Final Report on the Zooplankton Community Composition in Whitefish Lake

by

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Abstract

We conducted a survey of the zooplankton community of Whitefish Lake from April to October 2006 to estimate the community composition and abundance. Wisconsin style plankton nets of two sizes 200 um (net plankton) and 80 um (nanno-plankton) were towed in the northern and southern portions of the lake both vertically at the deepest location and horizontally to shore. This permitted us to accurately sample the entire water column (vertical tow) and the epilimnetic and littoral zones (horizontal tow) of the lake. Zooplankton population and community abundance was greater in the northern portion of the lake for all nanno- and net plankton collected. Samples from Whitefish Lake contained a total of three species of calanoid copepod (*Eurytemora affinis, Skistodiaptomus oregonensis, and Leptodiaptomus minutus), four* species of cyclopoid copepod (*Mesocyclops edax, Diacyclops thomasi, Acanthocyclops vernalis, and Tropocyclops prasinus*), ten cladocerans (*Bosmina longirostris*, *Daphnia galeata mendotae*, *Daphnia schodleri*, Chydoridae *sphaericus, Holopedium gibberum, Daphnia retrocurva, Diaphanosoma leuchtenbergianum, Leptodora kindti, Ceriodaphnia lacustris, and Daphnia longiremis*), and Chaoborus. Nanno-plankton samples identified five rotifers (*Alplanchna* sp., *Kellicottia bostoniensis*, *Polyarthra remata*, *Keratella* sp., and *Lecane* sp.), copepodites and many copepod nauplii. A comparison to a 1974 zooplankton community survey showed a loss of one species of cyclopoid copepod (*Orthocyclops modestus)* from 1974, but a gain of one species of calanoid copepod (*Eurytemora affinis*) in the 2006 survey. This study also showed a loss of one species of cladoceran (*Sida crystalline*) from 1974, but a gain of two species of cladoceran (*Daphnia schodleri* and *Leptodora kindti*) in 2006. Nanno-plankton were not surveyed in 1974 so a comparison could not be made. Overall, the abundance of zooplankton is within the range expected for an oligotrophic lake. The shift in zooplankton composition should be compared to fish diets, fish species introductions/losses, and changes in the productivity of the lake that may have occurred over the past 30 years to better understand factors that may be affecting the zooplankton community.

Introduction

Whitefish Lake in Douglas County, WI (T19N, R23E, Sections 33 and 34) is an oligotrophic lake currently being managed to preserve its unique water quality. Recent changes in the phosphorus concentration in the lake have led to a partnership between the Whitefish Lake Association, the United States Geological Survey (USGS) and the Wisconsin Department of Natural Resources (WDNR). There are several ongoing scientific studies of the lake focused on monitoring and preserving the exceptional water quality typically observed in the lake. The Whitefish Lake project was implemented to monitor any possible changes in the lake resulting from anticipated increases in development in the watershed. The objectives of the project include: 1. the development of a water budget for the lake, 2. to identify ground-water flow paths from recharge to discharge into the lake, 3. estimate a phosphorus loading associated with each inflow and outflow source, 4. evaluate present water quality relative to long-term trends estimated through the use of selected watershed models, 5. use of calibrated watershed models to predict the response of the lake to various management scenarios and 6. relate historical trends estimated from coring studies to historical precipitation records to assess the influence of non-anthropogenic variables on water quality. Each phase of the project has been initiated and the studies of the zooplankton communities have also been undertaken to establish baseline information and to make comparisons between the historical 1974 data collected by Torke and the 2006 data collected and presented here. The characteristics of lake food webs are known to influence water clarity, productivity and species composition and abundance (Carpenter and Kitchell 1993). Thus, it is important to monitor changes in the plankton community since zooplankton frequently represent the major diet item for larval fish and planktivorous adult fish. The objective of this project was to qualitatively and quantitatively monitor the zooplankton community and identify significant changes in species composition between 1974 and 2006. Shifts in the zooplankton composition and abundance can be indicators of changes in the food web and can be an important driver of water clarity in Whitefish Lake. The estimates of zooplankton abundance and composition may be used in future studies to assess the rate of plankton change brought about by shifts in the fish community and the importance of the zooplankton community in driving water clarity in Whitefish Lake.

Materials and Methods

The zooplankton community of Whitefish Lake, Douglas County, WI was sampled eight times in 2006 beginning April 27 (after ice-out, but before spring turnover), and then every other week on June 10 and 22, July 5 and 22, August 1 and 16, and October 17 (following fall turnover, but before early ice). All sampled were collected during daytime between 1000-1200 hours. Vertical plankton tows were collected in the deepest part of the northern and southern portion of Whitefish Lake to maximum depth. Horizontal plankton tows were also collected in the northern and southern portions of the lake with the tow beginning in the center of the lake and ending near shore. Thus, vertical tows sampled the entire water column, while horizontal tows sampled the epilimnetic water only. Horizontal tows were used to ensure collection of littoral and near-shore plankton that might otherwise be underrepresented in vertical open-water collections. Two Wisconsin-style plankton nets were used for each collection. An 80 um net was used to collect nanno-plankton, while a 200 um net was used to sample the net plankton. All plankton sampled were preserved in 5% buffered formalin-sucrose solution and identified to the lowest taxonomic unit possible using an Olympus Model SZX10 Zoom stereomicroscope with digital image capturing. A 1 mL subsample was taken from each sample, using a Hensen-Stempel pipette, and all zooplankton genera were enumerated and extrapolations were calculated to determine number of zooplankton per liter of lake water.

Results & Discussion

<u>Net Plankton Abundance & Composition</u>

Spring net plankton samples in the deep, northern portion of the lake (vertical tow) were dominated by two rotifers, *Asplanchna* sp. and *Kellicottia bostoniensis* and one cyclopoid copepod, *Mesocyclops edax* (Figure 2, Table 2). Early summer (June 10 & 22) net plankton samples were dominated by three cladocerans, *Daphnia schodleri, Holopedium gibberum and Daphnia galeata mendotae*. While mid to late summer samples contained higher abundances of a rotifer, *Polyarthra remata*, a calanoid copepod, *Eurytemora affinis* and copepod nauplii, and cladocerans, *Bosmina longirostris* and *Holopedium gibberum*. Fall samples were dominated by two cladocerans *Bosmina longirostris* and *Daphnia galeata mendotae*

Spring net plankton samples in the epilimnetic surface water of the northern portion of the lake (horizontal tow) were dominated by a rotifer, *Kellicottia bostoniensis* (Figure 4, Table 4). Early summer (June 22) net plankton samples were dominated by a calanoid copepod, *Eurytemora affinis*, while mid and late summer samples contained slightly higher abundances of *Holopedium gibberum*.

Spring net plankton samples in the deep, southern portion of the lake (vertical tow) had slightly higher abundances of a rotifer, *Asplanchna* sp. and cyclopoid copepodites (immature copepods; Figure 6, Table 6). Mid to late summer samples had slightly higher abundances of cladocerans, *Bosmina longirostris* and *Holopedium gibberum*. They also had slightly higher abundances of *Diaphanosoma leuchtenbergianum*. Fall samples were dominated by two cladocerans *Daphnia galeata mendotae* and *Bosmina longirostris*.

Spring net plankton samples in the epilimnetic surface water of the southern portion of the lake (horizontal tow) were dominated by two rotifers, *Asplanchna* sp. and *Kellicottia bostoniensis* and the cyclopoid copepod, *Mesocyclops edax* (Figure 8, Table 8). Early to late summer net plankton samples were dominated by cladocerans, *Bosmina longirostris, Holopedium gibberum and Diaphanosoma leuchtenbergianum*.

Nanno Plankton Abundance & Composition

Spring nanno-plankton samples in the deep, northern portion of the lake (vertical tow) were dominated by four rotifers, *Asplanchna* sp., *Kellicottia bostoniensis*, *Polyarthra remata*, and *Keratella* sp. and copepod nauplii (Figure 1, Table 1). Early to late summer nanno plankton samples had higher abundances of *Kellicottia bostoniensis,* copepod nauplii and *Holopedium gibberum*. Fall samples had slightly higher abundances of the cladoceran *Chydoridae sphaericus* and the cyclopoid copepod *Mesocyclops edax*.

Spring nanno-plankton samples in the epilimnetic surface water of the northern portion of the lake (horizontal tow) were dominated by two rotifers, *Asplanchna* sp. and *Polyarthra remata* and young cyclopoid copepods (copepodites; Figure 3, Table 3). Early to late summer nanno plankton samples contained higher abundances of a rotifer, *Keratella* sp., copepod nauplii, and young *Mesocyclops edax*.

Spring nanno-plankton samples in the deep, southern portion of the lake (vertical tow) were dominated by rotifers, *Asplanchna* sp., *Kellicottia bostoniensis*, and *Polyarthra remata* and copepod nauplii (Figure 5, Table 5). Early to late summer samples had higher abundances of copepod nauplii, the rotifer, *Keratella* sp, and the cladocerans, *Bosmina longirostris* and *Holopedium gibberum*. Fall samples had slightly higher abundances of *Mesocyclops edax*, *Bosmina longirostris*, and *Daphnia galeata mendotae.*

Spring nanno-plankton samples in the epilimnetic surface water of the southern portion of the lake (horizontal tow) has low abundances of all zooplankton with copepod nauplii showing slightly higher abundances in earl spring and the cyclopoid copepod, *Mesocyclops edax*, and the cladoceran, *Bosmina longirostris*, showing slightly higher abundances in late summer (Figure 7, Table 7).

<u>Comparison of Zooplankton Communities 1974 & 2006</u>

Zooplankton species and occurrence was evaluated in Whitefish Lake in 1974 by Torke (Table 9). With assistance from WI Department of Natural Resources staff, he sampled Whitefish Lake four times using a vertical tow with a ¼ meter, #20 mesh (80 *u*m) conical zooplankton net from a point of maximum water depth and preserved the samples in 5% formalin. Though not specifically identified, most likely all four samples were collected during daytime on the dates specified in Table 9. He identified two species of calanoid copepods, five species of cyclopoid copepods, nine species of cladocerans, and chaoborus. According to Torke's report (1974), he did not evaluate the nanno-plankton community and, therefore, there is no information available for small-sized zooplankton and rotifers.

The present survey (2006) found three species of calanoid copepod (*Eurytemora affinis, Skistodiaptomus oregonensis, and Leptodiaptomus minutus), four* species of cyclopoid copepod (*Mesocyclops edax, Diacyclops thomasi, Acanthocyclops vernalis, and Tropocyclops prasinus*), ten cladocerans (*Bosmina longirostris, Daphnia galeata mendotae, Daphnia schodleri, Chydoridae sphaericus, Holopedium gibberum, Daphnia retrocurva, Diaphanosoma leuchtenbergianum, Leptodora kindti, Ceriodaphnia lacustris, and Daphnia longiremis*), and Chaoborus. Also, since nanno-plankton were surveyed, we found five rotifers (*Alplanchna* sp., *Kellicottia bostoniensis*, *Polyarthra remata*, *Keratella* sp., and *Lecane* sp.), copepodites and many copepod nauplii.

This information suggests a loss of one species of cyclopoid copepod (*Orthocyclops modestus)* from 1974, but a gain of one species of calanoid copepod (*Eurytemora affinis*) in the 2006 survey, for a net change of zero copepod species. Torke (1974) collected *Orthocylops modestus* in only the August 12 sample, but did quantify it as "common" with a score of 3 on the abundance scale he used. In contrast, *Eurytemora affinis* was found in all samples from April to October and was collected in both the northern and southern portions of Whitefish Lake. But according to Torke's commonness scale it was "rare" to "uncommon" with scores between <1.0 to 15.85. This information also suggests the loss of one species of cladoceran (*Sida crystalline*) from the 1974 data, but a gain of two species of cladoceran (*Daphnia schodleri* and *Leptodora kindti*) in 2006. *Sida crystalline* was only collected on October 21, 1974 and was given an abundance score of 1 or "rare" by Torke. Whereas, *Daphnia schodleri* was collected on all dates except early spring (April 27) and was quantified as either "rare" or "uncommon", based on Torke's scale. *Leptodora kindti* was only collected on one date (June 22) and would be quantified as "rare" with an abundance score of 0.46 based on Torke's scale.

Some of the changes in biodiversity might be attributable to differences in sampling times since Torke (1974) sampled the zooplankton in January, May, August, and October and we sampled the zooplankton in April, June, July and August, and most of the species lost or gained would be classified as “rare” or “uncommon” based on Torke’s scale of occurrence. But it is doubtful that the recent occurrence of *Eurytemora affinis* and *Daphnia schodleri* could be best explained as missed during sampling in 1974. The abundance and frequency of occurrence of these two zooplanktors suggests that they colonized the lake over the past 30 years and have become well established. Shifts in fish community composition between 1974 and 2006 or changes in the trophic status of the lake might explain the loss of the cyclopoid copepod (*Orthocyclops modestus*) and cladoceran (*Sida crystalline*), but further sampling and analysis would be needed to confirm the loss of these species and the possible gain of *Leptodora kindti*. This assessment represents an initial step in identifying the present zooplankton community of Whitefish Lake and showed a moderate change in the zooplankton community over the past 30 years. Overall, the zooplankton community appears stable, but changes in the planktivorous fish populations may affect the food web and continued monitoring would provide a mechanism to monitor lake trophic dynamics and water clarity. Also, nighttime samples should be collected in future surveys to take into account the diel vertical migration patterns exhibited by some zooplankton that may under or overestimate members of the zooplankton community based on their daily behavior.

Footnote

In 2006, Dr. Thomas Hrabik, University of Minnesota-Duluth conducted an acoustic assessment of Whitefish Lake pelagic fish populations (http://www.uwsp.edu/cnr/landcenter/whitefish_lake/index.html) and observed the presence of two spiny water fleas (*Bythotrephes cederstroemi*) in the diets of the fish. Zooplankton samples did not detect the presence of this invasive species, but that may be a result of a small, yet present, population. Continued sampling of Whitefish Lake zooplankton should be performed and closely monitored for the presence and establishment of this exotic species since it has a rapid reproductive rate and can compete with native zooplankton and larval fish.

References

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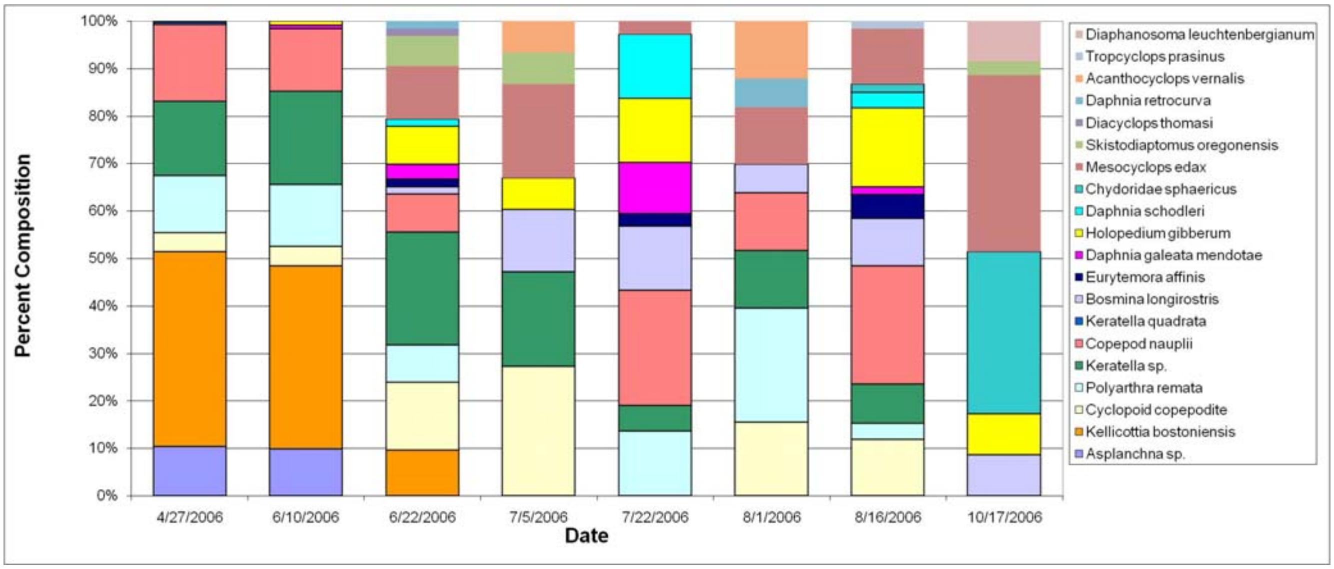


Figure 1. Nanno-plankton community composition from deep northern portion of Whitefish Lake.

Table 1. Nanno-plankton community abundance from deep northern portion of Whitefish Lake (values are number of nanno-plankton per liter of lake water).

	Date							
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16	October 17
Asplanchna sp.	123.81	8.84						
Kellicottia bostoniensis	489.34	34.64	3.05					
Cyclopoid copepodite	48.64	3.68						
Polyarthra remata	142.97	11.79	2.54		3.35	1.72	1.34	
Keratella sp.	187.19	17.69	7.61	2.01	1.34	0.86	3.35	
Copepod nauplii	193.08	11.79	2.54		6.03	0.86	10.05	
Keratella quadrata	5.90							
Bosmina longirostris	1.47		0.51	1.34	3.35	0.43	4.02	1.08
Eurytemora affinis	1.47		0.51		0.67		2.01	
Daphnia galeata mendotae		0.74	1.02		2.68		0.67	
Holopedium gibberum		0.74	2.54	0.67	3.35		6.70	1.08
Daphnia schodleri			0.51		3.35		1.34	
Chydoridae sphaericus							0.67	4.32
Mesocyclops edax			3.55	2.01	0.67	0.86	4.69	4.68
Skistodiaptomus oregonensis			2.03	0.67				0.36
Diacyclops thomasi			0.51					
Daphnia retrocurva			0.51			0.43		
Acanthocyclops vernalis				0.67		0.86		
Tropocyclops prasinus							0.67	
Diaphanosoma leuchtenbergianum								1.08

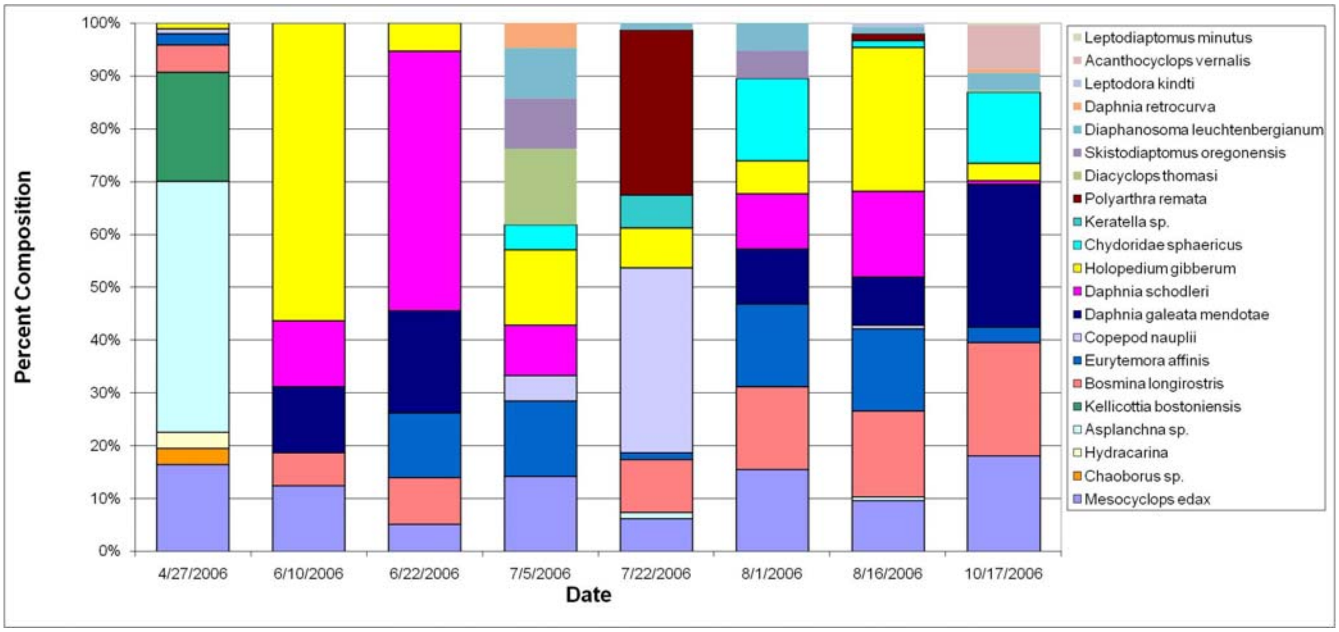


Figure 2. Net plankton community composition form deep northern portion of Whitefish Lake.

Table 2. Net-plankton community abundance from deep northern portion of Whitefish Lake (values are number of net plankton per liter of lake water).

	Date							
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16	October 17
Asplanchna sp.	36.83				0.36		0.36	
Kellicottia bostoniensis	16.01							
Mesocyclops edax	12.81	0.79	1.18	1.08	1.80	0.91	5.40	18.01
Polyarthra remata					9.01		0.72	
Keratella sp.					1.80			
Copepod nauplii	0.80			0.36	10.09		0.36	
Bosmina longirostris	4.00	0.40	1.97		2.88	0.91	9.01	21.26
Eurytemora affinis	1.60		2.76	1.08	0.36	0.91	8.65	2.88
Chaoborus sp.	2.40							
Hydracarina	2.40							
Daphnia galeata mendotae		0.79	4.33			0.60	5.04	26.66
Holopedium gibberum	0.80	3.57	1.18	1.08	2.16		15.13	3.24
Daphnia schodleri		0.79	11.03	0.72		0.60	9.01	0.72
Chydoridae sphaericus				0.36		0.91	0.72	13.33
Diacyclops thomasi				1.08				0.36
Skistodiaptomus oregonensis				0.72		0.30		
Diaphanosoma leuchtenbergianum				0.36	0.36	0.30	0.72	3.24
Daphnia retrocurva				0.36				0.72
Leptodora kindti							0.36	
Acanthocyclops vernalis								8.29
Leptodiaptomus minutus								0.36

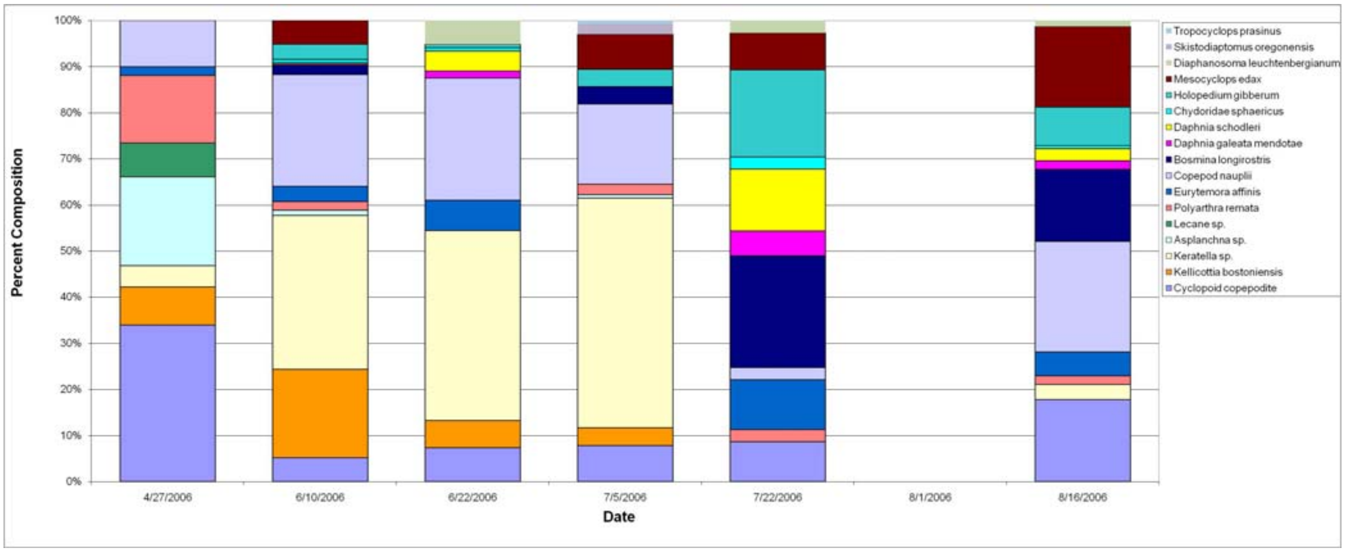


Figure 3. Nanno-plankton community composition from shallow, epilimnetic, northern portion of Whitefish Lake.

Table 3. Nanno-plankton community abundance from shallow, epilimnetic, northern portion of Whitefish Lake (values are number of nanno-plankton per liter of lake water).

	Date						
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16
Asplanchna sp.	30.95	0.18		1.47			
Kellicottia bostoniensis	13.27	3.12	5.98	7.37			
Cyclopoid copepodite	54.53	0.84	7.47				
Polyarthra remata	23.58	0.31		4.42	0.10		0.44
Keratella sp.	7.37	5.45	41.86	97.28			0.74
Copepod nauplii	16.21	3.96	26.91	33.90	0.10		5.45
Bosmina longirostris		0.32		7.37	0.88		3.54
Eurytemora affinis	2.95	0.53	6.73		0.39		1.18
Lecane sp.	11.79						
Holopedium gibberum		0.55	0.75	7.37	0.69		1.92
Daphnia galeata mendotae		0.04	1.49		0.20		0.44
Daphnia schodleri		0.04	4.48		0.49		0.59
Chydoridae sphaericus		0.12	0.75		0.10		0.15
Mesocyclops edax		0.84		14.74	0.29		3.98
Diaphanosoma leuchtenbergianum			5.23		0.10		0.29
Skistodiaptomus oregonensis				4.42			
Tropocyclops prasinus				1.47			

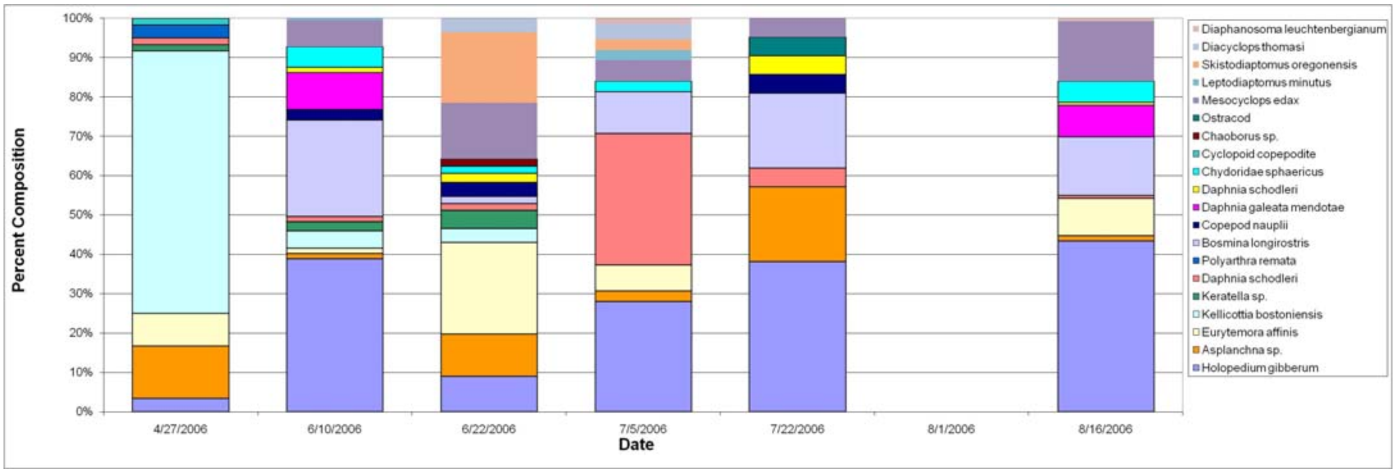


Figure 4. Net plankton community composition from shallow, epilimnetic, northern portion of Whitefish Lake.

Table 4. Net plankton community abundance from shallow, epilimnetic, northern portion of Whitefish Lake (values are number of net plankton per liter of lake water).

	Date						
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16
Asplanchna sp.	2.06	0.02	4.80	1.60	0.21		0.32
Kellicottia bostoniensis	10.29	0.08	1.60				
Cyclopoid copepodite	0.26						
Polyarthra remata	0.51						
Keratella sp.	0.26	0.04	1.60				
Copepod nauplii		0.05	1.60		0.05		
Bosmina longirostris		0.44	0.80	6.41	0.21		3.49
Eurytemora affinis	1.29	0.02	10.41	4.00			2.22
Holopedium gibberum	0.51	0.69	4.00	16.81	0.42		10.15
Daphnia galeata mendotae		0.17					1.90
Daphnia schodleri		0.02	0.80		0.05		0.16
Chydoridae sphaericus		0.10	0.80	1.60			1.27
Chaoborus sp.			0.80				
Ostracod					0.05		
Mesocyclops edax		0.12	6.41	3.20	0.05		3.57
Leptodiaptomus minutus		0.01		1.60			
Skistodiaptomus oregonensis			8.01	1.60			
Diacyclops thomasi			1.60	2.40			
Diaphanosoma leuchtenbergianum				0.80			0.16

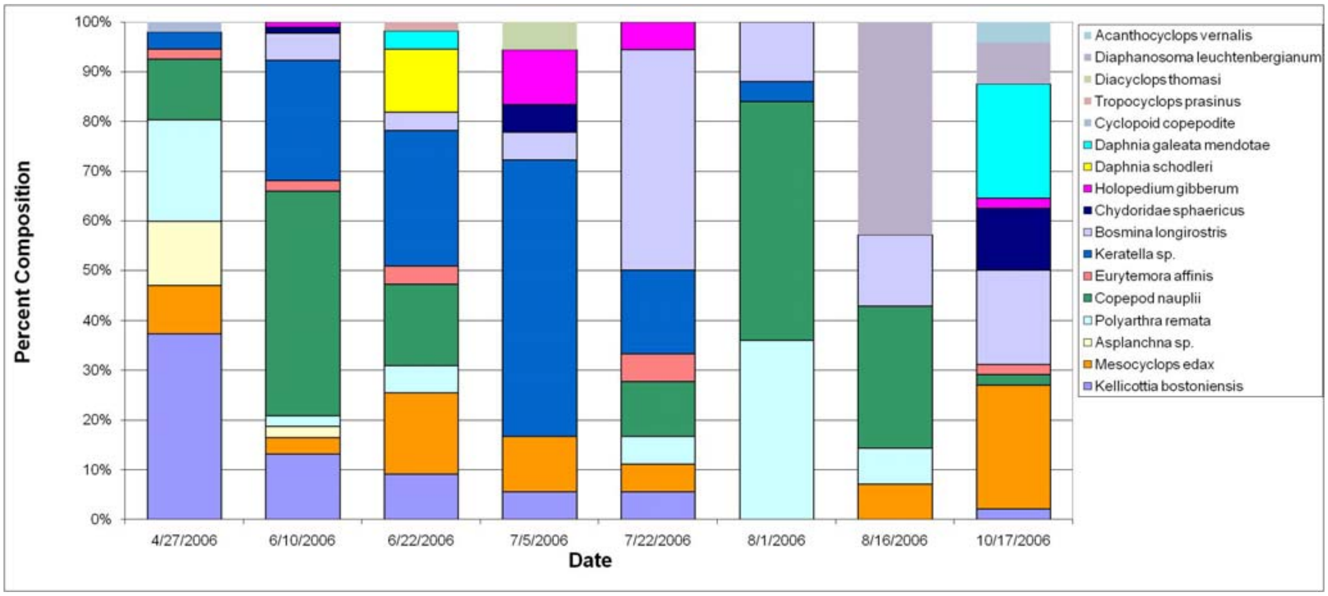


Figure 5. Nanno-plankton community composition from deep southern portion of Whitefish Lake.

Table 5. Nanno-plankton community abundance from deep southern portion of Whitefish Lake (values are number of nanno-plankton per liter of lake water).

	Date							
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16	October 17
Asplanchna sp.	28.00	0.67						
Kellicottia bostoniensis	81.07	4.02	4.32	0.67	0.67			0.36
Mesocyclops edax	20.63	1.00	7.77	0.67	0.67		5.36	4.32
Polyarthra remata	44.22	0.67	2.59		0.67	3.34	3.35	
Keratella sp.	7.37	7.37	12.95	6.70	2.01	0.74		
Copepod nauplii	26.53	13.73	7.77		1.34	4.45	8.71	0.36
Bosmina longirostris		1.67	1.73	0.67	5.36	1.11	16.08	3.24
Eurytemora affinis	4.42	0.67	1.73		0.67			0.36
Holopedium gibberum		0.33		0.67	0.67		18.09	0.36
Chydoridae sphaericus		0.33		0.67				2.16
Daphnia schodleri			6.04			0.37		
Daphnia galeata mendotae			1.73					3.96
Cyclopoid copepodite	4.42							
Tropocyclops prasinus			0.86					
Diacyclops thomasi				0.67				
Diaphanosoma leuchtenbergianum							18.09	1.44
Ceriodaphnia lacustris							2.68	
Acanthocyclops vernalis								0.72

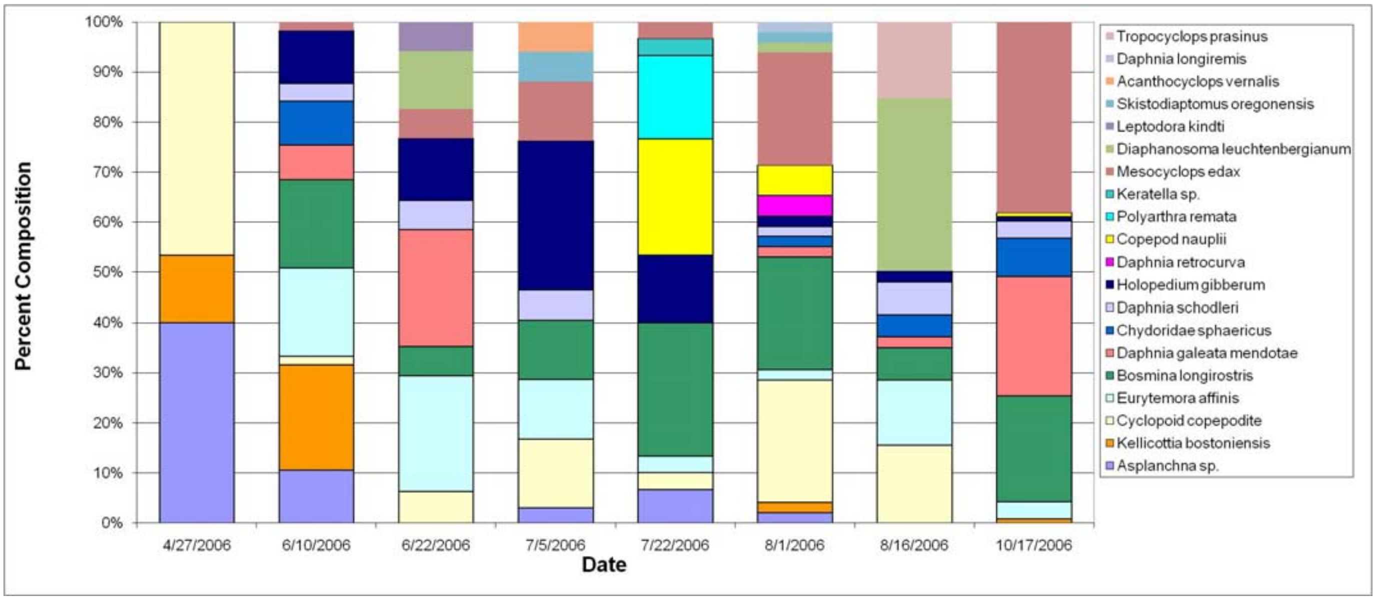


Figure 6. Net plankton community composition form deep southern portion of Whitefish Lake.

Table 6. Net-plankton community abundance from deep southern portion of Whitefish Lake (values are number of net plankton per liter of lake water).

	Date							
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16	October 17
Asplanchna sp.	4.00	0.99		0.36	0.72	0.20		
Kellicottia bostoniensis	1.33	1.98				0.20		0.36
Cyclopoid copepodite	4.67							
Polyarthra remata					1.80			
Keratella sp.					0.36			
Copepod nauplii					2.52	0.60		0.36
Bosmina longirostris		1.65	0.46	1.44	2.88	2.19	1.08	9.01
Eurytemora affinis		1.65	1.86	0.72	0.36	0.20	2.16	1.44
Holopedium gibberum		0.99	0.93	3.60	1.44	0.20	0.36	0.36
Daphnia schodleri		0.33	0.46	0.72		0.20	1.08	1.44
Daphnia galeata mendotae		0.66	1.86			0.20	0.36	10.09
Chydoridae sphaericus		0.83				0.20	0.72	3.24
Mesocyclops edax		0.17	0.46	1.44	0.36	2.19		16.21
Diaphanosoma leuchtenbergianum			0.93			0.20	5.76	
Leptodora kindti			0.46					
Skistodiaptomus oregonensis				0.72		0.20		
Acanthocyclops vernalis				0.72				
Daphnia retocurva						0.40		
Daphnia longiremis						0.20		
Tropocyclops prasinus							2.52	

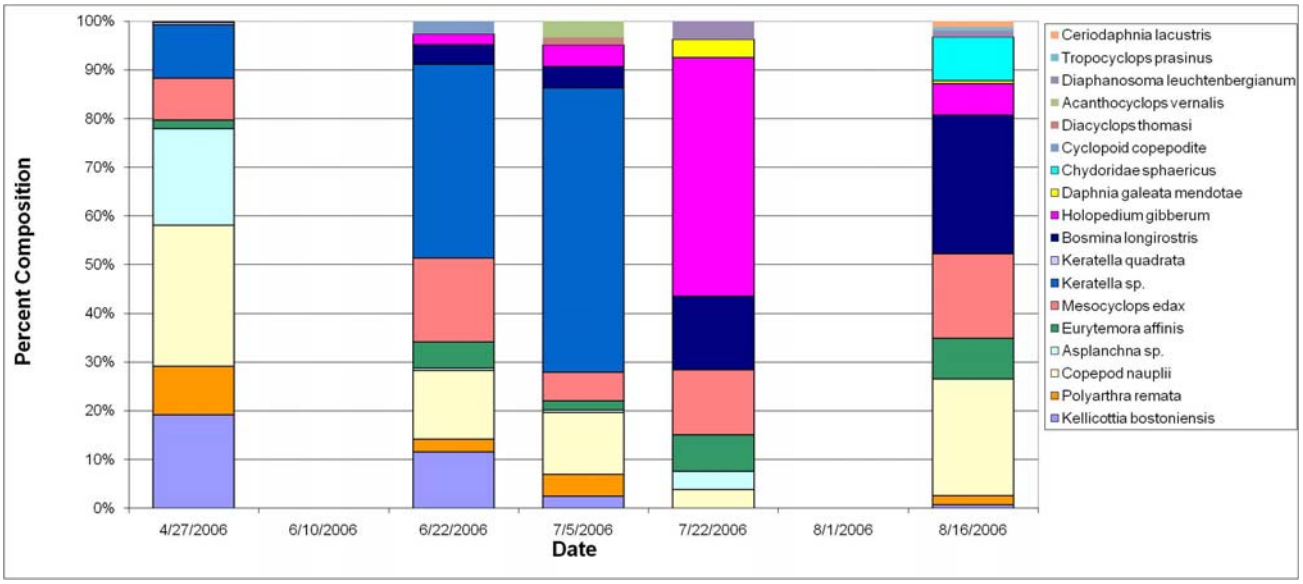


Figure 7. Nanno-plankton community composition from shallow, epilimnetic, southern portion of Whitefish Lake.

Table 7. Nanno-plankton community abundance from shallow, epilimnetic, southern portion of Whitefish Lake (values are number of nanno-plankton per liter of lake water).

	Date						
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16
Asplanchna sp.	2.74		0.01	0.01	0.07		
Kellicottia bostoniensis	2.64		0.38	0.07			0.15
Mesocyclops edax	1.18		0.57	0.18			3.98
Polyarthra remata	1.39		0.09	0.13			0.44
Keratella sp.	1.52		1.33	1.75			
Copepod nauplii	3.99		0.47	0.38	0.07		5.45
Keratella quadrata	0.07						
Bosmina longirostris	0.03		0.13	0.13	0.29		6.49
Eurytemora affinis	0.25		0.18	0.06	0.15		1.92
Holopedium gibberum			0.07	0.13	0.96		1.47
Daphnia galeata mendotae					0.07		0.15
Chydoridae sphaericus							2.06
Cyclopoid copepodite			0.09				
Diacyclops thomasi				0.04			
Acanthocyclops vernalis				0.10			
Diaphanosoma leuchtenbergianum					0.07		0.29
Tropocyclops prasinus							0.15
Ceriodaphnia lecustris							0.29

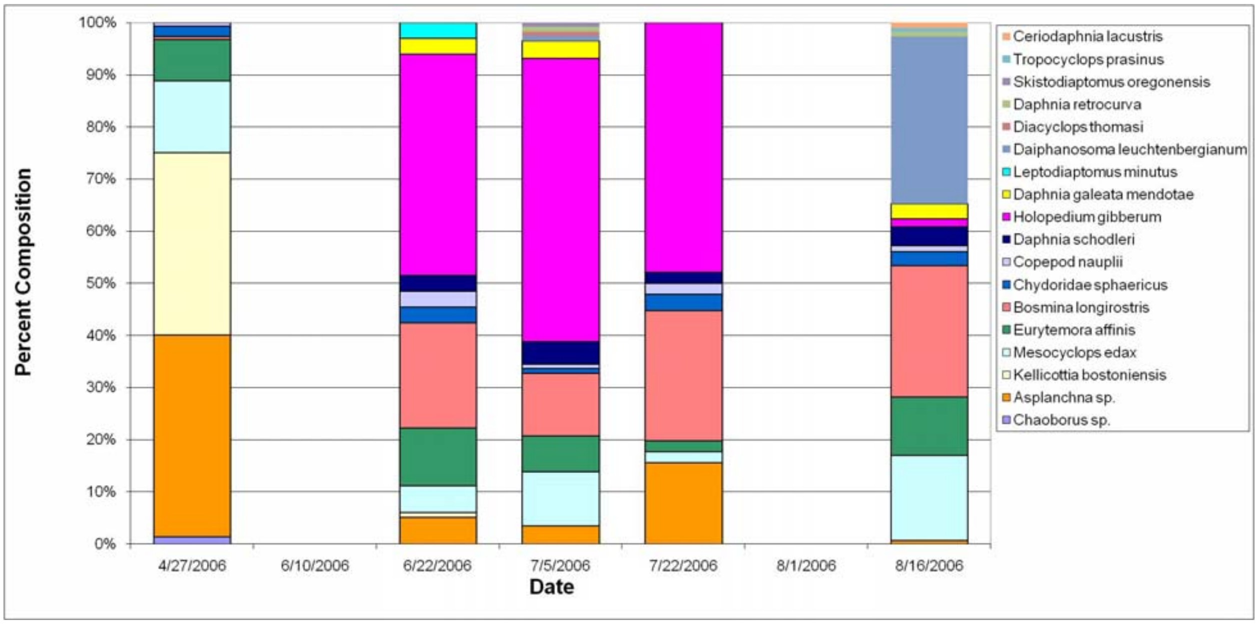


Figure 8. Net plankton community composition from shallow, epilimnetic, southern portion of Whitefish Lake.

Table 8. Net plankton community abundance from shallow, epilimnetic, southern portion of Whitefish Lake (values are number of net plankton per liter of lake water).

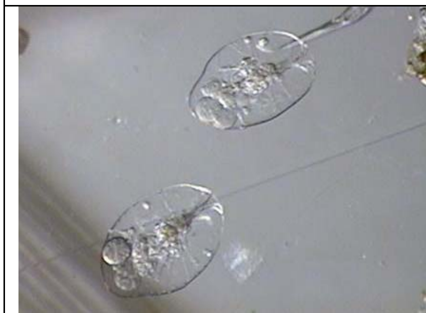
	Date						
Zooplankton	April 27	June 10	June 22	July 5	July 22	August 1	August 16
Asplanchna sp.	77.95		6.61	5.28	0.59		0.32
Kellicottia bostoniensis	70.02		1.32				
Mesocyclops edax	27.75		6.61	15.85	0.08		8.32
Copepod nauplii	1.32		3.96	1.32	0.08		0.63
Bosmina longirostris	1.32		26.42	18.50	0.95		12.76
Eurytemora affinis	15.85		14.53	10.57	0.08		5.71
Chaoborus sp.	2.64						
Chydoridae sphaericus	3.96		3.96	1.32	0.12		1.35
Daphnia schodleri			3.96	6.61	0.08		1.82
Holopedium gibberum			55.49	83.24	1.82		0.79
Daphnia galeata mendotae			3.96	5.28			1.43
Leptodiaptomus minutus			3.96				
Diaphanosoma leuchtenbergianum				1.32			16.33
Diacyclops thomasi				1.32			
Daphnia retrocurva				1.32			0.48
Skistodiaptomus oregonensis				1.32			
Tropocyclops prasinus							0.32
Ceriodaphnia lacustris							0.55

Table 9. Zooplankton species and occurrence, Whitefish Lake, 1974 (- = Not present, 1 = Rare (1-3), 2 = Uncommon (4-50), 3 = Common (51-1000), 4 = Abundant (> 1000)). Reprinted from: Torke, Byron G. Crustacean zooplankton data for 190 selected Wisconsin inland lakes (1979). Second table represents zooplankton species and occurrence in 2006 with similar sampling dates shown for comparison using the occurrence scale of Torke 1979.

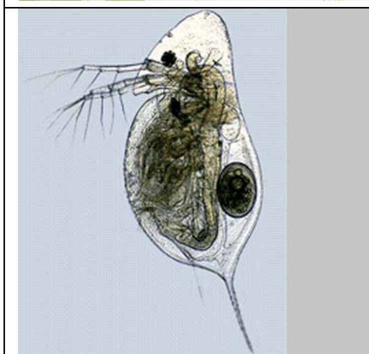
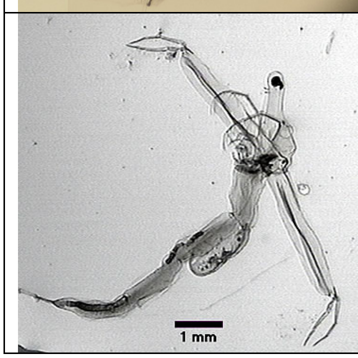
	Date 1974			
Zooplankton	January 28	May 13	August 12	October 21
Leptodiaptomus minutus	3	3	3	3
Skistodiaptomus oregonensis	3	3	3	3
Tropocyclops prasinus	3	3	3	-
Acanthocyclops vernalis	-	-	1	2
Diacyclops thomasi	3	3	3	3
Orthocyclops modestus	-	-	3	-
Mesocyclops edax	-	-	3	1
Holopedium gibberum	-	2	-	2
Sida crystalline	-	-	-	1
Diaphanosoma leuchtenbergianum	-	-	3	2
Daphnia retrocurva	-	2	2	3
Daphnia longiremis	2	2	3	2
Daphnia galeata mendotae	-	-	2	3
Ceriodaphnia lacustris	-	-	2	3
Bosmina longirostris	3	1	3	4
Chydorus sphaericus	2	2	3	4
Chaoborus sp.	-	-	2	-

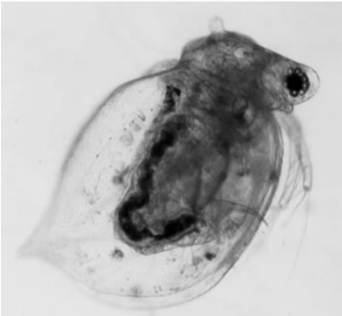
	Date 2006		
Zooplankton	April 27	August 16	October 17
Leptodiaptomus minutus	-	-	1
Skistodiaptomus oregonensis	-	-	1
Tropocyclops prasinus	-	1	-
Acanthocyclops vernalis	-	-	1
Diacyclops thomasi	-	-	1
Orthocyclops modestus	-	-	-
Mesocyclops edax	2	2	2
Holopedium gibberum	1	2	1
Sida crystalline	-	-	-
Diaphanosoma leuchtenbergianum	-	1	1
Daphnia retrocurva	-	1	1
Daphnia longiremis	-	-	-
Daphnia galeata mendotae	-	2	2
Ceriodaphnia lacustris	-	1	-
Bosmina longirostris	2	2	2
Chydorus sphaericus	2	1	2
Chaoborus sp.	1	-	-

Photographic Guide to the Plankton of Whitefish Lake

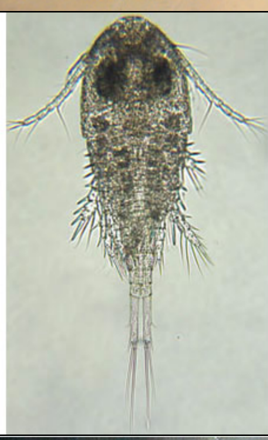
Rotifers	
Photo	Scientific name (Genus species)
	*Asplanchna* sp.
	*Kellicottia bostoniensis*
	*Polyarthra remata*
	*Keratella quadrata*
	*Lecane* sp.

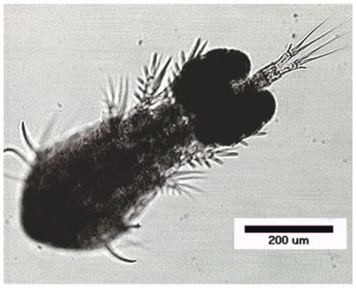
Cladocerans	
Photo	Scientific name (Genus species)
	*Bosmina longirostris* (Prefers cool, well-oxygenated waters; more common in eutrophic lakes), (0.4-0.6 mm)
	Chydoridae sphaericus (Near-shore species, commonly found clinging to filamentous algae), (0.3-0.5 mm)
	*Daphnia schodleri* *(1.5-2.0 mm)*
	*Daphnia galeata mendotae* (Most common in large, deep transparent water; resides in upper water column), (1.0-1.5 mm)

	*Holopedium gibberum (found in both littoral and pelagic zones of lakes; is a cold water stenotherm), (0.8-1.5 mm))*
	*Daphnia retrocurva (found nearshore and in patchy swarms), (1.0-1.5 mm)*
	*Diaphanosoma leuchtenbergianum (Limnetic species that occupies deep water), (0.5-0.9 mm)*
	*Leptodora kindti (Both a littoral and limnetic species that prefers warmer summer water), (5.0-6.0 mm)*

	*Ceriodaphnia lacustris (prefers nearshore and warmer water), (0.8-0.9 mm)*
	*Daphnia longiremis (prefers cool oxygenated waters of the hypolimnion), (0.6-1.0 mm)*

Copepods	
Photo	Scientific name (Genus species)
	*Mesocyclops edax* (Cyclopoid copepod; prefers warm epilimnetic water; predaceous on other zooplankton)
	Copepod nauplii (Young copepod)
	*Eurytemora affinis* (Calanoid copepod; prefers warm epilimnetic water and is euryhaline)

	Copepodite (juvenile copepod)
	*Skistodiaptomus oregonensis (stays offshore and above the metalimnion), (1.2-1.4 mm)*
	*Diacyclops thomasi (cool-water species with adults found offshore and young found nearshore), (0.9-1.2 mm)*
	*Acanthocyclops vernalis (abundant in warm nearshore areas), (0.8-1.2 mm)*

	*Tropocyclops prasinus (prefers warm water and concentrates near the surface), (0.5-0.9 mm)*
	*Leptodiaptomus minutes (cool-water species restricted to deep lakes), (0.9-1.1 mm)*

Other Zooplankton	
Photo	Scientific name (Genus species)
	Chaoborus sp. (Midge larvae; predaceous on zooplankton)
	Hydracarina (Water mite)
	Ostracod (Seed shrimp)