Three Lakes Zooplankton
2024 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 basins 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 2024. Zooplankton samples for each of the three lakes were collected by the client on August 7th, 2024.

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.

2024 Zooplankton Results

Table 1: 2024 Zooplankton Distribution						
Zooplankton Group	**Lake Rippowam**		**Lake Oscaleta**		**Lake Waccabuc**	
	Org./L	%	Org./L	%	Org./L	%
Rotifera	87	16.7%	6,909	85.0%	11,846	83.8%
Cladocera	165	31.5%	281	3.5%	751	5.3%
Copepoda	271	51.9%	940	11.6%	1,546	10.9%
Total Organisms	**523**	**100%**	**8,130**	**100%**	**14,142**	**100%**

Lake Rippowam

At Lake Rippowam in 2024, zooplankton abundance was considered moderate at 523 organisms/L (Table 1). A total of 19 different species of zooplankton were observed in the sample, which is the lowest of all three basins. Copepods dominated the assemblage, accounting for 51.9% of the sample at 271 organisms/L. The most abundant species within the Copepod group was *Cyclopoid nauplius* with 150 organisms/L. Within the Lake Rippowam sample, 6 other Copepod species were present including *Microcyclops rubellus, Diacyclops bicuspidatus odessanus (pictured left), Microcyclops varicans, Diacyclops thomasi, Calanoid nauplius, and Erasilus spp..*

Cladocera was the second most abundant group at Lake Rippowam with 165 organisms/L (or 31.5%) observed. This group had low diversity as three species were recorded including*, Bosmina longirostris, Daphnia catawba, and Ceriodaphnia lacustris.* The most abundant species of cladocera was *Bosmina longirostris* at 136 organisms/L.

The least common zooplankton group observed was Rotifers at 87 organisms/L, or 16.7%. Nine different species of Rotifers were observed which are considered moderate in diversity. The species that were recorded include*, Kellicottia bostoniensis, Keratella crassa, Synchaeta oblonga, Polyarthra dolichoptera, Polyarthra remata, Polyarthra vulgaris, Trichocerca cylindrica, Trichocera pusilla,* and *Hexarthra mira*. Of the nine observed species, *Synchaeta obonga* was the most abundant with 136 organisms/L recorded. Rotifers are a desirable group to have as their primary source of nutrients is algae.

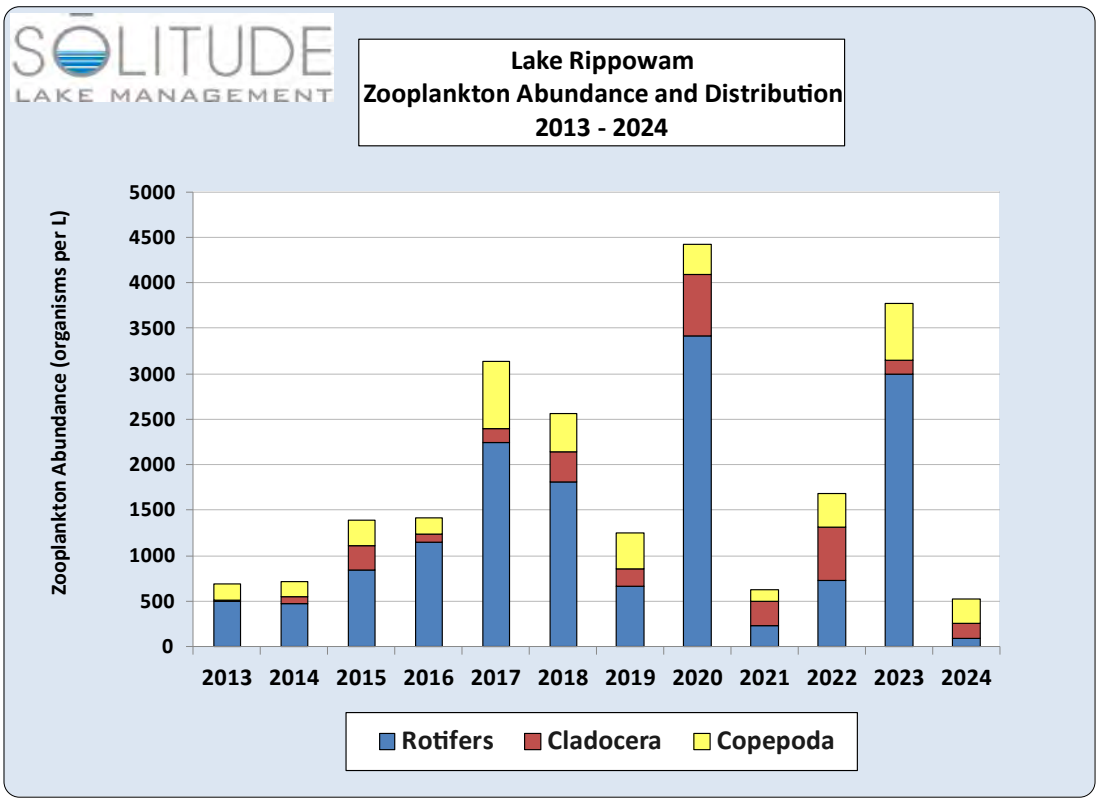

Figure 1. Lake Rippowam Zooplankton 2013-2024

The zooplankton abundance at Lake Rippowam had been consistently increasing from 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. Zooplankton abundance increased in 2022 and continued to rise in 2023. Samples collected in 2023 showed the second highest zooplankton abundance since sampling began in 2013. Zooplankton diversity drastically decreased in 2024 in comparison to previous years. Samples collected in 2024 showed the lowest zooplankton abundance to date.

Rotifers have been the dominant zooplankton group every year up until 2021 when Cladocera were the dominant group. 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, that does not seem to be the case when compared to the 2024 results. Total zooplankton abundance reached a high of 3,769 organisms/L in 2023 before greatly decreasing to 523 organisms/L in 2024. All of the zooplankton groups experienced a drastic decrease in density. According to the 2024 algal results, Lake Rippowam experienced a green algae bloom at the time of sampling. This bloom was most likely part of a cycle following a recent Rotifer bloom as they predominantly consume algae. This would have led to a chain reaction as Copepods would then become the dominant group, as seen in this year's results. Copepods are opportunistic and can

eat both algae and other zooplankton.

Lake Oscaleta

For Lake Oscaleta, the total zooplankton abundance this year was considered very high at 8,130 organisms/L. This was the second highest recorded zooplankton density since the start of the project in 2013. The basin also had the second highest total zooplankton abundance out of the Three Lakes in 2024. Zooplankton diversity was considered high for the basin as well with 24 different species recorded. Rotifera dominated the sample with a density of 6,909 organisms/L, or 85.0% of the assemblage. Of the Rotifers observed, 17 different species were recorded with the most dominant species being *Synchaeta pectinata* (pictured right).

The second most abundant zooplankton group at Lake Oscaleta was Copepoda. This group accounted for 940 organisms/L, or 11.6% of the sample, with four different species observed. The four species observed include *Cyclopoid nauplius, Microcyclops rubellus, Microcyclops varicans,* and *Calanoid nauplius*. *Calanoid nauplius* was the most dominant species of Cladocera observed in the basin at 407 organisms/L.

The least abundant group of zooplankton, Cladocera, were the least abundant group. Cladocera accounted for 281 organisms/L, or 3.5% of the sample. In 2024, three different Cladocera species were recorded in Lake Oscaleta including *Bosmina longirostris, Daphnia pulex, and Daphnia magna. Bosmina longirostris* was the most dominant Cladocera species at 189 organisms/L.

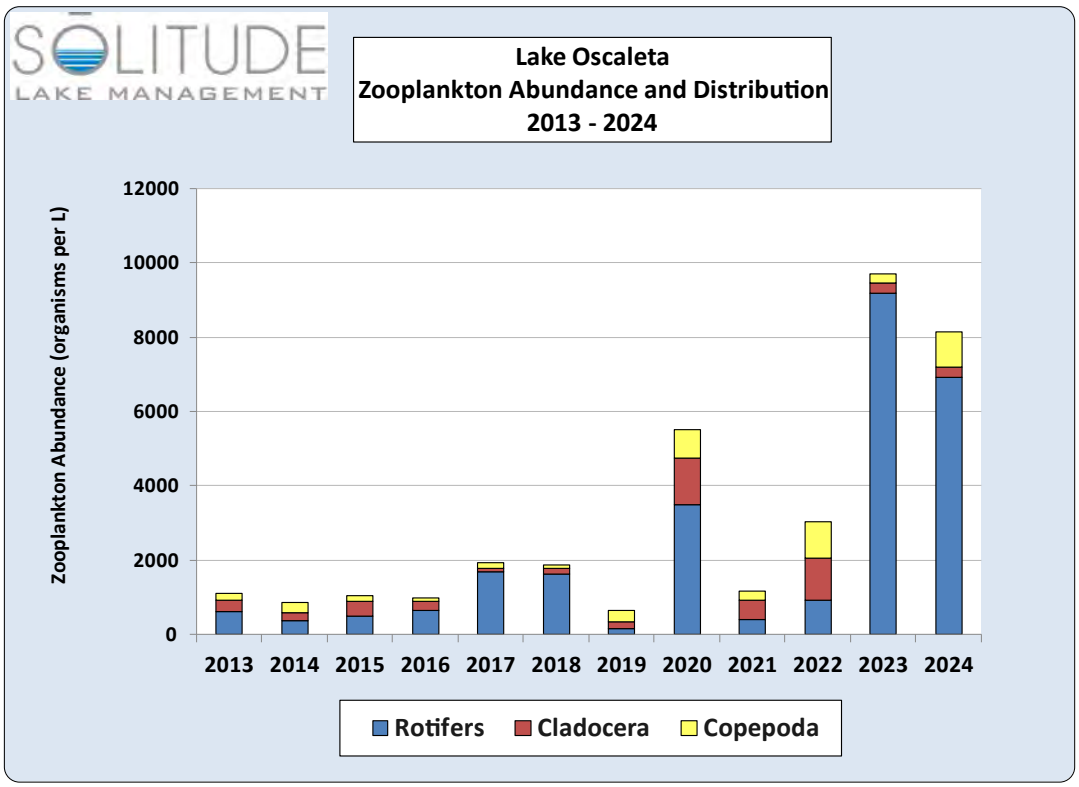

Figure 2. Lake Oscaleta Zooplankton 2013-2024

At Lake Oscaleta, high overall zooplankton has been observed more consistently starting in 2017 with a total of 1,923 organisms/L observed at the time. 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 continued to dominate in 2022. Before 2021, Rotifers had dominated every zooplankton sample at Lake Oscaleta. 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. However, in 2023, the results showed that Rotifers were once again the dominant zooplankton group and continue to be so in 2024.

Lake Waccabuc

At Lake Waccabuc, total zooplankton abundance was considered very high with 14,142 organisms/L observed. A total of 26 different species were observed in the 2024 sample. Rotifers were the dominant zooplankton group this year at 11,846 organisms/L, or 83.8% of the sample. The most dominant species of Rotifer was *Synchaeta oblonga* (pictured left), accounting for 7,427 organisms/L of the total sample.

Copepoda was the second most abundant group at 1,546 organisms/L, or 10.9% of the zooplankton sample. Five different species were documented at Lake Waccabuc including *Cyclopoid nauplius, Microcyclops rubellus, Microcyclops varicans, Diacyclops thomasi,* and *Calanoid nauplius*. Most of the Copepoda species were reported at the same density, indicating a well-balanced yet diverse community. *Microcyclops varicans* was the only copepod species that was observed less frequently than the others in the Lake Waccabuc sample.

The zooplankton group Cladocera was present at 571 organisms/L, or 5.3% of the sample. This group reported low diversity with three species observed: *Bosmina longirostris, Daphnia magna,* and *Ceriodaphnia lacustris.* The most dominant Cladocera species was *Bosmina longirostris* at 552 organisms/L.

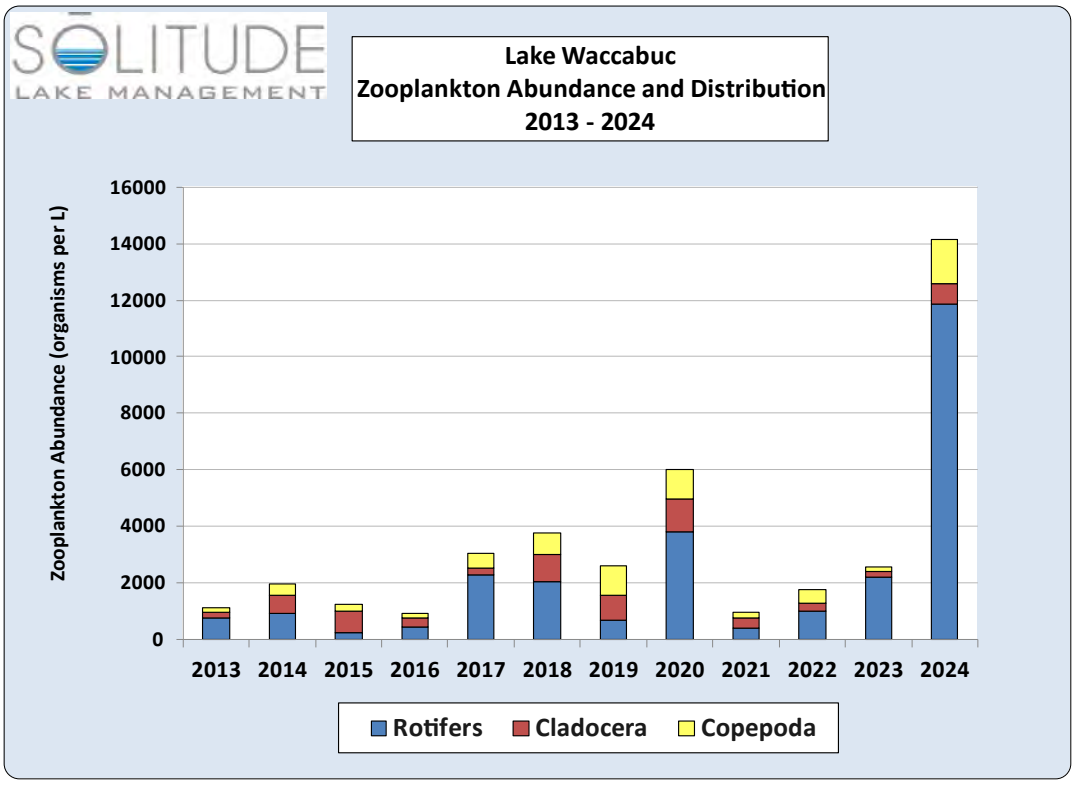

Figure 3. Lake Waccabuc Zooplankton 2013-2024

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 seven out of the 12 years of the monitoring project (2013, 2017, 2018, 2020, 2022, 2023, and 2024). The Rotifer community has developed the most out of the three groups since 2020.Lake Waccabuc once again contains the highest zooplankton abundance out of the three basins.

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 results. All three lakes experienced a similar trend with levels spiking in 2020 and decreasing significantly in 2021. In 2024, Lake Waccabuc has supported the highest density of zooplankton ever recorded in the three basins since the start of the project in 2013.

Conclusion

Summary

Zooplankton abundance decreased at two of the lakes, with the exception of Lake Waccabuc in 2024 as compared to 2023. At Lake Waccabuc, zooplankton abundance was very high and dominated by Rotifers. At Lake Oscaleta, a very high zooplankton abundance was recorded with Rotifers dominating the community. At Lake Rippowam, moderate zooplankton abundance was observed and dominated by Copepoda. Overall, each of the basins saw an increase in Rotifer abundance when compared to the data from 2023.

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 record the conditions of each basin. 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 12 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 continues to be suitable to assess the overall ecological status of the three basins.

SŌLitude Lake Management recommends the Three Lakes Council to continue monitoring zooplankton and algae in the 2025 season. Sampling throughout the growing season (May through September) would be more suitable to observe seasonal variation. However, continuing the same sampling format and techniques applied in 2013 through 2024 does provide value. Therefore, at least a single sample event should be collected in mid-July of 2025, to coincide with the SAV surveys and historical data.

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 during the 2025 lake management season.

Sincerely,

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Appendix

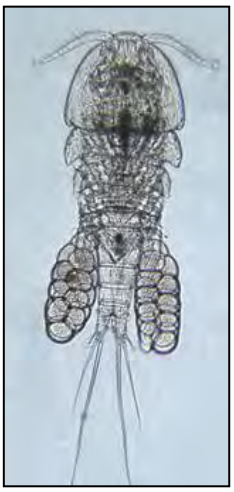
Zooplankton Primer
2024 Zooplankton Examination Data and Pie Charts
2013-2024 Zooplankton Abundance and Distribution Bar Graphs

Zooplankton Primer

Zooplankton provides an important link in a typical lake food web between algae and fish, especially during early 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. However, zooplankton group and 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). The remaining two suborders, the Calanoida and the Cyclopoida are of primary concern 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 crustacean zooplankton (including cannibalism on younger life stages), algae, and organic detritus ingestion (but less efficiently).

Zooplankton Count Results

Site: Lake Rippowam **Date: 8/07/24**

Group	Order	Family	Genus	Replicate			Total/3	x1000 mL	Water	# organisms
				A	B	C	(# per mL)	(= 1 L)	sampled (L)	per L
Rotifera	**Ploima**	Brachionidae	*Kellicottia bostoniensis*		1		0.33	333	68.8	5
			Keratella crassa	10	4	3	5.67	5667	68.8	82
		Synchaetidae	*Synchaeta oblonga*	4	6	18	9.33	9333	68.8	136
			Polyarthra dolichoptera	7	10		5.67	5667	68.8	82
			Polyarthra remata	7	12	8	9.00	9000	68.8	131
			Polyarthra vulgaris			9	3.00	3000	68.8	44
		Trichocercidae	*Trichocerca cylindrica*	1		3	1.33	1333	68.8	19
			Trichocerca pusilla	3	6	5	4.67	4667	68.8	68
		Hexarthridae	*Hexarthra mira*	2			0.67	667	68.8	10
									Total:	**87**
Cladocera	**Cladocera**	Bosminidae	*Bosmina longirostris*	9	12	7	9.33	9333	68.8	136
			Daphnia catawba		2	2	1.33	1333	68.8	19
			Ceriodaphnia lacustris	2			0.67	667	68.8	10
									Total:	**165**
Copepoda	**Cyclopoida**	Cyclopidae	*Cyclopoid nauplius*	15	9	7	10.33	10333	68.8	150
			Microcyclops rubellus	5	6	4	5.00	5000	68.8	73
			Diacyclops bicuspidatus odessanus	1			0.33	333	68.8	5
			Microcyclops varicans	1			0.33	333	68.8	5
			Diacyclops thomasi	1	1	2	1.33	1333	68.8	19
	Calanoida		*Calanoid nauplius*		2		0.67	667	68.8	10
	Poecilostomatoida	Ergasilidae	*Ergasilus spp.*	1	1		0.67	667	68.8	10
									Total:	**271**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
523	87	16.7%	165	31.5%	271	51.9%

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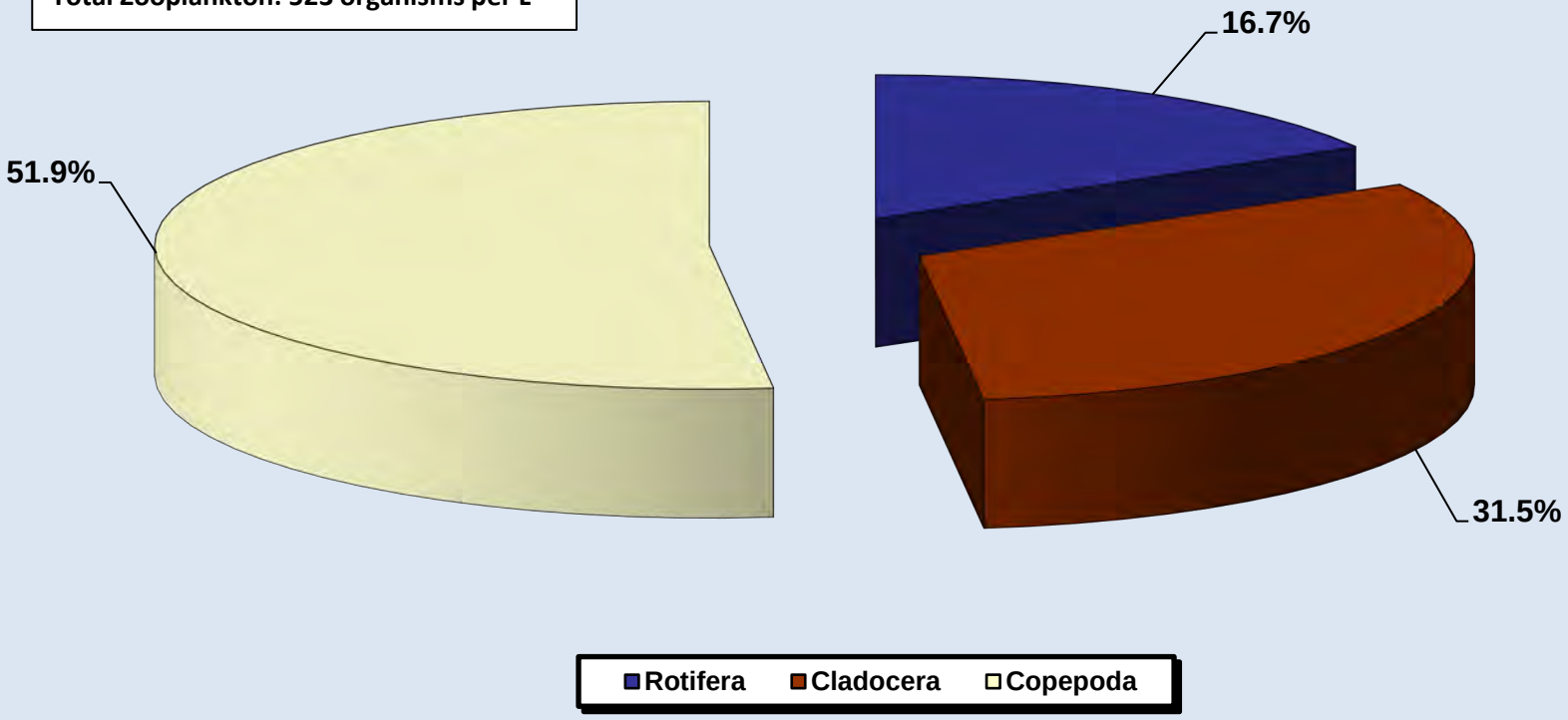
Lake Rippowam
August 07, 2024
Zooplankton Distribution

Total Zooplankton: 523 organisms per L



Zooplankton Count Results

Site: Lake Oscaleta **Date: 8/07/24**

Group	Order	Family	Genus	Replicate			Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
				A	B	C				
Rotifera	**Ploima**	Asplanchnidae	*Asplanchna priodonta*		16	2	6.00	6000	68.8	87
			Asplanchna brightwelli	3			1.00	1000	68.8	15
		Brachionidae	*Keratella crassa*	8	36	13	19.00	19000	68.8	276
			Keratella quadrata		2		0.67	667	68.8	10
			Kellicottia bostoniensis		3	1	1.33	1333	68.8	19
			Kellicottia longispina	2	20	11	11.00	11000	68.8	160
		Gastropidae	*Gastropus hyptopus*		14		4.67	4667	68.8	68
		Synchaetidae	*Polyarthra remata*		29		9.67	9667	68.8	141
			Polyarthra vulgaris			9	3.00	3000	68.8	44
			Polyarthra dolichoptera	3		5	2.67	2667	68.8	39
			Synchaeta pectinata	4	827	111	314.00	314000	68.8	4564
		Trichocercidae	*Trichocerca lata*		11		3.67	3667	68.8	53
			Trichocerca cylindrica		9	6	5.00	5000	68.8	73
			Trichocerca mucosa			3	1.00	1000	68.8	15
			Trichocerca pusilla	3			1.00	1000	68.8	15
	Flosculariaceae	Conochilidae	*Conochilus unicornis*	4	207	55	88.67	88667	68.8	1289
			Conochilus hippocrepis		9		3.00	3000	68.8	44
									Total:	**6909**
Cladocera	**Cladocera**	Bosminidae	*Bosmina longirostris*	2	25	12	13.00	13000	68.8	189
		Daphniidae	*Daphnia pulex*			1	0.33	333	68.8	5
			Daphnia magna	1	14	3	6.00	6000	68.8	87
									Total:	**281**
Copepoda	**Cyclopoida**	Cyclopidae	*Cyclopoid nauplius*	4		17	7.00	7000	68.8	102
			Microcyclops rubellus	4	34	16	18.00	18000	68.8	262
			Microcyclops varicans	1	26	8	11.67	11667	68.8	170
	Calanoida		*Calanoid nauplius*	3	72	9	28.00	28000	68.8	407
									Total:	**940**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
8130	6909	85.0%	281	3.5%	940	11.6%

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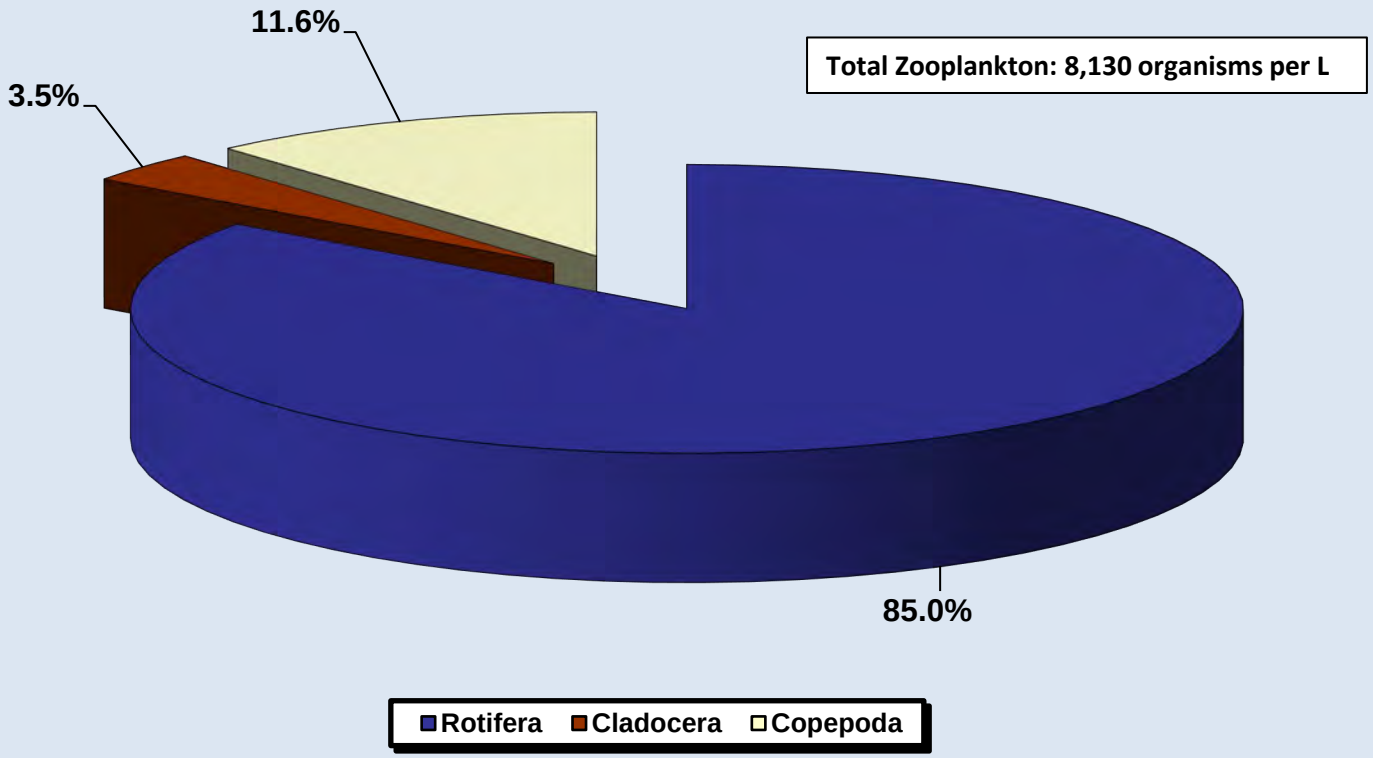
Lake Oscaleta
August 07, 2024
Zooplankton Distribution



Zooplankton Count Results

Site: Lake Waccabuc **Date: 8/07/24**

Group	Order	Family	Genus	Replicate			Total/3 (# per mL)	x1000 mL (= 1 L)	Water sampled (L)	# organisms per L
				A	B	C				
Rotifera	**Ploima**	Brachionidae	*Kellicottia longispina*	15		5	6.67	6667	68.8	97
			Kellicottia bostoniensis	7		1	2.67	2667	68.8	39
			Keratella crassa	115	16	41	57.33	57333	68.8	833
			Anuraeopsis fissa		6	48	18.00	18000	68.8	262
		Asplanchnidae	*Asplanchna brightwelli*	55			18.33	18333	68.8	266
			Asplanchna herricki		1		0.33	333	68.8	5
			Asplanchna priodonta			20	6.67	6667	68.8	97
		Synchaetidae	*Ploesoma truncatum*	27	4	19	16.67	16667	68.8	242
			Polyarthra remata	112	2	26	46.67	46667	68.8	678
			Polyarthra major		2		0.67	667	68.8	10
			Synchaeta oblonga	1,339	17	177	511.00	511000	68.8	7427
		Trichocercidae	*Trichocerca pusilla*	55	1	22	26.00	26000	68.8	378
			Trichocerca longiseta	108	1		36.33	36333	68.8	528
			Trichocerca lata	54		20	24.67	24667	68.8	359
	Flosculariaceae	Conochilidae	*Conochilus unicornis*	14	13	47	24.67	24667	68.8	359
		Filinidae	*Filinia terminalis*	11	1	4	5.33	5333	68.8	78
		Hexarthridae	*Hexarthra mira*	35	1	3	13.00	13000	68.8	189
									Total:	**11846**
Cladocera	**Cladocera**	Bosminidae	*Bosmina longirostris*	90	4	20	38.00	38000	68.8	552
		Daphniidae	*Ceriodaphnia lacustris*		2	10	4.00	4000	68.8	58
			Daphnia magna	28	1		9.67	9667	68.8	141
									Total:	**751**
Copepoda	**Cyclopoida**		*Cyclopoid nauplius*	50		15	21.67	21667	68.8	315
		Cyclopidae	*Microcyclops rubellus*	55	3	7	21.67	21667	68.8	315
			Microcyclops varicans	46	5	8	19.67	19667	68.8	286
			Diacyclops thomasi	55	2	8	21.67	21667	68.8	315
	Calanoida		*Calanoid nauplius*	50	3	12	21.67	21667	68.8	315
									Total:	**1546**

Total Organisms per L	Rotifera	%	Cladocera	%	Copepoda	%
14142	11846	83.8%	751	5.3%	1546	10.9%

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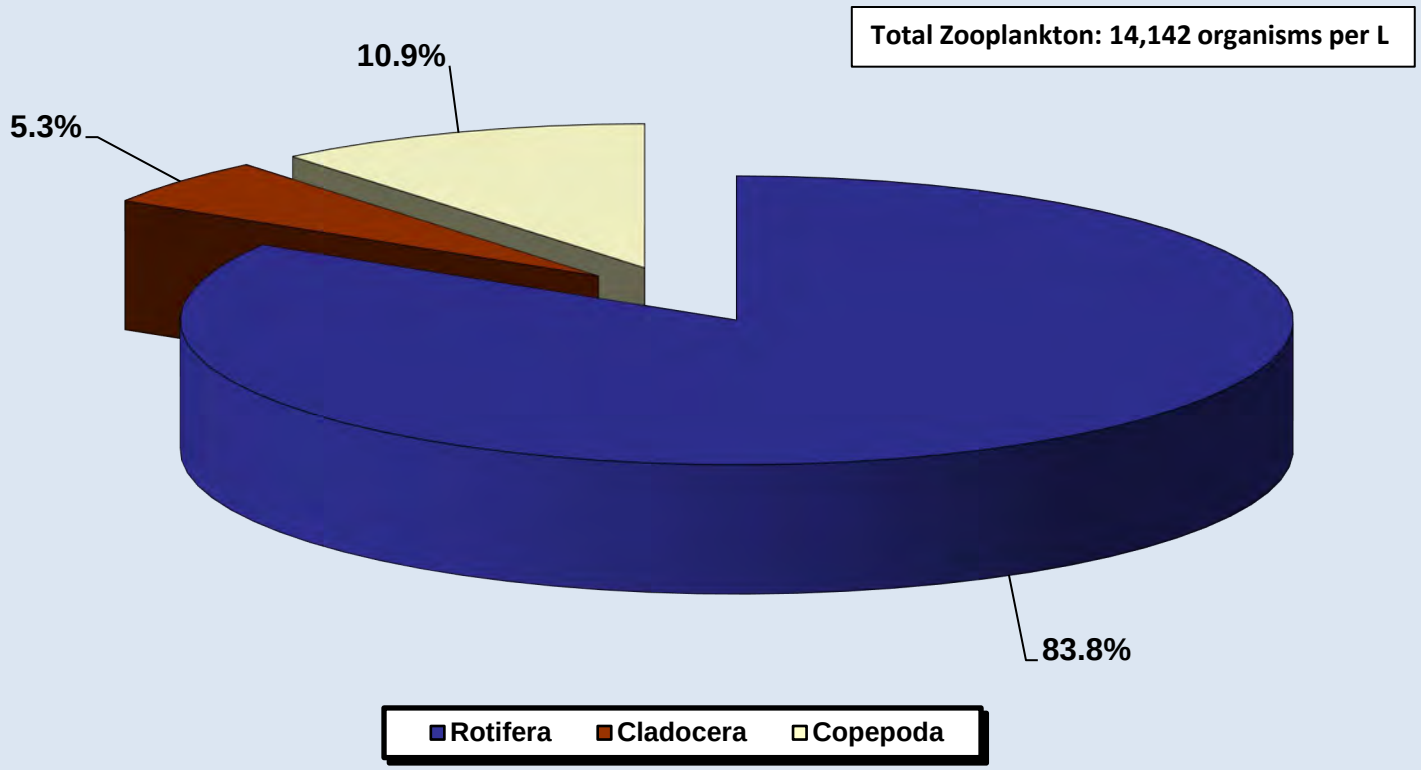
Lake Waccabuc
August 07, 2024
Zooplankton Distribution



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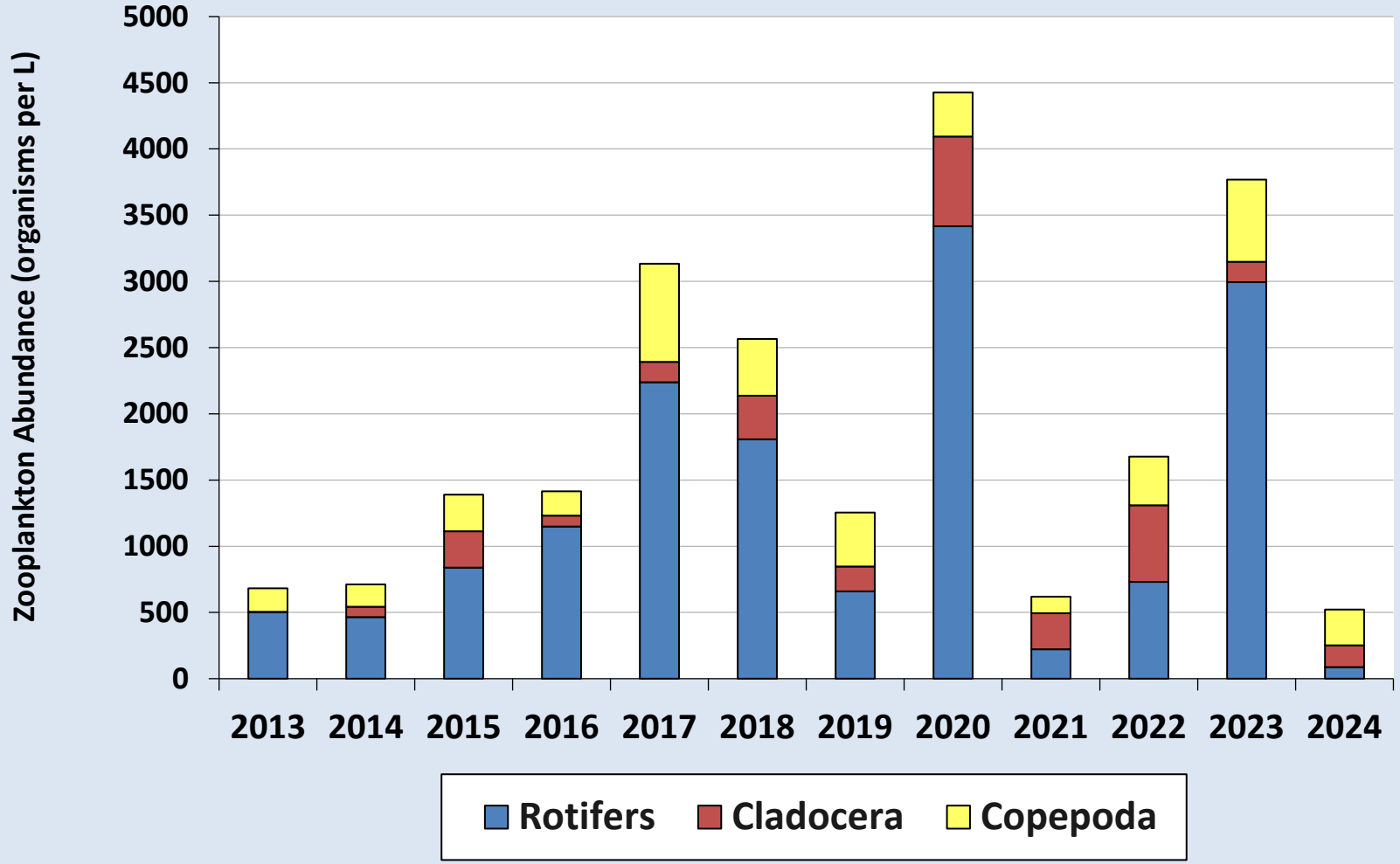
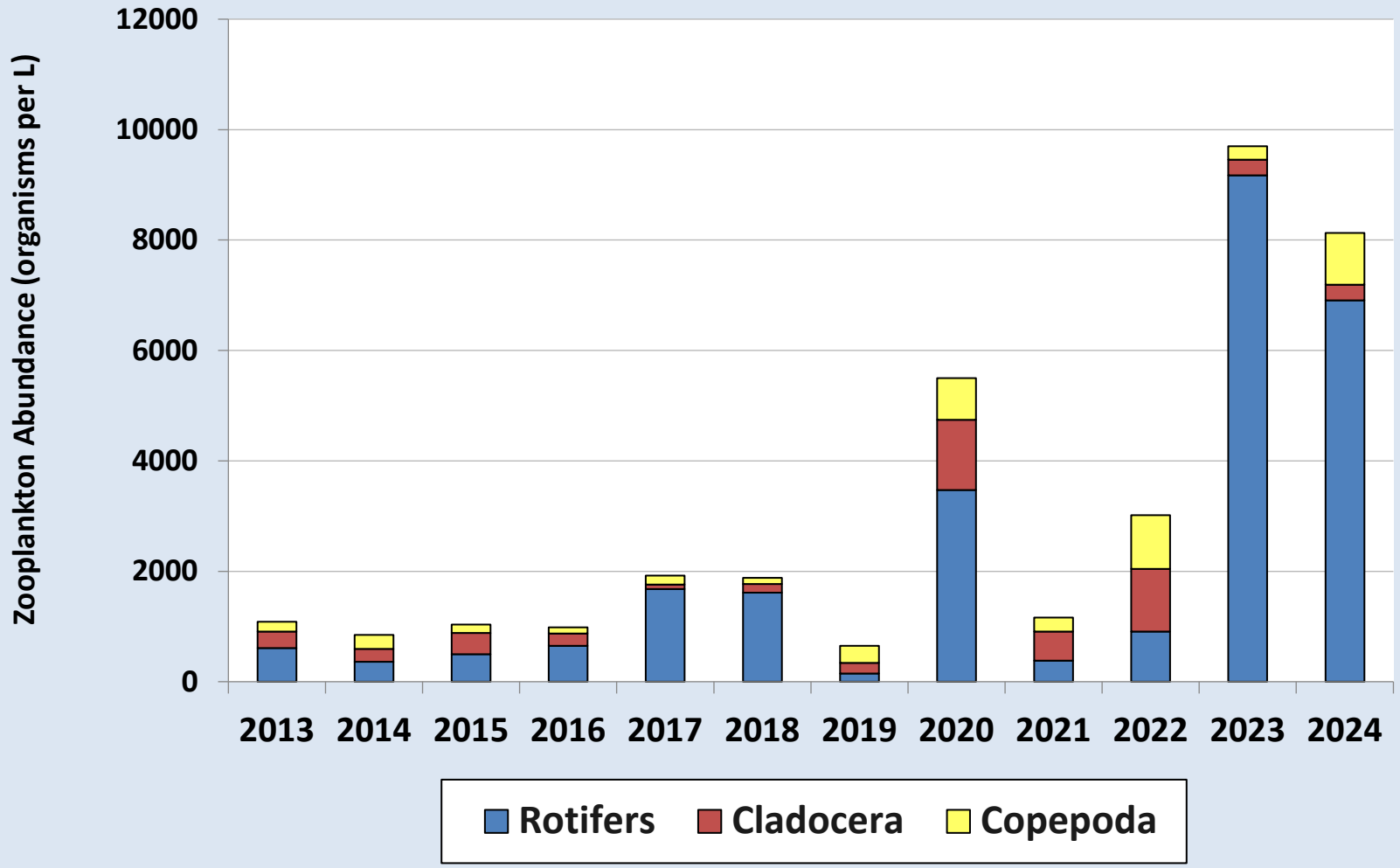
Lake Rippowam
Zooplankton Abundance and Distribution
2013 - 2024



SOLITUDE LAKE MANAGEMENT

Lake Oscaleta
Zooplankton Abundance and Distribution
2013 - 2024



SOLITUDE LAKE MANAGEMENT

Lake Waccabuc
Zooplankton Abundance and Distribution
2013 - 2024