

Swan Lake Benthic Invertebrate Monitoring

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Commissioned by



Objective

Currently as there has been no benthic invertebrate sampling done in Swan Lake it is proposed that a total of 21 sites throughout the lake will be sampled with the purpose of providing a baseline for current water quality and lake health but also to provide an understanding of any improvements to water quality following future restoration efforts over the coming years.

Indicator species of water quality and lake health provide a basis for understanding the impacts development has had on the waterbody but also provide baseline for the improvement of lake health.

If overall water quality is improving in Swan Lake this will be reflected in changes of abundance, diversity, and the presence of certain indicator species. Low water quality will provide a different taxon than higher water quality, and thus monitoring of invertebrates is an effective way of establishing a baseline for ecosystem health. Presence of Ephemeroptera (Mayfly), Plecoptera (Stonefly) and Trichoptera (Caddisfly), or EPT, are indicators of good water quality and overall ecosystem health and can be considered a great benchmark for future years.

It is proposed that a range of habitat types will be assessed throughout the lake, however sampling will be conducted in-shore at depths of less than 3 feet, along 20 foot transects with use of dip net, and wash tray for identification purposes (Rosenberg, Davies, Cobb, and Wiens; 1997).

Results

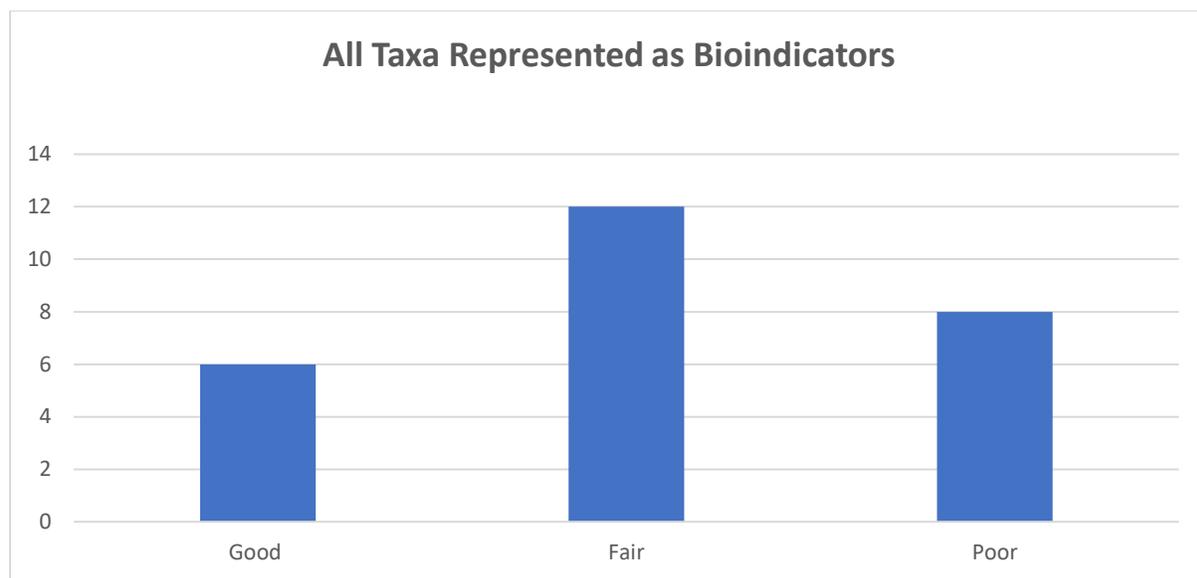
A total of 21 sites were sampled, over the course of 3 weeks. Sampling was conducted on days with no rainfall and very little cloud cover, days of sampling were July 22nd, July 30th, and August 5th.

Swan Lake is host to 16 taxonomic classes, these were categorized as good, fair or poor as bioindicators. Ephemeroptera (Mayflies), Trichoptera (Caddisflies), and Anisoptera (Dragonflies) were identified and categorized as bioindicators of good water quality. Gerridae (Water Strider), Zygoptera (Damselflies) Amphipoda (scuds), Isopoda (Isopods) were categorized as fair water quality bioindicators. Diptera [this includes 2 species of Midge, as well as *Aedes* sp. (Mosquito)], Corixidae (Water Boatmen), Gastropods (Snails), and Nematoda sp. (Nematode worm) were categorized as poor or low water quality.

Species that could not be used as water quality bioindicators included *Ranatra* (Water scorpion), and Coleoptera (2 different species of Water Beetle). Although *Ranatra* and Coleoptera were removed as water quality indicators their presence has been associated with elevated levels of salinity, also water boatmen and water striders are also associated with saline rich environments. Also, there was a painted turtle observed at one site and a Common carp captured in the dipnet during the survey.

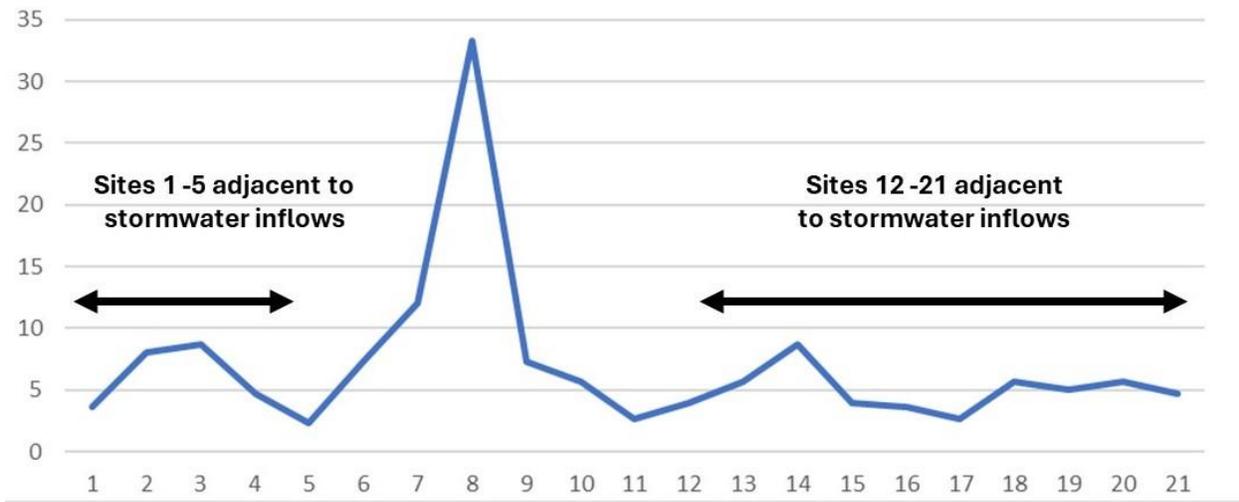
EPT as a percentage of all species sampled was found to be 12.5 % in respect to all taxonomic groups. Between 7% to 13% is typical of fair water quality (North Carolina Department of Environment, Health and Natural Resources; 1997).

Although EPT was found to be 48.96% of all individuals sampled in the survey. Mayflies are present at a few sites in high numbers, also some caddisflies were present, these species were found in less developed and more naturalized areas. Overall abundance in these areas was also high in comparison to other sites observed in the study. The total number of individuals according to EPT suggests good water quality, however given the diversity and types of species found overall the lake is found to be of fair or intermediate water quality.



Given taxa categorized and given EPT percentage to total taxa, it is concluded that Swan Lake based off existing invertebrate populations sampled is of intermediate or fair water quality. Although the overall abundance seems rather low, the majority of sites had very few individuals. Considering the areas of little or no invertebrates may suggest point sources of pollution, this however would need to be correlated with additional water quality measures.

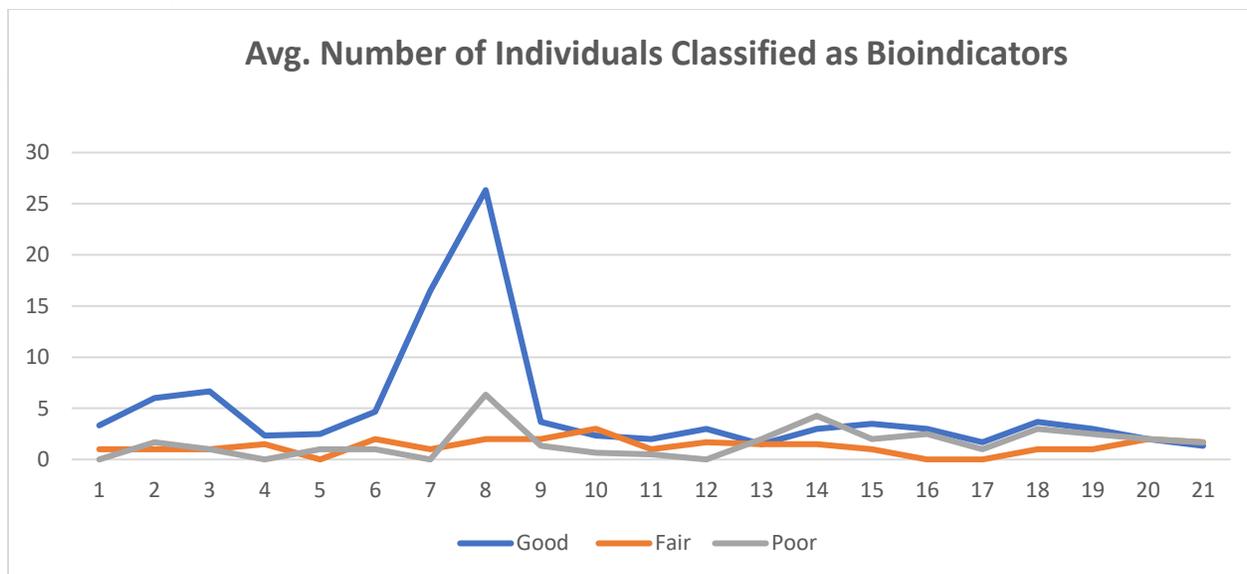
Overall Abundance (Total Species)



The purpose of this survey was to establish a baseline for water quality, if changes in the assemblage of bioindicators is observed in future years this will create a better understanding of improvements made in water quality. Also, the presence of water scorpions may be an indicator of higher-than-normal salinity. Elevated numbers of Hemiptera species would also be indicative of higher than usual salinity (Anufriyeva, Shadrin; 2016), also it is worth noting that water striders due to their presence on the surface are underrepresented in the surveyed benthic population, although Water Striders are still found in the survey it is most likely they are captured incidentally during the process of sampling (Spence, Anderson; 2003). The abundance of these species may be associated with road salt(s) run-off, however hydraulic conductivity data would be useful to gain a better understanding of this.

A lack of Oligochaete found in the survey seemed peculiar, it is difficult to say why this is the case as surficial sediment varied between sites sampled. Although it has been proposed that a Gerking sampler may be more effective at capturing sedentary species, this may be the reason for the lack of Oligochaete sp. as well as Leeches (Sychra, Zdeněk; 2010), also grab sampling may provide a better method for capturing these species (Rosenberg, Davies, Cobb, and Wiens; 1997).

In conclusion Swan Lake, given the taxa found and percentage of EPT, is currently of fair or intermediate water quality.



This report establishes a baseline for water quality. Changes in invertebrate populations in future years will establish a better understanding of either potential improvements or further degradation that may be occurring within the lake.

References

Anufriyeva, Shadrin (2016); First record of *Ranatra linearis* (Hemiptera, Nepidae) in Hypersaline Water Bodies of Crimea; January 2016; Hydrobiological Journal 52(2):49-53

Dodson (2005); Introduction to Limnology; McGraw-Hill

North Carolina Department of Environment, Health and Natural Resources (1997); Standard operating procedures for biological monitoring; Environmental Sciences Branch Biological Assessment Group; Division of Water Quality. Water Quality Section

Rosenberg, Davies, Cobb, and Wiens (1997); Protocols for measuring biodiversity: Benthic Macroinvertebrates in Freshwater; Department of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6

Sychra, Zdeněk (2010); Sampling Efficiency of Gerking Sampler and Sweep Net in Pond Emergent Littoral Macrophyte Beds – a Pilot Study; Turkish Journal of Fisheries and Aquatic Sciences 10(2)

Spence, Anderson (2003) Biology of Water Striders: Interactions Between Systematics and Ecology; November 2003; Annual Review of Entomology 39(1):101-128

Testing Locations in Swan Lake, Markham



Summary of Site Visit Data – Summer 2023

species classified as total individual		Good	Fair	Poor
site visit 1	total n	155	16	46
site visit 2	total n	59	62	23
site visit 3	total n	757	25	60
total		971	103	129

Species Composition (classification as bioindicators)	Good	Fair	Poor
	2	4	4
	3	5	2
	1	3	2
total	6	12	8

Avg. Number of Categorized Species per Site Visit			
Site Number	Good	Fair	Poor
1	3.333333	1	0
2	6	1	1.666667
3	6.666667	1	1
4	2.333333	1.5	0
5	2.5	0	1
6	4.666667	2	1
7	16.5	1	0
8	26.333333	2	6.333333
9	3.666667	2	1.333333
10	2.333333	3	0.666667
11	2	1	0.5
12	3	1.666667	0
13	1.5	1.5	2
14	3	1.5	4.25
15	3.5	1	2
16	3	0	2.5
17	1.666667	0	1
18	3.666667	1	3
19	3	1	2.5
20	2	2	2
21	1.333333	1.666667	1.666667

Data: Site Visit 1 - July 22, 2023

Site	Depth	Coordinates	Good	Poor	Poor	Fair	Fair	Fair	Poor		Fair	Good	Poor	Fair			
			Mayfly	Water Boatmen	Midge Sp total	Damselfly	Water Beetle	Water Strider	Gastropod	isopod	Amphopoda	Caddisfly	Mosquito (Aedes sp.)	Isopod	Water Strider (2)	Nematoda	
1	1	43.89694/-79.25047	4		0												
2	2	43.89762/-79.25072	3	1	3	1	1	2									
3	1	43.89764/-79.25107	12		1	1	1	1	1								
4	2.5	43.89805/-79.25193	4		0				1	2	2						
5	1	43.89809/-79.25209	4		1			1				1					
6	1	43.89775/-79.25326	12		1	1	2					1					
7	2.5	43.89745/-79.25511	30		0		1				1						
8	2	43.89748/-79.2552	50	3	0								1				
9	2.5	43.89747/-79.25527	3	2	0					1							
10	2	43.89627/-79.25435	1		0				1								
11	1.5	43.89625/-79.25427	1		0		1							1			
12	1	43.89575/-79.2526	1		0						1						
13	1	43.89591/-79.25231	2		2			2							1		
14	2	43.89606/-79.25212	5		10	3		7									1
15	2	43.89627/-79.25202	3		3	3											
16	2	43.89635/-79.25189	3		1	1											
17	2.5	43.89642/-79.25167	1		0												
18	2	43.8965/-79.25125	7		3	1	1	2									1
19	1.5	43.89652/-79.25108	4		4			4									
20	1	43.89655/-79.25095	2	1	1		1	1									
21	1	43.89663/-79.2508	2	1	3			3				2					
total			154	8	33	10	8	23	3	4	4	1	3	1	1	1	1

Data: Site Visit 2 - July 30, 2023

Site	Depth	Coordinates	Mayflies	Water Boatmen	Midge Sp total		Damselfly		Water Beetle	Water Strider	Gastropod	water beetle	Amphopoda	Caddisfly	Mosquito (Aedes sp.)	Isopod	Water Strider (2)	Nematoda	Dragon fly	water scorpion	
1		143.88694/-79.25047	2							1										1	
2		243.88762/-79.25072	2																		
3		143.88764/-79.25107	2	1										1							
4		2543.88805/-79.25193	1																		
5		143.88809/-79.25209																			
6		143.88775/-79.25326	1							3				2							
7		2543.88745/-7925511	3				1														
8		243.88748/-79.2552	13							2											
9		2543.88747/-79.25527	4	2						3											
10		243.88627/-79.25435	2	1													1				1
11		1543.88625/-79.25427	3	1																	
12		143.88575/-792526	5							2				2							
13		143.88591/-79.25291		1	1		2						2								
14		243.88606/-79.25212	1	1	1									1			2				
15		243.88627/-79.25202	4		1												1				
16		243.88655/-79.25189	3		4																
17		2543.88642/-79.25167	3		2										1						
18		243.8865/-79.25125	2		3																
19		1543.88652/-79.25108	3											1							
20		143.88655/-79.25095	2		4									4							
21		143.88663/-79.2508	1											2							
total			57	7	16	0	3	0	0	11	0	2	13	1	0	4	0	0	0	1	1

Data: Site Visit 3 – August 5, 2023

Site	Depth	Coordinates	Mayflys	WaterBoatmen	Midge Sp total	Damselfly	Water Beetle	Water Strider	Gastropod	water beetle	Amphopoda	Caddisfly	Mosquito (Aedes sp.)	Isopod	water strider	Nematoda	Dragonfly	water scorpion
1	1	43.89694/-79.25047	3															
2	2	43.89762/-79.25072	13	1		1												
3	1	43.89764/-79.25107	6			1												
4	2.5	43.89805/-79.25193	2					1									1	
5	1	43.89809/-79.25209	1															
6	1	43.89775/-79.25326	1		1													
7	2.5	43.89745/-79.25511				1												
8	2	43.89748/-79.2552	15		16													1?
9	2.5	43.89747/-79.25527	4					2									1	
10	2	43.89627/-79.25435	4		1			5										
11	1.5	43.89625/-79.25427									2							
12	1	43.89575/-79.2526						1										
13	1	43.89591/-79.25231	1		4													
14	2	43.89606/-79.25212			5													
15	2	43.89627/-79.25202																
16	2	43.89635/-79.25189																
17	2.5	43.89642/-79.25167	1															
18	2	43.8965/-79.25125	2															
19	1.5	43.89652/-79.25108	2		1													
20	1	43.89655/-79.25095						1									2	
21	1	43.89663/-79.2508	1		1			1										