Water-Quality Trends Associated with Algal Communty Changes in Florida Lakes: Historic Evidence for Defining Nutrient Criteria

Final Report

by

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Executive Summary

This study assesses historical changes in water quality for Lakes Conine, Haines, and May in Polk County, Florida using diatom assemblages in sediment cores from these lakes. In an earlier study (Whitmore and Riedinger 2002), we examined pigment concentrations of green algae and cyanobacteria in sediment cores from these lakes and found evidence of changes in algal populations that apparently resulted from cultural eutrophication. A preliminary study of diatoms in four levels of each sediment core (Whitmore and Brenner 2002) found evidence of eutrophication, but lacked sufficient resolution to adequately define pre-disturbance water-quality conditions or to relate changes in algal populations to water-quality changes. The present study provides detailed assessment of water-quality changes in Lakes Conine, Haines, and May, it relates algal community changes to eutrophication trends, it quantifies pre-distubance water-quality conditions in the lakes, and it presents information pertinent to nutrient criteria for lake management programs in EPA-defined Florida lake regions 75-31 and 75-36.

Past limnetic total P, averaged trophic state index (TSIAVG: Huber *et al.* 1982), and limnetic cholorphyll *a* values were estimated for Lakes Conine, Haines, and May using diatoms in sediment core samples and predictive models that are calibrated for large sets of Florida lakes. Modern measured water-quality means were compared with inferences for recent sediments to determine the accuracy of inferred values in each lake.

Limnetic total P inferences for Lake Conine underestimated modern measured limnetic total P because Lake Conine is N-limited. Consequently, TSIAVG and limnetic chlorophyll *a* values were used for quantitative assessment of recent trophic state

changes. All indicators demonstrated that cultural eutrophication had occurred in Lake Conine. Lake Conine was in the mesotrophic to eutrophic range before trophic state disturbance, and pre-disturbance limnetic chlorophyll *a* concentrations were approximately 8-17 ug/L, TSIAVG was 53-55, and pre-disturbance limnetic total P concentrations were approximately 35-40 ug/L. Chlorophyll *a* concentrations reached 87-90 ug/L during a peak in eutrophication. Productivity in Lake Conine decreased slightly in recent decades, probably because of the removal of point-source nutrient inputs.

In Lake Haines and particularly in Lake May, recent diatom-based inferences compared well with recent water quality measures which indicates high reliability of quantitative water-quality reconstructions. In Lake Haines, cyanobacteria were essentially absent in the pre-disturbance portion of the sediment core. Pre-disturbance limnetic total P in Lake Haines was approximately 40-42 ug/L, TSIAVG was 59, and limnetic chlor0phyll *a* was approximately 17-19 ug/L. Analyses suggest that a very slight recovery in trophic state occurred in Lake Haines during recent times.

In Lake May, pre-disturbance limnetic total P concentration was approximately 42 ug/L, TSIAVG was 58, and limnetic chlorophyll *a* was approximately 16 ug/L. A high peak of trophic state occurred at the 30-cm level, with a limnetic total P value of 78 ug/L, a TSIAVG value of 72, and a limnetic chlorophyll *a* value of approximately 70 ug/L. Lake May apparently experienced some trophic state recovery in the top 30-cm of the sediment core.

The timing of trophic changes in Lakes Conine, Haines and May are impossible to determine without radiometric dating, but it is reasonable to speculate that observed eutrophication trends occurred during the last century, that peaks in productivity for Lakes Conine and May occurred sometime during the last 50 years, and that trophic state recovery in Lakes Conine and May began sometime during the last one to several decades.

Paleolimnological evidence indicates that the lowest practical restoration target for Lake Haines, and perhaps for other lakes in region 75-36, is approximately 42 υg/L total P, which is half of the current median limnetic value of 82 υg/L total P for that region. Paleolimnolgical analyses also indicate that the modern median limnetic total P value of 29 υg/L for EPA-defined lake region 75-31 represents too low of a restoration goal for many lakes in that region. Pre-disturbance limnetic total P inferences for 13 cores from 6 eutrophic lakes that we studied previously yielded a mean pre-disturbance limnetic total P value of 45 υg/L, and pre-disturbance limnetic total P values for Lakes Conine and May in the present study were 35-40 υg/L and 42 υg/L, respectively. Attempts to manage lakes at limnetic nutrient concentrations that are less than pre-disturbance conditions are likely to prove costly and ineffective because such efforts would attempt to reduce nutrients below the levels at which they are supplied naturally by edaphic sources.

Introduction

Paleolimnological studies are useful to lake management programs because they define pre-disturbance water-quality conditions and document eutrophication when long-term water-quality data, obtained by direct measurement, are not available (Smol 1992, Anderson 1993). Water-quality inferences provided by paleolimnological methods are valuable because they help to define appropriate restoration target conditions, and to determine when mitigation efforts might not be cost-effective because lakes have been naturally high in productivity (Brenner *et al.* 1993). Many paleolimnological studies have been conducted in Florida (e.g., Brenner *et al.* 1995a, 1995b, 1996, 1999), and they have proven useful in defining lake-management objectives because of Florida's naturally wide range in water quality brought about by the state's geological diversity (Canfield 1981).

Diatoms are sensitive environmental indicators (Dixit *et al.* 1992). Statistical models that estimate former water quality based on sedimented diatom assemblages are the principal tool for quantitatively evaluating long-term changes in freshwater ecosystems (Stoermer and Smol 1999). Whitmore (1989) devised an index based on trophic state ecological preferences of diatoms and used this index with a calibration set of 47 Florida lakes to construct a linear regression model that predicts limnetic total P concentrations from sedimented diatom assemblages (Brenner *et al.* 1993). We also have constructed predictive models using weighted-averaging calibration (WACALIB: Line *et al.* 1994) on a set of 75 Florida lakes, and have applied these models to obtain quantitative estimates of past water-quality change (e.g., Whitmore and Brenner 2002, Whitmore *et al.* in prep.).

In 2001-2002, our project with the Florida Department of Environmental Protection (F-DEP) entitled "Paleolimnological Characterization of Pre-disturbance Water Quality Conditions in EPA-defined Florida Lake Regions" (Whitmore and Brenner 2002) examined general historic trophic state trends in sediment cores from eight Florida lakes. The study lakes are located in regions 75-08, 75-30, 75-31, and 75-36, as defined by F-DEP's Lake Bioassessment/Regionalization Initiative (Griffith *et al.*). We used a simplified sampling scheme similar to the "top and bottom" approach employed in EMAP studies (Dixit and Smol 1994). Sediment samples for diatom analyses were collected from sediment-core tops in order to compare recent inferences with modern water-quality measures. Budgetary contraints did not permit the ^{210}Pb dating of cores that would provide time controls for downcore sample selection. In order to select appropriate levels for three additional historic samples in each core, we examined the time periods represented by sediment cores in our earlier work. Our previous studies of 38 Florida sediment cores showed that supported ^{210}Pb activities, which represent approximately 100-150 year-old sediments, were reached between the 40-cm and 90-cm levels in all cores. We concluded, therefore, that samples obtained above the 90-cm levels were likely to reveal general trophic-state trends without being old enough to include climatic changes that would make past interpretations incomparable with modern lake conditions. Consequently, historic samples were analyzed from the 30-cm, 60-cm, and 90-cm levels in each sediment core.

In our 2001-2002 F-DEP diatom study (Whitmore and Brenner 2002), past values for Huber *et al.* (1982) averaged trophic state index values and limnetic concentrations of total P and chlorophyll *a* were inferred using the TROPH1 diatom index (Whitmore

1989, Brenner *et al.* 1993), and limnetic total P and chlorophyll a concentrations were inferred by weighted averaging calibration (Line *et al.* 1994). Our study concluded that three lakes, including Lakes Conine and May in Polk County, appeared to have undergone eutrophication followed by a slight recent recovery. Two lakes, including Lake Haines in Polk County, demonstrated europhication without recovery. One lake yielded an equivocal interpretation of eutrophication, and two lakes demonstrated consistently high or fluctuating trophic state without evidence of cultural eutrophication (Whitmore and Brenner 2002).

Sample analysis at 30-cm intervals in the 2001-2002 study provided cost-effective preliminary assessment of trophic state changes, but did not elucidate details about the timing and extent of change, nor about natural variation in trophic state of the study lakes. Such broad intervals between samples represented perhaps 30-50 years of time, for which no water quality information was available. In most cores, only a single sample, the 90-cm level, represented pre-disturbance water quality conditions.

A second project for F-DEP, "Sedimented Algal Pigment Profiles in Florida Lakes: Evaluating Algal Community Responses to Eutrophication" (Whitmore and Riedinger 2002), examined historic changes in green algal and cyanobacterial communities in four lakes from the previous study. Algal-pigment concentrations were assayed in contiguous samples from archived sediment cores in order to evaluate changes that occurred in algal communities during the last 150 years. Lakes selected for algal pigment analyses were Lakes Haines, May, and Conine in Polk County, and Lake Wauberg in Alachua County.

Sedimented algal pigment concentrations showed close correlation with preliminary diatom analyses in all study lakes (Whitmore and Riedinger 2002). In Lake Conine, abrupt increases in algal pigments and diatom-inferred water-quality indicators suggested that cultural eutrophication had occurred. Declines in pigment concentrations and inferred indicators in the top of the Lake Conine core, however, suggested that nutrient mitigation efforts might have brought about a reduction in trophic state during recent decades. In Lake Haines, the timing of algal pigment increases was consistent with preliminary diatom evidence of eutrophication, and both lines of investigation indicated that eutrophication was pronounced and comparatively recent in Lake Haines. Algal pigment profiles in Lake May showed increases that were consistent with diatom-based evidence that eutrophication had occurred during recent decades.

Because of broad-interval sampling in the initial F-DEP diatom study (Whitmore and Brenner 2002), several important questions that are pertinent to lake management remained unanswered. Specifically, preliminary diatom evidence suggested that trophic state had already begun to recover in Lake May during recent decades, but algal pigment concentrations, in contrast, indicated that trophic state had not recovered. Secondly, algal pigment profiles for Lake Conine showed increases consistent with cultural eutrophication, but the cyanobacterial pigments oscillaxanthin and myxoxanthophyll also were exceptionally high at the base of the Lake Conine core. This implied that cyanobacteria were present prior to recent eutrophication in Lake Conine and that the lake might be subject to considerable natural variation in trophic state. We could not determine unequivocally whether Lake Conine had undergone cultural eutrophication or was subject to naturally high periods in trophic state. Only a single diatom sample had been analyzed in the pre-disturbance portion of the Lake Conine sediment core, so more diatom analyses were required to define pre-disturbance water-quality conditions.

The objectives of the present study are to provide higher resolution diatom analyses for Lakes Conine, Haines, and May that will address questions regarding the extent of cultural eutrophication and the natural range in trophic state for these lakes. This study will allow us to determine whether recent trophic state conditions are within the range of pre-disturbance water quality conditions for Lake May. This study also will provide more information about the timing and probable cause of apparently rapid trophic state changes that occurred in Lake Haines. Additional diatom analyses will help to determine whether trophic state has recovered in Lake May, as suggested by preliminary diatom evidence, or whether it has remained high, as indicated by algal-pigment data. More detailed inferences will allow us to evaluate whether observed changes in algal populations corresponded in time with and resulted from water-quality changes in Lakes Conine, Haines, and May.

The present study also will provide necessary information about appropriate lake restoration goals for EPA-defined regions 75-31 (Lakes May and Conine), and 75-36 (Lake Haines). Data that quantify baseline trophic-state conditions and water-quality change are important for establishing appropriate nutrient criteria for lake management objectives. Region 75-31 has a modern region-wide median total P value of 29 υg/L. Our historic inferences for 13 cores from 6 eutrophic lakes in region 75-31 yield a mean pre-disturbance limnetic total P value of 45 υg/L, which suggests that even the region median value might be too low of a restoration goal for many eutrophic lakes in region 75-31. More information is needed about pre-disturbance water quality conditions in region 75-31, but only 2 of our 6 lakes in this region have received detailed study. Region 75-36 currently has a region-wide median total P value of 82 υg/L, although 3 cores from two separate preliminary studies in Lake Haines yield a mean pre-disturbance limnetic total P value of 41 υg/L, which is half of the current median value for the region. None of the 3 cores from region 75-36 have received detailed analysis to date. The present study, therefore, will provide missing baseline water-quality information that is pertinent to defining nutrient criteria and appropriate restoration goals for lakes in regions 75-31 and 75-36.

Methods

Sediment cores were collected previously in Lakes Conine, Haines, and May using a 4-cm diameter, 1.83-m long cellulose acetate butyrate sediment corer (Table 1). Cores were sectioned in the field into 5-cm intervals and refrigerated at the University of Florida's Department of Fisheries and Aquatic Sciences for future paleolomnolgical analyses.

Sediment samples in our initial F-DEP diatom study (Whitmore and Brenner 2002) were removed from cores at discrete levels that were located at 0-cm, 30-cm, 60-cm, and 90-cm depth in the sediment cores. Samples for algal-pigment analyses in our second F-DEP study (Whitmore and Riedinger 2002) were removed from archived 5-cm sections because large volumes of sample material were required for algal pigment analyses. Consequently, algal-pigment concentration values represented each entire 5-cm section, and were plotted graphically at the mid-point of each 5-cm section in our second report (Whitmore and Riedinger 2002). For the present study, samples for continued diatom analyses were taken from the same archived sections that were used for algal pigment analyses so that algal-pigment and diatom analyses would be performed on contemporaneous material. This was necessary in order to correlate in time any changes that have occurred in algal pigment concentrations, diatom communities, and in water quality. Although 24-27 diatom analyses were proposed for the present study, 31 samples were analyzed from the Conine, Haines, and May sediment cores in order to provide a more thorough assessment of water quality through time.

Diatom samples were processed in the laboratory following Van der Werff (1955). A minimum of 500 diatoms was counted in each sample at 1500x using an American Optical Microstar microscope with dark-phase oil immersion objectives.

Historic water quality interpretatons were obtained by statistical modelling in a manner similar to that used in our initial diatom study for F-DEP (Whitmore and Brenner 2002). Historic limnetic total P concentrations, limnetic chlorophyll *a* concentrations, and Huber *et al.* (1982) averaged trophic state index (TSIAVG) values were inferred using the TROPH1 diatom index (Whitmore 1989) and our calibratton set of 47 Florida lakes (Brenner *et. al.* 1993). Limnetic total P and chlorophyll *a* concentrations also were inferred by weighted-averaging calibration (WACALIB: Line *et al.* 1994) using our calibration set of 75 Florida lakes and the same models that we employed in our earlier F-DEP diatom study (Whitmore and Brenner 2002.). In addition, the present study includes inferences for Huber *et al.* (1982) averaged trophic state index values that were generated using the calibration set of 75 Florida lakes and a new weighted-averaging calibration model. All predictive models that were employed in the present study are described in more detail in Table 2.

Results

Lake Conine

Mesotrophic to eutrophic species of *Aulacoseira* dominate in the Lake Conine core below the 60-65-cm interval (Appendix A). *Stephanodiscus aegyptiacus*, which indicates eutrophic conditions (Whitmore 1989), represents 26% of the diatom assemblage in the 60-65-cm interval, and it reaches its maximum representation of 50% in the 35-40-cm interval. *Cyclotella meneghiniana*, which occurs in eutrophic conditions, and *Nitzschia palea*, which is tolerant of a wide range of trophic conditions, increase in abundance above the 55-60-cm interval. Above the 15-20-cm interval, *C. meneghiniana* declines again and *Pseudostaurosira brevistriata* and *Staurosira construens* var. *venter*, which indicate very high trophic state conditions, are the dominant taxa in the topmost samples.

Most diatom individuals found throughout the Lake Conine core have a trophic-state preference for eutrophic conditions (Table 3). In the 75-80-cm interval and below in the sediment core, eutrophic individuals range from 35-47% of the diatom assemblages, and mesotrophic individuals range from 34-40% of the assemblages. Between the 60-65-cm interval and the 30-cm level, eutrophic individuals increase to 62-81% of the assemblages, and mesotrophic individuals decrease to 10-26% of the assemblages. Above the 30-cm level, the percentage of eutrophic individuals declines again to 53-59% of the assemblages and mesotrophic individuals increase to 18-26% of the assemblages. Hypereutrophic individuals average ~ 1.5% in the 30-cm sample and below in the sediment core, but average ~ 8% above the 30-cm level in the core.

Limnetic total P inferences obtained by the TROPH1 and WACALIB predictive models for the Lake Conine core show different absolute values but similar trends (Table 4). The TROPH1-derived inferences for limnetic total P at the base of the Lake Conine core are approximately 24 υg/L whereas WACALIB-derived inferences are approximately 36 υg/L. In both reconstructions, limnetic total P values begin to increase abruptly above the 60-65-cm interval (Figure 1). In the TROPH1-derived reconstruction, limnetic total P increases to a maximum of 94 υg/L in the 55-60-cm sample, then declines generally to a value of ~41 υg/L at the top of the core (Table 4). In the WACALIB-derived reconstruction, limnetic total P increases to a maximum of 116 υg/L in the 30-cm sample, then declines to 70-83 υg/L in the 15-20-cm interval and above.

Huber *et al.* (1982) averaged trophic state index values (TSIAVG) are approximately 50 at the base of the core in the TROPH1-based reconstruction and 54 in the WACALIB-derived reconstruction (Table 5). TROPH1-based TSIAVG inferences increase to a maximum of 77 in the 55-60-cm interval and thereafter decline to approximately 60 above the 30-cm level. TSIAVG inferences obtained by WACALIB are generally more consistent throughout the core (Figure 2). Values increase from a mean of approximately 53 in the 75-80-cm interval and below to a value of 70 in the 55-60-cm interval, then they remain approximately 70-72 to the top of the sediment core.

Limnetic chlorophyll *a* inferences are approximately 11 υg/L at the base of the Lake Conine core as estimated by both the TROPH1 and WACALIB models (Table 6). TROPH1-based inferences for limnetic chlorophyll *a* begin to increase in the 60-65-cm interval to a maximum of 52 υg/L in the 55-60-cm interval, then decline upwards in the sediment core to approximately 20 υg/L at the top of the sediment core. WACALIB-derived inferences also begin to increase in the 60-65-cm interval proceeding upwards in the core. Between the 55-60-cm interval and the 30-cm sample, WACALIB-derived limnetic chlorophyll *a* averages 82 ug/L, but inferences decline to an average of 72 ug/L above the 30-cm level. In general, limnetic chlorophyll *a* inferences obtained with WACALIB do not decline to the same degree that inferences obtained with the TROPH1 model do in the upper portion of the sediment core (Figure 3).

Total carotenoid pigment concentrations (Figure 4a) from our 2002 F-DEP study (Whitmore and Riedinger 2002) bear strong similarity in their profile to WACALIB-derived limnetic chlorphyll *a* inferences (Figure 3b). Both figures indicate increasing algal populations in the lake above the 80-cm level, with maximum algal populations occurring between the 60 and 20-cm levels. Total carotenoid pigment concentrations decline to a greater extent in the top portion of the sediment core than do WACALIB-derived limnetic chlorophyll *a* inferences, The eventual decline in carotenoid pigments is more consistent with the degree of decline shown by chlorophyll *a* inferences that were obtained with the TROPH1 model (Figure 3a).

Lake Haines

Aulacoseira granulata and *A. granulata* var. *muzzanensis*, which indicate mesotrophic to eutrophic conditions, dominate between the 95-100-cm interval and the 30-cm level in Lake Haines (Appendix A). Between the 90-cm and 30-cm levels, *Aulacoseira granulata* and *A. granulata* var. *muzzanensis* dominate and indicate mesotrophic to eutrophic conditions. Between the 30-cm level and the 15-20-cm interval, *Cyclotella meneghiniana*, which indicates eutrophic conditions, joins species of

Aulacoseira in dominance. Above the 20-25-cm interval, increases occur in *Pseudostaurosira brevistriata* and *Staurosira construens* var. *venter*, which are benthic taxa that indicate very high trophic state conditions, and *Aulacoseira* spp. and *C. meneghiniana* decrease.

The percentage of eutrophic individuals was fairly constant and averaged 60% throughout the Lake Haines sediment core, with the exception of the 95-100-cm interval in which the eutrophic percentage is less because a greater percentage of individuals demonstrates unknown ecological affinity (Table 7). Mesotrophic individuals range from 31-46% of the assemblages in the 30-cm level and below in the core, but decrease to 18-28% of the assemblages above the 30-cm level. Hypereutrophic individuals range from 0-2% below the 30-cm level in the core, but increase to 5-15% above the 30-cm level. Diatom individuals have a clear preference for higher trophic state conditions above the 30-cm level in the sediment core.

Inferred limnetic total P values show a long period of constancy at the base of the Lake Haines sediment core (Figure 5). From the 30-cm level to the base of the sediment core, limnetic total P values obtained with the TROPH1 model average 37 υg/L (Table 8). Limnetic total P inferences obtained by WACALIB below the 30-cm level average 42 υg/L, with the exception of the 95-100-cm interval, which had a value of 29.8 υg/L. Above the 30-cm level, TROPH1-derived limnetic total P inferences increase to a maximum value of 74 υg/L in the 15-20-cm sample, then decline to approximately 60 υg/L at the top of the sediment core. WACALIB-derived limnetic total P inferences increase above the 30-cm level to a maximum value of 84 υg/L in the 10-15-cm interval, then maintain a constantly high value of about 83 υg/L to the top of the sediment core.

Huber *et al.* (1982) TSIAVG values for Lake Haines (Figure 6) follow trends similar to those shown by limnetic total P inferences. TSIAVG values from the 35-40-cm interval to the base of the sediment core average 58 for TROPH1-derived inferences, and WACALIB derived inferences show a similar mean baseline value of 59 (Table 9). TROPH1-derived inferences for TSIAVG increase to a maximum value of 72 in the 15-20-cm interval, then decrease to a value of 68 at the top of the core. WACALIB-derived inferences for TSIAVG increase above the 35-40-cm interval and reach a maximum of 74 in the topmost sample of the sediment core (Figure 6b).

Limnetic chlorphyll *a* inferences in Lake Haines (Figure 7) demonstrate trends very similar to the trends shown by limnetic total P inferences. Limnetic chlorophyll *a* inferences derived with the TROPH1 model average 17 υg/L from the 30-cm level to the base of the Lake Haines core (Table 10). TROPH1-derived limnetic chlorophyll *a* inferences increase above the 35-40-cm interval to a maximum of 40 υg/L in the 15-20-cm interval, then decline to a value of 31 υg/L in the topmost sample. WACALIB-derived limnetic chlorophyll *a* inferences between the 90-cm and 35-40-cm levels show a baseline average of 18 υg/L, with the value of 5.5 υg/L in the 95-100-cm interval being the only outlying exception. WACALIB-derived limnetic chlorophyll *a* values increase above the 30-cm sample to a maximum value of 70 υg/L in the topmost sample of the sediment core.

Algal pigment profiles from our previous F-DEP study (Whitmore and Riedinger 2002) show strong correlation with profiles of inferred limnetic total P, TSIAVG, and limnetic chlorphyll *a* for Lake Haines. Total carotenoid, oscillaxanthin, and myxoxanthophyll concentration profiles (Figure 8) increase abruptly above the 30-cm level in a manner that is consistent with increases shown by inferred limnetic total P (Figure 5b), TSIAVG (Figure 6b), and chlorophyll *a* values (Figure 7b). Maximum oscillaxanthin (Figure 8b) and myxoxanthophyll (Figure 8c) values occur in the topmost sample of the core as do maximum values for WACALIB-derived TSIAVG and WACALIB-derived limnetic chlorophyll *a*. Total carotennoid pigment values (Figure 8a) decrease slightly at the top of the core in a manner similar to that shown by WACALIB-inferred limnetic total P (Figure 5b), and as shown more clearly by TROPH1-derived limnetic total P (Figure 5a).

Lake May

Aulacoseira granulata and *A. granulata* var. *angustissima* dominate between the 90-cm and the 60-cm levels in Lake May (Appendix A) and indicate mesotrophic to eutrophic conditions during this time period. Between the 70-75-cm level and the 30-cm level, increases are observed in *Cyclotella meneghiniana*, a eutrophic indicator, and *Nitzschia palea*, which tolerates a wide range of trophic conditions. Above the 30-cm level, *Pseudostaurosira brevistriata* and *Staurosira construens* var. *venter* dominate and indicate very high productivity in the lake. In the top two samples of the sediment core, a decline in *Pseudostaurosira brevistriata*, which indicates eutrophic to hypereutrophic conditions (Whitmore 1989), and an increase in *Aulacoseira italica*, which indicates eutrophic conditions, suggest that a slight reduction in trophic state occurred.

The percentage of mesotrophic individuals is very constant throughout the Lake May core and averages 24% of the assemblages, with the exception of the 90-cm sample in which meostrophic individuals represent 46% of the assemblage and eutrophic individuals represent 46% (Table 11). The percentage of eutrophic individuals ranges from 58-71% between the 70-75-cm interval and the 30-cm level, but eutrophic diatoms decline to 52-60% above the 30-cm level. Hypereutrophic individuals generally represent <2% in the 35-40-cm interval and lower in the sediment core, but they increase to 7-16% in the 30-cm sample and above. The peak of hypereutrophic individuals occurs in the 15-20-cm interval, above which the percentage of hypereutrophic individuals decreases as the percentage of eutrophic individuals increases.

Limnetic total P inferences suggest that the period of greatest change in trophic state occurred above the 40-cm level in the sediment core (Figure 9). The mean of TROPH1-derived limnetic total P inferences from the 35-40-cm interval to the base of the core is 38 υg/L, whereas the mean of WACALIB-derived limnetic total P inferences in this section is 48 υg/L (Table 12). Limnetic total P inferences in this lower portion of the core fluctuate less in the WACALIB-derived profile (Figure 9b) than they do in the TROPH1-derived profile (Figure 9a). TROPH1-derived limnetic total P shows a single peak in the 70-75-cm interval that places this pre-disturbance value within the range of modern water quality (Figure 9a). WACALIB-derived total P inferences at the base of the core, in contrast, remain consistently less than the inferences shown from the 30-cm level to the topmost samples in the core (Figure 9b). Maximum limnetic total P inferences from both models occur in the 30-cm sample, with an inference of 61 υg/L predicted by the TROPH1 model and an inference of 78 υg/L predicted by WACALIB. Above the 30-cm level, limnetic total P inferences decline to the top of the sediment core and show a recent (0-cm) value of 38 υg/L for the TROPH1-derived inference and 63 υg/L for the WACALIB-derived inference (Table 12).

Inferred TSIAVG values for the 35-40-cm interval to the base of the Lake May core average 58 as inferred with the TROPH1 model, and they average 63 as inferred with the WACALIB model (Table 13). TROPH1-derived TSIAVG inferences increase to a maximum value of 68 in the 30-cm sample, then decline to the top of the sediment core to a value of 59 in the 0-cm sample. WACALIB-derived inferences for TSIAVG increase to a value of 72 in the 30-cm sample, and they maintain an average of 72 from the 30-cm level upward through the 5-10-cm interval before they decrease slightly in the top two samples (Figure 10).

Limnetic chlorophyll *a* inferences derived with the TROPH1 model do not show a very distinct directional trend over time (Figure 11a), and 95% confidence intervals for inferences overlap thoughout nearly the entire core. A period of higher chlorophyll *a* concentrations in recent sediments is implied, however, from the fact that inferences below the 30-cm level in the core have values generally less that 20 υg/L, whereas samples above the 30-cm level range from 18-31 υg/L (Table 14). WACALIB-derived inferences for limnetic chlorophyll *a*, in contrast, show a more distinct trend of eutrophication (Figure 11b). WACALIB infererences for chlorophyll *a* increase from a minimum value of 16 υg/L in the 90-cm sample to a maximum of 70 υg/L in the 30-cm sample, then they decline to a value of 48 υg/L at the top of the core (Table 14).

Total carotenoid pigment concentrations (Figure 12a) from our previous F-DEP project (Whitmore and Riedinger 2002) show very strong correlation with WACALIB-inferred limnetic chlorophyll *a* concentrations (Figure 11b). Both profiles show minimum values at the base of the sediment core, they increase to a peak around the 55-cm level before they brieflly decline, they increase to maximum values in the 30-cm sample, then they decrease above the 30-cm level. The principal difference between these profiles is that limnetic chlorophyll *a* inferences decrease above the 30-cm level to the top of the core (Figure 11b) whereas total carotenoid pigment concentrations increase once again above the 15-cm level (Figure 12a). The cyanobacterial pigments oscillaxanthin (Figure 12b) and myxoxanthophyll (Figure 12c) demonstrate low concentrations below the 60-cm level in the sediment core, but their period of rapid increase and highest concentrations occurs above the 35-40-cm interval, which is consistent with increases shown by WACALIB-derived inferences for limnetic total P (Figure 9b), TSIAVG (Figure 10b), and limnetic chlorophyll *a* (Figure 11b).

Discussion

Water-quality inferences based on diatoms in recent sediments are compared with means of recent water quality measures in Table 15. Measured limnetic total P, Huber *et al.* (1982) TSIAVG, and limnetic chlorophyll *a* values for Lakes Conine, Haines, and May are shown with inferences obtained using WACALIB and TROPH1 diatom models for recent (0-cm) samples. This comparison provides some indication of how accurately the predictive models are estimating absolute values for water-quality measures in these lakes. However, the Lakewatch (2000) "long-term" data that were available for this comparison actually represent rather short sampling periods: Lake Conine was sampled 1991-1995, Lake Haines was sampled 1996-1998, and Lake May was sampled 1991-1999. Differences shown by Lakewatch (2000) "long-term" and 1999 data for Lakes Haines and May illustrate the amount of variation that typically occurs in lakes on an annual basis.

Limnetic total P inferences obtained with the WACALIB (83.3 υg/L) and TROPH1 (40.5 υg/L) models significantly underestimate modern measured limnetic total P (322 υg/L) for Lake Conine (Table 15). This is not surprising, however, because the total N/total P ratio for Lake Conine, as estimated using Lakewatch (2000) data, is 5.3. This indicates that Lake Conine is N-limited (Huber *et al.* 1982). Lakes chosen for the WACALIB (n=69) and TROPH1 (n=47) limnetic total P calibration data sets were all P-limited lakes because limnetic total P cannot be accurately estimated for N-limited lakes in which phosphorus is present in excess of biological demand. Consequently, for N-limited lakes such as Lake Conine, it is necessary to rely upon indicators other than limnetic total P for numerically reliable estimates of trophic state change.

The WACALIB-inferred limnetic chlorophyll *a* for the 0-cm sample (75.0 υg/L) is a reasonably close approximation to measured limnetic cholrophyll *a* (80.4 υg/L) in Lake Conine. WACALIB-inferred TSIAVG (71.9) provides a very good approximation of measured TSIAVG (74.2) for the lake. As a result, quantative reconstructions of limnetic chlorophyll *a* and TSIAVG appear to be reliable for Lake Conine. TROPH1 inferences for these variables underestimate measured means and appear to be less reliable.

WACALIB-inferred limnetic chlorophyll *a* (Figure 3c) shows exceptionally close correlation with total carotenoid pigments (Figure 4a) in Lake Conine. This pattern, which suggests cultural eutrophication, is also evident in WACALIB-inferred limnetic total P (Figure 1b), although the absolute value of total P inferences are not reliable in the highly productive portion of the core. This pattern of eutrophication can also be seen in the WACALIB-inferred TSIAVG profile (Figure 2b), although the shape of this pattern is more subdued because TSIAVG is a log-transformed variable.

All trophic state indicators in the present study demonstrate cultural eutrophication in Lake Conine. In the pre-disturbance time period of Lake Conine, limnetic chlorophyll *a* concentrations were likely to have been approximately 8-17 υg/L, and TSIAVG was likely to have been 53-55. Because baseline limnetic total P inferences occur in a portion of the core when the lake was not likely to have been N-limited, they can be regarded as reliable: pre-disturbance limnetic total P concentrations in Lake Conine were likely to have been 35-40 υg/L. During the period of peak eutrophication in Lake Conine, limnetic chlorophyll *a* concentrations were probably as high as 87-90 υg/L. Trophic state indicators and algal pigment concentrations show that productivity in Lake

Conine has recovered slightly in recent decades, probably because of removal of point-source nutrient inputs related to sewage treatment. Despite the presence of oscillaxanthin and myxoxanthophyll cyanobacterial pigments at the base of the sediment core, quantitative indicators show that Lake Conine was in the mesotrophic to eutrophic range before the period of cultural disturbance. Cyanobacterial presence perhaps was seasonal or intermittent.

Total nitrogen/total P ratios estimated from Lakewatch (2000) for Lakes Haines (14) and May (22) indicate that these lakes are nutrient-balanced (Huber *et al.* 1982), which suggests that the lakes might be P-limited at certain times and N-limited at other times. TROPH1-derived estimates of limnetic total P, TSIAVG, and limnetic chlorophyll *a* for recent samples in Lakes Haines and May tend to underestimate modern measured means for these variables (Table 15). WACALIB-derived estimates, nevertheless, appear to be quite reliable for both lakes.

In Lake Haines, the WACALIB inference for limnetic total P (82.8 υg/L) compares favorably with the range of reported limnetic total P (74 υg/L to 115 υg/L). Inferred limnetic chlorophyll *a* (70.0 υg/L) also is within the range of reported values (59.3 υg/L to 82.2 υg/L), and inferred TSIAVG (74.3) is very close to reported TSIAVG values (70.1 to 74.8). In Lake May, the accuracy of WACALIB-predicted values is even more dramatic: inferred limnetic total P (62.6 υg/L), inferred limnetic chlorophyll *a* (48.3 υg/L), and TSIAVG (69.5) are within the rounding error of a single digit for "long-term" values reported for all three variables (Table 15).

In Lake Haines, the timing of changes and shape of profiles for limnetic total P (Figure 5b), TSIAVG (Figure 6b), and limnetic chlorophyll *a* (Figure 7b) are very consistent with profiles shown for total carotenoid and cyanobacteria pigments (Figure 8). Cyanobacteria were essentially absent in the pre-disturbance portion of the sediment core, and all trophic state changes occurred between the 40 and 30-cm levels. Pre-disturbance water quality conditions were constant in Lake Haines with limnetic total P values of approximately 40-42 ug/L, TSIAVG values of approximately 59, and limnetic chlorophyll *a* values of approximately 17-19 ug/L. Limnetic chlorophyll *a* (Figure 7b) and cyanobacterial profiles (Figure 8b-c) show no decline at the top of the core, but inferred limnetic total P (Figure 5b) and total carotenoid pigments (Figure 8a) indicate that a recent trophic state recovery probably occurred and was very slight.

In Lake May, profiles for WACALIB-inferred limnetic total P (Figure 9b), limnetic chlorophyll *a* (Figure 11b), and total carotenoid pigments (Figure 12a) show extremely close correlation. Water-quality changes probably began as early as the 70-cm level in the core with cyanobacterial populations becoming abundant above the 40-cm level (Figure 12b-c). Pre-disturbance conditions in Lake May consisted of limnetic total P concentrations of approximately 42 ug/L, TSIAVG values near 58, and limnetic chlorophyll *a* concentrations of approximately 16 ug/L. A high peak of trophic state occurred at the 30-cm level, with a limnetic total P value of approximately 78 ug/L, a TSIAVG value of 72, and a limnetic chlorophyll *a* value of approximately 70 ug/L. The lake apparently experienced some trophic state recovery in the top 30-cm of the sediment core as shown by trends in WACALIB-derived inferences for limnetic total P (Figure 9b), TSIAVG (Figure 10b), and limnetic chlorophyll *a* (Figure 11c). The failure of total carotenoid and cyanobacterial pigments (Figure 12) to demonstratte any recovery is probably the result of slightly better preservation of algal pigments at the top of the sediment core (Whitmore and Riedinger 2002).

Trophic state trends are very clear for Lakes Conine, Haines, and May, but the timing of changes is impossible to document without performing radiometric analyses to date samples. Budgetary constraints on the present study precluded dating of the sediment cores. We anticipate obtaining dates for these cores in the near future, however, through the work of collaborators at the University of South Florida-St. Petersburg campus. ^{210}Pb dating by gamma spectrometry will allow us to determine when eutrophication began, when trophic state was at a maximum, and when trophic state recovery occurred. ^{210}Pb dates also permit calculation of sediment and nutrient accumulation rates in lake basins, and when changes in these factors occurred. Because depths for supported ^{210}Pb levels, which represent 100-150 years of age, can occur any place in such cores between the depths of 40 and 90 cm, it's impossible to speculate about specific dates for depths in these sediment core. However, it would seem reasonable to speculate that trophic state changes in the Lake Conine, Haines, and May cores occurred during the last century, that trophic state maxima in Lakes Conine and May occurred sometime during the last 50 years, and that trophic state recovery in Lakes Conine and May began sometime during the last one to several decades.

In addition to historical reconstructions for Lakes Conine, Haines, and May, the present study provides important information pertinent to nutrient criteria for management and lake restoration programs in EPA- defined lake regions 75-31 and 75-36. Region 75-31 currently has a region-wide median limnetic total P value of 29 υg/L (Griffith *et al.*) . Pre-disturbance limnetic total P inferences for 13 cores from 6 eutrophic lakes that we studied previously (e.g., Whitmore and Brenner 1995, Whitmore and Brenner 2002) in region 75-31 yielded a mean pre-disturbance limnetic total P value of 45 υg/L, although only two of these lakes had received detailed analyses. Pre-disturbance limnetic total P values in the present study were 35-40 υg/L for Lake Conine and 42 υg/L for Lake May, which confirmed our preliminary speculations about baseline conditions in the region. Consequently, paleolimnolgical analyses indicate that the modern median value of 29 υg/L total P represents too low of a restoration goal for many lakes in region 75-31. Attempts to manage a lake at limnetic nutrient concentrations that are less than pre-disturbance conditions are likely to prove costly and ineffective.

Region 75-36 currently has a region-wide median limnetic total P value of 82 υg/L (Griffith *et al.*). In an earlier study of Lake Haines that provided only a single data point from the base of each of two sediment cores (Whitrmore and Brenner 1995), we speculated that the pre-disturbance mean limnetic total P value for Lake Haines was approximately 41 υg/L. Detailed analyses of the Lake Haines sediment core in the present study demonstrated a long period of early trophic state constancy with a limnetic total P value of approximately 42 υg/L. The region-wide medium value of 82 υg/L, therefore, is approximately twice the pre-disturbance value for some lakes in region 75-36. Paleolimnological evidence indicates that the lowest practical restoration target for Lake Haines, and perhaps other lakes in region 75-36, is approximately 42 υg/L.

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Table 1. Study lakes with dates and locations of sediment coring.

Lake	County	Coring date	Coring location
Haines	Polk	7-20-2001	N 28° 05.929' lat. W 81° 42.163' long.
Conine	Polk	7-20-2001	N 28° 03.522' lat. W 81° 43.569' long.
May	Polk	7-24-2001	N 28° 00.776' lat. W 81° 44.275' long.

Table 2. Diatom-based predictive models used to evaluate historic water quality.

Model 1: Predicting limnetic total P with the TROPH1 diatom index

TROPH1 is a ratio of the percentages of diatoms in various trophic state preference categories for a given sample (Whitmore 1989). Historic limnetic total P concentrations were inferred using the following equation (Brenner *et al.* 1993):

$$\text{Log10 total P} = -1.795 + 0.973\ (\text{Log10 TROPH1})$$

$$r^2 = 0.81,\ p < 0.001,\ n = 47.$$

Model 2: Predicting averaged trophic state index values with the TROPH1 index

Historic Huber *et. al.* (1982) averaged trophic state index values (TSIAVG) were inferred using the equation:

$$\text{TSIAVG} = 41.37 + 43.65\ (\text{Log10 TROPH1})$$

$$r^2 = 0.80,\ p < 0.001,\ n = 49.$$

Model 3: Predicting limnetic chlorophyll *a* concentrations with the TROPH1 index

Historic limnetic chlorophyll *a* concentrations were inferred using the equation:

$$\text{Log Chl. } a = 0.828 + 1.102\ (\text{Log10 TROPH1})$$

$$r^2 = 0.70,\ p < 0.001,\ n = 50.$$

Table 2 continued.

Model 4: Predicting limnetic total P concentrations with WACALIB

Historic limnetic total P concentrations were inferred by weighted-averaging calibration (WACALIB: Line *et al.* 1994) using ln-transformed limnetic P values for a calibration set of 69 Florida lakes. Predicted values were de-transformed to yield limnetic total P inferences.

r^2 adj. = 0.88, s.e. pred. = 0.387, n = 69

Model 5: Predicting averaged trophic state index values with WACALIB

Historic Huber *et. al.* (1982) averaged trophic state index values were inferred by weighted-averaging calibration using TSIAVG values for a calibration set of 75 Florida lakes.

r^2 adj. = 0.82, s.e. pred. = 8.9, n = 75

Model 6: Predicting limnetic chlorophyll *a* concentrations with WACALIB

Historic limnetic chlorophyll *a* concentrations were inferred by weighted-averaging calibration using log-transformed chlorophyll *a* values for a calibration set of 75 Florida lakes. Predicted values were de-transformed to yield limnetic chlorophyll *a* inferences.

r^2 adj. = 0.79, s.e. pred. = 0.273, n = 75

Table 3. Trophic-state preferences of diatoms in sediment-core samples from Lake Conine.

Depth in core (cm)	Hyper-eutrophic (%)	Eutrophic (%)	Meso-trophic (%)	Oligo-trophic (%)	Ultraoligo-trophic (%)	unknown (%)
0	7.0	56.7	25.2	11.1	0.0	0.0
5-10	12.4	53.4	21.6	11.7	0.0	0.9
10-15	10.5	52.6	25.8	10.4	0.0	0.7
15-20	3.6	57.3	22.9	15.1	0.0	0.8
20-25	5.3	58.8	17.9	15.5	0.0	2.4
30	0.5	70.8	15.0	13.7	0.0	0.0
35-40	0.5	80.2	10.1	7.3	0.0	1.9
50-55	3.9	74.1	16.4	5.1	0.0	0.4
55-60	2.3	80.9	10.7	4.3	0.0	1.7
60	2.9	61.8	22.1	12.6	0.0	0.2
60-65	3.3	63.0	26.2	7.2	0.0	0.4
75-80	0.4	46.7	33.8	13.2	0.2	1.6
90	0.0	35.0	35.6	20.4	0.2	1.4
90-95	0.1	46.1	39.6	7.6	0.6	1.8
95-100	1.1	42.9	36.1	10.9	0.2	2.6

Table 4. Inferred limnetic total P values for Lake Conine sediment-core samples.

Depth in sediment (cm)	LGTROPHI model Inferred P (υg/L)	LGTROPHI model 95% CI	WACALIB Inferred P (υg/L)
0	40.5	33.5-49.2	83.3
5-10	45.6	37.2-56.1	70.1
10-15	42.0	34.5-51.2	70.4
15-20	35.3	29.4-42.3	82.6
20-25	39.8	32.8-48.2	77.4
30	46.0	37.4-56.6	115.6
35-40	77.7	59.5-101.4	101.3
50-55	68.2	53.0-87.6	86.4
55-60	93.7	70.1-125.2	93.3
60	39.2	32.4-47.5	67.5
60-65	43.8	35.8-53.6	73.4
75-80	24.5	20.9-28.7	39.1
90	17.6	15.1-20.4	42.9
90-95	24.8	21.2-29.1	39.1
95-100	23.6	20.2- 27.6	35.7

Table 5. Inferred Huber *et al.* (1982) averaged trophic state index values (TSIAVG) for Lake Conine sediment-core samples.

Depth in sediments (cm)	LGTROPHI model		WACALIB
	Inferred TSIAVG	95% CI	Inferred TSIAVG
0	59.8	56.1-63.5	71.9
5-10	62.2	58.3-66.1	69.1
10-15	60.5	56.8-64.3	71.4
15-20	57.1	53.6-60.5	71.4
20-25	59.5	55.8-63.1	69.1
30	62.4	58.4-66.3	72.3
35-40	72.8	67.7-77.8	71.2
50-55	70.2	65.4-74.9	69.7
55-60	76.5	71.0-82.1	69.7
60	59.2	55.5-62.8	67.3
60-65	61.4	57.5-65.2	67.9
75-80	49.8	46.8-52.8	55.3
90	43.2	40.2-46.1	52.7
90-95	50.0	47.0-53.1	53.2
95-100	49.0	46.0-52.0	54.0

Table 6. Inferred limnetic chlorophyll *a* values for Lake Conine sediment-core samples.

Depth in sediments (cm)	LGTROPHI model Inferred Chl. *a* (υg/L)	LGTROPHI model 95% CI	WACALIB Inferred Chl. *a* (υg/L)
0	19.7	14.9-25.8	75.0
5-10	22.6	16.9-30.1	61.2
10-15	20.5	15.5-27.1	67.6
15-20	16.7	13.0-21.6	77.3
20-25	19.3	14.7-25.2	76.7
30	22.8	17.0-30.5	86.7
35-40	41.7	28.6-60.8	85.1
50-55	35.9	25.2-51.1	76.6
55-60	51.9	34.4-78.2	80.9
60	18.9	14.5-24.8	66.8
60-65	21.5	16.2-28.6	68.9
75-80	11.0	8.8-13.8	17.5
90	7.5	6.0-9.3	6.5
90-95	11.1	8.9-14.0	7.9
95-100	10.5	8.4 -13.1	10.9

Table 7. Trophic-state preferences of diatoms in sediment-core samples from Lake Haines.

Depth in core (cm)	Hyper-eutrophic (%)	Eutrophic (%)	Meso-trophic (%)	Oligo-trophic (%)	Ultraoligo-trophic (%)	unknown (%)
0	9.3	64.4	22.4	3.9	0.0	0.0
5-10.	9.6	58.9	28.4	3.1	0.0	0.0
10-15	15.0	58.2	23.2	3.5	0.0	0.0
15-20	11.1	67.1	18.0	3.5	0.0	0.2
20-25	5.8	64.6	23.1	5.5	0.0	1.0
25-30	3.6	62.5	22.3	10.9	0.0	0.6
30	5.2	52.8	30.9	9.4	0.0	1.2
35-40	0.1	65.0	32.9	1.4	0.0	0.2
45-50	0.0	56.9	41.1	1.6	0.0	0.0
60	1.4	56.0	39.7	2.4	0.0	0.2
70-75	0.0	56.0	42.9	0.6	0.0	0.2
80-85	0.0	53.1	46.0	0.7	0.0	0.2
90	0.1	61.9	36.9	0.9	0.0	0.2
95-100	1.8	46.8	32.1	3.8	0.0	15.2

Table 8. Inferred limnetic total P values for Lake Haines sediment-core samples.

Depth in sediment (cm)	LGTROPHI model		WACALIB
	Inferred P (υg/L)	95% CI	Inferred P (υg/L)
0	60.2	47.5-76.2	82.8
5-10	51.1	41.1-63.5	81.9
10-15	62.3	49.0-79.4	84.1
15-20	74.2	57.1-96.3	70.5
20-25	52.3	42.0-65.2	59.7
25-30	42.3	34.7-51.5	62.9
30	35.5	29.6-42.6	48.6
35-40	43.2	35.4-52.8	42.2
45-50	35.1	29.3-42.1	41.7
60	35.8	29.8-42.9	42.9
70-75	34.9	29.1- 41.8	41.6
80-85	32.9	27.6-39.2	42.1
90	40.1	33.0-48.6	43.9
95-100	35.1	29.4-42.0	29.8

Table 9. Inferred Huber *et al.* (1982) averaged trophic state index values (TSIAVG) for Lake Haines sediment-core samples.

Depth in sediments (cm)	LGTROPHI model		WACALIB
	Inferred TSIAVG	95% CI	Inferred TSIAVG
0	67.7	63.2-72.2	74.3
5-10	64.4	60.3- 68.6	73.5
10-15	68.4	66.9- 76.8	73.1
15-20	71.9	66.9-76.8	69.9
20-25	64.9	60.7-69.1	67.4
25-30	60.6	56.9- 64.4	67.6
30	57.2	53.7-60.7	63.1
35-40	61.1	57.3- 64.9	59.1
45-50	57.0	53.5- 60.4	58.6
60	57.3	53.9- 60.8	59.8
70-75	56.8	53.4- 60.3	58.7
80-85	55.7	52.3-59.0	59.2
90	59.6	55.9-63.3	59.9
95-100	56.9	53.5- 60.4	54.8

Table 10. Inferred limnetic chlorophyll *a* values for Lake Haines sediment-core samples.

Depth in sediments (cm)	LGTROPHI model Inferred Chl. *a* (υg/L)	LGTROPHI model 95% CI	WACALIB Inferred Chl. *a* (υg/L)
0	31.1	22.3-43.3	70.0
5-10	25.7	18.9-35.0	70.0
10-15	32.4	23.1-45.4	63.4
15-20	39.6	27.4-57.2	52.7
20-25	26.4	19.4-36.1	48.5
25-30	20.6	15.6-27.3	60.5
30	16.9	13.0-21.8	38.8
35-40	21.2	16.0-28.1	19.4
45-50	16.7	12.9-21.5	17.1
60	17.0	13.1-22.0	19.0
70-75	16.5	12.8-21.3	17.3
80-85	15.4	12.0-19.8	18.3
90	19.4	14.8-25.5	19.3
95-100	16.6	12.9-21.5	5.5

Table 11. Trophic-state preferences of diatoms in sediment-core samples from Lake May.

Depth in core (cm)	Hyper-eutrophic (%)	Eutrophic (%)	Meso-trophic (%)	Oligo-trophic (%)	Ultraoligo-trophic (%)	unknown (%)
0	9.0	51.5	26.5	11.9	0.0	1.0
0-5	6.7	58.4	25.6	8.0	0.0	1.2
5-10	11.8	53.6	24.3	9.3	0.0	0.8
10-15	13.6	52.2	25.1	8.7	0.0	0.2
15-20	15.7	52.7	23.7	7.7	0.0	0.2
20-25	7.7	59.7	26.5	5.1	0.0	0.8
30	9.3	65.9	17.7	6.6	0.2	0.2
35-40	0.5	63.9	25.6	8.7	0.2	1.0
40-45	0.4	63.9	22.5	12.5	0.0	0.4
45-50	1.9	60.4	22.5	13.3	0.0	1.6
50-55	1.0	58.0	23.8	15.0	0.0	1.9
60	2.0	62.8	23.4	10.5	0.0	1.0
70-75	0.1	70.5	22.5	4.7	0.0	1.6
90	0.0	46.1	46.0	5.6	0.0	1.6

Table 12. Inferred limnetic total P values for Lake May sediment-core samples.

Depth in sediment (cm)	LGTROPHI model Inferred P (υg/L)	LGTROPHI model 95% CI	WACALIB Inferred P (υg/L)
0	38.2	31.6-46.1	62.6
0-5	44.1	36.0-54.9	63.2
5-10	45.8	37.3-56.3	71.0
10-15	46.7	37.9-57.4	73.0
15-20	51.9	41.7-64.7	73.2
20-25	48.4	39.2-59.8	69.4
30	60.6	47.8-76.8	78.3
35-40	39.3	32.6-47.6	48.1
40-45	37.9	31.4-45.7	48.6
45-50	36.9	30.6-44.4	46.3
50-55	33.1	27.8-39.5	54.4
60	40.5	33.3-49.1	44.8
70-75	50.9	41.0-63.2	50.1
90	27.5	23.4-32.4	42.1

Table 13. Inferred Huber *et al.* (1982) averaged trophic state index values (TSIAVG) for Lake May sediment-core samples.

Depth in sediments (cm)	LGTROPHI model		WACALIB
	Inferred TSIAVG	95% CI	Inferred TSIAVG
0	58.6	55.1-62.2	69.5
0-5	61.5	57.7-65.3	66.5
5-10	62.3	58.4-66.2	72.6
10-15	62.6	58.7- 66.6	72.6
15-20	64.8	60.6-68.9	73.0
20-25	63.4	59.3-67.4	72.1
30	67.8	63.4-72.3	71.7
35-40	59.2	55.5- 62.8	64.8
40-45	58.5	54.9- 62.0	64.7
45-50	57.9	54.4- 61.5	64.2
50-55	55.8	52.4-59.1	64.4
60	59.8	56.1-63.5	63.2
70-75	64.3	60.2- 68.5	63.4
90	52.1	49.0-55.2	58.3

Table 14. Inferred limnetic chlorophyll *a* values for Lake May sediment-core samples.

Depth in sediments (cm)	LGTROPHI model Inferred Chl. *a* (υg/L)	LGTROPHI model 95% CI	WACALIB Inferred Chl. *a* (υg/L)
0	18.4	14.1-24.0	48.3
0-5	21.7	16.3-28.8	47.0
5-10	30.1	21.7-41.8	54.7
10-15	23.1	17.3-31.0	53.0
15-20	22.7	17.0-30.3	56.5
20-25	24.2	17.9-32.6	55.8
30	31.3	22.4-43.8	69.8
35-40	19.0	14.5-24.8	45.2
40-45	18.2	13.9-23.7	41.6
45-50	17.6	13.6-22.9	41.8
50-55	15.6	12.1-20.0	50.4
60	19.6	14.9-25.8	43.6
70-75	25.6	18.8-34.7	38.2
90	12.6	9.9-15.9	15.9

Table 15. Comparison of modern measured means of water-quality variables with modern (0-cm) inferences obtained with WACALIB and TROPH1 predictive models. Modern measured means are "long-term" data and data shown for 1999 in Lakewatch (2000). Modern measured TSIAVG values were calculated from data reported in Lakewatch (2000) using formulas presented in Huber *et al.* (1982).

	Lake Conine		
	Limnetic total P (υg/L)	Limnetic Chl. *a* (υg/L)	Huber *et al.* TSIAVG
Measured Lakewatch "long-term"	322	80.4	74.2
Inferred by WACALIB	83.3	75.0	71.9
Inferred by TROPH1	40.5	19.7	59.8

Table 15 continued.

	Lake Haines		
	Limnetic total P (υg/L)	Limnetic Chl. *a* (υg/L)	Huber *et al.* TSIAVG
Measured Lakewatch "long-term"	115	82.2	74.8
Measured Lakewatch 1999	74	59.3	70.1
Inferred by WACALIB	82.8	70.0	74.3
Inferred by TROPH1	60.2	31.1	67.7

Table 15 continued.

	Lake May		
	Limnetic total P (υg/L)	Limnetic Chl. *a* (υg/L)	Huber *et al.* TSIAVG
Measured Lakewatch "long-term"	63	49.4	70.0
Measured Lakewatch 1999	58	42.8	71.0
Inferred by WACALIB	62.6	48.3	69.5
Inferred by TROPH1	38.2	18.4	58.6

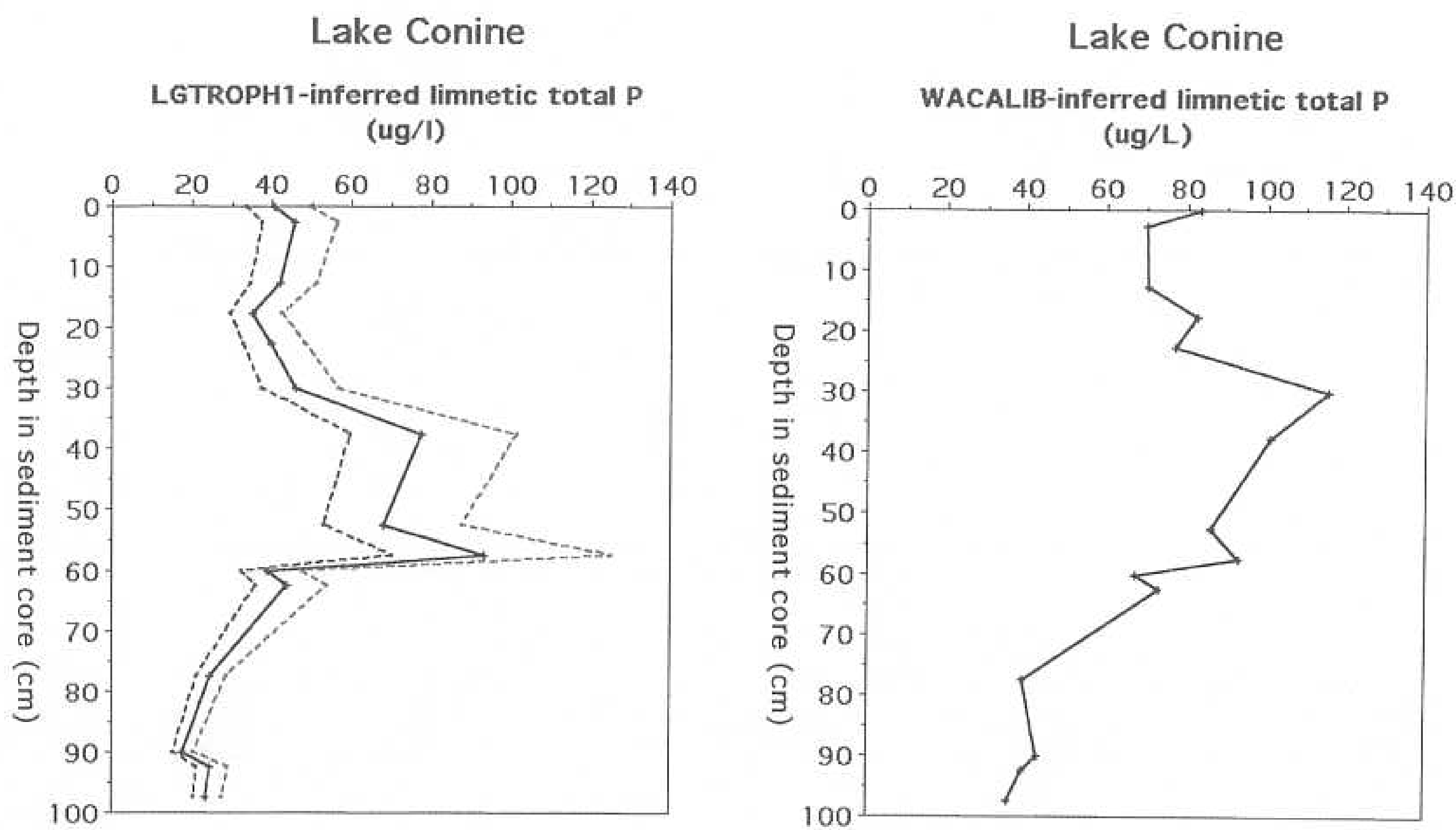


Figure 1. Limnetic total P inferences based on diatom assemblages in Lake Conine sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

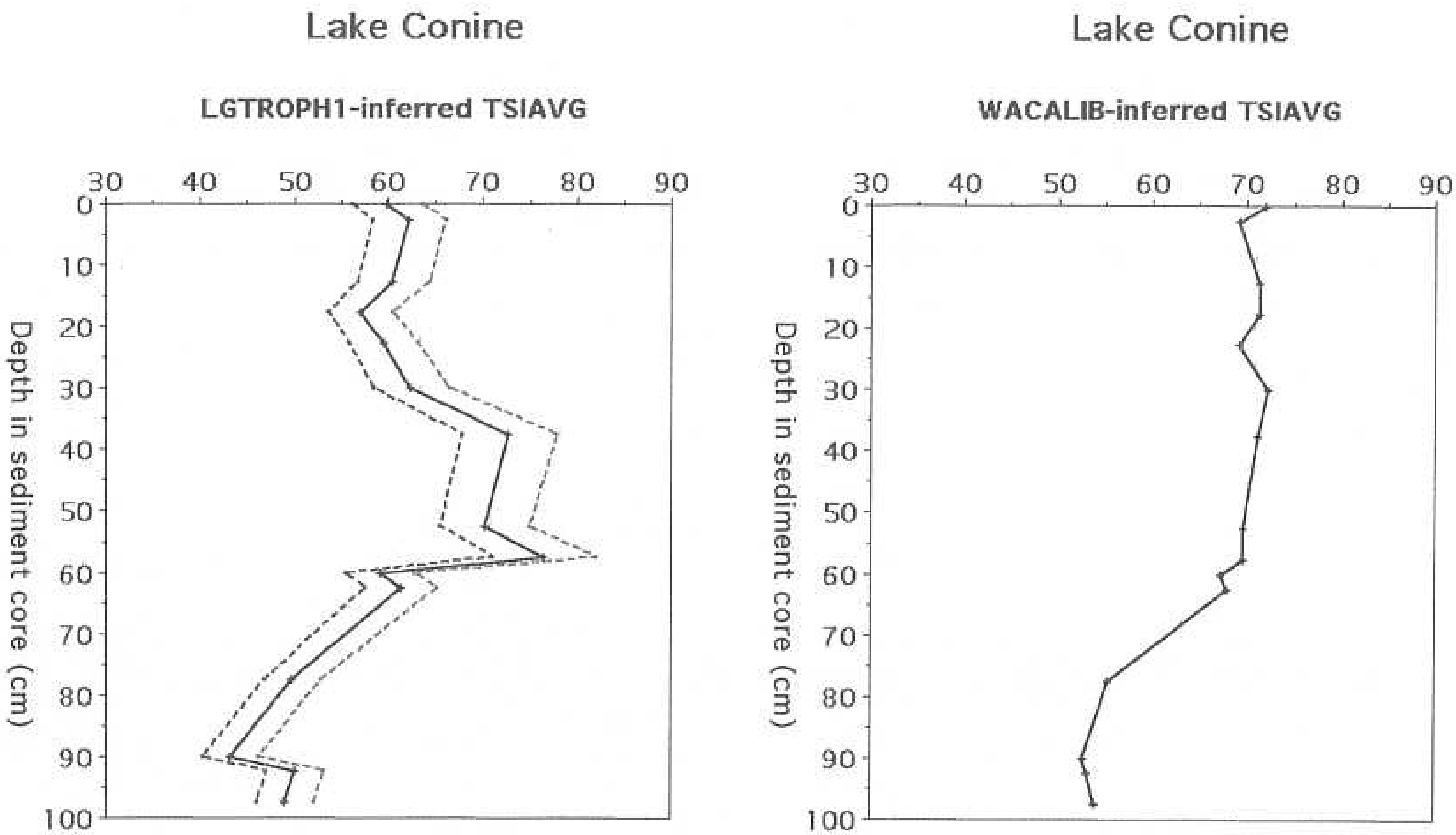


Figure 2. Huber *et al.* (1982) averaged trophic state index values (TSIAVG) based on diatom assemblages in Lake Conine sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

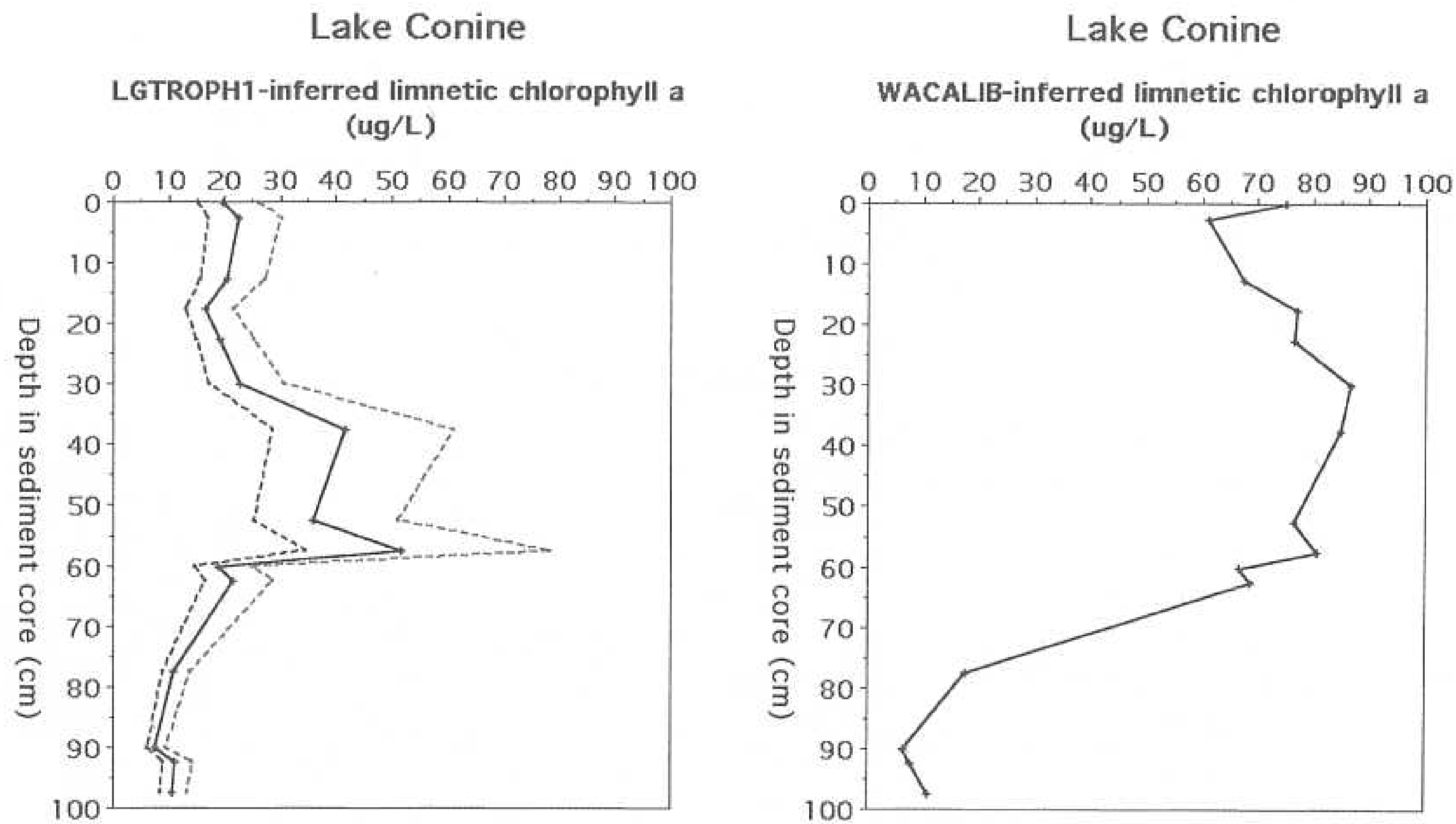


Figure 3. Limnetic chlorophyll *a* inferences based on diatom assemblages in Lake Conine sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

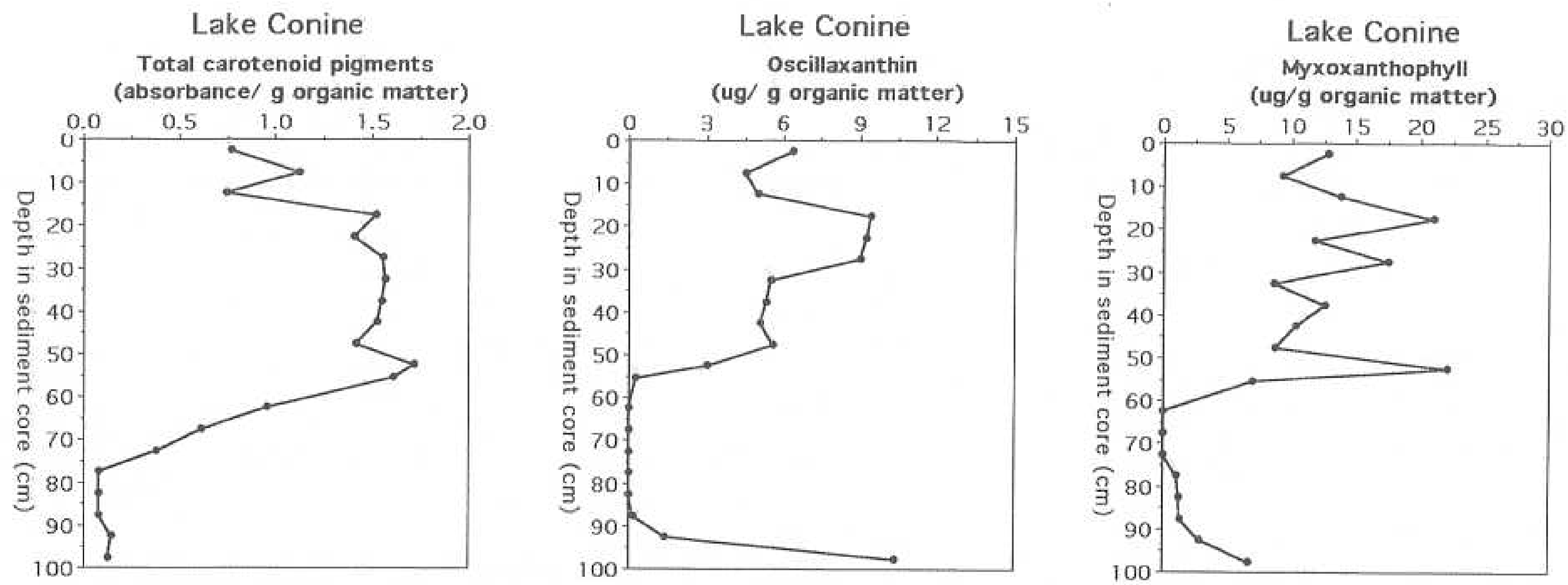


Figure 4. Total carotenoid, oscillaxanthin, and myxoxanthophyll pigment concentrations in Lake Conine sediment core samples, from Whitmore and Riedinger (2002).

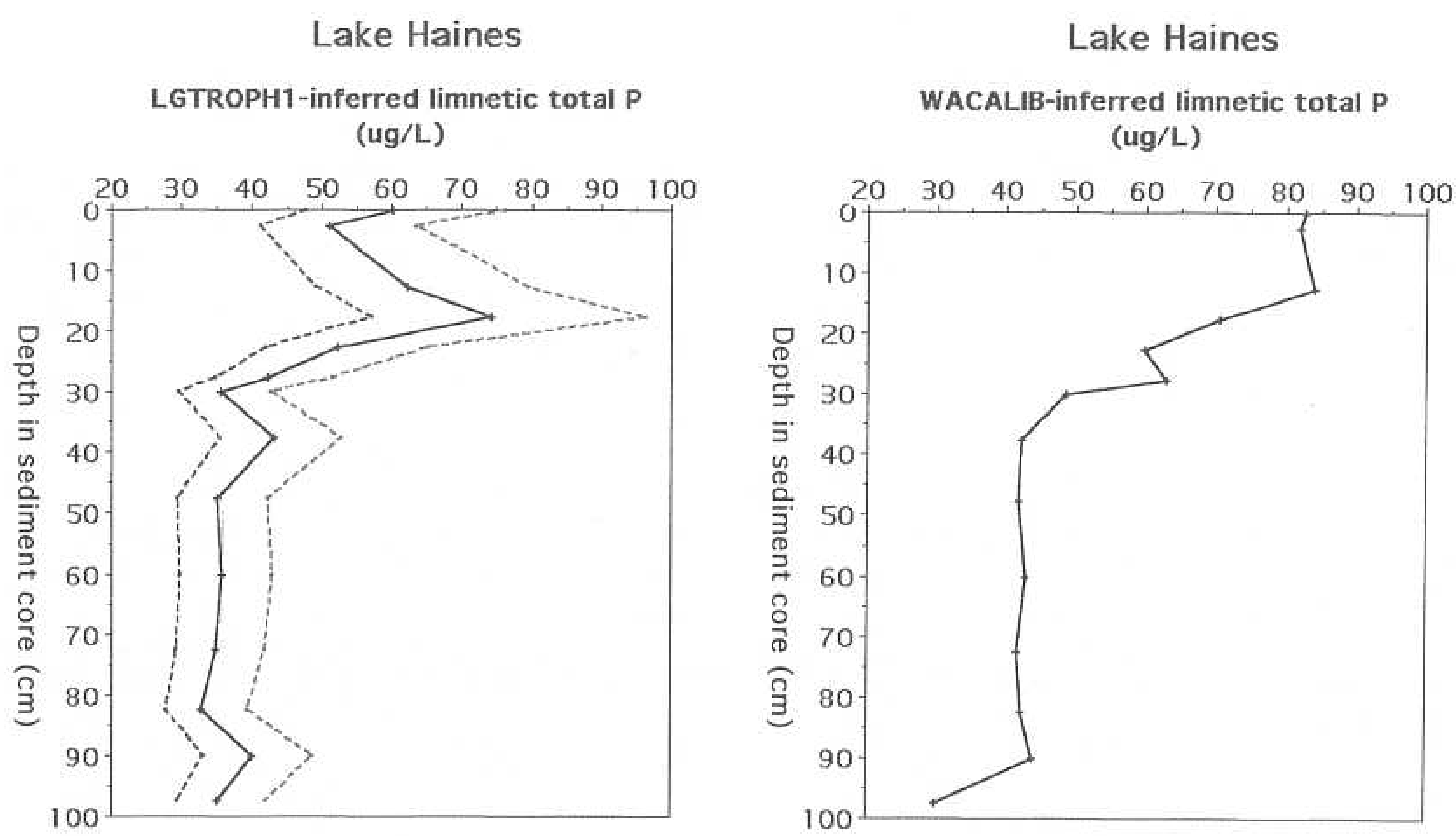


Figure 5. Limnetic total P inferences based on diatom assemblages in Lake Haines sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

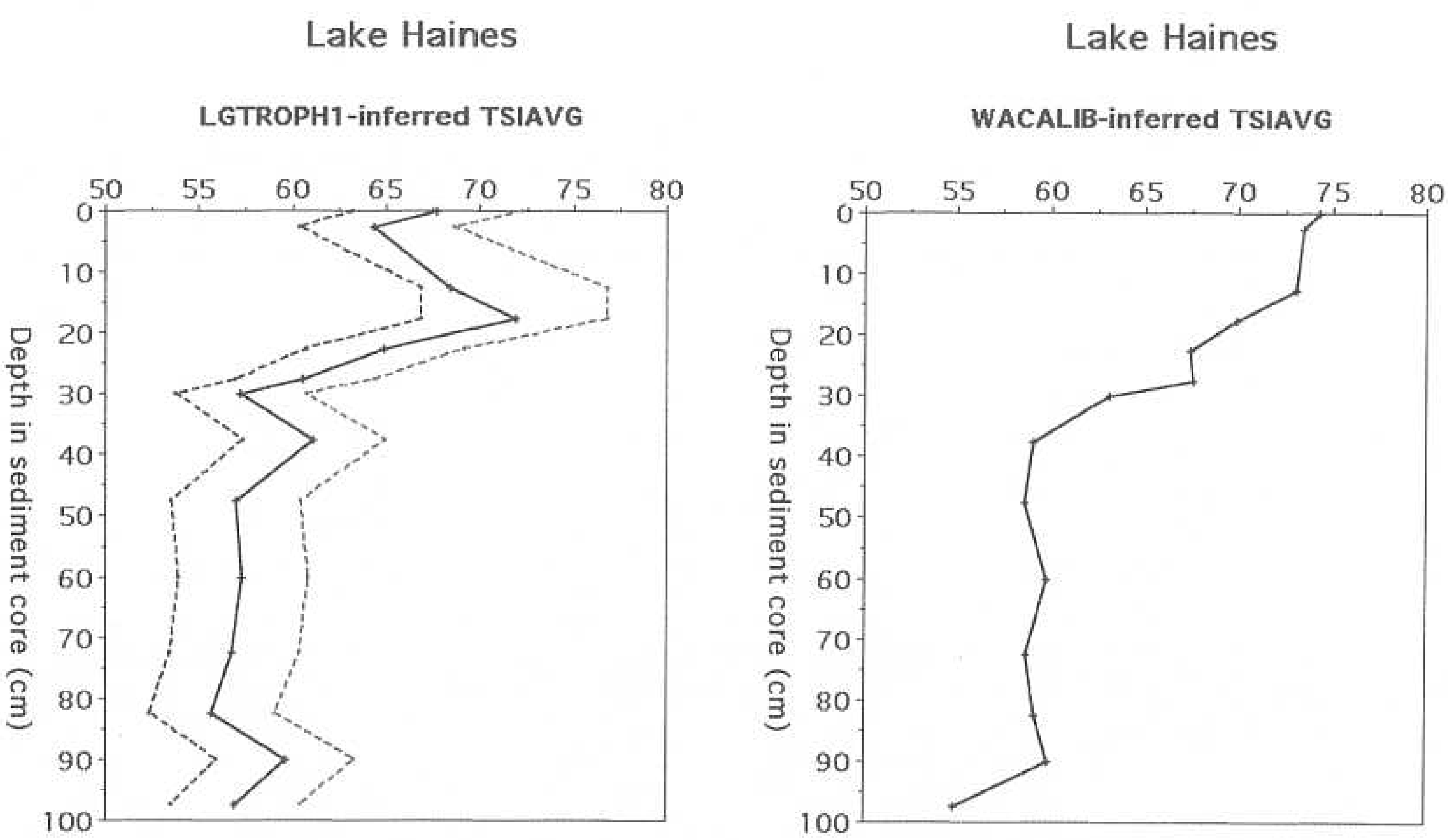
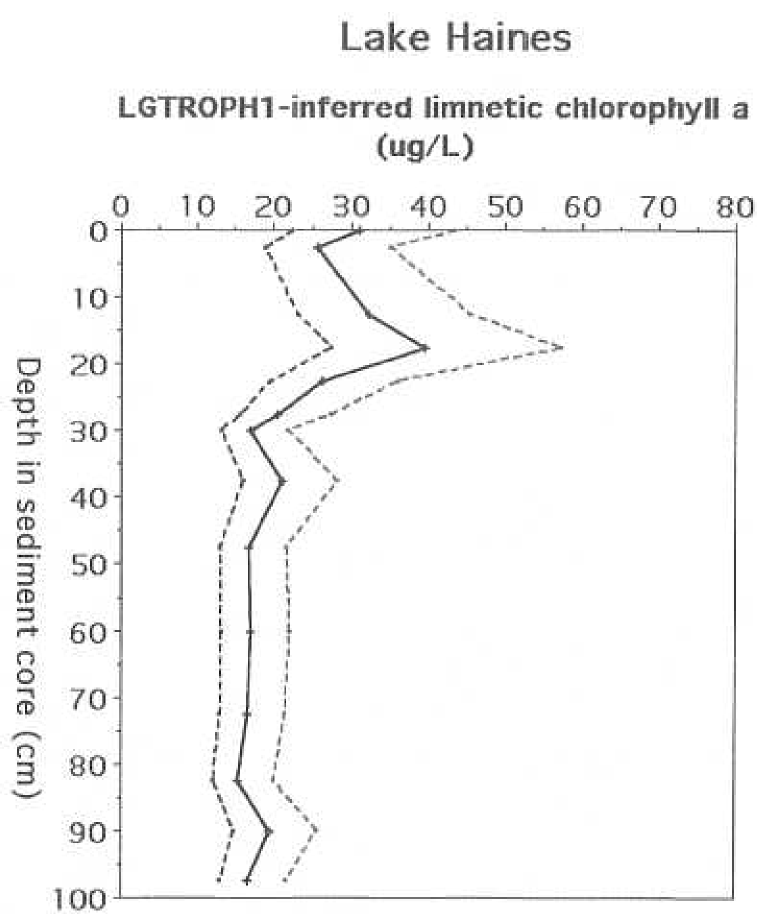


Figure 6. Huber *et al.* (1982) averaged trophic state index values (TSIAVG) based on diatom assemblages in Lake Haines sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).



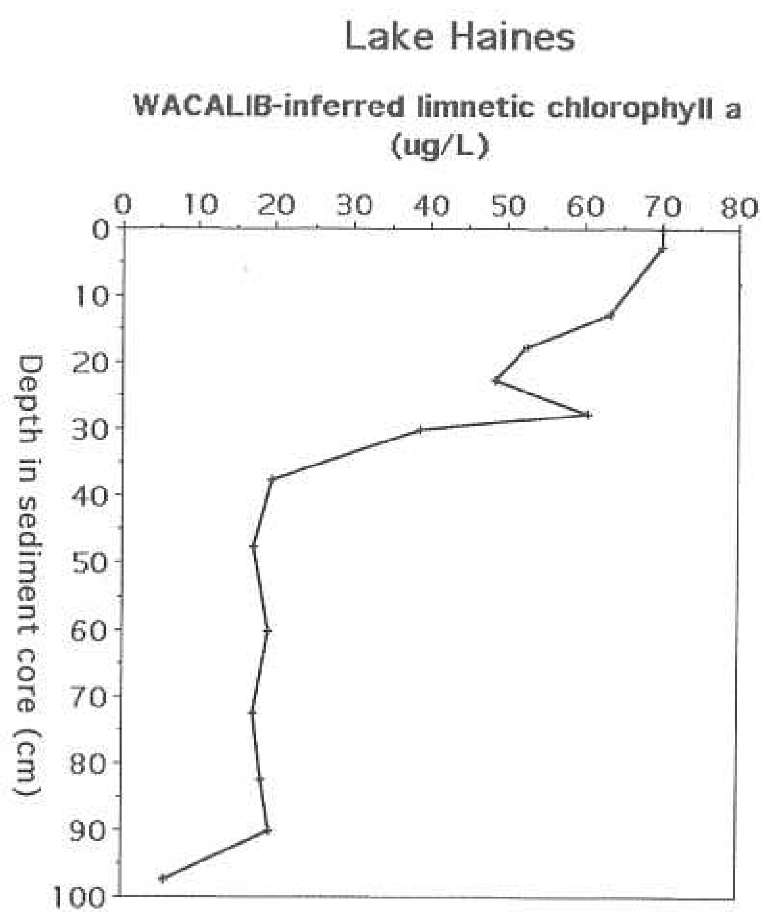


Figure 7. Limnetic chlorophyll *a* inferences based on diatom assemblages in Lake Haines sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

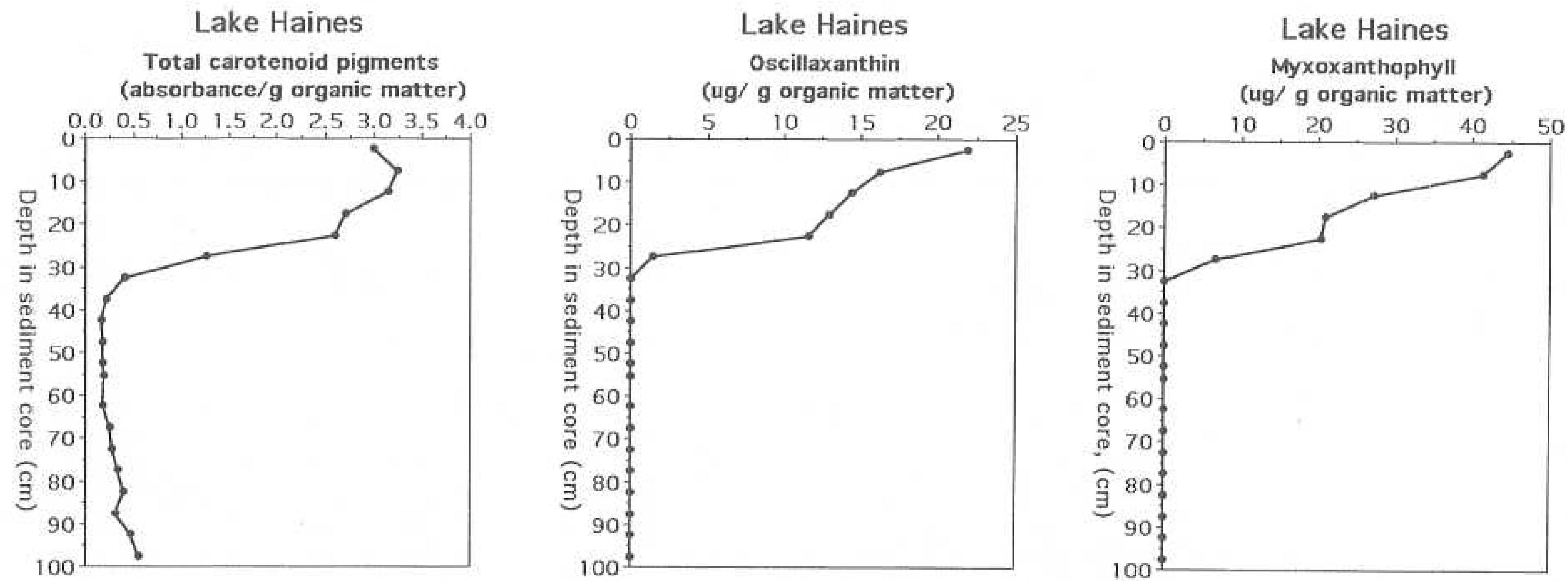


Figure 8. Total carotenoid, oscillaxanthin, and myxoxanthophyll pigment concentrations in Lake Haines sediment core samples, from Whitmore and Riedinger (2002).

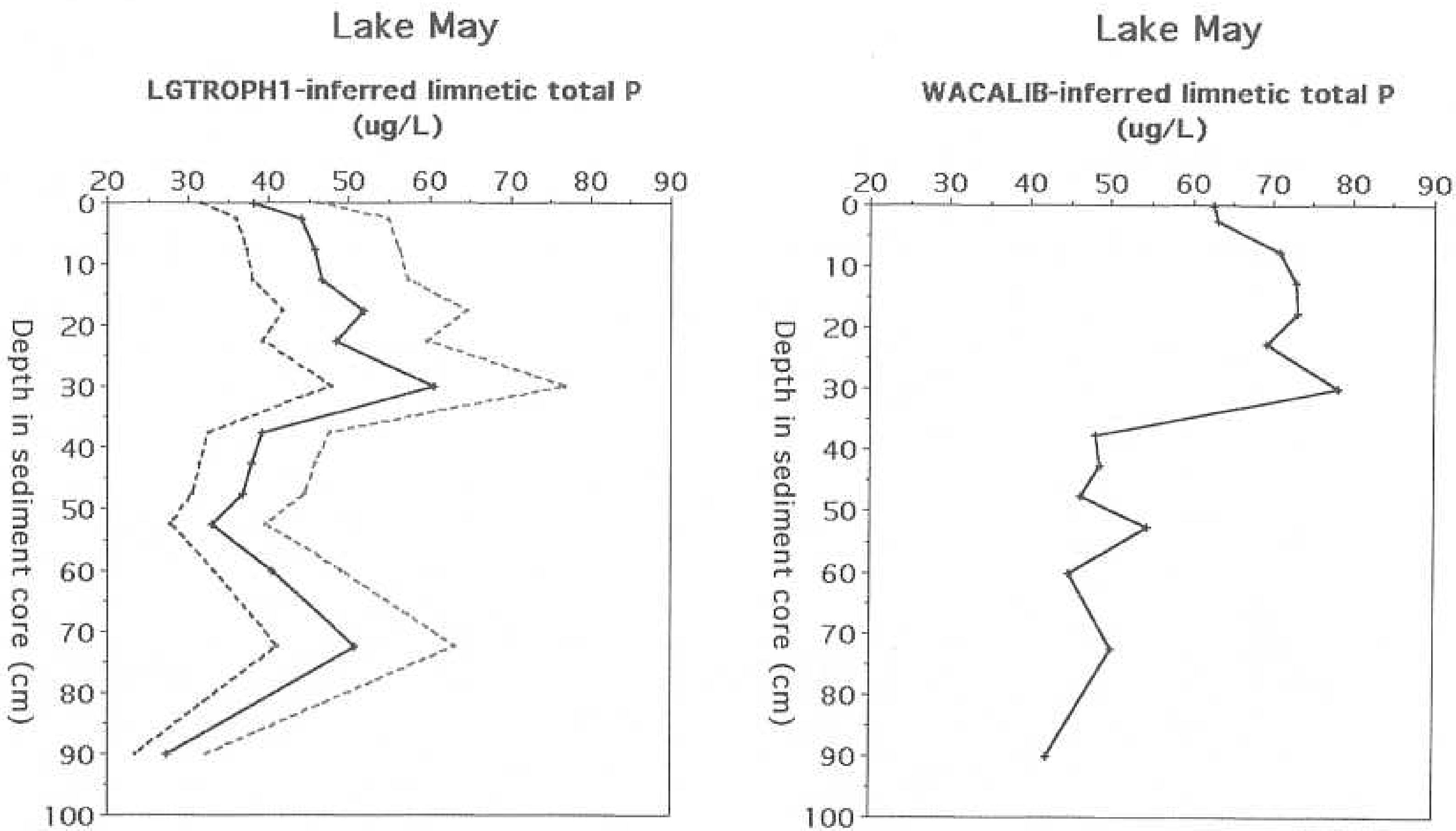


Figure 9. Limnetic total P inferences based on diatom assemblages in Lake May sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

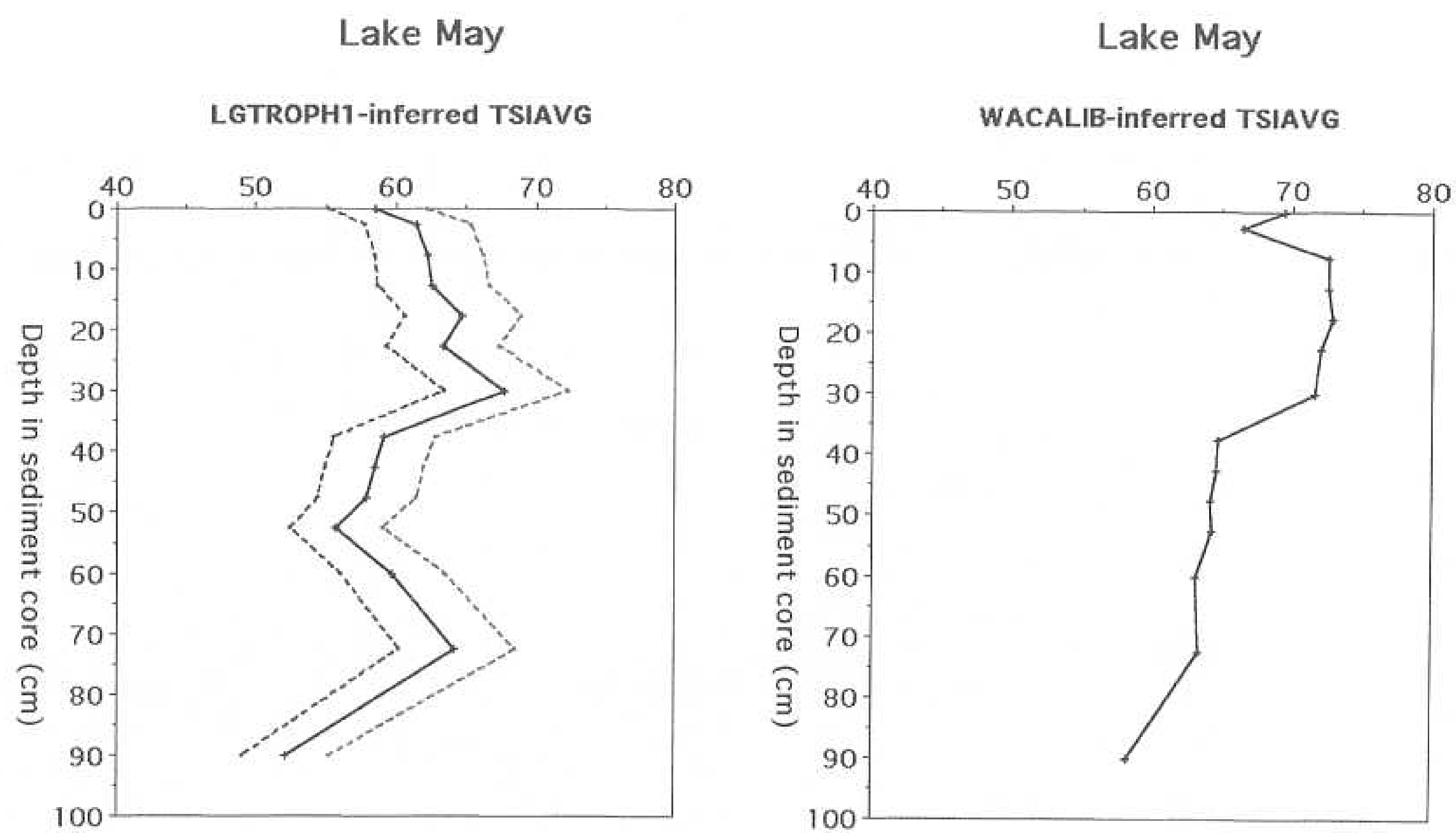


Figure 10. Huber *et al.* (1982) averaged trophic state index values (TSIAVG) based on diatom assemblages in Lake May sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

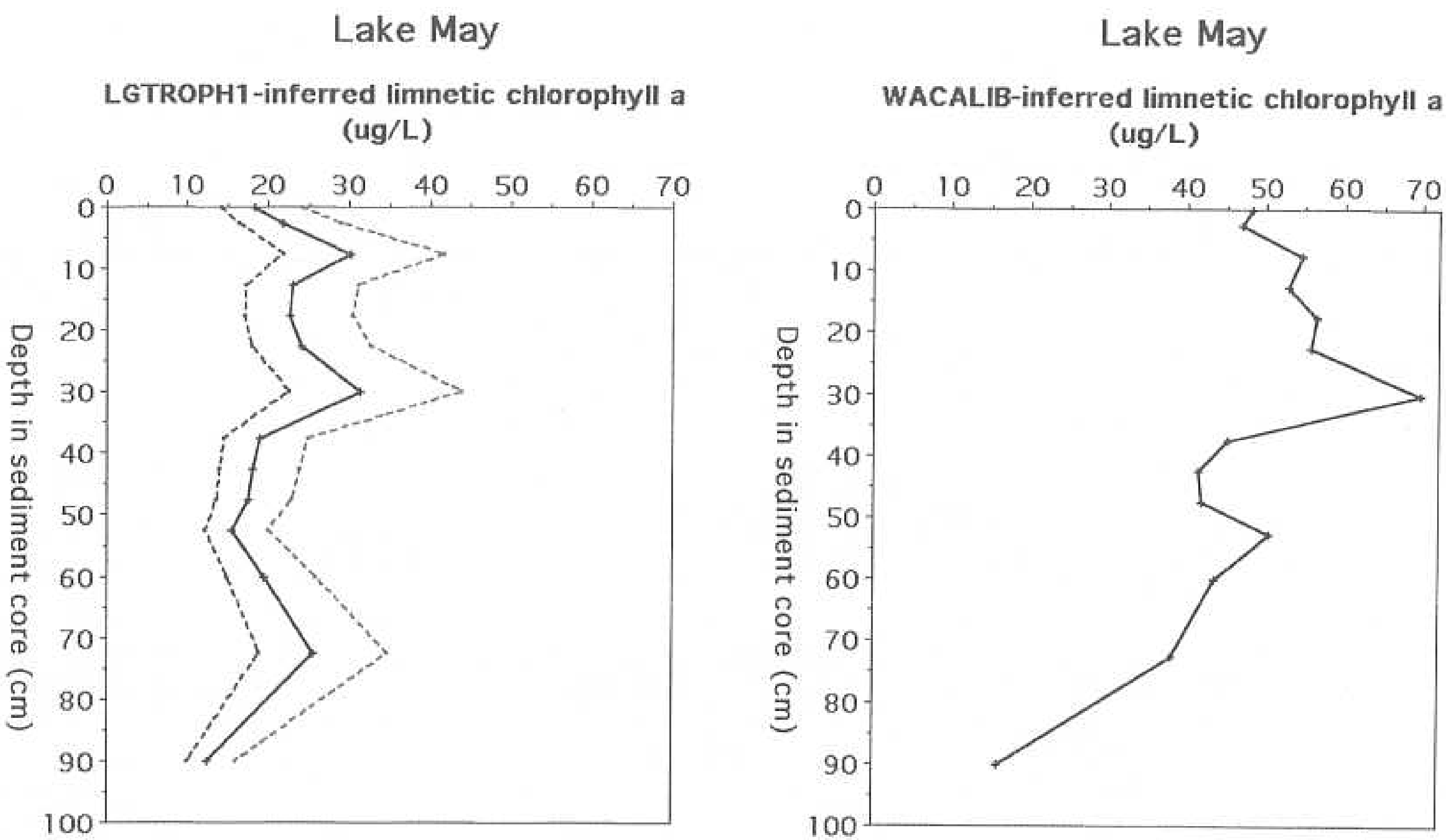


Figure 11. Limnetic chlorophyll *a* inferences based on diatom assemblages in Lake May sediment core samples. a). inferences obtained using the TROPH1 index model (Whitmore 1989), with 95% confidence intervals for the predictions, and b). inferences obtained by weighted-averaging calibration (WACALIB).

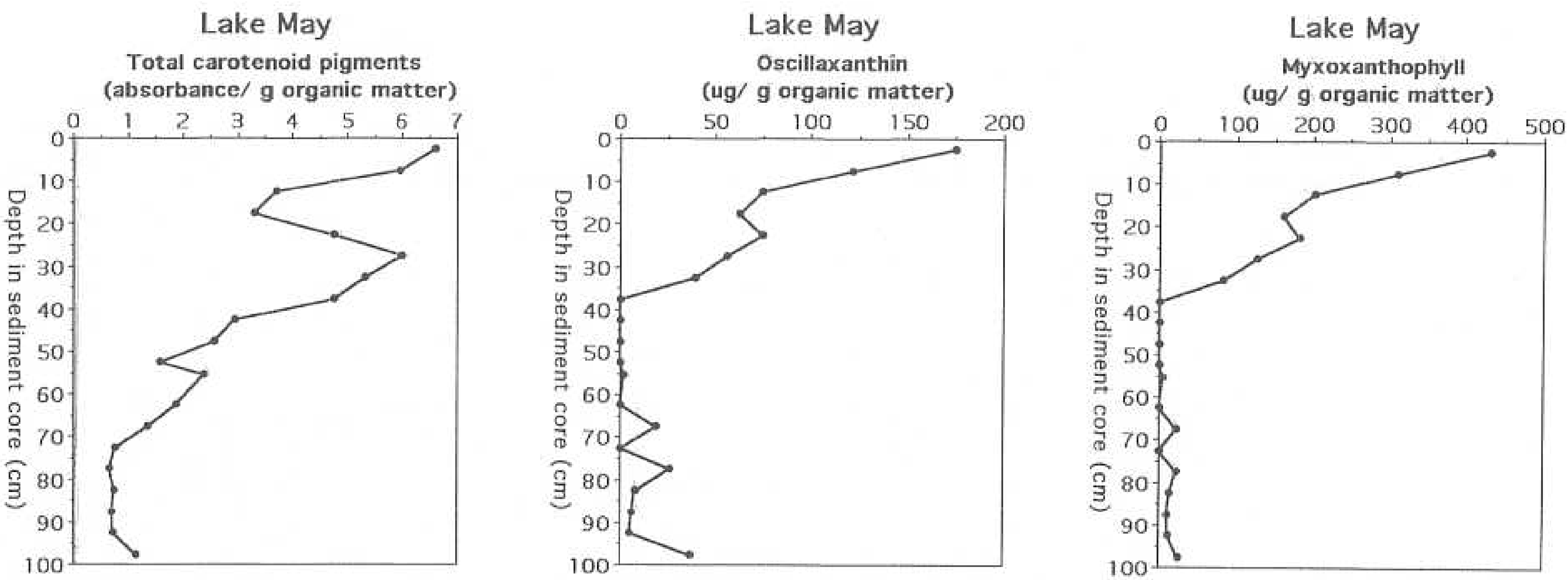


Figure 12. Total carotenoid, oscillaxanthin, and myxoxanthophyll pigment concentrations in Lake May sediment core samples, from Whitmore and Riedinger (2002).

Appendix A. Diatom count data for sediment samples.

Lake Conine, Depth = 0 cm

Species	Percentage of sample
Achnanthes linearis (W.Sm.) Gr.	0.17
Achnanthes minutissima Kutz.	0.34
Aulacoseira alpegina (Gr) Kram.	3.06
Aulacoseira ambigua (Gr.) Sim.	4.08
Aulacoseira granulata (Ehr.) Sim.	4.42
Aulacoseira granulata v. angustissima	0.51
Aulacoseira granulata v. muzzanensis	0.85
Aulacoseira italica (Ehr.) Sim.	6.80
Cyclotella meneghiniana Kutz.	3.23
Cyclotella stelligera (Cl. & Gr.)V.H.	0.17
Navicula seminulum v. intermedia Hust	0.17
Nitzschia fonticola Gr.	0.68
Nitzschia frustulum (Kutz) Gr.	0.34
Nitzschia palea (Kutz) W.Sm.	29.08
Pseudostaurosira brevistriata (G)W&R	12.24
Staurosira construens v venter (G)W&R	19.90
Staurosirella pinnata (Ehr) W & R	0.34
Stephanodiscus aegyptiacus Ehr.	9.52
Synedra delicatissima W. Sm.	0.68
Synedra filiformis v. exilis ClEul.	3.40
Total	99.98

Lake Conine, Depth = 5-10 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.74
Achnanthes minutissima Kutz.	0.30
Aulacoseira alpegina (Gr) Kram.	5.02
Aulacoseira ambigua (Gr.) Sim.	1.03
Aulacoseira granulata (Ehr.) Sim.	4.58
Aulacoseira granulata v. angustissima	0.30
Aulacoseira granulata v. muzzanensis	0.30
Aulacoseira italica (Ehr.) Sim.	9.16
Cocconeis placentula v. lineata (E)VH	1.33
Cyclotella meneghiniana Kutz.	6.65
Cyclotella stelligera (Cl. & Gr.)V.H.	3.25
Gomphonema parvulum Kutz.	0.15
Navicula gastrum (Ehr.) Kutz.	0.15
Navicula mutica Kutz.	0.15
Nitzschia amphibia Gr.	3.40
Nitzschia fonticola Gr.	0.44
Nitzschia palea (Kutz) W.Sm.	21.86
Opephora americana M.Perag	0.59
Pinnularia abaujensis v. linearis	0.15
Pseudostaurosira brevistriata (G)W&R	16.54
Staurosira construens v pumila (G)W&R	1.18
Staurosira construens v venter (G)W&R	14.48
Stephanodiscus aegyptiacus Ehr.	4.43
Synedra delicatissima W. Sm.	0.15
Synedra delicatissima v. angustissima	0.15
Synedra filiformis v. exilis ClEul.	2.95
Synedra rumpens v. familiaris(Kutz)Gr	0.44
Unknown	0.15
Total	100.02

Lake Conine, Depth = 10-15 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.82
Achnanthes linearis (W.Sm.) Gr.	0.33
Anomoeoneis vitrea (Gr.) Ross.	0.16
Aulacoseira alpegina (Gr) Kram.	1.96
Aulacoseira granulata (Ehr.) Sim.	8.81
Aulacoseira granulata v. angustissima	0.82
Aulacoseira italica (Ehr.) Sim.	6.36
Cyclotella meneghiniana Kutz.	4.73
Cyclotella stelligera (Cl. & Gr.)V.H.	3.10
Navicula exigua var. capitata Pat.	0.16
Nitzschia amphibia Gr.	4.40
Nitzschia fonticola Gr.	0.33
Nitzschia palea (Kutz) W.Sm.	24.47
Pseudostaurosira brevistriata (G)W&R	15.66
Stauroneis species	0.16
Staurosira construens v venter (G)W&R	19.25
Stephanodiscus aegyptiacus Ehr.	5.87
Synedra delicatissima v. angustissima	0.16
Synedra filiformis v. exilis ClEul.	2.12
Unknown	0.33
Total	100.00

Lake Conine, Depth = 15-20 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.59
Achnanthes minutissima Kutz.	0.20
Aulacoseira alpegina (Gr) Kram.	0.79
Aulacoseira granulata (Ehr.) Sim.	3.96
Aulacoseira granulata v. angustissima	0.40
Aulacoseira granulata v. muzzanensis	0.40
Aulacoseira italica (Ehr.) Sim.	5.54
Cyclotella meneghiniana Kutz.	12.28
Cyclotella stelligera (Cl. & Gr.)V.H.	0.20
Frustulia rhomboides Ehr. DeT.	0.40
Navicula seminulum v. intermedia Hust	0.20
Nitzschia palea (Kutz) W.Sm.	42.97
Opephora americana M.Perag	0.79
Pseudostaurosira brevistriata (G)W&R	6.34
Staurosira construens v venter (G)W&R	10.10
Staurosirella pinnata (Ehr) W & R	0.79
Stephanodiscus aegyptiacus Ehr.	13.07
Synedra filiformis v. exilis ClEul.	0.99
Total	100.01

Lake Conine, Depth = 20-25 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.39
Aulacoseira alpegina (Gr) Kram.	0.58
Aulacoseira granulata (Ehr.) Sim.	0.58
Aulacoseira granulata v. angustissima	0.39
Aulacoseira granulata v. muzzanensis	0.19
Aulacoseira italica (Ehr.) Sim.	0.58
Coscinodiscus lacustris Gr.	1.16
Cyclotella Kuetzingiana Thw.	0.58
Cyclotella meneghiniana Kutz.	17.60
Cyclotella stelligera (Cl. & Gr.)V.H.	1.93
Frustulia rhomboides Ehr. DeT.	0.39
Navicula exigua v. capitata Pat.	0.19
Navicula gottlandica Gr.	0.19
Navicula pupula Kutz.	0.19
Nitzschia amphibia Gr.	0.77
Nitzschia fonticola Gr.	0.39
Nitzschia palea (Kutz) W.Sm.	42.36
Opephora americana M.Perag	0.39
Pinnularia legumen (Ehr) Ehr.	0.19
Pseudostaurosira brevistriata (G)W&R	0.97
Staurosira construens v pumila (G)W&R	4.26
Staurosira construens v venter (G)W&R	3.48
Stephanodiscus aegyptiacus Ehr.	21.66
Synedra filiformis v. exilis ClEul.	0.39
Synedra sp	0.19
Total	99.99

Lake Conine, Depth = 30 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Aulacoseira granulata (Ehr.) Sim.	0.75
Aulacoseira italica (Ehr.) Sim.	0.75
Cocconeis placentula v. lineata (E)VH	0.19
Cyclotella meneghiniana Kutz.	13.88
Navicula pupula v. mutata (Kras.)Hust	0.19
Nitzschia palea (Kutz) W.Sm.	40.15
Pseudostaurosira brevistriata (G)W&R	0.75
Staurosira construens v venter (G)W&R	1.13
Staurosirella pinnata (Ehr) W & R	0.38
Stephanodiscus aegyptiacus Ehr.	40.90
Synedra filiformis v. exilis ClEul.	0.75
Total	100.01

Lake Conine, Depth = 35-40 cm

Species	Percentage of sample
Achnanthes exigua Gr.	1.52
Achnanthes linearis f. curta H.L. Sm.	0.19
Aulacoseira alpegina (Gr) Kram.	0.19
Aulacoseira granulata (Ehr.) Sim.	1.52
Aulacoseira italica (Ehr.) Sim.	0.38
Cocconeis placentula v. lineata (E)VH	0.19
Coscinodiscus lacustris Gr.	1.14
Cyclotella Keutzingiana Thw.	0.57
Cyclotella meneghiniana Kutz.	19.54
Cyclotella stelligera (Cl. & Gr.)V.H.	0.19
Cymbella Muelleri Hust.	0.19
Frustulia rhomboides Ehr. DeT.	0.19
Navicula pupula v. mutata (Kras.)Hust	0.19
Nitzschia amphibia Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	18.60
Pseudostaurosira brevistriata (G)W&R	0.57
Staurosira construens v venter (G)W&R	3.80
Stephanodiscus aegyptiacus Ehr.	49.91
Synedra filiformis v. exilis ClEul.	0.76
Unknown	0.19
Total	100.02

Lake Conine, Depth = 50-55 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Achnanthes minutissima Kutz.	0.75
Aulacoseira alpegina (Gr) Kram.	9.02
Aulacoseira granulata (Ehr.) Sim.	13.35
Aulacoseira granulata v. angustissima	1.13
Aulacoseira granulata v. muzzanensis	0.56
Aulacoseira italica (Ehr.) Sim.	17.29
Cyclotella Keutzingiana Thw.	0.38
Cyclotella meneghiniana Kutz.	10.34
Eunotia pectinalis (Mull?) Rab.	0.19
Navicula gottlandica Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	6.39
Pinnularia legumen (Ehr) Ehr.	0.19
Pinnularia viridis v. minor Cl.	0.19
Staurosira construens v pumila (G)W&R	1.69
Staurosira construens v venter (G)W&R	4.89
Stephanodiscus aegyptiacus Ehr.	30.83
Synedra delicatissima v. angustissima	1.50
Synedra filiformis v. exilis ClEul.	0.56
Synedra sp	0.19
Tabellaria fenestrata (Lyngb.) Kutz.	0.19
Total	100.01

Lake Conine, Depth = 55-60 cm

Species	Percentage of sample
Achnanthes exigua Gr.	1.33
Aulacoseira alpegina (Gr) Kram.	6.83
Aulacoseira granulata (Ehr.) Sim.	11.57
Aulacoseira granulata v. angustissima	0.38
Aulacoseira granulata v. muzzanensis	0.57
Aulacoseira italica (Ehr.) Sim.	11.39
Coscinodiscus lacustris Gr.	0.38
Cyclotella Keutzingiana Thw.	0.19
Cyclotella meneghiniana Kutz.	14.61
Cyclotella stelligera (Cl. & Gr.)V.H.	1.33
Eunotia incisa W. Sm. ex Greg.	0.19
Frustulia rhomboides Ehr. DeT.	0.19
Navicula gastrum (Ehr.) Kutz.	0.19
Navicula pupula v. mutata (Kras.)Hust	0.19
Nitzschia amphibia Gr.	0.76
Nitzschia palea (Kutz) W.Sm.	3.61
Opephora americana M.Perag	0.76
Pinnularia legumen (Ehr) Ehr.	0.19
Staurosira construens v pumila (G)W&R	0.19
Stephanodiscus aegyptiacus Ehr.	42.88
Synedra delicatissima W. Sm.	0.38
Synedra filiformis v. exilis ClEul.	1.14
Synedra sp	0.38
Unknown	0.38
Total	100.01

Lake Conine, Depth = 60 cm

Species	Percentage of sample
Achnanthes exigua Gr.	1.35
Aulacoseira alpegina (Gr) Kram.	11.20
Aulacoseira ambigua (Gr.) Sim.	0.58
Aulacoseira distans (Ehr.) Sim.	8.11
Aulacoseira granulata (Ehr.) Sim.	16.99
Aulacoseira granulata v. angustissima	0.39
Aulacoseira granulata v. muzzanensis	0.97
Aulacoseira italica (Ehr.) Sim.	11.97
Cyclotella meneghiniana Kutz.	7.14
Cyclotella stelligera (Cl. & Gr.)V.H.	6.37
Eunotia pectinalis v. minor (Kutz)Rab	0.77
Frustulia rhomboides Ehr. DeT.	0.77
Gomphonema gracile Ehr.em.V.H.	0.39
Gomphonema parvulum Kutz.	0.39
Navicula pupula v. rectangularis	0.19
Navicula radiosa v. parva Wallace	0.19
Nitzschia fonticola Gr.	0.39
Nitzschia palea (Kutz) W.Sm.	8.49
Opephora martyi Herib.	0.77
Pinnularia legumen (Ehr) Ehr.	0.19
Staurosira construens v venter (G)W&R	2.32
Staurosirella pinnata (Ehr) W & R	0.39
Stephanodiscus aegyptiacus Ehr.	19.31
Synedra delicatissima W. Sm.	0.19
Synedra rumpens v. meneghiniana Gr.	0.19
Total	100.01

Lake Conine, Depth = 60-65 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.39
Achnanthes pinnata Hust.	0.19
Aulacoseira alpegina (Gr) Kram.	13.06
Aulacoseira granulata (Ehr.) Sim.	33.53
Aulacoseira granulata v. angustissima	0.58
Aulacoseira granulata v. muzzanensis	2.92
Aulacoseira italica (Ehr.) Sim.	2.73
Cyclotella meneghiniana Kutz.	7.02
Cyclotella stelligera (Cl. & Gr.)V.H.	0.97
Cymbella lunata W Sm.	0.19
Eunotia pectinalis (Mull?) Rab.	0.19
Eunotia pectinalis v. minor (Kutz)Rab	0.19
Frustulia rhomboides Ehr. DeT.	0.19
Nitzschia palea (Kutz) W.Sm.	9.55
Pinnularia viridis v. minor Cl.	0.19
Staurosira construens v venter (G)W&R	0.19
Stephanodiscus aegyptiacus Ehr.	25.93
Synedra delicatissima v. angustissima	1.56
Synedra filiformis v. exilis ClEul.	0.39
Total	99.96

Lake Conine, Depth = 75-80 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	0.39
Aulacoseira distans (Ehr.) Sim.	7.56
Aulacoseira granulata (Ehr.) Sim.	53.10
Aulacoseira granulata v. angustissima	3.29
Aulacoseira granulata v. muzzanensis	10.27
Cyclotella Keutzingiana Thw.	0.39
Cyclotella meneghiniana Kutz.	1.36
Eunotia Naegelii Migula	0.39
Eunotia Vanheurckii Pat.	0.39
Eunotia bidentula W. Sm.	0.19
Eunotia curvata Kutz	1.36
Eunotia flexuosa Breb. ex Kutz.	0.19
Eunotia flexuosa v. eurycephala Gr.	0.78
Eunotia formica Ehr.	0.19
Eunotia incisa W. Sm. ex Greg.	0.39
Eunotia monodon Ehr.	0.97
Eunotia pectinalis (Mull?) Rab.	0.19
Eunotia pectinalis v. minor (Kutz)Rab	1.94
Frustulia rhomboides Ehr. DeT.	6.59
Navicula seminulum v. intermedia Hust	0.19
Neidium iridis v. amphigomphus (Eh)Ma	0.39
Nitzschia amphibia Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	1.36
Pinnularia latevittata Cl.	0.39
Pinnularia legumen (Ehr) Ehr.	2.91
Pinnularia viridis v. minor Cl.	0.39
Pseudostaurosira brevistriata (G)W&R	0.39
Stephanodiscus aegyptiacus Ehr.	2.91
Synedra delicatissima W. Sm.	0.19
Tabellaria fenestrata (Lyngb.) Kutz.	0.78
Total	100.02

Lake Conine, Depth = 90 cm

Species	Percentage of sample
Actinella punctata Lewis.	0.40
Aulacoseira alpegina (Gr) Kram.	0.20
Aulacoseira distans (Ehr.) Sim.	37.92
Aulacoseira granulata (Ehr.) Sim.	23.95
Aulacoseira granulata v. angustissima	17.96
Aulacoseira italica (Ehr.) Sim.	0.60
Eunotia bidentula W. Sm.	0.20
Eunotia flexuosa Breb. ex Kutz.	0.60
Eunotia formica Ehr.	1.20
Eunotia monodon v. constricta ClEul	1.00
Eunotia pectinalis (Mull?) Rab.	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.40
Frustulia rhomboides Ehr. DeT.	13.77
Nitzschia palea (Kutz) W.Sm.	0.20
Pinnularia central areas	0.40
Pinnularia legumen (Ehr) Ehr.	0.60
Unknown	0.40
Total	100.00

Lake Conine, Depth = 90-95 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	0.39
Aulacoseira distans (Ehr.) Sim.	0.20
Aulacoseira granulata (Ehr.) Sim.	66.21
Aulacoseira granulata v. angustissima	6.88
Aulacoseira granulata v. muzzanensis	7.47
Coscinodiscus lacustris Gr.	0.20
Cyclotella meneghiniana Kutz.	0.59
Eunotia Naegelii Migula	0.20
Eunotia bidentula W. Sm.	0.59
Eunotia diodon Ehr.	0.59
Eunotia flexuosa Breb. ex Kutz.	0.39
Eunotia formica Ehr.	1.96
Eunotia monodon Ehr.	0.20
Eunotia monodon v. constricta ClEul	0.59
Eunotia pectinalis (Mull?) Rab.	0.20
Eunotia pectinalis v. minor (Kutz)Rab	1.57
Eunotia zygodon Ehr.	0.20
Frustulia rhomboides Ehr. DeT.	8.25
Opephora americana M.Perag	0.20
Pinnularia latevittata Cl.	0.39
Pinnularia legumen (Ehr) Ehr.	1.57
Pinnularia viridis v. minor Cl.	0.20
Stephanodiscus aegyptiacus Ehr.	0.79
Unknown	0.20
Total	100.03

Lake Conine, Depth = 95-100 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	4.37
Aulacoseira distans (Ehr.) Sim.	0.40
Aulacoseira granulata (Ehr.) Sim.	59.33
Aulacoseira granulata v. angustissima	2.98
Aulacoseira granulata v. muzzanensis	6.94
Aulacoseira italica (Ehr.) Sim.	0.60
Cyclotella meneghiniana Kutz.	0.60
Cyclotella stelligera (Cl. & Gr.)V.H.	1.39
Eunotia carolina Pat.	0.20
Eunotia Maior (W. Sm.) Rab.	0.20
Eunotia Naegelii Migula	0.20
Eunotia Vanheurckii Pat.	0.20
Eunotia bidentula W. Sm.	0.20
Eunotia flexuosa Breb. ex Kutz.	0.40
Eunotia formica Ehr.	1.59
Eunotia monodon v. constricta ClEul	2.38
Eunotia pectinalis v. minor (Kutz)Rab	0.99
Frustulia rhomboides Ehr. DeT.	11.51
Navicula sp	0.20
Nitzschia palea (Kutz) W.Sm.	0.79
Pinnularia central areas	0.40
Pinnularia dactylus Ehr.	0.40
Pinnularia legumen (Ehr) Ehr.	1.39
Pinnularia termitina (Ehr.) Patr.	0.20
Pinnularia viridis v. minor Cl.	0.79
Staurosira construens v venter (G)W&R	0.40
Stephanodiscus aegyptiacus Ehr.	0.60
Tabellaria fenestrata (Lyngb.) Kutz.	0.40
Total	100.05

Lake Haines, Depth = 0 cm

Species	Percentage of sample
Achnanthes minutissima Kutz.	0.74
Aulacoseira alpegina (Gr) Kram.	0.93
Aulacoseira ambigua (Gr.) Sim.	2.04
Aulacoseira distans (Ehr.) Sim.	0.93
Aulacoseira granulata (Ehr.) Sim.	5.57
Aulacoseira granulata v. angustissima	1.11
Aulacoseira granulata v. muzzanensis	0.74
Aulacoseira italica (Ehr.) Sim.	25.42
Cyclotella meneghiniana Kutz.	2.97
Eunotia formica Ehr.	0.19
Eunotia incisa W. Sm. ex Greg.	0.19
Gomphonema gracile Ehr.em.V.H.	0.19
Navicula radiosa v. parva Wallace	0.19
Nitzschia fonticola Gr.	0.56
Nitzschia frustulum (Kutz) Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	7.98
Pseudostaurosira brevistriata (G)W&R	18.18
Staurosira construens v venter (G)W&R	28.94
Stephanodiscus aegyptiacus Ehr.	1.67
Synedra filiformis v. exilis ClEul.	1.11
Synedra ulna (Nitz.) Ehr.	0.19
Total	100.03

Lake Haines, Depth = 5-10 cm.

Species	Percentage of sample
Aulacoseira ambigua (Gr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	16.41
Aulacoseira granulata v. angustissima	1.35
Aulacoseira granulata v. muzzanensis	2.51
Aulacoseira italica (Ehr.) Sim.	11.97
Cocconeis placentula v. lineata (E)VH	0.19
Cyclotella meneghiniana Kutz.	3.67
Cyclotella stelligera (Cl. & Gr.)V.H.	0.39
Eunotia pectinalis v. minor (Kutz)Rab	0.19
Gomphonema sp	0.39
Nitzschia amphibia Gr.	0.97
Nitzschia palea (Kutz) W.Sm.	8.11
Pseudostaurosira brevistriata (G)W&R	18.15
Staurosira construens v venter (G)W&R	30.69
Stephanodiscus aegyptiacus Ehr.	3.09
Synedra delicatissima v. angustissima	0.19
Synedra filiformis v. exilis ClEul.	1.35
Total	100.01

Lake Haines, Depth = 10-15 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	4.34
Aulacoseira ambigua (Gr.) Sim.	2.37
Aulacoseira granulata (Ehr.) Sim.	11.44
Aulacoseira granulata v. angustissima	1.78
Aulacoseira granulata v. muzzanensis	3.16
Aulacoseira italica (Ehr.) Sim.	8.88
Cocconeis placentula v. lineata (E)VH	0.59
Cyclotella meneghiniana Kutz.	5.13
Cyclotella stelligera (Cl. & Gr.)V.H.	0.99
Frustulia rhomboides Ehr. DeT.	0.20
Nitzschia amphibia Gr.	1.18
Nitzschia fonticola Gr.	0.20
Nitzschia palea (Kutz) W.Sm.	3.75
Pinnularia viridis v. minor Cl.	0.20
Pseudostaurosira brevistriata (G)W&R	26.63
Staurosira construens v venter (G)W&R	26.82
Stephanodiscus aegyptiacus Ehr.	1.58
Synedra filiformis v. exilis ClEul.	0.79
Total	100.03

Lake Haines, Depth = 15-20 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	4.99
Aulacoseira ambigua (Gr.) Sim.	2.20
Aulacoseira distans (Ehr.) Sim.	0.20
Aulacoseira granulata (Ehr.) Sim.	18.56
Aulacoseira granulata v. angustissima	2.20
Aulacoseira granulata v. muzzanensis	8.58
Aulacoseira italica (Ehr.) Sim.	14.77
Cocconeis placentula v. lineata (E)VH	0.20
Cyclotella meneghiniana Kutz.	12.38
Cyclotella stelligera (Cl. & Gr.)V.H.	0.20
Eunotia formica Ehr.	0.20
Eunotia incisa W. Sm. ex Greg.	0.40
Eunotia pectinalis v. minor (Kutz)Rab	0.20
Gomphonema gracile Ehr.em.V.H.	0.40
Nitzschia fonticola Gr.	0.60
Nitzschia palea (Kutz) W.Sm.	3.59
Pinnularia viridis v. minor Cl.	0.20
Pseudostaurosira brevistriata (G)W&R	19.76
Staurosira construens v venter (G)W&R	8.38
Stephanodiscus aegyptiacus Ehr.	1.60
Synedra ulna (Nitz.) Ehr.	0.20
Unknown	0.20
Total	100.01

Lake Haines, Depth = 20-25 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Aulacoseira alpegina (Gr) Kram.	3.46
Aulacoseira ambigua (Gr.) Sim.	2.31
Aulacoseira granulata (Ehr.) Sim.	26.92
Aulacoseira granulata v. angustissima	1.15
Aulacoseira granulata v. muzzanensis	7.31
Aulacoseira italica (Ehr.) Sim.	8.85
Cocconeis placentula v. lineata (E)VH	0.96
Cyclotella meneghiniana Kutz.	15.19
Cyclotella stelligera (Cl. & Gr.)V.H.	1.54
Eunotia Maior (W. Sm.) Rab.	0.19
Eunotia formica Ehr.	0.38
Eunotia quaternaria Ehr.	0.19
Gomphonema brasiliense Gr.	0.19
Gomphonema gracile Ehr.em.V.H.	0.19
Gomphonema parvulum Kutz.	0.19
Navicula arvensis Hust.	0.19
Navicula mutica Kutz.	0.38
Nitzschia fonticola Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	6.92
Pinnularia legumen (Ehr) Ehr.	0.38
Pinnularia viridis v. minor Cl.	0.38
Pseudostaurosira brevistriata (G)W&R	9.81
Staurosira construens v venter (G)W&R	9.23
Stephanodiscus aegyptiacus Ehr.	2.50
Synedra sp	0.19
Synedra ulna (Nitz.) Ehr.	0.19
Unknown	0.38
Total	99.95

Lake Haines, Depth = 25-30 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.20
Aulacoseira alpegina (Gr) Kram.	3.56
Aulacoseira ambigua (Gr.) Sim.	0.79
Aulacoseira granulata (Ehr.) Sim.	21.58
Aulacoseira granulata v. angustissima	0.59
Aulacoseira granulata v. muzzanensis	10.30
Aulacoseira italica (Ehr.) Sim.	5.94
Cocconeis placentula v. lineata (E)VH	1.39
Cyclotella meneghiniana Kutz.	11.68
Cyclotella stelligera (Cl. & Gr.)V.H.	2.38
Eunotia pectinalis v. minor (Kutz)Rab	0.40
Gomphonema gracile Ehr.em.V.H.	0.40
Gomphonema parvulum Kutz.	0.79
Navicula exigua v. capitata Pat.	0.20
Navicula pupula v. rectangularis	0.20
Navicula radiosa v. parva Wallace	0.20
Nitzschia amphibia Gr.	0.20
Nitzschia fonticola Gr.	0.40
Nitzschia palea (Kutz) W.Sm.	17.23
Pinnularia abaujensis v. linearis	0.20
Pinnularia central areas	0.40
Pinnularia legumen (Ehr) Ehr.	0.20
Pinnularia viridis v. minor Cl.	0.99
Pseudostaurosira brevistriata (G)W&R	5.15
Staurosira construens v venter (G)W&R	4.16
Stephanodiscus aegyptiacus Ehr.	9.50
Surirella linearis W. Sm.	0.20
Synedra filiformis v. exilis ClEul.	0.59
Unknown	0.20
Total	100.02

Lake Haines, Depth = 30 cm

Species	Percentage of sample
Achnanthes lanceolata v lanceolatoide	0.21
Actinella punctata Lewis.	0.21
Aulacoseira alpegina (Gr) Kram.	17.45
Aulacoseira ambigua (Gr.) Sim.	1.23
Aulacoseira distans (Ehr.) Sim.	0.41
Aulacoseira granulata (Ehr.) Sim.	36.14
Aulacoseira granulata v. angustissima	2.67
Aulacoseira granulata v. muzzanensis	10.68
Aulacoseira islandica (O.Mull.) Sim.	0.41
Aulacoseira italica (Ehr.) Sim.	4.11
Cocconeis placentula v. lineata (E)VH	0.41
Cyclotella meneghiniana Kutz.	2.05
Cyclotella stelligera (Cl. & Gr.)V.H.	5.95
Diploneis elliptica (Kutz) Cl.	0.41
Eunotia flexuosa v. eurycephala Gr.	0.21
Eunotia formica Ehr.	0.41
Eunotia pectinalis v. minor (Kutz)Rab	0.21
Eunotia serra v. diadema (Ehr.) Pat.	0.21
Frustulia rhomboides Ehr. DeT.	0.41
Nitzschia palea (Kutz) W.Sm.	5.95
Pinnularia central areas	0.62
Pseudostaurosira brevistriata (G)W&R	1.64
Staurosira construens v venter (G)W&R	2.67
Stephanodiscus aegyptiacus Ehr.	4.52
Unidentifiable central areas	0.21
Unknown	0.62
Total	100.02

Lake Haines, Depth = 35-40 cm

Species	Percentage of sample
Aulacoseira ambigua (Gr.) Sim.	0.79
Aulacoseira distans (Ehr.) Sim.	1.18
Aulacoseira granulata (Ehr.) Sim.	61.22
Aulacoseira granulata v. angustissima	0.59
Aulacoseira granulata v. muzzanensis	30.51
Aulacoseira italica (Ehr.) Sim.	0.39
Cyclotella meneghiniana Kutz.	1.18
Cyclotella stelligera (Cl. & Gr.)V.H.	0.20
Eunotia flexuosa Breb. ex Kutz.	0.20
Eunotia formica Ehr.	0.59
Eunotia pectinalis v. minor (Kutz)Rab	0.79
Fragilaria virescens Ralfs	0.20
Frustulia rhomboides Ehr. DeT.	0.59
Nitzschia amphibia Gr.	0.20
Nitzschia palea (Kutz) W.Sm.	0.39
Pinnularia central areas	0.20
Pinnularia viridis v. minor Cl.	0.20
Staurosira construens v venter (G)W&R	0.20
Stephanodiscus aegyptiacus Ehr.	0.20
Unknown	0.20
Total	100.02

Lake Haines, Depth = 45-50 cm

Species	Percentage of sample
Aulacoseira distans (Ehr.) Sim.	1.40
Aulacoseira granulata (Ehr.) Sim.	78.80
Aulacoseira granulata v. angustissima	0.40
Aulacoseira granulata v. muzzanensis	16.80
Eunotia formica Ehr.	0.40
Eunotia pectinalis v. minor (Kutz)Rab	0.80
Frustulia rhomboides Ehr. DeT.	0.60
Pinnularia central areas	0.20
Pinnularia legumen (Ehr) Ehr.	0.40
Pinnularia viridis v. minor Cl.	0.20
Total	100.02

Lake Haines, Depth = 60 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	5.51
Aulacoseira ambigua (Gr.) Sim.	0.20
Aulacoseira granulata (Ehr.) Sim.	71.85
Aulacoseira granulata v. angustissima	2.76
Aulacoseira granulata v. muzzanensis	15.35
Aulacoseira italica (Ehr.) Sim.	1.77
Eunotia formica Ehr.	0.39
Eunotia pectinalis v. minor (Kutz)Rab	0.39
Frustulia rhomboides Ehr. DeT.	0.79
Mastagloia sp	0.20
Pinnularia central areas	0.39
Pinnularia legumen (Ehr) Ehr.	0.20
Tabellaria fenestrata (Lyngb.) Kutz.	0.20
Total	100.00

Lake Haines, Depth = 70-75 cm

Species	Percentage of sample
Aulacoseira distans (Ehr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	83.86
Aulacoseira granulata v. angustissima	0.20
Aulacoseira granulata v. muzzanensis	13.78
Eunotia formica Ehr.	0.39
Eunotia pectinalis v. minor (Kutz)Rab	0.20
Frustulia rhomboides Ehr. DeT.	0.59
Pinnularia central areas	0.20
Pinnularia viridis v. minor Cl.	0.20
Surirella sp	0.20
Total	100.01

Lake Haines, Depth = 80-85 cm

Species	Percentage of sample
Aulacoseira distans (Ehr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	87.67
Aulacoseira granulata v. angustissima	1.37
Aulacoseira granulata v. muzzanensis	8.02
Aulacoseira italica (Ehr.) Sim.	0.20
Cyclotella stelligera (Cl. & Gr.)V.H.	0.39
Eunotia camelus Ehr.	0.20
Eunotia formica Ehr.	0.59
Eunotia pectinalis v. minor (Kutz)Rab	0.20
Gomphonema gracile Ehr.em.V.H.	0.39
Pinnularia central areas	0.39
Pinnularia dactylus Ehr.	0.20
Total	100.01

Lake Haines, Depth = 90 cm

Species	Percentage of sample
Aulacoseira alpegina (Gr) Kram.	0.39
Aulacoseira distans (Ehr.) Sim.	2.16
Aulacoseira granulata (Ehr.) Sim.	66.60
Aulacoseira granulata v. angustissima	4.52
Aulacoseira granulata v. muzzanensis	22.40
Aulacoseira italica (Ehr.) Sim.	1.96
Cyclotella meneghiniana Kutz.	0.98
Gomphonema gracile Ehr.em.V.H.	0.39
Pinnularia central areas	0.39
Unknown	0.20
Total	99.99

Lake Haines, Depth = 95-100 cm

Species	Percentage of sample
Amphora acutiuscula Kutz.	12.86
Anomoeoneis serians v. acuta Hust.	0.71
Aulacoseira alpegina (Gr) Kram.	0.18
Aulacoseira ambigua (Gr.) Sim.	0.54
Aulacoseira distans (Ehr.) Sim.	0.18
Aulacoseira granulata (Ehr.) Sim.	51.79
Aulacoseira granulata v. muzzanensis	13.75
Cyclotella meneghiniana Kutz.	0.71
Cyclotella stelligera (Cl. & Gr.)V.H.	0.54
Cymbella Muelleri Hust.	3.57
Cymbella aspera (Ehr.) Cl.	0.18
Cymbella lunata W Sm.	0.36
Cymbella minuta Hilse ex Rab.	0.54
Diploneis elliptica (Kutz) Cl.	0.36
Eunotia Naegelii Migula	0.54
Eunotia monodon Ehr.	0.36
Eunotia pectinalis v. minor (Kutz)Rab	0.36
Gomphonema abbreviatum Ag.	0.18
Gomphonema gracile Ehr.em.V.H.	0.36
Hantzschia amphioxys (Ehr.) Gr..	0.18
Mastagloia Smithii Thwaites ex W. Sm.	0.18
Mastagloia Smithii v. lacustris Gr.	2.32
Navicula exigua v. capitata Pat.	0.36
Navicula pupula v. rectangularis	1.25
Navicula radiosa Kutz.	0.36
Neidium ladogense v. densestriatum	0.18
Nitzschia amphibia Gr.	1.07
Nitzschia denticula Gr.	0.54
Nitzschia frustulum (Kutz) Gr.	0.18
Nitzschia palea (Kutz) W.Sm.	0.71
Pinnularia abaujensis (Pant) Ross	0.18
Pinnularia abaujensis v. linearis	0.18
Pinnularia braunii (Gr) Cl.	0.18
Pinnularia central areas	0.54
Pinnularia latevittata Cl.	0.54
Pinnularia latevittata v. domingensis	0.36
Pinnularia viridis v. minor Cl.	0.89
Stauroneis phoenocenteron v. gracilis	0.18

Lake Haines, Depth = 95-100 cm continued

Species	Percentage of sample
Staurosira construens v venter (G)W&R	0.36
Surirella tenera Greg.	0.18
Synedra delicatissima W. Sm.	0.18
Synedra filiformis v. exilis ClEul.	0.36
Unknown	0.54
Total	100.07

Lake May, Depth = 0 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Achnanthes lanceolata v. dubia Gr.	0.38
Achnanthes linearis (W.Sm.) Gr.	0.19
Achnanthes minutissima Kutz.	4.13
Anomoeoneis serians v. brachysira(B)G	0.38
Anomoeoneis vitrea (Gr.) Ross.	0.19
Aulacoseira alpegina (Gr) Kram.	0.56
Aulacoseira ambigua (Gr.) Sim.	5.44
Aulacoseira distans (Ehr.) Sim.	0.19
Aulacoseira granulata (Ehr.) Sim.	5.25
Aulacoseira granulata v. angustissima	1.31
Aulacoseira granulata v. muzzanensis	0.56
Aulacoseira italica (Ehr.) Sim.	8.82
Cocconeis placentula v. lineata (E)VH	0.75
Cyclotella meneghiniana Kutz.	1.50
Cyclotella stelligera (Cl. & Gr.)V.H.	5.07
Cymbella minuta Hilse ex Rab.	0.19
Eunotia flexuosa Breb. ex Kutz.	0.19
Eunotia pectinalis v. minor (Kutz)Rab	1.69
Frustulia rhomboides Ehr. DeT.	0.38
Gomphonema gracile Ehr.em.V.H.	0.56
Navicula cuspidata (Kutz) Kutz.	0.38
Navicula radiosa v. parva Wallace	1.13
Nitzschia amphibia Gr.	3.19
Nitzschia palea (Kutz) W.Sm.	15.38
Opephora americana M.Perag	0.38
Pinnularia appendiculata (Ag) Cl.	0.38
Pseudostaurosira brevistriata (G)W&R	14.45
Stauroneis phoenocenteron (Nitz)Ehr.	0.19
Staurosira construens Ehr.	0.19
Staurosira construens v venter (G)W&R	22.51
Stephanodiscus aegyptiacus Ehr.	1.13
Synedra filiformis v. exilis ClEul.	2.25
Synedra incisa Boy.	0.19
Unknown	0.38
Total	100.05

Lake May, Depth = 0-5 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.38
Achnanthes minutissima Kutz.	4.62
Anomoeoneis vitrea (Gr.) Ross.	0.19
Aulacoseira alpegina (Gr) Kram.	0.38
Aulacoseira ambigua (Gr.) Sim.	8.85
Aulacoseira distans (Ehr.) Sim.	0.19
Aulacoseira granulata (Ehr.) Sim.	3.46
Aulacoseira granulata v. angustissima	1.54
Aulacoseira granulata v. muzzanensis	0.19
Aulacoseira italica (Ehr.) Sim.	15.19
Cocconeis placentula v. lineata (E)VH	1.73
Cyclotella meneghiniana Kutz.	2.12
Cyclotella stelligera (Cl. & Gr.)V.H.	2.88
Epithemia argus v. alpestris Gr.	0.19
Eunotia arcus Ehr.	0.19
Eunotia pectinalis v. minor (Kutz)Rab	1.73
Frustulia rhomboides Ehr. DeT.	0.19
Gomphonema parvulum Kutz.	0.38
Navicula cuspidata (Kutz) Kutz.	0.38
Navicula elginensis (Greb.) Ralfs	0.19
Navicula gastrum (Ehr.) Kutz.	0.38
Navicula gottlandica Gr.	0.19
Navicula pupula v. rectangularis	0.19
Navicula sp	0.19
Nitzschia amphibia Gr.	3.46
Nitzschia fonticola Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	4.81
Pinnularia latevittata v. domingensis	0.19
Pinnularia viridis v. minor Cl.	0.38
Pseudostaurosira brevistriata (G)W&R	9.04
Staurosira construens v pumila (G)W&R	0.38
Staurosira construens v venter (G)W&R	32.12
Stephanodiscus aegyptiacus Ehr.	0.19
Synedra delicatissima W. Sm.	0.19
Synedra filiformis v. exilis ClEul.	2.31
Unknown	0.77
Total	99.95

Lake May, Depth = 5-10 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Achnanthes linearis (W.Sm.) Gr.	0.97
Achnanthes minutissima Kutz.	4.47
Amphora ovalis Kutz.	0.39
Amphora ovalis v. pediculus(Kutz.) V.H.	0.19
Anomoeoneis serians v. acuta Hust.	0.58
Aulacoseira ambigua (Gr.) Sim.	1.75
Aulacoseira granulata (Ehr.) Sim.	2.52
Aulacoseira granulata v. angustissima	0.19
Aulacoseira italica (Ehr.) Sim.	14.17
Cocconeis placentula v. lineata (E)VH	1.55
Cyclotella meneghiniana Kutz.	2.72
Cyclotella stelligera (Cl. & Gr.)V.H.	1.75
Eunotia Naegelii Migula	0.19
Eunotia pectinalis v. minor (Kutz)Rab	1.55
Frustulia rhomboides Ehr. DeT.	0.19
Gomphonema gracile Ehr.em.V.H.	0.19
Gomphonema parvulum Kutz.	0.19
Gomphonema subclavatum v. commutatum	0.19
Navicula capitata v. hungarica (Gr)Ro	0.39
Navicula cuspidata (Kutz) Kutz.	0.19
Navicula pupula v. mutata (Kras.)Hust	0.78
Navicula radiosa v. parva Wallace	0.39
Nitzschia amphibia Gr.	3.88
Nitzschia fonticola Gr.	0.39
Nitzschia palea (Kutz) W.Sm.	6.21
Pseudostaurosira brevistriata (G)W&R	19.81
Staurosira construens v venter (G)W&R	31.07
Synedra acus Kutz.	0.19
Synedra delicatissima W. Sm.	0.19
Synedra filiformis v. exilis ClEul.	2.14
Unknown	0.39
Total	99.96

Lake May, Depth = 10-15 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.39
Achnanthes linearis (W.Sm.) Gr.	0.20
Achnanthes minutissima Kutz.	4.92
Anomoeoneis serians v. acuta Hust.	0.20
Anomoeoneis vitrea (Gr.) Ross.	0.20
Aulacoseira ambigua (Gr.) Sim.	4.53
Aulacoseira distans (Ehr.) Sim.	0.59
Aulacoseira granulata (Ehr.) Sim.	3.54
Aulacoseira granulata v. angustissima	0.59
Aulacoseira granulata v. muzzanensis	0.20
Aulacoseira italica (Ehr.) Sim.	6.50
Cocconeis placentula v. lineata (E)VH	1.57
Cyclotella meneghiniana Kutz.	3.15
Cyclotella stelligera (Cl. & Gr.)V.H.	3.54
Eunotia formica Ehr.	0.20
Eunotia monodon Ehr.	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.98
Frustulia rhomboides Ehr. DeT.	0.39
Navicula capitata v. hungarica (Gr)Ro	0.20
Navicula mutica Kutz.	0.20
Nitzschia amphibia Gr.	4.33
Nitzschia fonticola Gr.	0.39
Nitzschia palea (Kutz) W.Sm.	6.50
Pinnularia latevittata Cl.	0.20
Pinnularia legumen (Ehr) Ehr.	0.20
Pinnularia viridis v. minor Cl.	0.59
Pseudostaurosira brevistriata (G)W&R	21.65
Staurosira construens Ehr.	0.20
Staurosira construens v pumila (G)W&R	0.59
Staurosira construens v venter (G)W&R	31.10
Synedra filiformis v. exilis ClEul.	1.97
Total	100.01

Lake May, Depth = 15-20 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.67
Achnanthes linearis (W.Sm.) Gr.	0.17
Achnanthes minutissima Kutz.	6.58
Anomoeoneis vitrea (Gr.) Ross.	0.34
Aulacoseira ambigua (Gr.) Sim.	2.02
Aulacoseira granulata (Ehr.) Sim.	2.70
Aulacoseira granulata v. angustissima	0.84
Aulacoseira granulata v. muzzanensis	0.51
Aulacoseira italica (Ehr.) Sim.	6.41
Cocconeis placentula v. lineata (E)VH	0.34
Cyclotella meneghiniana Kutz.	4.89
Cyclotella stelligera (Cl. & Gr.)V.H.	5.06
Cymbella minuta Hilse ex Rab.	0.17
Eunotia pectinalis (Mull?) Rab.	0.17
Eunotia pectinalis v. minor (Kutz)Rab	0.84
Gomphonema gracile Ehr.em.V.H.	0.34
Gomphonema parvulum Kutz.	0.17
Gomphonema subclavatum v. commutatum	0.17
Navicula capitata v. hungarica (Gr)Ro	0.34
Navicula exigua v. capitata Pat.	0.17
Navicula gottlandica Gr.	0.34
Navicula sp	0.17
Nitzschia amphibia Gr.	6.24
Nitzschia palea (Kutz) W.Sm.	5.90
Pinnularia central areas	0.17
Pseudostaurosira brevistriata (G)W&R	25.13
Staurosira construens v venter (G)W&R	26.98
Surirella robusta Ehr.	0.17
Synedra delicatissima v. angustissima	0.17
Synedra filiformis v. exilis ClEul.	1.69
Synedra ulna (Nitz.) Ehr.	0.17
Total	100.03

Lake May, Depth = 20-25 cm

Species	Percentage of sample
Achnanthes linearis (W.Sm.) Gr.	0.38
Achnanthes minutissima Kutz.	3.65
Anomoeneis serians v. acuta Hust.	0.19
Aulacoseira ambigua (Gr.) Sim.	2.31
Aulacoseira distans (Ehr.) Sim.	0.19
Aulacoseira granulata (Ehr.) Sim.	6.54
Aulacoseira granulata v. angustissima	0.38
Aulacoseira granulata v. muzzanensis	1.15
Aulacoseira italica (Ehr.) Sim.	18.46
Cocconeis placentula v. lineata (E)VH	0.19
Cyclotella meneghiniana Kutz.	3.08
Cyclotella stelligera (Cl. & Gr.)V.H.	1.73
Cymbella minuta Hilse ex Rab.	0.19
Eunotia pectinalis v. minor (Kutz)Rab	0.19
Frustulia rhomboides Ehr. DeT.	0.58
Gomphonema affine Kutz.	0.38
Gomphonema gracile Ehr.em.V.H.	0.58
Navicula capitata v. hungarica (Gr)Ro	0.58
Navicula gottlandica Gr.	0.38
Navicula mutica Kutz.	0.58
Navicula pupula v. rectangularis	0.38
Nitzschia amphibia Gr.	1.54
Nitzschia fonticola Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	4.62
Opephora americana M.Perag	0.19
Pinnularia abaujensis v. linearis	0.19
Pinnularia legumen (Ehr) Ehr.	0.38
Pseudostaurosira brevistriata (G)W&R	13.85
Staurosira construens v venter (G)W&R	35.19
Stephanodiscus aegyptiacus Ehr.	0.19
synedra berolinensis	0.19
Synedra delicatissima v. angustissima	0.19
Synedra filiformis v. exilis ClEul.	1.15
Total	99.96

Lake May, Depth = 30 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.96
Achnanthes linearis f. curta H.L. Sm.	0.58
Achnanthes minutissima Kutz.	0.96
Aulacoseira ambigua (Gr.) Sim.	1.92
Aulacoseira granulata (Ehr.) Sim.	10.00
Aulacoseira granulata v. angustissima	0.58
Aulacoseira granulata v. muzzanensis	1.35
Aulacoseira italica (Ehr.) Sim.	11.54
Capartogramma cruciclula (Gr ex Cl)Ro	0.19
Cocconeis placentula v. lineata (E)VH	0.77
Cyclotella meneghiniana Kutz.	16.73
Cyclotella stelligera (Cl. & Gr.)V.H.	2.12
Eunotia pectinalis v. minor (Kutz)Rab	0.77
Frustulia rhomboides Ehr. DeT.	0.19
Navicula gottlandica Gr.	0.19
Navicula pupula v. rectangularis	0.19
Navicula seminulum v. intermedia Hust	0.58
Nitzschia amphibia Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	9.42
Pinnularia braunii v. amphicephala	0.19
Pinnularia central areas	0.19
Pinnularia viridis v. minor Cl.	0.38
Pseudostaurosira brevistriata (G)W&R	18.46
Staurosira construens Ehr.	0.19
Staurosira construens v venter (G)W&R	11.15
Stephanodiscus aegyptiacus Ehr.	7.69
Synedra delicatissima W. Sm.	0.19
Synedra filiformis v. exilis ClEul.	1.92
Synedra rumpens v. familiaris(Kutz)	0.19
Total	99.97

Lake May, Depth = 35-40 cm

Species	Percentage of sample
Achnanthes exigua Gr.	1.38
Achnanthes minutissima Kutz.	4.13
Anomoeoneis serians v. acuta Hust.	0.20
Aulacoseira alpegina (Gr) Kram.	0.59
Aulacoseira ambigua (Gr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	21.41
Aulacoseira granulata v. angustissima	0.20
Aulacoseira granulata v. muzzanensis	1.38
Aulacoseira italica (Ehr.) Sim.	20.04
Capartogramma cruciclula (Gr ex Cl)Ro	0.20
Cocconeis placentula v. lineata (E)VH	0.20
Cyclotella meneghiniana Kutz.	13.56
Cyclotella stelligera (Cl. & Gr.)V.H.	2.36
Cymbella aspera (Ehr.) Cl.	0.20
Cymbella lunata W Sm.	0.20
Eunotia monodon v. constricta ClEul	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.39
Eunotia sp	0.20
Fragilaria crotonensis Kitton	0.59
Frustulia rhomboides Ehr. DeT.	0.20
Gomphonema gracile Ehr.em.V.H.	0.20
Gomphonema parvulum Kutz.	0.20
Gomphonema subclavatum v. commutatum	0.20
Navicula capitata v. hungarica (Gr)Ro	0.39
Navicula gottlandica Gr.	0.20
Navicula mutica Kutz.	0.39
Navicula pupula v. mutata (Kras.)Hust	0.20
Navicula pupula v. rectangularis	0.39
Navicula radiosa Kutz.	0.39
Navicula seminulum v. intermedia Hust	0.20
Nitzschia amphibia Gr.	0.20
Nitzschia palea (Kutz) W.Sm.	13.75
Opephora americana M.Perag	0.20
Pinnularia central areas	0.20
Pinnularia viridis v. minor Cl.	0.39
Pseudostaurosira brevistriata (G)W&R	0.59
Staurosira construens v venter (G)W&R	4.72
Stephanodiscus aegyptiacus Ehr.	2.55
Synedra delicatissima W. Sm.	0.20

Lake May, Depth = 35-40 cm continued

Species	Percentage of sample
Synedra delicatissima v. angustissima	0.98
Synedra filiformis v. exilis ClEul.	5.11
Synedra rumpens v. familiaris(Kutz)Gr	0.20
Unknown	0.20
Total	100.07

Lake May, Depth = 40-45 cm

Species	Percentage of sample
Achnanthes linearis (W.Sm.) Gr.	0.78
Achnanthes minutissima Kutz.	4.49
Aulacoseira ambigua (Gr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	14.06
Aulacoseira granulata v. angustissima	1.37
Aulacoseira granulata v. muzzanensis	1.95
Aulacoseira italica (Ehr.) Sim.	28.52
Cocconeis placentula v. lineata (E)VH	0.78
Cyclotella meneghiniana Kutz.	9.18
Cyclotella stelligera (Cl. & Gr.)V.H.	2.34
Cymbella Muelleri Hust.	0.20
Eunotia monodon v. constricta ClEul	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.20
Frustulia rhomboides Ehr. DeT.	0.20
Gomphonema parvulum Kutz.	0.20
Gomphonema subclavatum v. commutatum	0.20
Navicula gottlandica Gr.	0.20
Navicula radiosa v. parva Wallace	0.59
Nitzschia fonticola Gr.	0.59
Nitzschia palea (Kutz) W.Sm.	21.88
Pinnularia legumen (Ehr) Ehr.	0.39
Pinnularia termitina (Ehr.) Patr.	0.20
Pinnularia viridis v. minor Cl.	0.39
Pseudostaurosira brevistriata (G)W&R	0.59
Staurosira construens v venter (G)W&R	0.98
Stephanodiscus aegyptiacus Ehr.	1.76
Synedra delicatissima W. Sm.	0.59
Synedra delicatissima v. angustissima	0.98
Synedra filiformis v. exilis ClEul.	5.66
Unidentifiable central areas	0.20
Total	100.06

Lake May, Depth = 45-50 cm

Species	Percentage of sample
Achnanthes minutissima Kutz.	2.75
Anomoeoneis serians v. brachysira(B)G	0.20
Aulacoseira alpegina (Gr) Kram.	1.57
Aulacoseira ambigua (Gr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	12.77
Aulacoseira granulata v. angustissima	0.20
Aulacoseira granulata v. muzzanensis	0.59
Aulacoseira italica (Ehr.) Sim.	17.68
Cocconeis placentula v. lineata (E)VH	0.39
Cyclotella meneghiniana Kutz.	16.50
Cyclotella stelligera (Cl. & Gr.)V.H.	4.32
Cymbella minuta Hilse ex Rab.	0.20
Eunotia carolina Pat.	0.20
Eunotia Vanheurckii Pat.	0.20
Eunotia Vanheurckii v. intermedia	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.79
Frustulia rhomboides Ehr. DeT.	0.20
Gomphonema gracile Ehr.em.V.H.	0.39
Gomphonema parvulum Kutz.	0.39
Navicula gottlandica Gr.	0.59
Navicula radiosa Kutz.	0.20
Navicula seminulum v. intermedia Hust	0.20
Nitzschia amphibia Gr.	0.20
Nitzschia fonticola Gr.	0.20
Nitzschia palea (Kutz) W.Sm.	24.36
Pinnularia abaujensis v. linearis	0.20
Pinnularia legumen (Ehr) Ehr.	0.39
Pinnularia viridis v. minor Cl.	0.20
Pseudostaurosira brevistriata (G)W&R	0.79
Stauroneis phoenocenteron v. gracilis	0.39
Staurosira construens v pumila (G)W&R	0.98
Staurosira construens v venter (G)W&R	1.38
Stephanodiscus aegyptiacus Ehr.	2.36
Synedra delicatissima v. angustissima	0.39
Synedra filiformis v. exilis ClEul.	5.70
Synedra incisa Boy.	1.18

Lake May, Depth = 45-50 cm continued

Species	Percentage of sample
Synedra rumpens Kutz.	0.20
Synedra rumpens v. familiaris(Kutz)Gr	0.20
Total	100.04

Lake May, Depth = 50-55 cm

Species	Percentage of sample
Achnanthes exigua Gr.	0.19
Achnanthes linearis (W.Sm.) Gr.	0.37
Achnanthes minutissima Kutz.	2.81
Aulacoseira alpegina (Gr) Kram.	2.81
Aulacoseira ambigua (Gr.) Sim.	0.37
Aulacoseira distans (Ehr.) Sim.	0.19
Aulacoseira granulata (Ehr.) Sim.	15.17
Aulacoseira granulata v. angustissima	2.25
Aulacoseira granulata v. muzzanensis	0.75
Aulacoseira italica (Ehr.) Sim.	14.23
Coscinodiscus lacustris Gr.	0.56
Cyclotella meneghiniana Kutz.	11.80
Cyclotella stelligera (Cl. & Gr.)V.H.	3.00
Cymatopleura angulata Grev.	0.19
Cymbella minuta Hilse ex Rab.	0.19
Eunotia monodon v. constricta ClEul	0.19
Eunotia pectinalis v. minor (Kutz)Rab	0.19
Frustulia rhomboides Ehr. DeT.	0.75
Navicula gottlandica Gr.	0.75
Navicula radiosa Kutz.	0.19
Navicula mutica Kutz.	0.19
Nitzschia amphibia Gr.	0.19
Nitzschia palea (Kutz) W.Sm.	30.15
Pinnularia abaujensis v. linearis	0.19
Pinnularia appendiculata (Ag) Cl.	0.19
Pinnularia braunii v. amphicephala	0.37
Pinnularia central areas	0.19
Pinnularia legumen (Ehr) Ehr.	0.56
Staurosira construens v pumila (G)W&R	0.19
Stephanodiscus aegyptiacus Ehr.	5.99
Synedra delicatissima W. Sm.	0.19
Synedra filiformis v. exilis ClEul.	3.18
Synedra incisa Boy.	0.56
Synedra pulchella Ralfs ex Kutz.	0.19
Synedra rumpens v. familiaris(Kutz)Gr	0.75
Total	100.03

Lake May, Depth = 60 cm

Species	Percentage of sample
Achnanthes minutissima Kutz.	0.20
Aulacoseira alpegina (Gr) Kram.	5.29
Aulacoseira ambigua (Gr.) Sim.	0.39
Aulacoseira granulata (Ehr.) Sim.	20.39
Aulacoseira granulata v. angustissima	4.31
Aulacoseira granulata v. muzzanensis	1.76
Aulacoseira italica (Ehr.) Sim.	10.98
Cyclotella meneghiniana Kutz.	20.98
Cyclotella stelligera (Cl. & Gr.)V.H.	13.33
Cymbella lunata W Sm.	0.20
Eunotia camelus Ehr.	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.39
Frustulia rhomboides Ehr. DeT.	0.59
Gomphonema gracile Ehr.em.V.H.	0.59
Gomphonema sp	0.39
Navicula gottlandica Gr.	0.59
Navicula mutica Kutz.	0.20
Navicula radiosa Kutz.	0.20
Navicula radiosa v. parva Wallace	0.20
Nitzschia amphibia Gr.	0.39
Nitzschia palea (Kutz) W.Sm.	9.80
Pinnularia legumen (Ehr) Ehr.	0.20
Pinnularia viridis v. minor Cl.	0.20
Pseudostaurosira brevistriata (G)W&R	0.78
Staurosirella pinnata (Ehr) W & R	0.39
Stephanodiscus aegyptiacus Ehr.	4.51
Surirella robusta Ehr.	0.20
Synedra filiformis v. exilis ClEul.	1.37
Synedra incisa Boy.	0.78
Synedra rumpens v. familiaris(Kutz)Gr	0.20
Total	100.00

Lake May, Depth = 70-75 cm

Species	Percentage of sample
Achnanthes minutissima Kutz.	0.19
Asterionella formosa Hass.	0.19
Aulacoseira alpegina (Gr) Kram.	0.58
Aulacoseira ambigua (Gr.) Sim.	1.36
Aulacoseira granulata (Ehr.) Sim.	36.38
Aulacoseira granulata v. angustissima	3.31
Aulacoseira granulata v. muzzanensis	3.89
Aulacoseira italica (Ehr.) Sim.	23.74
Cyclotella Keutzingiana Thw.	0.97
Cyclotella meneghiniana Kutz.	15.18
Cyclotella stelligera (Cl. & Gr.)V.H.	1.17
Eunotia Naegelii Migula	0.78
Eunotia Vanheurckii Pat.	0.19
Eunotia camelus Ehr.	0.19
Eunotia monodon v. constricta ClEul	0.19
Frustulia rhomboides Ehr. DeT.	0.78
Navicula gottlandica Gr.	0.19
Neidium iridis v. amphigomphus (Eh)Ma	0.19
Nitzschia palea (Kutz) W.Sm.	4.47
Pinnularia legumen (Ehr) Ehr.	0.78
Pinnularia viridis v. minor Cl.	0.19
Pinnularia viridis v. minor Cl.	0.19
Stephanodiscus aegyptiacus Ehr.	3.70
Surirella linearis W. Sm.	0.39
Surirella sp	0.19
Synedra filiformis v. exilis ClEul.	0.58
Total	99.96

Lake May, Depth = 90 cm

Species	Percentage of sample
Asterionella formosa Hass.	0.20
Aulacoseira alpegina (Gr) Kram.	0.20
Aulacoseira granulata (Ehr.) Sim.	79.45
Aulacoseira granulata v. angustissima	11.26
Aulacoseira italica (Ehr.) Sim.	0.40
Eunotia flexuosa v. eurycephala Gr.	0.99
Eunotia indica Gr.	0.20
Eunotia monodon v. constricta ClEul	0.20
Eunotia pectinalis (Mull?) Rab.	0.20
Eunotia pectinalis v. minor (Kutz)Rab	0.59
Eunotia sp	0.20
Frustulia rhomboides Ehr. DeT.	1.58
Pinnularia legumen (Ehr) Ehr.	1.19
Pinnularia viridis v. minor Cl.	0.20
Surirella robusta Ehr.	3.16
Total	100.02