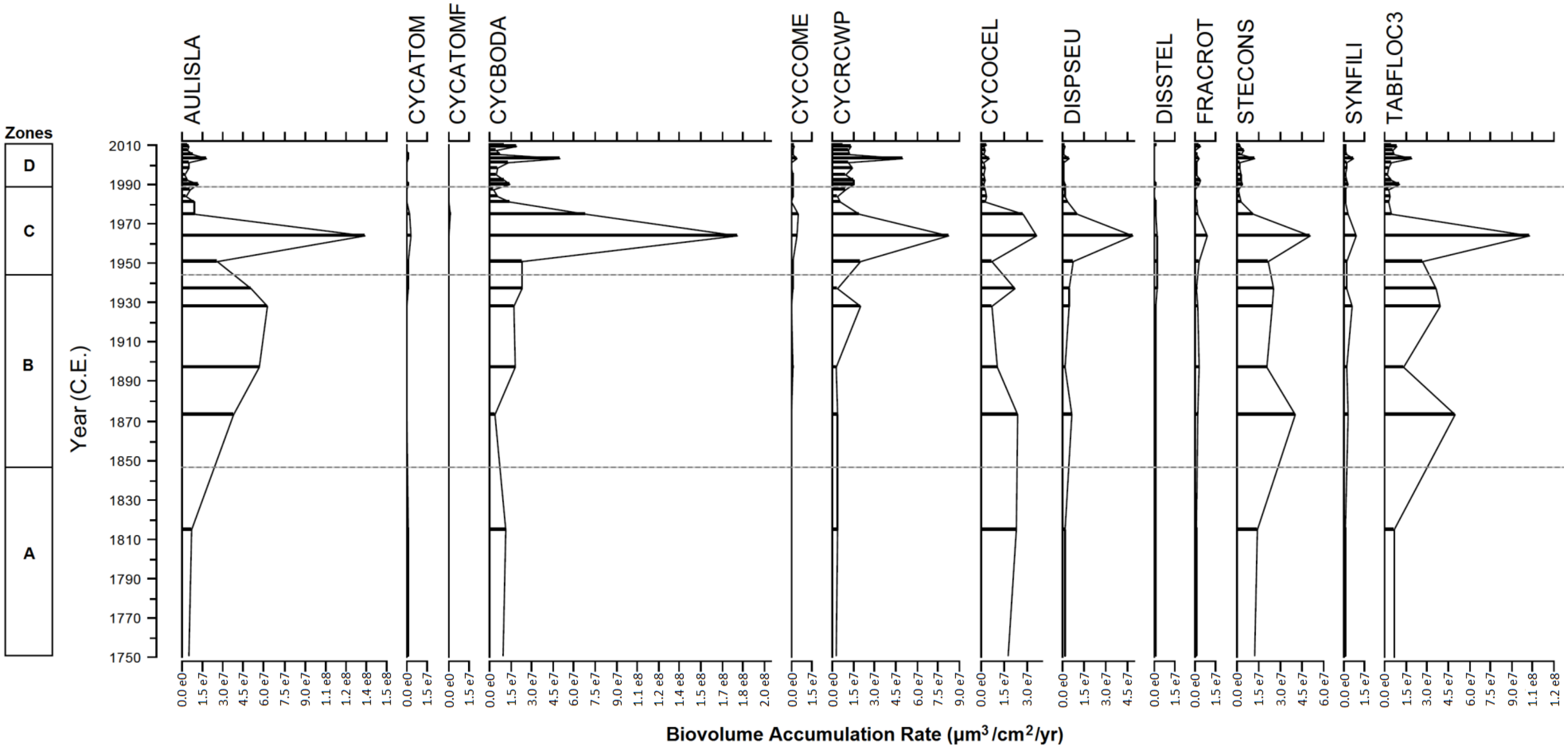


Figure 10. Dominant diatom species (>5% relative abundance in either core) for the western core of Lake Superior over the last ~250 years shown in terms of biovolume accumulation rate (μm^3/cm^2/yr). Dotted lines represent zones of dissimilarity derived from cluster analysis of diatom relative abundance.

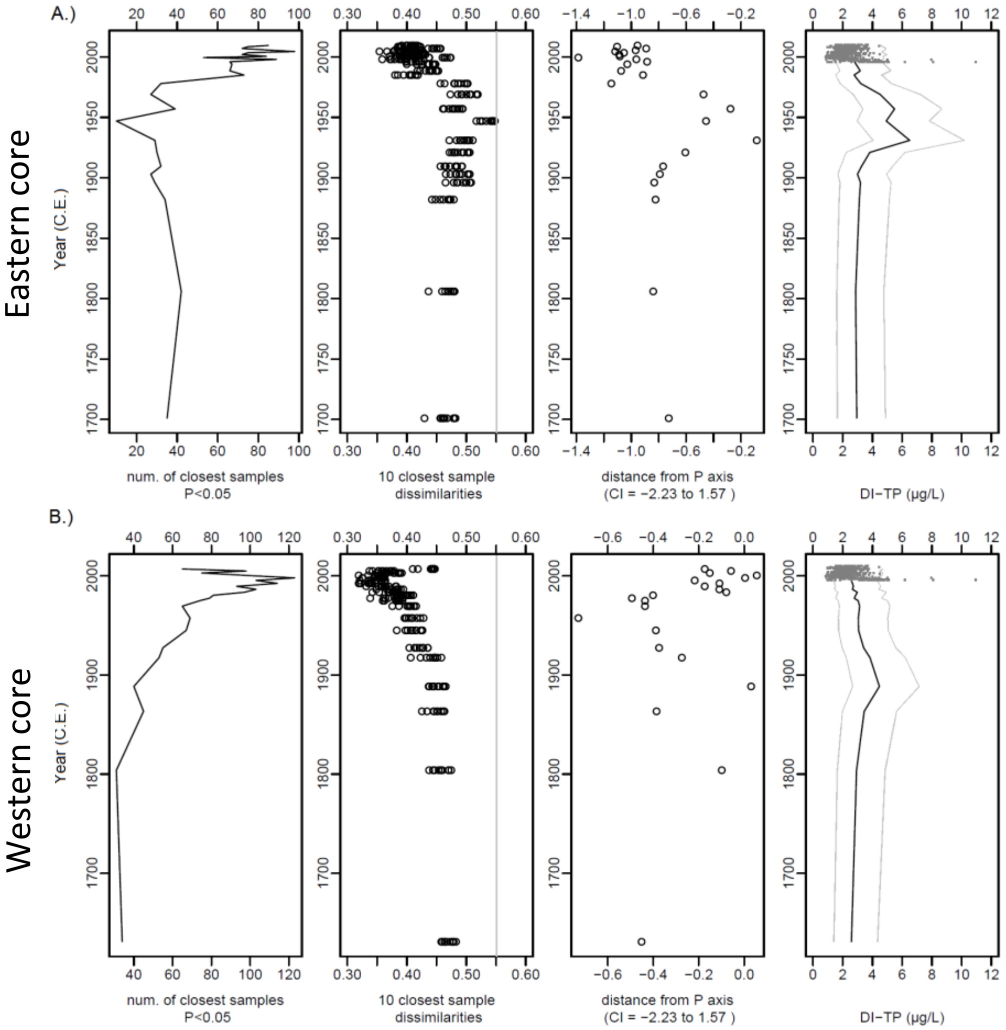


Figure 11. Diatom assemblage analog, fit-to-TP and DI-TP results for the A.) eastern core and B.) western core. From left to right stratigraphic plots indicate: the number of significantly close modern phytoplankton sample assemblages to each fossil assemblage based on analog analysis; dissimilarity values for the 10 modern assemblages closest to each fossil assemblage (grey line indicates 95th percentile based on all modern samples); distance of each fossil sample from the TP axis in a CCA constrained to TP (lower and upper extremes of the 95% confidence interval shown in axis label); DI-TP for fossil assemblages (black line indicates inferred TP and grey lines indicate the range of model error). DI-TP plots also show measured pelagic TP data (dark grey dots) collected as part of the GLNPO monitoring program since 1996.

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Appendix 1a. ^{210}Pb Dating of Lake Superior eastern core (LG#1)

Sediment Interval (cm)	Sediment accumulation (g/cm^2/yr)	Error of sediment accumulation (±s.d.)	Cumulative dry mass (g/cm^2)	Unsupported activity (pCi/g)	Error of unsupported activity (±s.d.)	Cumulative activity below interval (pCi/cm^2)	Age: base of interval (yr)	Error of age (±s.d.)	Year (C.E.)
0-0.5	0.0262	0.00212	0.0347	66.0841	1.9375	54.3757	1.33	3.43	2009.0
2-2.5	0.0250	0.00248	0.2985	51.8754	1.3523	39.4939	11.60	4.02	1998.7
4-4.5	0.0264	0.00291	0.6852	31.1767	0.9648	24.8712	26.45	4.34	1983.8
6-6.5	0.0358	0.00305	1.1307	14.7090	0.4974	16.0827	40.45	3.57	1969.8
8-8.5	0.0354	0.00336	1.6332	9.6841	0.3629	10.3720	54.53	3.82	1955.8
10-10.5	0.0427	0.00366	2.1387	5.3103	0.2254	6.9582	67.35	3.47	1942.9
10-12.5	0.0404	0.00432	2.5997	3.9487	0.1931	4.9133	78.53	4.00	1931.8
14-14.5	0.0405	0.00544	3.0623	2.7691	0.1474	3.4426	89.95	4.81	1920.3
16-16.5	0.0368	0.00682	3.5359	2.0851	0.1358	2.3392	102.36	6.35	1907.9
18-18.5	0.0505	0.01217	4.0256	1.0572	0.0917	1.6513	113.54	7.91	1896.8
20-21	0.0246	0.00943	4.6660	1.3040	0.1165	0.8697	134.13	14.34	1876.2
24-25	0.0252	0.01094	5.7187	0.3025	0.0698	0.2064	180.32	14.78	1830.0
26-27	0.0233	0.01925	6.2664	0.1609	0.0702	0.0995	203.75	28.59	1806.5

Supported ^{210}Pb: 1.232 ± 0.0423 pCi/g

Number of Supported Samples: 4

Cumulative Unsupported ^{210}Pb-210: 56.6688 pCi/cm^2

Unsupported ^{210}Pb Flux: 1.8418 pCi/cm^2/yr

Appendix 1b. ^{210}Pb Dating of Lake Superior western core (IR#2a)

Top of interval (cm)	Sediment accumulation (g/cm^2/yr)	Error of sediment accumulation (±s.d.)	Cumulative dry mass (g/cm^2)	Unsupported activity (pCi/g)	Error of unsupported activity (±s.d.)	Cumulative activity below interval (pCi/cm^2)	Age: base of interval (yr)	Error of age (±s.d.)	Year (C.E.)
0	0.0224	0.0010	0.0551	47.3906	1.2806	32.8041	2.46	1.56	2008.0
1	0.0190	0.0009	0.2258	44.4473	1.1350	25.1101	11.04	1.82	1999.4
2	0.0179	0.0010	0.4310	33.8024	0.4988	17.6759	22.32	2.17	1988.1
3	0.0225	0.0010	0.6837	18.5377	0.2982	12.2117	34.19	1.87	1976.2
4	0.0271	0.0010	0.9679	10.8506	0.3304	8.6595	45.23	1.30	1965.2
5	0.0230	0.0007	1.2588	8.8807	0.1706	5.9403	57.33	1.32	1953.1
5.5	0.0225	0.0009	1.4040	7.4599	0.2491	4.8571	63.80	1.41	1946.6
6	0.0187	0.0009	1.5505	7.1850	0.2704	3.8045	71.64	1.55	1938.8
6.5	0.0168	0.0009	1.6951	6.1929	0.2335	2.9093	80.26	1.78	1930.2
7	0.0144	0.0009	1.8411	5.3844	0.2034	2.1234	90.37	2.18	1920.1
7.5	0.0132	0.0010	1.9851	4.2619	0.1843	1.5099	101.32	2.83	1909.1
8	0.0143	0.0015	2.1270	2.8290	0.1497	1.1085	111.24	3.68	1899.2
8.5	0.0162	0.0022	2.2718	1.8635	0.1208	0.8387	120.20	4.72	1890.2
9.5	0.0217	0.0041	2.5614	0.8440	0.0892	0.5282	135.05	5.87	1875.4
11.5	0.0142	0.0036	3.1343	0.4713	0.0513	0.1822	169.23	8.82	1841.2
13	0.0122	0.0051	3.5637	0.1907	0.0484	0.0621	203.79	13.70	1806.6

Supported ^{210}Pb-210: 1.1233 ± 0.0205 pCi/g
Number of Supported Samples: 5

Cumulative Unsupported ^{210}Pb: 35.4153 pCi/cm^2
Unsupported ^{210}Pb Flux: 1.1383 pCi/cm^2 yr

Appendix 2. Taxon codes for Lake Superior diatoms

Taxon Code	Species Name
ACHFLEX	*Achnanthes (Eucocconeis) flexella*
PLALANC	*Achnanthes (Planothidium) lanceolatum*
ACHAMOE	*Achnanthes amoena*
ACHBIOS	*Achnanthes biosolettiana*
ACHCLEV	*Achnanthes cleveii*
ACHCLEVB	*Achnanthes cleveii var. bottnica*
ACHCONSP	*Achnanthes conspicua*
ACHFREQ	*Achnanthes frequentissima*
ACHHOLS	*Achnanthes (holsatica) levanderi*
ACHLAEV	*Achnanthes (laevis) lapponica v. ninckei*
ACHMINU	*Achnanthes minutissima*
ACHMINS	*Achnanthes minutissima var. scotica*
ACHNITI	*Achnanthes (nitidiformis) amoena*
ACHPLOE	*Achnanthes ploenensis*
ACHSUCH	*Achnanthes suchlandii*
ACHTHER	*Achnanthes thermalis*
ACHSPP	*Achnanthes species*
APLPELL	*Amphipleura pellucida*
AMPINAE	*Amphora inaerensis*
AMPNEGL	*Amphora neglecta*
AMPPEDI	*Amphora pediculus*
ASTFORM	*Asterionella formosa*
AULAMBI	*Aulacoseira alpigena*
AULGRAN	*Aulacoseira granulata*
AULISLA	*Aulacoseira islandica*
AULSUBA	*Aulacoseira subarctica*
BRACHY	*(Brachysira) Anomoneis spp.*
COCNEOD	*Cocconeis (neo)diminuata*
COCPLAC	*Cocconeis placentula*
CYCATOM	*Cyclotella atomus*
CYCATOMF	*Cyclotella atomus "fine form"*
CYCCOMTRI	*Cyclotella comenis var tripartita*
CYCCOME	*Cyclotella comensis*
CYCRCWP	*Cyclotella comensis rcwp*
CYCCOME1	*Cyclotella comensis var. 1*
CYCBODA	*Cyclotella comta*

Taxon Code	**Species Name**
CYCBODAQ	*Cyclotella comta v. affinis*
CYCCMENE	*Cyclotella meneghaniana*
CYCOCEL	*Cyclotella ocellata*
CYCOPER	*Cyclotella operculata/distinguenda*
CYMAMPH	*Cymbella amphicephela*
CYMANGEL	*Cymbella caulumetica*
CYMCIST	*Cymbella cistula*
CYMDELI	*Cymbella delicatula*
CYMHYBL	*Cymbella hybrida var. lanceolata*
CYMMICRO	*Cymbella microcephela*
CYMMINU	*Cymbella minuta*
CYMPERP	*Cymbella perpusilla*
CYMSILE	*Cymbella minuta var silesiaca*
CYMSINU	*Cymbella sinuata*
CYMSPP	*Cymbella species*
DIAMONO	*Diatoma (monoliformis) anceps*
DIATENU	*Diatoma tenue*
DIATENUE	*Diatoma tenue var. elongatum*
DIPELLI	*Diploneis elliptica*
DISPSEU	*Discotella pseudostelligera*
DISSTEL	*Discotella stelligera*
ENCTRIA	*Encyonema cf. triangulum*
ENTORNA	*Entomoneis ornata*
EPISPP	*Epithemia ssp.*
EUNOTIA	*Eunotia*
FRACROT	*Fragilaria crotonensis*
FRAGLATA	*Fragilaria lata*
FRAGPINN	*Fragilaria pinnata*
FRAVAUC	*(Fragilaria vaucherie) Synedra amphicephala var austriaca*
GOMSPP	*Gomphonema species*
MARMART	*Martyana Martyii*
NAVATOM	*Navicula atomus*
NAVCLEM	*Navicula cf clementis*
NAVPORI	*Navicula cf porifera*
NAVTUSC	*Navicula cf tuscula*
NAVCOCC	*Navicula cocconeiformis*

Appendix 2. Taxon codes for Lake Superior diatoms

Taxon Code	**Species Name**
NAVCRYPC	*Navicula Cryptocephela*
NAVCRYPT	*Navicula cryptotenella*
NAVHALO	*Navicula halophila*
NAVHARV	*Navicula harveyi*
NAVHOLS	*Navicula holsatica*
NAVIGNOA	*Navicula ignota var. acceptata*
NAVLATE	*Navicula latens*
NAVMINI	*Navicula minima*
NAVJAEF	*Navicula pseudoscutiformis*
NAVPUPU	*Navicula pupula*
NAVRADI	*Navicula radiosa*
NAVSPP	*Navicula species*
NITAGNI	*Nitzschia (agnita) kuetzingioides*
NITAMPH	*Nitzschia amphibia*
NITFLEX	*Nitzschia flexoides/gracilis*
NITFONT	*Nitzschia fonticola*
NITLARG	*Nitzschia large-size unknown*
NITLAUE	*Nitzschia lauenbergiana*
NITLINE	*Nitzschia linearis var. dibilis*
NITPALE	*Nitzschia palea*
NITSIGM	*Nitzschia sigma*
NITTERR	*Nitzschia terrestris*
NITTHER	*Nitzschia thermaloides*
NITSPP	*Nitzschia species*
PINSPP	*Pinnularia spp. Small*
RAPHID	*Raphid indeterminable*
RHIERIE	*Rhizosolenia eriensis*
RHIGRAC	*Rhizosolenia gracilis*
STEALPI	*Stephanodiscus alpinus*
STEBIND	*Stephanodiscus binderanus*
STESP51	*Stephanodiscus cf. sp #51*
STECONS	*Stephanodiscus conspicueporous*
STEHANT	*Stephanodiscus hantzschii*
STEMINU	*Stephanodiscus minutulus*
STENIAG	*Stephanodiscus niagarae*
STESP10	*Stephanodiscus sp #10*

Taxon Code	**Species Name**
STESUPE	*Stephanodiscus subtransylvanicus*
STEPARV	*Stephanodisucus parvus*
SURMINU	*Surirella (minuta) ovata v. pinnata*
SYNCYCL	*Synedra cyclopum*
SYNDELI	*Synedra delicatissima*
SYNFILI	*Synedra filiformis*
SYNFILIE	*Synedra filiformis var. exilis*
SYNNANA	*Synedra nanana*
SYNOSTE	*Synedra ostenfeldii*
SYNRADI	*Synedra radians*
SYNULNA	*Synedra ulna*
SYNULNAB	*Synedra ulna var. biceps*
TABFLOC	*Tabellaria flocculosa (Type A)*
TABFLOC3P	*Tabellaria flocculosa strain IIIp (Type B)*
TABQUAD	*Tabellaria (quadriseptata) spp.*
CYMUNID	*Unidentified cymbelloid*

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
ACHFLEX					1.00		1.00		
PLALANC				2.00	1.00		0.00		
ACHAMOE							0.00		
ACHBIOS							0.00		
ACHCLEV	3.25	1.50		2.50		1.75	0.00		
ACHCLEVB							0.00		
ACHCONSP							0.00		
ACHHOLS		1.00	2.00				0.00		
ACHLAEV				1.00			1.00		
ACHMINU	6.00	1.50	5.00	5.00	6.50	3.50	5.00	2.00	4.00
ACHMINS	1.67	7.25	3.00	1.25	2.00	2.00	10.00	1.00	1.33
ACHNITI							0.00	2.00	
ACHPLOE									
ACHSUCH		0.50		0.50		2.00	1.75	3.00	
ACHTHER							0.00		
ACHSPP		0.50		1.75		1.00	2.88		0.33
APLPELL							0.00		
AMPINAE	2.00		1.00		4.00	2.00	0.00	0.50	2.00
AMPNEGL				2.00			2.50		2.00
AMPPEDI	0.58						1.83	0.75	
ASTFORM	10.38	7.00	9.67	6.54	10.67	6.79	4.63	2.46	4.83

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
AULAMBI	2.00	1.00		1.00		2.13	3.88		1.00
AULGRAN							1.50		
AULISLA	32.96	28.50	33.25	42.38	25.33	28.25	43.42	29.04	24.17
AULSUBA							0.00	4.50	
BRACHY			2.00						
COCNEOD	0.25	0.25	1.25		1.00		0.50		
COCPLAC	0.25	0.75	0.13	0.13	1.33		0.25	0.13	
CYCATOM	20.00	20.00	26.00	20.00	9.25	18.00	18.00	15.50	10.00
CYCATOMF	10.50	10.50	7.50	14.50	2.00	14.25	13.50	10.50	9.00
CYCCOMTRI							0.00		
CYCCOME	42.00	53.46	22.75	38.38	42.83	32.00	53.71	25.50	52.33
CYCRCWP	147.63	100.88	89.92	140.46	90.88	115.38	78.21	124.42	69.58
CYCCOME1	8.00	8.00	1.00	4.00	2.00	5.00	6.00	17.00	
CYCBODA	17.00	10.96	17.75	9.88	16.38	15.67	24.50	12.33	9.83
CYCBODAQ		2.00	2.00		1.00		1.00		5.00
CYCCMENE	1.00					4.00		2.00	
CYCOCEL	37.25	74.92	80.04	76.21	96.25	60.38	86.17	78.29	88.08
CYCOPER	2.00	5.46	0.30	3.38		1.58	4.50		6.50
CYMAMPH									
CYMCIST									
CYMDELI	1.75	1.00	2.46	2.75	0.75	0.25	0.33	0.75	2.00

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
CYMMICRO		1.00	1.00						
CYMMINU									
CYMPERP									
CYMSILE	1.33								
CYMSINU									
CYMSPP									
DIAMONO									
DIATENU		0.25							
DIATENUE							0.67		
DIPELLI									
DISPSEU	56.50	43.50	67.50	62.25	64.58	65.75	74.08	87.00	78.50
DISSTEL	5.00	10.00	4.00	4.00	2.00	13.00	2.75	4.00	6.25
ENCTRIA	0.50	0.75							0.25
ENTORNA									
EPISPP									1.00
EUNOTIA									
FRACROT	14.38	11.42	35.46	9.25	21.33	15.83	3.75	8.25	15.29
FRAGLATA									
FRAGPINN	1.00			1.00	1.00				
FRAVAUC							1.00		
GOMSPP			0.50	1.00		2.50			1.00

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
MARMART	2.00	1.00		0.75					
NAVATOM									
NAVCLEM									
NAVPORI					1.00				
NAVTUSC									
NAVCOCC									
NAVCRYPC									
NAVCRYPT	0.63	1.00		3.25				1.00	
NAVHALO	1.00					1.00			
NAVHARV									
NAVIGNOA									
NAVLATE					1.00		0.50		
NAVMINI	2.00		2.00	4.00		2.00	3.00		1.00
NAVJAEF	0.33				1.00				
NAVPUPU									
NAVRADI							1.00		
NAVSPP	3.75	1.79	3.13	0.38		0.88	2.96	2.71	
NITAGNI						5.00		1.00	
NITAMPH									
NITFLEX					1.00				
NITFONT									

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
NITLAUE	2.00						0.50		0.38
NITLINE		0.50	0.50			0.50	1.00	0.33	
NITPALE	2.96	4.25	2.00	2.58	1.00	1.54	3.83	4.00	0.58
NITSIGM									
NITTERR									
NITTHER									
NITSPP			2.00						
PINSPP									
RAPHID									
RHIERIE	10.50	13.00	2.00	9.00	5.00	8.75	10.25	8.00	1.00
RHIGRAC	6.75	4.00	11.00	12.50	4.00	4.75	4.00	10.00	6.00
STEALPI		0.75		2.50		0.38	0.38	1.50	
STEBIND								2.00	
STESP51	1.00	1.00		1.00					
STECONS	8.54	13.63	12.00	9.42		7.79	14.17	4.50	12.71
STEHANT	1.00	1.00	2.00	2.50	2.75	5.00	1.00		1.00
STEMINU	2.00	2.00							
STENIAG	1.38	0.02	0.38	0.63			0.38	0.88	
STESP10			3.00	5.00	2.00	2.50	2.00	2.00	1.00
STESUPE	4.42	1.13	5.13	0.50	5.88	3.63	0.75	3.13	2.75
STEPARV	5.00	5.00		5.00	1.00	7.00	1.00	6.00	1.50

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**
SURMINU			0.50		0.50				
SYNCYCL		0.25				0.50			
SYNDELI						0.67			
SYNFILI	15.38	14.83	4.71	10.21	21.29	13.54	18.04	25.08	12.04
SYNFILIE	10.29	5.58	8.50	8.58	16.00	9.25	17.08	5.00	1.00
SYNNANA	2.00	1.00							
SYNOSTE	5.63	4.38		3.54	1.33	4.54	8.33	5.88	0.50
SYNRADI	1.00	3.92	8.25	1.96	10.67	0.13	3.00	2.54	0.83
SYNULNA		1.25	0.88	0.75	0.71	1.38	1.13	1.08	1.13
SYNULNAB	1.13					0.75			
TABFLOC	3.08		2.00	2.04	2.25	1.92	0.58	3.38	0.50
TABFLOC3P	5.88	10.50	3.71	5.96	9.21	4.21	15.25	4.88	13.21
TABQUAD									
CYMUNID									
Interval Total	524.79	495.60	489.13	546.13	490.67	500.58	558.42	525.79	451.42
Pollen		2							
Chrysophyte cyst	2	5	4	3	5	8	5	1	1
Chrysophyte scale				1					

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
ACHFLEX			0.50					1.25	
PLALANC	0.75			1.00	1.25				
ACHAMOE									
ACHBIOS				0.50					
ACHCLEV	1.75	2.00	1.25		1.46		1.00	1.00	2.75
ACHCLEVB									
ACHCONSP									
ACHHOLS									2.00
ACHLAEV		1.75							
ACHMINU	1.75	3.00	4.25	8.00	5.00	9.00	3.00	1.00	3.50
ACHMINS	8.00	4.50	2.00	3.50	2.00		4.00	3.00	2.50
ACHNITI									
ACHPLOE									
ACHSUCH	1.58	1.00		1.25		1.00	2.00	4.00	4.00
ACHTHER									
ACHSPP			1.50	1.25			0.25		2.25
APLPELL				0.58					
AMPINAE		1.00			1.33		1.67		1.50
AMPNEGL			2.00	2.00				2.00	2.00
AMPPEDI	1.50	2.25			1.00			0.50	
ASTFORM	5.46	7.71	4.46	7.21	12.67	5.75	6.79	9.88	14.96

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
AULAMBI		4.00			0.25	1.67	1.00	5.00	3.00
AULGRAN									
AULISLA	34.67	32.08	29.88	47.33	24.21	29.38	130.04	213.42	148.54
AULSUBA							2.33		6.00
BRACHY		1.00							
COCNEOD	1.00		1.33	0.25	0.25	0.13	1.00		
COCPLAC	1.13	1.13					0.25		1.25
CYCATOM	21.50	16.75	19.00	10.00	20.00	4.50	1.00	7.00	4.00
CYCATOMF	21.00	22.50	16.00	8.25	12.50	6.50	5.00	11.50	8.50
CYCCOMTRI			2.00			1.00			
CYCCOME	45.75	24.50	21.33	37.25	18.33	20.83	9.75	8.50	4.33
CYCRCWP	108.71	129.75	106.04	68.13	98.25	7.58	9.13	25.58	2.00
CYCCOME1	3.00	1.00	2.00	1.00	3.00		0.25		
CYCBODA	11.83	20.13	12.21	31.96	11.13	10.63	14.50	19.42	17.67
CYCBODAQ						1.00			1.00
CYCCMENE			1.00		0.33		1.00		
CYCOCEL	67.08	64.58	94.92	101.79	92.50	123.67	73.04	73.17	108.63
CYCOPER	2.00		3.00	1.00	6.50				
CYMAMPH	1.50								
CYMCIST	2.25								
CYMDELI	2.21	2.08	2.25	1.25	1.50	2.00	2.33		0.25

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
CYMMICRO	1.00		1.00					3.00	
CYMMINU									
CYMPERP				1.00					
CYMSILE									
CYMSINU									
CYMSPP				2.00				1.00	
DIAMONO				0.58					
DIATENU					0.25				
DIATENUE									
DIPELLI									
DISPSEU	57.75	74.75	68.00	76.00	92.75	150.00	75.08	70.50	77.50
DISSTEL	2.50	0.75	4.00	1.00	3.50	11.00	11.00	9.25	11.50
ENCTRIA	0.38					0.33		1.00	
ENTORNA	0.13			0.25					
EPISPP									1.33
EUNOTIA				2.00				1.00	
FRACROT	8.29	10.25	10.42	30.04	7.75	22.33	55.96	9.04	10.79
FRAGLATA									
FRAGPINN				2.50		1.00	4.00	2.00	1.00
FRAVAUC		2.00		2.00	0.33		2.00	0.50	0.50
GOMSPP				1.75	1.00		1.00		

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
MARMART	2.00	1.25	3.00		1.00				
NAVATOM				2.00					
NAVCLEM									
NAVPORI									
NAVTUSC						1.00			
NAVCOCC									
NAVCRYPC									
NAVCRYPT	0.58	3.50	1.00		0.25	2.33			1.00
NAVHALO			1.00					1.00	
NAVHARV									
NAVIGNOA									
NAVLATE									
NAVMINI	1.00	1.00	1.00	2.00	0.50	1.00		0.50	
NAVJAEF	1.00					2.00			
NAVPUPU	2.00	1.00							
NAVRADI									
NAVSPP	0.58	0.33	2.33	3.75	1.21		2.00	0.25	
NITAGNI	4.50	1.50			6.00			1.00	
NITAMPH								1.00	
NITFLEX									
NITFONT			1.50						

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
NITLAUE				0.25				0.13	
NITLINE			0.38						
NITPALE	2.00	3.92	1.00		1.42			1.71	
NITSIGM									
NITTERR									
NITTHER									
NITSPP				0.75					
PINSPP									
RAPHID									
RHIERIE	13.75	13.25	2.00	3.50	8.00	1.00	4.00	4.25	4.00
RHIGRAC	6.00	4.00	5.00	6.00	5.75	2.00	5.00	3.00	5.00
STEALPI		1.63	3.42		1.00				1.00
STEBIND		3.00	1.00		1.00				
STESP51		1.00	1.00						
STECONS	3.38	5.63	7.63	9.42	14.63	16.04	32.83	33.79	33.96
STEHANT	1.00		1.00	0.50	1.00			1.00	0.50
STEMINU		4.00			2.00				
STENIAG	0.38	0.63		1.75				0.63	0.25
STESP10	2.00	1.00	2.00	1.00	1.00			3.00	4.50
STESUPE	1.00	6.00	7.38	3.83	3.46	6.50	4.58	13.54	8.71
STEPARV	4.50	3.00	16.25	1.00	2.00	3.25		9.00	2.00

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**2.25-2.5**	**2.5-2.75**	**2.75-3**	**3.5-3.75**	**4-4.25**	**5-5.25**	**6.25-6.5**	**8-8.25**	**9.5-9.75**
SURMINU						1.00	0.25	1.75	1.00
SYNCYCL		1.00							
SYNDELI	0.50			2.17					
SYNFILI	9.79	11.63	6.25	10.63	17.92	2.79	15.33	5.21	4.42
SYNFILIE	22.42	13.83	4.83	5.83	10.29	2.00	4.00	6.25	0.67
SYNNANA					9.00				
SYNOSTE	2.67	3.50	1.58	1.33	7.04	4.00		3.79	1.00
SYNRADI	13.58	4.00	2.13	8.63	2.38	2.54	11.42	4.79	3.58
SYNULNA	0.50	1.13	1.00		0.50	0.75	0.13	0.75	
SYNULNAB	0.38	0.25						0.13	
TABFLOC	2.50	0.75	2.25	1.00	0.50	5.38	3.83	6.13	4.42
TABFLOC3P	6.04	7.83	5.63	11.29	6.79	9.75	41.08	35.71	12.33
TABQUAD								1.00	
CYMUNID				1.00					
Interval Total	518.50	530.00	491.88	530.25	523.67	472.63	542.83	622.79	531.58
Pollen					2			2	
Chrysophyte cyst		3	5	9	8	2	3	4	2
Chrysophyte scale						1			1

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
ACHFLEX		1.00						
PLALANC	1.00	2.25	0.33			1.00		2.25
ACHAMOE	1.00				1.00			
ACHBIOS								
ACHCLEV		1.96	5.83	1.50	1.00	3.83	2.63	8.33
ACHCLEVB	1.96							
ACHCONSP				1.00				
ACHHOLS	1.00							
ACHLAEV		1.00		1.00	1.00			
ACHMINU	1.00	4.50		2.00		1.75	2.00	9.83
ACHMINS	4.00	2.00	3.08	2.00	2.75	4.75	2.00	0.67
ACHNITI								
ACHPLOE								2.00
ACHSUCH	3.00	2.00	0.75	4.00	2.00	4.50	3.50	3.00
ACHTHER								
ACHSPP	0.58	2.50			1.00	1.00	2.08	0.50
APLPELL								
AMPINAE				3.25	3.00		2.50	1.08
AMPNEGL					2.00			
AMPPEDI		2.00	2.00		2.00	3.00		3.50
ASTFORM	9.38	7.38	7.96	6.54	6.42	5.25	5.83	10.21

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
AULAMBI	8.00	15.00	14.50	8.50	5.50	5.50	3.50	6.00
AULGRAN							0.75	
AULISLA	237.29	83.33	31.79	22.21	24.25	18.04	40.83	23.38
AULSUBA								
BRACHY			1.00			1.00		0.50
COCNEOD		2.00	2.75		0.13		1.00	
COCPLAC	1.00	1.50		1.50	1.50	0.50	1.25	2.38
CYCATOM	1.00	3.00	24.00	17.50	25.00	24.25	7.00	14.83
CYCATOMF	6.50	19.50	17.50	50.33	26.50	22.83	31.50	56.50
CYCCOMTRI								
CYCCOME	2.00	5.00	9.88	3.00	7.50	10.00	10.50	10.58
CYCRCWP	8.75	18.71	3.25	32.96	8.25	3.75	67.33	48.42
CYCCOME1		2.00	3.75	1.00	4.00	2.00		1.00
CYCBODA	18.25	2.63	2.13	5.58	1.71	9.08	8.63	6.17
CYCBODAQ								
CYCCMENE			1.25		0.50	0.25	0.50	3.83
CYCOCEL	81.17	104.29	107.54	98.54	103.96	117.58	122.67	87.13
CYCOPER								1.00
CYMAMPH								
CYMCIST								
CYMDELI	0.33	2.13	0.25	1.00			0.63	1.75

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
CYMMICRO			0.25			1.00	1.00	
CYMMINU								
CYMPERP								
CYMSILE								
CYMSINU								
CYMSPP	1.00				0.75			
DIAMONO	1.00	1.00				0.75		
DIATENU								
DIATENUE								0.13
DIPELLI				2.00			1.00	
DISPSEU	30.00	54.00	103.75	69.13	139.00	109.00	60.92	91.50
DISSTEL	5.25	26.00	5.50	25.00	5.00	1.33	7.25	6.00
ENCTRIA	0.25	1.88			0.46		0.63	0.25
ENTORNA			0.13		0.25			
EPISPP								
EUNOTIA			1.50					
FRACROT	19.71	13.88	0.75	35.63	2.13	2.71	5.17	8.21
FRAGLATA								
FRAGPINN	4.00	1.00	0.50	4.00	1.00		8.00	6.25
FRAVAUC			3.75	0.33	1.00	6.50		
GOMSPP			0.50		0.50	4.00	2.00	

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
MARMART			4.00		3.75	5.50	1.00	4.33
NAVATOM								
NAVCLEM								
NAVPORI				0.25				
NAVTUSC	1.00							
NAVCOCC								1.50
NAVCRYPC								
NAVCRYPT		1.33	0.25	0.00	1.75	1.83	0.75	0.50
NAVHALO							2.00	
NAVHARV								
NAVIGNOA								
NAVLATE								
NAVMINI	1.00	4.00	3.00	8.00	4.25	1.00	6.50	3.00
NAVJAEF		0.83		1.50				1.00
NAVPUPU					0.50		1.00	
NAVRADI								
NAVSPP	0.75		0.50	4.25		0.25	1.50	2.83
NITAGNI			2.00			1.00		
NITAMPH								
NITFLEX								
NITFONT			0.75					1.00

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
NITLAUE			0.13		0.13	1.00	0.71	
NITLINE	1.00			1.00				
NITPALE			1.50	1.38	3.67	1.75	3.50	1.63
NITSIGM								
NITTERR								
NITTHER								
NITSPP	0.83			0.67				
PINSPP								
RAPHID								
RHIERIE	7.50	9.00	12.25	7.00	8.75	8.50	7.83	7.08
RHIGRAC	10.00	7.00	15.00	9.33	4.00	18.00	8.33	10.25
STEALPI		3.83	5.17		3.50	1.33		0.50
STEBIND						1.00		
STESP51			2.00		1.00	2.00		1.00
STECONS	35.00	33.13	19.92	30.92	24.88	26.00	41.00	33.38
STEHANT	1.00		3.00	1.00	1.00	2.00		2.00
STEMINU			1.00		1.00	4.00		
STENIAG	0.25			0.38	0.13	0.50	1.38	0.25
STESP10		3.00	10.50	10.00	7.00	11.50	1.00	6.00
STESUPE	2.88	3.83	3.38	5.63	3.33	4.96	4.50	2.58
STEPARV	2.00	3.00	14.00	6.00	7.75	13.00	2.00	10.00

Appendix 3a.

Diatom count data for Lake Superior eastern core (LG#1)

Interval/ Taxon Code	**12.25-12.5**	**14-14.25**	**15.5-15.75**	**17-17.25**	**18-18.25**	**19.5-19.75**	**26.5-26.75**	**35-36**
SURMINU			0.13				0.13	
SYNCYCL								
SYNDELI			0.13		1.08	0.13		
SYNFILI	6.00	4.63	15.46	2.17	7.13	7.79	8.21	9.08
SYNFILIE	4.00	6.96	11.04	2.42	6.92	6.13	6.25	
SYNNANA			2.58		0.75	0.25		
SYNOSTE	2.13	1.00	3.75	2.67	2.75	3.25	3.00	2.71
SYNRADI	8.50	8.17	1.25	6.42	2.25	3.33	2.13	4.79
SYNULNA	0.75	1.38		1.00			1.38	0.88
SYNULNAB			0.63			0.13	0.88	
TABFLOC	2.83	3.92	8.13	0.50	10.33	9.79	3.71	6.83
TABFLOC3P	12.13	17.46	18.71	12.71	12.83	12.17	21.54	17.63
TABQUAD								
CYMUNID		1.00						
Interval Total	547.96	496.88	516.29	515.67	501.46	513.25	532.79	547.92
Pollen		1				1		2
Chrysophyte cyst		6		1		6	2	13
Chrysophyte scale						1		

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**	**2.25-2.5**	**2.5-2.75**	**2.75-3**
ACHAMOE			0.75									
ACHBINO											2.00	
ACHCLEV	0.25	0.75		1.00					2.75	1.00		1.00
ACHFLEX										0.25		
ACHLAEV												
ACHLARG	0.33											
ACHMEDI										0.50		
ACHMINS		1.50	2.00	4.25	1.00	1.25	1.00	1.50	1.25	2.83	2.00	1.50
ACHMINU	1.00	1.83	1.00	1.25	4.75	1.00		2.50	1.00	1.50	3.00	1.00
ACHSUCH		1.00				0.75			1.00			
AMPINAE					2.00							
AMPNEGL												2.00
AMPPEDI												
ASTFORM	3.17	6.17	12.38	7.42	4.00	6.79	8.83	11.50	5.63	6.63	5.58	4.00
AULAMBI	0.13	2.00	2.00		4.00	0.33	1.00	1.00	2.00	3.75		2.33
AULGRAN		1.00										
AULISLA	24.54	20.13	18.33	24.50	19.75	23.75	20.88	15.50	22.79	37.29	20.50	14.00
AULSUBA											3.00	
BRACHY		0.50	0.33	1.83		0.25				0.25		
COCNEOD									1.00			
COCPLAC		0.13					0.38			0.33		

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**	**2.25-2.5**	**2.5-2.75**	**2.75-3**
CYCATOM	9.00	19.00	29.00	33.00	20.50	21.00	27.00	21.50	18.00	32.75	17.75	17.00
CYCATOMF	7.00	19.50	19.00	29.50	19.00	14.00	21.00	12.50	26.00	13.50	6.00	6.00
CYCBODA	15.17	14.63	10.46	13.33	12.33	19.71	7.38	6.71	9.83	13.17	6.13	14.33
CYCBODAQ	4.71				1.00			0.13		0.25		
CYCCMENE		1.00	4.04				0.50				2.00	
CYCCOME	52.17	54.33	27.75	21.50	44.33	18.33	21.75	38.00	26.00	36.75	28.75	37.67
CYCCOME1	6.00	5.00	5.00	5.00	13.00	5.00	9.00	5.50	5.00	2.00	8.00	5.00
CYCCOMRCA	58.17	75.25	68.29	74.50	86.58	61.54	90.75	81.00	95.83	72.58	70.00	39.00
CYCCOMRCB	36.75	31.88	43.71	46.88	41.88	57.83	35.79	27.08	37.33	45.33	28.83	19.92
CYCDIST			2.00		1.00			0.50				
CYCMICH												
CYCOCEL	86.71	52.92	62.13	59.38	50.46	67.25	69.38	76.75	59.88	54.25	67.83	97.75
CYCOCEL3	6.50											
CYCOPER	6.13	1.00	0.13	1.00	3.83	0.50		3.50	2.33	2.00	2.13	1.08
CYMCIST								2.00				
CYMDELI	1.00	0.75		0.33			0.33			0.58	0.25	2.00
CYMMICRO											1.00	
CYMSILE												
CYMSINU						0.25				2.00		
DIAMONO								1.00				
DIATENU				2.13								

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**	**2.25-2.5**	**2.5-2.75**	**2.75-3**
DIATENUE				0.50								
DISPSEU	60.00	83.50	77.25	65.50	71.50	91.25	75.75	78.75	82.25	73.50	111.50	112.75
DISSTEL	10.25	5.00	2.00	2.58	3.00	2.50	2.00	1.25	5.75	13.25	6.00	9.00
ENCTRIA	1.00			0.13								
ENTORNA								0.13			0.13	
EUNOTIA												
FRACROT	19.67	13.00	1.50	4.92	5.38	3.17	3.63	6.13	10.08	11.04	1.71	1.71
FRAGLATA												
FRAGPINN		0.25		0.75			0.50		2.25	0.50		2.00
FRAVAUC			1.00				1.00	1.50			0.75	0.50
GOMSPP	1.00					0.33						
MARMART								1.00			2.50	1.50
NAVCRYPC												
NAVCRYPT	1.00		0.50	1.00			0.25	0.63	0.50	0.50		
NAVIGNOA								0.75				
NAVJAEF												
NAVLARG	0.50			1.00	0.25		0.38	0.25	0.25		0.25	
NAVMEDI	2.08		0.50									1.00
NAVMINI	2.33				1.00	1.00				2.00	0.50	
NAVPUPU									1.00			
NAVRADI				1.00		1.13						

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**	**2.25-2.5**	**2.5-2.75**	**2.75-3**
NITAGNI		0.50							1.75	0.50	1.00	1.00
NITAMPH								1.00				
NITFLEX			0.25					0.13				
NITFONT	1.00						0.50		1.00	2.75		
NITLARG	1.25											
NITLAUE	0.58											0.38
NITLINE		0.13	1.00									
NITPALE		1.75	4.75	1.25	0.83	1.75	0.13	1.13	2.88	2.67	1.25	1.13
NITTHER												
PLALANC												
RHIERIE	9.00	11.50	6.00	11.00	9.25	11.00	8.25	6.25	13.75	5.00	12.25	10.50
RHIGRAC	4.00	8.25	2.00	5.00	5.00	10.00	8.00	5.67	8.00	5.00	1.75	7.00
STEALPI		1.00	2.96	5.00		2.71	2.00	0.58	0.25	0.63	0.83	1.00
STEBIND	1.00		4.00	3.00	4.00		1.00	4.00	3.50		1.00	3.75
STECONS	9.92	5.79	12.13	5.79	6.50	5.88	2.88	4.54	6.71	4.92	2.79	5.08
STEHANT	1.00	1.00	3.00	2.00	1.00	1.00	0.50	4.00		2.00	2.00	2.00
STEMINU	5.00		2.00	2.00	1.00		1.00	5.00		1.00	2.00	
STENIAG	1.25	0.13	0.13	0.88	0.13	0.38	0.13	2.25	0.25	0.13	0.13	0.13
STEPARV	1.00	7.00	12.00	8.00	7.00	6.00	10.00	7.50	5.50	10.50	9.50	7.50
STESP10	1.00		3.00		2.00	1.00	3.00	2.00	1.00		5.00	1.00
STESP51		1.00	1.00		1.00		1.00		4.00			1.75

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**0-0.25**	**0.25-0.5**	**0.5-0.75**	**0.75-1**	**1-1.25**	**1.25-1.5**	**1.5-1.75**	**1.75-2**	**2-2.25**	**2.25-2.5**	**2.5-2.75**	**2.75-3**
STESUPE	5.00	5.42	2.96	2.92	2.13	5.88	4.25	2.46	1.75	5.04	0.75	4.67
SURMINU								0.50				0.13
SYNCYCL				0.50		1.33						
SYNDELI	0.38	0.75	0.50	0.75	0.58		0.63	2.13	0.63	0.25	0.13	0.88
SYNFILI	1.50	11.50	8.83	22.96	21.83	21.00	20.67	20.75	17.08	23.33	13.92	13.83
SYNFILIE	8.96	21.04	25.75	28.13	24.63	31.08	28.25	44.29	10.58	13.83	21.67	30.75
SYNNANA		2.75		0.75		0.75	0.67	3.83				0.50
SYNOSTE	4.75		5.88	10.75	9.46	5.83	6.17	2.75	3.00	10.88	4.83	2.67
SYNRADI	1.63	5.29	6.58	6.08	3.88	9.13	1.71		7.17	0.58		3.33
SYNULNAB		0.75	2.63	0.25		0.75	0.25		1.00	1.75		0.50
TABFLOC	1.88	4.67			0.25	1.33		6.00	0.75		1.50	4.63
TABFLOC3P	5.17	6.33	6.63	6.58	5.58	5.25	4.00	3.25	5.46	9.50	5.17	5.21
TABQUAD											0.58	
Total Diatoms	481.79	508.54	505.00	527.75	516.58	520.96	503.42	528.54	515.71	530.54	486.13	503.33
Pollen								2				
Chrysophyte Cyst		8	4	2		4	4	6	1	4	5	11
Chrysophyte Scale		1		1					1			

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	3-3.25	3.5-3.75	4.5-4.75	5.5-5.75	6.5-6.75	7-7.25	8.5-8.75	10-10.25	13-13.25	20-20.25
ACHAMOE										1.00
ACHBINO			1.25				1.00			
ACHCLEV		1.00		1.50	0.25	0.75		1.00	2.00	1.33
ACHFLEX								2.00		
ACHLAEV					1.00	0.25				
ACHLARG										
ACHMEDI				0.25	1.00					
ACHMINS	2.00	3.00	0.50	5.25	4.00	2.00	3.00	6.50	2.00	2.50
ACHMINU	1.50	1.00	9.00	4.00	2.50	1.00	1.75	1.50		4.00
ACHSUCH	1.00	0.50	1.00	2.00		1.00			0.83	
AMPINAE					0.83				0.25	0.50
AMPNEGL		0.33		4.50				1.33	1.00	
AMPPEDI								2.00		0.50
ASTFORM	4.63	3.58	1.71	5.50	9.71	6.79	6.33	8.46	3.00	1.88
AULAMBI	1.75	4.00	1.00		1.83	11.00	25.00	13.50	4.00	15.33
AULGRAN										
AULISLA	23.38	15.67	26.04	36.04	47.79	97.08	118.00	67.33	13.13	17.83
AULSUBA		0.50			2.00		2.75			
BRACHY				0.50	2.50					
COCNEOD	1.25								1.00	3.58
COCPLAC		1.33		0.46	2.00	0.25			0.75	

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**3-3.25**	**3.5-3.75**	**4.5-4.75**	**5.5-5.75**	**6.5-6.75**	**7-7.25**	**8.5-8.75**	**10-10.25**	**13-13.25**	**20-20.25**
CYCATOM	21.75	26.50	18.00	14.00	13.00	13.00	9.00	5.50	32.00	9.00
CYCATOMF	25.25	18.50	6.00	15.00	11.00	15.00	9.00	8.50	44.00	18.50
CYCBODA	10.21	11.58	10.38	13.21	8.88	8.88	7.63	2.54	5.71	12.29
CYCBODAQ			0.50		1.00					
CYCCMENE				0.50						1.00
CYCCOME	11.50	22.58	11.50	16.25	11.50	0.00	11.75	4.00	6.50	6.00
CYCCOME1	1.00	7.50	5.00	5.00	9.00	2.00		2.00	1.00	1.00
CYCCOMRCA	53.58	31.33	33.50	31.88	6.83	30.13	7.00	9.00	12.33	16.50
CYCCOMRCB	28.46	7.50	18.08	22.63	5.50	23.83	5.75	2.25	6.83	8.75
CYCDIST										
CYCMICH									1.00	
CYCOCEL	57.33	74.00	66.92	53.46	84.50	72.92	79.58	107.83	138.58	185.83
CYCOCEL3										
CYCOPER	1.25	1.33	0.25	2.00	0.25			0.25	0.75	0.38
CYMCIST			2.00							
CYMDELI										0.88
CYMMICRO								0.75		
CYMSILE					1.75			0.25		
CYMSINU				0.50					0.33	
DIAMONO	0.25				1.00					0.75
DIATENU				0.25		0.13				

Appendix 3b. Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**3-3.25**	**3.5-3.75**	**4.5-4.75**	**5.5-5.75**	**6.5-6.75**	**7-7.25**	**8.5-8.75**	**10-10.25**	**13-13.25**	**20-20.25**
DIATENUE										
DISPSEU	133.50	118.50	164.00	122.50	102.50	105.08	51.50	84.83	47.50	56.00
DISSTEL	4.75	3.83	3.00	12.75	11.75	3.58	6.00	3.83	10.25	5.00
ENCTRIA	0.13	0.13	0.33	0.25						
ENTORNA										
EUNOTIA				0.50						
FRACROT	3.88	1.75	3.38	3.67	2.00	3.75	7.50	4.33	2.75	3.63
FRAGLATA		1.00								
FRAGPINN	2.00			2.50	0.75		3.00	2.00		0.50
FRAVAUC		4.75			3.00		1.21	6.75	1.25	0.50
GOMSPP		0.33				2.00		0.58	0.83	0.50
MARMART				2.00	1.00			2.00	3.00	4.00
NAVCRYPC	0.25									
NAVCRYPT	0.46	0.33		0.25			0.33	0.38	1.00	0.50
NAVIGNOA										1.00
NAVJAEF									0.75	
NAVLARG	0.13	0.25		0.13			0.50	1.13		
NAVMEDI			0.75							
NAVMINI				1.00		2.00		1.00	0.50	
NAVPUPU										
NAVRADI		1.00								

Interval/ Taxon Code	**3-3.25**	**3.5-3.75**	**4.5-4.75**	**5.5-5.75**	**6.5-6.75**	**7-7.25**	**8.5-8.75**	**10-10.25**	**13-13.25**	**20-20.25**
NITAGNI		1.75	1.00		1.13	1.75	1.00	2.00		
NITAMPH										
NITFLEX					1.13		1.25			0.25
NITFONT	3.75	0.50		2.75				2.00		
NITLARG										
NITLAUE		0.88		0.25	0.38		1.29	0.25	0.38	
NITLINE										
NITPALE	0.75	1.25	0.25	0.25		1.00	2.67	1.08	1.58	0.25
NITTHER			1.50							
PLALANC										1.50
RHIERIE	12.00	7.25	7.25	23.00	15.00	10.00	26.50	8.50	12.50	4.25
RHIGRAC	8.75	5.75	6.25	8.75	17.50	12.50	20.00	23.25	5.50	7.75
STEALPI	0.75	5.83	3.75	0.25	2.83	2.38	1.38	0.33	6.42	5.13
STEBIND	2.00		1.00	2.00			2.00	0.50		1.00
STECONS	6.00	10.54	14.08	15.17	27.71	33.25	34.83	44.54	41.08	55.13
STEHANT	6.50	5.50	1.00	1.00	5.50	5.50	3.50	2.00	9.00	0.50
STEMINU	1.00	2.00			2.00	1.00	2.00		9.00	4.00
STENIAG	0.25	0.13	0.25	0.75	1.08	0.13		1.00	1.33	0.25
STEPARV	17.00	14.00	11.00	10.00	19.50	15.25	18.00	15.50	13.50	7.33
STESP10	3.50	2.50	8.00	10.50	8.50	12.50	21.50	2.00	17.00	1.00
STESP51				2.00	5.00	1.00	3.75		1.50	1.00

Appendix 3b.

Diatom count data for Lake Superior western core (IR#2)

Interval/ Taxon Code	**3-3.25**	**3.5-3.75**	**4.5-4.75**	**5.5-5.75**	**6.5-6.75**	**7-7.25**	**8.5-8.75**	**10-10.25**	**13-13.25**	**20-20.25**
STESUPE	1.63	2.50	2.25	3.25	3.13	4.13	4.88	10.08	8.67	7.38
SURMINU		0.33		1.00	0.25		0.25			
SYNCYCL	0.75			1.50				0.75		
SYNDELI	1.00		0.38	0.13	0.63	1.50	0.13	0.13		0.88
SYNFILI	14.04	4.08	6.50	8.08	8.92	13.75	11.33	11.42	3.79	3.79
SYNFILIE	23.79	20.08	18.50	18.96	28.67	10.58	6.13	11.25	13.58	17.38
SYNNANA	2.00		1.04	2.00	0.13	1.83	1.00	1.21		1.13
SYNOSTE	5.13	6.63	9.46	10.46	9.13	5.79	5.83	7.25	5.96	1.67
SYNRADI	0.75	0.50	4.50	4.33	1.00	5.13		0.75		0.25
SYNULNAB	0.25	0.75		0.88	0.50		0.25	0.13		
TABFLOC		0.25	1.25		6.17	3.08	3.83	2.33	2.25	7.54
TABFLOC3P	2.75	1.00	7.92	9.46	11.88	18.08	15.50	20.13	6.96	12.96
TABQUAD					0.25				1.33	
Total Diatoms	505.50	458.63	491.21	516.92	528.50	562.54	546.38	521.71	506.17	523.25
Pollen	1		1			2	1		2	4
Chrysophyte Cyst	5		3	7	3	2	5	8	4	16
Chrysophyte Scale							1			

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes biosolettiana*		*Achnanthes (Karyvekii) cleveii*								*Achnanthes (Eucocconeis) flexella*			
Sediment	Dimensions		Dimensions								Dimensions			
Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25			21.5	9	21.5	9								
0.25 - 0.5			20	9										
0.5 - 0.75			14	6										
0.75 - 1			15	7							14	8		
1 - 1.25											23	11		
1.25 - 1.5														
1.5 - 1.75											13	7	26	12
1.75 - 2														
2 - 2.25														
2.25 - 2.5			19	7.5										
2.5 - 2.75			15	7	20	6								
2.75 - 3			10	4										
3.5-3.75	50	6												
4-4.25			10	6										
5-5.25														
6.25-6.5														
8-8.25											17	6		
9.5-9.75			18	8	18	8								
12.25-12.5			13	6	13	6								
14-14.25			12.5	6							15	7		
15.5-15.75			12.5	5.5	27	10	9.5	5	13.5	6				
17-17.25			14	7							14	8		
18-18.25														
19.5-19.75														
26.5-26.75			12	5										
35-36			11	5.5	14	6								

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes frequentissima*				*Achnanthes harvyeii*		*Achnanthes hintzii*		*Achnanthes holsatica*			
Sediment Interval	Dimensions				Dimensions		Dimensions		Dimensions			
	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25												
0.25 - 0.5									6	4		
0.5 - 0.75												
0.75 - 1												
1 - 1.25												
1.25 - 1.5												
1.5 - 1.75							6.5	4				
1.75 - 2												
2 - 2.25												
2.25 - 2.5												
2.5 - 2.75												
2.75 - 3					19	6						
3.5-3.75												
4-4.25												
5-5.25	7.5	5	10.5	3								
6.25-6.5	7	6										
8-8.25												
9.5-9.75									9	5	9	5
12.25-12.5												
14-14.25												
15.5-15.75												
17-17.25	19	1.5										
18-18.25												
19.5-19.75												
26.5-26.75												
35-36												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes laevis*		*Achnanthes (Planothidium)lanceolata*				
Sediment	Dimensions		Dimensions				
Interval	L	W	L	W	D	L	W
0 - 0.25							
0.25 - 0.5							
0.5 - 0.75							
0.75 - 1							
1 - 1.25			12	4			
1.25 - 1.5							
1.5 - 1.75							
1.75 - 2							
2 - 2.25							
2.25 - 2.5							
2.5 - 2.75	11	5					
2.75 - 3							
3.5-3.75			15	3.5			
4-4.25			12	6		10	4.5
5-5.25							
6.25-6.5							
8-8.25							
9.5-9.75							
12.25-12.5			13	9			
14-14.25			8.5	5		8.5	5
15.5-15.75							
17-17.25							
18-18.25	14	5					
19.5-19.75							
26.5-26.75							
35-36			18.5		8	6	4

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes minutissima*																			
Sediment Interval	Dimensions																			
	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W
0 - 0.25	14	3																		
0.25 - 0.5	9	3																		
0.5 - 0.75	9		3	5	2		7	3		12	3									
0.75 - 1	10	2		12	4		10	4		8	4		6	3		8	2			
1 - 1.25	8	3		8.5	2.5															
1.25 - 1.5	10.5	2		11		4														
1.5 - 1.75	8		3	8		3	7		3	7		3	14		4	14		4	8	3
1.75 - 2	14.5	2.5		14	3															
2 - 2.25	8	3		7	3															
2.25 - 2.5	15	4																		
2.5 - 2.75	9		3	7	3															
2.75 - 3	11	4		13.5	3		10		2.5	15	3									
3.5-3.75	16		3	15	3		15	3		16	2		17.5	5		11	3		11	3
4-4.25	10	3		10		3	10		3	11	2.5									
5-5.25	15	3.5		17	4		10	4		8	2									
6.25-6.5	10			10	4		8	3.5												
8-8.25	10	3																		
9.5-9.75	9	3		6	3		9.5	2.5												
12.25-12.5	8	4																		
14-14.25	22	4		15	5		14.5	3		12	3									
15.5-15.75																				
17-17.25	7		4																	
18-18.25																				
19.5-19.75																				
26.5-26.75	12	3.5		14.5	3															
35-36	8	3		11	3		11	2		14	3		13		2.4	10	2		17	4

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes minutissima var. scotica*														
Sediment Interval	Dimensions														
	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D
0 - 0.25	26	3													
0.25 - 0.5	18	3		14		3	15		4	20	3		16	2.5	
0.5 - 0.75	17	4		17	4		16		3						
0.75 - 1	16	4													
1 - 1.25															
1.25 - 1.5	9	3		14	2.5										
1.5 - 1.75	7		2	7		2	17		3	15	3				
1.75 - 2	20	3													
2 - 2.25	26	3.5													
2.25 - 2.5	25	3.5		24	3.5		16		2.3	13		5.4	19		3.3
2.5 - 2.75	15	3		14	3		20	3.5							
2.75 - 3	12		3	12		3									
3.5-3.75	20	2.5		21	3		21	3							
4-4.25	23		2	20	4										
5-5.25															
6.25-6.5	23	4		16	4										
8-8.25	14.5		3.5	14.5		3.5	15	3							
9.5-9.75	27	3		27	3										
12.25-12.5	16	3		16	3		16		3						
14-14.25	21	3		28	4										
15.5-15.75	15		4.7	20	3										
17-17.25	16	3.5													
18-18.25	14		3.4												
19.5-19.75															
26.5-26.75	19		3.4												
35-36															

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Achnanthes suchlandii*															
Sediment	Dimensions															
Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25																
0.25 - 0.5																
0.5 - 0.75																
0.75 - 1																
1 - 1.25																
1.25 - 1.5	8	4	9	4												
1.5 - 1.75	9	4														
1.75 - 2	10	3.5	8.5	4	18	3										
2 - 2.25																
2.25 - 2.5	8	3.5														
2.5 - 2.75	11	5														
2.75 - 3																
3.5-3.75	8	3														
4-4.25																
5-5.25	10	4														
6.25-6.5	10	4	10	4												
8-8.25	10	5	9	4	7	3	7	3	16	5	15	4	16	5	8	4
9.5-9.75																
12.25-12.5	8	5	8	4	9	4										
14-14.25	8	3	7.5	3												
15.5-15.75																
17-17.25	7	3.5	9	4	9	4	8	4								
18-18.25	8	4	8	3.5												
19.5-19.75																
26.5-26.75	8	4	8	4	23	9										
35-36	7	3.5	6	3												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Amphora inaeriensis*					*Amphora neglecta*			*Amphora pediculus*								
Sediment	Dimensions					Dimensions			Dimensions								
Interval	L	W	D	L	W	L	W	D	L	W	D	L	W	L	W	L	W
0 - 0.25																	
0.25 - 0.5																	
0.5 - 0.75									15	5							
0.75 - 1									19	3	9						
1 - 1.25									10	2		10	2	10	2	17	3
1.25 - 1.5									22	5		22	5				
1.5 - 1.75									20	4	2						
1.75 - 2																	
2 - 2.25									16	3		16	3	19	3	19	3
2.25 - 2.5																	
2.5 - 2.75									16	4							
2.75 - 3									15	3	7						
3.5-3.75																	
4-4.25									16	5							
5-5.25																	
6.25-6.5									20	4							
8-8.25									29	4	11						
9.5-9.75									13	3		15	3	15	3		
12.25-12.5																	
14-14.25																	
15.5-15.75									7	2		11	3.5				
17-17.25									16	2	6	16	2	12	3		
18-18.25	16	3	7.5	17	5	37	4.5	14	7.5	2	3.6						
19.5-19.75																	
26.5-26.75									15		8						
35-36																	

L = Length, W = Width, D = Depth

Species	*Amphora perpusilla*					*Asterionella formosa*														
Sediment Interval	Dimensions					Dimensions														
	L	W	D	L	W	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W
0 - 0.25						74		4												
0.25 - 0.5						62		3.5	56		5									
0.5 - 0.75						63	5		53		5	94	5							
0.75 - 1						93	5	7		4		55	5		55	5				
1 - 1.25						89			89			46	3		46	3	58	3	58	3
1.25 - 1.5						60	5		50	5		55.5	4							
1.5 - 1.75	3		8			54	4		54	4										
1.75 - 2	2		9																	
2 - 2.25						54	2		50	2		50	2							
2.25 - 2.5	10	3				50		3												
2.5 - 2.75	9	3				53	3													
2.75 - 3						53		6												
3.5-3.75																				
4-4.25	8	2.5				88		4	52		5	46		5	88					
5-5.25						48	4		50.5			18	1		50.5					
6.25-6.5																				
8-8.25	12	4																		
9.5-9.75						66	5		66	5		73	4		73	4	55	4		
12.25-12.5						47		4.5	45	5										
14-14.25	7	2		7	2	55	5		65	5										
15.5-15.75						101	5		51		4									
17-17.25						63	5													
18-18.25																				
19.5-19.75																				
26.5-26.75																				
35-36	8	2	4	12	2.5			4												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Brachysira (Anomoneis)*				*Cocconeis neodiminuta*				*Cocconeis placentula*				*Cymbella amphicephela*	
Sediment	Dimensions				Dimensions				Dimensions				Dimensions	
Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25									26	14				
0.25 - 0.5									16	9.5				
0.5 - 0.75	25	5	32	6										
0.75 - 1														
1 - 1.25														
1.25 - 1.5														
1.5 - 1.75														
1.75 - 2														
2 - 2.25														
2.25 - 2.5									17	12			18	4
2.5 - 2.75	20.5	4							19	11				
2.75 - 3														
3.5-3.75														
4-4.25														
5-5.25														
6.25-6.5														
8-8.25														
9.5-9.75									20	12				
12.25-12.5									11	6.5				
14-14.25									12	9				
15.5-15.75	28	5			10	5	14	8						
17-17.25									15	9				
18-18.25									14	9				
19.5-19.75														
26.5-26.75									18	8				
35-36	24	5							12	7	12	9		

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Cymbella cistula*		*Cymbella delicatula*				*Cymbella incerta*		*Cymbella microcephela*						*Cymbella silesiaca*	
	Dimensions		Dimensions				Dimensions		Dimensions						Dimensions	
Sediment Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25															36	11
0.25 - 0.5			30	6					17	3.5						
0.5 - 0.75			24	4.5	23	5										
0.75 - 1			35	7	24	5										
1 - 1.25																
1.25 - 1.5																
1.5 - 1.75																
1.75 - 2			38	7												
2 - 2.25			28	5.5	22	5	23	5								
2.25 - 2.5	22	8.5							13	3						
2.5 - 2.75			24.5	5												
2.75 - 3			26	5	27	6										
3.5-3.75			28	5.5					7	2.5						
4-4.25			26	5												
5-5.25			18	4												
6.25-6.5			22	5	22	5	20	7								
8-8.25									14	3.5	14	3	14	3		
9.5-9.75																
12.25-12.5																
14-14.25			25	6												
15.5-15.75																
17-17.25			16	3.5												
18-18.25																
19.5-19.75																
26.5-26.75																
35-36			24	5												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Diatoma vulgaris*		*Diploneis elliptica*				*Encyonema triangulatum*		*Eunotia*		*Fragilaria capucina*	
Sediment	Dimensions		Dimensions				Dimensions		Dimensions		Dimensions	
Interval	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25												
0.25 - 0.5							47	19				
0.5 - 0.75												
0.75 - 1												
1 - 1.25												
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2												
2 - 2.25												
2.25 - 2.5												
2.5 - 2.75												
2.75 - 3												
3.5-3.75									19	5.5		
4-4.25												
5-5.25												
6.25-6.5												
8-8.25							77.5	31	39	3		
9.5-9.75												
12.25-12.5	18	4										
14-14.25	18	5.5										
15.5-15.75									70	4.5		
17-17.25			34	15	17	9					24	3
18-18.25												
19.5-19.75												
26.5-26.75			30.5	15.5								
35-36												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Fragilaria crotonensis*																						
Sediment	Dimensions																						
Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	L
0 - 0.25	91	2		68		5																	
0.25 - 0.5	90	3		94	2		94	2		76		1.6	76		2.6								
0.5 - 0.75	76		5	82		4	100			100													
0.75 - 1	90			120			120		3.2	105													
1 - 1.25	100	2		78	3		54	2		78	3		54	2									
1.25 - 1.5	88	2		69		5	140	3		140	3		120		5								
1.5 - 1.75	84			98		1.4																	
1.75 - 2																							
2 - 2.25	85																						
2.25 - 2.5	93																						
2.5 - 2.75	100		6	100					3.5														
2.75 - 3	89	3		89	3		104	2		120	2		60	3									
3.5-3.75			2.5	47	2		47	2				2.5			5	94	3						
4-4.25	61		3	110		3																	
5-5.25																							
6.25-6.5	107	2		135	2		135	2		100	2		100	2		80	2	80	2	90	2	110	100
8-8.25																							
9.5-9.75																							
12.25-12.5			4																				
14-14.25	136		6	136		7.5																	
15.5-15.75																							
17-17.25	130	2.5		69		5																	
18-18.25	86																						
19.5-19.75																							
26.5-26.75																							
35-36																							

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Fragilaria lata*		*Fragilaria pinnata*																
Sediment	Dimensions		Dimensions																
Interval	L	W	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	W
0 - 0.25			15		5														
0.25 - 0.5	15	4																	
0.5 - 0.75																			
0.75 - 1																			
1 - 1.25			6	3															
1.25 - 1.5																			
1.5 - 1.75																			
1.75 - 2																			
2 - 2.25																			
2.25 - 2.5			6	4															
2.5 - 2.75																			
2.75 - 3			12	4		8		2											
3.5-3.75																			
4-4.25	24	4																	
5-5.25			4	2															
6.25-6.5			5	2		5	2		5	3									
8-8.25			6	4	7														
9.5-9.75			9	4															
12.25-12.5			5	2		4	3		6		3.4								
14-14.25			8	3															
15.5-15.75			5	3															
17-17.25			5.5		4	5	5												
18-18.25			5	3															
19.5-19.75																			
26.5-26.75			6		6.5	5.5	3		4	3		6	3.5	6	3	9	4	6	3
35-36	18	5	5	3		5	3		5	3		5	3						

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Gomphonema angustatum*				*Martyana martyii*								*Navicula cf clementis*	
Sediment	Dimensions				Dimensions								Dimensions	
Interval	L	W	L	W	L	W	D	L	W	D	L	W	L	W
0 - 0.25													19	9
0.25 - 0.5														
0.5 - 0.75														
0.75 - 1	24.5	5												
1 - 1.25														
1.25 - 1.5														
1.5 - 1.75														
1.75 - 2														
2 - 2.25														
2.25 - 2.5														
2.5 - 2.75														
2.75 - 3														
3.5-3.75	30	7												
4-4.25	30	7												
5-5.25														
6.25-6.5														
8-8.25														
9.5-9.75														
12.25-12.5														
14-14.25														
15.5-15.75					9	4	1.8	10		5	10	4		
17-17.25														
18-18.25					9.5	3								
19.5-19.75														
26.5-26.75	20	6	25	6										
35-36														

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Navicula cryptotenella*					*Navicula halophila*				*Navicula jaerferneltii*		*Navicula latens*	
Sediment	Dimensions					Dimensions				Dimensions		Dimensions	
Interval	L	W	D	L	W	L	W	L	W	L	W	L	W
0 - 0.25						7.5	4						
0.25 - 0.5	23	5											
0.5 - 0.75													
0.75 - 1	16		3.2										
1 - 1.25										9	7	28	10.5
1.25 - 1.5						7	5						
1.5 - 1.75													
1.75 - 2	12	4											
2 - 2.25													
2.25 - 2.5										8	5		
2.5 - 2.75	58	11											
2.75 - 3	25	5				11	6						
3.5-3.75													
4-4.25	44.5	10											
5-5.25	30	5		28	5								
6.25-6.5													
8-8.25	19	4				7.5	4.5						
9.5-9.75													
12.25-12.5													
14-14.25	10	6											
15.5-15.75	23	6											
17-17.25													
18-18.25	24	5		24	5								
19.5-19.75													
26.5-26.75	33	5				10	5	8	4				
35-36										10	4.5		

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Navicula minima*															*Navicula pupula*			
Sediment	Dimensions															Dimensions			
Interval	L	W	D	L	W	D	L	W	L	W	L	W	L	W		L	W	L	W
0 - 0.25		3	8																
0.25 - 0.5																			
0.5 - 0.75	5	3.5		5	2														
0.75 - 1	5	3.5		5	3		5	3	7.5	4									
1 - 1.25																			
1.25 - 1.5	5	3		5	3														
1.5 - 1.75																			
1.75 - 2																			
2 - 2.25	9	4																	
2.25 - 2.5	5.5	3														14	5	9	4
2.5 - 2.75	6	3														11	4		
2.75 - 3	7.5	3																	
3.5-3.75	8	4		6	3														
4-4.25	10	4																	
5-5.25																			
6.25-6.5																			
8-8.25																			
9.5-9.75																			
12.25-12.5	5.5	3																	
14-14.25	5	3		5	3		6	2	7	4									
15.5-15.75	6	3		8	3.5		6	3											
17-17.25	6.5		3	6		3	6	3	5	3	6	3	10	4					
18-18.25	7	3.5		9	4		7	3.5	7	3						15	3		
19.5-19.75																			
26.5-26.75	8	3.5		7		3	7	3	8	3	7	4	7	3		10	4		
35-36	6	3.5		9	4.5		7	3											

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Navicula scutelloides*					*Navicula tuscula*	
Sediment Interval	Dimensions					Dimensions	
	L	W	D	L	W	L	W
0 - 0.25							
0.25 - 0.5							
0.5 - 0.75	9	3					
0.75 - 1							
1 - 1.25	16	9.5					
1.25 - 1.5							
1.5 - 1.75							
1.75 - 2							
2 - 2.25							
2.25 - 2.5							
2.5 - 2.75							
2.75 - 3	10	9					
3.5-3.75							
4-4.25							
5-5.25						38	17
6.25-6.5	12	7					
8-8.25							
9.5-9.75							
12.25-12.5						49	17.5
14-14.25	10	6.5		10	7		
15.5-15.75							
17-17.25							
18-18.25							
19.5-19.75							
26.5-26.75	12	7					
35-36							

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Navicula* unknown																			
Sediment	Dimensions																			
Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	68.5	12																		
0.25 - 0.5																				
0.5 - 0.75																				
0.75 - 1																				
1 - 1.25	4	3	7	4	4	4	6	7	18	5.5	24	6	25	4	10	5	25	8	20	4
1.25 - 1.5																				
1.5 - 1.75																				
1.75 - 2																				
2 - 2.25	25	12	12	6	8	6														
2.25 - 2.5	14	5	9	4																
2.5 - 2.75																				
2.75 - 3																				
3.5-3.75	10	8	12	6																
4-4.25																				
5-5.25																				
6.25-6.5	11	4	8	3.5																
8-8.25																				
9.5-9.75	16	8	8	3	20	8	15	4	8	6										
12.25-12.5																				
14-14.25																				
15.5-15.75																				
17-17.25																				
18-18.25																				
19.5-19.75																				
26.5-26.75	68.5	11																		
35-36																				

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Nitzschia agnita*										*Nitzschia amphibia*		*Nitzschia flexoides*	
Sediment Interval	Dimensions										Dimensions		Dimensions	
	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25														
0.25 - 0.5														
0.5 - 0.75														
0.75 - 1														
1 - 1.25													48	4
1.25 - 1.5	25	3	30	3	20	3	21	3	20	2				
1.5 - 1.75														
1.75 - 2	16	4												
2 - 2.25														
2.25 - 2.5	21	2	19	3.5										
2.5 - 2.75	27	3.5												
2.75 - 3														
3.5-3.75														
4-4.25	15	3	21	4	17	3								
5-5.25														
6.25-6.5														
8-8.25	15	3									13	4		
9.5-9.75														
12.25-12.5														
14-14.25														
15.5-15.75	19	3	13	2.5										
17-17.25														
18-18.25														
19.5-19.75														
26.5-26.75														
35-36														

L = Length, W = Width, D = Depth

Appendix 4.

Diatom size data for eastern core of Lake Superior (LG#1)

Pennate

Species	*Nitzschia fonticola*		*Nitzschia linearis*		*Nitzschia palea*						*Nitzschia sigma*	
Sediment	Dimensions		Dimensions		Dimensions						Dimensions	
Interval	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25			60	4	30.5	4					180	6
0.25 - 0.5					42	4	42	5				
0.5 - 0.75					34	3	34	3				
0.75 - 1												
1 - 1.25					49	7						
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2			90	2	48	6	48	6	45	2		
2 - 2.25					60	4	16	8				
2.25 - 2.5					58	3						
2.5 - 2.75					68	6.5	55	3.5				
2.75 - 3	17	4										
3.5-3.75												
4-4.25												
5-5.25												
6.25-6.5												
8-8.25					34	4						
9.5-9.75												
12.25-12.5			44	3								
14-14.25	17	2.5										
15.5-15.75	20	2			70	4						
17-17.25					49	4.5						
18-18.25					41	4.5	52	3				
19.5-19.75												
26.5-26.75					48	4						
35-36	16	2.6			40	4						

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Nitzschia terrestris*		*Nitzschia* unknown									
Sediment Interval	Dimensions		Dimensions									
	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25												
0.25 - 0.5												
0.5 - 0.75			5	4								
0.75 - 1	31	4										
1 - 1.25			16	8	35	5						
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2												
2 - 2.25												
2.25 - 2.5												
2.5 - 2.75												
2.75 - 3												
3.5-3.75			12.5	3.6	9.5	3.5	13	4				
4-4.25												
5-5.25			7	4	24	3	18	4	16	4		
6.25-6.5			18	6	6	3	30	6	11	2.5	10	6
8-8.25												
9.5-9.75												
12.25-12.5												
14-14.25												
15.5-15.75												
17-17.25												
18-18.25												
19.5-19.75												
26.5-26.75												
35-36			20	3	28	4						

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Rhizosolenia eriensis*																					
Sediment Interval	Dimensions																					
	L	W	L	W	D	L	W	D	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	25	6.5	14.5	4		17	3		34	7	13	4										
0.25 - 0.5	13.5	3	7	4		24	4		27.5	4	12	3	23	5	45	6	35	3	31	2	28	6
0.5 - 0.75	24	5	31	3																		
0.75 - 1	23	6	31	4		19	3		20	4	37	11										
1 - 1.25	12	4	30	6		13	4		35	4	25	7										
1.25 - 1.5	19		27	8		30	5		13	4	27	5	21.5	5	20	6						
1.5 - 1.75	30	5	18	6		35	6		29	4.5	19	5	7	3	10	4	29	4	20	4.5		
1.75 - 2	22	4	21	5.5		30	8		25.5	4	40	7	31	4	28	5	35	6.5	20.5	4		
2 - 2.25	18	5																				
2.25 - 2.5	16.5	3	9	2.5		28	8		20	3	28	3	21	3	27.5	5	24	3	33	6		
2.5 - 2.75	25	6	8	4.5		28	6		9	4	32	4	25	3	25	4.5						
2.75 - 3	22	5	27	4		26	4.5															
3.5-3.75	37	4	20	3		14	4															
4-4.25	19	3	19	6		19.5	3.5		26	3	25	4	11	3	22	6	27	5				
5-5.25	34	4																				
6.25-6.5	25	5	34	4		19	5		27	4												
8-8.25	14	4	50	7																		
9.5-9.75	25	4	18	2		18	6		30	3												
12.25-12.5	12	3	34		4	34		4	8.5	3.5	42.5	5	26	5	31	8.5						
14-14.25	12	3.5	15	5		31	4		33	4	21	4	27	6.5	16	5	32	4	20	6		
15.5-15.75	27	5	40	8		21	5		15	5	10	3	19	4	20	5						
17-17.25	10	3	9	5		6	3		9	5	10	4	16	5	31	3						
18-18.25	29	3.5	20	3		26	4		30	5.5												
19.5-19.75																						
26.5-26.75	11	5	9	3.5		20	2.5		23	5	28	4										
35-36	10	2	21	2.5		20	3		14	3	18	3	18	3								

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Rhizosolenia gracilis*																				
	Dimensions																				
Sediment Interval	L	W	L	W	L	W	D	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	10.5	3	8	2	67		4	20	2	10	2										
0.25 - 0.5	10	1	26	3	31	2.5		16	3.5												
0.5 - 0.75	24	2	30	3	20	1		19	3.5	20	1	20	2	28	2	60	5	15	3	34	2
0.75 - 1	31	3	21	1	40	1		10	1	8	1										
1 - 1.25	28	4	32	2	32	2		28	2												
1.25 - 1.5	14	3	41	2	9	2		10	2												
1.5 - 1.75	22	1	9	1	20	2		6.5	1												
1.75 - 2	36	1.5	20	1	14	1		15	4	35	6	20	1	31	2						
2 - 2.25	26	4	26	3	41	4		30	1	30	1	26	2								
2.25 - 2.5	13	1.4	12	2	18	2		20.5	1.3	36	3										
2.5 - 2.75	13	2	26	3	21	2															
2.75 - 3	37	1	21	1.5	10	4		14	2	27	3.5										
3.5-3.75	16	2	12	1	30	3		16	2.5	20	2	22	2								
4-4.25	38	3	28	1	28	3		26	2												
5-5.25	28	1	40	2																	
6.25-6.5	20	1	35	3.5	22	1		20	1	10	2										
8-8.25	20	2	10.5	2.5	37	4															
9.5-9.75	10	2	43	3	40	1		20	1	36	4										
12.25-12.5	13	1	28	2	29		3	23	2	35	3	26	3	23	4	20	1	20	1		
14-14.25	12	2	9	2	10	2		40	1	12	2	25	1	30	2						
15.5-15.75	28	1	12	1	18	4		32	4	29	3	36	3	10	1	16	1.5	12	1		
17-17.25	27	4.5	11	1	14	4		8	3	28.5	4	8	2	27	3	13	2	15	3		
18-18.25	30	1	30	1																	
19.5-19.75																					
26.5-26.75	20	3	11	2	19	2		11	1.5	30	1	30	1	80.5	3.5						
35-36	6.5	2	6	2.5	11	2		29	1.5	11	1	10	2	20	1.5	8	1				

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Surirella*		*Synedra amphicelphela/ Fragilaria vaucherie*					*Synedra delicatissima/nanana*				
Sediment Interval	Dimensions		Dimensions					Dimensions				
	L	W	L	W	D	L	W	L	W	D	L	W
0 - 0.25								95		3		
0.25 - 0.5								88	2			
0.5 - 0.75												
0.75 - 1												
1 - 1.25	17	7										
1.25 - 1.5						88	3					
1.5 - 1.75												
1.75 - 2				4								
2 - 2.25												
2.25 - 2.5												
2.5 - 2.75			50	2		28	4					
2.75 - 3												
3.5-3.75												
4-4.25												
5-5.25	32	12										
6.25-6.5												
8-8.25												
9.5-9.75	34	4										
12.25-12.5												
14-14.25												
15.5-15.75			34		3.5			75	2		71	2.5
17-17.25												
18-18.25												
19.5-19.75												
26.5-26.75			86	4								
35-36												

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Synedra filiformis*																									
Sediment	Dimensions																									
Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	W	L	W	D
0 - 0.25	92	2		88	3		47	2.5																		
0.25 - 0.5	51		3	54		2.5	54		1.6																	
0.5 - 0.75	57	2		60	1		81	3		52	2.5		54	2		51	2	58	2	52	2.5					
0.75 - 1	61	3		62	3																					
1 - 1.25	52	2.5		49			49			57	3		56	3		52	2	57	3	52		86.5	3	55	3	
1.25 - 1.5	62	3		46	4		58.5	3		64	3		49	2												
1.5 - 1.75	60.5	3		40	2.5		51	2		51	2															
1.75 - 2	66		3																							
2 - 2.25	50	2																								
2.25 - 2.5	47.5		3	51		2.6	43.5		3.2	52		3	46	2		46	2	44	2	56	2	58	2	50		2.6
2.5 - 2.75	40.5	2		43	2		41	3		41	3		55	2		55										
2.75 - 3	58	4																								
3.5-3.75	67	5		67	5		50	2		50	2															
4-4.25	57	4		61	3		70	2.5		57	4		80	3.5		51.5	2.5									
5-5.25	66	2		79	2																					
6.25-6.5	66	3		60	3		78	2.5		60	3															
8-8.25	48	4																								
9.5-9.75	64	2		60	2																					
12.25-12.5	65	2		60	3		76	2																		
14-14.25	65	2		82	3																					
15.5-15.75	65		3.5	66		3	60		2.5	57		2.7	65		4											
17-17.25	57	2.5																								
18-18.25																										
19.5-19.75																										
26.5-26.75	50	2																								
35-36																										

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Synedra filiformis var. exilis*																										
Sediment Interval	L	W	D	L	W	L	W	D	L	W	D	L	W	D	L	W	L	W	D	L	W	D	L	W	D	L	W
0 - 0.25	43		3	46	5	46	3																				
0.25 - 0.5	45	2		40	2	40	2		44	3		41	3		38	2	30	3		37	3						
0.5 - 0.75	22	2																									
0.75 - 1	40			40		42	2.5																				
1 - 1.25	32	3		44	3	50	2		43	2		40	3		50	2	40	3		45	3		40	3		30	2
1.25 - 1.5	42	3		28	2	40	2.5		31	2		33		2	40	2	40	2									
1.5 - 1.75	32	2		41	2	41	2		41	2		36	2		38	3											
1.75 - 2	42	3		41	2	29	2		45		3.6	53	2.5		41	2.5	44	3		40	2		38	2		41	2
2 - 2.25	44	2		40	2	36	3		41	3		40	2		42	2	38	3		40	2		36	2			
2.25 - 2.5	29		5.5																								
2.5 - 2.75	44	2		35	2																						
2.75 - 3	39	3		40	2																						
3.5-3.75	27	2		56	3	24	3		45	2.5																	
4-4.25	41	3		40	3	27		3	32	3		26		4	24	3	32	2.5		27		3	34		3		
5-5.25	32	3																									
6.25-6.5																											
8-8.25	27	2																									
9.5-9.75																											
12.25-12.5	65	2		76	2	60	3																				
14-14.25																											
15.5-15.75	46	3																									
17-17.25																											
18-18.25	21		2.5	38	3																						
19.5-19.75																											
26.5-26.75	29		3	36	2.5																						
35-36																											

L = Length, W = Width, D = Depth

Diatom size data for eastern core of Lake Superior (LG#1)

Species	*Synedra ostenfeldii*																
	Dimensions																
Sediment Interval	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	W
0 - 0.25	118	2.5		77		5											
0.25 - 0.5	100	2		96		3.4			4.3								
0.5 - 0.75																	
0.75 - 1			3														
1 - 1.25	124	3															
1.25 - 1.5	90	2.5		93	3												
1.5 - 1.75	149	2.5		146	2		92	2.5		93	2	93	2	93	2	130	3.5
1.75 - 2	113	2.5		101	3		99	3.5		99	3.5						
2 - 2.25																	
2.25 - 2.5																	
2.5 - 2.75	80	3.5															
2.75 - 3	97	3.5															
3.5-3.75	70	3															
4-4.25	102	2															
5-5.25	120	3		122	3		130	2		112	4						
6.25-6.5																	
8-8.25																	
9.5-9.75	114	5															
12.25-12.5	65	2.5		75	2.5												
14-14.25	107	2.5															
15.5-15.75																	
17-17.25	100	3		102	4												
18-18.25																	
19.5-19.75																	
26.5-26.75			4														
35-36																	

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Synedra radians*																			
	Dimensions																			
Sediment Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W	D	L	W
0 - 0.25																				
0.25 - 0.5	108		4																	
0.5 - 0.75	40		3.5	60	3		33		8.5	74	3									
0.75 - 1																				
1 - 1.25	28	3		24	3		28	3		24	3		28	3		34			34	
1.25 - 1.5																				
1.5 - 1.75	130	3		43	3															
1.75 - 2																				
2 - 2.25																				
2.25 - 2.5																				
2.5 - 2.75																				
2.75 - 3	104		4	71	3															
3.5-3.75	82	3		82	3		32		4.5	52	2		52	2		50	2		50	2
4-4.25	56		4																	
5-5.25	114	3																		
6.25-6.5	66	3		45		4	26	4												
8-8.25	40.5	3		34	3															
9.5-9.75	54	2		30			30													
12.25-12.5	67	2		56	2		56	2		38	3		50	3				3.4		
14-14.25																				
15.5-15.75																				
17-17.25	67	3		53		5														
18-18.25																				
19.5-19.75																				
26.5-26.75																				
35-36	38		4																	

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Tabellaria flocculosa*									
	Dimensions									
Sediment Interval	L	W	D	L	W	D	L	W	L	W
0 - 0.25	46	6								
0.25 - 0.5										
0.5 - 0.75	29		10							
0.75 - 1										
1 - 1.25	41	6								
1.25 - 1.5										
1.5 - 1.75										
1.75 - 2	29	6.5		40	8					
2 - 2.25										
2.25 - 2.5	35	7		31	9					
2.5 - 2.75										
2.75 - 3	23		9							
3.5-3.75	33	8								
4-4.25										
5-5.25	48	5		48	5		39	7	40	6
6.25-6.5	36	7								
8-8.25	31	7		30	7					
9.5-9.75	26	4		33	7		27	5		
12.25-12.5	45	5								
14-14.25	41	7		44	6		44	6		
15.5-15.75	32	7		33.5		7.3				
17-17.25										
18-18.25	37	7		33		12	34	6	42	9.5
19.5-19.75										
26.5-26.75										
35-36	30	5		30	5		40	6.5	54	6

L = Length, W = Width, D = Depth

Appendix 4. Diatom size data for eastern core of Lake Superior (LG#1) Pennate

Species	*Tabellaria flocculosa strain IIIp*																							
Sediment	Dimensions																							
Interval	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	D	L	W	L	W	L	W	L	W
0 - 0.25	61	5																						
0.25 - 0.5	51		5	44		9	65		8															
0.5 - 0.75	57		8	57		8																		
0.75 - 1	73	5																						
1 - 1.25	40			56			56			64	4	53	5											
1.25 - 1.5																								
1.5 - 1.75	32		3																					
1.75 - 2	53	6																						
2 - 2.25	45	6		45	6																			
2.25 - 2.5	55	4.5		41		8																		
2.5 - 2.75	43		5	70		5																		
2.75 - 3	67.5		8	32		11																		
3.5-3.75	41		8	55		5.5	45		5															
4-4.25	41		9																					
5-5.25	53	4		53	4		53	4		48														
6.25-6.5	59			59			38			38		52	6	66	5									
8-8.25	62	5.5		50		5	52		7	53	5	52	5.5	49	5		48	6						
9.5-9.75	55	5		55	5		55	5		55	5	55	5	55	5		55	5	34	6	47	6	47	6
12.25-12.5	56	6		47	5		44	4		56	4													
14-14.25	60	5		66	4		58	4	3	56	5	56	5	61	5.5									
15.5-15.75	33		7																					
17-17.25	35		4	44		8	57	5		57	5													
18-18.25	61		7																					
19.5-19.75																								
26.5-26.75	66.5	5		48	7		35		11															
35-36	62	4		61	4		61	4																

L = Length, W = Width, D = Depth

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Aulacoseira alpigena*																			
Sediment	Dimensions																			
Interval	L	W	L	W	L	W	L	W	L	W	D	L	W	L	W	D	L	W	L	W
0 - 0.25		6	6	8																
0.25 - 0.5																				
0.5 - 0.75																				
0.75 - 1																				
1 - 1.25																				
1.25 - 1.5	13	8																		
1.5 - 1.75	6.5	5	6	9																
1.75 - 2	16	6	10	5	15	10.5	15	6												
2 - 2.25	12	6																		
2.25 - 2.5																				
2.5 - 2.75																				
2.75 - 3																				
3.5-3.75																				
4-4.25																				
5-5.25	6.5	4.5																		
6.25-6.5																				
8-8.25	6	10	6	10	4	6	5.5	8												
9.5-9.75	14	4	17	6	5	10	6	8	4	9										
12.25-12.5	10	7	10	7	17	8	14	6	7	8		7	8	9	8		9	8		
14-14.25	9	3	7	9	8	9	5	6	6	9		6	9	6	9		6	11	6	11
15.5-15.75	5	10		11	4	8.5	4	8	5	10.5	11.6	3	10	5	10	10				
17-17.25	7	9	7	9	6	9	6	9	4	6		5	6	5	9		5	9		
18-18.25	6	9	5	10																
19.5-19.75																				
26.5-26.75	5.5	7	4	5																
35-36	6	8	6	8	5	8	5	8	7	11										

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Aulacoseira islandica*																					
Sediment	Dimensions																					
Interval	L	W	L	W	D	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	D
0 - 0.25	16	6	16	6		20	9.5	10	10	14	5.5	14.5	9.5	16	9.5	12	7					
0.25 - 0.5	7	6	7	4		14	8	6	5	9	3	17	8	13	5	11	5	21	4	15	9	
0.5 - 0.75	8	2	7.5	4		6	8	11	5	9	4.5	6	4	11	6	11	8	12	3.5	13	7	
0.75 - 1	11.5	7	15	6		14	5	12	8	15	6	19	7	9	5	17	5	11	10	16	8	
1 - 1.25	13	4.5	18	8		11	3	18	8	14	7	14	7	15	5.5	18	6	10	8			
1.25 - 1.5	6	8	14	9		5	7.5	19	10	15	5	12	12	15	12	15	5.5	10.5	5	13	7	
1.5 - 1.75	9	2	20	12		8	6	6	4	15	8	14	4	17	8	5	6	9	5	12	6	
1.75 - 2	11	6	14	9		16	8	14	8	14	9	15	6	12	5	14	8	14.5	3	10.5	6	
2 - 2.25	12	8.5	8	5		7	5	15	9	20	8	13	7	19	10	16	5	18	7	15	9	
2.25 - 2.5	9	5	19	5.5		16.5	8	8	5	14	11	14	8	19	9	17	10	15	10	12.5	8	
2.5 - 2.75	18	11	15	8.5		14	9	16	10	16	8.5	13	8	17	9	17	8	16	8	17	8	
2.75 - 3	8	4	8.5	5		12	6	16	7	9	4	15	9	14	7	6	10	15	6	21	6	
3.5-3.75	11.5	4.5	6	5		17	8	13	5	10	5	15	11	11	6	10	5	14	4	15	8	
4-4.25	19	10	10	5		18	5	20	8	13	7	15	7	12	9	14	5					
5-5.25	17	10	15	9		14.5	9	11	6	18	9	13	7.5	20	6	26	8	18	10	16	10	
6.25-6.5	13	10	10	7		17	7	14	6	19	9	17	6	8.5	6.5	18	8.5	6	5	7	5	
8-8.25	18.5	10	15	11		16	10	16	10	14	3	20	7	15	8	13	7	12	6	11	7	
9.5-9.75	13	6	12	5		17	9	17	9	26	4	10	8	15	8	17	5	15	5	13	6	
12.25-12.5	10	7	18	10	9	9	5	18	5	9	7	15.5	5	13	5	13	9	10	7	17	6	10
14-14.25	13	5	8	5		8	6	10	8	3	10	8	4	11	6	7	4	10	5	6	4	
15.5-15.75	12	7	15.5	10	33	14	5	19	10	6	4	16	9	10	3	8	3	16	8			
17-17.25	15	6	9	15		4	6	8	5	16	7	5	6.5	6	6	11	7					
18-18.25	17	9	14	9		15	6	10	6	10	4											
19.5-19.75																						
26.5-26.75	11	7	16	6		7.5	6	10	3	9	8	10	8	9	4	7.5	6	9	7	7	6	
35-36	16	10	14	5		20	7	16.5	8.5	13	5											

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Cyclotella atomus*									
Sediment	Dimensions									
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	5	5	6	4.5	6	5	5	5	5.5	5
0.25 - 0.5	5	5	5	5	5.5	5	6	5.5	5	5
0.5 - 0.75	5	6.5	5	6	5	6	5	5	5.5	5
0.75 - 1	8	5	5.5	5	5	6	5.5	5	6	5
1 - 1.25	6	7	6	5	5	6	5.5	6	7	
1.25 - 1.5	5	5	5	6	5.5	6	5	5	5	5
1.5 - 1.75	5	5.5	7.5	7	4.5	6.5	5	6	6	6
1.75 - 2	5	5.5	5	5	5	7.5	6	5.5	5	5
2 - 2.25	5	6.5	6	6	5	5	6.5	5	5.5	
2.25 - 2.5	5	6	5	5	7	6	5.5	5	5	6
2.5 - 2.75	5	5	7	5	6	5	6	6	5.5	6
2.75 - 3	5.5	6	5	5.5	5	6	5	5	4.5	5
3.5-3.75	6	7	6	6	7	6	6	5	6.5	
4-4.25	5	5	5	6	5	5	5	7	5	5
5-5.25	6	5	6	6.5	5.5					
6.25-6.5	8.5									
8-8.25	5	5	5	6	5	6				
9.5-9.75	5.5	5.5	6	5						
12.25-12.5	5									
14-14.25	5	5								
15.5-15.75	4	5	6	4.5	6.5	4	5.5	4.5	5	4
17-17.25	4.5	5	5.5	4	4	5.5	5	6	5	5
18-18.25	5	5	4	4	4	5	4	4.5	4	4
19.5-19.75										
26.5-26.75	4	5	4.5	6	5	5	5			
35-36	5	5	5	5	5	6	5	5	4.5	4

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella atomus* 'fine form'									
Sediment	Dimensions									
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	4	4	3.5	4	3.5	3	4	3.5	3	4
0.25 - 0.5	4	4.5	4	3	4	4	3	4	4	4
0.5 - 0.75	5	3	4	4	3	4	4			
0.75 - 1	4	5	3	5	3	4	4	4	3	4
1 - 1.25	4	4								
1.25 - 1.5	4	3	4	4	5	4	3.5	5	3	3.5
1.5 - 1.75	4	4	4	5	5	5	4	4	4	4
1.75 - 2	4	4	4	4	4.5	5	4	4		
2 - 2.25	4.5	4	4	4	5	3	5	5	4.5	
2.25 - 2.5	5	4	4	4	5	4	4	4	4	4
2.5 - 2.75	4	4	4	4.5	4.5	4	4	4	5	5
2.75 - 3	5	4	4	4	4	3	4	5	5	4
3.5-3.75	5	4	4	5	4	4	5	3		
4-4.25	4.5	3	4	4	4	5	4	4	4	
5-5.25	4.5	4.5	4	4	5	5	3			
6.25-6.5	4.5	4	4.5	5	4.5					
8-8.25	3	4	4	3	3	4	3	4	4	
9.5-9.75	3.5	4	4.5	4.5	4	4	4			
12.25-12.5	4.5	4.5	4	4	4	4				
14-14.25	3.5	3.5	4.5	3	4	4	4	4	4	4
15.5-15.75	4	3.5	4	4.5	4	3	3	4	3.5	3
17-17.25	3	4.5	3.5	4	3	4	4	4	3.5	4
18-18.25	3.5	4	3	4	4	3	4	4	3	3
19.5-19.75										
26.5-26.75	3.5	4	4	4	4.5	4	4	4	3	3
35-36	4	4	4	3.5	4	4	4	3	3.5	4

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella bodanica*												*Cyclotella bodanica var. affinis*			
	Dimensions												Dimensions			
Sediment Interval	Dm	D	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	10	3	10	19		16	23	20	16	16						
0.25 - 0.5	2		22	7		17	40	20								
0.5 - 0.75	17		31	19		19	21	40	14	17	15	19	12	16		
0.75 - 1	16		18	12		21	25									
1 - 1.25	18		16	23.5		27	17	36	16	21	17	26	17			
1.25 - 1.5	19		26	15.5		15	18	31	24	30						
1.5 - 1.75	18		14	11		29	12	14					16			
1.75 - 2	18		18	26		22	32	15	22	18						
2 - 2.25	22		15	22		14	16	12					16	20	22	20
2.25 - 2.5	20		16	15.5		28										
2.5 - 2.75	19		18	22.5		17	11	17.5	16	18	20	20				
2.75 - 3	20	12	28	24		34	20	14	15							
3.5-3.75	25	8	17	19		31	18.5	20	13	22	18	18				
4-4.25	14		34	15		19	16.5	16								
5-5.25	26		22	20		44	30						20			
6.25-6.5	14		8	15		14	13	23	15							
8-8.25	14		35	16		23	20	35	13	17	17	17				
9.5-9.75	18		12	19		17	20	8	12	18	20	22	18			
12.25-12.5	14															
14-14.25	19															
15.5-15.75	20															
17-17.25	36		20	21												
18-18.25																
19.5-19.75																
26.5-26.75	13		21		6											
35-36	16															

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella comensis*									
Sediment	Dimensions									
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	5	5	4	5	4	5	6	5.5	5	6
0.25 - 0.5	4	5	5.5	5	4.5	6.5	7	6	4.5	7
0.5 - 0.75	6	6.5	4	6	8	5	6	7	5	5
0.75 - 1	5.5	5	5	6	5	5	5	6	6	4.5
1 - 1.25	6	8.5	6	6	6	5	7	5	5	5
1.25 - 1.5	6	6	6	5	5	7	6	7	7	4
1.5 - 1.75	6	6	5	5	5	14	5	5	6	5
1.75 - 2	6	6	7	6	5	8	6	4	6	5
2 - 2.25	7	8	6	6	6	7	8	7	5	8
2.25 - 2.5	6	7.5	6	5	6.5	5	6	5	7	6
2.5 - 2.75	6	7	5	5	5	6	8	6	6	5
2.75 - 3	6	6	5	6.5	5	6	5.5	7	7	6
3.5-3.75	7	6	5	5	6	6	5	6	6.5	6
4-4.25	6	7	6	7	7	6	6	6		
5-5.25	8	6	6	8	6	7	8	6	8	6
6.25-6.5	6	6	7	6	6	5	7	6		
8-8.25	7	6	6	6	6	6	5.5	5.5	5.5	5
9.5-9.75	10	6	7	6						
12.25-12.5										
14-14.25	6	6	8	6	6					
15.5-15.75	6	6	5	4	4	6	8	5	4	4
17-17.25										
18-18.25	6	4	4	5	4	5				
19.5-19.75										
26.5-26.75	4	5	5	5	5	6	5	4.5	4	4.5
35-36	5	6	6	4	4	5	5	4	4	

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella comensis var. 1*										*Cyclotella comensis var. tripartita*	
Sediment	Dimensions										Dimensions	
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	5.5	5	3.5	4	5	5	6	4.5				
0.25 - 0.5	5	6										
0.5 - 0.75	5											
0.75 - 1	5	5	5	5								
1 - 1.25	5	4.5	4	4								
1.25 - 1.5	5.5	5	5	5	6						7	
1.5 - 1.75	7	5.5	4	6	6	5						
1.75 - 2	5	5.5										
2 - 2.25												
2.25 - 2.5	6	6	5									
2.5 - 2.75	6											
2.75 - 3	5.5	6.5									4	6
3.5-3.75												
4-4.25												
5-5.25											6	
6.25-6.5												
8-8.25												
9.5-9.75												
12.25-12.5												
14-14.25	4.5	5										
15.5-15.75	5	6	6	6								
17-17.25	3.5	3.5	4	3.5	3.5	4	4	4	4	3		
18-18.25	4	4	4	4								
19.5-19.75												
26.5-26.75	5	5	4									
35-36	6											

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella comensis* var. 'rough center with process'										
Sediment	Dimensions										
Interval	Dm	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm
0 - 0.25	7	6	6.5	5	6	6		5.5	6	5	7
0.25 - 0.5	7	8	6	7	5.5	6		7	7	6	7
0.5 - 0.75	7	8	6	6	8	7		6	7	5.5	8
0.75 - 1	6	6	8	5	7	7		5.5	7	8	9
1 - 1.25	6	6	5	6	7	6		7	6	7	7
1.25 - 1.5	7	7	7	7.5	7	7	2	7	6	6	7
1.5 - 1.75	7	8	7	7	7	7		7	7	7	7
1.75 - 2	7	5	6	6	7	8		7	7		
2 - 2.25	6	8	6	8	6	6		7	8	8	7
2.25 - 2.5	6	7	7.5	6	6	7		7	6	6	6
2.5 - 2.75	7	7	7	6	6	7		6	8	6	6
2.75 - 3	8	6	6	8	6	6		5.5	7	8	6
3.5-3.75	6	6	7	5	7	7		7	7	5	9
4-4.25	7	7	7	6	8	7		6.5	8	6.5	7
5-5.25	7	6	6	6	6	6					
6.25-6.5	7	7	6								
8-8.25	6.5	8.5	7	7	7	7					
9.5-9.75	9										
12.25-12.5											
14-14.25	6	8	8								
15.5-15.75	7.5	8	10								
17-17.25	6	6	7								
18-18.25	5	7	6	6	7	7					
19.5-19.75											
26.5-26.75	6	7	7	6	7	6		8	7	6	9
35-36	8.5	7.5	7	8	9	8		8	6	9	

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella comensis* var. 'rough center with process' Type B									
Sediment	Dimensions									
Interval	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	7.5		9	8	8.5	7	9	10	9	8	12
0.25 - 0.5	9		8.5	13.5	8	8	11.5	9	8	11	10
0.5 - 0.75	10		8	9	7	7	7.5	8	9	8	10
0.75 - 1	9		8	10	8.5	8	10	9	9		
1 - 1.25	9		8	8.5	7	8	8	8	8	8	8
1.25 - 1.5	8		8	11	9	8	7	8	10	7.5	7
1.5 - 1.75	10		9	9	12	8	10	8	12	11	10
1.75 - 2	9.5		9	8	8	10.5	12	7	11	8	9
2 - 2.25	10		10	11	10	11	10	12	13	10	10
2.25 - 2.5	10	10	8	9.5	10	9.5	7.5	7			
2.5 - 2.75	11		8	12	9	11	11	10	12	9	9
2.75 - 3	7		6	7.5	7.5	11	7	8	8	8	8
3.5-3.75	8		8	11	7.5	9.5	8	10	8	7	8
4-4.25	8		9	9.5	8	9.5	10	9	10	9	13
5-5.25	12		10								
6.25-6.5	6		8	8	8	8	8				
8-8.25	12.5		10	13	15	11	14				
9.5-9.75	16										
12.25-12.5	9		8	7	7	8	8				
14-14.25	13.5		13.5	13	13	13	11	13	11	13	12
15.5-15.75	15		15	14	14	12	21	8	14	9	7
17-17.25											
18-18.25	25.5		21								
19.5-19.75											
26.5-26.75	11.5		14	9	17	10	16	10	9	11	11
35-36	10		11	15	16	11.5	11	12	10	11	11

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella distinguenda/ operculata*						*Cyclotella meneghaniana*			
Sediment	Dimensions						Dimensions			
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	10						6	7		
0.25 - 0.5	15						7	7	6	
0.5 - 0.75										
0.75 - 1	17	14					11.5			
1 - 1.25										
1.25 - 1.5	18	11					6.5	6.5	6	7
1.5 - 1.75	16						6	6	6	6
1.75 - 2							6	6		
2 - 2.25	5	6	5	6	10	10				
2.25 - 2.5	12	12								
2.5 - 2.75										
2.75 - 3	15						6	6	6	
3.5-3.75	7									
4-4.25	6	6	6	6	6	6				
5-5.25										
6.25-6.5							6			
8-8.25							6	6		
9.5-9.75										
12.25-12.5										
14-14.25										
15.5-15.75							8	8		
17-17.25										
18-18.25							8			
19.5-19.75										
26.5-26.75										
35-36	10.5						6	6	6	

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Cyclotella ocellata*																
Sediment	Dimensions																
Interval	Dm	D	Dm	D	Dm	D	Dm	D	Dm	D	Dm	D	Dm	Dm	Dm	Dm	D
0 - 0.25	5		6		5		6		5		6		6	5	5.5	6	
0.25 - 0.5	4		6		6		4.5		6		5		6	4.5	5	5	
0.5 - 0.75	4		5	1.2	5		7		5	2	6		7	6	7.5	8	
0.75 - 1	5		5.5		6.5		5		7		4		5	6	5	7	
1 - 1.25	6		4.5		7		5		6		6		7	5	4	6	
1.25 - 1.5	6.5	3.2	5	3	7		9.5		7		6		5	7	6	6	
1.5 - 1.75	6		7		6		6		5		4.5		5.5	6	8	12	
1.75 - 2	5.5		5		5		5		7		7		6	5	5	4	
2 - 2.25	4		8		5		8		6		6		6	4	7	10	
2.25 - 2.5	5.5		6		7		6		5		6.5		6	5	5	4	
2.5 - 2.75	5		4		7		8		7		4		7	5	7	4	
2.75 - 3	5		6		6		6		6		6		6	5	5	4	
3.5-3.75	6		5	3	6		8		5		6.5		5	6	10	5.5	
4-4.25	5	2	6	2	5.5	4	5	3	6		5		6.5	8	7	4	3
5-5.25	6		6		5		6		7		8		8	10	7	9	
6.25-6.5	6		5		6		6		7.5		10		11	9	7	10	
8-8.25	6.5		7		6		7		6		9		5	9	6	6	
9.5-9.75	7		8		7		8		5		9		12	9	10	8	
12.25-12.5	8		6		7.5		8		7		5	3	13	13	15	9	
14-14.25	6.5		6.5		6		7		7		12		5	6	11	5	
15.5-15.75	15		17	4.5	20		12		6.5		6		4	11	6.5	7	
17-17.25	6.5	4.5	6		8		8		5		10		7	11	6	10	
18-18.25	12		12		7		15		5		13		14	9	5	7	
19.5-19.75																	
26.5-26.75	5		6		10		6		7	4	9		6	10	9	7	
35-36	7		6		9.5		7.5		7		10		7	3	5.5	8	5

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Discostella pseudostelligera*																												
Sediment	Dimensions																												
Interval	Dm	D		Dm	D		Dm	D		Dm	D		Dm	D		Dm	D		Dm	D		Dm	D		Dm	D		Dm	D
0 - 0.25	5			4			4.5			4			3.5			3.5			5			4			5				
0.25 - 0.5	4	2.2		4	2.6		3			3.5			3			4			4			3			3.5			3	
0.5 - 0.75	4			5	1.5		4			4			5			4.5			5	3.5		4			3.5	3		3.5	
0.75 - 1	4.5			4	2.4		4	3		3	2.4		4			3			4			3			4			5	
1 - 1.25	4			3.5			3			3			4			4			3.5			3			3			4	
1.25 - 1.5	5	1.6		4	2		3	2		4			3.5			5			4			4			6			5	
1.5 - 1.75	2			2			3.5			3			4	2		4	2		4			4			4			4	
1.75 - 2	4	1.9		5			4			4			4			3	4		4			4.5			4			4	
2 - 2.25	5			5			4			2			2			4			5			4			2			3	
2.25 - 2.5	5			4			3	3		4			4			4			5			4			3			6	
2.5 - 2.75	3.5			3.5			3.5			2.5			3			4	3		4			5			5			5	
2.75 - 3	4			4	2		4			5			4.5			3	3		5			4.5			3			5	
3.5-3.75	4	3		3.5			4			4			4			4			4			4			4	2		4	
4-4.25	4.5	2		5	3		3			4			4			4			4.5			4			4			4	
5-5.25	2			2			4			4			4			5			5			6			4			4	
6.25-6.5	4			4			4			4			3			3			3		3	3			3			3	
8-8.25	4.5			4			6			4			4			6			6			5			5			4	
9.5-9.75	4			4			5			3			4			4			5			4			5			4	
12.25-12.5	3.5	2		4			3			5			5			4.5			4			3			5				
14-14.25	6	3		4	2		4			4			4			4			4			5			5			5	
15.5-15.75	3.5			3			4.5			3			3			4			6	5		4			6.5			4	3
17-17.25	4			4			3			4			4	2		3.5			3.5			5			4			4	
18-18.25	5			3			4			3.5	2.7		3	2		4.5			3			3.5			3			4.5	
19.5-19.75																													
26.5-26.75	2.5			3.5			3			4.5			4			4			5			5			3			4	
35-36	4	3.4		4	3.1		4	2		6			3.5			5			4			5			4.5			3	

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Discostella stelligera*										
Sediment	Dimensions										
Interval	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	6	5		5	7						
0.25 - 0.5	7	5		5	5	5	7	5	5	5	5
0.5 - 0.75	6.5	5.5		6	6	6	6				
0.75 - 1	5	8		5							
1 - 1.25	6	8									
1.25 - 1.5	8	6	2	6	6	6.5	5	5	5	6	7
1.5 - 1.75	5	5									
1.75 - 2	6	5		7	6						
2 - 2.25	9	8		9	7	6	10				
2.25 - 2.5	5	5									
2.5 - 2.75											
2.75 - 3	5	5		8	5						
3.5-3.75	10										
4-4.25	6	7.5		5							
5-5.25	8	6.5		8	8	10	4	9	6	8	10
6.25-6.5	5	6.5		7	8	6	5	6	7	5	6
8-8.25	7	6		6	6	6	7	6	6	7	
9.5-9.75	8	7		8	6	8	6	8	10	7	6
12.25-12.5	5	8		5	5						
14-14.25	5	6		6	5	5.5	6	5	6	6	6
15.5-15.75	5.5	5		7	5	6	6				
17-17.25	5	6		5	5.5	5	4.5	6	4	5	5
18-18.25	6	6		5	7	5					
19.5-19.75											
26.5-26.75	6	6		6	6	6	5	6			
35-36	8	8		8	5	6					

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b.

Diatom size measurements for eastern core of Lake Superior (LG#1)

Centric

Species	*Stephanodiscus #10*										*Stephanodiscus #51*	
Sediment	Dimensions										Dimensions	
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25											6	
0.25 - 0.5	4	5										
0.5 - 0.75	4	4	6									
0.75 - 1	4.5	4	4	4							5	
1 - 1.25	5	4										
1.25 - 1.5	5	6	6									
1.5 - 1.75	7	6										
1.75 - 2	4	6.5										
2 - 2.25	6.5											
2.25 - 2.5	5.5	6.5										
2.5 - 2.75	5										7	
2.75 - 3	5	4.5									6	
3.5-3.75	6											
4-4.25	7											
5-5.25												
6.25-6.5												
8-8.25	5	5	6									
9.5-9.75	5.5	6	5	6	5							
12.25-12.5												
14-14.25	6.5	6	6									
15.5-15.75	6	6	6	7	6	6	6	7	5	6	7	5
17-17.25	5	5	5	6	5	5	6.5	5	6	6		
18-18.25	5	7	5.5	5	4.5	7	6				6	
19.5-19.75												
26.5-26.75	4.5											
35-36	5	5	5	7	6	7					6	

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Stephanodiscus alpinus*										*Stephanodiscus binderanus*		
Sediment	Dimensions										Dimensions		
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25													
0.25 - 0.5	25												
0.5 - 0.75													
0.75 - 1	15	10											
1 - 1.25													
1.25 - 1.5													
1.5 - 1.75													
1.75 - 2	24										6	5	
2 - 2.25													
2.25 - 2.5													
2.5 - 2.75	16										6	7	7
2.75 - 3	12.5	10									7		
3.5-3.75													
4-4.25	24.5	15.5	13	11	13	10	20	17	20	18	6		
5-5.25													
6.25-6.5													
8-8.25	12.5	13	19	14	14	14	10	15	12	16			
9.5-9.75	12												
12.25-12.5													
14-14.25	13	12	12										
15.5-15.75	11.5	15	9	16	11								
17-17.25													
18-18.25	10.5	12	12										
19.5-19.75													
26.5-26.75													
35-36													

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Stephanodiscus conspicueporous*													
Sediment	Dimensions													
Interval	Dm	D	Dm	Dm	D	Dm	D	Dm	Dm	Dm	Dm	D	Dm	Dm
0 - 0.25	16		15											
0.25 - 0.5	18		40	9		16		9	17	23				
0.5 - 0.75	16		13	14	9	14		18	24	13	14	9	18	
0.75 - 1	23.5		14.5	16		40		45						
1 - 1.25	17		23	12		17.5		15	10					
1.25 - 1.5	11	6.6	16	18										
1.5 - 1.75	17		18	19		12		27	36					
1.75 - 2	16		13	17										
2 - 2.25	13		18	13		16		10	21	15	12		10	
2.25 - 2.5	35													
2.5 - 2.75	16		25.5	9										
2.75 - 3	11		12	19										
3.5-3.75	22		12	13		17		17						
4-4.25	13		24.5	11		15.5		10	20	17	13		20	18
5-5.25	11		12	10		17		15	14	17	12		12	16
6.25-6.5	15		18	10		17		13	13.5	18	13		13	15
8-8.25	12.5		13	19		14		14	14	10	15		12	16
9.5-9.75	17		15	17		17		18	10	13	9		13	15
12.25-12.5	12		13.5	14.5		11	2	10	15	16	9		12	
14-14.25	13		11	12		15		17	11	16	15		15	
15.5-15.75	13.5		10	10		14		9	17	15	16		12	29
17-17.25	12		12	10		10		14	12	16	14		20	10
18-18.25	16		16	14		11.5		16.5	6	8	14		10	8
19.5-19.75	11.5		10	14		15		14	17	26	17		19	
26.5-26.75														
35-36	10		9	20		15		13	11	8	12		17	12

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Stephanodiscus hantzschii*					*Stephanodiscus minutulus*		*Stephanodiscus niagarae*	
Sediment	Dimensions					Dimensions		Dimensions	
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	D
0 - 0.25	6					3.5	5	49.5	
0.25 - 0.5						4			
0.5 - 0.75	6	6						49	
0.75 - 1	6	6							
1 - 1.25	5	5.5							
1.25 - 1.5	7	6	5.5	6.5	5				
1.5 - 1.75	5								
1.75 - 2								61	
2 - 2.25	6					5			
2.25 - 2.5	7								
2.5 - 2.75						4			
2.75 - 3	6.5								
3.5-3.75	5							60	
4-4.25	6					4	5		
5-5.25									
6.25-6.5									
8-8.25	6								
9.5-9.75	6.5								
12.25-12.5	6								
14-14.25									
15.5-15.75	7	7	7			4			
17-17.25	6								
18-18.25	7					4			
19.5-19.75									
26.5-26.75								56	
35-36	7	7							

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4b. Diatom size measurements for eastern core of Lake Superior (LG#1) Centric

Species	*Stephanodiscus parvus*										*Stephanodiscus subtransylvanicus*							
Sediment	Dimensions										Dimensions							
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	4	4	4	5	4	5	4	4	4.5	5	47	37	44					
0.25 - 0.5																		
0.5 - 0.75											48	49	49					
0.75 - 1	5	5	5	5.5														
1 - 1.25	4.5										43	42	42	41				
1.25 - 1.5	5	6	7.5	4.5	6.5	5	5				44	46						
1.5 - 1.75	6																	
1.75 - 2	6	4	6	5	7	7					38	32						
2 - 2.25	6										46							
2.25 - 2.5	6.5	6.5	6	6	6													
2.5 - 2.75	6	7	5								33	38	39	44				
2.75 - 3	5.5	4.5	6	5							40	28	45	35	32			
3.5-3.75	5										38	38	38					
4-4.25	6.5	5									45	39						
5-5.25	6	4.5	6								25	48	39					
6.25-6.5											36.5	48						
8-8.25	6	6.5	5	4	4.5	4.5	5.5	5	5		40	36	42	43	32	42	44	41
9.5-9.75	6	5.5									40	37	50	40	37			
12.25-12.5	6	6																
14-14.25	6	7	6															
15.5-15.75	8	6	6	5	7	8	6	6	6	8	49	39	42					
17-17.25	6.5	6	6	6	5						36	35	35	45				
18-18.25	6	6	5	5	6	6	7	6	5	6	31	33						
19.5-19.75																		
26.5-26.75	6	5									43	43	38					
35-36	6.5	5	6.5	5.5	5	6	6	5.5	5	6								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Achnanthes (Eucocconeis) flexella*		*Achnanthes (Karyvekii) cleveii*				*Achnanthes amoena*		*Achnanthes binodis*		*Achnanthes laevis*	
Sediment	Dimensions		Dimensions				Dimensions		Dimensions		Dimensions	
Interval	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25												
0.25 - 0.5												
0.5 - 0.75							9	4				
0.75 - 1			18	7								
1 - 1.25												
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2												
2 - 2.25			13	6	14	6						
2.25 - 2.5			9	4								
2.5 - 2.75									8	2.5		
2.75 - 3			24	9								
3-3.25												
3.5-3.75			13.5	6								
4.5-4.75									13	5		
5.5-5.75			13	5								
6.5-6.75											17	6
7-7.25											14	8
8.5-8.75									7	3		
10-10.25	24	10	13	5								
13-13.25			20	7								
20-20.25			16	5	14	5	9	4				

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Achnanthes minutissima*													
Sediment Interval	Dimensions													
	L	W	D	L	W	D	L	W	L	W	D	L	W	D
0 - 0.25	13	2												
0.25 - 0.5	13	3		15	4									
0.5 - 0.75	16	3												
0.75 - 1	11	3												
1 - 1.25	11		4	9	3		9	3						
1.25 - 1.5	17	3												
1.5 - 1.75														
1.75 - 2	15		3.9											
2 - 2.25	12	3												
2.25 - 2.5														
2.5 - 2.75	12.5		3	10		2.8								
2.75 - 3	8	3												
3-3.25	14	2		10	2									
3.5-3.75	10.5	3												
4.5-4.75	6.5		2	10	3		14	3.5	15		3.4	8		2.6
5.5-5.75	9	3		7	3		10	3	9	3				
6.5-6.75	14	3		14	2.5									
7-7.25														
8.5-8.75	8	3		14	3									
10-10.25	15	2		10		2.8								
13-13.25														
20-20.25	15		3.7	9		2.3								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Achnanthes minutissima var. scotica*									*Achnanthes suchlandii*			
Sediment Interval	Dimensions									Dimensions			
	L	W	D	L	W	D	L	W	D	L	W	L	W
0 - 0.25													
0.25 - 0.5										11	5		
0.5 - 0.75	23.5	4		21		3.9							
0.75 - 1	14	2.5		12	3.6								
1 - 1.25													
1.25 - 1.5	23	4								8	4		
1.5 - 1.75	20	3											
1.75 - 2	25	4		22	3								
2 - 2.25										10	5		
2.25 - 2.5	13	4.5		25.5	3								
2.5 - 2.75	16		2.8	16		6							
2.75 - 3	13.5	3											
3-3.25	20	4		27	4					9	3.5		
3.5-3.75	20	3		15		3				8	4		
4.5-4.75	24	2								8	4		
5.5-5.75	17		3.8	18.5		3.9				9	6	10	4
6.5-6.75	22	3		26	3		17		2.7				
7-7.25	15	3.5		22	3								
8.5-8.75	24	2.5											
10-10.25	27		4	22		4	19	3					
13-13.25	21		5							8	4		
20-20.25	22	3		24	3								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Amphora inaeriensis*			*Amphora neglecta*						*Amphora pediculus*		
Sediment	Dimensions			Dimensions						Dimensions		
Interval	L	W	D	L	W	D	L	W	D	L	W	D
0 - 0.25												
0.25 - 0.5												
0.5 - 0.75												
0.75 - 1												
1 - 1.25	38		11									
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2												
2 - 2.25												
2.25 - 2.5												
2.5 - 2.75												
2.75 - 3				24	11.9							
3-3.25												
3.5-3.75												
4.5-4.75												
5.5-5.75				22		9.2	13	2	5.4			
6.5-6.75												
7-7.25												
8.5-8.75												
10-10.25				41	7.5					10	2	4.4
13-13.25				30	5							
20-20.25												

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Asterionella formosa*													
	Dimensions													
Sediment Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W
0 - 0.25														
0.25 - 0.5	61	5	3											
0.5 - 0.75	58		2.4	62		3.5	53	5		48		2.3		
0.75 - 1	82		3											
1 - 1.25	58	5												
1.25 - 1.5	71		2.6	8	5		13	8.5						
1.5 - 1.75	56	5		50		3								
1.75 - 2	81		4.9	94	2	4	53	4	2.7	53	4	2.6	74	6
2 - 2.25	59		4.2											
2.25 - 2.5	45	4.5		45	5		78	4	3					
2.5 - 2.75	53.5	5				6								
2.75 - 3	76		7.6	59	5	1.8								
3-3.25			3											
3.5-3.75														
4.5-4.75														
5.5-5.75	81	5	3.8											
6.5-6.75	61		2.6											
7-7.25														
8.5-8.75														
10-10.25	65		4											
13-13.25														
20-20.25														

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Brachysira (Anomoneis)*				*Cocconeis neodiminuta*				*Cocconeis placentula*	
	Dimensions				Dimensions				Dimensions	
Sediment Interval	L	W	L	W	L	W	L	W	L	W
0 - 0.25										
0.25 - 0.5	26	6								
0.5 - 0.75										
0.75 - 1	24	5								
1 - 1.25										
1.25 - 1.5	32	4								
1.5 - 1.75										
1.75 - 2										
2 - 2.25					12	9				
2.25 - 2.5										
2.5 - 2.75										
2.75 - 3										
3-3.25					10	6				
3.5-3.75									19.5	12.5
4.5-4.75										
5.5-5.75										
6.5-6.75	12	4	18	4.5					21	13.5
7-7.25										
8.5-8.75										
10-10.25										
13-13.25					12	8			14	8.5
20-20.25					10	6	12	8		

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Cymbella cistula*		*Cymbella delicatula*			*Cymbella microcephela*		*Cymbella silesciaca*			
Sediment Interval	Dimensions		Dimensions			Dimensions		Dimensions			
	L	W	L	W	D	L	W	L	W	L	W
0 - 0.25			29	6							
0.25 - 0.5			22	4							
0.5 - 0.75											
0.75 - 1											
1 - 1.25											
1.25 - 1.5											
1.5 - 1.75											
1.75 - 2	45	19									
2 - 2.25											
2.25 - 2.5											
2.5 - 2.75						13	3.5				
2.75 - 3			25		5						
3-3.25											
3.5-3.75											
4.5-4.75	36	12									
5.5-5.75											
6.5-6.75								14	5.5	15	6
7-7.25											
8.5-8.75											
10-10.25						17	3				
13-13.25											
20-20.25											

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Cymbella sinuata*				*Diatoma monoliformis*		*Diatoma tenue*			*Eunotia*	
Sediment	Dimensions				Dimensions		Dimensions			Dimensions	
Interval	L	W	L	W	L	W	L	W	D	L	W
0 - 0.25	40	15									
0.25 - 0.5											
0.5 - 0.75											
0.75 - 1							33		4.3		
1 - 1.25											
1.25 - 1.5											
1.5 - 1.75											
1.75 - 2					17	4.5					
2 - 2.25											
2.25 - 2.5	12	4	12	4							
2.5 - 2.75											
2.75 - 3											
3-3.25											
3.5-3.75											
4.5-4.75											
5.5-5.75	15	4								65	11
6.5-6.75					16	4					
7-7.25											
8.5-8.75											
10-10.25											
13-13.25											
20-20.25					18	4					

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Fragilaria capuncina*		*Fragilaria crotonensis*													
Sediment Interval	Dimensions		Dimensions													
	L	W	L	W	D	L	W	D	L	W	D	L	L	L	L
0 - 0.25			67			78			90			83	76	78	80
0.25 - 0.5			120		4										
0.5 - 0.75					3.1										
0.75 - 1															
1 - 1.25					3			3.7							
1.25 - 1.5															
1.5 - 1.75					4										
1.75 - 2			53		4.2										
2 - 2.25					6.4										
2.25 - 2.5					3.5			3			4.5				
2.5 - 2.75					2.6										
2.75 - 3															
3-3.25			124												
3.5-3.75	21	3													
4.5-4.75															
5.5-5.75															
6.5-6.75															
7-7.25															
8.5-8.75			67		5.2	75		2.7							
10-10.25			84		3										
13-13.25			130												
20-20.25			76		7										

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Fragilaria pinnata*					*Gomphonema*			*Martyana martyii*				
	Dimensions					Dimensions			Dimensions				
Sediment Interval	L	W	D	L	W	L	W	D	L	W	D	L	W
0 - 0.25						27	6						
0.25 - 0.5													
0.5 - 0.75													
0.75 - 1													
1 - 1.25													
1.25 - 1.5													
1.5 - 1.75													
1.75 - 2									11		5		
2 - 2.25	5	3											
2.25 - 2.5													
2.5 - 2.75									11		3.7		
2.75 - 3	5.5	4		5.5	3				9	4			
3-3.25	8	3		5	3								
3.5-3.75													
4.5-4.75													
5.5-5.75	6		4.7	10	3.5				10		7		
6.5-6.75	5	3							14	5			
7-7.25						26		7					
8.5-8.75	5		7.3	6	3								
10-10.25	6	3				24	8						
13-13.25									13	6.2		14	5
20-20.25	6	3							10	5			

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Navicula cf radiosa*		*Navicula cryptotenella*				*Navicula holsatica*		*Navicula minima*			
	Dimensions		Dimensions				Dimensions		Dimensions			
Sediment Interval	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25			25	6					6.5	4	8	4
0.25 - 0.5												
0.5 - 0.75												
0.75 - 1	70	13	32	6								
1 - 1.25									7.5	5		
1.25 - 1.5	62	12							6	3		
1.5 - 1.75												
1.75 - 2			34	6.5					11	5		
2 - 2.25												
2.25 - 2.5									5	3	8	4
2.5 - 2.75									10	4		
2.75 - 3												
3-3.25												
3.5-3.75	36.5	7					6	4				
4.5-4.75												
5.5-5.75									5	3		
6.5-6.75												
7-7.25									6	3	10	4
8.5-8.75												
10-10.25									6	2.5		
13-13.25			24	5	23	6						
20-20.25									10	5		

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Navicula pseudoscutiformis*		*Navicula pupula*		*Navicula unknown*							
	Dimensions		Dimensions		Dimensions							
Sediment Interval	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25					8	3	8	6	10	3	10	4
0.25 - 0.5												
0.5 - 0.75					15	4						
0.75 - 1												
1 - 1.25												
1.25 - 1.5												
1.5 - 1.75												
1.75 - 2												
2 - 2.25			10	4.5								
2.25 - 2.5												
2.5 - 2.75												
2.75 - 3					25	4.5						
3-3.25												
3.5-3.75					44	18						
4.5-4.75					15.5	4						
5.5-5.75												
6.5-6.75												
7-7.25												
8.5-8.75												
10-10.25					40	7						
13-13.25	12	8										
20-20.25												

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Nitzschia agnita*				*Nitzschia amphibia*		*Nitzschia fonticola*					
Sediment Interval	Dimensions				Dimensions		Dimensions					
	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25												
0.25 - 0.5												
0.5 - 0.75												
0.75 - 1												
1 - 1.25												
1.25 - 1.5												
1.5 - 1.75							30	4				
1.75 - 2					13	3						
2 - 2.25	15.5	2					15	4				
2.25 - 2.5							22	3	20	3		
2.5 - 2.75	25.5	2.5										
2.75 - 3	18	3										
3-3.25							22	3	21.5	2.5		
3.5-3.75	31	3	21	3								
4.5-4.75	18	2										
5.5-5.75							18	3	15	3	20	3
6.5-6.75	17	3										
7-7.25	27	3										
8.5-8.75	16	3										
10-10.25	19	2.5	23	3			28	4.5				
13-13.25												
20-20.25												

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Nitzschia gracilis*				*Nitzschia lauenburgiana*					*Nitzschia linearis*	
Sediment Interval	Dimensions				Dimensions					Dimensions	
	L	W	L	W	L	W	L	W	D	L	W
0 - 0.25											
0.25 - 0.5											
0.5 - 0.75	96	4	92	3						57	3
0.75 - 1											
1 - 1.25											
1.25 - 1.5											
1.5 - 1.75											
1.75 - 2											
2 - 2.25											
2.25 - 2.5											
2.5 - 2.75											
2.75 - 3											
3-3.25											
3.5-3.75					90	4					
4.5-4.75											
5.5-5.75											
6.5-6.75											
7-7.25											
8.5-8.75	94	3.5			106	5.5	93	3.75	6.7		
10-10.25											
13-13.25											
20-20.25											

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Nitzschia palea*						
Sediment Interval	Dimensions						
	L	W	D	L	W	L	W
0 - 0.25							
0.25 - 0.5	60	4		64	5		
0.5 - 0.75	93	3.5		91	3	30	4.5
0.75 - 1							
1 - 1.25							
1.25 - 1.5	105	4.5					
1.5 - 1.75							
1.75 - 2	39	3		57	3		
2 - 2.25							
2.25 - 2.5	130	5					
2.5 - 2.75	47	3.5		52	4		
2.75 - 3	49	4					
3-3.25							
3.5-3.75							
4.5-4.75							
5.5-5.75							
6.5-6.75							
7-7.25	58	4					
8.5-8.75	49	4					
10-10.25							
13-13.25	29		5				
20-20.25							

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Rhizosolenia eriensis*																			
	Dimensions																			
Sediment Interval	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	18	6	20	5	20	7	29	3	12	4	29	5	30	5	31	7	26	6		
0.25 - 0.5	24	4.5	19	3	15	3	10	3	21	6	15	5.5	25	3						
0.5 - 0.75	18	5	16	4.5	33	6														
0.75 - 1	32	3	27	3	29	5	8	5	25	3	14	5	32	3	14	3				
1 - 1.25	27.5	5	13	4	25	4	30	3	24	2	32	5	12	5						
1.25 - 1.5	27	5	21	6	30	9	36	3	29	6	36	5	32	5						
1.5 - 1.75	17	3	7	3	38	4	37	5	29	4	33.5	5.5								
1.75 - 2	28	5.5	20	4	30	5														
2 - 2.25	12	6	29	5	41	5	14.5	4	24	4.5	14	2.5	22.5	4	23	6.5				
2.25 - 2.5	9	2.5	32	6	33	4														
2.5 - 2.75	22.5	5	29	4	33	4	21	4	31.5	5	28	6	22.5	2.5	36	8	11.5	4	39	7
2.75 - 3	27	8	14	6.5	27	6.5	22	3	24	3	23	5.5								
3-3.25	29	5	35	3	9	3.5	13	4	13	5	17	2	11	6	25	4				
3.5-3.75																				
4.5-4.75	23	4	18	4.5	16	3	34	6	43	5										
5.5-5.75	11	5	19	3.5	36	4	9	2	16	3.5	23	6	17	5.5	22	3	31	3	27	5
6.5-6.75	23	4	28	6	41	4	15	2	11	4	24	5	29	5	10	3	30	5		
7-7.25	32	6.5	28	6	32	4	28	4	15	3.5	34	6	47	7						
8.5-8.75	26.5	4	15	5	41	4	17	5	21	4	20	2	17	5	20	4	34	3.5	15	5
10-10.25	25	5	15	5	38	6	18	3.5	11	3	45	8								
13-13.25	22	5	29	7	30	4	18	6	24	5	56	15	22	6						
20-20.25	13.5	4	28	3.5																

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Rhizosolenia gracilis*																			
Sediment Interval	Dimensions																			
	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	8	2	15	3	10	2	9	1												
0.25 - 0.5	14	2	10	3.5	13	2.5	15	3	29	2	22	1.5								
0.5 - 0.75	17	3	14	2																
0.75 - 1	20	3	20	3	10	1														
1 - 1.25	22	1	5	1	25	2.5	25	4												
1.25 - 1.5	10	2	10	2	20	2	27	2	16	1.5	17	3								
1.5 - 1.75	9.5	2	11	3	41	4	6.5	2	15	1.5	30	1.5								
1.75 - 2	12	1	10	1.5	9	1	21	2	28	1.5										
2 - 2.25	27	4.5	10	1	35	2	10	2	8	2										
2.25 - 2.5	26	2	29	2	5.5	2	12	2	33	3										
2.5 - 2.75	25	1.3																		
2.75 - 3	29	3	21	1	10	4.5	28	2	16	1	15	2								
3-3.25	16	3.5	24	1	25	1	10	2	29	1	29.5	2.5								
3.5-3.75																				
4.5-4.75	40	4	25	2	13	3	9	2												
5.5-5.75	21	2	11	3	13	3	10	1.5	8	3	28	3	13	2						
6.5-6.75	10	2	8	1	20	2	13	1.5	17	3	17	1.5	20	1	13	1	30	4	22	1.5
7-7.25	22	3	18	4	25	3	19	2.5	20	5	29	1								
8.5-8.75	28	2	12	2	16	2	14	1	11	2	40	2	9	2	16	3	17	2	20	2
10-10.25	20	2	7	2	17.5	2	30	2	26	4	40	2	20	4	31	3	40	1	12	4
13-13.25	10	2	11	3	20	4	10	1												
20-20.25	14	1	12	3	17	3	10	2	8	2	20	2	12.5	3						

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Surirella*		*Synedra amphicephela (Fragilaria vaucherie)*								*Synedra cyclopum*	
Sediment Interval	Dimensions		Dimensions								Dimensions	
	L	W	L	W	D	L	W	D	L	W	L	W
0 - 0.25												
0.25 - 0.5			44	4.5								
0.5 - 0.75			160		7.8	42	2					
0.75 - 1												
1 - 1.25												
1.25 - 1.5			74	5.5							31	4
1.5 - 1.75			43	2.5								
1.75 - 2	116	28	35	3		24		4				
2 - 2.25												
2.25 - 2.5			61	4								
2.5 - 2.75												
2.75 - 3			27	6		28	3					
3-3.25											62	4
3.5-3.75			40	3		32		3.6	24.5	4.5		
4.5-4.75												
5.5-5.75	83	31									37	4
6.5-6.75			32	4		28	3					
7-7.25												
8.5-8.75												
10-10.25			22	3.5		30		2.5	33	3	36	4
13-13.25												
20-20.25			36	2								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Synedra filiformis*																					
	Dimensions																					
Sediment Interval	L	W	D	L	W	D	L	W	L	W	D	L	W	L	W	L	W	L	W	L	W	D
0 - 0.25	98	3																				
0.25 - 0.5	46	3		54	3		50	3														
0.5 - 0.75	58		3.9																			
0.75 - 1	55		2.9	47		3	46	2	53	3		59	2									
1 - 1.25	59		3.2	52.5	2.5		27.5	2.5	48		2.5	53	2.5	51	4							
1.25 - 1.5	48		2.6	50		2.7	54	3	46		3.5											
1.5 - 1.75	56		3	60		3	45	2	60.5		2.7	60	2	47	2	50		62.5	2	50		2.8
1.75 - 2	50		3	52		2.2	61	2	47		2.3	53	3	48	2	64	3	56	3	59		2.5
2 - 2.25	69		2.3	57		3	77	2	83	3.5		77	2									
2.25 - 2.5	43.5		2.2	43		3	60	3	45		4	48	2	53	2							
2.5 - 2.75	62		2.3	56		3	58	2.5	67		2.7											
2.75 - 3	48	2	3.8	60		3	51	1.5	47	2		46	2.5	68								
3-3.25	54	2		50	2																	
3.5-3.75																						
4.5-4.75	70	2																				
5.5-5.75	46	2		50		2.8																
6.5-6.75	61	3		55		2.7	56	2	79	2												
7-7.25	90	2.5																				
8.5-8.75																						
10-10.25	66.5		2.6	51	2.5		48	2														
13-13.25	91	3																				
20-20.25	52		2.5	65		3.5																

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Synedra filiformis var. exilis*																							
Sediment	Dimensions																							
Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	38	3																						
0.25 - 0.5	35.5		3.5	44	2		39	3		39	3													
0.5 - 0.75	43		3.2	45		2.3	40		2	40		3	45	2										
0.75 - 1	43		2.9	34		2.3	39		2.6	39	2		32	2	42	2	43							
1 - 1.25	40	2		28		2	32	2		46	2.5		46	2.5	42	3	22	2	39	3	42	3	47	3
1.25 - 1.5	46		2.8	40		3	37		2.5	38	3.5		40	3	26	2	48	2	48	3	41	2		
1.5 - 1.75	36		2.6	42	2.5		25	2		40	2.5		41	2.5	44	2.5	39	3	43	2				
1.75 - 2	29		2	45		2.4	38		2	29	1.5		24	2.5	33	2	41	2.5	42	3	38	2	35	2
2 - 2.25	31	2																						
2.25 - 2.5	40		3.7	31	2		39	3		33	2.5		34	2.5	44	3	30	2.5						
2.5 - 2.75	40		3	43	2	3.6	35		2.6	7.5	2.5		33	2	25	2	30	2						
2.75 - 3	26	1.5	3	44		3.6	32	3		7		2.3	33	2	38	2	35	2	26	2	28	2		
3-3.25	35		3	41		3.8	30		2	30		3	39	2			48							
3.5-3.75										33	2.5													
4.5-4.75	20		1.7	20		2.5	29		2.2	25		3												
5.5-5.75	26		3.2	29		1.8	29	2		36	3													
6.5-6.75	41	2	3.5	30		3	35		2.5	46	3		31	3	34	3	27	2	29	2	34	3	32	2
7-7.25																								
8.5-8.75	25	3																						
10-10.25	26		2.4	35	2		37		2.5															
13-13.25	38		2.2			6			3															
20-20.25																								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Synedra nanan/ delicatissima*								*Synedra radians*					
	Dimensions								Dimensions					
Sediment Interval	L	W	D	L	W	L	W	D	L	W	D	L	W	D
0 - 0.25									92	3				
0.25 - 0.5	86		5.5						46		4.5			
0.5 - 0.75									88		4.4			
0.75 - 1									61		4.4			
1 - 1.25														
1.25 - 1.5									65		5.8	76		6
1.5 - 1.75														
1.75 - 2	55		7	220	3	93		3.2						
2 - 2.25									58.5		3.9	60		6
2.25 - 2.5														
2.5 - 2.75														
2.75 - 3														
3-3.25	86	2.5		90	3.5									
3.5-3.75														
4.5-4.75														
5.5-5.75	66	2									4			
6.5-6.75									51		3.8			
7-7.25	68	2												
8.5-8.75														
10-10.25														
13-13.25														
20-20.25														

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Synedra ostenfeldii*													
Sediment	Dimensions													
Interval	L	W	D	L	W	D	L	W	D	L	W	D	L	W
0 - 0.25	120	3		95	3									
0.25 - 0.5														
0.5 - 0.75	98		4	123	3		76	3		115	2			
0.75 - 1	81		3	105		3.7	93		2.5	131	3			
1 - 1.25	92.5		4.3											
1.25 - 1.5	81		2.8	135	3									
1.5 - 1.75	82		3.4	110		3.4								
1.75 - 2	86	3												
2 - 2.25	123	2		92	3									
2.25 - 2.5	126		3	135	3.5		92	3		96		4		
2.5 - 2.75														
2.75 - 3														
3-3.25	92		3.8											
3.5-3.75	106	2		104	3		100	3		98	3		116	3
4.5-4.75	87.5		3.5	84.5	3.5		94		4	100	3			
5.5-5.75	87		2.6	126	3		93	3						
6.5-6.75	99	2.5		100		4.5	80		3	84		3.7		
7-7.25														
8.5-8.75	112	3.5												
10-10.25	113	2.5		116	3									
13-13.25	92	3				3								
20-20.25														

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Tabellaria flocculosa*							
Sediment	Dimensions							
Interval	L	W	D	L	W	D	L	W
0 - 0.25	28	8						
0.25 - 0.5	32	7		32	6.5			
0.5 - 0.75								
0.75 - 1								
1 - 1.25								
1.25 - 1.5								
1.5 - 1.75								
1.75 - 2	33		10	31		8.2		
2 - 2.25								
2.25 - 2.5								
2.5 - 2.75	40	6						
2.75 - 3	25		6.7	30		12.5		
3-3.25								
3.5-3.75								
4.5-4.75								
5.5-5.75								
6.5-6.75	46	7	4.8	40	6		38	8
7-7.25	40	9		38	6			
8.5-8.75	28	8		43	7			
10-10.25								
13-13.25	29	7						
20-20.25	32		6.8	32		10	48	6.5

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4c. Diatom size data for the western core of Lake Superior (IR#2) Pennate

Species	*Tabellaria flocculosa strain IIIp*											
Sediment	Dimensions											
Interval	L	W	D	L	W	D	L	W	D	L	W	D
0 - 0.25	66	6		66	6							
0.25 - 0.5	60		8									
0.5 - 0.75	66	5		63		6						
0.75 - 1	45.5		8									
1 - 1.25	56		7.3									
1.25 - 1.5	70	5										
1.5 - 1.75	67		4.4									
1.75 - 2												
2 - 2.25												
2.25 - 2.5	35		5.3	70		8			6			
2.5 - 2.75	46		6.2									
2.75 - 3	55		8	60	5		54		7.4			
3-3.25												
3.5-3.75												
4.5-4.75	62		5.7	78	4				7.3			8.3
5.5-5.75	44		7.4	51		6.3						
6.5-6.75	49	6		64.5		6.6	49		6.8			
7-7.25	53	6		51	6		42	6		44		6
8.5-8.75	51		4	53		2.7	68	4.5	2.5	67		3.7
10-10.25	57	5		73	5	5.4	58		5.7			
13-13.25	65		3.2	67	4.5		70		5.1			
20-20.25	66	5		41		9						

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Aulacoseira alpigena*																					
Sediment Interval	Dimensions																					
	L	W	D	L	W	D	L	W	D	L	W	D	L	W	L	W	L	W	L	W	L	W
0 - 0.25																						
0.25 - 0.5	4	8		20	8																	
0.5 - 0.75	5.5	10.5	11																			
0.75 - 1																						
1 - 1.25	6	5		6	5																	
1.25 - 1.5																						
1.5 - 1.75	11	6																				
1.75 - 2																						
2 - 2.25	5	6																				
2.25 - 2.5	7	10	13.7																			
2.5 - 2.75																						
2.75 - 3	4.5	9		5	8																	
3-3.25	6.5	5.5																				
3.5-3.75																						
4.5-4.75	5	6																				
5.5-5.75																						
6.5-6.75																						
7-7.25	6	10	13	5	8		5	10		5	10		6	7	5	8						
8.5-8.75	5	9		6	10	13.6	7	10		5	10	12	14	6.5	5	8	5	11	7	9	4	6
10-10.25																						
13-13.25																						
20-20.25	4	11	12	4	9	10.5	8	7		7	10.5		7	10								

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Aulacoseira islandica*																				
Sediment	Dimensions																				
Interval	L	W	L	W	L	W	D	L	W	L	W	L	W	L	W	L	W	L	W	L	W
0 - 0.25	11	8	13	7	15	6		12	7	11	6	13	7	15	7	6	4	21	4	15	6
0.25 - 0.5	13.5	8	7.5	3.5	21	9		8	5.5	15.5	10	14	5								
0.5 - 0.75	7	5	13	16	18	9		13	7	13	4	14	7	15	5.5	10.5	5				
0.75 - 1	9.5	4	6	5	17	8		14	7	17	10	14	10	14	8.5	15.5	9	13.5	4.5	21	6
1 - 1.25	13	4	13	4	16.5	9		13.5	6	15	11	11	5	15	10	9	8	18	8	7	5
1.25 - 1.5	14	6	14	8	8.5	7		11	8	13	4	14	7	12	11	12	8				
1.5 - 1.75	8	6.5	8	7	7	4		18.5	8.5	18	8	21	11.5	7	4	15	6				
1.75 - 2	16	8	9	6	13	5		10	6	10	10										
2 - 2.25	18	7	7	6	11	5															
2.25 - 2.5	10	6	8.5	5	17	13		12	10	7	6	18	8	10	4.5	10	5	14	5	14	4
2.5 - 2.75	14	7	10	8	16	6		11.5	10	18	9.5	19	6	13	7	14	10.5	13	6	10.5	11
2.75 - 3	17	7	16	8	12	7		15	8												
3-3.25	7	4.5	12	7	16	8		13	14	12	13.5	16	6.5	25	5	10	4	19	5	17	8
3.5-3.75																					
4.5-4.75	13	4	15	8	18	9	37	18	8	12	6	14.5	12	14	12	14	8	16	11	14.5	4
5.5-5.75	15	9.5	14	5	5	4	13	10	10	6	6	14	5	9	8	15	4	19	7	17	8
6.5-6.75	10	4	14.5	5	17.5	6		14.5	9	22	9	16.5	7	15	7	18	11	20	10	10	4
7-7.25	15	4	18	7	6	7		13	4	13	6	14.5	11	10	9	14	7	18	7		
8.5-8.75	10	2	21	5	10	3		18	7	15	3	16.5	7.5	17	8	15	7.5	12	10	15	6
10-10.25	13.5	7	10	4	22	5.5		21	6	20	10	17	4	13	10	4	4	19	7	13	6.5
13-13.25	13.5	4.5	15	6.5	19	12		12	5	13	10	16	8.5								
20-20.25	12	5	18	10.5	9	5															

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella atomus*										
Sediment	Dimensions										
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm
0 - 0.25	4.5	6	5	5	4.5	5	5	5		5	
0.25 - 0.5	4.5	6	5	4.5	5	4	5	5		4.5	5
0.5 - 0.75	4.5	5	5	5	5	5	5	5		6	6
0.75 - 1	5	6	4	5	5	5	5.5	4.5		5	5
1 - 1.25	5.5	5	5	4.5	5	5	5	4.5		5	3.5
1.25 - 1.5	6	5	5	5	5	4.5	4	5		4	5
1.5 - 1.75	5	5	4.5	6.5	5	5	5	4		4	4.5
1.75 - 2	5	5	4.5	5	4	5	4.5	5	1.3	6	6
2 - 2.25	5	5	4.5	5	7	4.5	5	4		5	5
2.25 - 2.5	6	5	4	4.5	4	6	4	5		4.5	6
2.5 - 2.75	4.5	4	5	5	4.5	3	5	4		5	5
2.75 - 3	4	5	4	5	5.5	5	7	4.5		5	5
3-3.25	6	5	4	4	6	4	5	5		5	6
3.5-3.75	5	6	5	6	6	5	5.5	7.5		5	6
4.5-4.75	4	5	6	5	4	4.5	5	6		4.5	4
5.5-5.75	5	4.5	4	4	5	6	4.5	5		4	5.5
6.5-6.75	6.5	5	5	5	4	5	4	5		4.5	6
7-7.25	4	4	5	4.5	5	5	5	4.5		4.5	4
8.5-8.75	6	6	6	6	5	6	5	5		4	
10-10.25	4	4.5	5	4.5							
13-13.25	5	6	6	5	6	5	5	6		4.5	5
20-20.25	5	4.5	5	4.5	5	4.5	4.5				

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella atomus "fine form"*									
Sediment Interval	Dimensions									
	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	3	4	4	4	5	3.5				
0.25 - 0.5	4.5	4	3.5	3.5	5	4	4.5	4	4	4
0.5 - 0.75	5	4	4	5	5	5	4	3	3	5
0.75 - 1	3.5	3.5	4	4	4	4	5	5	4	4
1 - 1.25	4	4	3.5	5	4	4	4	4	4	4
1.25 - 1.5	3.5	4	3	4	4.5	4	4	4	3.5	4
1.5 - 1.75	4	4	4	4	4	4	3.5	5	5	3
1.75 - 2	3	4	4.5	3	4	3	4	5	4	4
2 - 2.25	4	3.5	4	4	4	4	5	3	4	3.5
2.25 - 2.5	4	3.5	4	4	4	4	4			
2.5 - 2.75	3	4	4	3	3					
2.75 - 3	4	4.5	3	4	4	4				
3-3.25	3	4	3	4	4	4	4	3	4	3.5
3.5-3.75	4	4	4	4.5	3.5	4	4	4	4	4
4.5-4.75	4	4.5	3	4						
5.5-5.75	4	4	4	4	3.5	3	4	4	4	3
6.5-6.75	4	5	3.5	3	4	4	4	4	4	4
7-7.25	4	4	4	4	4	3	4	3.5	3	4
8.5-8.75	3	4	4	4	4	4	4	4	3	
10-10.25	4	4	4	4	4	3	3.5			
13-13.25	4	4	4	3	3	4	4	4	3.5	5
20-20.25	4	3	4	3	4	4	3	3.5	4	4

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella bodanica*											*Cyclotella bodanica var. affinis*	
Sediment	Dimensions											Dimensions	
Interval	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	11	8		30	19.5	32	12	22	15	32	12	17	
0.25 - 0.5	40	15		22	17	16	19	38	22	13	18	16	
0.5 - 0.75	30	16	3.6	22	19	18	16	17				18	
0.75 - 1	15	13.5		16	16	19	10					14	
1 - 1.25	15	14		32	38	17	14	31	17			16	
1.25 - 1.5	14	17		26	23	14	15	18	22	12	20		
1.5 - 1.75	15	15.5		18	17	19							
1.75 - 2	16	30.5	4.6	30	22	17	30						
2 - 2.25	15	24		25	18	19							
2.25 - 2.5	17	21		15	16	29	18	16	19				
2.5 - 2.75	11	13		9	17	19							
2.75 - 3	41	14	3.6	12.5	16	14	17	35	13	15	28		
3-3.25	9	18		19	21	48	21	20	16				
3.5-3.75	26	17	8	28.5	16	16	11	20	19				
4.5-4.75	29	16		23	15.5	47	20	22	16	17	23	11	
5.5-5.75	12	12		18	14	16							
6.5-6.75	26	18		13	22	15	17	12	20	29		16	20
7-7.25	13	16		24									
8.5-8.75	15	20		28	28	27	22	15					
10-10.25	18	11											
13-13.25	18	20		23	47	10	23						
20-20.25	19	18		20	19	27	16	22	19				

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Cyclotella comensis*										
Sediment	Dimensions										
Interval	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm
0 - 0.25	10	6	6	8	6		6	7	8	5	7
0.25 - 0.5	6	6	6	7	7		6	6	6		
0.5 - 0.75	5	5.5	5	5	7.5	2.6	5	4	5	5	6
0.75 - 1	6	6	6	5	5						
1 - 1.25	5	5	6	6	6.5		4	4.5	5	6	5
1.25 - 1.5	5	5	6	6	6		5	6	6	4	4
1.5 - 1.75	5	5.5	4.5	4	5		4	5	3.5	4	4
1.75 - 2	5	6	10	6	5.5		6	5.5	5	6	8
2 - 2.25	6	6	6	5	6		5	6	7	5	4
2.25 - 2.5	6	5.5	4	5	5		6.5	6	5	7.5	6
2.5 - 2.75	6	4.5	5	6	6		5	6	6	5	7
2.75 - 3	8	4	7	5	4		6	5	9	5.5	9
3-3.25	5	5	5	5	5		4	4	4	5	5
3.5-3.75	7	13	6	6	6		7	6	5	5	6
4.5-4.75	6	6	4	5	5		6	5	4		
5.5-5.75	6	6	6	6	6.5		6				
6.5-6.75	6	5	5	4	5		10	5	6	4.5	6
7-7.25											
8.5-8.75	4	5	6	6	6		6	5	9.5	5	6
10-10.25	4	5.5	6	6							
13-13.25	7	4	6	5	7		5	4			
20-20.25	5	9	4	12.5	5						

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella comensis var. 1*									
Sediment	Dimensions									
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	5	7	5.5	6	5	6				
0.25 - 0.5	4.5	5	5	4.5	4					
0.5 - 0.75	5.5	4	6	6	5					
0.75 - 1	8	7	5	7	6	4	6	5	4.5	5
1 - 1.25										
1.25 - 1.5	6	7	5	6	5					
1.5 - 1.75	7	5	5	6	6	7	6	7	6	
1.75 - 2	6	5	6	6	5	7				
2 - 2.25	6	4	5	5	5	5	5	5	5	5.5
2.25 - 2.5	4	6								
2.5 - 2.75	5	5	6	4	6	7.5	7	5		
2.75 - 3	5	6	6.5	6	7					
3-3.25	4									
3.5-3.75	5	6	7	6	6	5	6	6		
4.5-4.75	4.5	6.5	5	5	4					
5.5-5.75										
6.5-6.75	4.5	6	6	5	5.5	5	7	6	8	
7-7.25	5	5								
8.5-8.75										
10-10.25	4	4								
13-13.25	6									
20-20.25	6									

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Cyclotella comensis var. rough center with process*											
Sediment Interval	Dimensions											
	Dm	Dm	Dm	Dm	D	Dm	Dm	D	Dm	Dm	Dm	Dm
0 - 0.25	10	7	7	7.5		8	8		7	6	7	8
0.25 - 0.5	7	7	6	6		6	7		6.5	6	7	8
0.5 - 0.75	7	6.5	7	5		7	7		8	7	7.5	5.5
0.75 - 1	5	6	5	6		6	6		6	8	5.5	6
1 - 1.25	7	7	6	6		8	7.5		8	7	6	6
1.25 - 1.5	7	7	6	6		7	6		7	6	8	7
1.5 - 1.75	5.5	8	5.5	6.5		7.5	7		8	5	5	7
1.75 - 2	7.5	9	7	8		7	10	3.7	7	7	6	6
2 - 2.25	8	7	5	6		7	7		7	6.5	6	7
2.25 - 2.5	6	6	7	7		7	6.5		6	7	6	6.5
2.5 - 2.75	7.5	5	6	7	5	5	7		6	7	8	5.5
2.75 - 3	5.5	6	6	6		9	6		6	8	7	8
3-3.25	6	6	6	7		6	6		6.5	5	6	7
3.5-3.75	7	8	8	8		8	6.5		7	6	6	6.5
4.5-4.75	7	6	6	6		7.5	6.5		6	6	6	6
5.5-5.75	5	6	6	6		6	5.5		6	6	6	6
6.5-6.75	6	8	5	6		7	7					
7-7.25	6	5	6	7.5		6	7		7	8.5	7.5	6
8.5-8.75	6	6	6	7		6	8.5					
10-10.25	7	6	6	7		8	5		6	7	8	
13-13.25	6	6	6.5	8		6	6.5		8	7	6	7
20-20.25	7	8	7	6		8	9.5		5	7	6	10

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella comensis var. rough center with process Type B*										
Sediment Interval	Dimensions										
	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	9	9	9		10	8	13	8	10	7	8
0.25 - 0.5	9	8.5	12.5		11	10	7	13	9	9.5	
0.5 - 0.75	9	9	8		10	13	8.5	15	7.5	11	9
0.75 - 1	9	8	10		8.5	10	8	11	8.5	8	8
1 - 1.25	9	10.5	11		10	9	9	10.5	10	9	10.5
1.25 - 1.5	9.5	11	10		9	10.5	9	8	10	11	10
1.5 - 1.75	14	8	11		10	10	8.5	14	9	10	
1.75 - 2	11	11	8		10	6	9	17	14	12	8
2 - 2.25	9	10	9		9	11	11	9	9	8.5	8.5
2.25 - 2.5	9.5	8	8		12	8	8	8	10	9	11.5
2.5 - 2.75	11	9	8		8	8	11.5	11	9.5	8	10.5
2.75 - 3	8.5	8	7		6	11	9	7	12	9	8
3-3.25	8.5	12	14	2.2	8	6	10	12	9	10.5	9
3.5-3.75	11	9	8.5		8.5	8.5	10				
4.5-4.75	13	8.5	16		10	11.5	9	8	12	10	8
5.5-5.75	9.5	9	11		14	10.5	10.5	15	11		
6.5-6.75	13	12	10		11						
7-7.25	9	12	15	5	11.5	9	14.5	9			
8.5-8.75	9	7	10		11						
10-10.25	20	12									
13-13.25	18	10	9		17	10					
20-20.25	11	9	16		9	11					

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella distinguenda/operculata*					*Cyclotella meneghiniana*					
Sediment Interval	Dimensions					Dimensions					
	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25						5.5	7	8	8	6	5.5
0.25 - 0.5						6.5					
0.5 - 0.75	13					18	11	9	7		
0.75 - 1	13	12									
1 - 1.25	13	17.5	10	10							
1.25 - 1.5											
1.5 - 1.75						10					
1.75 - 2	14.5	16	14	14	16	6					
2 - 2.25	21	18									
2.25 - 2.5	15	13									
2.5 - 2.75	12.5	10				6.5	10				
2.75 - 3	12										
3-3.25											
3.5-3.75											
4.5-4.75											
5.5-5.75	10	8									
6.5-6.75	12										
7-7.25											
8.5-8.75											
10-10.25											
13-13.25											
20-20.25						10					

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Cyclotella ocellata*													
Sediment	Dimensions													
Interval	Dm	Dm	Dm	D	Dm	Dm	D	Dm	D	Dm	D	Dm	Dm	Dm
0 - 0.25	6	4	6		5	6		6		6		5	8	9
0.25 - 0.5	5	6	6		6	5		8		5.5		6	4	4
0.5 - 0.75	5.5	5	6.5		5	6.5		5		4		6.5	6	8
0.75 - 1	6	6	6		6	7		6		5.5	2.9	5	4	5
1 - 1.25	7	5.5	6		5	6		6	2.4	5		6	7	7.5
1.25 - 1.5	5	5	6		6.5	6.5	2.6	5.5		5		6	5	8
1.5 - 1.75	5	6	6		7	5		5		6		6	6	6
1.75 - 2	5	7.5	9		5.5	5	3.2	5		5.5	2.8	7	8	4
2 - 2.25	4	6	5		6	5		6		3.5		5.5	6	7
2.25 - 2.5	5	6	5		6	5		4		5.5		6.5	4	6
2.5 - 2.75	6	6	4.5		6.5	5		5.5		6		5	4.5	8
2.75 - 3	6	4.5	4		6	5		6	3.7	5		6	7	12
3-3.25	5	6	6		4	5		6		6		5	6	6
3.5-3.75	4.5	5	5		7	7	6	5		5		6.5	6	4.5
4.5-4.75	6	5	11		7	6		4.5		6		5.5	5	4
5.5-5.75	5	6	6	2.8	6	5		4		7		9	6	5
6.5-6.75	6	8	6.5	5	6	10		8		6		12	7	4.5
7-7.25	8	4	9		6	5		7.5		8		6	5.5	5
8.5-8.75	8.5	5	10		11	7		6	3.5	14		4	7	6.5
10-10.25	15	5	4.5		7	12		6		8		4	6	13
13-13.25	15	6	6	3.3	9	6		9		12.5		17	11.5	5
20-20.25	6	14	8		7	8		11	3.4	8		4.5	12	15

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Discotella pseudostelligera*													
Sediment Interval	Dimensions													
	Dm	D	Dm	Dm	D	Dm	Dm	Dm	D	Dm	Dm	D	Dm	Dm
0 - 0.25	3		4	3		4.5	3	2		5	2		4	4
0.25 - 0.5	5		5	5		4	4	3		3	4		5	3.5
0.5 - 0.75	4	2.7	4	4	3	3	4.5	3.5	2.8	4	3.5	3	5.5	5
0.75 - 1	5		3	4	1.7	4	4.5	3		3	4	3.6	5	4
1 - 1.25	4.5		3	4		4	3.5	5		5	5		5	4
1.25 - 1.5	4		3	5	2.8	4	4	3.5	2	4.5	3.5	1.4	6	4
1.5 - 1.75	4		4	3.5	3.5	5	4	4	2	4.5	3	2.4	5.5	3.5
1.75 - 2	4		3	4		5	2	3.5	2.3	4.5	4	2.7	4.5	6.5
2 - 2.25	3		5	5		3	4.5	3	2.4	3.5	3.5	2.5	4	4
2.25 - 2.5	4		4	3		4	4	4.5		5	4		3	4
2.5 - 2.75	4	2.6	3	4	3	4	2.5	4	3.5	5	3	2.4	5	4
2.75 - 3	3.5		4	4	3.4	3.5	4	4.5		5.5	4		4.5	6.5
3-3.25	4		4	4	3	4	4	4.5	3	5.5	3.5		4.5	4
3.5-3.75	3.5	3	4.5	4	2.7	4.5	4	4	3	5	5.5	3	3	4
4.5-4.75	4		5	5	3	5	4.5	3.5	2.7	6.5	5		4	3.5
5.5-5.75	4.5		4	4.5		4	4.5	4		4.5	3.5	3	3	5
6.5-6.75	4	2.4	5	4		4	5	3		5	4	2	3	5
7-7.25	4		5	4		5	4	4	2	6	4	1.3	6	3.5
8.5-8.75	4		4	4		6	5	4		5	5		3.5	4
10-10.25	4		4	4.5		5.5	3	3.5	5.7	3.5	4	3.5	3	4
13-13.25	5		4	5		4.5	5	5.5		4	4		4.5	5
20-20.25	4	3.4	4	4	3	3	4	5		4.5	5		4	3.5

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Discostella stelligera*												
Sediment	Dimensions												
Interval	Dm	D	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	D	Dm	Dm
0 - 0.25	8		8	7	8	8	8		6	6		8	6
0.25 - 0.5	6	4	8	6									
0.5 - 0.75	6												
0.75 - 1	6		6										
1 - 1.25	6		6	5									
1.25 - 1.5	8		6										
1.5 - 1.75	9		6										
1.75 - 2	6												
2 - 2.25	7.5		5	5	6	5	6						
2.25 - 2.5	6.5	6	5	5	5	7	5		7	5.5	2.5	5	9
2.5 - 2.75	7	2	6.5	5	9	6							
2.75 - 3	7		7	6.5	6	6	6.5		6	7			
3-3.25	6		16	14.5	11	13							
3.5-3.75	5		8	5	8								
4.5-4.75	6.5		5										
5.5-5.75	6	3.2	9	6.5	6	5	6		6.5		9.5	6	6
6.5-6.75	7		6	6	6	6	5		7	5.5		7	8
7-7.25	8		8	8									
8.5-8.75	6		7	6	6.5	6	6						
10-10.25	7		6	8									
13-13.25	5	3	7	5.5	6	6	6		8	5.5		7	7
20-20.25	9		5	10.5	6	5							

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Stephanodiscus #10*											*Stephanodiscus #51*				
Sediment Interval	Dimensions											Dimensions				
	Dm	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	D	Dm
0 - 0.25	6															
0.25 - 0.5												7				
0.5 - 0.75	4	6	5									6				
0.75 - 1																
1 - 1.25	5	7										5				
1.25 - 1.5	6															
1.5 - 1.75	5	6	5									5.5				
1.75 - 2	8	5														
2 - 2.25	4.5											6	6	6		
2.25 - 2.5																
2.5 - 2.75	5	5	5	5	6											
2.75 - 3	5											5	6			
3-3.25	6	4	5	7.5												
3.5-3.75	5	5	6.5													
4.5-4.75	6	6	5	7	7	5		5	6							
5.5-5.75	6	6	5	7	5	6		7.5	6	6	6	6	6			
6.5-6.75	6	7	5	6	7	6		7	9	5		6	6	7	2	6
7-7.25	6	7	6	6	6	7	1.3	6	6	5	5	6				
8.5-8.75	4.5	5.5	6	5	5.5	5		6	5.5	8	7	6	6	6.5		5
10-10.25	7.5	7														
13-13.25	5	5.5	6	5.5	6	6		5	6	5.5	6	6	6.5			
20-20.25	6											6				

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Stephanodiscus alpinus*						*Stephanodiscus binderanus*				
Sediment Interval	Dimensions						Dimensions				
	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25							6				
0.25 - 0.5	21										
0.5 - 0.75	14	10					6	6	6.5	6	
0.75 - 1	12	13	13	19			5	5	6		
1 - 1.25							6	6	6	6	
1.25 - 1.5	11	16									
1.5 - 1.75	12.5	12.5					6				
1.75 - 2							8	7	7	7	6
2 - 2.25							6	7	6.5	7	
2.25 - 2.5	12										
2.5 - 2.75	12						7				
2.75 - 3	17						6	6	7	7	
3-3.25							6	6			
3.5-3.75	16	13	15	14.5	16	15					
4.5-4.75	11.5	13	14				6				
5.5-5.75							7	6			
6.5-6.75	13	14	10								
7-7.25	21	10									
8.5-8.75	14						7	7			
10-10.25							6				
13-13.25	13	11	11	16	21						
20-20.25	8	11	13	12			7				

L = Length, W = Width, D = Depth, Dm = Diameter

Species	*Stephanodiscus conspicueporous*										
Sediment	Dimensions										
Interval	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm
0 - 0.25	15	18	13	12	10						
0.25 - 0.5	14	16	11	17							
0.5 - 0.75	21.5	20	16	13	11		11	14	14	18	16
0.75 - 1	18	15	13	20							
1 - 1.25	18	11	17.5	21	21						
1.25 - 1.5	14	16	18								
1.5 - 1.75	19	21									
1.75 - 2	14	18	18	30	35.5		17				
2 - 2.25	13	19	13	16							
2.25 - 2.5	15	24									
2.5 - 2.75	12										
2.75 - 3	22	12	10	14	15		19	15			
3-3.25	16.5	15	16								
3.5-3.75	10	11.5	10	13	9	3	10	19	24		
4.5-4.75	11	12	15	9	12		16	15	11	11.5	12
5.5-5.75	16.5	16	11.5	22	22		18	15	13	11	10
6.5-6.75	14.5	12	15	19.5	12		9	23	9	11	14
7-7.25	14	13	12	13	12		14	11.5	13	9	16
8.5-8.75	9.5	16	11	10	17		12	13.5	10.5	15.5	14
10-10.25	11	9	12	10	15	6	13	9.5	14	11	13
13-13.25	9	17	11	14	11	3	22.5	16	14	20	10
20-20.25	15	17	18	8	14		8	6	20	13	12

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Stephanodiscus hantzschii*								*Stephanodiscus minutulus*							
Sediment	Dimnesions								Dimensions							
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	D	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	8								5	4						
0.25 - 0.5	6															
0.5 - 0.75	6.5	6.5	6						4	4						
0.75 - 1	7	6							5	4.5						
1 - 1.25	7								4.5							
1.25 - 1.5	6															
1.5 - 1.75	7								4							
1.75 - 2	7	6.5	7	7					4	4	4	5	4			
2 - 2.25																
2.25 - 2.5	6.5	7							4							
2.5 - 2.75	7	7							4	4						
2.75 - 3	6	6														
3-3.25	6.5	7	7	6	6.5	6	7		4							
3.5-3.75	7	7	7	7	7	6			4	4.5						
4.5-4.75	6.5															
5.5-5.75	6.5															
6.5-6.75	6	7	6	7	5	7			5	4						
7-7.25	7	8	6	7	7	6			4							
8.5-8.75	9	6	7	5					4	4						
10-10.25	6	6.5														
13-13.25	7	7	6	7	7	6.5	7	4.3	4	5	4	4.5	4	4.5	5	4
20-20.25	7								5	4.5	5	4				

L = Length, W = Width, D = Depth, Dm = Diameter

Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

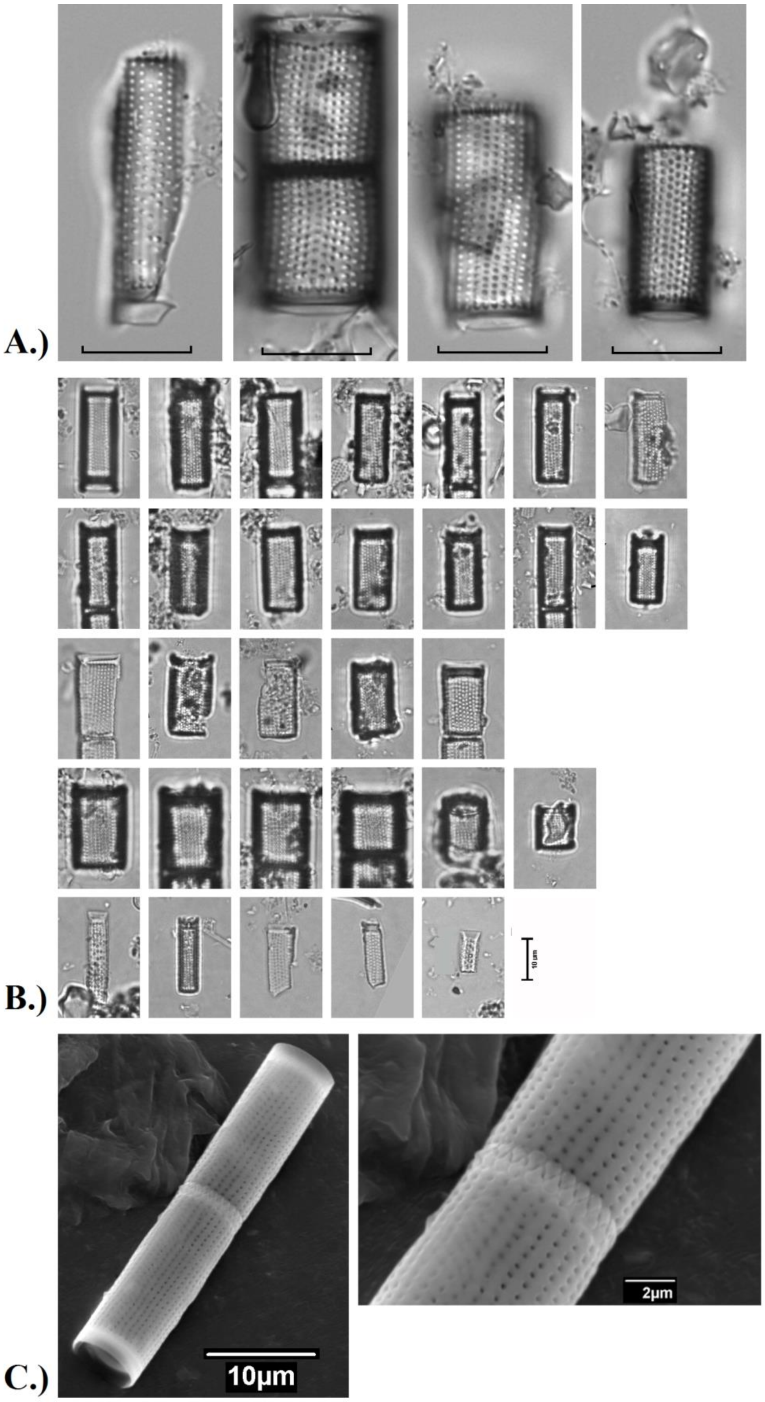
Species	*Stephanodiscus niagarae*			*Stephanodiscus parvus*									
Sediment	Dimensions			Dimensions									
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25				7									
0.25 - 0.5				6	5	7	6	6.5	4.5	7			
0.5 - 0.75				6	5	6	6	6	6.5	6	4	6	6
0.75 - 1	54			6	7	7	6	5.5	6	6	6		
1 - 1.25				5	7	6	6	5	5	7			
1.25 - 1.5				6	6	5	7	5	6				
1.5 - 1.75				6	6	6.5	6	6	6.5	6	6	6	5
1.75 - 2	43	52		7	7	6	6	7	6.5	6			
2 - 2.25				6.5	6.5	5.5	7	6					
2.25 - 2.5				6	5	6.5	6	6.5	6	5	6.5		
2.5 - 2.75				6	6	5	7	6	6	7	7	7	7
2.75 - 3				6	6	5	5	6.5	5	6	6		
3-3.25				7	6	7	5	5	6	6.5	6	7	6
3.5-3.75				7	6	6	7	7	6	5	6.5	6	6
4.5-4.75				6	6	6.5	6	6	6	6.5	6	6	6
5.5-5.75	60			5	6.5	6	5	6	6	6	6.5	6	6.5
6.5-6.75	56	50		5	7	5	6	5	6	7	6	7	7
7-7.25				6	5	6	5	6	5	6	6	6.5	6
8.5-8.75				5	6	6	6.5	6	5	6	5	5	5.5
10-10.25				6	6	6	5.5	6	6	5	6	5	7
13-13.25	63	52	53	7	5	6.5	6	5.5	6	5	6	5	5.5
20-20.25				6	6	6	6	6	6				

L = Length, W = Width, D = Depth, Dm = Diameter

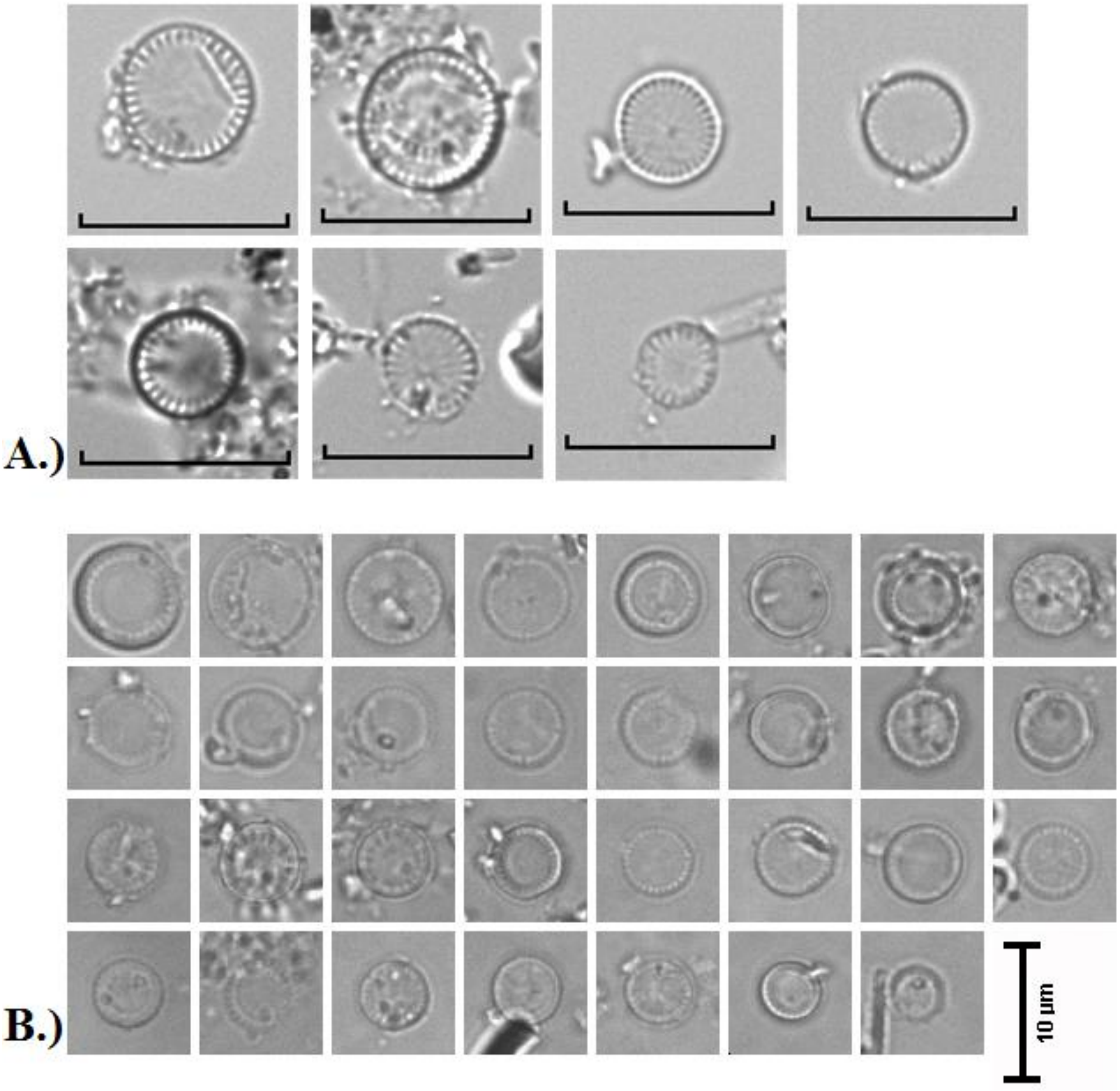
Appendix 4d. Diatom size measurements for the western core of Lake Superior (IR#2) Centric

Species	*Stephanodiscus subtransylvanicus*							
Sediment	Dimensions							
Interval	Dm	Dm	Dm	Dm	Dm	Dm	Dm	Dm
0 - 0.25	37	42						
0.25 - 0.5	40	45	44					
0.5 - 0.75	40							
0.75 - 1	44	37						
1 - 1.25	55	42						
1.25 - 1.5	25	42	34					
1.5 - 1.75	36	47	36					
1.75 - 2	35	42						
2 - 2.25	39							
2.25 - 2.5	41	43	36	40	42			
2.5 - 2.75								
2.75 - 3	35	34	40					
3-3.25	58	39						
3.5-3.75	37.5	45						
4.5-4.75	41	42						
5.5-5.75	44	42	45					
6.5-6.75	42	30						
7-7.25	42	32	35					
8.5-8.75	42	43	49					
10-10.25	26	24	35	33	40	27	38	
13-13.25	38	37	32	40	27	33		
20-20.25	32	34	31	33	41	38	33.5	38

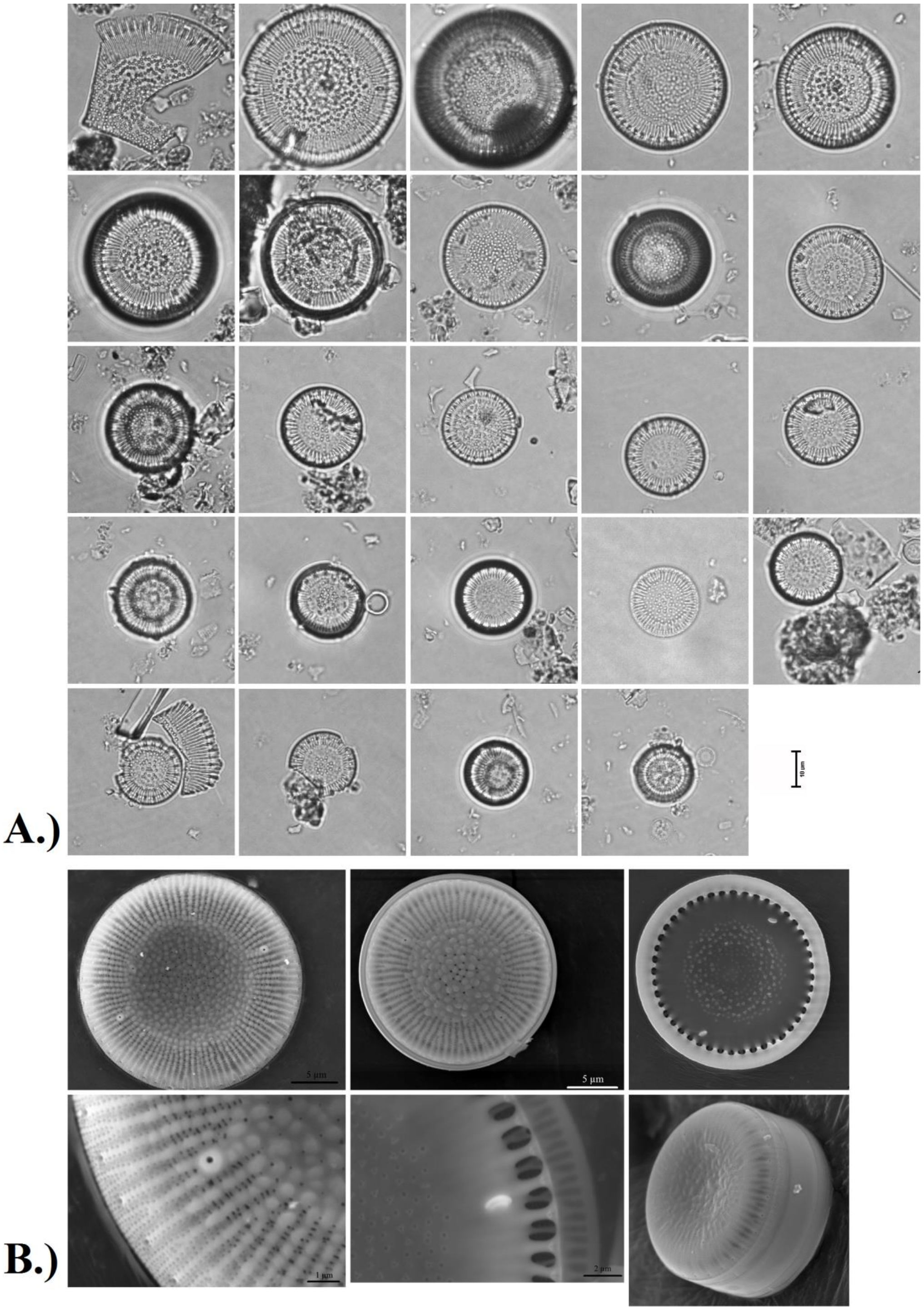
L = Length, W = Width, D = Depth, Dm = Diameter



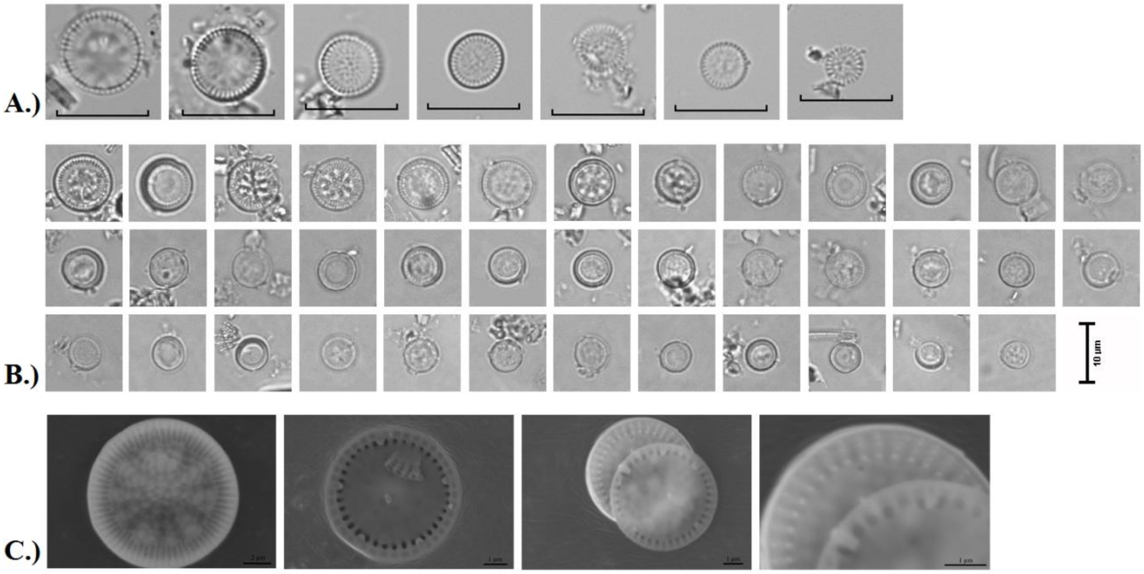
Aulacoseira islandica O.Müller**.** A.) As viewed in high resolution light microscopy. B.) Size diminution series of different valve morphologies as viewed in light microscopy. C.) SEM view of finer structure.



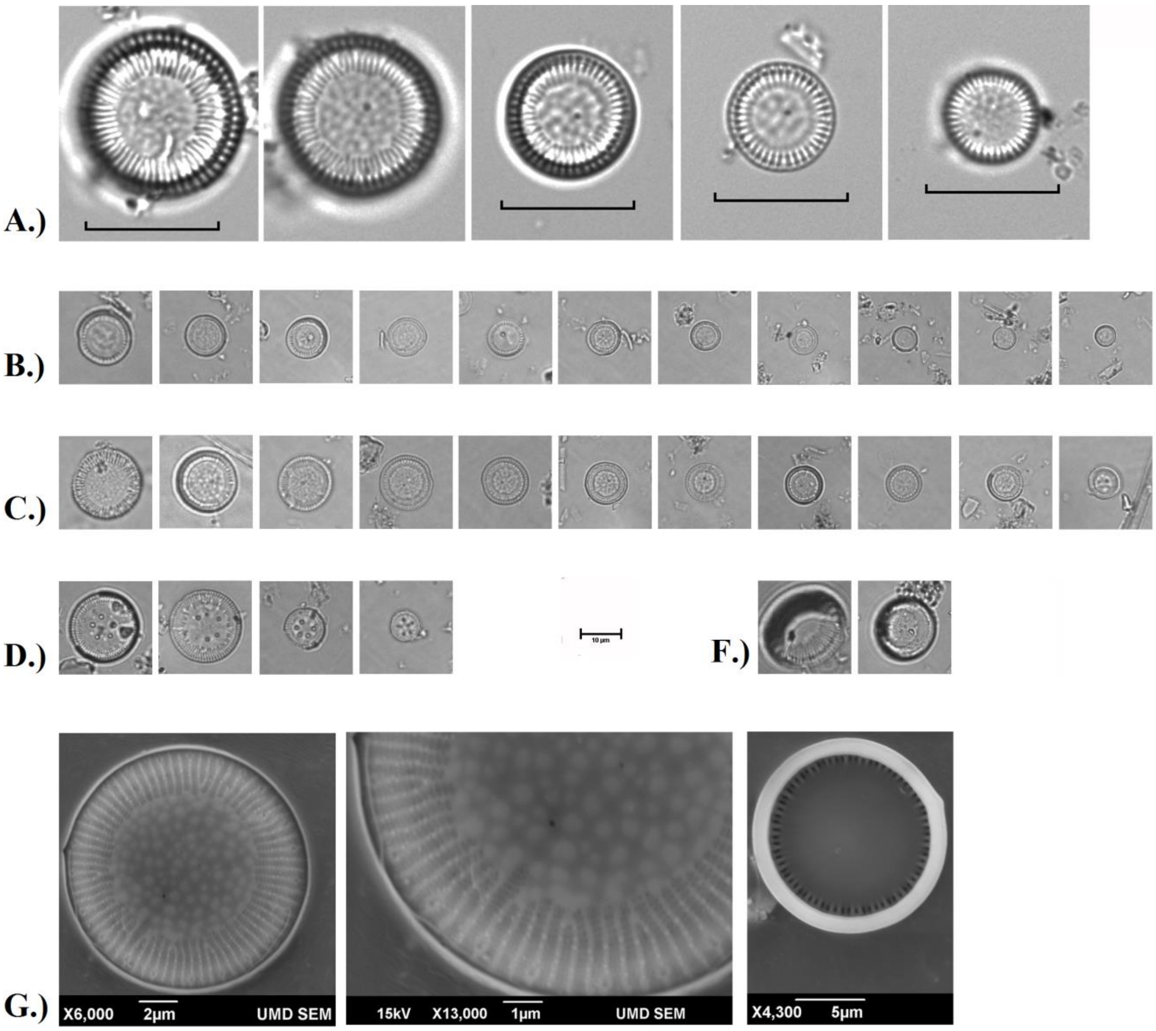
***Cyclotella atomus* and *Cyclotella atomus* variety “fine form.”** A.) As viewed using high resolution light microscopy. B.) Size diminution series using light microscopy.



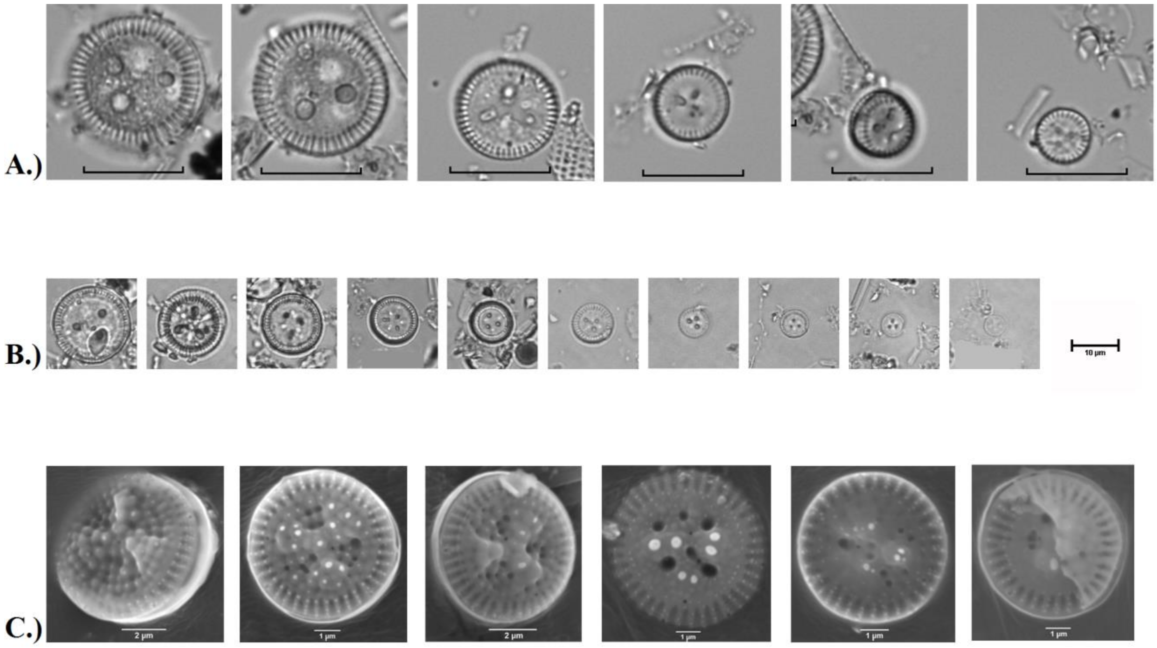
Cyclotella bodanica Grunow. A.) Size diminution series using light microscopy. B.) SEM of finer structure.



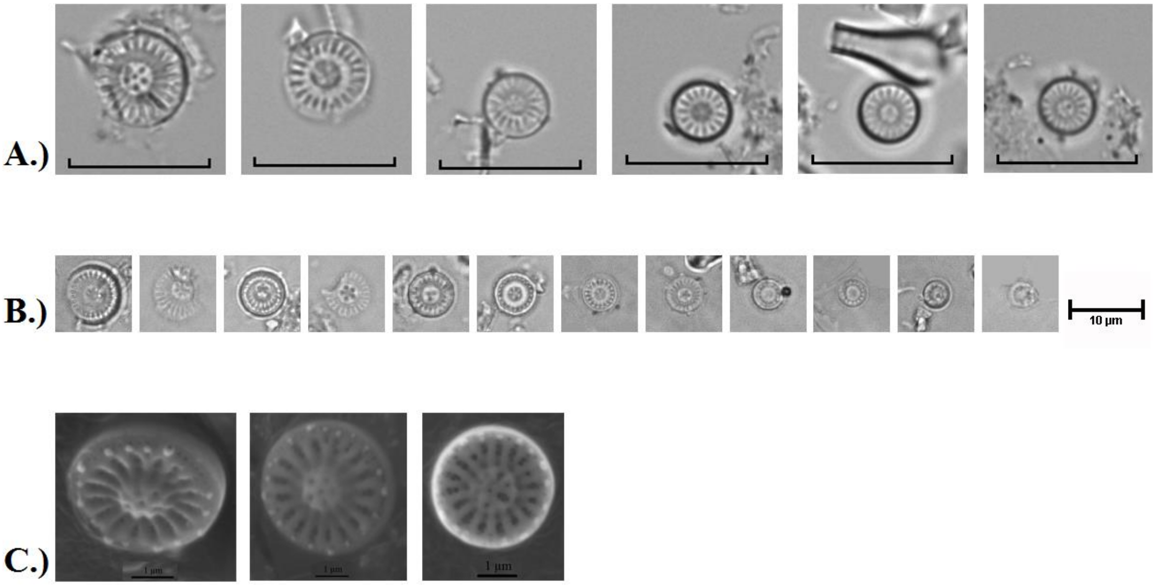
Cyclotella comensis **Grunow.** A.) As viewed using high resolution light microscopy. B.) Size diminution series using light microscopy. C.) SEM of finer structure.



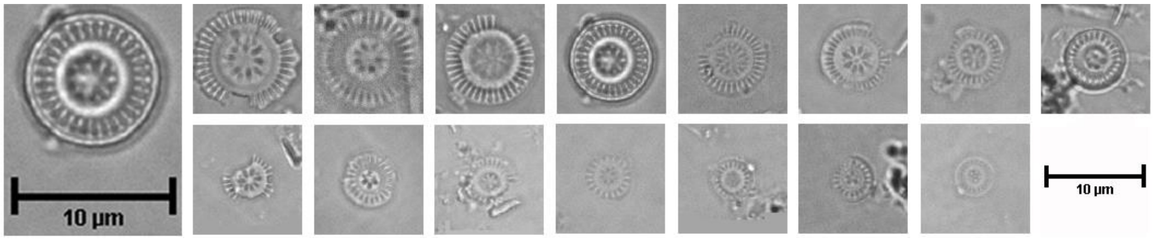
***Cyclotella comensis* variety “rough center with process.”** A.) Detail as viewed using high resolution light microscopy. B.) Size diminution series of one potential morphological type. C.) Size diminution series of one potential morphological type. D.) Size diminution series of valves considered transitional with *Cyclotella ocellata*. F.) Auxospores. G.) SEM views of finer structure.



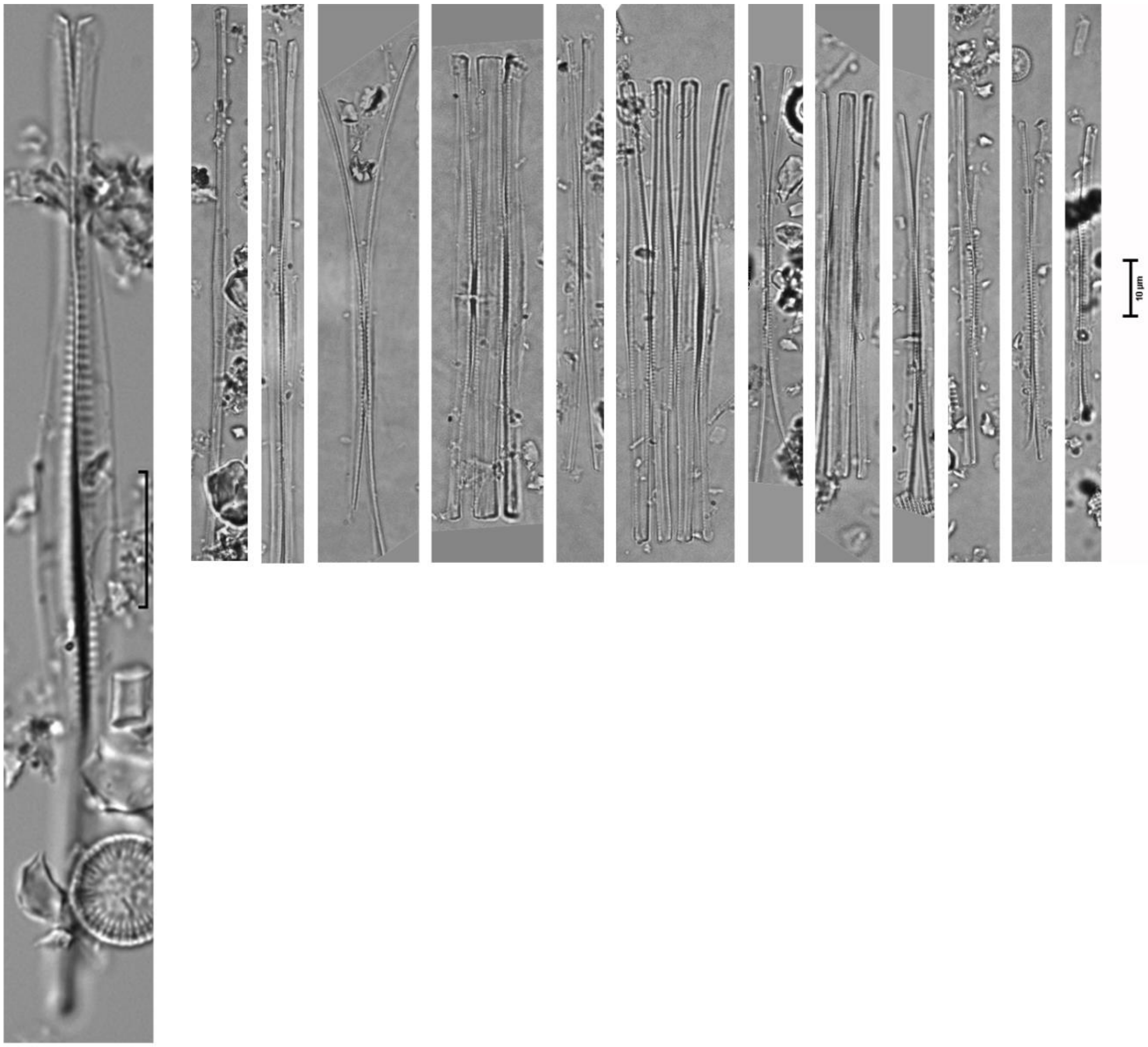
Cyclotella ocellata Pantocsek **.** A.) As viewed using high resolution light microscopy. B.) Size diminution series using light microscopy. C.) SEM views of finer structure.



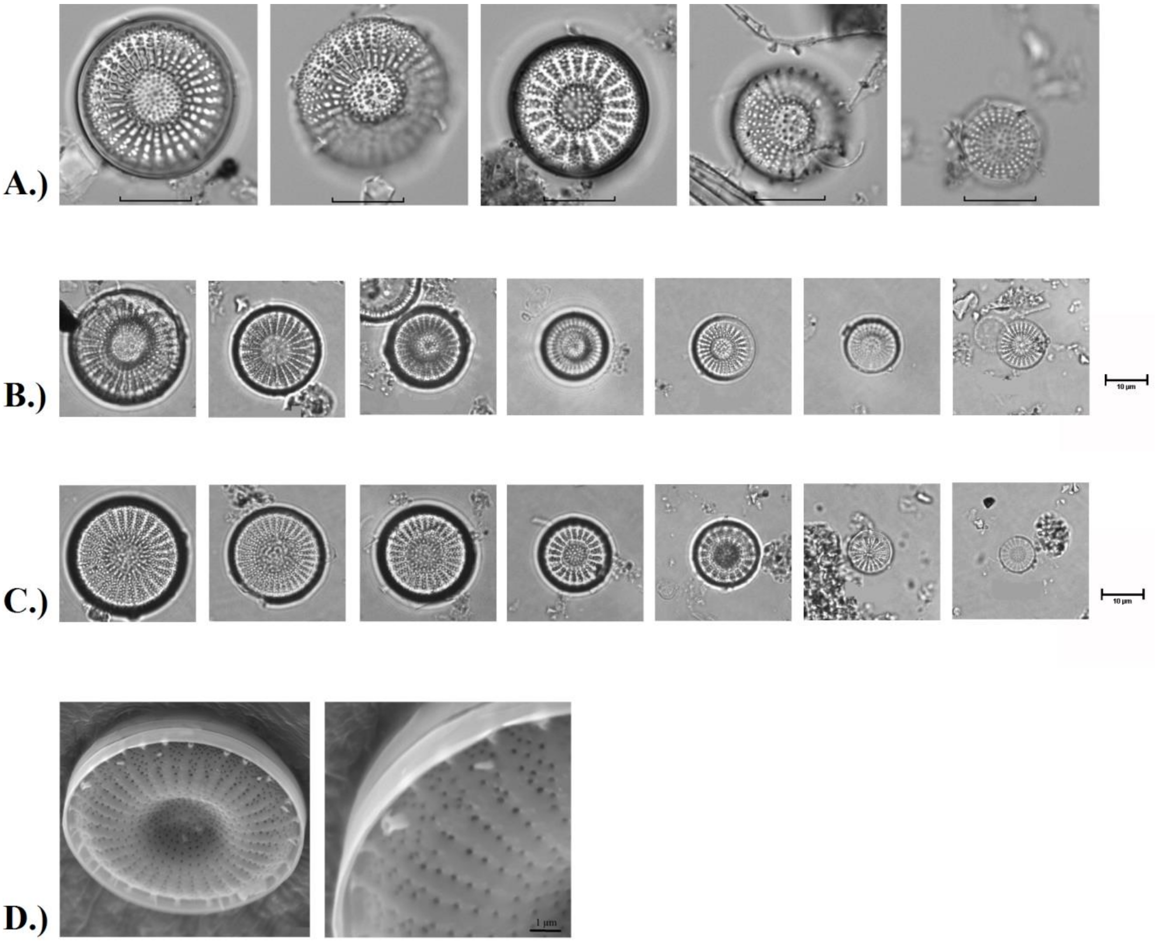
Discostella pseudostelligera (Hustedt) Houk & Kell. A.) As viewed using high resolution light microscopy. B.) Size diminution series. C.) SEM views of finer structure.



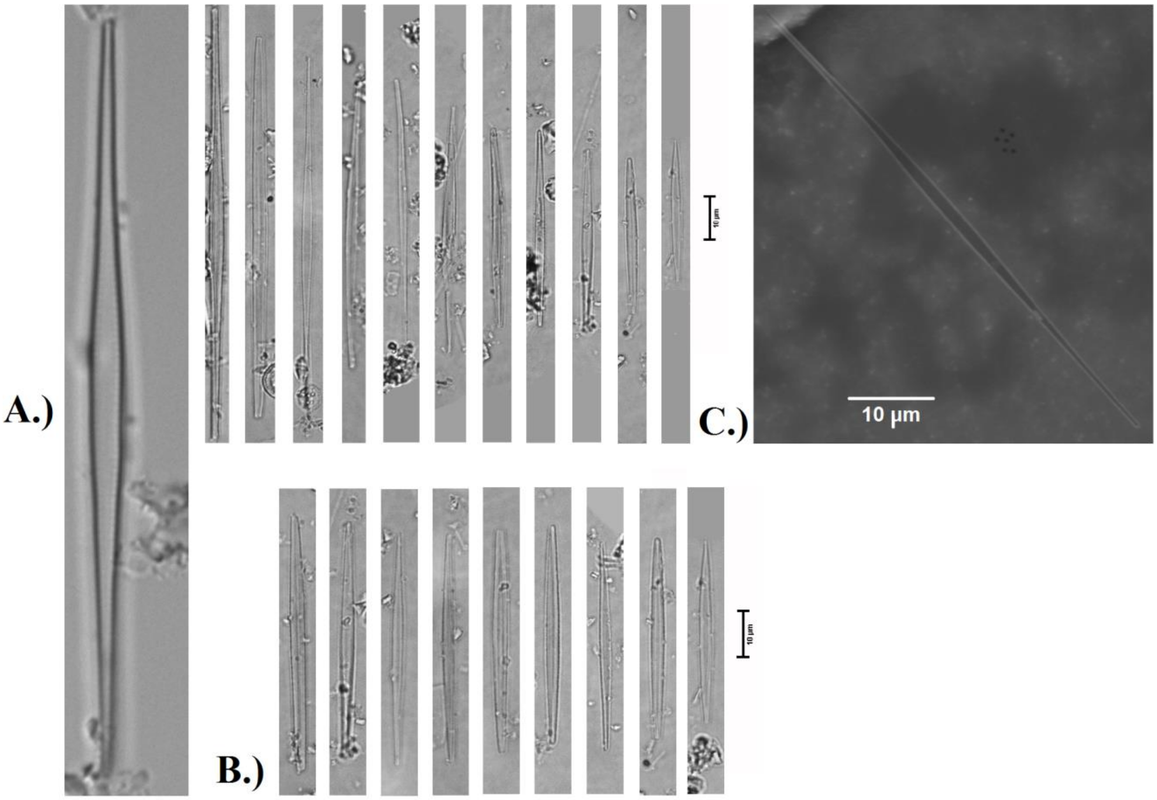
Discostella stelligera (Cleve & Grunow) Houk & Klee**.** Size diminution series.



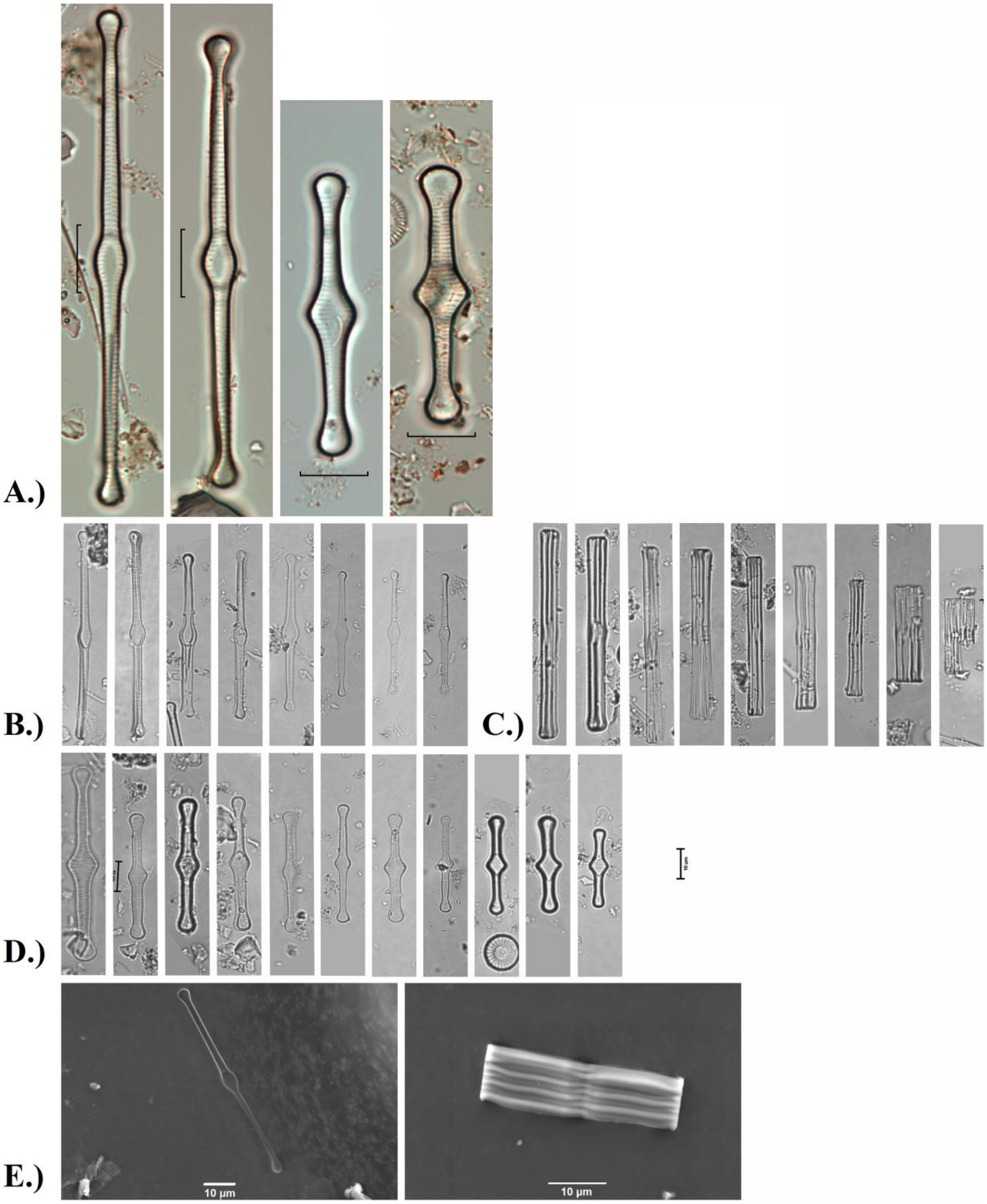
Fragilaria crotonensis Kitton**.** Size diminution series of whole valves (usually in girdle view) viewed using light microscopy.



Stephanodiscus conspicueporous Stoermer, Håkansson & Theriot**.** A.) As viewed using high resolution light microscopy. B.) Size diminution series of convex side of valve. C.) Size diminution series of concave side of valve. D.) SEM views of finer structure.



Synedra filiformis Carter & Denny**.** A.) Large picture to show detail. B.) Size diminution series of Synedra filiformis. C.) Size diminution series of Synedra filiformis var. exilis. D.) SEM view.



Tabellaria flocculosa (Roth) Kützing **strain IIIP** sensu Koppen**.** A.) As viewed using high resolution light microscopy (note some deformations). B.) Size diminution series of one potential morphological type. C.) Size diminutions series of frustules in girdle view. D.) Size diminution series of one potential morphological type. E.) SEM views of valve and frustules in girdle view.

Appendix 6. Pollen count data from Lake Superior western Core (IR#2)

	Mid-Depth Interval									
Identification	**7-7.25**	**7.75-8**	**8-8.25**	**8.25-8.5**	**8.5-8.75**	**8.75-9**	**9-9.25**	**9.25-9.5**	**9.5-9.75**	**9.75-10**
Microspheres	74	75	59	51	1	75	48	32	58	65
Ambrosia	31	27	37	42	20	19	32	57	21	51
Conifer	237	247	243	231	29	257	256	242	253	212
Other Pollen	59	52	62	76	3	50	65	77	69	72
Other Pollen Identifications		*Acer* *Artemisia* *Carey* Chenopod *Lycopodium* *Salix*	*Acer* *Artemesia?* *Carey* *Chenopod* *Salix*	*Acer* *Artesmia* *Carey* *Chenopod* *Salix*		*Alnus* *Artemisia* *Carey* Chenopod *Lycopodium* paper birch *Salix*	*Betula* *Carey* *Fraxinus* *Lycopodium* *Salix*	*Acer* *Carey* *Fraxinus?* *Salix*	*Betula* *Calix?* *Carey* *Lycopodium* *Salix*	*Alnus* *Carey* *Lycopodium* *Salix*
Diatoms			*Aulacoseira*					*Aulacoseira*		

Appendix 7a. LOI data for Lake Superior eastern core (LG#2)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
0-0.5	1.095	0.073	93.333	0.065	10.959	0.063	2.740
0.5-1	1.161	0.148	87.252	0.133	10.135	0.128	3.378
1-1.5	1.123	0.161	85.663	0.146	9.317	0.141	3.106
1.5-2	1.163	0.180	84.523	0.161	10.556	0.158	1.667
2-2.5	1.109	0.171	84.581	0.153	10.526	0.149	2.339
2.5-3	1.052	0.172	83.650	0.155	9.884	0.152	1.744
3-3.5	1.267	0.217	82.873	0.196	9.677	0.191	2.304
3.5-4	1.183	0.209	82.333	0.189	9.569	0.184	2.392
4-4.5	1.128	0.209	81.472	0.192	8.134	0.185	3.349
4.5-5	1.108	0.227	79.513	0.208	8.370	0.203	2.203
5-5.5	1.149	0.228	80.157	0.208	8.772	0.202	2.632
5.5-6	1.158	0.231	80.052	0.212	8.225	0.205	3.030
6-6.5	1.357	0.277	79.587	0.252	9.025	0.246	2.166
6.5-7	1.262	0.257	79.635	0.234	8.949	0.229	1.946
7-7.5	1.182	0.248	79.019	0.228	8.065	0.223	2.016
7.5-8	1.187	0.294	75.232	0.272	7.483	0.265	2.381
8-8.5	1.228	0.280	77.199	0.257	8.214	0.252	1.786
8.5-9	1.339	0.319	76.176	0.294	7.837	0.286	2.508
9-9.5	1.181	0.285	75.868	0.263	7.719	0.257	2.105
9.5-10	1.176	0.265	77.466	0.243	8.302	0.237	2.264
10-10.5	1.299	0.280	78.445	0.260	7.143	0.252	2.857
10.5-11	1.169	0.254	78.272	0.235	7.480	0.228	2.756
11-11.5	1.273	0.262	79.419	0.242	7.634	0.234	3.053
11.5-12	1.379	0.276	79.985	0.254	7.971	0.246	2.899

Appendix 7a. LOI data for Lake Superior eastern core (LG#2)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
12-12.5	1.447	0.283	80.442	0.261	7.774	0.253	2.827
12.5-13	1.202	0.239	80.116	0.221	7.531	0.212	3.766
13-13.5	1.085	0.222	79.539	0.206	7.207	0.198	3.604
13.5-14	1.247	0.295	76.343	0.275	6.780	0.269	2.034
14-14.5	1.380	0.288	79.130	0.267	7.292	0.261	2.083
14.5-15	1.181	0.237	79.932	0.220	7.173	0.213	2.954
15-15.5	1.142	0.233	79.597	0.213	8.584	0.210	1.288
15.5-16	1.161	0.249	78.553	0.229	8.032	0.223	2.410
16-16.5	1.223	0.254	79.231	0.234	7.874	0.228	2.362
16.5-17	1.048	0.225	78.531	0.207	8.000	0.201	2.667
17-17.5	1.206	0.255	78.856	0.236	7.451	0.231	1.961
17.5-18	1.077	0.241	77.623	0.224	7.054	0.220	1.660
18-18.5	1.233	0.269	78.183	0.248	7.807	0.242	2.230
18.5-19	1.053	0.223	78.822	0.205	8.072	0.198	3.139
19-19.5	1.058	0.215	79.679	0.197	8.372	0.193	1.860
19.5-20	1.196	0.251	79.013	0.230	8.367	0.224	2.390
20-21	1.174	0.264	77.513	0.243	7.955	0.237	2.273
21-22	1.263	0.267	78.860	0.247	7.491	0.239	2.996
22-23	1.272	0.315	75.236	0.294	6.667	0.288	1.905
23-24	1.124	0.263	76.601	0.245	6.844	0.239	2.281
24-25	1.208	0.278	76.987	0.258	7.194	0.250	2.878
25-26	1.224	0.281	77.042	0.260	7.473	0.253	2.491
26-27	1.340	0.319	76.194	0.296	7.210	0.288	2.508
27-28	1.072	0.249	76.772	0.232	6.827	0.224	3.213

Appendix 7a. LOI data for Lake Superior eastern core (LG#2)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550^{o}C (g dry wt)	% Organics (of dry wt)	LOI 1000^{o}C (g dry wt)	% Carbonates (of dry wt)
28-29	1.214	0.301	75.206	0.282	6.312	0.274	2.658
29-30	1.169	0.308	73.653	0.288	6.494	0.283	1.623
30-31	1.239	0.306	75.303	0.285	6.863	0.279	1.961
31-32	1.205	0.287	76.183	0.267	6.969	0.263	1.394
32-33	1.180	0.276	76.610	0.255	7.609	0.250	1.812
33-34	1.254	0.300	76.077	0.276	8.000	0.270	2.000
34-35	1.295	0.318	75.444	0.297	6.604	0.289	2.516
35-36	1.169	0.313	73.225	0.291	7.029	0.286	1.597
36-37	1.277	0.316	75.255	0.292	7.595	0.285	2.215
37-38	1.143	0.282	75.328	0.259	8.156	0.256	1.064
38-39	1.339	0.337	74.832	0.311	7.715	0.302	2.671
39-40	1.322	0.334	74.735	0.310	7.186	0.302	2.395
40-41	1.216	0.312	74.342	0.287	8.013	0.282	1.603
41-42	1.184	0.311	73.733	0.291	6.431	0.281	3.215
42-43	1.208	0.307	74.586	0.285	7.166	0.277	2.606
43-44	1.052	0.257	75.570	0.238	7.393	0.231	2.724
44-45	1.153	0.281	75.629	0.260	7.473	0.254	2.135
45-46	1.293	0.325	74.865	0.302	7.077	0.294	2.462
46-47	1.221	0.301	75.348	0.278	7.641	0.270	2.658
47-48	1.137	0.280	75.374	0.256	8.571	0.248	2.857
48-49	1.117	0.271	75.739	0.249	8.118	0.242	2.583
49-50	1.167	0.277	76.264	0.257	7.220	0.251	2.166
50-51	1.326	0.340	74.359	0.318	6.471	0.310	2.353
51-52	1.153	0.295	74.415	0.274	7.119	0.269	1.695

Appendix 7a. LOI data for Lake Superior eastern core (LG#2)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
52-53	1.181	0.307	74.005	0.287	6.515	0.279	2.606
53-54	1.171	0.309	73.612	0.289	6.472	0.282	2.265
54-55	1.149	0.360	68.668	0.342	5.000	0.337	1.389
55-56	1.326	0.359	72.926	0.337	6.128	0.329	2.228
56-57	1.278	0.332	74.022	0.310	6.627	0.301	2.711
57-58	1.217	0.310	74.528	0.288	7.097	0.282	1.935
58-59	1.152	0.303	73.698	0.284	6.271	0.276	2.640
59-60	1.222	0.322	73.650	0.299	7.143	0.291	2.484
60-61	1.158	0.302	73.921	0.280	7.285	0.274	1.987
61-62	1.164	0.295	74.656	0.274	7.119	0.266	2.712
62-63	1.201	0.316	73.689	0.293	7.278	0.287	1.899

Appendix 7b. LOI data for Lake Superior western core (IR#2a)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
0-0.5	1.381	0.143	89.645	0.130	9.091	0.125	3.497
0.5-1	1.252	0.215	82.827	0.193	10.233	0.188	2.326
1-1.5	1.124	0.193	82.829	0.175	9.326	0.169	3.109
1.5-2	1.306	0.226	82.695	0.205	9.292	0.199	2.655
2-2.5	1.192	0.223	81.292	0.205	8.072	0.197	3.587
2.5-3	1.327	0.274	79.352	0.251	8.394	0.243	2.920
3-3.5	1.390	0.321	76.906	0.295	8.100	0.285	3.115
3.5-4	1.240	0.305	75.403	0.279	8.525	0.269	3.279
4-4.5	1.371	0.340	75.201	0.309	9.118	0.301	2.353
4.5-5	1.367	0.334	75.567	0.306	8.383	0.296	2.994
5-5.5	1.330	0.331	75.113	0.302	8.761	0.295	2.115
5.5-6	1.192	0.296	75.168	0.273	7.770	0.265	2.703
6-6.5	1.231	0.308	74.980	0.285	7.468	0.277	2.597
6.5-7	1.152	0.285	75.260	0.265	7.018	0.256	3.158
7-7.5	1.251	0.312	75.060	0.291	6.731	0.280	3.526
7.5-8	1.347	0.332	75.353	0.310	6.627	0.299	3.313
8-8.5	1.310	0.319	75.649	0.298	6.583	0.289	2.821
8.5-9	1.235	0.306	75.223	0.285	6.863	0.278	2.288
9-9.5	1.115	0.286	74.350	0.265	7.343	0.258	2.448
9.5-10	1.336	0.331	75.225	0.308	6.949	0.299	2.719
10-10.5	1.228	0.305	75.163	0.285	6.557	0.277	2.623
10.5-11	1.286	0.316	75.428	0.295	6.646	0.287	2.532
11-11.5	1.426	0.348	75.596	0.325	6.609	0.316	2.586
12-12.5	1.353	0.330	75.610	0.308	6.667	0.300	2.424

Appendix 7b. LOI data for Lake Superior western core (IR#2a)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
12.5-13	1.471	0.359	75.595	0.335	6.685	0.327	2.228
13-13.5	1.293	0.318	75.406	0.295	7.233	0.288	2.201
13.5-14	1.402	0.343	75.535	0.320	6.706	0.312	2.332
14-14.5	1.424	0.350	75.421	0.325	7.143	0.318	2.000
14.5-15	1.320	0.326	75.303	0.301	7.669	0.295	1.840
15-15.5	1.195	0.297	75.146	0.274	7.744	0.268	2.020
15.5-16	1.267	0.316	75.059	0.292	7.595	0.285	2.215
16-16.5	1.217	0.305	74.938	0.282	7.541	0.275	2.295
16.5-17	1.166	0.294	74.786	0.271	7.823	0.264	2.381
17-17.5	1.225	0.305	75.102	0.281	7.869	0.273	2.623
17.5-18	1.288	0.320	75.155	0.296	7.500	0.289	2.187
18-18.5	1.408	0.352	75.000	0.325	7.670	0.318	1.989
18.5-19	1.344	0.336	75.000	0.313	6.845	0.305	2.381
19-19.5	1.101	0.277	74.841	0.257	7.220	0.251	2.166
19.5-20	1.232	0.317	74.269	0.294	7.256	0.287	2.208
20-21	1.371	0.356	74.034	0.331	7.022	0.323	2.247
21-22	1.359	0.349	74.319	0.321	8.023	0.314	2.006
22-23	1.278	0.322	74.804	0.303	5.901	0.294	2.795
23-24	1.212	0.308	74.587	0.290	5.844	0.282	2.597
24-25	1.307	0.335	74.369	0.315	5.970	0.306	2.687
25-26	1.208	0.315	73.924	0.298	5.397	0.289	2.857
26-27	1.285	0.319	75.175	0.301	5.643	0.292	2.821
27-28	1.342	0.353	73.696	0.333	5.666	0.323	2.833
28-29	1.410	0.369	73.830	0.347	5.962	0.336	2.981

Appendix 7b. LOI data for Lake Superior western core (IR#2a)

Sediment interval	Wet sediment wt (g)	Dry sediment wt (g)	% Water	LOI 550°C (g dry wt)	% Organics (of dry wt)	LOI 1000°C (g dry wt)	% Carbonates (of dry wt)
29-30	1.199	0.307	74.395	0.288	6.189	0.281	2.280
30-31	1.191	0.314	73.636	0.296	5.732	0.286	3.185
31-32	1.180	0.319	72.966	0.301	5.643	0.293	2.508
32-33	1.245	0.333	73.253	0.316	5.105	0.307	2.703
33-34	1.192	0.322	72.987	0.303	5.901	0.295	2.484
34-35	1.306	0.352	73.047	0.332	5.682	0.323	2.557
35-36	1.324	0.356	73.112	0.336	5.618	0.327	2.528
36-37	1.293	0.360	72.158	0.333	7.500	0.330	0.833
37-38	1.413	0.393	72.187	0.363	7.634	0.361	0.509
38-39	1.510	0.420	72.185	0.393	6.429	0.387	1.429
39-40	1.618	0.453	72.002	0.420	7.285	0.415	1.104
40-41	1.263	0.357	71.734	0.332	7.003	0.327	1.401
41-42	1.271	0.349	72.541	0.324	7.163	0.319	1.433
42-43	1.336	0.376	71.856	0.350	6.915	0.345	1.330
43-44	1.251	0.349	72.102	0.327	6.304	0.320	2.006
44-45	1.375	0.385	72.000	0.359	6.753	0.353	1.558
45-46	1.258	0.341	72.893	0.319	6.452	0.311	2.346
46-47	1.253	0.353	71.828	0.329	6.799	0.322	1.983
47-48	1.124	0.326	70.996	0.301	7.669	0.297	1.227
48-49	1.210	0.352	70.909	0.327	7.102	0.322	1.420

Appendix 8a. Trace metal data for Lake Superior eastern core (LG#1)

Sediment interval (cm)	Trace Metals											Internal Standards		
	Al (µg/g)	Ba (µg/g)	Ca (µg/g)	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Mn (µg/g)	Na (µg/g)	P (µg/g)	Si (µg/g)	Sr (µg/g)	Y_2243 A (cts/s)	Y_3710 R (cts/s)	Y_3710 A (cts/s)
0-0.25	7839	128	6264.2	14990	1352	3593.3	1737	248.15	626.6	5344	16.88	7633.2	9941.5	304590
0-0.25	7589	125.5	6210.1	15120	1342	3620	1749	248.98	629.3	5382	16.99	7599.4	9344.9	305640
mean	7714	126.75	6237.2	15055	1347	3606.65	1743	248.565	627.95	5363	16.935			
0.25-0.5	8110	125.4	6168.2	15600	1389	3665.9	1786	248.77	643.1	5593	16.75	7642	9955.7	304440
0.25-0.5	7835	123.3	6180.8	15670	1372	3693.4	1789	248.25	638.9	5572	16.85	7593	9598.3	303550
mean	7973	124.35	6174.5	15635	1380.5	3679.65	1787.5	248.51	641	5582.5	16.8			
0.5-0.75	8180	123.8	6206.4	15630	1385	3672.9	1781	247.86	644.8	5680	16.61	7666.1	9917.3	304510
0.5-0.75	7948	121.1	6210.2	15660	1360	3706.4	1782	247.39	644	5657	16.74	7618.6	9631.9	303570
mean	8064	122.45	6208.3	15645	1372.5	3689.65	1781.5	247.625	644.4	5668.5	16.675			
0.75-1	8851	126.5	6390	16820	1401	3886.4	1995	248.44	671.8	6010	16.77	7662.6	9693.9	300940
0.75-1	8485	124.7	6288.5	16740	1397	3914.3	1990	249.92	671.7	5970	16.96	7618.5	9548.6	303620
mean	8668	125.6	6339.3	16780	1399	3900.35	1992.5	249.18	671.75	5990	16.865			
1-1.25	8612	135.1	6219.3	16430	1405	3767.7	2438	246.73	686.5	5891	16.85	7639.8	9922.6	306020
1-1.25	8294	133.7	6229.6	16450	1377	3784.7	2441	243.72	680.3	5866	17.09	7610.9	9720.5	305660
mean	8453	134.4	6224.5	16440	1391	3776.2	2439.5	245.225	683.4	5878.5	16.97			
1.25-1.5	7990	135.7	5950.8	15740	1309	3493.6	2709	231.06	643.3	5626	16.09	7674.4	9844.9	304830
1.25-1.5	7572	133.9	5917.7	15760	1405	3523.8	2736	243.17	634.6	5658	16.19	7639.3	8887.4	293410
mean	7781	134.8	5934.3	15750	1357	3508.7	2722.5	237.115	638.95	5642	16.14			
1.5-1.75	8128	149	6201.9	18760	1279	3470.5	3218	226.68	758	5690	16.58	7670.4	9895.8	304910
1.5-1.75	7761	147.5	6214.4	18830	1271	3489.5	3254	227.38	747.8	5705	16.73	7630.7	9481.4	302830
mean	7945	148.25	6208.2	18795	1275	3480	3236	227.03	752.9	5697.5	16.655			

Appendix 8a.

Trace metal data for Lake Superior eastern core (LG#1)

	Trace Metals											Internal Standards		
Sediment interval (cm)	Al (µg/g)	Ba (µg/g)	Ca (µg/g)	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Mn (µg/g)	Na (µg/g)	P (µg/g)	Si (µg/g)	Sr (µg/g)	Y_2243 A (cts/s)	Y_3710 R (cts/s)	Y_3710 A (cts/s)
1.75-2	7633	149.6	6114.4	22330	1166	3147.9	3325	207.14	869.1	5430	16.01	7654.1	9771.3	300420
1.75-2	7164	148.5	5966.2	22300	1168	3159.3	3344	207.42	865	5388	16.21	7614.5	9645.8	305200
mean	7399	149.05	6040.3	22315	1167	3153.6	3334.5	207.28	867.05	5409	16.11			
2.75-3	7531	133.3	5901.4	30030	1175	3135.5	941.4	210.11	2050	5656	16.43	7630.4	9791.7	303710
2.75-3	7126	133.1	5798.9	30090	1203	3156.5	933.2	213.99	2005	5661	16.71	7619.2	9588.7	305020
mean	7329	133.2	5850.2	30060	1189	3146	937.3	212.05	2027.5	5658.5	16.57			
3.5-3.75	9937	135.6	5978.7	19730	1519	4127.9	630.5	261.03	1199	6316	16.64	7645.8	9848	306060
3.5-3.75	9397	134.1	6026.3	19890	1526	4159.3	631.9	263.87	1175	6344	16.91	7646.1	9475.5	302620
mean	9667	134.85	6002.5	19810	1522.5	4143.6	631.2	262.45	1187	6330	16.775			
4-4.25	8371	124.9	5461	14140	1470	3884	496.3	253.75	1074	5720	15.24	7618.1	9840.4	305270
4-4.25	8560	125.4	5435.4	14210	1478	3877.2	497.8	252.77	1071	5678	15.41	7616.5	9443.1	306410
mean	8466	125.15	5448.2	14175	1474	3880.6	497.05	253.26	1072.5	5699	15.325			
5-5.25	8353	124.8	5146.4	12670	1406	3881.4	394.5	240.28	863.2	5814	14.32	7652.4	9849.6	305120
5-5.25	8523	124.7	5180	12710	1429	3901	393.3	243.4	868.1	5793	14.4	7558.8	9437.4	300590
mean	8438	124.75	5163.2	12690	1417.5	3891.2	393.9	241.84	865.65	5803.5	14.36			
6.25-6.5	8434	128	5092.1	11210	1397	3915.4	311.8	234.66	470.3	5693	14.01	7632.7	9684.8	302310
6.25-6.5	8531	129.5	4955.8	11190	1425	3916.9	308.8	235.53	478.6	5628	14.25	7507.5	9494.5	304040
mean	8482.5	128.75	5023.95	11200	1411	3916.15	310.3	235.095	474.45	5660.5	14.13			
8-8.25	7819	119.3	4648.8	12740	1285	3686	487.1	219.21	1129	5280	12.98	7641.3	9812.9	305240
8-8.25	7923	119.6	4554	12720	1302	3696.6	482.9	219.74	1143	5280	13.12	7590	9535.1	306340
mean	7871	119.45	4601.4	12730	1293.5	3691.3	485	219.475	1136	5280	13.05			

Appendix 8a.

Trace metal data for Lake Superior eastern core (LG#1)

	Trace Metals											Internal Standards		
Sediment interval (cm)	Al (µg/g)	Ba (µg/g)	Ca (µg/g)	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Mn (µg/g)	Na (µg/g)	P (µg/g)	Si (µg/g)	Sr (µg/g)	Y_2243 A (cts/s)	Y_3710 R (cts/s)	Y_3710 A (cts/s)
9.5-9.75	7498	117.4	4488.2	11830	1219	3520.8	376.2	204.75	799.3	5319	12.26	7686.5	9506	303310
9.5-9.75	7624	119.4	4377.7	11780	1287	3525.4	372.3	211.49	801.7	5301	12.5	7603.9	9483.5	304720
mean	7561	118.4	4432.95	11805	1253	3523.1	374.25	208.12	800.5	5310	12.38			
12.25-12.5	8514	129.7	4651.5	11490	1424	3780.7	335.3	243.88	450.8	5703	13.18	7671.9	9718	304230
12.25-12.5	8528	131.3	4572.6	11490	1457	3777.4	333.9	244.16	446.9	5708	13.44	7603.5	9516.8	305520
mean	8521	130.5	4612.05	11490	1440.5	3779.05	334.6	244.02	448.85	5705.5	13.31			
14-14.25	9055	139.2	4690.2	12310	1523	3942.9	347.7	257.1	442.6	5882	13.7	7648.4	9808.2	304690
14-14.25	9048	140.7	4595.9	12360	1573	3947.4	346.8	257.98	437.4	5875	13.93	7613	9430.9	307180
mean	9051.5	139.95	4643.05	12335	1548	3945.15	347.25	257.54	440	5878.5	13.815			
17-17.25	8757	131.4	4584.2	11490	1486	3808.9	326.5	246.11	424.5	5586	13.08	7628.6	9545.6	302250
17-17.25	8639	135.3	4447.5	11480	1571	3789	321.4	252.06	424.3	5587	13.46	7629.9	9407.8	306550
mean	8698	133.35	4515.85	11485	1528.5	3798.95	323.95	249.085	424.4	5586.5	13.27			
26.5-27	7852	121.1	4272.9	11000	1382	3483.7	305.3	223.62	499.5	5093	12.23	7613.7	9618.3	303310
26.5-27	7771	123	4245.8	10990	1420	3481.5	301.8	224.8	501.7	5062	12.43	7559.3	9456.5	302450
mean	7812	122.05	4259.4	10995	1401	3482.6	303.55	224.21	500.6	5077.5	12.33			
35-36	8210	126.9	4529.3	10970	1386	3689.2	274.6	238.33	395.1	5407	12.86	7648.4	9665.2	304540
35-36	8070	129.9	4423	10920	1442	3686.4	269.1	240.58	399.6	5357	13.16	7515.6	9508	304860
mean	8140	128.4	4476.2	10945	1414	3687.8	271.85	239.455	397.35	5382	13.01			

Appendix 8b. Trace metal data for Lake Superior western core (IR#2a)

	Trace Metals											Internal Standards		
Sediment interval (cm)	Al (µg/g)	Ba (µg/g)	Ca (µg/g)	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Mn (µg/g)	Na (µg/g)	P (µg/g)	Si (µg/g)	Sr (µg/g)	Y_2243 A (cts/s)	Y_3710 R (cts/s)	Y_3710 A (cts/s)
0-0.25	8629.0	124.9	6885.3	11690	1642.0	4202.8	1559.0	5416.6	526.2	4892.0	16.8	7556.4	9424.1	296880
0-0.25	7890.0	125.1	6973.7	11750	1675.0	4172.0	1556.0	5376.4	520.8	4893.0	17.2	7680.4	9171.6	296040
mean	8259.5	125.0	6929.5	11720	1658.5	4187.4	1557.5	5396.5	523.5	4892.5	17.0			
0.25-0.5	9662.0	127.0	6391.1	13080	1757.0	4476.2	1778.0	1046.5	543.8	5511.0	16.5	7660.1	9385.3	297660
0.25-0.5	8673.0	126.2	6461.2	13080	1789.0	4442.8	1777.0	1057.9	531.1	5499.0	16.8	7746.0	9145.3	297490
mean	9167.5	126.6	6426.2	13080	1773.0	4459.5	1777.5	1052.2	537.5	5505.0	16.7			
0.5-0.75	9469.0	123.7	5989.6	12680	1703.0	4233.8	1744.0	395.7	543.8	5286.0	15.9	7716.7	9394.3	301360
0.5-0.75	8457.0	122.3	6095.7	12580	1702.0	4226.1	1736.0	413.7	524.9	5245.0	16.1	7726.5	9165.6	297470
mean	8963.0	123.0	6042.7	12630	1702.5	4230.0	1740.0	404.7	534.4	5265.5	16.0			
0.75-1	9579.0	121.3	6067.1	12660	1695.0	4242.5	1728.0	234.0	529.7	5340.0	15.9	7690.2	9285.8	298930
0.75-1	8477.0	120.1	6120.3	12520	1685.0	4229.5	1723.0	254.0	519.6	5268.0	16.1	7771.1	9197.7	299590
mean	9028.0	120.7	6093.7	12590	1690.0	4236.0	1725.5	244.0	524.7	5304.0	16.0			
1-1.25	10430.0	120.3	6267.5	13640	1739.0	4470.1	1826.0	210.5	560.1	5544.0	16.2	7716.3	9055.1	296100
1-1.25	8942.0	119.3	6256.7	13360	1772.0	4453.6	1806.0	232.5	544.7	5457.0	16.3	7752.8	9133.0	297820
mean	9686.0	119.8	6262.1	13500	1755.5	4461.9	1816.0	221.5	552.4	5500.5	16.3			
1.25-1.5	10400.0	117.0	6097.2	13290	1783.0	4450.1	1675.0	200.7	554.1	5383.0	16.0	7642.7	9336.5	295940
1.25-1.5	8945.0	117.4	6080.1	13250	1763.0	4449.0	1674.0	220.0	538.6	5381.0	16.2	7680.6	9228.9	298920
mean	9672.5	117.2	6088.7	13270	1773.0	4449.6	1674.5	210.4	546.4	5382.0	16.1			

	Trace Metals											Internal Standards		
Sediment interval (cm)	Al (µg/g)	Ba (µg/g)	Ca (µg/g)	Fe (µg/g)	K (µg/g)	Mg (µg/g)	Mn (µg/g)	Na (µg/g)	P (µg/g)	Si (µg/g)	Sr (µg/g)	Y_2243 A (cts/s)	Y_3710 R (cts/s)	Y_3710 A (cts/s)
1.5-1.75	10540.0	111.2	6054.2	13640	1791.0	4551.4	1650.0	197.7	555.2	5585.0	16.0	7570.2	8937.4	295050
1.5-1.75	9109.0	110.5	6021.8	13370	1804.0	4517.4	1630.0	217.0	532.5	5501.0	16.2	7657.3	9126.1	297790
mean	9824.5	110.9	6038.0	13505	1797.5	4534.4	1640.0	207.3	543.9	5543.0	16.1			
1.75-2	10470.0	103.0	5748.7	12850	1754.0	4393.2	1546.0	188.8	515.2	5316.0	15.7	7633.1	9459.2	297620
1.75-2	8980.0	100.9	5867.5	12910	1720.0	4386.5	1555.0	207.1	503.1	5350.0	15.8	7682.5	9106.0	295610
mean	9725.0	102.0	5808.1	12880	1737.0	4389.9	1550.5	197.9	509.2	5333.0	15.7			
2-2.25	11000.0	107.5	5992.7	13550	1846.0	4565.6	2099.0	195.1	556.5	5637.0	16.3	7665.6	9330.6	297220
2-2.25	9343.0	106.7	6069.0	13610	1828.0	4553.1	2108.0	213.7	536.9	5578.0	16.4	7752.2	9002.7	297120
mean	10171.5	107.1	6030.9	13580	1837.0	4559.4	2103.5	204.4	546.7	5607.5	16.4			
2.25-2.5	10590.0	154.0	6539.9	12420	1767.0	4332.2	5207.0	194.4	522.2	5334.0	18.1	7677.6	9217.3	296310
2.25-2.5	8895.0	151.1	6609.7	12330	1712.0	4317.3	5213.0	209.8	507.8	5289.0	18.1	7748.7	9067.9	298670
mean	9742.5	152.6	6574.8	12375	1739.5	4324.8	5210.0	202.1	515.0	5311.5	18.1			
2.5-2.75	9725.0	157.6	6755.0	12480	1777.0	4368.9	6397.0	226.5	509.9	5478.0	19.7	7702.1	9379.0	299790
2.5-2.75	10940.0	159.3	6957.7	12550	1762.0	4353.8	6785.0	213.6	523.1	5527.0	19.6	7670.0	9846.6	300790
mean	10332.5	158.5	6856.4	12515	1769.5	4361.4	6591.0	220.0	516.5	5502.5	19.6			
2.75-3	8975.0	146.5	7010.5	23290	1676.0	4060.4	6152.0	214.4	2619.0	5527.0	22.3	7651.6	9188.1	296100
2.75-3	10080.0	149.4	7112.9	23130	1679.0	4048.8	6452.0	202.8	2749.0	5483.0	22.2	7652.1	9980.6	301710
mean	9527.5	148.0	7061.7	23210	1677.5	4054.6	6302.0	208.6	2684.0	5505.0	22.2			

Appendix 8b. Trace metal data for Lake Superior western core (IR#2a)

	Trace Metals											Internal Standards		
Sediment interval (cm)	**Al (µg/g)**	**Ba (µg/g)**	**Ca (µg/g)**	**Fe (µg/g)**	**K (µg/g)**	**Mg (µg/g)**	**Mn (µg/g)**	**Na (µg/g)**	**P (µg/g)**	**Si (µg/g)**	**Sr (µg/g)**	**Y_2243 A (cts/s)**	**Y_3710 R (cts/s)**	**Y_3710 A (cts/s)**
3.5-3.75	10410.0	96.2	5336.1	18650	1849.0	4504.2	584.0	225.8	1416.0	5578.0	17.1	7557.0	9317.0	297500
3.5-3.75	12290.0	96.5	5501.2	18540	1837.0	4450.7	575.1	210.9	1448.0	5575.0	16.9	7644.0	10030.0	303820
mean	11350.0	96.3	5418.7	18595	1843.0	4477.5	579.6	218.4	1432.0	5576.5	17.0			
4.5-4.75	9157.0	253.8	5955.8	36180	1600.0	3867.4	1138.0	211.8	4575.0	5562.0	25.1	7671.3	9174.3	294620
4.5-4.75	10600.0	251.5	6020.1	35550	1580.0	3862.6	1119.0	200.5	4864.0	5524.0	24.7	7612.8	10056.0	301860
mean	9878.5	252.7	5988.0	35865	1590.0	3865.0	1128.5	206.2	4719.5	5543.0	24.9			
5.5-5.75	10130.0	143.5	4749.9	13740	1773.0	4358.0	654.5	217.7	517.4	5171.0	14.5	7710.7	9151.4	297180
5.5-5.75	11990.0	143.8	4777.8	13550	1758.0	4337.3	643.4	205.6	538.1	5119.0	14.3	7646.2	10032.0	304400
mean	11060.0	143.7	4763.9	13645	1765.5	4347.7	649.0	211.7	527.8	5145.0	14.4			
6.5-6.75	10600.0	154.4	4841.2	14600	1873.0	4535.7	721.0	228.8	568.1	5452.0	14.9	7695.7	9229.6	297840
6.5-6.75	13040.0	154.6	4942.6	14600	1816.0	4512.0	715.1	213.6	595.5	5439.0	14.6	7653.4	9752.0	303190
mean	11820.0	154.5	4891.9	14600	1844.5	4523.9	718.1	221.2	581.8	5445.5	14.8			
7-7.25	10070.0	157.5	4821.1	14240	1780.0	4353.0	705.4	221.1	607.9	5235.0	14.7	7719.0	9219.1	299350
7-7.25	12300.0	156.6	4964.8	14110	1731.0	4345.1	696.1	207.4	630.3	5226.0	14.4	7635.8	9952.3	301370
mean	11185.0	157.1	4893.0	14175	1755.5	4349.1	700.8	214.3	619.1	5230.5	14.6			
8.5-8.75	10270.0	157.8	4482.5	14860	1820.0	4426.4	808.1	216.0	832.1	5305.0	13.9	7662.3	9175.4	297840
8.5-8.75	12580.0	158.7	4567.4	14770	1817.0	4401.8	798.3	206.7	872.1	5306.0	13.7	7648.5	9904.0	303690
mean	11425.0	158.3	4525.0	14815	1818.5	4414.1	803.2	211.3	852.1	5305.5	13.8			

Appendix 8b.

Trace metal data for Lake Superior western core (IR#2a)

Sediment interval (cm)	Trace Metals											Internal Standards		
	Al (µg/g)	**Ba (µg/g)**	**Ca (µg/g)**	**Fe (µg/g)**	**K (µg/g)**	**Mg (µg/g)**	**Mn (µg/g)**	**Na (µg/g)**	**P (µg/g)**	**Si (µg/g)**	**Sr (µg/g)**	**Y_2243 A (cts/s)**	**Y_3710 R (cts/s)**	**Y_3710 A (cts/s)**
13-13.25	11520.0	165.8	4781.6	15550	1984.0	4891.2	620.7	232.5	549.4	5774.0	14.7	7592.1	9067.6	294410
13-13.25	14900.0	164.1	4844.2	15280	1983.0	4863.8	610.8	221.8	578.3	5719.0	14.4	7628.2	9988.9	302950
mean	13210.0	165.0	4812.9	15415	1983.5	4877.5	615.8	227.1	563.9	5746.5	14.6			
20-20.5	10960.0	160.8	4607.6	24400	1866.0	4642.4	1918.0	226.5	4338.0	5602.0	13.7	7703.7	9191.2	295260
20-20.5	13650.0	159.6	4620.3	24050	1867.0	4628.5	1918.0	219.1	4700.0	5563.0	13.4	7645.4	9916.9	303730
mean	12305.0	160.2	4614.0	24225	1866.5	4635.5	1918.0	222.8	4519.0	5582.5	13.5			

Appendix 9a.

Biogenic silica data for Lake Superior eastern core (LG#2)

Sediment Top Interval	Year (C.E.)	Spectrophotometer Y-intercept	Dry Wt	% Bsi (dry wt)	Bsi concentration (mg SiO_2/g dry wt)	Sediment Accumulation Rate (g/cm^2/y)	Bsi Accumulation Rate (g Bsi/cm^2/y)
0	2009	0.2421	0.0303	9.60	0.0960	0.0262	0.00252
1	2004	0.2681	0.0303	10.64	0.1064	0.0259	0.00275
2	1999	0.2446	0.0307	9.58	0.0958	0.0253	0.00242
3	1993	0.2070	0.0310	8.03	0.0803	0.0254	0.00203
4	1984	0.2048	0.0303	8.12	0.0812	0.0261	0.00212
5	1977	0.2115	0.0301	8.45	0.0845	0.0288	0.00243
6	1970	0.2268	0.0301	9.06	0.0906	0.0335	0.00303
7		0.2064	0.0303	8.19	0.0819	0.0357	0.00292
8	1956	0.1322	0.0301	5.28	0.0528	0.0355	0.00187
9		0.1469	0.0302	5.85	0.0585	0.0372	0.00218
10	1946	0.2144	0.0300	8.59	0.0859	0.0409	0.00351
11		0.2072	0.0303	8.22	0.0822	0.0421	0.00346
12	1932	0.1909	0.0301	7.62	0.0762	0.0410	0.00312
13		0.2449	0.0306	9.62	0.0962	0.0404	0.00389
14	1920	0.1793	0.0305	7.07	0.0707	0.0405	0.00286
15		0.2050	0.0304	8.11	0.0811	0.0396	0.00321
16		0.1528	0.0301	6.10	0.0610	0.0377	0.00230
17	1902	0.1422	0.0304	5.62	0.0562	0.0402	0.00226
18		0.1241	0.0304	4.91	0.0491	0.0471	0.00231
19		0.1980	0.0300	7.93	0.0793	0.0447	0.00355
20		0.1651	0.0301	6.59	0.0659	0.0332	0.00219
21		0.1837	0.0300	7.36	0.0736	0.0246	0.00181
23		0.1482	0.0300	5.94	0.0594	0.0249	0.00148
25		0.0992	0.0304	3.92	0.0392	0.0252	0.00099
27	1800	0.1800	0.0305	7.09	0.0709	0.0233	0.00165

Appendix 9b. Biogenic silica data for Lake Superior western core (IR#2)

Sediment Top Interval	Year (C.E.)	Spectro-photometer Y-intercept	Dry Wt	% Bsi (dry wt)	Bsi concentration (mg SiO_2/g dry wt)	Sediment Accumulation Rate ($g/cm^2/y$)	Bsi Accumulation Rate (g $Bsi/cm^2/y$)
0	2008	0.1297	0.0302	5.1622	0.0516	0.0224	0.00116
0.5	2004	0.2313	0.0301	9.2366	0.0924	0.0207	0.00191
1	1999	0.1735	0.0304	6.8601	0.0686	0.0190	0.00130
1.5	1994	0.1826	0.0304	7.2199	0.0722	0.0185	0.00133
2	1988	0.1046	0.0304	4.1358	0.0414	0.0179	0.00074
2.5	1982	0.1952	0.0304	7.7181	0.0772	0.0202	0.00156
3	1976	0.1224	0.0304	4.8396	0.0484	0.0225	0.00109
3.5	1971	0.0905	0.0303	3.5901	0.0359	0.0248	0.00089
4		0.1705	0.0305	6.7194	0.0672	0.0271	0.00182
4.5	1959	0.0987	0.0304	3.9025	0.0390	0.0251	0.00098
5		0.1843	0.0301	7.3598	0.0736	0.0230	0.00169
5.5	1947	0.1253	0.0300	5.0204	0.0502	0.0225	0.00113
6		0.1665	0.0303	6.6050	0.0661	0.0187	0.00124
6.5	1930	0.1307	0.0302	5.2020	0.0520	0.0168	0.00087
7	1920	0.1540	0.0302	6.1294	0.0613	0.0144	0.00088
7.5		0.1465	0.0301	5.8503	0.0585	0.0132	0.00077
8		0.1726	0.0303	6.8470	0.0685	0.0143	0.00098
8.5	1890	0.1392	0.0301	5.5588	0.0556	0.0162	0.00090
9		0.1219	0.0301	4.8679	0.0487	0.0190	0.00092
9.5		0.0818	0.0304	3.2343	0.0323	0.0217	0.00070
10	1866	0.0637	0.0303	2.5270	0.0253	0.0198	0.00050
10.5		0.1607	0.0304	6.3540	0.0635	0.0180	0.00114
11.5		0.1299	0.0303	5.1531	0.0515	0.0142	0.00073
12.5		0.0561	0.0301	2.2403	0.0224	0.0129	0.00029
13.5	1807	0.0537	0.0305	2.1163	0.0212	0.0122	0.00026

Append Appendix 10. Lake Superior watershed land use 1820 - 2021

Total watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1820	0	1857	0	1894	1799121.5
1821	0	1858	0	1895	1827953.4
1822	0	1859	0	1896	1856819.5
1823	0	1860	316748.9	1897	1885610.5
1824	0	1861	325359.1	1898	1914404.3
1825	0	1862	333974.0	1899	1943233.7
1826	0	1863	342580.7	1900	1790713.9
1827	0	1864	351221.1	1901	1853026.5
1828	0	1865	359834.5	1902	1915339.0
1829	0	1866	368442.6	1903	1977654.4
1830	0	1867	377056.3	1904	2040182.6
1831	0	1868	385690.6	1905	2102514.3
1832	0	1869	394303.2	1906	2164839.2
1833	0	1870	402913.5	1907	2227156.6
1834	0	1871	779213.1	1908	2289636.0
1835	0	1872	819998.2	1909	2352026.4
1836	0	1873	860672.7	1910	2413794.7
1837	0	1874	901344.7	1911	1252870.5
1838	0	1875	942012.9	1912	1289252.4
1839	0	1876	982798.0	1913	1325501.9
1840	0	1877	1023472.4	1914	1361780.4
1841	0	1878	1064146.7	1915	1398056.4
1842	0	1879	1104808.7	1916	1434417.8
1843	0	1880	894387.6	1917	1470701.5
1844	0	1881	1357475.4	1918	1506992.2
1845	0	1882	1414094.7	1919	1543245.1
1846	0	1883	1470723.9	1920	1579975.8
1847	0	1884	1527508.8	1921	1620206.6
1848	0	1885	1584122.1	1922	1660392.0
1849	0	1886	1640735.0	1923	1700697.0
1850	0	1887	1697371.1	1924	1740967.8
1851	0	1888	1754158.6	1925	1776637.8
1852	0	1889	1810763.0	1926	1761296.9
1853	0	1890	1867403.7	1927	1745864.1
1854	0	1891	1712649.1	1928	1730464.2
1855	0	1892	1741549.2	1929	1715080.4
1856	0	1893	1770344.9	1930	1705640.6

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1931	1465948.4	1968	718087.5	2005	529558.1
1932	1517806.4	1969	666744.7	2006	519046.0
1933	1569496.0	1970	651434.0	2007	509353.4
1934	1621196.6	1971	636273.1	2008	509353.4
1935	1666341.2	1972	623040.6	2009	509353.4
1936	1638109.2	1973	609798.1	2010	509353.4
1937	1609942.8	1974	598755.4	2011	509353.4
1938	1581743.4	1975	612119.5	2012	509353.4
1939	1553580.9	1976	625712.7	2013	509353.4
1940	1528721.7	1977	641010.0	2014	509353.4
1941	1541393.1	1978	654462.0	2015	509353.4
1942	1554503.3	1979	647207.8	2016	509353.4
1943	1567570.6	1980	639948.2	2017	509353.4
1944	1580636.7	1981	632704.9	2018	509353.4
1945	1591293.8	1982	625174.3	2019	509353.4
1946	1574501.1	1983	614501.9	2020	509353.4
1947	1557700.2	1984	603790.9	2021	509353.4
1948	1540864.3	1985	593103.6		
1949	1524092.1	1986	582429.2		
1950	1505646.0	1987	571851.3		
1951	1467924.2	1988	562467.2		
1952	1425051.5	1989	553129.3		
1953	1382348.9	1990	543785.0		
1954	1337762.9	1991	534429.4		
1955	1273116.0	1992	525512.3		
1956	1208449.9	1993	521515.7		
1957	1146492.2	1994	517549.9		
1958	1084501.5	1995	513558.1		
1959	1026154.8	1996	511696.4		
1960	1008838.5	1997	508650.7		
1961	991539.1	1998	519342.6		
1962	974246.3	1999	530067.7		
1963	956968.0	2000	540775.2		
1964	936553.2	2001	551548.6		
1965	881967.0	2002	561089.8		
1966	827421.2	2003	550596.6		
1967	772815.2	2004	540055.1		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1820	0	1857	0	1894	582513.4
1821	0	1858	0	1895	598858.6
1822	0	1859	0	1896	615229.8
1823	0	1860	186544.2	1897	631550.1
1824	0	1861	190229.8	1898	647875.2
1825	0	1862	193915.4	1899	664224.2
1826	0	1863	197595.6	1900	613819.8
1827	0	1864	201295.9	1901	659289.7
1828	0	1865	204981.9	1902	704753.5
1829	0	1866	208663.0	1903	750220.3
1830	0	1867	212348.4	1904	795843.5
1831	0	1868	216044.5	1905	841319.4
1832	0	1869	219728.7	1906	886782.6
1833	0	1870	223411.6	1907	932248.6
1834	0	1871	227097.3	1908	977843.2
1835	0	1872	230791.0	1909	1023352.3
1836	0	1873	234477.8	1910	1068668.9
1837	0	1874	238162.2	1911	641025.3
1838	0	1875	241842.0	1912	673819.4
1839	0	1876	245539.7	1913	706507.8
1840	0	1877	249225.4	1914	739214.1
1841	0	1878	252913.5	1915	771912.7
1842	0	1879	256589.8	1916	804697.7
1843	0	1880	149846.5	1917	837414.9
1844	0	1881	544429.6	1918	870129.3
1845	0	1882	560161.1	1919	902806.7
1846	0	1883	575901.3	1920	935890.1
1847	0	1884	591677.9	1921	971644.6
1848	0	1885	607407.6	1922	1007353.8
1849	0	1886	623132.7	1923	1043194.8
1850	0	1887	638874.8	1924	1078996.0
1851	0	1888	654658.7	1925	1110790.2
1852	0	1889	670377.1	1926	1098385.7
1853	0	1890	686122.5	1927	1085899.4
1854	0	1891	533479.0	1928	1073453.4
1855	0	1892	549862.9	1929	1061014.8
1856	0	1893	566191.1	1930	1053566.1

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1931	1101387.2	1968	565208.1	2005	417749.8
1932	1145520.0	1969	524719.2	2006	406451.6
1933	1189524.6	1970	514901.9	2007	395905.4
1934	1233553.0	1971	505172.8	2008	395905.4
1935	1272198.3	1972	496627.9	2009	395905.4
1936	1250897.6	1973	488067.4	2010	395905.4
1937	1229639.5	1974	481108.0	2011	395905.4
1938	1208348.6	1975	491874.4	2012	395905.4
1939	1187077.1	1976	502819.7	2013	395905.4
1940	1168446.7	1977	514911.0	2014	395905.4
1941	1179727.6	1978	525557.3	2015	395905.4
1942	1191844.1	1979	519945.7	2016	395905.4
1943	1203928.0	1980	514338.9	2017	395905.4
1944	1216016.5	1981	508738.9	2018	395905.4
1945	1226327.2	1982	502926.9	2019	395905.4
1946	1216085.3	1983	494801.9	2020	395905.4
1947	1205840.4	1984	486638.8	2021	395905.4
1948	1195576.8	1985	478501.5		
1949	1185372.9	1986	470374.6		
1950	1173655.9	1987	462157.2		
1951	1144632.3	1988	453050.8		
1952	1110760.2	1989	443992.7		
1953	1077025.4	1990	434934.2		
1954	1041889.2	1991	425858.3		
1955	991925.0	1992	417161.2		
1956	941950.8	1993	412697.3		
1957	894209.4	1994	408268.1		
1958	846433.3	1995	403811.8		
1959	801549.1	1996	401497.2		
1960	789432.0	1997	398159.6		
1961	777297.2	1998	409094.3		
1962	765165.7	1999	420055.7		
1963	753064.3	2000	431003.9		
1964	738337.4	2001	442009.2		
1965	695075.3	2002	451621.0		
1966	651855.3	2003	440351.6		
1967	608576.4	2004	429028.4		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1820	0	1857	0	1894	1636581.4
1821	0	1858	0	1895	1649572.6
1822	0	1859	0	1896	1662566.7
1823	0	1860	129221.3	1897	1675542.6
1824	0	1861	135972.3	1898	1688513.6
1825	0	1862	142731.8	1899	1701493.9
1826	0	1863	149489.2	1900	1564683.1
1827	0	1864	156260.0	1901	1573606.8
1828	0	1865	163015.7	1902	1582541.7
1829	0	1866	169773.6	1903	1591475.6
1830	0	1867	176531.6	1904	1600437.8
1831	0	1868	183301.2	1905	1609379.2
1832	0	1869	190059.8	1906	1618334.4
1833	0	1870	196817.2	1907	1627272.7
1834	0	1871	618669.0	1908	1636214.7
1835	0	1872	661614.6	1909	1645182.8
1836	0	1873	704439.8	1910	1653568.0
1837	0	1874	747265.1	1911	616798.4
1838	0	1875	790091.8	1912	619782.2
1839	0	1876	833032.1	1913	622741.0
1840	0	1877	875858.6	1914	625710.7
1841	0	1878	918681.8	1915	628685.8
1842	0	1879	961505.9	1916	631658.2
1843	0	1880	975564.2	1917	634621.8
1844	0	1881	1036750.3	1918	637595.5
1845	0	1882	1093164.4	1919	640569.3
1846	0	1883	1149577.3	1920	643608.2
1847	0	1884	1206158.3	1921	647443.5
1848	0	1885	1262566.6	1922	651279.7
1849	0	1886	1318983.1	1923	655100.4
1850	0	1887	1375402.9	1924	658927.8
1851	0	1888	1431973.9	1925	662230.5
1852	0	1889	1488390.0	1926	659473.6
1853	0	1890	1544810.7	1927	656708.2
1854	0	1891	1597641.2	1928	653934.2
1855	0	1892	1610662.9	1929	651169.1
1856	0	1893	1623631.1	1930	649278.7

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed agricultural acres

Year	Acres	Year	Acres	Year	Acres
1931	364561.2	1968	152879.4	2005	111808.2
1932	372286.4	1969	142025.5	2006	112594.4
1933	379971.5	1970	136532.1	2007	113448.0
1934	387643.5	1971	131100.3	2008	113448.0
1935	394142.8	1972	126412.6	2009	113448.0
1936	387211.6	1973	121730.8	2010	113448.0
1937	380303.2	1974	117647.4	2011	113448.0
1938	373394.7	1975	120245.1	2012	113448.0
1939	366503.8	1976	122893.0	2013	113448.0
1940	360275.0	1977	126099.0	2014	113448.0
1941	361665.4	1978	128904.7	2015	113448.0
1942	362659.2	1979	127262.1	2016	113448.0
1943	363642.6	1980	125609.3	2017	113448.0
1944	364620.2	1981	123966.0	2018	113448.0
1945	364966.6	1982	122247.4	2019	113448.0
1946	358415.8	1983	119700.1	2020	113448.0
1947	351859.8	1984	117152.1	2021	113448.0
1948	345287.6	1985	114602.1		
1949	338719.2	1986	112054.6		
1950	331990.1	1987	109694.1		
1951	323291.9	1988	109416.4		
1952	314291.3	1989	109136.6		
1953	305323.5	1990	108850.9		
1954	295873.7	1991	108571.2		
1955	281191.0	1992	108351.1		
1956	266499.1	1993	108818.4		
1957	252282.8	1994	109281.8		
1958	238068.2	1995	109746.2		
1959	224605.7	1996	110199.2		
1960	219406.4	1997	110491.1		
1961	214241.9	1998	110248.3		
1962	209080.6	1999	110012.0		
1963	203903.7	2000	109771.4		
1964	198215.8	2001	109539.4		
1965	186891.7	2002	109468.8		
1966	175565.9	2003	110245.0		
1967	164238.8	2004	111026.7		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed population

Year	People	Year	People	Year	People
1820	0	1857	98183.2	1894	525439.3
1821	0	1858	110054.4	1895	564426.7
1822	0	1859	121916.8	1896	603547.3
1823	0	1860	92257.3	1897	642542.3
1824	0	1861	97833.3	1898	681540.9
1825	0	1862	103403.4	1899	720527.2
1826	0	1863	108978.8	1900	748856.6
1827	0	1864	114574.7	1901	373834.4
1828	0	1865	120145.5	1902	391111.9
1829	0	1866	125720.9	1903	408413.1
1830	0	1867	131294.9	1904	425759.9
1831	0	1868	136884.6	1905	443064.1
1832	0	1869	142459.8	1906	460363.9
1833	0	1870	156667.4	1907	477655.1
1834	0	1871	184614.1	1908	494989.3
1835	0	1872	191031.2	1909	512273.3
1836	0	1873	197427.5	1910	528775.4
1837	0	1874	203812.6	1911	359382.6
1838	0	1875	210206.9	1912	364005.4
1839	0	1876	216620.4	1913	368639.2
1840	0	1877	223020.2	1914	373268.9
1841	0	1878	229408.9	1915	377911.5
1842	0	1879	235804.9	1916	382534.7
1843	0	1880	182303.8	1917	387172.5
1844	0	1881	200201.7	1918	391788.5
1845	0	1882	225248.5	1919	396423.0
1846	0	1883	250297.2	1920	400589.9
1847	0	1884	275392.8	1921	399541.1
1848	0	1885	300430.8	1922	398029.4
1849	0	1886	325483.3	1923	396517.9
1850	15037.2	1887	350504.2	1924	395004.4
1851	26906.1	1888	375616.7	1925	393472.3
1852	38806.5	1889	400647.9	1926	391966.2
1853	50678.6	1890	390046.2	1927	390474.8
1854	62547.3	1891	408347.1	1928	388935.1
1855	74413.4	1892	447435.7	1929	387419.2
1856	86318.1	1893	486448.7	1930	386162.3

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed population

Year	People	Year	People	Year	People
1931	387706.9	1968	469799.1	2005	466166.6
1932	389360.3	1969	469823.6	2006	466231.6
1933	391038.9	1970	469993.4	2007	466005.1
1934	392723.9	1971	471814.0	2008	465778.3
1935	394390.1	1972	473633.7	2009	465552.7
1936	396044.9	1973	475445.6	2010	465325.4
1937	397725.5	1974	477267.7	2011	465117.4
1938	399401.1	1975	479089.9	2012	465117.4
1939	401067.3	1976	480889.5	2013	465117.4
1940	402580.9	1977	482336.4	2014	465117.4
1941	402195.6	1978	483778.9	2015	465117.4
1942	402011.4	1979	485208.5	2016	465117.4
1943	401794.2	1980	486426.8	2017	465117.4
1944	401571.2	1981	484893.2	2018	465117.4
1945	401375.4	1982	482580.3	2019	465117.4
1946	401156.0	1983	480296.8	2020	465117.4
1947	400947.5	1984	477982.9	2021	465117.4
1948	400748.0	1985	475704.3		
1949	400534.9	1986	473410.2		
1950	400553.5	1987	471482.0		
1951	403206.0	1988	469564.8		
1952	406872.5	1989	467619.1		
1953	410494.8	1990	465921.1		
1954	414156.2	1991	466809.2		
1955	417807.0	1992	467804.3		
1956	421507.2	1993	468798.6		
1957	425777.5	1994	469802.4		
1958	430049.9	1995	470805.3		
1959	434310.2	1996	471627.4		
1960	438441.9	1997	470594.2		
1961	441077.8	1998	469582.1		
1962	446908.9	1999	468560.0		
1963	452736.7	2000	467448.7		
1964	458571.8	2001	465801.2		
1965	464411.4	2002	465892.3		
1966	469765.3	2003	465983.7		
1967	469776.4	2004	466076.1		

Appendix 10.

Lake Superior watershed land use 1820 - 2021

Western watershed population

Year	People	Year	People	Year	People
1820	0	1857	53969.3	1894	224320.4
1821	0	1858	60688.3	1895	237305.2
1822	0	1859	67398.9	1896	250345.6
1823	0	1860	44320.6	1897	263337.2
1824	0	1861	45305.3	1898	276329.4
1825	0	1862	46285.5	1899	289316.5
1826	0	1863	47270.1	1900	293772.5
1827	0	1864	48258.9	1901	286054.4
1828	0	1865	49239.5	1902	301114.0
1829	0	1866	50223.7	1903	316197.8
1830	0	1867	51208.0	1904	331323.6
1831	0	1868	52193.2	1905	346408.3
1832	0	1869	53178.3	1906	361488.3
1833	0	1870	60531.0	1907	376554.5
1834	0	1871	62474.0	1908	391658.7
1835	0	1872	64434.4	1909	406730.8
1836	0	1873	66389.1	1910	421190.1
1837	0	1874	68333.5	1911	272490.1
1838	0	1875	70286.5	1912	276356.5
1839	0	1876	72243.0	1913	280230.6
1840	0	1877	74195.5	1914	284108.4
1841	0	1878	76143.4	1915	287992.9
1842	0	1879	78097.2	1916	291859.4
1843	0	1880	64393.6	1917	295745.0
1844	0	1881	75313.1	1918	299602.2
1845	0	1882	86245.3	1919	303481.3
1846	0	1883	97176.1	1920	306937.2
1847	0	1884	108124.1	1921	305660.3
1848	0	1885	119051.9	1922	304619.0
1849	0	1886	129984.3	1923	303579.8
1850	6923.0	1887	140900.8	1924	302535.5
1851	13638.5	1888	151858.8	1925	301473.9
1852	20372.1	1889	162776.2	1926	300437.0
1853	27090.5	1890	171476.0	1927	299413.7
1854	33806.4	1891	185309.9	1928	298345.6
1855	40519.5	1892	198327.4	1929	297302.0
1856	47256.4	1893	211335.7	1930	296445.7

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed population

Year	People	Year	People	Year	People
1931	297593.1	1968	333789.4	2005	328022.4
1932	298645.8	1969	332826.2	2006	328052.7
1933	299720.5	1970	331989.8	2007	327831.1
1934	300806.9	1971	332662.6	2008	327609.3
1935	301878.7	1972	333917.0	2009	327388.4
1936	302933.3	1973	335165.0	2010	327166.2
1937	304011.4	1974	336424.4	2011	326962.6
1938	305088.3	1975	337678.7	2012	326962.6
1939	306157.0	1976	338910.6	2013	326962.6
1940	307109.6	1977	339793.9	2014	326962.6
1941	306566.8	1978	340670.6	2015	326962.6
1942	306046.2	1979	341539.7	2016	326962.6
1943	305500.7	1980	342228.3	2017	326962.6
1944	304947.3	1981	340658.7	2018	326962.6
1945	304416.1	1982	338714.3	2019	326962.6
1946	303867.7	1983	336799.9	2020	326962.6
1947	303329.5	1984	334849.7	2021	326962.6
1948	302793.1	1985	332938.7		
1949	302247.6	1986	331016.1		
1950	301894.1	1987	329452.2		
1951	303725.1	1988	327901.3		
1952	306555.3	1989	326325.3		
1953	309349.4	1990	324974.4		
1954	312180.2	1991	325935.0		
1955	314997.6	1992	326645.3		
1956	317843.6	1993	327346.3		
1957	321005.6	1994	328062.5		
1958	324169.7	1995	328774.6		
1959	327321.8	1996	329399.5		
1960	330347.1	1997	329192.9		
1961	331599.6	1998	329001.0		
1962	332455.8	1999	328807.0		
1963	333309.7	2000	328538.1		
1964	334160.6	2001	327809.9		
1965	335023.4	2002	327862.7		
1966	335731.4	2003	327915.9		
1967	334757.1	2004	327970.2		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed population

Year	People	Year	People	Year	People
1820	0	1857	45176.4	1894	375640.9
1821	0	1858	50393.6	1895	410423.4
1822	0	1859	55611.3	1896	445303.3
1823	0	1860	61045.7	1897	480084.5
1824	0	1861	68695.8	1898	514869.9
1825	0	1862	76345.8	1899	549646.3
1826	0	1863	83994.8	1900	584321.4
1827	0	1864	91670.9	1901	93906.9
1828	0	1865	99321.2	1902	96576.8
1829	0	1866	106971.2	1903	99247.1
1830	0	1867	114618.4	1904	101922.3
1831	0	1868	122291.6	1905	104594.7
1832	0	1869	129939.2	1906	107267.2
1833	0	1870	138107.5	1907	109943.9
1834	0	1871	135399.5	1908	112626.8
1835	0	1872	140378.3	1909	115291.6
1836	0	1873	145339.9	1910	117773.0
1837	0	1874	150301.9	1911	86892.5
1838	0	1875	155263.4	1912	87648.9
1839	0	1876	160242.9	1913	88408.7
1840	0	1877	165211.5	1914	89160.5
1841	0	1878	170173.1	1915	89918.7
1842	0	1879	175135.7	1916	90675.3
1843	0	1880	144135.7	1917	91427.5
1844	0	1881	150854.9	1918	92186.4
1845	0	1882	167287.5	1919	92941.7
1846	0	1883	183724.8	1920	93652.7
1847	0	1884	200198.3	1921	93880.8
1848	0	1885	216625.9	1922	93410.3
1849	0	1886	233065.7	1923	92938.1
1850	8617.9	1887	249488.3	1924	92468.9
1851	13836.9	1888	265968.6	1925	91998.4
1852	19069.3	1889	282403.9	1926	91529.2
1853	24288.3	1890	253906.8	1927	91061.1
1854	29506.6	1891	271202.0	1928	90589.5
1855	34725.4	1892	306076.6	1929	90117.3
1856	39958.6	1893	340853.5	1930	89716.6

Eastern watershed population

Year	People	Year	People	Year	People
1931	90113.7	1968	136009.7	2005	138144.2
1932	90714.5	1969	136997.4	2006	138178.9
1933	91318.4	1970	138003.5	2007	138174.0
1934	91917.0	1971	139151.4	2008	138169.0
1935	92511.4	1972	139716.7	2009	138164.4
1936	93111.6	1973	140280.5	2010	138159.2
1937	93714.1	1974	140843.3	2011	138154.7
1938	94312.8	1975	141411.2	2012	138154.7
1939	94910.3	1976	141978.8	2013	138154.7
1940	95471.3	1977	142542.5	2014	138154.7
1941	95628.9	1978	143108.3	2015	138154.7
1942	95965.2	1979	143668.8	2016	138154.7
1943	96293.5	1980	144198.6	2017	138154.7
1944	96624.0	1981	144234.5	2018	138154.7
1945	96959.3	1982	143866.0	2019	138154.7
1946	97288.3	1983	143496.9	2020	138154.7
1947	97618.0	1984	143133.2	2021	138154.7
1948	97955.0	1985	142765.6		
1949	98287.2	1986	142394.1		
1950	98659.4	1987	142029.8		
1951	99481.0	1988	141663.5		
1952	100317.2	1989	141293.8		
1953	101145.4	1990	140946.7		
1954	101976.0	1991	140874.2		
1955	102809.4	1992	141159.1		
1956	103663.6	1993	141452.3		
1957	104771.9	1994	141739.9		
1958	105880.2	1995	142030.7		
1959	106988.4	1996	142227.9		
1960	108094.8	1997	141401.3		
1961	109478.1	1998	140581.1		
1962	114453.1	1999	139753.0		
1963	119427.0	2000	138910.6		
1964	124411.2	2001	137991.3		
1965	129387.9	2002	138029.7		
1966	134033.9	2003	138067.8		
1967	135019.3	2004	138105.9		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total North Shore taconite mining

Year	Taconite	Year	Taconite	Year	Taconite
1820	0	1857	0	1894	0
1821	0	1858	0	1895	0
1822	0	1859	0	1896	0
1823	0	1860	0	1897	0
1824	0	1861	0	1898	0
1825	0	1862	0	1899	0
1826	0	1863	0	1900	0
1827	0	1864	0	1901	0
1828	0	1865	0	1902	0
1829	0	1866	0	1903	0
1830	0	1867	0	1904	0
1831	0	1868	0	1905	0
1832	0	1869	0	1906	0
1833	0	1870	0	1907	0
1834	0	1871	0	1908	0
1835	0	1872	0	1909	0
1836	0	1873	0	1910	0
1837	0	1874	0	1911	0
1838	0	1875	0	1912	0
1839	0	1876	0	1913	0
1840	0	1877	0	1914	0
1841	0	1878	0	1915	0
1842	0	1879	0	1916	0
1843	0	1880	0	1917	0
1844	0	1881	0	1918	0
1845	0	1882	0	1919	0
1846	0	1883	0	1920	0
1847	0	1884	0	1921	0
1848	0	1885	0	1922	0
1849	0	1886	0	1923	0
1850	0	1887	0	1924	0
1851	0	1888	0	1925	0
1852	0	1889	0	1926	0
1853	0	1890	0	1927	0
1854	0	1891	0	1928	0
1855	0	1892	0	1929	0
1856	0	1893	0	1930	0

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total North Shore taconite mining

Year	Taconite	Year	Taconite	Year	Taconite
1931	0	1968	1	2005	0
1932	0	1969	1	2006	0
1933	0	1970	1	2007	0
1934	0	1971	0.65	2008	0
1935	0	1972	0	2009	0
1936	0	1973	0	2010	0
1937	0	1974	0	2011	0
1938	0	1975	0	2012	0
1939	0	1976	0	2013	0
1940	0	1977	0	2014	0
1941	0	1978	0	2015	0
1942	0	1979	0	2016	0
1943	0	1980	0	2017	0
1944	0	1981	0	2018	0
1945	0	1982	0	2019	0
1946	0	1983	0	2020	0
1947	0	1984	0	2021	0
1948	0	1985	0		
1949	0	1986	0		
1950	0	1987	0		
1951	0	1988	0		
1952	0	1989	0		
1953	0	1990	0		
1954	0	1991	0		
1955	0	1992	0		
1956	0	1993	0		
1957	0	1994	0		
1958	0	1995	0		
1959	0	1996	0		
1960	0	1997	0		
1961	0.12	1998	0		
1962	0.37	1999	0		
1963	0.55	2000	0		
1964	0.65	2001	0		
1965	0.75	2002	0		
1966	0.85	2003	0		
1967	0.95	2004	0		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed taconite mining

Year	Taconite	Year	Taconite	Year	Taconite
1820	0	1857	0	1894	0
1821	0	1858	0	1895	0
1822	0	1859	0	1896	0
1823	0	1860	0	1897	0
1824	0	1861	0	1898	0
1825	0	1862	0	1899	0
1826	0	1863	0	1900	0
1827	0	1864	0	1901	0
1828	0	1865	0	1902	0
1829	0	1866	0	1903	0
1830	0	1867	0	1904	0
1831	0	1868	0	1905	0
1832	0	1869	0	1906	0
1833	0	1870	0	1907	0
1834	0	1871	0	1908	0
1835	0	1872	0	1909	0
1836	0	1873	0	1910	0
1837	0	1874	0	1911	0
1838	0	1875	0	1912	0
1839	0	1876	0	1913	0
1840	0	1877	0	1914	0
1841	0	1878	0	1915	0
1842	0	1879	0	1916	0
1843	0	1880	0	1917	0
1844	0	1881	0	1918	0
1845	0	1882	0	1919	0
1846	0	1883	0	1920	0
1847	0	1884	0	1921	0
1848	0	1885	0	1922	0
1849	0	1886	0	1923	0
1850	0	1887	0	1924	0
1851	0	1888	0	1925	0
1852	0	1889	0	1926	0
1853	0	1890	0	1927	0
1854	0	1891	0	1928	0
1855	0	1892	0	1929	0
1856	0	1893	0	1930	0

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed taconite mining

Year	Taconite	Year	Taconite	Year	Taconite
1931	0	1968	1	2005	0
1932	0	1969	1	2006	0
1933	0	1970	1	2007	0
1934	0	1971	0.65	2008	0
1935	0	1972	0	2009	0
1936	0	1973	0	2010	0
1937	0	1974	0	2011	0
1938	0	1975	0	2012	0
1939	0	1976	0	2013	0
1940	0	1977	0	2014	0
1941	0	1978	0	2015	0
1942	0	1979	0	2016	0
1943	0	1980	0	2017	0
1944	0	1981	0	2018	0
1945	0	1982	0	2019	0
1946	0	1983	0	2020	0
1947	0	1984	0	2021	0
1948	0	1985	0		
1949	0	1986	0		
1950	0	1987	0		
1951	0	1988	0		
1952	0	1989	0		
1953	0	1990	0		
1954	0	1991	0		
1955	0	1992	0		
1956	0	1993	0		
1957	0	1994	0		
1958	0	1995	0		
1959	0	1996	0		
1960	0	1997	0		
1961	0.12	1998	0		
1962	0.37	1999	0		
1963	0.55	2000	0		
1964	0.65	2001	0		
1965	0.75	2002	0		
1966	0.85	2003	0		
1967	0.95	2004	0		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed taconite mining

Year	Taconite	Year	Taconite	Year	Taconite
1820	0	1857	0	1894	0
1821	0	1858	0	1895	0
1822	0	1859	0	1896	0
1823	0	1860	0	1897	0
1824	0	1861	0	1898	0
1825	0	1862	0	1899	0
1826	0	1863	0	1900	0
1827	0	1864	0	1901	0
1828	0	1865	0	1902	0
1829	0	1866	0	1903	0
1830	0	1867	0	1904	0
1831	0	1868	0	1905	0
1832	0	1869	0	1906	0
1833	0	1870	0	1907	0
1834	0	1871	0	1908	0
1835	0	1872	0	1909	0
1836	0	1873	0	1910	0
1837	0	1874	0	1911	0
1838	0	1875	0	1912	0
1839	0	1876	0	1913	0
1840	0	1877	0	1914	0
1841	0	1878	0	1915	0
1842	0	1879	0	1916	0
1843	0	1880	0	1917	0
1844	0	1881	0	1918	0
1845	0	1882	0	1919	0
1846	0	1883	0	1920	0
1847	0	1884	0	1921	0
1848	0	1885	0	1922	0
1849	0	1886	0	1923	0
1850	0	1887	0	1924	0
1851	0	1888	0	1925	0
1852	0	1889	0	1926	0
1853	0	1890	0	1927	0
1854	0	1891	0	1928	0
1855	0	1892	0	1929	0
1856	0	1893	0	1930	0

Appendix 10. Lake Superior watershed land use 1820 - 2021

Eastern watershed taconite mining

Year	Taconite
1931	0
1932	0
1933	0
1934	0
1935	0
1936	0
1937	0
1938	0
1939	0
1940	0
1941	0
1942	0
1943	0
1944	0
1945	0
1946	0
1947	0
1948	0
1949	0
1950	0
1951	0
1952	0
1953	0
1954	0
1955	0
1956	0
1957	0
1958	0
1959	0
1960	0
1961	0
1962	0
1963	0
1964	0
1965	0
1966	0
1967	0
1968	0
1969	0
1970	0
1971	0
1972	0
1973	0
1974	0
1975	0
1976	0
1977	0
1978	0
1979	0
1980	0
1981	0
1982	0
1983	0
1984	0
1985	0
1986	0
1987	0
1988	0
1989	0
1990	0
1991	0
1992	0
1993	0
1994	0
1995	0
1996	0
1997	0
1998	0
1999	0
2000	0
2001	0
2002	0
2003	0
2004	0
2005	0
2006	0
2007	0
2008	0
2009	0
2010	0
2011	0
2012	0
2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	0
2021	0

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1820	0	1857	3	1894	46
1821	0	1858	5	1895	47
1822	0	1859	5	1896	48
1823	0	1860	6	1897	49
1824	0	1861	6	1898	48
1825	0	1862	6	1899	48
1826	0	1863	6	1900	51
1827	0	1864	9	1901	52
1828	0	1865	9	1902	55
1829	0	1866	11	1903	55
1830	0	1867	11	1904	53
1831	0	1868	11	1905	52
1832	0	1869	11	1906	52
1833	0	1870	11	1907	53
1834	0	1871	11	1908	55
1835	0	1872	15	1909	57
1836	0	1873	16	1910	59
1837	0	1874	16	1911	59
1838	0	1875	16	1912	58
1839	0	1876	16	1913	60
1840	0	1877	16	1914	60
1841	0	1878	16	1915	59
1842	0	1879	17	1916	58
1843	0	1880	19	1917	58
1844	0	1881	19	1918	57
1845	0	1882	20	1919	56
1846	0	1883	20	1920	55
1847	0	1884	26	1921	55
1848	0	1885	29	1922	55
1849	2	1886	33	1923	56
1850	2	1887	37	1924	53
1851	2	1888	40	1925	51
1852	2	1889	40	1926	49
1853	2	1890	42	1927	48
1854	3	1891	43	1928	48
1855	3	1892	44	1929	47
1856	3	1893	45	1930	48

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	48	1968	21.7	2005	7.2
1932	47	1969	20.8	2006	6.3
1933	46	1970	20.8	2007	6.3
1934	45	1971	20.8	2008	5.4
1935	44	1972	19.8	2009	5.5
1936	43	1973	19.9	2010	4.6
1937	42	1974	19.9	2011	4.8
1938	41	1975	18.9	2012	4.9
1939	40.1	1976	19.9	2013	5
1940	40.1	1977	19	2014	5.2
1941	38.1	1978	20	2015	5.3
1942	38.1	1979	20	2016	5.4
1943	38.1	1980	19	2017	5.5
1944	37.2	1981	18	2018	5.7
1945	36.2	1982	17.1	2019	5.8
1946	35.2	1983	16.1	2020	5.9
1947	34.2	1984	16.2	2021	6
1948	35.3	1985	14.2		
1949	34.3	1986	13.3		
1950	33.3	1987	12.3		
1951	31.3	1988	11.4		
1952	30.3	1989	10.4		
1953	32.4	1990	9.5		
1954	32.4	1991	9.5		
1955	31.4	1992	9.6		
1956	32.4	1993	8.6		
1957	31.5	1994	8.7		
1958	31.5	1995	8.7		
1959	29.5	1996	8.8		
1960	27.5	1997	8.8		
1961	26.6	1998	6.9		
1962	25.6	1999	6.9		
1963	24.6	2000	7		
1964	24.6	2001	7		
1965	24.7	2002	7.1		
1966	25.7	2003	7.1		
1967	22.7	2004	7.2		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1820	0	1857	0	1894	27
1821	0	1858	0	1895	30
1822	0	1859	0	1896	32
1823	0	1860	0	1897	33
1824	0	1861	0	1898	34
1825	0	1862	0	1899	34
1826	0	1863	0	1900	35
1827	0	1864	0	1901	36
1828	0	1865	0	1902	38
1829	0	1866	0	1903	38
1830	0	1867	0	1904	37
1831	0	1868	0	1905	38
1832	0	1869	0	1906	38
1833	0	1870	0	1907	39
1834	0	1871	0	1908	40
1835	0	1872	0	1909	41
1836	0	1873	0	1910	42
1837	0	1874	0	1911	43
1838	0	1875	0	1912	42
1839	0	1876	0	1913	42
1840	0	1877	0	1914	44
1841	0	1878	0	1915	44
1842	0	1879	0	1916	44
1843	0	1880	0	1917	44
1844	0	1881	0	1918	44
1845	0	1882	0	1919	45
1846	0	1883	0	1920	44
1847	0	1884	6	1921	44
1848	0	1885	9	1922	46
1849	0	1886	14	1923	45
1850	0	1887	18	1924	43
1851	0	1888	20	1925	41
1852	0	1889	20	1926	39
1853	0	1890	22	1927	39
1854	0	1891	22	1928	39
1855	0	1892	25	1929	38
1856	0	1893	26	1930	39

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	39	1968	21	2005	7
1932	37	1969	20	2006	6
1933	36	1970	20	2007	6
1934	35	1971	20	2008	5
1935	34	1972	19	2009	6
1936	33	1973	19	2010	5
1937	32	1974	19	2011	5
1938	31	1975	18	2012	5
1939	30	1976	19	2013	5
1940	30	1977	18	2014	5
1941	28	1978	19	2015	5
1942	28	1979	19	2016	5
1943	29	1980	18	2017	6
1944	28	1981	17	2018	6
1945	28	1982	16	2019	6
1946	27	1983	15	2020	6
1947	26	1984	15	2021	6
1948	26	1985	13		
1949	26	1986	12		
1950	26	1987	11		
1951	25	1988	10		
1952	24	1989	9		
1953	26	1990	8		
1954	26	1991	9		
1955	26	1992	9		
1956	27	1993	8		
1957	26	1994	8		
1958	26	1995	8		
1959	25	1996	8		
1960	24	1997	8		
1961	23	1998	7		
1962	22	1999	7		
1963	21	2000	7		
1964	22	2001	7		
1965	22	2002	7		
1966	23	2003	7		
1967	22	2004	7		

Eastern watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1820	0	1857	3	1894	19
1821	0	1858	5	1895	17
1822	0	1859	5	1896	16
1823	0	1860	6	1897	16
1824	0	1861	6	1898	14
1825	0	1862	6	1899	14
1826	0	1863	6	1900	16
1827	0	1864	9	1901	16
1828	0	1865	9	1902	17
1829	0	1866	11	1903	17
1830	0	1867	11	1904	16
1831	0	1868	11	1905	14
1832	0	1869	11	1906	14
1833	0	1870	11	1907	14
1834	0	1871	11	1908	15
1835	0	1872	15	1909	16
1836	0	1873	16	1910	17
1837	0	1874	16	1911	16
1838	0	1875	16	1912	16
1839	0	1876	16	1913	18
1840	0	1877	16	1914	16
1841	0	1878	16	1915	15
1842	0	1879	17	1916	14
1843	0	1880	19	1917	14
1844	0	1881	19	1918	13
1845	0	1882	20	1919	11
1846	0	1883	20	1920	11
1847	0	1884	20	1921	11
1848	0	1885	20	1922	9
1849	2	1886	19	1923	11
1850	2	1887	19	1924	10
1851	2	1888	20	1925	10
1852	2	1889	20	1926	10
1853	2	1890	20	1927	9
1854	3	1891	21	1928	9
1855	3	1892	19	1929	9
1856	3	1893	19	1930	9

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	9	1968	1	2005	0
1932	10	1969	1	2006	0
1933	10	1970	1	2007	0
1934	10	1971	1	2008	0
1935	10	1972	1	2009	0
1936	10	1973	1	2010	0
1937	10	1974	1	2011	0
1938	10	1975	1	2012	0
1939	10	1976	1	2013	0
1940	10	1977	1	2014	0
1941	10	1978	1	2015	0
1942	10	1979	1	2016	0
1943	9	1980	1	2017	0
1944	9	1981	1	2018	0
1945	8	1982	1	2019	0
1946	8	1983	1	2020	0
1947	8	1984	1	2021	0
1948	9	1985	1		
1949	8	1986	1		
1950	7	1987	1		
1951	6	1988	1		
1952	6	1989	1		
1953	6	1990	1		
1954	6	1991	1		
1955	5	1992	1		
1956	5	1993	1		
1957	5	1994	1		
1958	5	1995	1		
1959	5	1996	1		
1960	4	1997	1		
1961	4	1998	0		
1962	4	1999	0		
1963	4	2000	0		
1964	3	2001	0		
1965	3	2002	0		
1966	3	2003	0		
1967	1	2004	0		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed non-ferrous mining

Year	# Mines
1820	0
1821	0
1822	0
1823	0
1824	0
1825	0
1826	0
1827	0
1828	0
1829	0
1830	0
1831	0
1832	0
1833	0
1834	0
1835	0
1836	0
1837	0
1838	0
1839	0
1840	0
1841	0
1842	0
1843	0
1844	2
1845	7
1846	13
1847	13
1848	17
1849	20
1850	26
1851	31
1852	37
1853	44
1854	46
1855	46
1856	47
1857	48
1858	48
1859	52
1860	52
1861	54
1862	59
1863	62
1864	68
1865	67
1866	65
1867	64
1868	62
1869	65
1870	66
1871	66
1872	70
1873	72
1874	73
1875	73
1876	72
1877	70
1878	70
1879	71
1880	71
1881	70
1882	72
1883	74
1884	74
1885	70
1886	70
1887	70
1888	71
1889	69
1890	70
1891	73
1892	73
1893	72
1894	71
1895	71
1896	72
1897	73
1898	74
1899	77
1900	77
1901	76
1902	77
1903	77
1904	80
1905	79
1906	79
1907	78
1908	77
1909	77
1910	77
1911	77
1912	77
1913	77
1914	78
1915	79
1916	78
1917	75
1918	72
1919	71
1920	67
1921	64
1922	64
1923	61
1924	59
1925	55
1926	55
1927	54
1928	55
1929	54
1930	53

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Total watershed non-ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	50	1968	55	2005	12
1932	50	1969	55	2006	11
1933	52	1970	55	2007	10
1934	56	1971	54	2008	8
1935	59	1972	56	2009	8
1936	59	1973	57	2010	7
1937	56	1974	57	2011	6
1938	55	1975	56	2012	6
1939	55	1976	56	2013	6
1940	54	1977	56	2014	6
1941	54	1978	55	2015	6
1942	54	1979	55	2016	6
1943	55	1980	52	2017	6
1944	53	1981	51	2018	6
1945	54	1982	49	2019	6
1946	53	1983	46	2020	6
1947	54	1984	45	2021	6
1948	54	1985	42		
1949	54	1986	41		
1950	55	1987	39		
1951	55	1988	38		
1952	55	1989	34		
1953	57	1990	33		
1954	57	1991	30		
1955	57	1992	29		
1956	58	1993	28		
1957	59	1994	23		
1958	59	1995	19		
1959	61	1996	20		
1960	60	1997	19		
1961	60	1998	19		
1962	61	1999	17		
1963	61	2000	16		
1964	61	2001	15		
1965	62	2002	15		
1966	62	2003	13		
1967	61	2004	12		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed non-ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1820	0	1857	47	1894	49
1821	0	1858	47	1895	48
1822	0	1859	51	1896	49
1823	0	1860	51	1897	49
1824	0	1861	53	1898	49
1825	0	1862	58	1899	50
1826	0	1863	61	1900	48
1827	0	1864	65	1901	44
1828	0	1865	64	1902	45
1829	0	1866	62	1903	44
1830	0	1867	61	1904	46
1831	0	1868	60	1905	46
1832	0	1869	63	1906	45
1833	0	1870	64	1907	43
1834	0	1871	64	1908	43
1835	0	1872	67	1909	43
1836	0	1873	70	1910	43
1837	0	1874	71	1911	43
1838	0	1875	70	1912	43
1839	0	1876	69	1913	43
1840	0	1877	67	1914	44
1841	0	1878	67	1915	45
1842	0	1879	68	1916	44
1843	0	1880	68	1917	41
1844	2	1881	66	1918	38
1845	7	1882	65	1919	36
1846	13	1883	65	1920	33
1847	13	1884	63	1921	31
1848	16	1885	59	1922	29
1849	19	1886	57	1923	28
1850	25	1887	56	1924	27
1851	30	1888	55	1925	22
1852	36	1889	54	1926	23
1853	43	1890	52	1927	24
1854	45	1891	51	1928	24
1855	45	1892	51	1929	24
1856	46	1893	50	1930	25

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Western watershed non-ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	22	1968	14	2005	5
1932	22	1969	15	2006	5
1933	23	1970	15	2007	4
1934	25	1971	14	2008	4
1935	26	1972	16	2009	4
1936	26	1973	17	2010	3
1937	25	1974	17	2011	2
1938	24	1975	16	2012	2
1939	24	1976	16	2013	2
1940	23	1977	16	2014	2
1941	23	1978	15	2015	2
1942	23	1979	15	2016	2
1943	24	1980	14	2017	2
1944	22	1981	14	2018	2
1945	21	1982	12	2019	2
1946	20	1983	12	2020	2
1947	21	1984	12	2021	2
1948	21	1985	9		
1949	20	1986	8		
1950	20	1987	8		
1951	20	1988	8		
1952	19	1989	8		
1953	20	1990	10		
1954	20	1991	9		
1955	19	1992	9		
1956	19	1993	8		
1957	19	1994	7		
1958	19	1995	6		
1959	20	1996	7		
1960	19	1997	7		
1961	19	1998	7		
1962	19	1999	7		
1963	20	2000	7		
1964	20	2001	6		
1965	21	2002	6		
1966	21	2003	5		
1967	20	2004	5		

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed non-ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1820	0	1857	1	1894	22
1821	0	1858	1	1895	23
1822	0	1859	1	1896	23
1823	0	1860	1	1897	24
1824	0	1861	1	1898	25
1825	0	1862	1	1899	27
1826	0	1863	1	1900	29
1827	0	1864	3	1901	32
1828	0	1865	3	1902	32
1829	0	1866	3	1903	33
1830	0	1867	3	1904	34
1831	0	1868	2	1905	33
1832	0	1869	2	1906	34
1833	0	1870	2	1907	35
1834	0	1871	2	1908	34
1835	0	1872	3	1909	34
1836	0	1873	2	1910	34
1837	0	1874	2	1911	34
1838	0	1875	3	1912	34
1839	0	1876	3	1913	34
1840	0	1877	3	1914	34
1841	0	1878	3	1915	34
1842	0	1879	3	1916	34
1843	0	1880	3	1917	34
1844	0	1881	4	1918	34
1845	0	1882	7	1919	35
1846	0	1883	9	1920	34
1847	0	1884	11	1921	33
1848	1	1885	11	1922	35
1849	1	1886	13	1923	33
1850	1	1887	14	1924	32
1851	1	1888	16	1925	33
1852	1	1889	15	1926	32
1853	1	1890	18	1927	30
1854	1	1891	22	1928	31
1855	1	1892	22	1929	30
1856	1	1893	22	1930	28

Appendix 10.

Lake Superior watershed land use 1820 - 2021
Eastern watershed non-ferrous mining

Year	# Mines	Year	# Mines	Year	# Mines
1931	28	1968	41	2005	7
1932	28	1969	40	2006	6
1933	29	1970	40	2007	6
1934	31	1971	40	2008	4
1935	33	1972	40	2009	4
1936	33	1973	40	2010	4
1937	31	1974	40	2011	4
1938	31	1975	40	2012	4
1939	31	1976	40	2013	4
1940	31	1977	40	2014	4
1941	31	1978	40	2015	4
1942	31	1979	40	2016	4
1943	31	1980	38	2017	4
1944	31	1981	37	2018	4
1945	33	1982	37	2019	4
1946	33	1983	34	2020	4
1947	33	1984	33	2021	4
1948	33	1985	33		
1949	34	1986	33		
1950	35	1987	31		
1951	35	1988	30		
1952	36	1989	26		
1953	37	1990	23		
1954	37	1991	21		
1955	38	1992	20		
1956	39	1993	20		
1957	40	1994	16		
1958	40	1995	13		
1959	41	1996	13		
1960	41	1997	12		
1961	41	1998	12		
1962	42	1999	10		
1963	41	2000	9		
1964	41	2001	9		
1965	41	2002	9		
1966	41	2003	8		
1967	41	2004	7		