Three Lakes Zooplankton
2022 Report

Lake Rippowam, Lake Oscaleta, & Lake Waccabuc

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Three Lakes Zooplankton Report

Lake Rippowam, Lake Oscaleta, & Lake Waccabuc

Introduction

The Three Lakes Council maintains an outstanding water quality monitoring program to properly manage its three lakes: Lake Waccabuc, Lake Oscaleta and Lake Rippowam. This includes conducting the CSLAP Water Quality Monitoring Program with assistance from the New York State Department of Environmental Conservation (NYSDEC) and the New York State Federation of Lake Associations (NYSFOLA), as well as further water quality testing beyond these programs. This data is reviewed and used to maintain the lakes as a natural resource for the community for recreation and aesthetic value. SŌLitude Lake Management was pleased to provide services to the Three Lakes Council again in 2022. Zooplankton samples for each of the three lakes were collected by the client on July 21st, 2022.

Zooplankton Monitoring

Methodology

Zooplankton samples were collected, by the client, with an 80 µm Nitex plankton net. At Lake Waccabuc and Lake Oscaleta, a single vertical tow was performed to a depth of 18 feet. At Lake Rippowam, two 9-foot vertical tows were composited into a single sample due to the water depth at the sampling station. Using as little site water as possible, the sides of the net were rinsed of any trapped zooplankton, concentrating the organisms into the net bottom. This concentrate was then emptied into a clean 1,000 mL HDPE sample bottle. Immediately after collection, the sample was preserved with an equal amount of 10% sucrose formalin, to achieve a 5% solution. Sucrose was added to the preservative to help maintain carapace integrity. The samples were then placed in a cooler stocked with blue icepacks. On arrival at SŌLitude Lake Management's laboratory, the samples were stored in a dark refrigerator until being identified and enumerated.

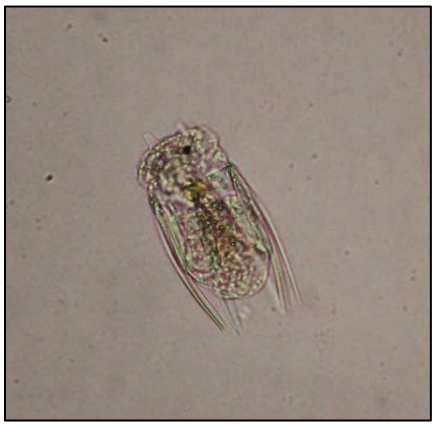
In the laboratory, each sample was manually mixed for about one minute, before a one mL subsample was removed using a calibrated syringe. The subsample was placed on a Sedgewick-Rafter counting cell and examined under a compound microscope at 100X magnification. By using

calibrated guides on the microscope stage, the entire one mL sample was examined, and any zooplankton were identified and enumerated to the lowest practical taxa using regionally appropriate taxonomic keys. This procedure was repeated two more times to generate a total of three replicate counts. The counts were then averaged, and back calculated to achieve an organism per liter density. The zooplankton examination data sheets are included in the appendix of this report. Also included in the appendix are descriptions of the zooplankton groups and individual lake distribution pie charts.

2022 Zooplankton Results

Table 1: 2022 Zooplankton Distribution						
Zooplankton Group	**Lake Rippowam**		**Lake Oscaleta**		**Lake Waccabuc**	
	Org./L	%	Org./L	%	Org./L	%
Rotifera	732	43.6%	910	30.2%	1,003	57.0%
Cladocera	577	34.4%	1,132	37.5%	257	14.6%
Copepoda	368	22.0%	974	32.3%	499	28.4%
Total Organisms	**1,676**	**100%**	**3,016**	**100%**	**1,759**	**100%**

Lake Rippowam



At Lake Rippowam in 2022, zooplankton abundance was considered high at 1,676 organisms/L (Table 1). A total of 15 different species of zooplankton were observed in the sample. Zooplankton diversity would be considered high for this basin. Rotifera dominated the assemblage, accounting for 43.6% of the sample at 732 organisms/L. The most abundant species within the rotifera group was *Ascplanchna priodonta* with 596 organisms/L. Eight other rotifera species were present including *Conochilus unicornis, Keratella crassa, Kellicottia longispina, Trichocerca cylindrica, Polyarthra vulgaris* (pictured left)*, Synchaeta oblonga, Gastropus hyptopus,* and *Ascomorpha saltans*.

Cladocera was the next most abundant group at Lake Rippowam with 577 organisms/L (or 34.4%) observed. This group had low diversity as only two species were recorded: *Daphnia magna* and *Bosmina longirostris.* The most abundant species of Cladocera was *Daphnia magna* at 480 organisms/L. Cladocera are a desirable group to have as their primary source of nutrients is algae.

The least common zooplankton group observed was Copepoda at 368 organisms/L, or 22.0%. Three different species of copepods were observed: *Microcyclops rubellus, Microcyclops varicans* and *Calanoid nauplius*. Of the three observed species, *Calanoid nauplius* was the most abundant at 315 organisms/L.

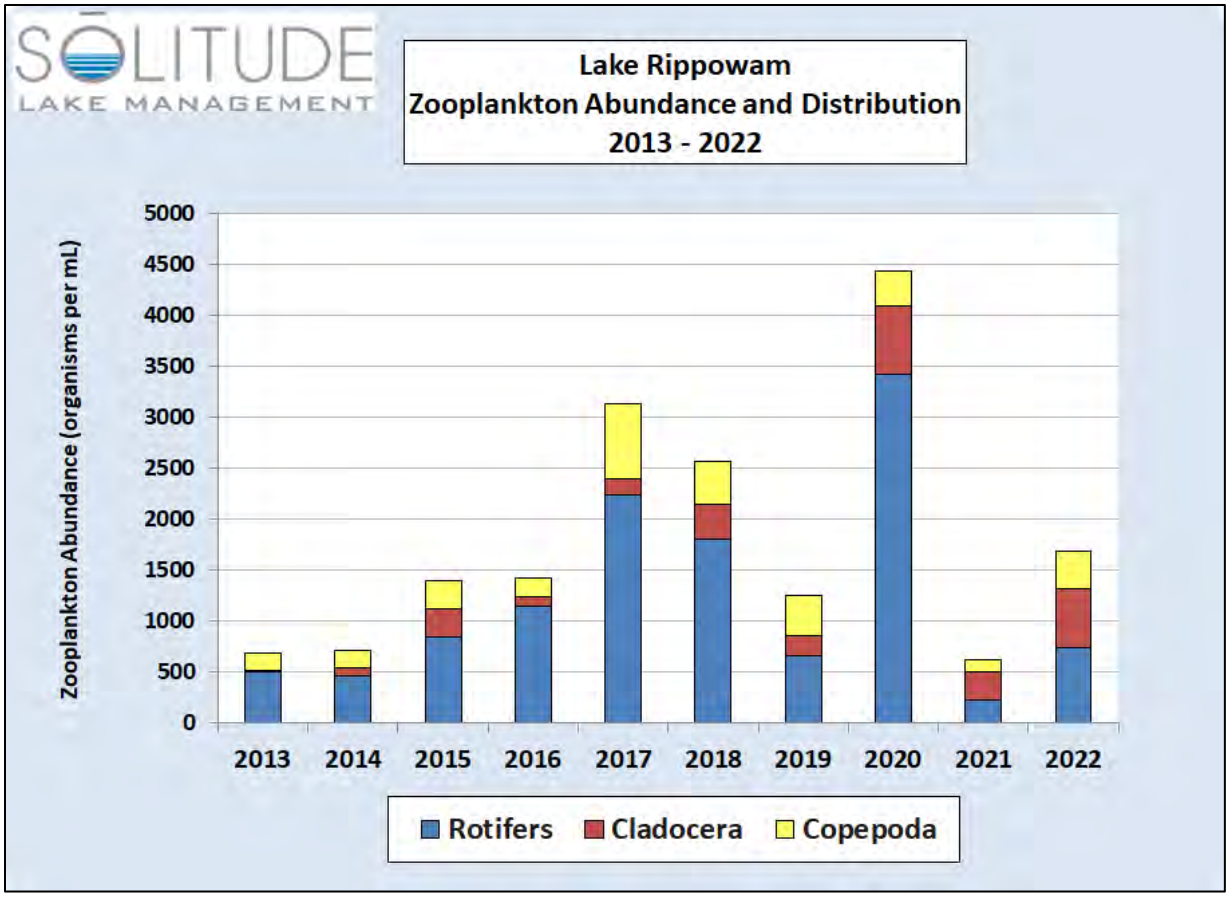


Figure 1. Lake Rippowam Zooplankton 2013-2022

The zooplankton abundance at Lake Rippowam had been consistently increasing since 2013 until 2018 (Figure 1). Zooplankton density was considered moderate in 2013, 2014 and 2021. From 2015 to 2019, zooplankton abundance was considered high despite the significant decrease in 2019. In 2020, levels increased significantly to the highest seen at Lake Rippowam. These levels decreased dramatically in 2021 as the lake experienced the lowest density of zooplankton since sampling began. The sample from 2022 reported another increase in zooplankton abundance and was considered high once again.

Rotifers have been the dominant zooplankton group every year up until 2021 (cladocera dominated). Copepods have continuously been the second most abundant group with the exceptions of 2015, 2021, and 2022. The sudden population increase and then subsequent die off might have changed the order of dominance within Lake Rippowam. However, future samples will be able to better confirm this. Total zooplankton abundance reached a high of 4,428 organisms/L in 2020 before greatly decreasing to 620 organisms/L in 2021. Copepods and rotifers experienced this decrease significantly more than cladocera. It is likely that the low development of submersed aquatic vegetation (SAV) could explain the rotifer dominance in the data set. SAV beds act as refuge for zooplankton, helping evade predaceous fish (such as alewives).

Lake Oscaleta

For Lake Oscaleta, the total zooplankton abundance was considered high at 3,016 organisms/L. Zooplankton diversity was the highest out of all Three Lakes with 18 different species recorded. Lake Oscaleta also had the highest total zooplankton abundance out of the Three Lakes in 2022. Cladocera dominated the sample with a density of 1,132 organisms/L, or 37.5% of the assemblage. Three different species of cladocera were observed including *Bosmina longirostris* (pictured right), *Ceriodaphnia dubia,* and *Daphnia magna*.

The second most abundant zooplankton group at Lake Oscaleta was copepods. This group accounted for 974 organisms/L, or 32.3%, of the sample. The three species observed include *Microcyclops rubellus, Microcyclops varicans,* and *Calanoid nauplius*. The least abundant group of zooplankton, rotifera, was only a few organisms away from being the second most abundant group. Rotifers accounted for 910 organisms/L, or 30.2%, of the sample. As the most diverse group, a total of 12 different species of rotifers were observed at Lake Oscaleta in 2022.

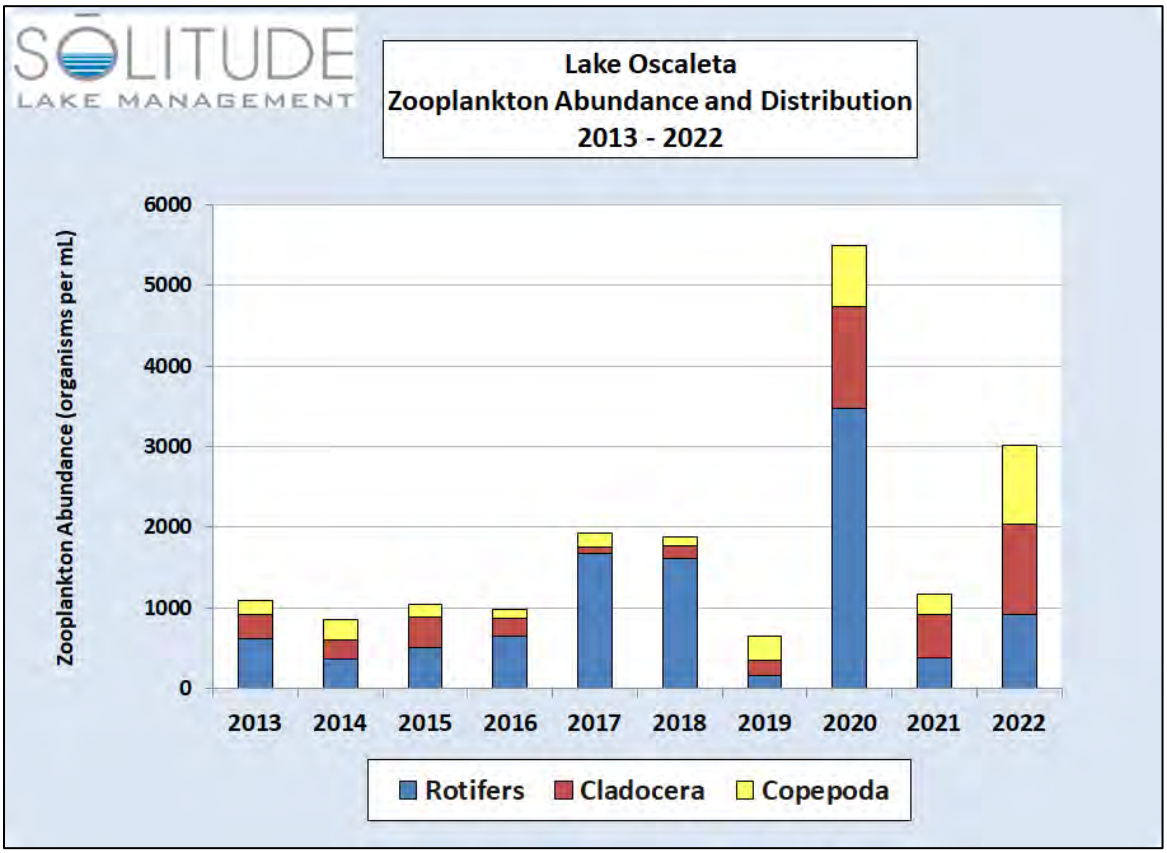


Figure 2. Lake Oscaleta Zooplankton 2013-2022

At Lake Oscaleta, high overall zooplankton has been observed more consistently starting in 2017

with a total of 1,923 organisms/L and 1,880 organisms/L in 2018. In 2019, we saw the lowest zooplankton abundance at Lake Oscaleta since the start of the monitoring project. This was then followed by a dramatic increase in zooplankton populations in 2020. The overall abundance in 2020 was considered very high as levels increased to 5,489 organisms/L. In 2021, levels dropped greatly and were more consistent with the historical data. It is interesting to note that cladocera dominated in 2021 and continues to dominate in 2022. Before 2019, rotifers had dominated every zooplankton sample at Lake Oscaleta, including 2020. Greater distribution between the three zooplankton groups is displayed from 2019 to 2022, compared to 2016 to 2018. Cladocera and copepod densities were very low in 2017 and 2018 while rotifer abundances were high. Dominance has shifted as cladocera and copepods increased in the past four years. This trend is very similar to that of Lake Rippowam, where total zooplankton decreased in 2019, increased significantly in 2020, and decreased again in 2021.

Lake Waccabuc

At Lake Waccabuc, total zooplankton abundance was considered high with 1,759 organisms/L. A total of 13 different species were observed in the 2022 sample. Rotifers were the dominant zooplankton group this year at 1,003 organisms/L, or 57.0% of the sample. The most common species of rotifer was *Asplancha priodonta*, accounting for 567 organisms/L.

Copepoda was the second most abundant group at 499 organisms/L, or 28.4% of the zooplankton sample. Three different species were observed including *Microcyclops rubellus, Microcyclops varicans,* and *Calanoid nauplius*. The most common species being *Calanoid nauplius* at 344 organisms/L.

The zooplankton group cladocera was present at 257 organisms/L, or 14.6% of the sample. This group reported low diversity with only two species observed: *Bosmina longirostris* and *Daphnia magna.* The most dominant cladocera species was *Daphnia magna* at 141 organisms/L.

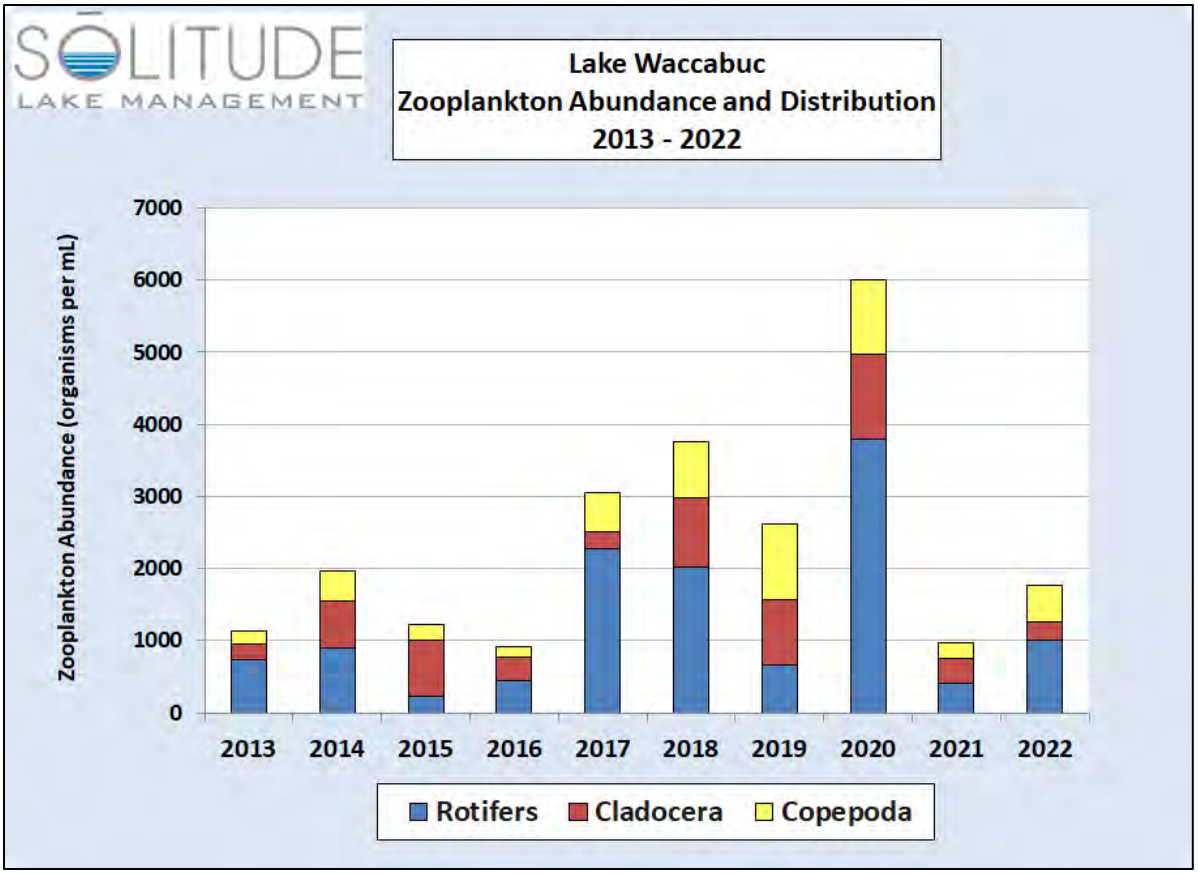


Figure 3. Lake Waccabuc Zooplankton 2013-2022

At Lake Waccabuc, zooplankton distribution has been the most diverse over the years compared to the other two lakes. Cladocera and copepod abundance has fluctuated the most at Lake Waccabuc. These two groups outnumbered rotifers over multiple years including 2014, 2015, 2016, 2019 and 2021. One year to note is 2015 when cladocera dominated the assemblage. Another year to note is 2019 where copepods were the dominate zooplankton group. However, rotifers have been the dominant group for five out of the ten years of the monitoring project (2013, 2017, 2018, 2020, and 2022). Although rotifers were the least common group in 2019, the rotifer community has developed the most out of the three groups since 2017.

Overall zooplankton abundance has been considered high for most of the monitoring project, with the exception of 2016 and 2021. In 2021, zooplankton density decreased significantly and was considered moderate in abundance, which is similar to the 2016 sample. All three lakes experienced a similar trend with levels spiking in 2020 and decreasing significantly in 2021. The most abundant year for zooplankton was in 2020 with 6,003 organisms/L reported at this lake. Lake Waccabuc typically contains the highest zooplankton abundance out of the three lakes but is second to Lake Oscaleta this year.

Conclusion

Summary

Zooplankton abundance increased at all three lakes in 2022 as compared to 2021. At Lake Waccabuc, we observed high zooplankton abundance, dominated by rotifers. At Lake Oscaleta, we observed high zooplankton abundance, with cladocera dominating the community. At Lake Rippowam, we observed high zooplankton abundance, dominated by rotifers. All three lakes saw an increase in rotifer abundance from 2021.

Recommendations

It is recommended that the Three Lakes Council continues at least their historical monitoring program. It is strongly recommended that stakeholders invest in a robust monitoring program including increased sampling frequency and water quality parameters, to better inform the conditions of the lakes. Zooplankton and algae are incredibly variable and can shift populations within a day, so single sampling events only inform what was happening at the exact time the sample was obtained. With increased sampling frequency, biologists will be able to analyze seasonal changes and offer more insight into system dynamics. Oftentimes, problems with zooplankton and algae are attributed to nutrients, so obtaining nutrient data would address root causes of the issue.

The Three Lakes Council has now compiled ten years of zooplankton data for Lake Rippowam, Lake Oscaleta, and Lake Waccabuc. Monitoring the health of a lake ecosystem requires sampling a diverse array of biological communities such as fish, aquatic plants, algae, and zooplankton. This is essential to providing stewardship to a delicate ecosystem. The comprehensive water quality data collected via the CSLAP program is suitable to be combined with available biological data, to assist with completing the picture of the overall ecological status of the three basins.

SŌLitude Lake Management recommends the 3LC to continue monitoring zooplankton and algae in the 2023 season. Although sampling throughout the growing season (May through September) would be more suitable to observe seasonal variation continuing the same sampling format and techniques applied in 2013 through 2022, does provide value. Therefore, at least a single sample event should be collected in mid-July of 2023, to coincide with the SAV surveys and historical data. SŌLitude Lake Management will be updating their algal sampling analyses for 2023 to cells/mL as it is more in line with EPA standards of reporting.

SŌLitude Lake Management would like to take this opportunity to thank the Three Lakes Council for allowing us to provide lake management consulting services. We look forward to working with you again throughout the 2023 lake management season.

Appendix

Zooplankton Primer

2022 Zooplankton Examination Data and Pie Charts

2013-2022 Zooplankton Abundance and Distribution Graphs

A Zooplankton Primer

Zooplankton provides an important link in a typical lake's food web between algae and fish, especially developing and juvenile stages. In general, zooplankton feed on algae, while fish in turn feed on zooplankton. The rate of feeding efficiency is primarily based on body size, but zooplankton group, and to some effect specific genera, also plays an important role. There are three main groups of zooplankton found in freshwater systems: rotifers, cladocera, and copepods.

Rotifers are a diverse group of zooplankton, very common in lakes and marine environments alike. Rotifers are generally the smallest zooplankton of the three groups,and thus typically the least efficient algae grazers. Feeding preferences are determined primarily by mouth structures and include generalist feeders (omnivores) or predators. Generalists can eat any small organic detritus encountered. Meanwhile, predators can eat other smaller rotifers and small algae. Generalist feeders include *Filinia spp., Keratella spp., Lecane spp., Euchlanis spp.*, and *Brachionus spp*. Predator genera include *Polyarthra spp.* (larger species)*, Asplanchna spp., Synchaeta spp.*, and *Trichocerca spp*.

Cladocera are less diverse, but also very common in freshwater lakes. They are sometimes called "water fleas". They spend most of their lifecycle reproducing via parthenogenesis (asexual reproduction with an all-female population) only switching to less efficient sexual reproduction when environmental conditions decline. Some genera (such as *Daphnia*) can be quite large (up to 5.0 mm long, visible without magnification), and thus can be classified as highly efficient phytoplankton grazers. Most cladocera are phytoplankton grazers, although their diet includes most organic matter ingested, including bacteria and protozoa. Body size (and thus mouth size) determines feeding efficiency, but ironically the larger-bodied genera are easier to see by predaceous fish, and thus typically have reduced numbers in populations of zooplanktivorous fish. *Daphnia spp.* are the most efficient algae feeders, while *Ceriodaphnia spp., Bosmina spp.* and *Eubosmina spp.* are less efficient. There are a few predator genera as well, including *Polyphemus spp.* and *Leptodora spp*.

Copepods are almost excusive to freshwater lake systems (not streams or rivers) and estuarine and marine systems. Of the six suborders native to the United States, three are parasitic, and three are free living. One of the free-living suborders, Harpacticoida, are exclusively benthic and thus are often not collected in in traditional plankton tows (unless the bottom sediments are disturbed). Theremaining two suborders, the Calanoida and the Cyclopoida are of primaryconcern during lake studies. All copepods have several naupilar stages, followed by several immature stages, before reaching an adult stage. Both suborders are considered large-bodied zooplankton but have distinct feeding preferences. Calanoids are almost exclusively algae feeders and have even demonstrated selective feeding strategies. Cyclopoids have mouth parts suitable for biting and seizing prey. Their diet is primarily other crustaceanzooplankton (including cannibalism on younger life stages), algae, and organic detritus ingestion (but less efficiently).

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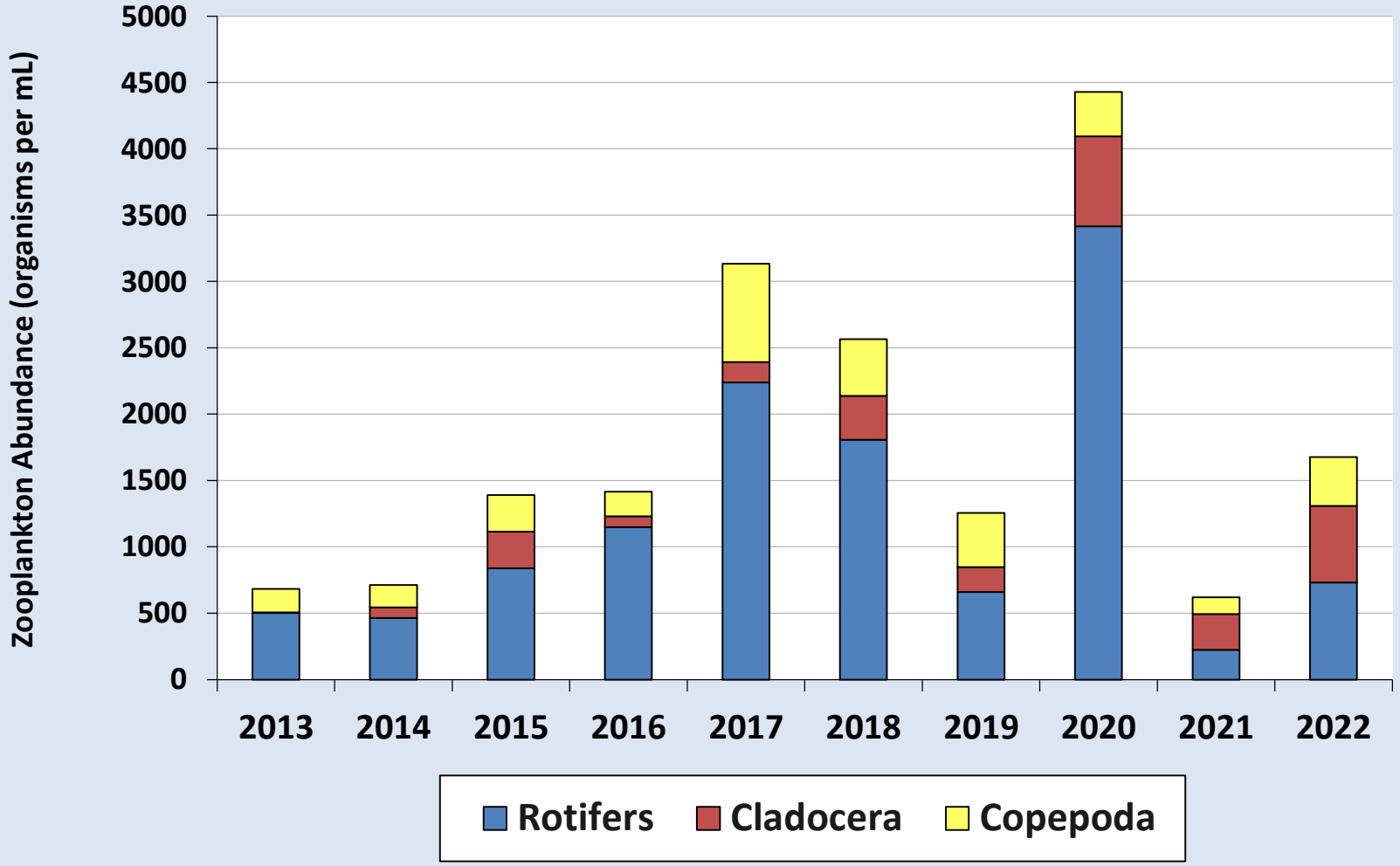
Lake Rippowam
Zooplankton Abundance and Distribution
2013 - 2022



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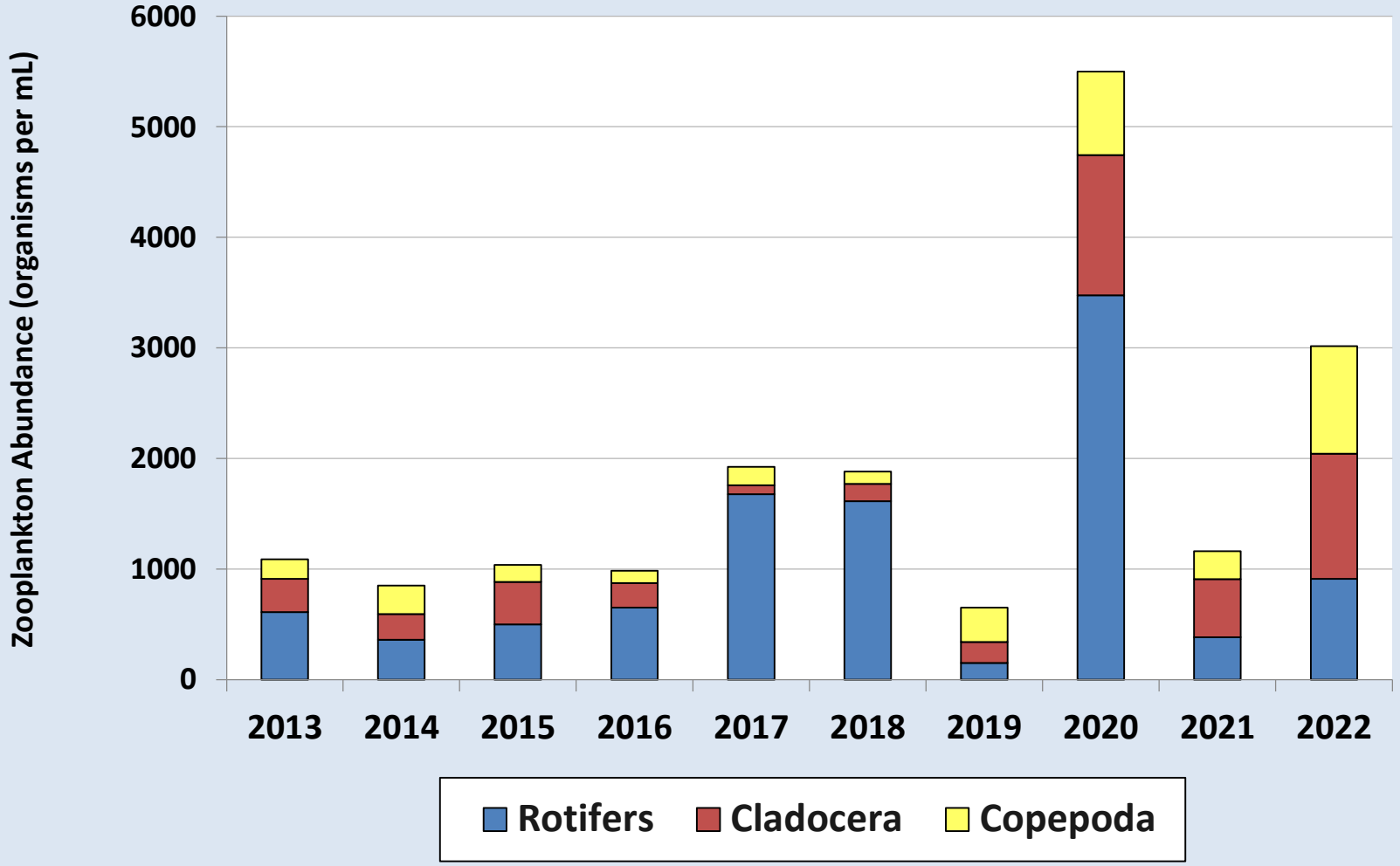
Lake Oscaleta
Zooplankton Abundance and Distribution
2013 - 2022



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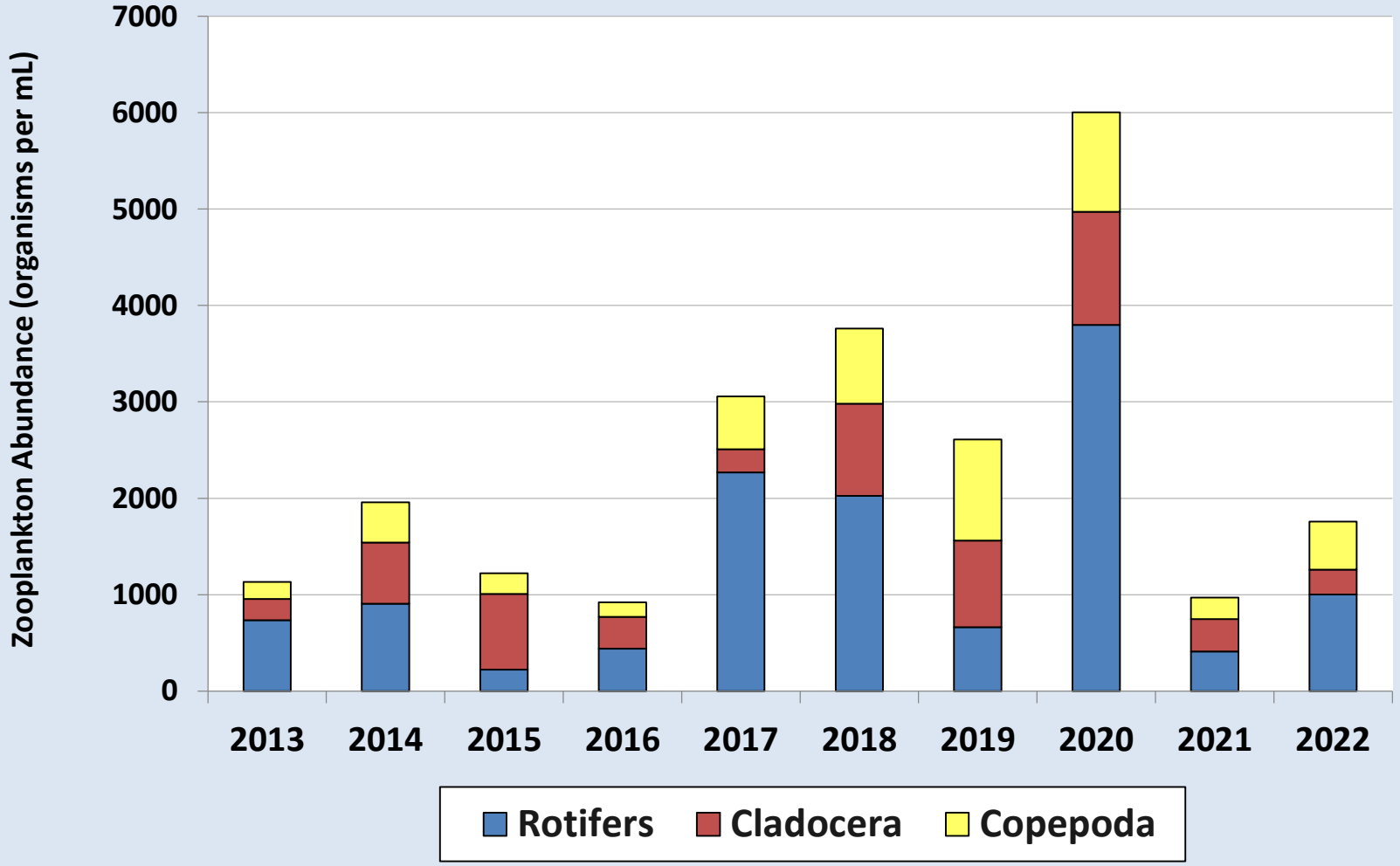
Lake Waccabuc
Zooplankton Abundance and Distribution
2013 - 2022



Zooplankton Count Results

Site: Lake Rippowam **Date: 7/21/22**

Group	Order	Family	Genus	Replicate			Total/3	x1000 mL	Water	# organisms
				A	B	C	(# per mL)	(= 1 L)	sampled (L)	per L
Rotifera	**Flosculariacea**	**Conochilidae**	*Conochilus unicornis*	1	2		1.00	1000	68.8	15
	Ploima	**Brachionidae**	*Keratella crassa*	4	3	2	3.00	3000	68.8	44
			Kellicottia longispina		1		0.33	333	68.8	5
		Trichocercidae	*Trichocerca cylindrica*	2	1		1.00	1000	68.8	15
		Asplanchnidae	*Asplanchna priodonta*	42	50	31	41.00	41000	68.8	596
		Synchaetidae	*Polyarthra vulgaris*	1	1		0.67	667	68.8	10
			Synchaeta oblonga	5	1	1	2.33	2333	68.8	34
		Gastropidae	*Gastropus hyptopus*	1	2		1.00	1000	68.8	15
			Ascomorpha saltans		2	10	4.00	4000	68.8	58
									Total:	**732**
Cladocera	**Cladocera**	**Daphniidae**	*Daphnia magna*	28	39	32	33.00	33000	68.8	480
		Bosminidae	*Bosmina longirostris*	10	5	5	6.67	6667	68.8	97
									Total:	**577**
Copepoda	**Cyclopoida**	**Cyclopidae**	*Microcyclops rubellus*			3	1.00	1000	68.8	15
			Microcyclops varicans	4	2	2	2.67	2667	68.8	39
	Calanoida		*Calanoid nauplius*	19	19	27	21.67	21667	68.8	315
									Total:	**368**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1676	732	43.6%	577	34.4%	368	22.0%

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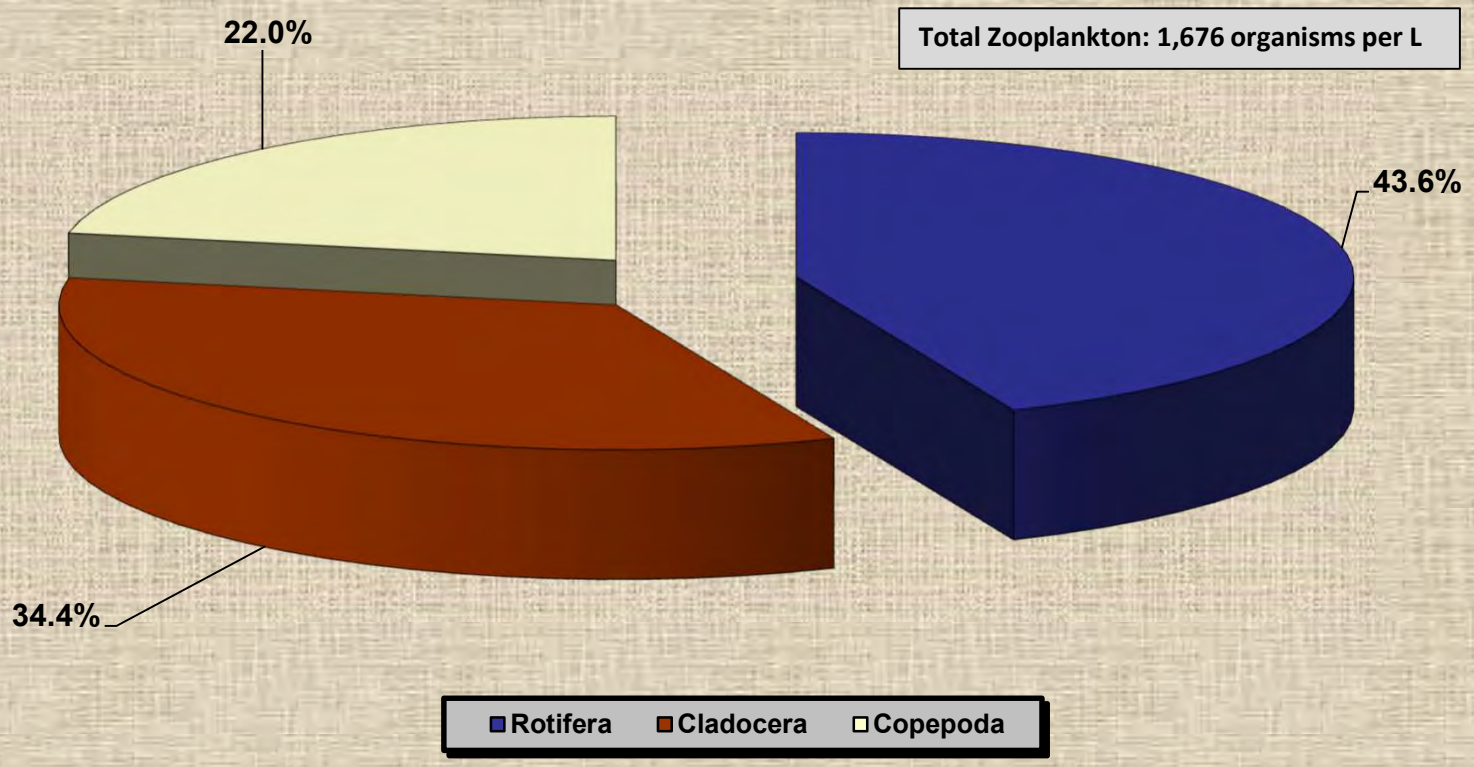
Lake Rippowam
July 21, 2022
Zooplankton Distribution



Zooplankton Count Results

Site: Lake Oscaleta **Date: 7/21/22**

Group	Order	Family	Genus	Replicate			Total/3	x1000 mL	Water	# organisms
				A	B	C	(# per mL)	(= 1 L)	sampled (L)	per L
Rotifera	**Plioma**	Brachionidae	*Kellicottia bostoniensis*	10	4		4.67	4667	68.8	68
			Kellicottia longispina		6	5	3.67	3667	69.8	53
			Keratella crassa	28	18	38	28.00	28000	68.8	407
			Keratella quadrata		1	1	0.67	667	68.8	10
			Anuraeopsis navicula			1	0.33	333	68.8	5
		Trichocercidae	*Trichocerca cylindrica*			2	0.67	667	68.8	10
			Trichocerca multicrinis		1	1	0.67	667	68.8	10
		Gastropidae	*Ascomorpha saltans*	1			0.33	333	68.8	5
			Ascomorpha ecaudis		6	13	6.33	6333	68.8	92
		Synchaetidae	*Polyarthra remata*	2	5	7	4.67	4667	68.8	68
			Synchaeta oblonga	14	7	12	11.00	11000	68.8	160
	Floscullariacea	Conochilidae	*Conochilus unicornis*		1	4	1.67	1667	68.8	24
									Total:	**910**
Cladocera		Bosminidae	*Bosmina longirostris*	23	16	20	19.67	19667	68.8	286
		Daphniidae	*Ceriodaphnia dubia*	20			6.67	6667	69.8	96
			Daphnia magna	47	51	57	51.67	51667	68.8	751
									Total:	**1132**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops rubellus*	19	6	15	13.33	13333	68.8	194
			Microcyclops varicans	29	16	14	19.67	19667	68.8	286
	Calanoida		*Calanoid nauplius*	25	33	44	34.00	34000	68.8	494
									Total:	**974**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
3016	910	30.2%	1132	37.5%	974	32.3%

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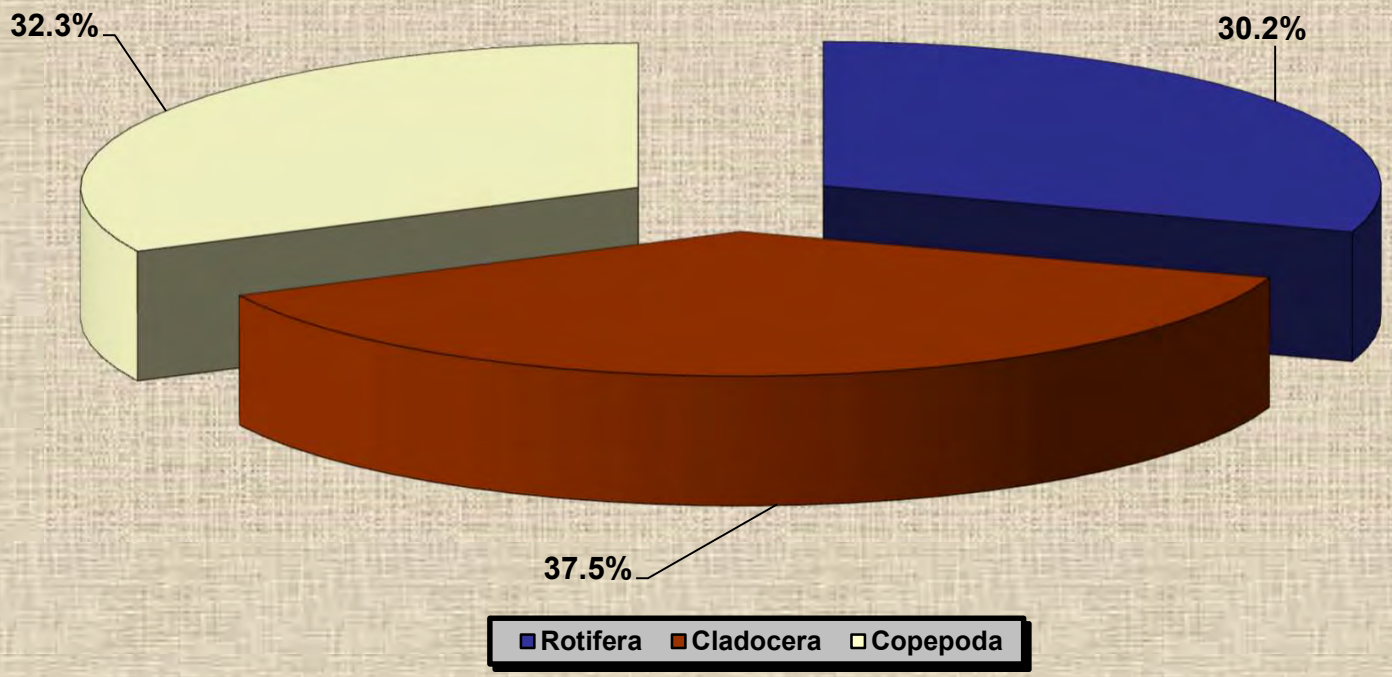
Lake Oscaleta
July 21, 2022
Zooplankton Distribution

Total Zooplankton: 3,016 organisms per L



Zooplankton Count Results

Site: Lake Waccabuc **Date: 7/21/22**

Group	Order	Family	Genus	Replicate			Total/3	x1000 mL	Water	# organisms
				A	B	C	(# per mL)	(= 1 L)	sampled (L)	per L
Rotifera	**Ploima**	Branchionidae	*Kellicottia longispina*	1			0.33	333	68.8	5
			Keratella cochlearis			1	0.33	333	68.8	5
		Gastropidae	*Gastropus hyptopus*	21	12	18	17.00	17000	68.8	247
		Syncheatidae	*Polyarthra vulgaris*	3	3	5	3.67	3667	68.8	53
			Synchaeta oblonga	1			0.33	333	68.8	5
		Asplanchnidae	*Asplanchna priodonta*	42	33	42	39.00	39000	68.8	567
		Trichoceridae	*Trichocerca multicrinis*	1	4	1	2.00	2000	68.8	29
	Flosculariaceae	Conochilidae	*Conochilus unicornis*	7	7	5	6.33	6333	68.8	92
									Total:	**1003**
Cladocera	**Cladocera**	Bosminidae	*Bosmina longirostris*	7	9	8	8.00	8000	68.8	116
		Daphniidae	*Daphnia magna*	15	10	4	9.67	9667	68.8	141
									Total:	**257**
Copepoda	**Cyclopoida**	Cyclopidae	*Microcyclops rubellus*	1			0.33	333	68.8	5
			Microcyclops varicans	5	10	16	10.33	10333	68.8	150
	Calanoida		*Calanoid nauplius*	19	26	26	23.67	23667	68.8	344
									Total:	**499**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
1759	1003	57.0%	257	14.6%	499	28.4%

SOLITUDE LAKE MANAGEMENT

Lake Waccabuc
July 21, 2022
Zooplankton Distribution

Total Zooplankton: 1,759 organisms per L