Environment Office
Saugeen Ojibway Nation.

Saugeen Ojibway Nation
COASTAL WATERS MONITORING PROGRAM (CWMP)
2019 Field Season Summary Report

Saugeen Ojibway Nation Environment Office
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November 2020

INTRODUCTION

The Saugeen Ojibway Nation (SON) is comprised of the Chippewas of Nawash Unceded First Nation and the Chippewas of Saugeen First Nation. The SON members are among the Anishnaabek people of the Great Lakes region. The SON includes the Indigenous Peoples of the Anishnaabe-aki or Anishnaabekiing, which describes the Territory encompassing the Saugeen (Bruce) Peninsula, and extending south of Goderich to the Maitland River and east of Collingwood to the Nottawasaga River, and the Waters of Lake Huron and Georgian Bay extending in the South from Point Clark (Lake Huron), west to the US border, around the Peninsula to the mouth of the Nottawasaga River (Figure 1).

The Territory is the source of SON rights and identity and the basis of SON cultural, spiritual, and economic survival. SON members have a deep connection to all of the lands, waters and non-human beings in the Territory, but there is a special connection to the water. SON members have relied on the water for sustenance and livelihood while caring for and celebrating it through ceremony and stewardship. This is a sacred relationship and it is imperative that SON uphold their duty to care for and protect the water.

In 2019, we launched the Saugeen Ojibway Nation Coastal Waters Monitoring Program (CWMP). The CWMP is a nearshore (or coastal) monitoring program with the goal of building a comprehensive baseline inventory and then to continue annual monitoring of the nearshore habitats and wildlife of the Saugeen Ojibway Nation Territory. This information will form the basis of how we understand the current conditions and health of coastal habitats and wildlife (especially fish) across the Territory. It will allow us to investigate differences in conditions between sites, and potential causes for decreased health over time. All of this together will support us in the coming years to monitor changes that will occur as the climate changes and the lake, fish, wildlife and plants change in response and help us develop climate mitigation and adaptation strategies.

In 2019, the CWMP had 24 monitoring sites spanning from Inverhuron, along the western shore of the Saugeen Peninsula to Johnson's Harbour and from Lion's Head down the eastern shore of the Saugeen Peninsula to Collingwood.

At each monitoring site the CWMP measures:

- **Nearshore fish community** (fish, turtles, snakes and aquatic invertebrates)
  - Live fish assessment techniques (Fyke and Seine netting).
  - Fyke nets are set for 24 hours and collected.
  - Seine netting occurs at the site over the course of 1 – 2 hours.

- **Water Temperature**
  - Temperature loggers installed and anchored with cinder blocks and monitoring temperature continuously at the bottom of the lake at various depths.
  - Surface and bottom temperature measured at each fish community assessment site.

- **Water Quality**
  - Measured at each site when setting fish nets or assessing wetlands.

- **Aquatic and semi-aquatic vegetation and wetland community.**
  - At each site the aquatic plants are identified and density estimated.

There are five core objectives of the CWMP:

1. To complete a comprehensive ecological baseline of the coastal / nearshore region of the Territory, and continue monitoring annually.
2. To assert SON's jurisdiction in the Territory, and enhance SON's ability to engage with and make ecologically informed decisions about new and ongoing projects in the Territory in engagement with Government and proponents.
3. To connect SON Community members to the environment of their Territory (and to understand the current and changing health).
4. To incorporate the Ecological Knowledge and priorities of SON Community members into the scope of monitoring, and in the analysis and interpretation of data.
5. To provide meaningful training and employment opportunities to SON membership.

Photo 1: Painted Turtle

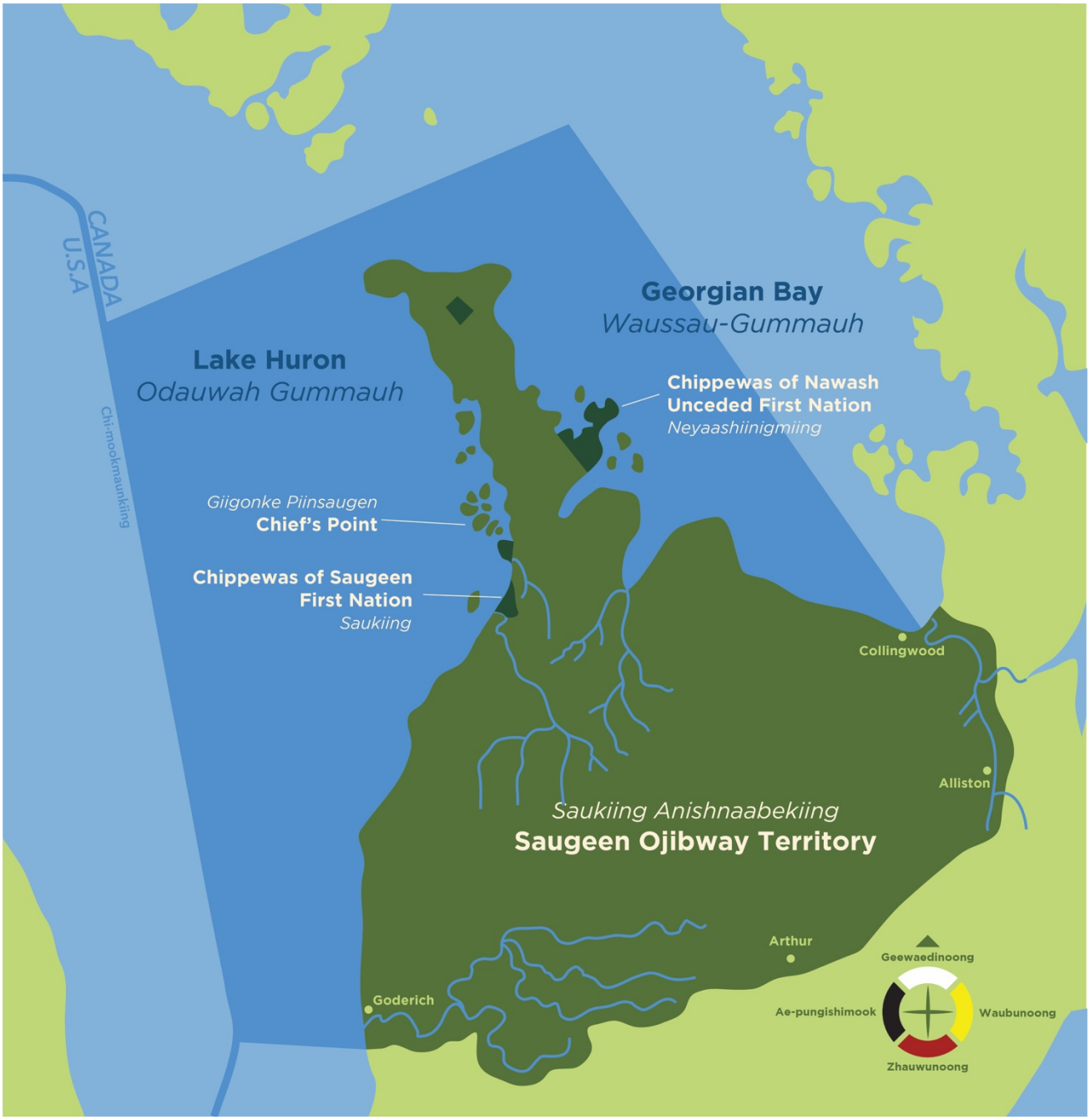

Figure 1: Illustrates the Extent of Saugeen Ojibway Nation Territorial Lands and Waters.

METHODS

Study Area

In 2019, the CWMP collected environmental data from 15 regions across the Territory and across those 15 regions completed n=74 fish and water quality assessments throughout Georgian Bay and Lake Huron. The CWMP study area included coastal sites in Georgian Bay from Collingwood north to Tobermory and in Lake Huron from Tobermory south to Goderich. Fish community, water quality and temperature data were collected at total of n=74 fish community monitoring sites (n=54 fyke net sample locations, and n=20 seine net sample locations) (Figure 2 and Figure 3). There was a total of 19 temperature and water level data loggers n=17 temperature (only) logger sites, and n=2 temperature/level logger sites (Figure 2). Within the Lake Huron shoreline region of the study area, 45 netting sites, 11 temperature logger and 1 temperature and level logger sites were located from Little Eagle Harbour (N) to Inverhuron Bay (S). Within the Georgian Bay shoreline region of the study area, 23 fyke netting sites, 6 seine sites, 6 temperature logger and 1 temperature and level logger sites were located between Isthmus Bay (N) to Nottawasaga Island (S).

Sampling locations were determined based on accessibility, gear deployment feasibility/appropriateness, habitat type, and based on pre-determined site importance and/or feedback from the SON Community.

Field Sampling Protocol

At each of the nearshore fish community sites we measured and/or observed multiple parameters including, environmental conditions (weather, temperature, wind direction, wave height, precipitation), water temperature, water quality, substrate type, and vegetation community. Nearshore fish community sites in 2019 were assessed between June and October.

Fish Community Assessment

Fish community assessments were completed using two (2) fyke nets deployed at each site: one (1) large net - 3’ x 4’ front opening - 2 wings - 25’ long - lead line 25’ long - mesh size 2mm, and one (1) small net - 2’ x 4’ front opening - 2 wings 25’ long - lead line 25’ long - mesh size 2mm. The net was set with the lead line as close to the shore as possible (with no gap) using a T-bar or tied to a tree The net was pulled away perpendicular from the shore with the front opening of the net facing the shoreline. The end of the fyke net was tied off and secured with T-bar. The wings were set at a 45° angle towards the shore away from the net and secured using T-bars (Figure 4). Nets were set over night for a maximum of 24 hours in depths of water ranging from 0.3m – 1.1m. Nets were collected and all fish species present were identified, measured (total length and fork length mm), and enumerated. Species were measured to a total count of 30, once passed 30 species measured they were then identified and enumerated only. Identification was verified based on Royal Ontario Museum Field Guide to Fish (Holm et al. 2009) and Freshwater Fishes of Canada (Scott and Crossman 1998). Each fish was returned to sample location following identification and measurement. Seine net samples were completed using a seine net (50’ long, 4’ height, central collection bag 4’ X 4’ X 4’, mesh size 2mm). Seine net samples were completed in areas that were a maximum of 1.2 m and had the appropriate substrate to complete the seine net protocol (sandy, cobble, flat rock, low vegetation density).

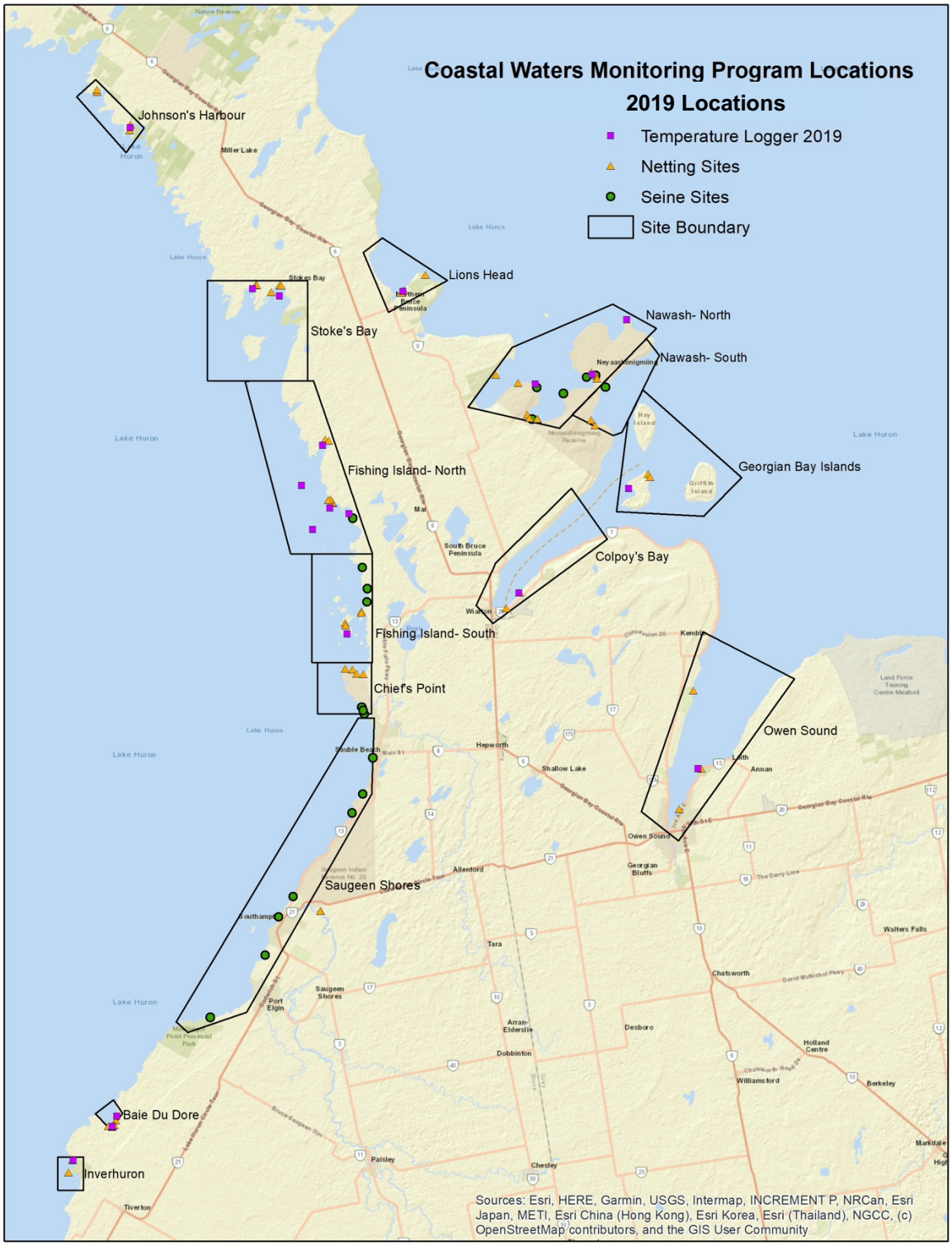

Figure 2: Shows the distribution and locations of CWMP fyke, seine and temperature data logger sites across SON Territory.

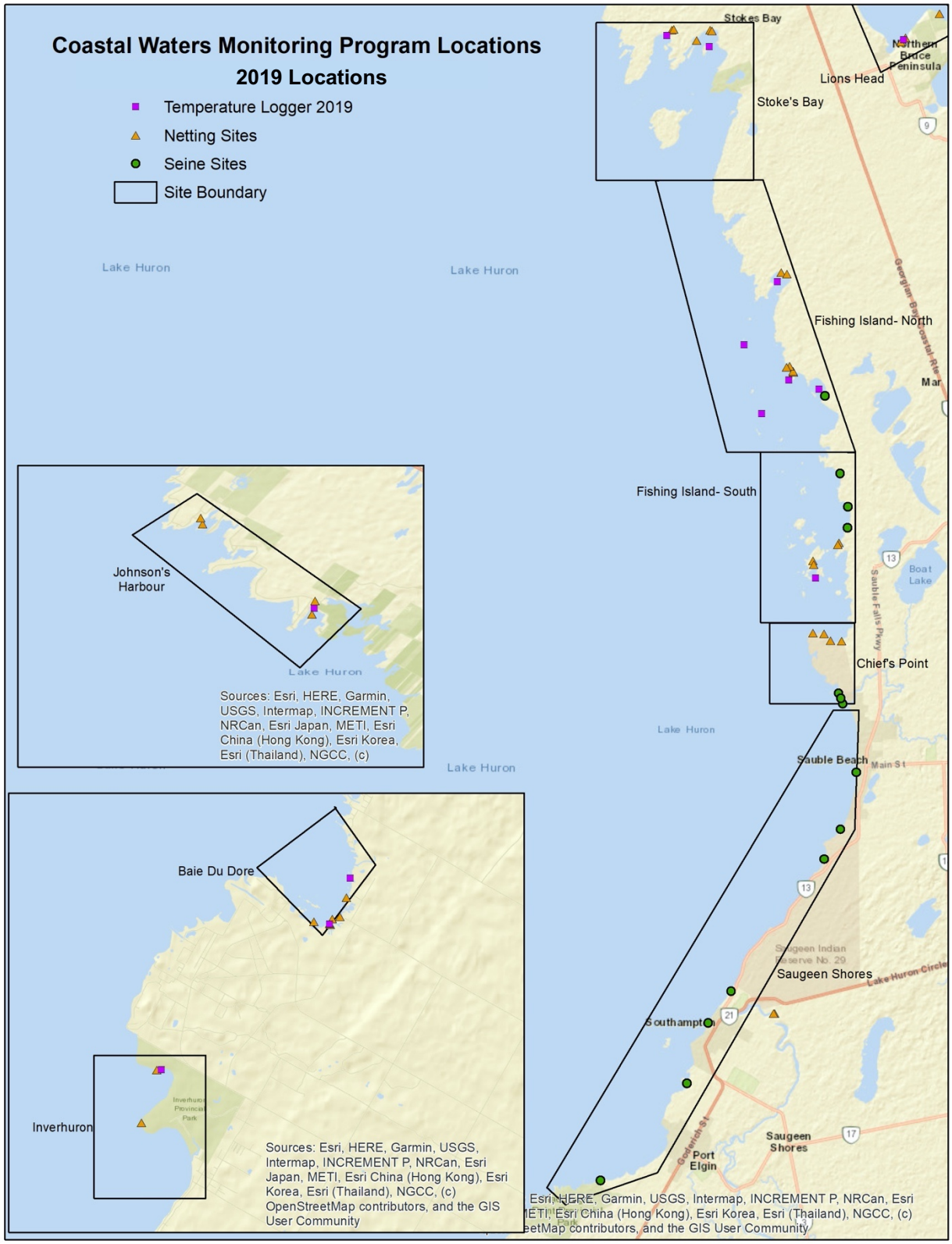

Figure 3: Shows the distribution and locations of CWMP fyke, seine and temperature data logger sites along the Lake Huron shoreline.

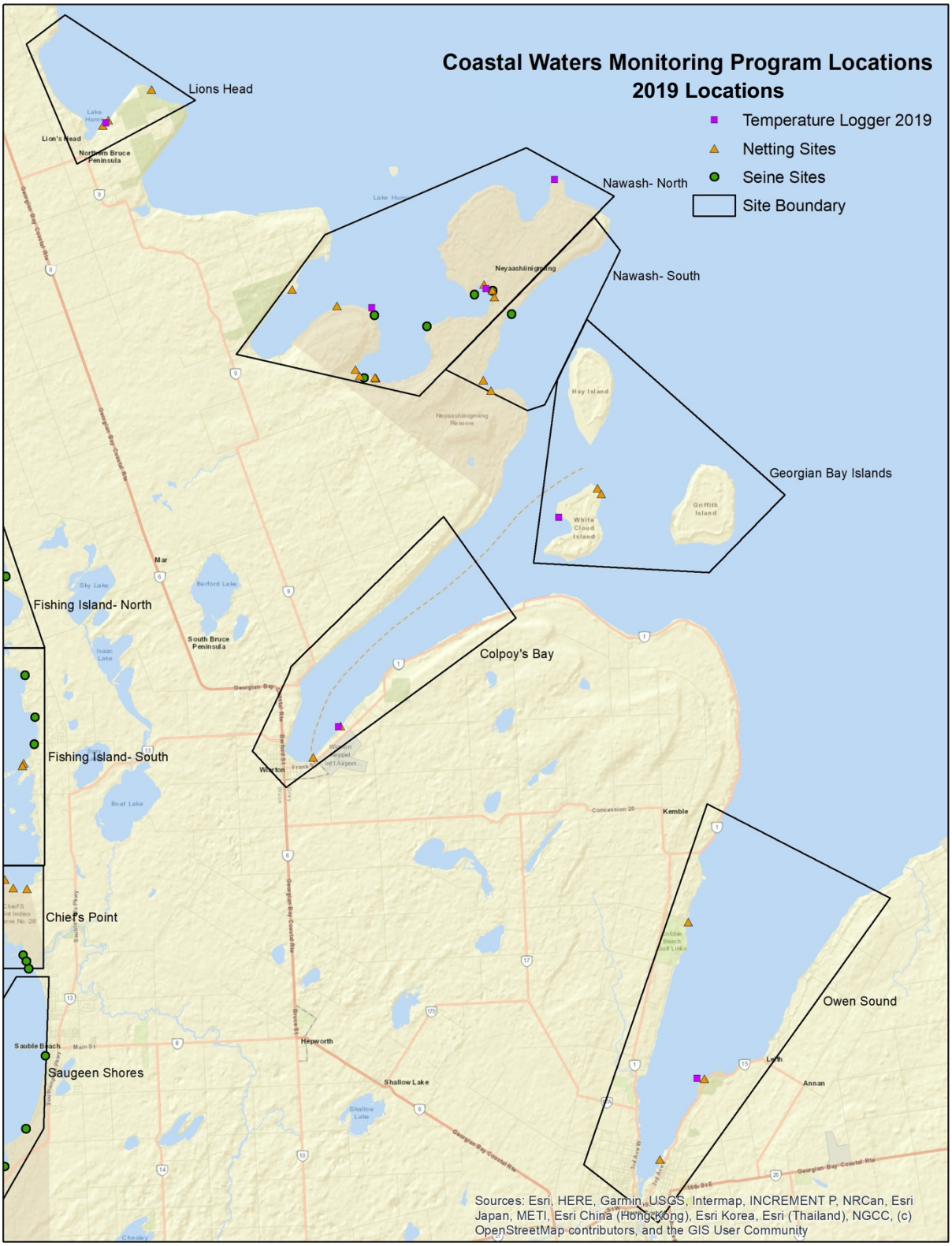

Figure 4: Shows the distribution and locations of CWMP fyke, seine and temperature data logger sites along the Georgian Bay.

Figure 5: Shows locations of fyke and seine netting locations across SON Territory.

Fyke and Seine Nets

Photo 2: Shows a fyke net with a lead line.

Photo 3: Shows a fyke net without a lead line.

Photos 2&3: Shows a fyke net set with and without a lead line.

The fyke net is a live trap net that consist of two mesh “wings”, a lead line and a series of hoops that funnel the fish down to the back of the net. Once the fish are in the net they are unable to get out until they are sampled and released. The fyke net stays in the water overnight for approximately 24 hours.

Photo 4: Shows seine net being pulled through the water.

Photo 4: Shows seine net being pulled through the water.
The seine net is a live trap net that collects the fish that are using that area of the shoreline during that time of sampling. The net gets pulled along the shoreline, as the net is being pulled the fish move backwards to large pocket located at the back of the net.

RESULTS

Nearshore Fish Community

In 2019, a total of n=74 nets were deployed and assessments were complete for corresponding fish community and environmental conditions across the SON Territorial waters. A total of n=76,509 individuals representing n=49 species were sampled.

- Of the total abundance of fish (n=76,509), the majority (82.1%) were caught at sites (n=29) within the Georgian Bay region of the study area.
    - The Nottawasaga Island site accounted for 43% of the total abundance (33,308 of 76,509).

- Species diversity was greater (n=44 species) at sites located in the Lake Huron region of the study area. Species diversity in the Georgian Bay region of the study area included n=36 species.

- The fish species caught in greatest abundance include:
    - Mimic Shiner (n=8315) (%) caught at 38 different sites
    - Bluntnose Minnow (n=4103) (%) at 44 different sites.
    - Sand Shiner (n=3380) at 27 different sites.

Photo 5: Bluntnose Minnow

Photo 6: Sand Shiner

The fish species with the greatest distributional representation (most common) include:

- Round Goby (n=46 sites) (% sites)
- Bluntnose Minnow (n=44 sites) (% sites)
- Mimic Shiner (n=38 sites) (% sites)

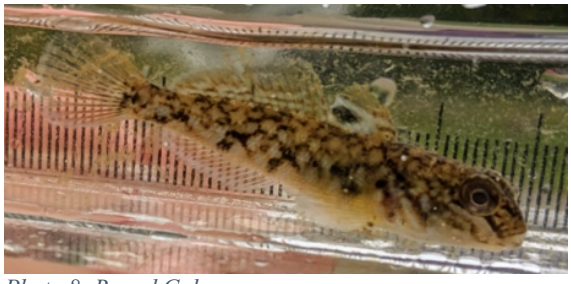

Photo 8: Round Goby

Photo 7: Mimic Shiner

- The fish species with the least distributional representation (un common) include:
    - Blacknose Dace (n=1)
    - Northern Hog Sucker (n=1)
    - Northern Pike (n=1)
    - Yellow Bullhead (n=3)
    - Muskellunge (n=3)
    - Finescale Dace (n=4)

Photo 10:Finescale Dace

Photo 9: Northern Pike

- Fish species captured outside previously identified ranges include:
  Brook silverside captured 12 times at 4 different sites, and only caught along the Lake Huron shoreline.

Photo 11: Brook Silverside

Photo 12: Northern Hog Sucker

Table 1: List of n= 74 2019 fish community sampling locations, including date of assessment, total abundance and species diversity count for all locations (cross reference site ID with Figure 5)

Boundary Location	**Date**	**Number of Nets Set**	**Species Diversity**	**Fish Abundance**
Baie Du Dore (BDD)	July 31, Aug 13, 2019	6	17	1633
Chief's Point (CP)	Jul 3, Sept 24, 2019	6	24	2438
Colpoy's Bay (CB)	Aug 20, 2019	2	11	674
Georgian Bay Islands (GBI)	Aug 19, 2019	2	9	948
Inverhuron (IH)	Jul 20, 2019	3	4	19
Johnson's Harbour (JH)	Jun 4, 2019	6	22	320
Lion's Head (JH)	Jun 6, 2019	3	0	0
Fishing Islands-North (FIN)	Jul 2, 22, 23, Aug 28, 2019	7	27	1598
Fishing Islands- South (FIS)	Jun 24, Sep 24, 25, 2019	7	29	3713
Nawash – North (NAN)	June 25, 26, 27, July 16, 18, Aug 14, 22, 2019	15	36	27241
Nawash – South (NAS)	Jun 26, Aug 12, 2019	2	14	437
Nottawasaga Bay (NB)	Sept 18, 2019	2	15	33308
Owen Sound (OS)	July 24, 2019	3	12	188
Saugeen Shores (SA)	Jun 3, 18, 2019	7	16	2268
Stokes Bay (SB)	Jun 3, 18, Aug 28, 2019	10	29	1724

Table 2: List of fish species, total occurrences and total abundance of species caught in study area from June 3 to September 24 2019.

Common Name	Scientific Name	Species Occurrences (number of sites of n=74)	Total abundance
Banded Killifish	*Fundulus diaphanus*	24	436
Blackchin Shiner	*Notropis heterodon*	14	832
Blacknose Dace	*Rhinichthys atrarulus*	1	1
Blacknose Shiner	*Notropis heterolepis*	22	1463
Blackside Darter	*Percina maculata*	4	15
Bluegill	*Lepomis macrochirus*	4	178
Bluntnose Minnow	*Pimpephales notatus*	44	4103
Bowfin	*Amia calva*	9	30
Brassy Minnow	*Hybognathus hankinsoni*	5	11
Brook Silverside	*Labidesthes sicculus*	4	12
Brook Stickleback	*Culaea inconstans*	5	12
Brown Bullhead	*Ictalurus nebulosus*	16	1476
Central Mudminnow	*Umbra limi*	5	6
Common Carp	*Cyrinus carpio*	6	17
Common Shiner	*Notropis cornutus*	3	20
Creek Chub	*Semothilus atromaculatus*	9	64
Cyprinidae sp.	*Cyprinidae*	2	19
Darter sp.		1	4
Emerald Shiner	*Notropis atherinoides*	33	2983
Fathead Minnow	*Pimephales promelas*	7	17
Finescale Dace	*Chrosomus neogaeus*	2	4
Gizzard Shad	*Dorosoma cepedianum*	4	14
Golden Shiner	*Notemigonus crysoleucas*	19	349
Greater Redhorse	*Moxostoma valenciennesi*	1	2
Hornyhead Chub	*Nocomis biguttatus*	1	1
Hybrid Dace		2	5
Iowa Darter	*Etheostoma exile*	11	40
Johnny Darter	*Etheostoma nigrum*	1	1
Lake Chub	*Couesius plumbeus*	5	48
Largemouth Bass	*Micropterus salmoides*	7	18
Larval Fish		1	68
Least Darter	*Etheostoma microperca*	14	108
Lepomis sp.	*Lepomis*	16	584
Longnose Dace	*Rhinichthys cataractae*	14	45
Longnose Gar	*Lepisosteus osseus*	2	5

Mimic Shiner	*Notropis volucellus*	39	8317
Muskellunge	*Esox masquinongy*	1	3
Ninespine Stickleback	*Pungitius pungitius*	5	13
Northern Hog Sucker	*Hypentelium nigricans*	2	2
Northern Pearl Dace	*Margariscus nachtriebi*	6	38
Northern Pike	*Esox lucius*	1	1
Northern Redbelly Dace	*Chrosomus eos*	5	323
Pumpkinseed	*Lepomis gibbosus*	21	623
Rainbow Smelt	*Osmerus mordax*	10	32
Rainbow Trout	*Oncorhynchus mykiss*	2	9
Redhorse sp.	*Moxostoma*	3	328
River Chub	*Nocomis micropogon*	1	1
Rock Bass	*Ambloplites rupestris*	37	174
Round Goby	*Neogobius melanostomus*	46	1056
Salmonidae sp.	*Salmoninae*	3	21
Sand Shiner	*Notropis stramineus*	27	3380
Shorthead Redhorse	*Moxostoma macrolepidotum*	1	2
Smallmouth Bass	*Micropterus dolomieui*	16	131
Spotfin Shiner	*Notropis spilopterus*	11	201
Spottail Shiner	*Notropis hudsonius*	30	2975
Stonecat	*Noturus flavus*	1	1
Sucker sp.	*Catostomidae*	1	1
Threespine Stickleback	*Gasterosteus aculeatus*	6	13
Too small to ID		14	45536
Trout sp.	*Salmoninae*	1	1
White Sucker	*Catostomus commersoni*	12	325
Yellow Bullhead	*Ictalurus natalis*	3	3
Yellow Perch	*Perca flavescens*	17	59

Table 3: Fish species captured along the Lake Huron Coastal Shoreline within the Saugeen Ojibway Nation Territory between June and September 2019.

Common Name	Minimum Total Length (mm)	Maximum Total Length(mm)	Total abundance	Number of Sites observed
Banded Killifish	18	83	223	15
Blackchin Shiner	21	95	326	13
Blacknose Shiner	22	77	1028	18
Blackside Darter	32	57	5	2
Bluegill	38	153	180	4
Bluntnose Minnow	20	95	557	23
Bowfin	37	586	29	9
Brassy Minnow	49	68	8	2
Brook Silverside	30	62	12	4
Brook Stickleback	25	45	8	4
Brown Bullhead	26	244	921	15
Central Mudminnow	32	82	6	5
Common Carp	33	124	5	2
Common Shiner	46	0	1	1
Creek Chub	21	48	10	2
Cyprinidae sp.	58	76	19	2
Darter sp.	23	28	4	1
Emerald Shiner	23	90	342	21
Fathead Minnow	45	91	11	5
Finescale Dace	30	57	4	2
Gizzard Shad	24	66	13	3
Golden Shiner	42	132	302	15
Iowa Darter	30	49	8	8
Largemouth Bass	19	125	18	7
Least Darter	13	54	10	8
Lepomis sp.	13	85	305	15
Longnose Dace	37	90	13	6
Longnose Gar	34	852	5	2
Mimic Shiner	19	71	548	16
Muskellunge	143	155	3	1
Northern Hog Sucker	54	N/A	1	1
Northern Pearl Dace	45	67	13	3
Northern Pike	330	330	1	1
Northern Redbelly Dace	43	68	14	1
Pumpkinseed	31	182	557	15
Rainbow Smelt	44	65	4	2
Rainbow Trout	57	70	8	1
Redhorse sp.	33	46	13	2
Rock Bass	20	190	72	19
Round Goby	19	106	82	24
Sand Shiner	21	93	290	12
Smallmouth Bass	34	160	17	8

Spotfin Shiner	20	92	197	11
Spottail Shiner	17	85	521	12
Sucker sp.	25	N/A	1	1
Threespine Stickleback	52	52	1	1
Too small to ID	12	23	376	9
White Sucker	89	195	3	3
Yellow Bullhead	29	29	3	3
Yellow Perch	30	111	42	10

Within the Lake Huron coastal region, there was a total of 13,713 individuals sampled, representing 44 different species. The number of fishes sampled in Lake Huron represents 17.9% of the total number of fishes sampled across the study area in 2019. The most commonly caught species were the Sand Shiner followed by the Mimic Shiner and Brown Bullhead. The Species that was most represented throughout the sites was the Round Goby (n=24 sites), followed by Bluntnose Minnow (n=23 sites), and Emerald Shiner (n=21 sites). The least common species included: Common Shiner, Northern Hog Sucker, Northern Pike and Threespine Stickleback each captured once, followed by the White Sucker, Yellow Bullhead and Muskellunge each captured 3 times.

Photo 13: Longnose Gar

*Table 2: Fish species captured along the Georgian Bay Coastal Shoreline within the Saugeen Ojibway Nation Territory between June and September 2019. *Note: "N/A" not measured*

Common Name	Minimum Total Length (mm)	Maximum Total Length(mm)	Total Abundance	# of sites observed
Too small to ID	11	14	44441	7
Mimic Shiner	22	92	6174	22
Bluntnose Minnow	21	96	3550	21
Emerald Shiner	24	101	2609	12
Spottail Shiner	19	0	2436	18
Round Goby	12	618	974	22
Blacknose Shiner	22	97	442	4
White Sucker	27	385	321	8
Redhorse sp.	25	41	315	1
Northern Redbelly Dace	37	69	309	4
Sand Shiner	21	75	265	15
Banded Killifish	27	71	216	9
Smallmouth Bass	20	417	104	5
Rock Bass	29	205	100	17
Least Darter	18	85	98	6
Larval Fish	N/A	N/A	68	1
Creek Chub	35	113	53	6
Lake Chub	27	171	48	5
Longnose Dace	42	100	32	8
Iowa Darter	25	55	32	4
Rainbow Smelt	43	135	28	8
Northern Pearl Dace	33	86	25	3
Salmonidae sp.	23	47	21	3
Blackchin Shiner	23	89	20	1
Yellow Perch	31	90	17	7
Common Shiner	46	73	15	1
Ninespine Stickleback	44	75	13	5
Threespine Stickleback	17	66	12	5
Common Carp	75	618	12	4
Pumpkinseed	39	126	9	4
Spotfin Shiner	66	83	7	2
Fathead Minnow	43	77	6	2
Golden Shiner	62	79	5	2
Hybrid Finescale/Red Belly Dace	40	79	5	2
Brook Stickleback	42	49	4	1
Brassy Minnow	56	70	3	3
Lepomis sp.	34	42	3	1
Blacknose Dace	67	67	1	1

Gizzard Shad	53	53	1	1
Rainbow Trout	63	63	1	1
Trout sp.	23	23	1	1

Within the coastal region of Georgian Bay 62,796 fishes were sampled representing 35 different species. The number of fishes sampled in Georgian Bay represents 82.1% of the total fish sampled throughout the Territory in 2019. The most commonly caught species were Mimic Shiner, than Bluntnose Shiner, followed by Emerald Shiner. The species that were most represented throughout the sites were Mimic Shiner and Round Goby (n=22 sites), followed by Bluntnose Minnow (n= 21 sites) and Spottail Shiner (n=18 sites). The least common species collected were the Blacknose Dace, Gizzard Shad, Rainbow Trout each caught once, followed by the Brassy Minnow caught three times and Brook Stickleback caught 4 times.

Photo 14: Eastern Newt

Reptiles and Amphibians

Photo 15:Obtaining measurements of a Painted Turtle

Site ID	Painted Turtle	Snapping Turtle	Milk Snake	Water Snake	Eastern Newt
Nawash-North (NAN)	1				1
Stoke's Bay (SB)	7	1	1	1	
Baie du Dore (BDD)	5				
Johnson's Harbour (JH)	2				
Fishing Islands - North (FIN)	5				
Chief's Point (CP)	2				

Table 3:Shows the number of turtles, snakes, and newts that were caught in the fyke nets throughout the regions. All the species were accidental catches (not a target species) and were all released healthy conditions.

Wetland Fish Index

There are several systems that have been developed for assessing the condition of Great Lakes coastal wetlands. The Wetland Fish Index (WFI) was developed by Chow-Fraser and Steilheimer (2006 and 2007) and is used across the Great Lakes to assess the relative health of wetlands. This method ranks wetlands based on the tolerance of present fish species to degraded water-quality conditions. We can use this tool to compare the relative quality of nearshore habitats based on the fish species presences, absence, and abundance of species. For example, a site characterized by a high abundance of non-native species, such as round goby, would have a low WFI score and a site characterized by a high diversity (but low abundance) of native species will have a higher WFI score. Equations were developed by Chow-Fraser and Steilheimer (2006 and 2007) that use the fish species recorded at each site, compared with previous research related to fish tolerance in a variety of environmental conditions (tolerance to turbidity, low dissolved oxygen, contaminants, dissolved oxygen, etc.). Here we have compared our WFI results to a WFI ranking as calculated by Parks Canada for applicability to the regional context. We have not presented a full analysis in this report, but will include additional analysis in a secondary report 2019 report and in our 2020 report, comparing the data collected in 2019 and 2020. We will also use our water quality data from 2020 with our fish data from 2019 and 2020 to develop a WFI ranking specific to the Territory.

Table 5: Shows Wetland Fish Index (WFI) scores for each study region across the Territory. WFI scores are shown for the mean value for Fish Presence/Absence and Abundance WFI values. Scores range from Moderately Degraded to Very Good.

Study Area Region	Mean WFI (PA – A)	WFI Score
Baie du Dore (BDD)	3.47	Good
Chief's Point (CP)	3.50	Good
Colpoy's Bay (CB)	3.47	Good
Georgian Bay Islands (GBI)	3.19	Moderately Degraded
Inverhuron (IH)	2.59	Very Degraded
Johnson's Harbour (JH)	3.40	Good
Lion's Head (LH)	N/A	N/A
Fishing Island-North(FIN)	3.78	Very Good
Fishing Island- South (FIS)	3.26	Moderately Degraded
Owen Sound (OS)	3.28	Moderately Degraded
Nawash- North (NAN)	3.54	Good
Nawash- South (NAS)	3.11	Moderately Degraded
Saugeen Shores (SA)	2.91	Very Degraded
Stokes Bay (SB)	3.46	Good
Nottawasaga Bay (NB)	3.35	Moderately Degraded

Table 6: Shows Wetland Fish Index Categories used to Rank Wetland Condition.

Wetland category	Mean WFI-PA score	Median WFI P-A score
Very good	3.75 +/- 0.26	3.80
Good	3.50 +/- 0.21	3.51
Moderately degraded	3.26 +/- 0.25	3.28
Very degraded	2.68 +/- 0.33	2.60
Highly degraded	2.12 +/- 0.35	2.12

Data collected across the 15 regions (74 sites) in 2019 were analyzed through the Wetland Fish Index and demonstrate that all habitats ranged from Moderately Degraded – Very Good condition. Lion's Head could not be assessed as effort at these sites yielded no collection of fish data. In 2020, we collected additional water quality data that will allow us to include a Water Quality Index into this assessment and provide a more accurate score for each region. We will continue to complete this analysis each year to understand changes in wetland health. We can also compare these results to the same analysis completed by other researchers around Lake Huron and Georgian Bay, and long-term Wetland Fish Index analysis completed by Parks Canada.

Vegetation

Plant species were identified within the perimeter of the net at each fish sampling location. Plants that could not be identified to species were recorded by family name. There was a total of 56 plants identified to species and 18 plants identified to family. Plant communities are an important part of nearshore fish habitat and fishes rely on the structure created by vegetation for refuge (shelter), feeding, and nursery. In general, locations with more vegetation also have higher abundance and diversity of fish species present. As water levels rise, the plant composition in nearshore habitats are changing. In many locations, plants are becoming submerged and this creates more structural habitat for nearshore fish communities. However, if the density of vegetation is too high in any given area, the habitat value and use for fishes will decrease due lower dissolved oxygen and less suitability as refuge (since the fish can't fit between the plants).

Photo 17:The Arrowhead – waabiziipin - Is an aquatic plant that traditionally was used as a source of starchy food - in particular, the root or corm. It was also recorded to be used to relieve indigestion.

*Photo 16:Curly-leaved Pondweed (**Potamogeton crispus)** is a non- native species to Ontario*

Photo 18: Aquatic plants provide good habitat for many aquatic invertebrates and cover for young fish and amphibians. Some aquatic plants can be indicators of a site's water quality, either through its presence or its abundance.

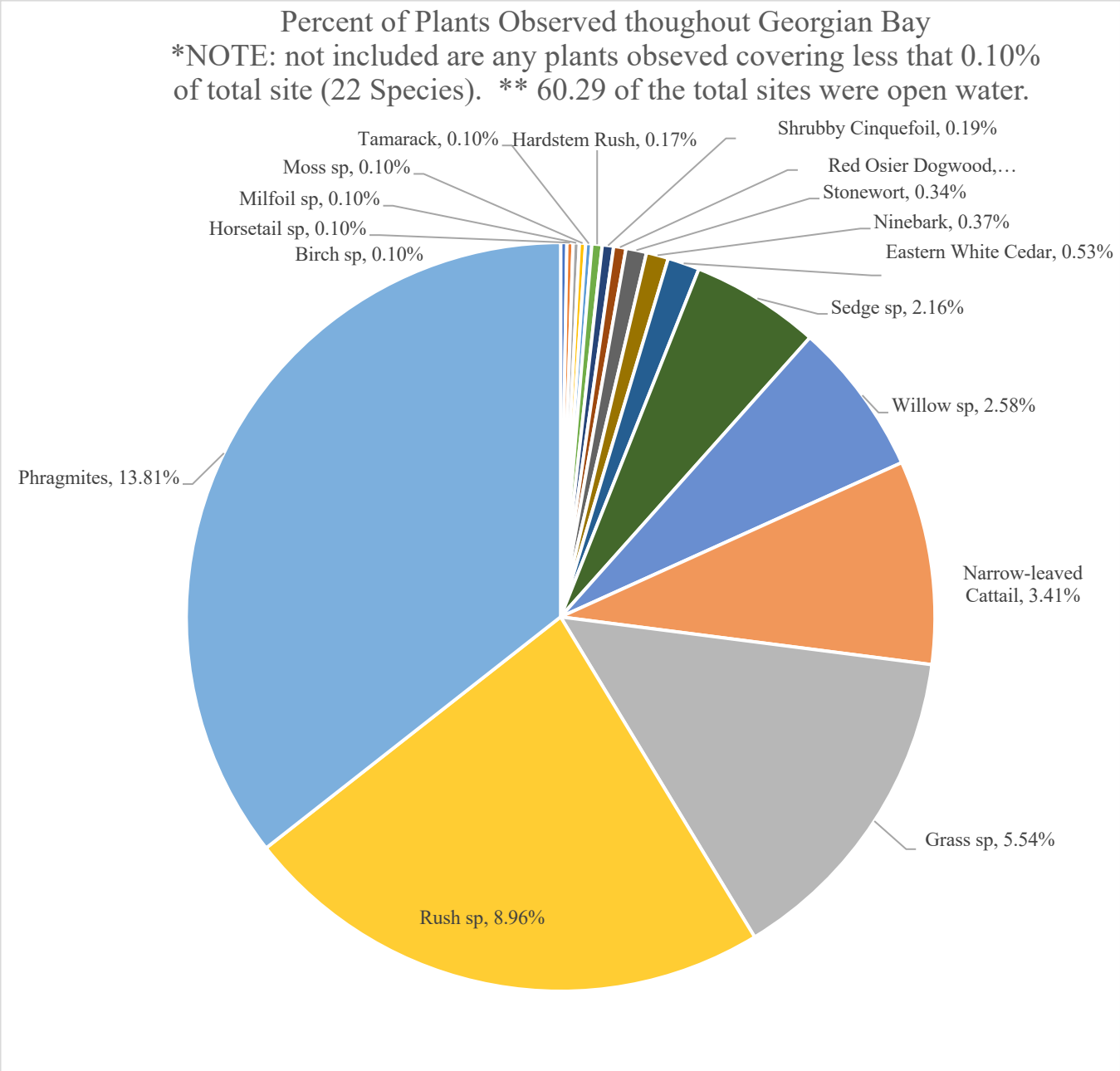

Figure 6:Percentage of plants by species sampled throughout sites in Georgian Bay

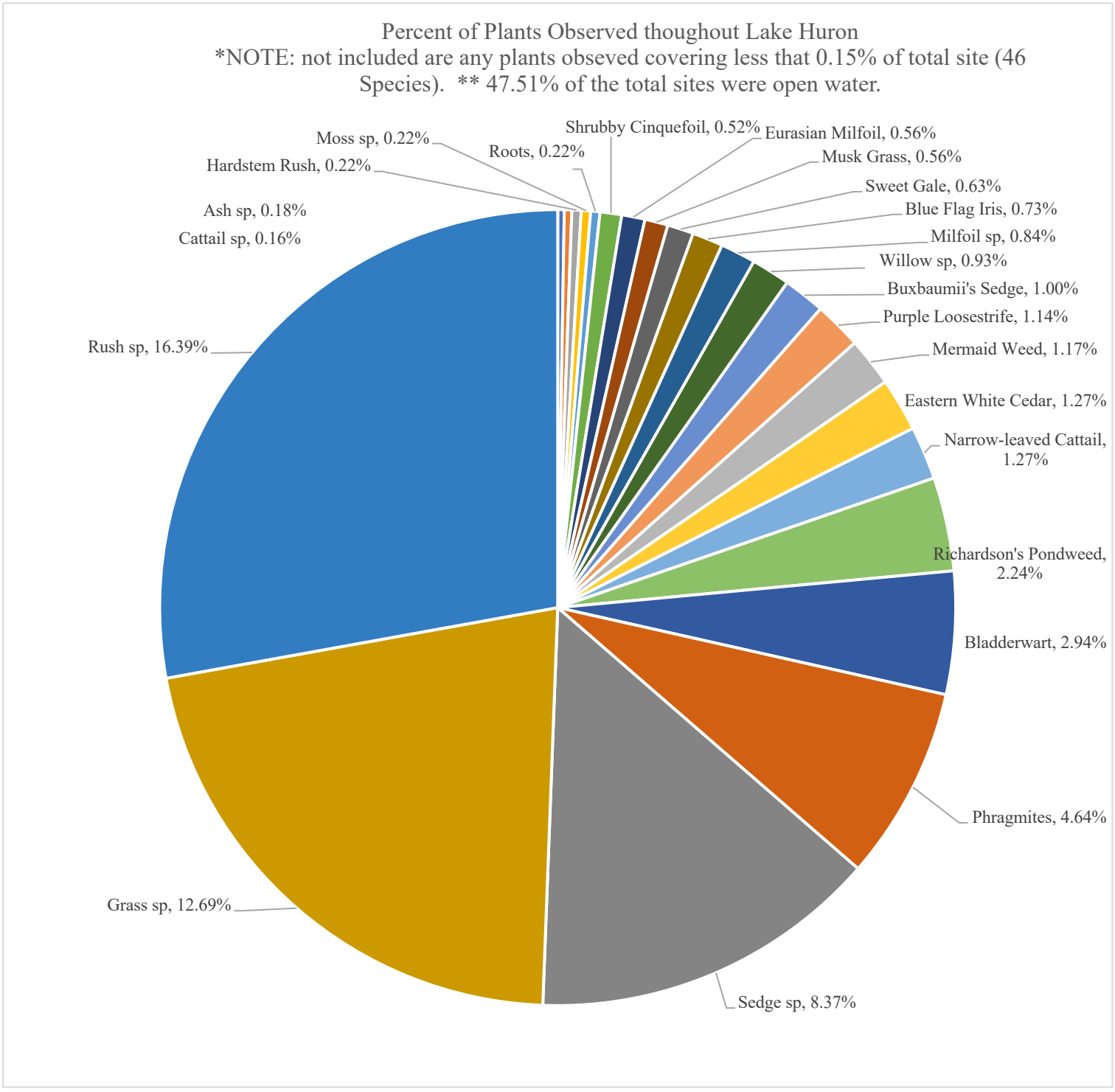

Figure 7: Percentage of plants by species sampled throughout sites in Lake Huron

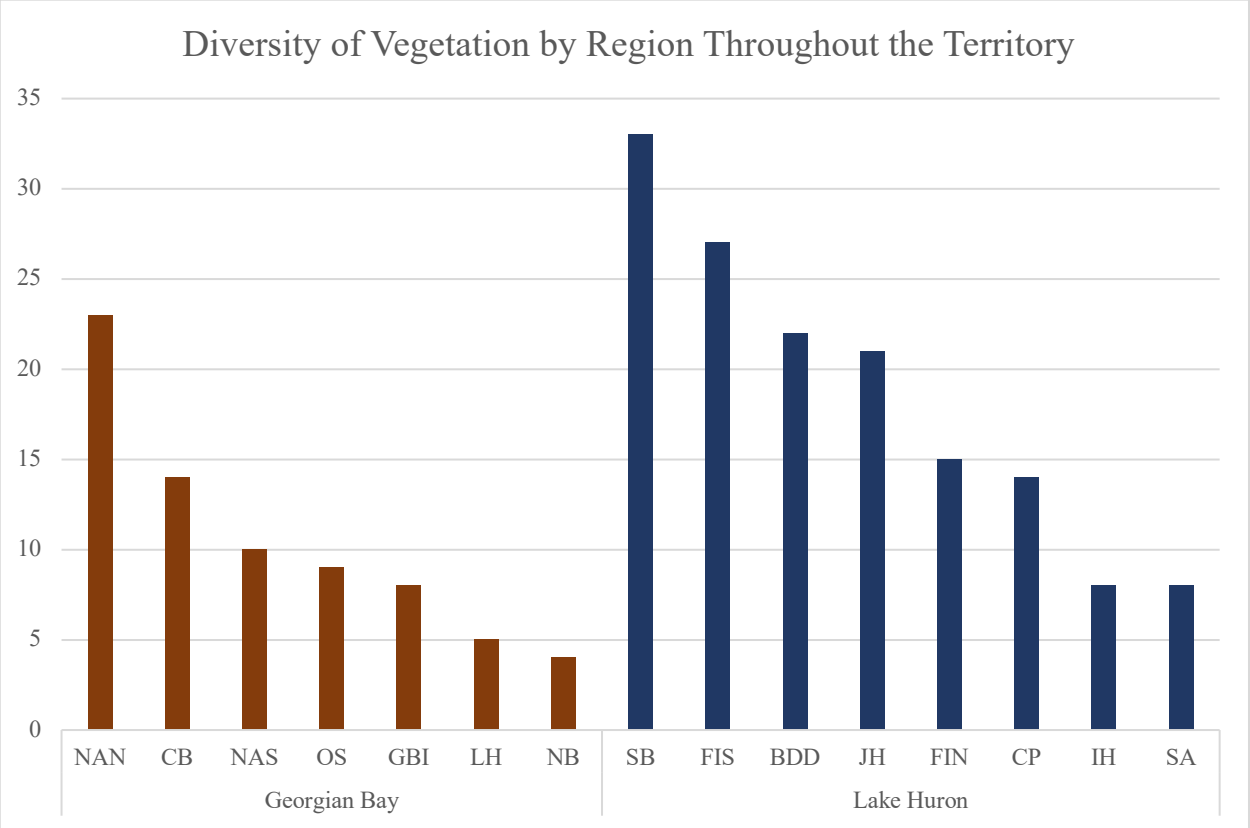

Figure 8: Diversity of vegetation by region throughout the Territory.

This graph (with Figures 7 and 8) shows that diversity of vegetation species in coastal regions of Lake Huron is notably higher than diversity in coastal regions of Georgian Bay. This is partially due to the differences in environmental characteristics on either side of the Lake, including differences in dominant sediment types (e.g., rock, sand, clay), water temperature and clarity, and movements of wind and water currents (and nutrients). There was a total of 74 vegetation species observed throughout the Territory with a total of 404 species sampled. Macrophyte diversity was higher at Lake Huron sites (n = 61 species) than Georgian Bay sites (n=38 species).

Water Quality

Water Quality refers to the chemical, physical, biological and radiological characteristics of water. We measure water quality to understand the health of a habitat or ecosystem based on the composition and condition of the water (contaminants, pH, oxygen, nutrients) and what other biota (fish, plankton) are living (or not living) within that system. Water quality helps us to understand why certain fish species are present or absent from an area and what stressors may be impacting a system (e.g., run off from roads).

Conductivity, total dissolved solids, dissolved oxygen, pH, and water temperature were measured at each seine and fyke net site using a H198194 pH/EC/DO Multiparameter Hanna Meter.
Photo: Using the Hanna Meter to assess water quality at Nawash Sweet Corner (NAF09)

Photo 19: Using the Hanna Meter to assess water quality at Nawash (NAF09)

Photo 20: the Hanna Meter is used to assess water quality

Conductivity

Conductivity refers to waters ability to conduct electricity. It is measured based on levels of dissolved salts and other inorganic chemicals in the water. Conductivity can be affected by the number of and type of ions as well as temperature. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered the water.

Many aquatic species are sensitive to abrupt changes in the amount of salt within their environment. High or low conductivity may have negative effects for these species and could indicate that the habitat may not be suitable.

Low 0µS/cm to 200µS/cm	Mid-range 200µS/cm to 1,000µS/cm	High 1,000µS/cm to 10,000µS/cm

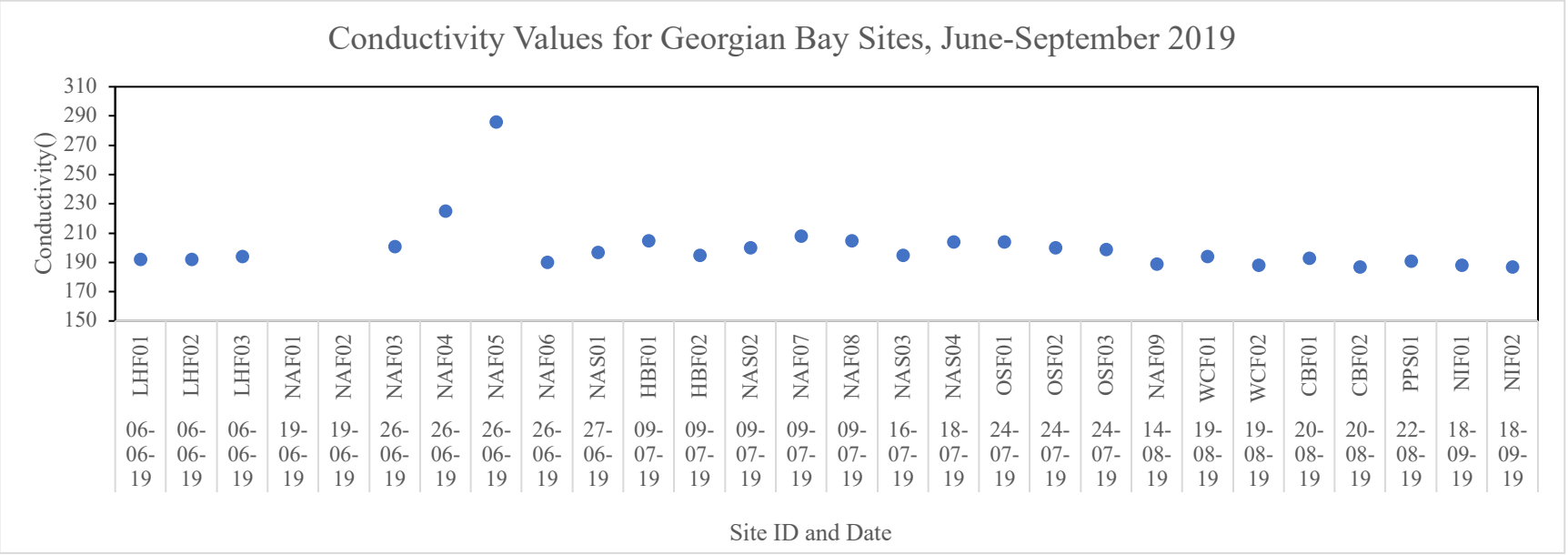

Figure 9: Conductivity levels were relatively consistent throughout Georgian Bay with an average of 109.20 µS ± 19.39µS and ranging between 187 µS and 286 µS. NAF05 was significantly higher than the remaining Georgian bay sites. While CBF02 and NIF02 were lower

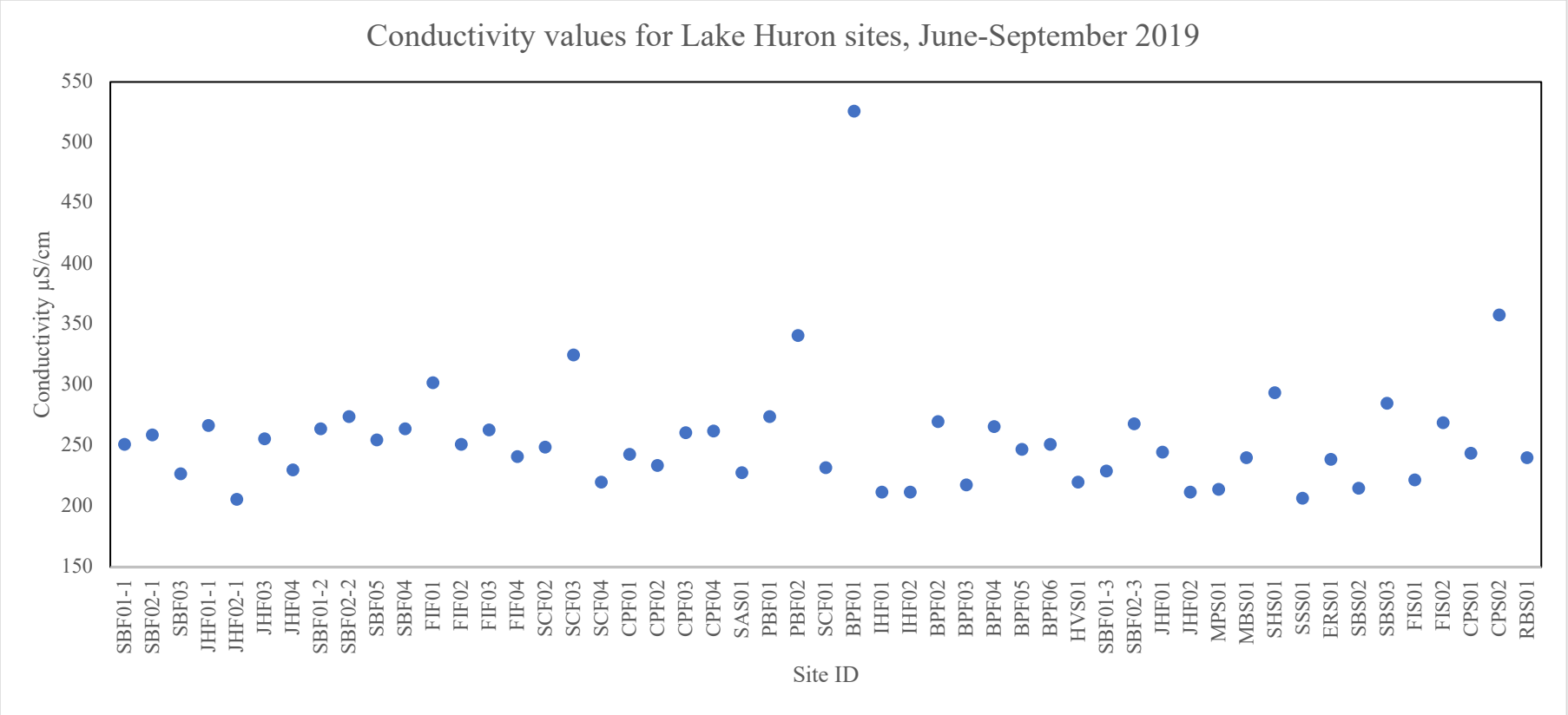

Figure 10: Conductivity levels were relatively consistent throughout the Lake Huron with an average of 256.5µS ± 50.29µS and range between 206µS and 526µS. BPF01 (Baie Du Dore) was significantly higher than the remaining site. While JHF02-1 had the lowest levels.

The sites with a highest conductivity values in Lake Huron and Georgian Bay were BPF01(Baie Du Dore) and NAF05 (Nawash-North). All the site levels were well within the acceptable range for conductivity (no concern).The sites outside the ideal range could be influenced by a number of factors including proximity to river or creek mouth (run off after storm event).

Dissolved Oxygen (DO)

DO is the amount of oxygen present in the water. It is produced by aquatic plants and other influences from the atmosphere such as wind and currents. DO levels can decrease from aquatic animals and microorganisms breathing and through decomposition of plant or animal materials. The DO requirement varies for different fish species and ages, but is essential for the survival of fish and other aquatic animals. DO has the ability to affect the depths at which species can be found as well as their activity level and ability to protect themselves from predation.

Fish unable to survive 0-4.0 Mg/L	Very few fish can survive 4.0-6.4 Mg/L	Most large fish can survive 6.5-9.5 Mg/L	All fish can survive 9.5-14 Mg/L

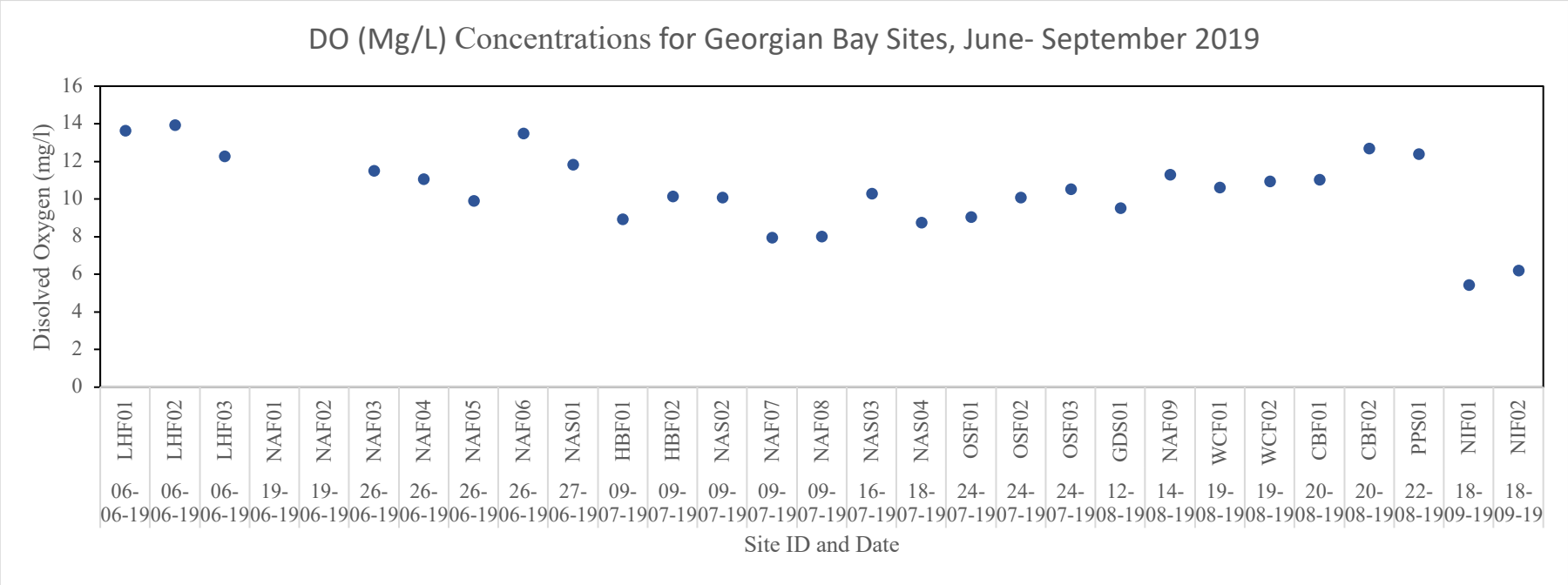

Figure 11: The dissolved oxygen values range from a low of 5.43 mg/l at the NIF01(Nottawasaga Bay) site to a high of 13.95 mg/l at the LHF02 (Lion's Head) site. The average DO concentration is 10.47 mg/l (± 2.12) throughout the sites along Georgian Bay.

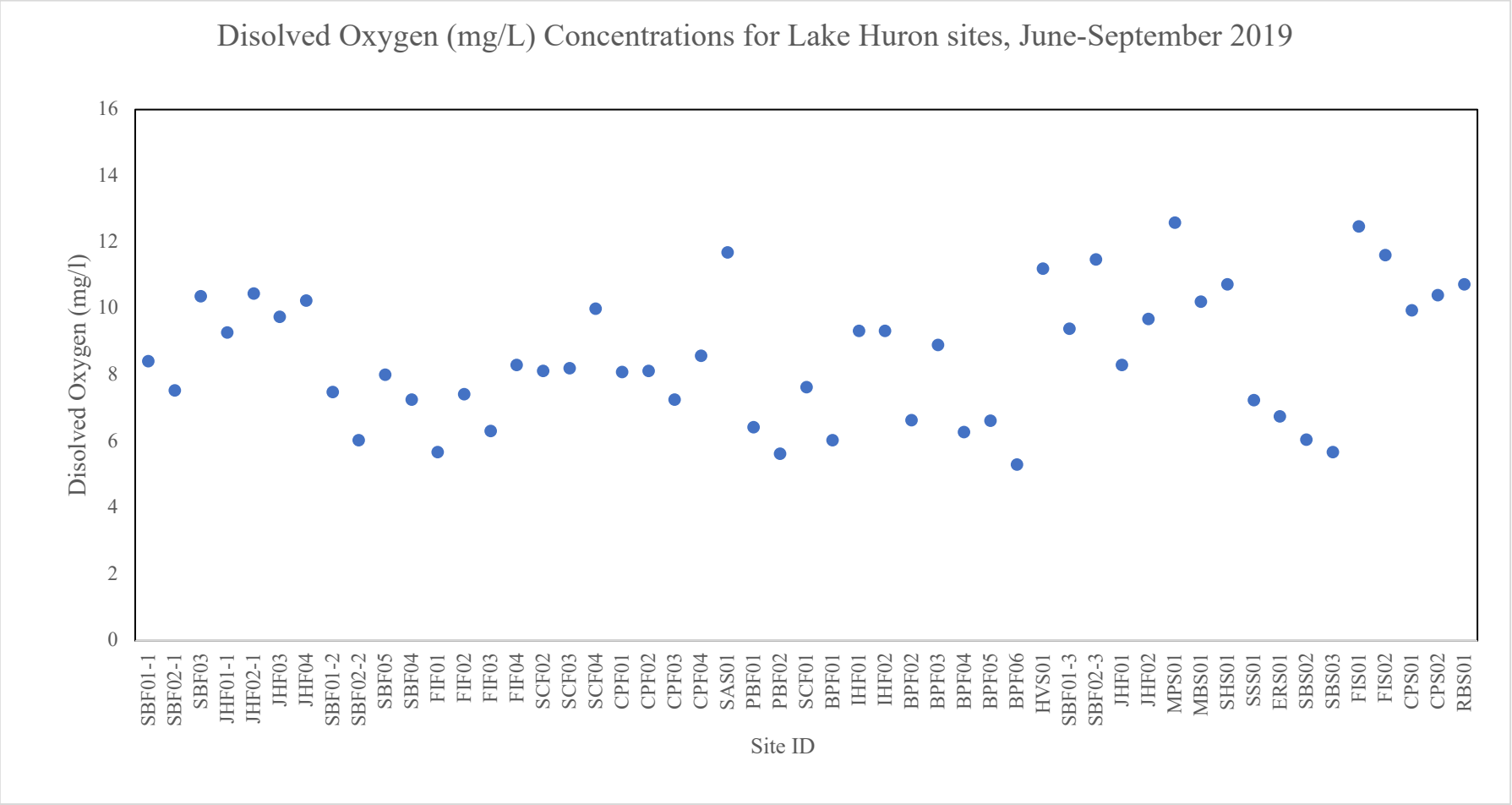

Figure 12: The dissolved oxygen values range from a low of 5.31mg/L at the BPF06 (Baie Du Dore) to a high of 12.61mg/l at the MPS01(Saugeen Shores). The average is 8.55mg/l (±1.96) throughout Lake Huron sites.

The dissolved oxygen concentrations for Lake Huron sites show more variability when compared to Georgian Bay. The shoreline and habitat composition of Lake Huron is more variable (depths, plant density and habitat composition) than Georgian Bay which can influence dissolved oxygen greatly.

Total Dissolved Solids (TDS)

TDS is the measurement of any mineral, salt, metal or small amounts of organic/inorganic matter dissolved in the water. This matter originates from sewage, urban and agricultural runoff, salts used for road de-icing, drinking water treatment chemicals, storm water and wastewater discharges.

High TDS levels can reduce water clarity, creating a decrease in photosynthesis and an increase in water temperature. This reduction of clarity can affect the fish ability to forage food and sediment could clog gills, reduce growth rates and decrease resistance to disease. Depending on the properties of TDS, excessive amounts can produce toxic effects on reproduction and survival rates for fish and fish eggs.

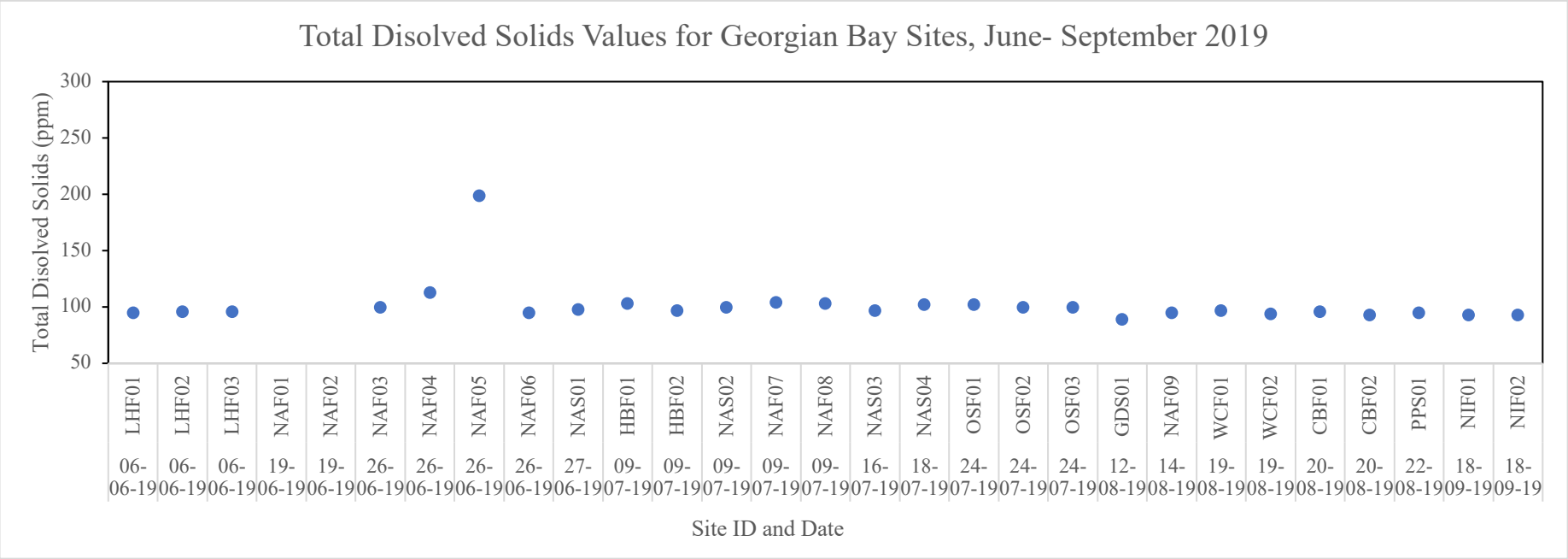

Figure 13:The Total Dissolved Solids (TDS) were relatively consistent throughout Georgian Bay. The average TDS was 102.1 ppm (±20.25) for the sites, with TDS values ranging from a low of 93 ppm at CBF02 (Chief's Point), NIF01, NIF02 (Nottawasaga Bay) and the highest being 199 ppm at NAF05 (Nawash South). This site was located next to a mouth of a river.

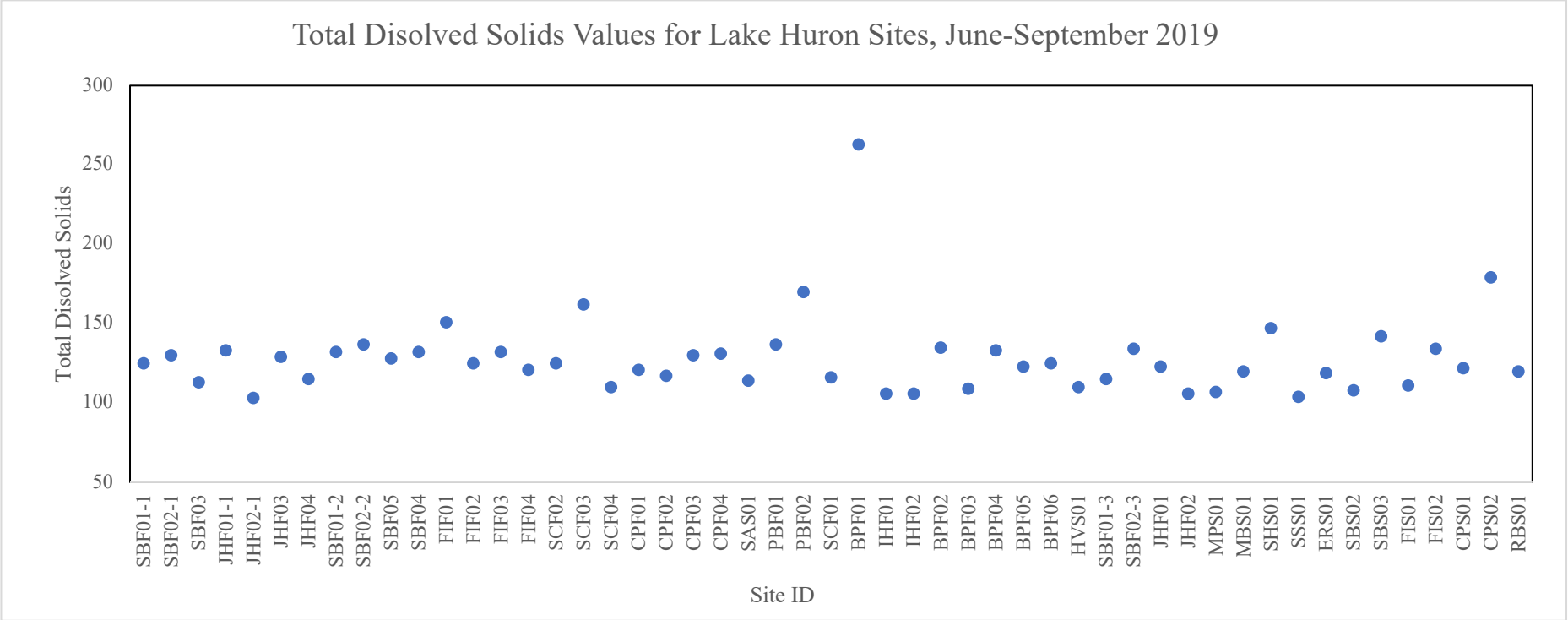

Figure 14:The Total Dissolved Solid values (TDS) at the Lake Huron sites showed more vitiation than the sites on Georgian Bay. The average TDS was 128.24 ppm (±25.089) with TSD values ranging from a low of 103 ppm at JHF02-1 (Johnson's Harbour) and the highest TDS value being 263 ppm at BPF01 (Baie Du Dore). BPF01 (Baie Du Dore) had a significantly higher value than the other sites, which could be a number of factors that affect these levels.

Power of Hydrogen (pH):

The pH scale is used to measure how acidic or alkaline a water-based solution is. Significant or long-term changes in pH levels can impact fish spawning and survival of hatchlings. It can also affect the availability variability of food sources within the area.

Fish can't survive 0-4.0	Very few fish can survive 0-6.3	Fish like best 6.4-8.4	Very few fish can survive 8.5-11.4	Fish can't survive 11.5 – 14

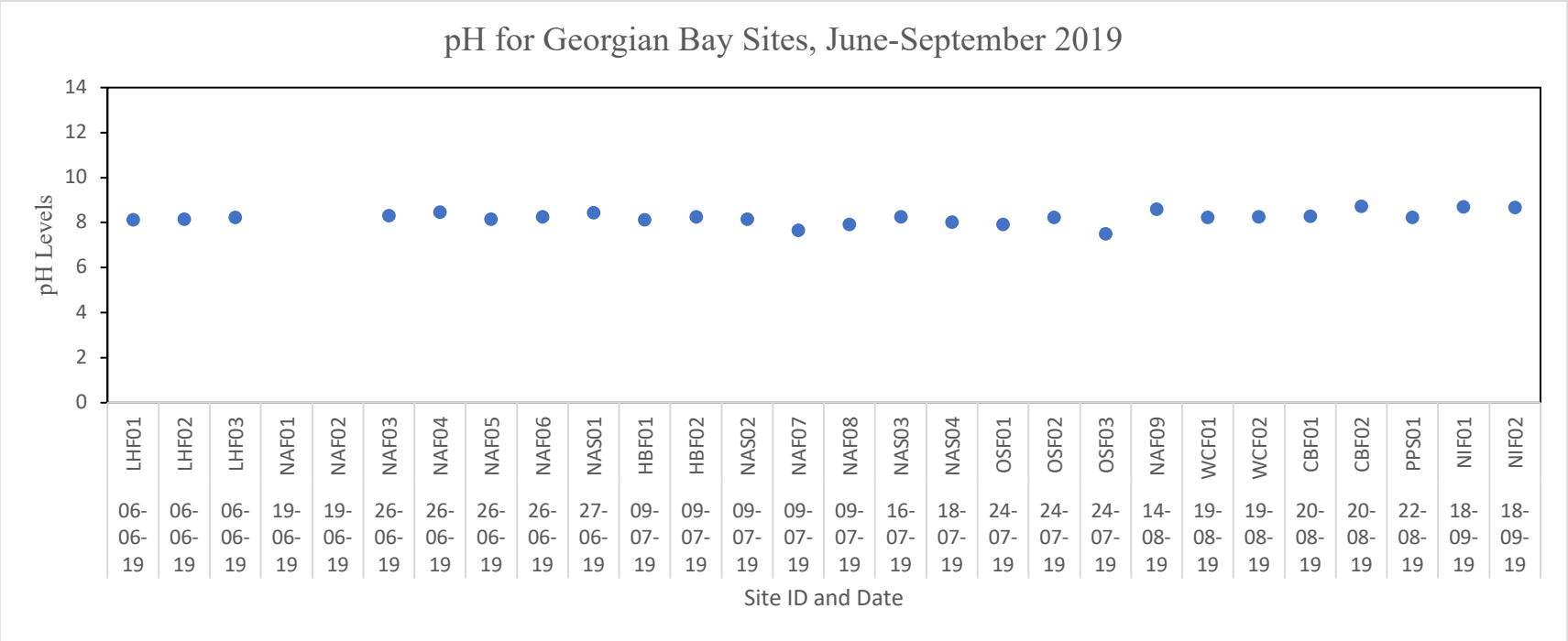

Figure 15:The pH throughout Georgian Bay ranged between a low of 7.51 at OSF03(Owen Sound) and the highest being 8.73 at CBF02 (Colpoy's Bay) The average pH was 8.23 ± 0.28.

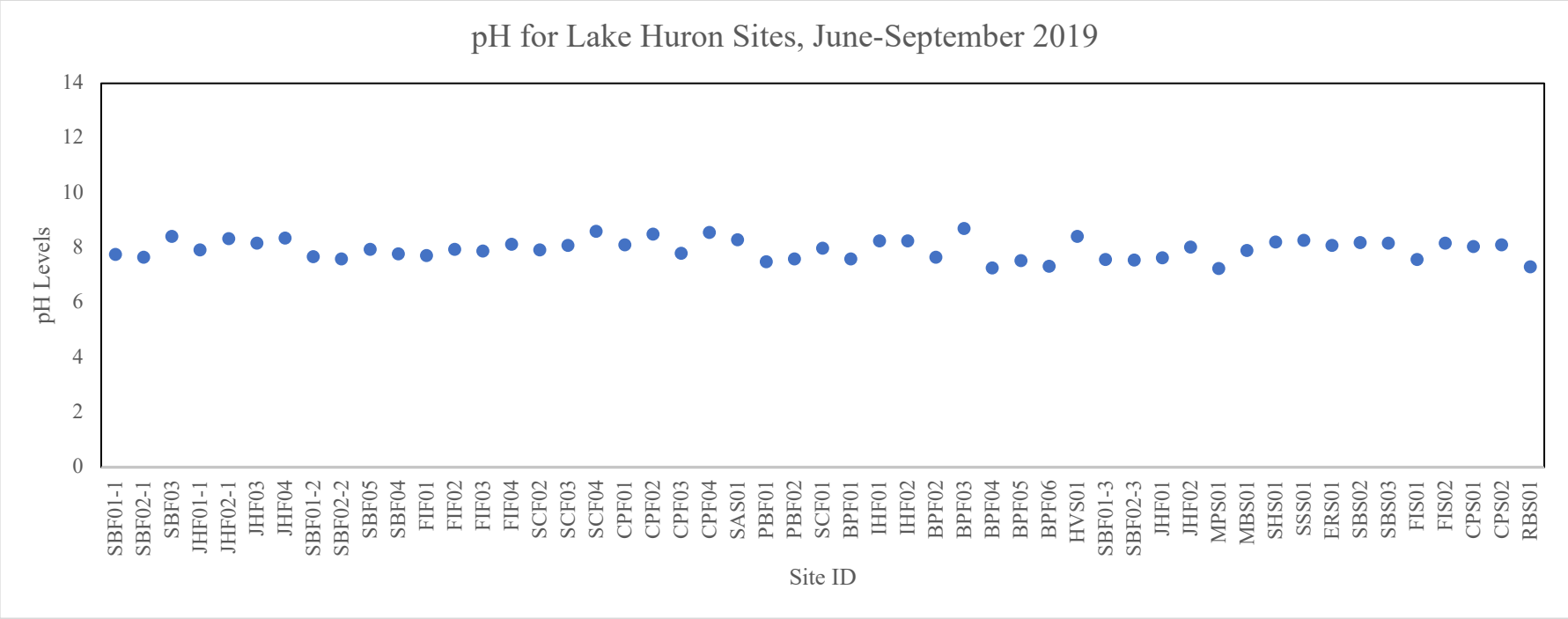

Figure 16:The pH throughout Lake Huron ranged between a low of 7.24 at MPS01(Saugeen Shores) and the highest being 8.70 at BPF03 (Baie Du Dore), the average pH was 7.95 ± 0.367

The sites throughout the Territory were fairly consistent throughout the season. Although the majority of the sites were within the range that 'fish like best' (Power of Hydrogen range table), there was 8 sites that had a slightly higher pH levels where few fish can survive.

Temperature Loggers

In 2019, a total of 19 HOBO TidBit (vX) Temperature Loggers were set along the coastal waters of Georgian Bay and Lake Huron, with water depths ranging from 1 m to 3.2 m (Figure 18). Loggers were set within various habitat types and substrates of rock varying in size (bedrock, bolder, cobble, pebble), rock-sand mix, sand, silty-sand, muck and detritus. Temperature logger sites were deployed in representative locations based on fish sampling sites.

Note: temperature logger NAL03 was not retrieved at the end of 2019 field season due to weather.

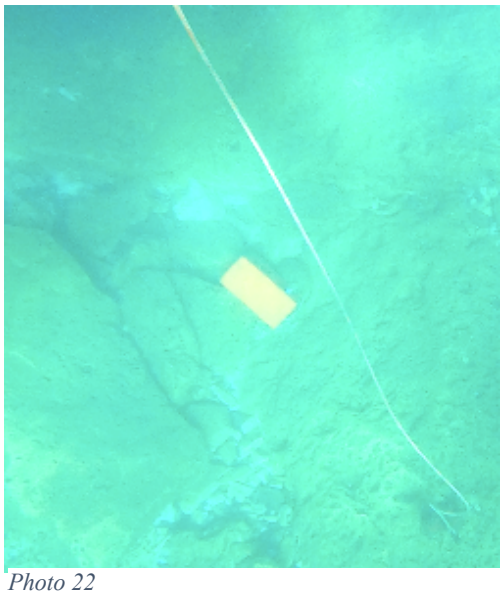

Photo 22

Photo 21

Photo 24

Photo 23

Photos 18 and 19 show a temperature logger deployed at two separate sites. Photo 20 shows the HOBO Temperature Logger and the HOBO Water Level and Temperature Logger. Photo 21 shows the setup of a temperature logger on a cinder block.

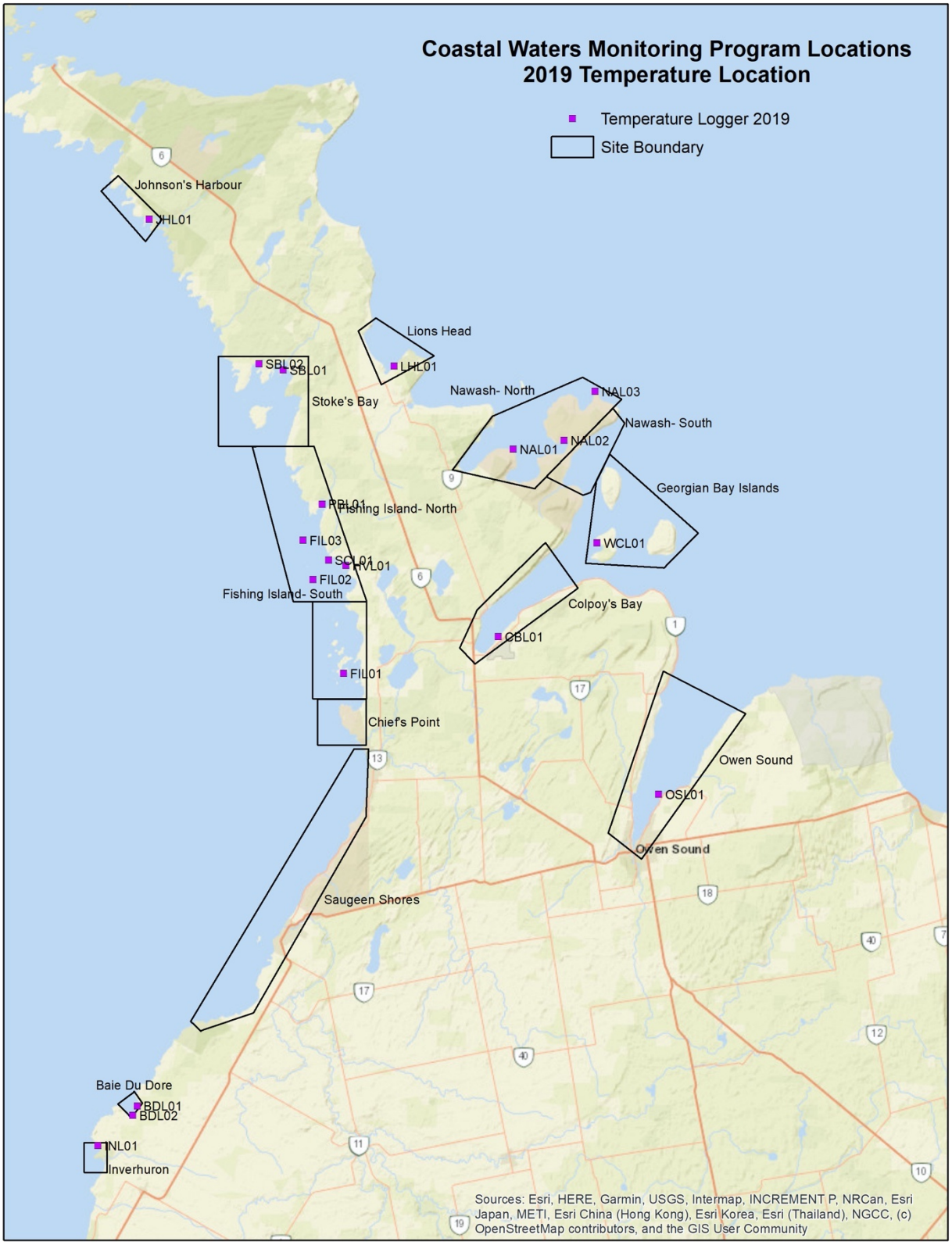

Figure 17:Shows the location of temperature loggers with Logger ID

Water Temperature

Water temperature was measured at the surface and bottom of the water column at both the deployment and collection of the net. Each site was georeferenced using a Garmin inReach SE+ global positioning system unit.

Cold water fish <19 °C	Cool water fish 19 °C To 25 °C	Warm water fish 19 °C - >25 °C	Can't survive or become lethargic 35 °C +

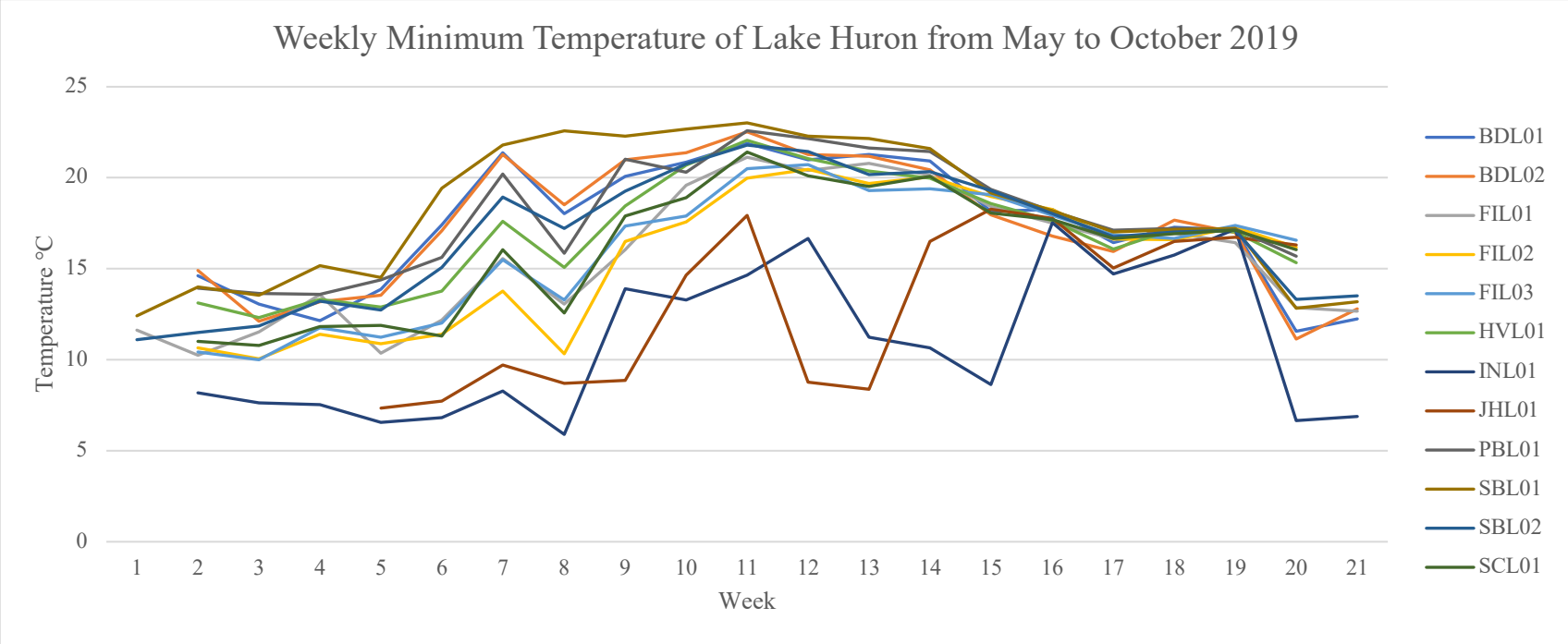

Figure 18:Comparing the minimum weekly temperatures in Lake Huron. INL01 (Inverhuron) and JHL01 (Johnson's Harbour) had the lowest temperature compared to other sites. SBL01 (Stokes Bay) recorded the highest minimum weekly temperature and stayed most consistent from weeks 7 to 14.

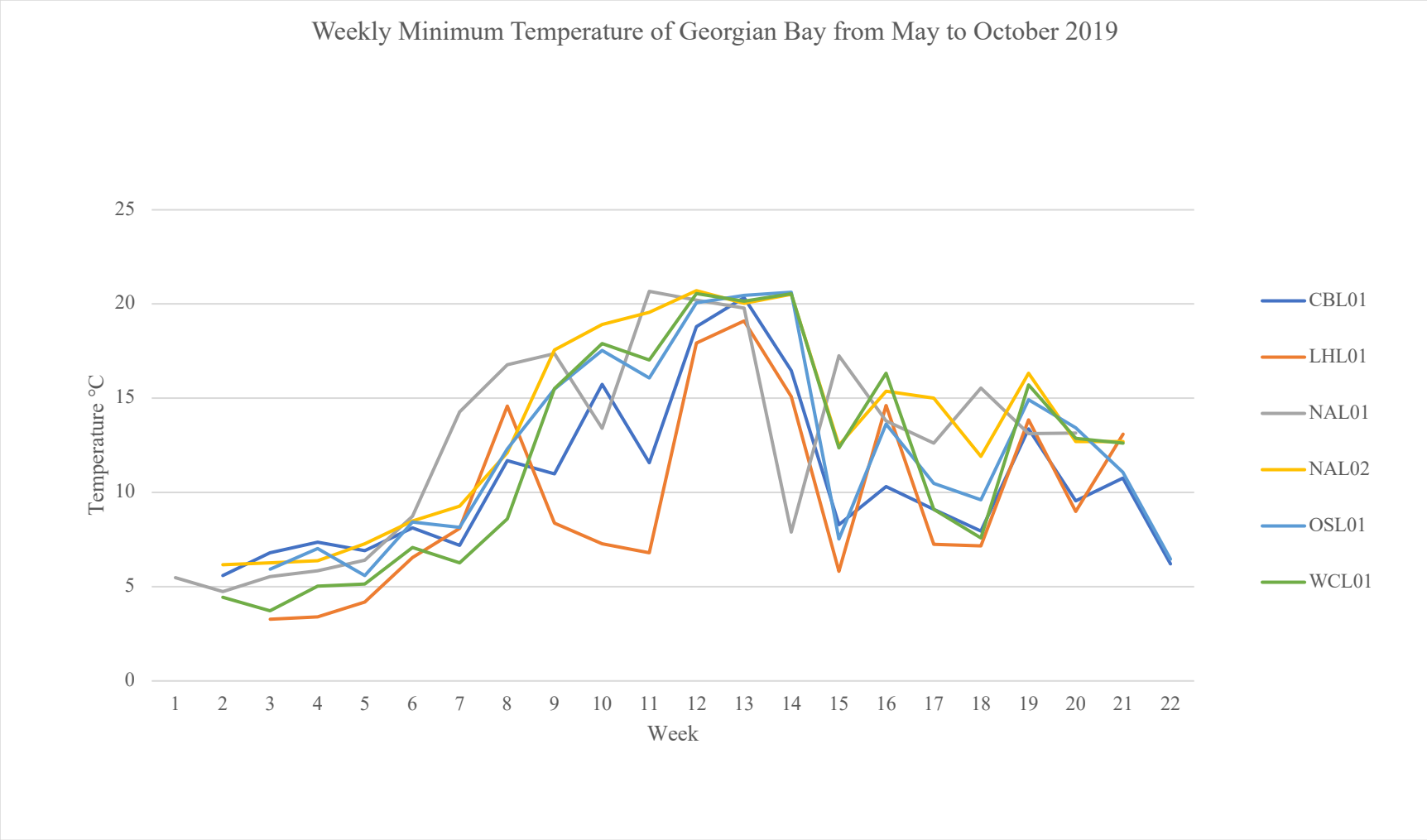

Figure 19: Comparing the minimum weekly temperatures throughout Georgian Bay. LHL01 (Lion's Head) had the lowest weekly minimum temperatures compared to other sites. Lion's Head also had the greatest temperature increase during weeks 11 and 12.

When comparing Figure 17 to Figure 18 it is evident that weekly minimum temperatures on the Lake Huron side are more consistent.

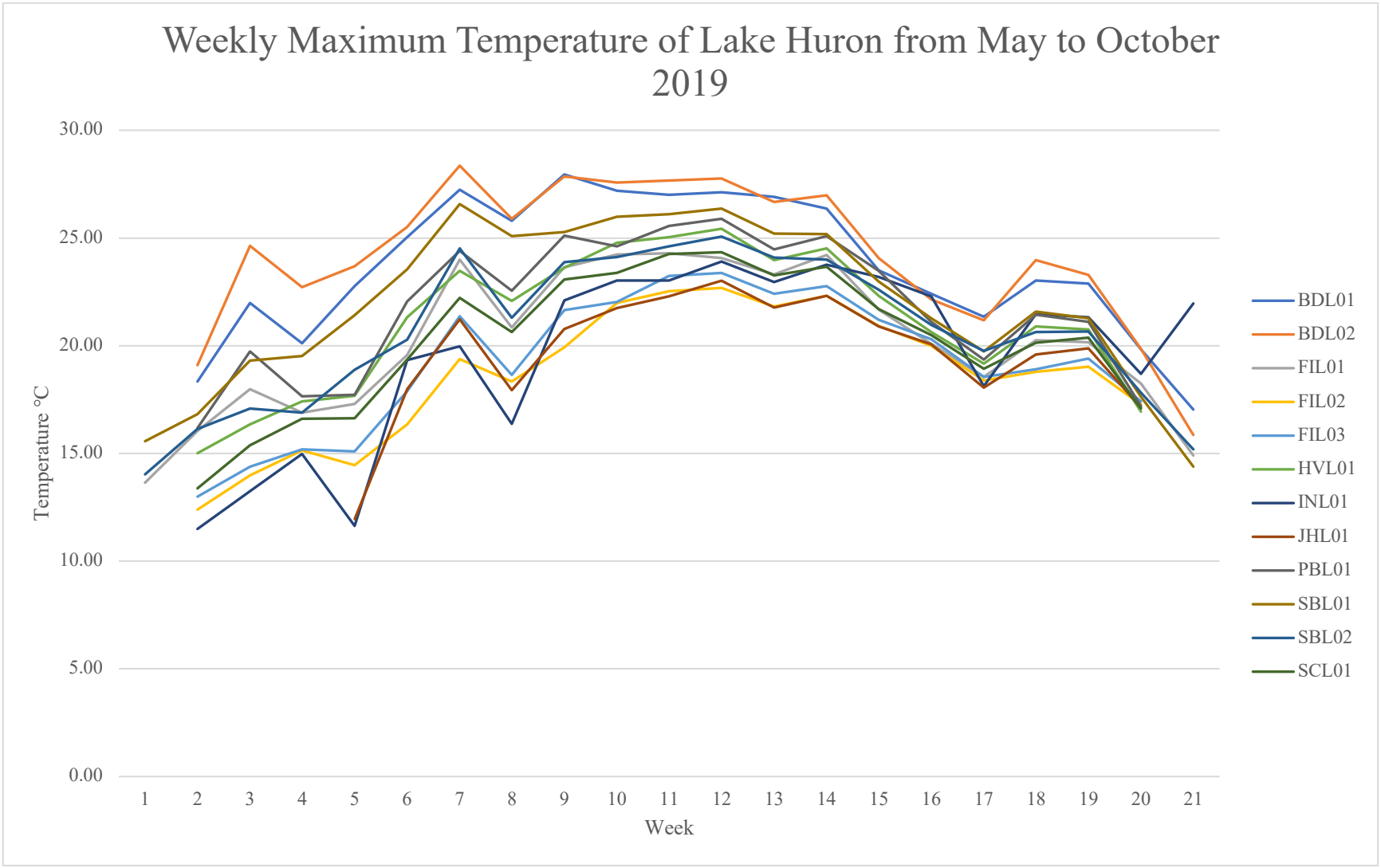

Figure 20: The weekly maximum temperatures for Lake Huron stayed fairly consistent. BDL01 (Baie Du Dore) and BDL02 (Baie Du Dore) had the highest temperatures throughout the season.

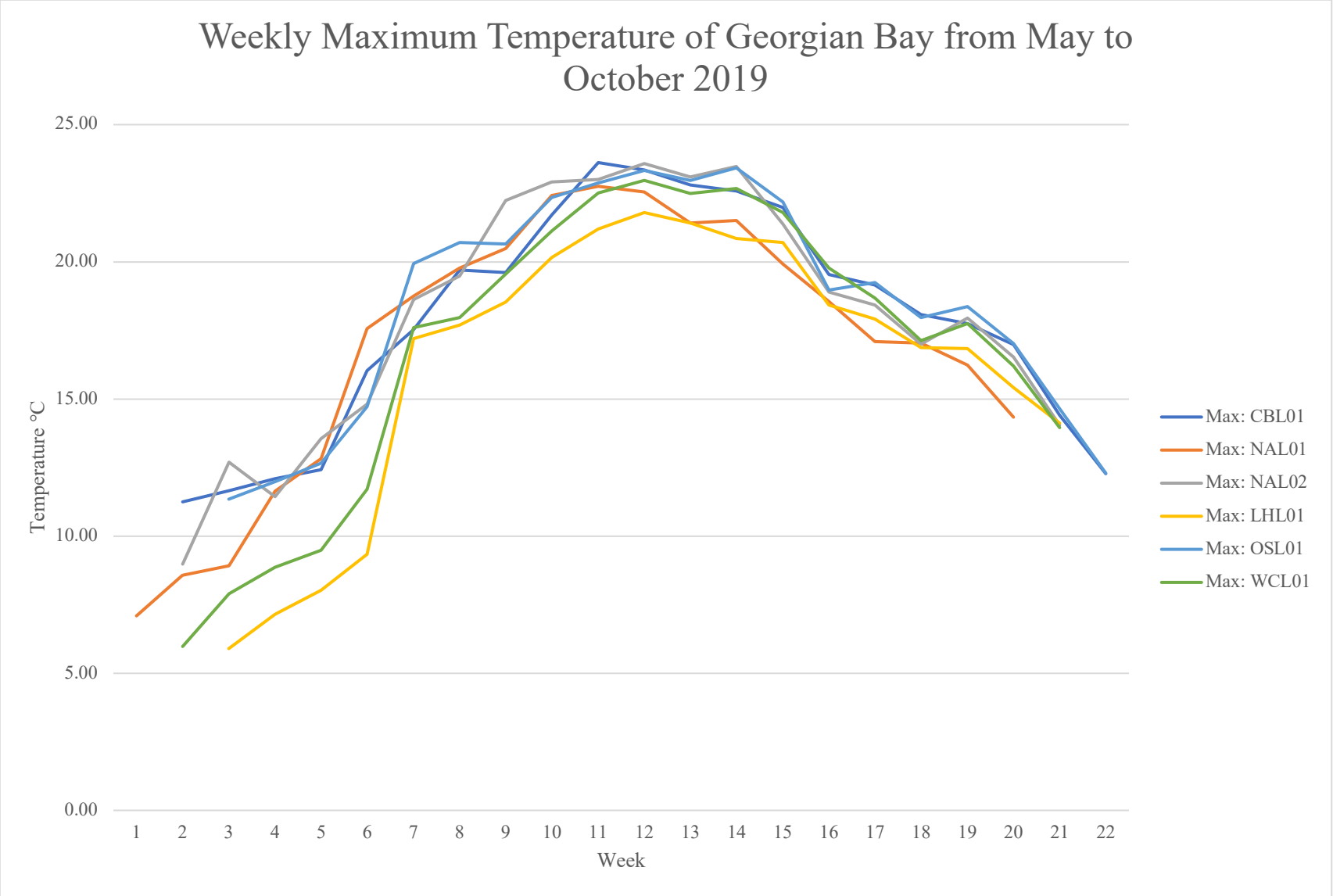

Figure 21: Shows that LHF01 (Lion's Head) took longer than all other Georgian Bay Sites to increase its maximum weekly temperature. When comparing figure to Figure X it is evident that weekly maximum temperatures are more consistent on Georgian Bay.

Bruce Power Study Area

The interactions between the Bruce Nuclear Generating Station (BNGS) and the environment have been an ongoing concern for SON since Bruce nuclear operations began. Of particular interest are enhancing our understandings of the thermal conditions in the vicinity of Bruce Power and how the thermal (and other environmental conditions) in the area interact with fish community composition and habitat use. Water discharged from Bruce Power (as part of the once-through cooling system) is heated above the natural lake temperature, and these thermal changes can impact fish both physiologically and behaviourally. Baie du Dore is included in the study area for Bruce Power due to its location immediately north of the Bruce A water discharge channel and its wetland habitat characteristics. Inverhuron is included in the study area for Bruce Power due to its proximity to Bruce Power, to the Bruce B water discharge channel, and its characteristics (much different than Baie du Dore). Chief's Point is also included in the study area for Bruce Power due to its proximity to Bruce Power, and its location relevant to the dominant coastal currents that move discharge water northward (from our temperature loggers we can begin to understand how the warmer water moves from the discharge along the Territory). Chief's Point can also be used as a (good condition) reference location for fish communities.

In 2019, the CWMP completed fish community assessments and basic water quality and habitat assessments within the vicinity of Bruce Power, including Six (6) sites located in Baie du Dore, four (4) sites in Chief's Point (fishing islands), and two (2) sites at Inverhuron.

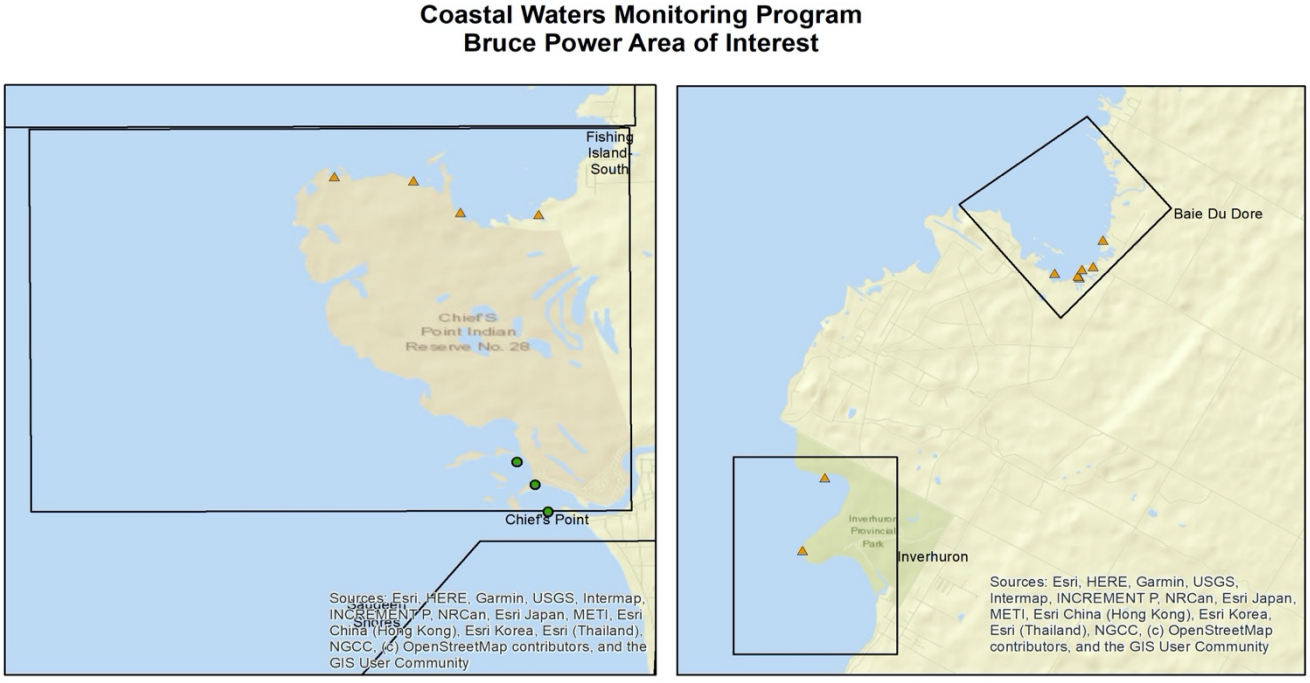

Figure 22: Bruce Power Area of Interest. Inverhuron, Baie Du Dore, and Chief's Point

Fish community sampling occurred between July 3rd and September 25th across the eleven (11) Bruce Power areas of interest. Baie du Dore sites were sampled on July 31 (3 sites) and August 13 (3 sites). Replicate site samples did not occur in 2019. All sites were sampled utilizing the

fyke net deployment, fish collection method and basic water quality assessment method outlined in the Methods section of this report.

Baie du Dore fish sampling locations (BPF01-BPF06) locations are identified on Figure 23. A total abundance of 1,628 fish were collected across BPF01-BPF06 representing 14 species, including 2 non-native/invasive species (note: *lepomis* sp. are included with abundance calculation for pumpkinseed). Brown bullhead accounted for 85% of total abundance, pumpkinseed 10%, and the remaining species each accounted for less than 1% of total abundance at Baie du Dore (Figure 24).

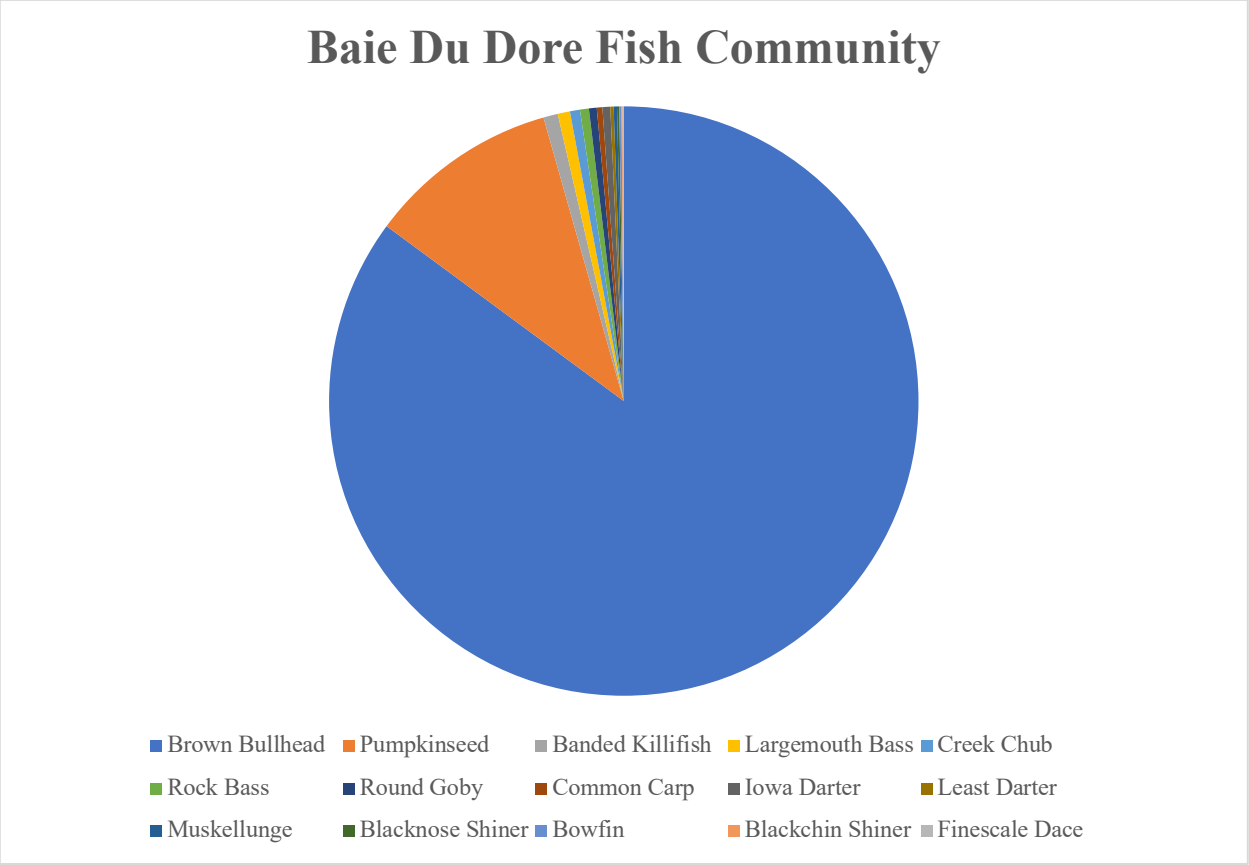

Figure 23: Baie Du Dore fish communities

Temperature loggers (HOBO Tidbit v2) were deployed at six (6) locations in the Bruce Power vicinity in depths ranging from 0.8 – 3.2 m from May 30, 2019 to October 8, 2019. The Baie du Dore temperature loggers were located at 0.8 m and 1 m and were deployed in locations representative of nearshore fish sampling locations. Figure 25 shows temperature data for the six (6) Bruce Power vicinity site.

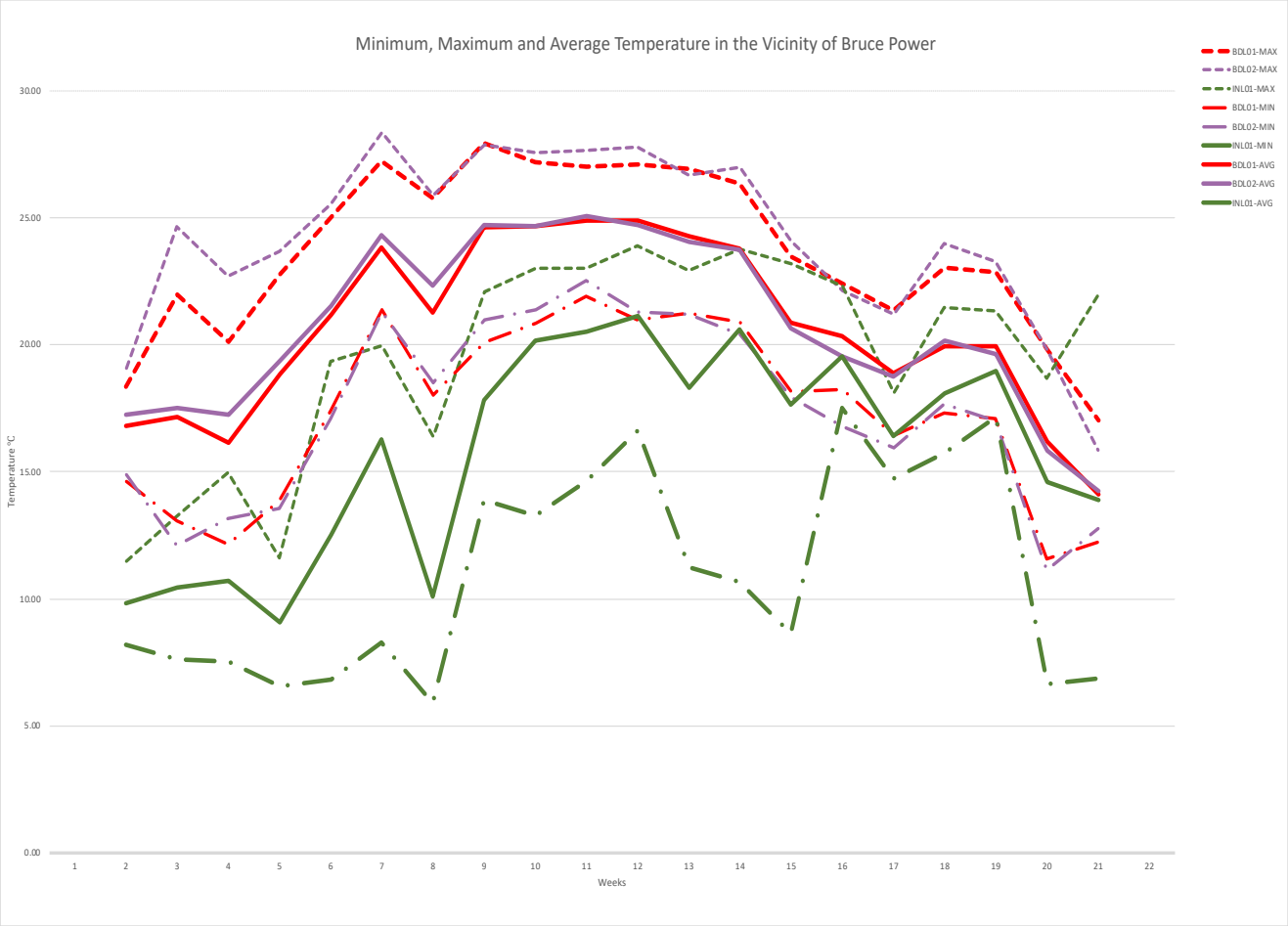

Figure 24: Shows the minimum, maximum and average temperature for the six (6) temperature logger in the Bruce Power area of interest.

Table 6: Water quality data for Baie Du Dore from July 31 to Aug 14, 2019.

Site ID	Set/Ret Date	Surface Temp	Bottom Temp	DO (mg/L)	DO (%)	Cond	TDS	pH
BPF01	31-Jul-19	26.44	28.88	6.05	76.6	526	263	7.59
BPF01	01-Aug-19	23.12	23.18	4.05	50.3	556	278	7.41
BPF02	31-Jul-19	26.56	26.61	6.65	84.2	270	135	7.65
BPF02	01-Aug-19	23.32	23.35	6.58	75.8	260	130	7.7
BPF03	31-Jul-19	25.35	25.36	8.92	110	218	109	8.7
BPF03	01-Aug-19	24.8	24.8	10.58	125	219	110	8.7
BPF04	13-Aug-19	24.06	24.09	6.29	74.5	266	133	7.26
BPF04	14-Aug-19	24.19	24.33	6.63	79.5	263	131	7.54
BPF05	13-Aug-19	23.86	23.85	6.64	80.4	247	123	7.54
BPF05	14-Aug-19	23.3	23.29	7.2	23.29	246	123	7.74
BPF06	13-Aug-19	24.17	24.66	5.31	64.7	251	125	7.34
BPF06	14-Aug-19	24.9	24.66	7.85	94.6	251	125	7.55

2019 Community Engagement

In 2019, the CWMP created several opportunities to engage with SON Community members. CWMP hosted a hands-on in-person workshop with the Community Leaders in Training Program (youth program at Neyaashiinigmiing), had an information booth at the Kikendaasogamig Elementary School career fair, and CWMP had a booth to share photos and data from the 2019 field season in both Saugeen First Nation and Nawash Unceded First Nation.

2020 Sampling Program

The data and information gathered by the CWMP in 2019 will be used as a baseline inventory of the Saugeen Ojibway Nation Territorial waters. Moving forward, we will have the ability to begin to compare data across years and to begin to understand the health/condition of the Territory and track changes or potential cumulative effects across our waters.

Challenges

In 2020, the team was unable to move ahead as planned due to COVID-19 closures and restrictions. Sampling began in late June 2020 and the originally planned larval sampling (April – May) was not completed. Although COVID-19 delays did affect our goals to enhance the amount of data collected and sites assessed, we were still able to collect a comparable amount of data to 2019.

Community Engagement

The CWMP hosted one workshop with Celtic Camp in summer 2020 and worked to create a social media presence and engagement for the program, despite the effects that COVID-19 had on our abilities to create in person community engagement opportunities. We will host several webinars and interactive sessions through the winter of 2020/2021, focussed on creating more opportunities for Community input and participation (citizen science).

Training

Despite the challenges of COVID-19, the CWMP team was able to attend two (2) certification workshops hosted by the Royal Ontario Museum (ROM), (1) Introductory Workshop of the Ontario Fishes and (2) Identification of Ontario Minnow workshop. We were also able to participate in the Virtual Indigenous Mapping Workshop hosted by the Firelight Group. In 2021 the team hopes to secure more funding in order to work with Water First (an organization working with First Nations to help address environmental water concerns and providing water science education for youth). This additional funding will help to acquire further training opportunities for our monitors such as Species at Risk- ROM workshop, Geospatial Information System mapping (GIS) and drone training.

Fish Community

In 2020, a total of n=55 nets were deployed across 14 regions in the Territory, and corresponding sampling was completed to assess fish community and environmental conditions. A total of n=62,657 individuals representing n=43 species were sampled.

Temperature

In 2019, temperature loggers were deployed at shallow depths at representative locations relative to nearshore fish sampling (fyke) sites. However, we determined that additional temperature loggers at greater depths (depths between 2m and 10m) are required to provide insight into the thermal dynamics in the nearshore regions of the Territory, and specifically as it relates to areas of interest such as Bruce Power.

In 2020, a total of 37 temperature loggers were deployed across the Territory. 19 temperature loggers were deployed at depths of ~1-2m and 18 additional temperature loggers were deployed at depths between 3 and 5 meters to provide additional representation of the environmental and fish habitat conditions in the nearshore waters of the Territory, and in the vicinity of Bruce Power.

22 temperature loggers were collected (to October 2020) and 15 temperature loggers will remain in the lake throughout the winter to attempt to collect a winter temperature data set. Temperature loggers can be easily lost during winter due to ice scour and storms, but we are hopeful to recover the loggers we have deployed.

Water Quality

In 2020, we enhanced our water quality assessment to include analysis of nutrients (e.g., phorsphorus, nitrogen), metals, and contaminants. Water samples were collected at 20 sites representing all 15 sampling regions across the Territory. Samples were collected in open water 10m from the edge of emergent aquatic vegetation for analysis of planktonic algae, primary nutrients and suspended solids (for sites with submergent vegetation throughout –we sampled in deeper areas with little submergent vegetation to minimize epiphytic or periphytic algae contamination of the sample).

Water samples were analyzed for the following parameters:

- Total Phosphorus
- Dissolved Metals (Iron, Magnesium, Lead, Sulfur)
- Dissolved Mercury
- Ammonia
- Nitrite
- Total Suspended Solids
- Chlorophyll a
- Orthophosphate

Conclusions and Next Steps

2019 was the pilot year of the CWMP and the work completed is a great accomplishment for SON. The geographic scale of the work and the fish community assessments completed was immense. In 2019, the CWMP crew fine-tuned our program and developed the skills and knowledge to undertake this important work. We have now completed the second year of the CWMP (2020) and it has again been a great success. Even in the face of the COVID-19 pandemic, our crew was able to complete an impressive amount of work and even enhanced our temperature and water quality assessments.

The CWMP is now one of the largest nearshore sampling programs in the Great Lakes and many agencies and organizations will look to our program and the information we have been able to collect to enhance our collective understanding of coastal regions of Lake Huron and Georgian Bay. We can also use this information to help inform our Communities and Leadership and support decision making about new and on-going projects and issues impacting environmental health across our Territory.

Not only is the program important for collecting data and understanding environmental conditions and changes, but it is important for the simple fact of being on the land and in the waters of the Territory every day. The CWMP crew's exploration of areas for assessment have brought to light ongoing issues in the Territory, such as shoreline developments and infrastructure projects. The crew has identified potentially harmful works that the Environment Office would otherwise be unaware of such as shoreline cottage developments and alterations to wetlands that are occurring without regulation and are harmful or destructive to nearshore environments and health. We now have the ability through our CWMP crew to monitor our Territory, and to follow-up and investigate any areas where SON Community members or leadership may have concerns.

Through the winter of 2020/21, we will be working to review and summarize our data from 2020, to complete detailed analysis of the data collected from 2019 and comparative analysis of the data from 2019 and 2020. We will also be developing tools for enhanced community engagement in the program, including webinars, and other interactive programming.

In 2021, we are planning to begin our field season in early April with sampling of larval fishes in Lake Huron. Beginning in May, we plan to replicate the temperature, water quality, and fish community assessments completed in 2019 and 2020 across the Territory. We also plan to add an additional region and sampling locations near Meaford, SON Territory, and to add several rivers and creeks in the Territory to our sampling program using backpack electrofishing methodology to sample fishes.

We invite SON Community members with questions, feedback, or concerns to contact us at: cwmp@saugeenojibwaynation.ca

Acknowledgments

We would like say miigwech to everyone who has supported the CWMP with your knowledge, equipment and emergency services. Esme Batten (Nature Conservancy of Canada), Cavan Harper (Bruce Peninsula National Park), Environment Office staff, Travis Jones, Blake Jones, Katrina Keeshig, Ryan Lauzon, Jay 'Tattoo' Jones, Jackie Solomon, Polly Keeshig-Tobias, Peter "Peto" Ashkewe, and Shane Nadjiwon. This program would not be possible without Bruce Power's financial support and their willingness to work collaboratively and openly with the Saugeen Ojibway Nation to address our questions, issues and concerns.

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