CAMP Twelve Year Data Report (2008-2019)

Technical Document 4:

Upper Churchill River Region

Prepared by

Manitoba Hydro

And

North/South Consultants Inc.

2024

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EXECUTIVE SUMMARY

This report presents the results of monitoring conducted under the Coordinated Aquatic Monitoring Program (CAMP) for years 1 through 12 (i.e., 2008/2009 through 2019/2020) in the Upper Churchill River Region. The Upper Churchill River Region is composed of the Churchill River watershed extending from the Saskatchewan/Manitoba border downstream to the natural outlet of Southern Indian Lake at Missi Falls and the outlet of Notigi Lake (i.e., at the Notigi Control Structure [CS]), located on the Rat River system. Waterbodies and sites monitored in this region over this period included seven on-system and one off-system waterbodies/areas as follows:

- Southern Indian Lake – Area 4;
- Opachuanau Lake;
- Southern Indian Lake – Area 1;
- Southern Indian Lake – Area 6;
- Rat Lake;
- Central Mynarski Lake;
- Notigi Lake; and
- Granville Lake (off-system).

Monitoring on-system waterbodies addresses the primary objective of CAMP – to monitor aquatic ecosystem health along Manitoba Hydro's hydraulic operating system. The off-system waterbodies were included in CAMP to provide regional information collected in a manner consistent with monitoring of on-system waterbodies that will assist in interpreting any observed environmental changes over time. Such comparisons are intended to help distinguish between hydroelectric-related effects and other external factors (e.g., climate change) in each CAMP region.

Monitoring was conducted annually at some waterbodies and river reaches and on a three-year rotation at other sites. Components monitored under CAMP in the Upper Churchill River Region presented in this report include the physical environment (water regime), water quality, benthic macroinvertebrates, fish community, and mercury in fish. Climatological data for the region are also included to provide supporting information to assist with interpretation of CAMP monitoring results.

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ABBREVIATIONS, ACRONYMS, AND UNITS

ANN	Annual
CAMP	Coordinated Aquatic Monitoring Program
CCME	Canadian Council of Ministers of the Environment
CL(s)	Confidence limit(s)
cms	Cubic metres per second
CONT	Continuous
CPUE	Catch-per-unit-effort
CRD	Churchill River Diversion
CS	Control structure(s)
DELTs	Deformities, Erosion, Lesions, and Tumours
DL(s)	Detection limit(s)
DO	Dissolved oxygen
ECCC	Environment and Climate Change Canada
EPT	Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)
FA	Fall
FLA	Fork length-at-age
FNU	Formazin nephelometric unit
GN	Standard gang index gill net
h	hour
IC	Ice-cover season
IQR	Interquartile range
KF	Fulton’s Condition Factor
m	Metre
m^2	Metre squared
Max	Maximum
µg/L	Micrograms per litre
mg/L	Milligrams per litre
Min	Minimum
mm	Millimetre
MWQSOGs	Manitoba Water Quality Standards, Objectives, and Guidelines
MWS	Manitoba Water Stewardship
n	Sample size or number of samples
n_F	Number of fish
n_S	Number of sites
ND	No data

no.	Number
NS	Nearshore
n_{spp}	Number of species caught in standard and small mesh gill nets
NTU	Nephelometric turbidity units
O+C	Oligochaeta and Chironomidae
OECD	Organization for Economic Cooperation and Development
OS	Offshore
OW	Open-water season
PAL	Protection of aquatic life
ppm	Parts per million
RCEA	Regional cumulative effects assessment
ROT	Rotational
RSA	Relative species abundance
RYCS	Relative year-class strength
SD	Standard deviation
SE	Standard error
SN	Small mesh index gillnet gang
SP	Spring
SU	Summer
T/day	Tonnes per day
TN	Total nitrogen
TOC	Total organic carbon
TP	Total phosphorus
TSS	Total suspended solids
WI	Winter
Wr	Relative weight
°C	Degrees Celsius

WATERBODY ABBREVIATIONS

Abbreviation	Waterbody
SIL-4	Southern Indian Lake – Area 4
OPACH	Opachuanau Lake
SIL-1	Southern Indian Lake – Area 1
SIL-6	Southern Indian Lake – Area 6
RAT	Rat Lake
MYN	Central Mynarski Lake
NTG	Notigi Lake
UCR GF	Upper Churchill River at Granville Falls
GRV	Granville Lake

FISH SPECIES LIST

Abbreviation	Common Species Name	Species Name
BURB	Burbot	*Lota lota*
CISC	Cisco	*Coregonus artedi*
EMSH	Emerald Shiner	*Notropis atherinoides*
GOLD	Goldeye	*Hiodon alosoides*
LGPR	Logperch	*Percina caprodes*
LKCH	Lake Chub	*Couesius plumbeus*
LKWH	Lake Whitefish	*Coregonus clupeaformis*
LNSC	Longnose Sucker	*Catostomus catostomus*
MOON	Mooneye	*Hiodon tergisus*
MTSC	Mottled Sculpin	*Cottus bairdii*
NRPK	Northern Pike	*Esox lucius*
SAUG	Sauger	*Sander canadensis*
SHRD	Shorthead Redhorse	*Moxostoma macrolepidotum*
SLSC	Slimy Sculpin	*Cottus cognatus*
SPSC	Spoonhead Sculpin	*Cottus ricei*
SPSH	Spottail Shiner	*Notropis hudsonius*
TRPR	Trout-perch	*Percopsis omiscomaycus*
WALL	Walleye	*Sander vitreus*
WHSC	White Sucker	*Catostomus commersonii*
YLPR	Yellow Perch	*Perca flavescens*

1.0 INTRODUCTION

This report presents the results of monitoring conducted under the Coordinated Aquatic Monitoring Program (CAMP) for years 1 through 12 (i.e., 2008/2009 through 2019/2020) in the Upper Churchill River Region. The Upper Churchill River Region is composed of the Churchill River watershed extending from the Saskatchewan/Manitoba border downstream to the natural outlet of Southern Indian Lake at Missi Falls and the outlet of Notigi Lake (i.e., at the Notigi Control Structure [CS]), located on the Rat River system. Waterbodies and sites monitored in this region over this period included seven on-system and one off-system waterbodies/areas as follows:

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- Southern Indian Lake – Area 1;
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- Notigi Lake; and
- Granville Lake (off-system).

Monitoring on-system waterbodies addresses the primary objective of CAMP – to monitor aquatic ecosystem health along Manitoba Hydro’s hydraulic operating system. The off-system waterbodies were included in CAMP to provide regional information collected in a manner consistent with monitoring of on-system waterbodies that will assist in interpreting any observed environmental changes over time. Such comparisons are intended to help distinguish between hydroelectric-related effects and other external factors (e.g., climate change) in each CAMP region.

A summary of monitoring conducted by waterbody or river reach presented in this data report is provided in Table 1-1 and monitoring areas are shown in Figure 1-1. As noted in Table 1-1, monitoring was conducted annually at some waterbodies and river reaches and on a three-year rotation at other sites. Components monitored under CAMP in the Upper Churchill River Region presented in this report include the physical environment (water regime), water quality, benthic macroinvertebrates, fish community, and mercury in fish. Climatological data for the region are also included to provide supporting information to assist with interpretation of CAMP monitoring results.

Table 1-1. Upper Churchill River Region CAMP monitoring summary.

Waterbody/ Area	Abbreviation	On/Off-System		Component					
		On-System	Off-System	Water Regime	Sedimentation	Water Quality	Benthic Invertebrates	Fish Community	Fish Mercury
Southern Indian Lake – Area 4	SIL-4	●		CONT		ANN	ANN	ANN	ROT
Opachuanau Lake	OPACH	●				ROT	ROT	ROT	
Southern Indian Lake – Area 1	SIL-1	●		CONT		ROT	ROT	ROT	
Southern Indian Lake – Area 6	SIL-6	●		CONT		ROT	ROT	ROT	ROT
Rat Lake	RAT	●		CONT		ROT	ROT	ROT	ROT
Central Mynarski Lake	MYN	●				ROT	ROT	ROT	
Notigi Lake	NTG	●		CONT		ROT	ROT	ROT	
Upper Churchill River at Granville Falls	UCR GF	●		CONT					
Granville Lake	GRV		●	CONT		ANN	ANN	ANN	ROT

Notes:

1. CONT = site monitored continuously; ANN = site sampled each year; ROT = site sampled every 3 years.

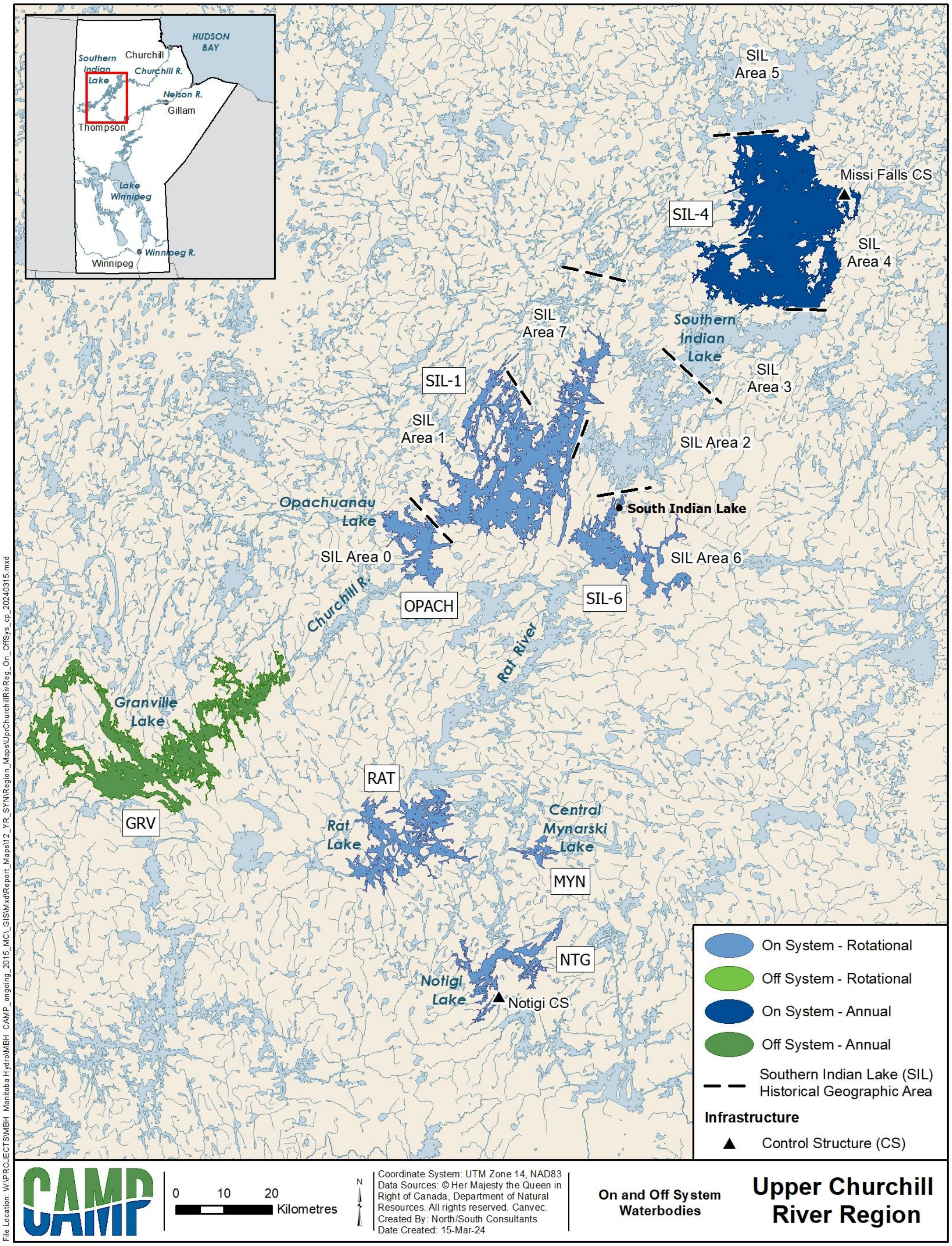


Figure 1-1. On-system and off-system waterbodies and river reaches sampled under CAMP in the Upper Churchill River Region: 2008-2019.

Photograph 1. Southern Indian Lake – Area 1.

Photograph 2. Granville Lake.

Photograph 3. Opachuanau Lake.

Photograph 4. Southern Indian Lake – Area 4.

Photograph 5. Southern Indian Lake – Area 6.

Photograph 6. Central Mynarski Lake.

Photograph 7. Rat Lake.

Photograph 8. Notigi Lake west (left panel) and east (right panel).

2.0 PHYSICAL ENVIRONMENT

2.1 INTRODUCTION

The following presents the results of the physical environment monitoring conducted from 2008 to 2019 in the Upper Churchill River Region. Six waterbodies were monitored in the Upper Churchill River Region: five on-system sites (Southern Indian Lake; Opachuanau Lake; Rat Lake; Notigi Lake (Notigi Forebay); and, Central Mynarski Lake) and one off-system site (Granville Lake). A continuous water quality monitoring station was installed on the upper Churchill River near Leaf Rapids in 2020, after the monitoring period for this report and these data will be presented in the next reporting cycle. Though CAMP does not directly monitor climate, data from Environment and Climate Change Canada (ECCC) is included in reporting to contextualize the data collected under each CAMP component. For the Upper Churchill River Region, meteorological conditions from ECCC's Lynn Lake station are reported.

Three indicators (climate; water regime; and sedimentation) were selected for detailed reporting (Table 2.1-1). Metrics for these indicators include temperature, precipitation, water flow, level and variability, water temperature, continuous turbidity, and suspended sediment load (Table 2.1-1). A detailed description of these indicators is provided in CAMP (2024).

A detailed description of the program design and sampling methods is provided in Technical Document 1, Sections 2.1 and 2.2.

Table 2.1-1. Physical Environment indicators and metrics.

Indicator	Metric	Units
Climate[1]	• Temperature	Degrees Celsius (°C)
	• Precipitation	Millimetres (mm)
Water Regime	• Flow	Cubic meters per second (cms)
	• Water Level and Variability	Metres (m)
	• Water Temperature	Duration of temperature in 5-degree Celsius increments (#days/5 °C)
Sedimentation	• Continuous Turbidity	Formazin nephelometric unit (FNU)
	• Suspended Sediment Load	Tonnes/day (T/day)

Notes:

1. Climate is not monitored through CAMP; data are included for reporting purposes only.

2.2 CLIMATE

In this section, mean monthly air temperatures and total monthly precipitation for each year in the monitoring program (2008-2020) are compared to ECCC climate normals to provide a summary of the Lynn Lake station meteorological conditions. Climate normals are used to summarize the average climatic conditions of a particular location. As recommended by the World Meteorological Organization, ECCC calculates climate normals using a 30-year period (e.g., 1981-2010). The Lynn Lake station is used herein to illustrate climate conditions in the Upper Churchill River Region.

Historical monthly average air temperature and total monthly precipitation during the monitoring period were calculated based on available daily data from ECCC at multiple stations. It is important to note that the use of multiple stations could introduce inhomogeneities in observations between various stations and the station used for climate normals (Climate ID: 5061646). For instances where datasets were missing more than 10% of the daily data in a month, monthly values were gap-filled using ERA5-Land data (Muñoz Sabater 2019). Seasonal and annual maps derived from ERA5-Land data are also provided in Appendices 2-1 and 2-2 to complement the station data and offer a broader spatial representation of temperature and precipitation conditions across Manitoba. Although the ERA5-Land data correlated reasonably well with the actual observed ECCC data for the Lynn Lake station, it should be noted that ERA5-Land is a gridded reanalysis product, meaning the dataset combines modelled data with observations, and therefore may not provide an entirely accurate representation of observed climate.

2.2.1 TEMPERATURE

Figure 2.2-1 illustrates the mean monthly air temperatures (in ºC) for each year during the monitoring period compared to the 1981-2010 normal mean temperature. As shown, air temperatures at this location follow a distinct seasonal pattern; warmer in the summer (warmest in July) and cooler in the winter (coldest in January). In general, recorded air temperatures for the monitoring period were consistent with the climate normal pattern. Some deviations can be seen, for example, 2010 recorded considerably warmer than normal temperatures from January to April.

Table 2.2-1 summarizes the mean monthly air temperature data and categorizes each month in the monitoring period as “below normal”, “near normal” or “above normal” conditions. It should be noted that the “near normal” category was subjectively defined as +/- 1ºC of the ECCC climate normal. Months “below normal” are highlighted in blue, “near normal” are highlighted in grey, and “above normal” are highlighted in orange. Over the monitoring period, the months of January, September, and December generally experienced warmer than normal conditions (≥ 7 out of 13 months above normal), while March and April generally experienced cooler than normal conditions (≥ 7 out of 13 months below normal). On an annual basis, no distinct patterns in the data were identified as most years in the monitoring period were near normal conditions, however there were more years with above normal temperatures than below normal in the monitoring period; 2010 had the warmest annual average temperature at -0.6°C, while 2014 had the coolest annual average temperature at -4.5°C. The maximum and minimum monthly average air temperatures during the monitoring period were 18.7°C (July 2012) and -29.8°C (December 2013), respectively.

Table 2.2-1. Lynn Lake mean monthly and annual air temperature (in ˚C) compared to 1981-2010 normal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	-23.1	-25.0	-17.5	-5.1	4.6	13.9	16.3	16.6	7.2	2.0	-10.2	-27.9	-4.0
2009	-23.0	-21.2	-17.4	-3.7	0.2	10.7	14.5	13.5	12.0	-1.1	-6.2	-24.4	-3.8
2010	-18.4	-16.4	-5.3	2.4	5.7	14.6	17.5	13.4	6.7	2.0	-10.7	-18.5	-0.6
2011	-25.3	-20.6	-16.2	-3.1	6.4	13.2	17.4	15.7	12.0	2.0	-10.9	-16.4	-2.2
2012	-20.5	-16.3	-11.1	-3.5	6.9	13.2	18.7	15.4	9.3	-1.3	-15.1	-24.1	-2.4
2013	-25.7	-19.6	-14.8	-7.0	7.6	16.1	16.0	15.1	10.9	-0.2	-14.4	-29.8	-3.8
2014	-25.6	-25.0	-19.5	-7.9	5.5	12.9	16.7	15.3	7.2	1.0	-16.5	-17.7	-4.5
2015	-22.4	-25.2	-12.9	-2.7	5.4	13.3	13.6	17.1	8.2	1.4	-6.8	-14.5	-2.1
2016	-19.5	-22.1	-11.7	-4.6	8.6	13.5	16.7	14.3	10.4	-0.2	-3.8	-20.1	-1.5
2017	-18.3	-18.7	-16.2	-4.6	6.3	12.6	17.0	16.1	9.8	0.0	-16.1	-22.3	-2.9
2018	-25.0	-23.4	-13.7	-6.8	7.5	14.4	16.4	13.7	3.5	-4.5	-17.1	-18.4	-4.5
2019	-26.0	-25.5	-9.8	-2.4	3.8	12.4	15.2	13.8	9.5	-0.3	-12.2	-20.5	-3.5
2020	-19.3	-19.2	-15.7	-8.4	3.0	11.6	17.8	14.8	6.5	-2.9	-14.0	-18.5	-3.7
1981-2010 Normal	-24.3	-20.3	-13.0	-3.1	5.6	12.9	16.2	14.7	7.7	-0.6	-12.5	-21.4	-3.2

Below Normal	Near Normal	Above Normal

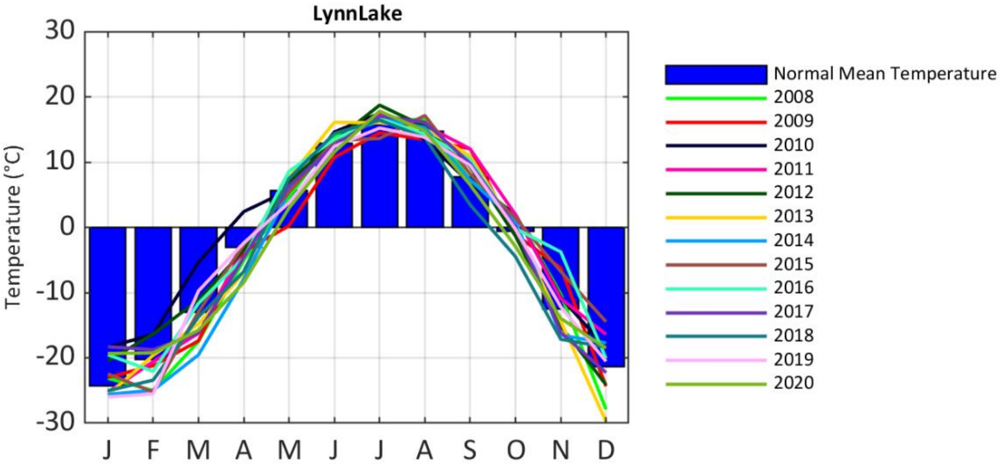


Figure 2.2-1. Lynn Lake mean monthly air temperature (in ºC) compared to 1981-2010 normal.

2.2.2 PRECIPITATION

Figure 2.2-2 illustrates the monthly total precipitation (in mm) for each year during the monitoring period compared to the 1981-2010 normal total precipitation. Total precipitation refers to the water equivalent of all types of precipitation. The total precipitation at Lynn Lake follows a noticeable seasonal pattern, where generally the highest amounts of precipitation fall during the summer months (July and August) and the lowest amounts fall during the winter months (December to February). Overall, recorded precipitation for the monitoring period followed similar patterns to the climate normal, although deviations can be seen, such as 2013; where the recorded total precipitation for September was much higher than normal, whereas May and June recorded total precipitation well below the normal condition.

Table 2.2-2 summarizes the total monthly precipitation data and categorizes each month in the monitoring period as “below normal”, “near normal” or “above normal” conditions. It should be noted that the “near normal” was subjectively defined as +/- 10% of the ECCC climate normal. Months “below normal” are highlighted in light brown, “near normal” are highlighted in grey, and “above normal” are highlighted in green. Over the monitoring period, August generally experienced more than normal precipitation (≥ 7 out of 13 months above normal), while February, May, September, and December generally experienced less than normal precipitation (≥ 7 out of 13 months below normal). On an annual basis, no distinct patterns in the data were identified, however there were more years with above normal precipitation than below normal in the monitoring period; 2009 had the highest annual total precipitation (641.9 mm), while 2014 had the lowest annual total precipitation (348.4 mm). The maximum and minimum monthly total precipitation recorded during the monitoring period were 175.0 mm (August 2019) and 0.0 mm (November 2010), respectively.

Table 2.2-2. Lynn Lake total monthly and annual precipitation (in mm) compared to 1981-2010 normal.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	16.0	19.5	45.5	20.0	12.0	34.5	124.5	115.0	51.5	34.0	40.5	17.0	530.0
2009	19.5	41.0	47.0	16.0	28.0	49.0	116.5	107.0	53.5	87.0	60.4	17.0	641.9
2010	20.0	9.5	20.5	26.6	60.8	16.5	64.7	105.5	54.4	0.2	0.0	9.0	387.7
2011	16.7	15.5	11.1	12.3	10.6	68.9	102.6	80.9	11.2	37.0	26.6	25.7	419.1
2012	27.5	7.1	60.3	54.0	19.7	62.9	56.3	88.6	66.0	48.1	21.2	16.5	528.1
2013	9.2	2.8	8.0	24.7	4.2	13.8	63.7	39.7	139.9	35.6	51.2	5.8	398.6
2014	21.3	6.8	21.9	7.0	35.4	103.0	43.0	49.6	17.8	18.9	16.4	7.3	348.4
2015	16.8	6.0	13.7	29.5	26.6	68.4	78.3	62.5	71.9	47.7	33.0	17.4	471.8
2016	17.4	15.2	19.0	24.6	33.4	38.4	105.4	50.1	79.2	102.5	16.4	17.1	518.7
2017	25.8	27.9	66.8	25.8	58.1	55.5	41.1	17.5	54.0	75.8	30.8	14.5	493.6
2018	31.0	5.4	6.0	19.6	12.5	93.9	112.6	91.6	83.0	40.0	24.4	14.9	535.0
2019	22.6	2.2	2.8	21.4	37.0	116.7	75.3	175.0	36.8	20.1	25.1	12.5	547.5
2020	24.2	13.2	35.0	46.4	49.0	99.9	107.7	88.3	63.3	34.2	36.2	27.9	625.3
1981-2010 Normal	20.3	16.3	19.8	24.1	37.3	61.8	85.4	68.8	61.0	37.6	26.8	18.8	477.9

Below Normal	Near Normal	Above Normal

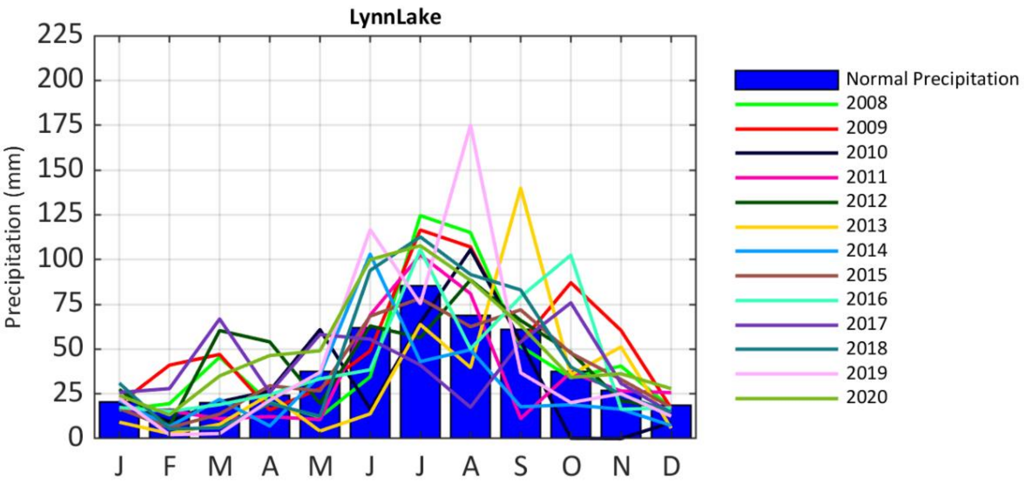


Figure 2.2-2. Lynn Lake total monthly precipitation (in mm) compared to 1981-2010 normal.

2.3 WATER REGIME

Upper Churchill River flows entering Manitoba are influenced by run-off from snowmelt and precipitation across the Churchill River drainage basin, which begins in Alberta and covers a large portion of northwestern Saskatchewan. The drainage basin includes several large lakes which act as reservoirs, the largest being Reindeer Lake along the Manitoba-Saskatchewan border. Water levels from Southern Indian Lake to Notigi Lake and outflow from the region at Missi Falls and Notigi Lake are influenced by operation of the Churchill River Diversion (CRD). Additional information on the upper Churchill River water regime and CRD can be found in the Physical Environment Part IV section of the Regional Cumulative Effects Assessment – Phase II Report (RCEA 2015).

On-System Sites

On-system CAMP monitoring occurred on Southern Indian Lake and Opachuanau Lake, which act together as a hydroelectric reservoir for Manitoba Hydro as part of the CRD (Figure 2.3-1). Monitoring also occurred on Rat Lake, Notigi Lake (Notigi forebay), and Mynarski Lake, which also act as part of the reservoir along the diversion route between Southern Indian Lake and the Notigi CS. Continuous water temperature is measured on the upper Churchill River near Leaf Rapids at the continuous water quality monitoring site beginning in 2020 (Figure 2.3-1).

Off-System Sites

CAMP monitors Granville Lake as the off-system waterbody for this region (Figure 2.3-1). Granville Lake is located along the upper Churchill River and is typically upstream from the effect of any backwater from Southern Indian Lake except under a combination of low flows in the Churchill River and high levels on Southern Indian Lake.

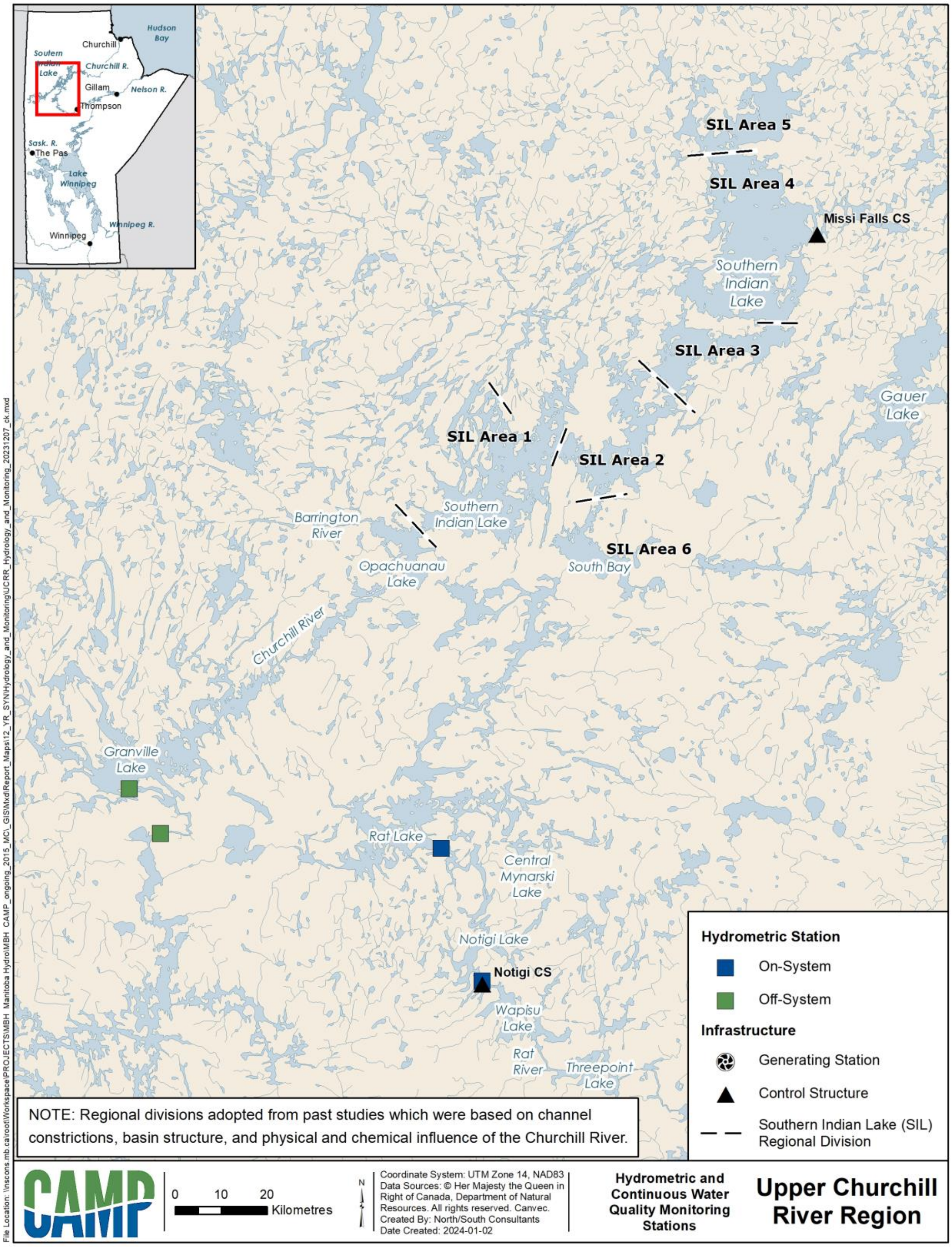


Figure 2.3-1. Hydrometric and continuous water quality monitoring stations in the Upper Churchill River Region.

2.3.1 FLOW

2.3.1.1 ON-SYSTEM SITES

Granville Falls

From 2008 to 2020, flow conditions on the upper Churchill River ranged from dry to very wet and were more frequently above average than below average compared to the reference period from 1981 to 2010 (Figure 2.3-2 and Table 2.3-1). Monthly mean flow ranged from 523 to 2,392 cms with the overall mean from 2008 to 2020 at 954 cms. Very dry flow conditions, defined as lower than 10th percentile, did not occur in any months during the 2008 to 2020 CAMP monitoring period (Table 2.3-1). Flow conditions were very wet, defined as above the 90th percentile, in parts of nine years during CAMP, during the following months; July to August 2008, June to December 2009, September 2011, June to August and December 2012, October 2013, May to December 2017 and 2018, June and November 2019 and May to December 2020 (Table 2.3-1).

2.3.1.2 OFF-SYSTEM SITES

There are no off-system flows reported for this region.

Table 2.3-1. Upper Churchill River at Granville Falls (06EA006) monthly average flow (cms).

Year	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	836	717	719	727	727	836	1029	1251	1100	780	686	708	741
2009	1095	709	699	727	734	889	1138	1177	1465	1667	1527	1291	1099
2010	787	1010	951	900	879	822	768	653	638	761	738	675	657
2011	782	722	735	657	621	732	727	697	951	1103	926	791	717
2012	945	785	770	737	751	970	1139	1228	1037	935	926	1015	1040
2013	896	977	901	843	789	800	781	891	1030	967	1048	903	822
2014	831	794	800	793	693	881	983	997	955	840	805	725	702
2015	710	717	706	709	732	818	741	763	742	698	662	629	601
2016	670	568	543	523	525	685	668	704	851	718	599	764	883
2017	1210	861	836	818	798	1282	1654	1760	1634	1473	1252	1087	1030
2018	1239	957	912	859	819	1155	1231	1275	1568	1670	1562	1258	1092
2019	965	989	923	871	861	1004	1046	1006	943	875	950	1078	1025
2020	1490	972	928	887	862	1046	1331	1827	2392	2254	2029	1817	1502

Very Dry Lower than 10th percentile	**Dry** 10th to 30th percentile	**Average** 30th to 70th percentile	**Wet** 70th to 90th percentile	**Very Wet** Higher than 90th percentile

Notes:

1. Percentiles calculated using 1981-2010 as the reference period.

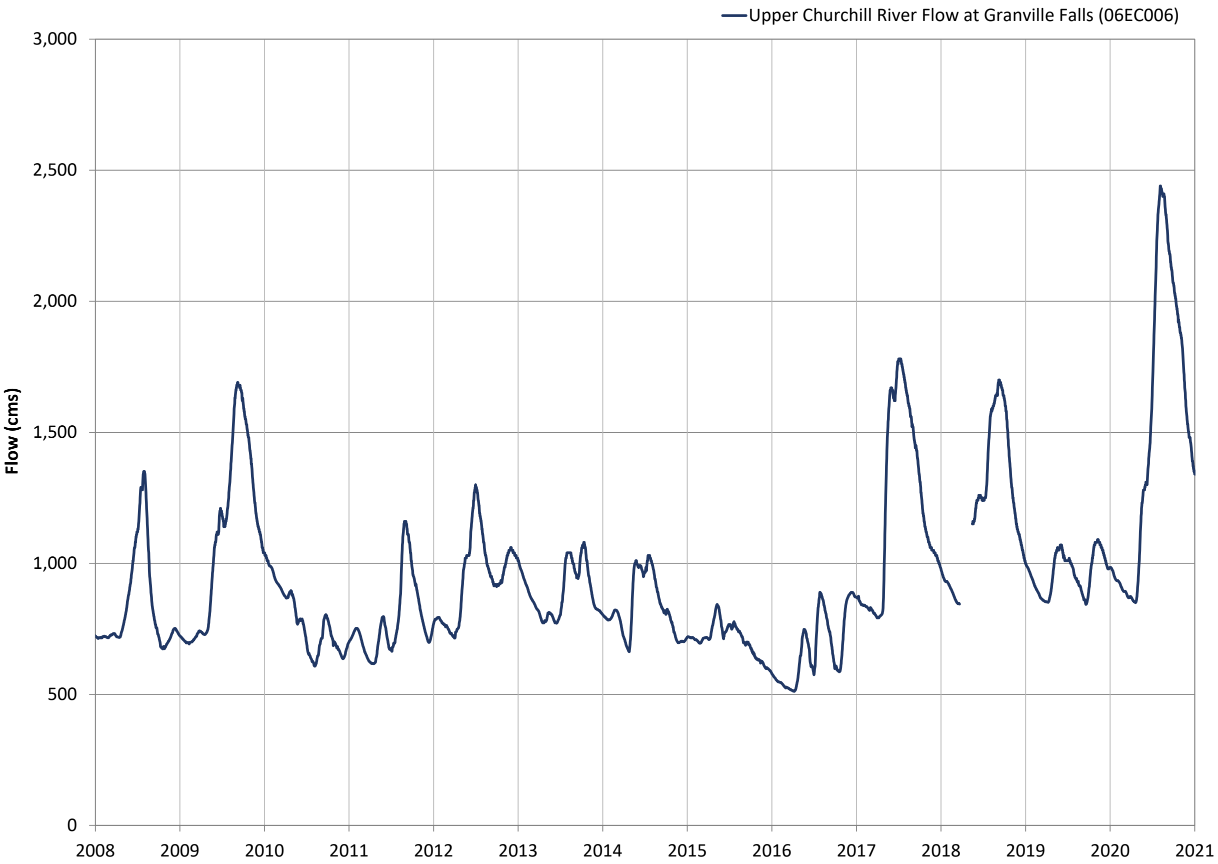


Figure 2.3-2. 2008-2020 Upper Churchill River daily mean flow.

2.3.2 WATER LEVEL AND VARIABILITY

2.3.2.1 ON-SYSTEM SITES

Southern Indian Lake

Southern Indian Lake is a controlled reservoir with water levels typically following a predictable pattern each year. In spring, water levels typically rise because of both increased inflows with the spring freshet and reduced outflows at the Notigi CS as energy demand is lower. Summer outflows from Southern Indian Lake are managed depending on precipitation conditions and inflows such that water levels peak in late summer/fall each year. Southern Indian Lake water levels then typically decline steadily through the winter as inflows drop off and the Notigi CS outflows are maximized to meet Manitoba’s higher winter energy requirements. Water Levels on Southern Indian Lake generally followed the typical trend from 2008 to 2020 (Figure 2.3-3). During the period from 2008-2020, monthly average Southern Indian Lake water levels were never more than

0.5 m above the 2008-2020 average and were lower than 0.5 m below the 2008-2020 average in 16 months (Table 2.3-2). Southern Indian Lake monthly water level variability was lower (below 0.25 m) in 137 months and moderate (between 0.25 and 0.75 m) in 19 months. Southern Indian Lake monthly water level variability was never in the higher (above 0.75 m) category (Table 2.3-3).

Rat Lake

Rat Lake water levels are influenced by inflows from the upper Churchill River but driven mainly by regulated outflows at Missi Falls and the Notigi CS as part of CRD (Figure 2.3-4). During the period from 2008-2020, Rat Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 13 months and lower than 0.5 m below the 2008-2020 average in 24 months (Table 2.3-4). Rat Lake monthly water level variability was lower (below 0.25 m) in 98 months, moderate (between 0.25 and 0.75 m) in 53 months, and higher (above 0.75 m) in 5 months (Table 2.3-5).

Notigi Lake

Notigi Lake water levels are influenced by inflows from the upper Churchill River but driven mainly by regulated outflows at Missi Falls and Notigi Lake as part of CRD (Figure 2.3-5). During the period from 2008-2020, Notigi Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 27 months and lower than 0.5 m below the 2008-2020 average in 24 months (Table 2.3-6). Notigi Lake monthly water level variability was lower (below 0.25 m) in 84 months, moderate (between 0.25 and 0.75 m) in 63 months, and higher (above 0.75 m) in 9 months (Table 2.3-7).

2.3.2.2 OFF-SYSTEM SITES

Granville Lake

Water levels on Granville Lake vary with flow in the upper Churchill River (Figure 2.3-6). During the period from 2008-2020, Granville Lake monthly average water levels were more than 0.5 m above the 2008-2020 average in 26 months and lower than 0.5 m below the 2008-2020 average in 48 months (Table 2.3-8). Granville Lake monthly water level variability was lower (below 0.25 m) in 105 months, moderate (between 0.25 and 0.75 m) in 45 months, and higher (above 0.75 m) in 5 months (Table 2.3-9).

Table 2.3-2. Southern Indian Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	257.85	257.69	257.54	257.35	257.24	257.40	257.72	258.23	258.20	258.12	257.97	257.84
2009	257.67	257.51	257.35	257.16	257.25	258.07	258.29	258.12	258.19	258.19	258.19	258.14
2010	258.15	258.17	258.12	258.04	258.06	258.15	258.10	258.19	258.22	258.23	258.13	257.94
2011	257.74	257.57	257.38	257.16	257.21	257.51	257.90	258.19	258.13	258.24	258.18	258.05
2012	257.89	257.75	257.60	257.54	257.92	258.21	258.19	258.13	258.21	258.18	258.23	258.27
2013	258.24	258.18	258.10	257.99	257.95	258.04	258.05	258.14	258.22	258.30	258.25	258.22
2014	258.14	258.02	257.90	257.74	257.79	258.20	258.23	258.12	258.18	258.28	258.19	258.03
2015	257.84	257.65	257.46	257.28	257.34	257.59	257.79	257.92	258.04	258.15	258.09	257.90
2016	257.64	257.38	257.16	257.02	257.29	257.78	258.10	258.27	258.18	258.24	258.26	258.25
2017	258.21	258.15	258.13	258.03	258.25	258.28	258.11	258.06	258.05	258.21	258.29	258.25
2018	258.22	258.12	257.95	257.74	257.88	258.14	258.22	258.14	258.25	258.27	258.28	258.26
2019	258.23	258.11	257.93	257.69	257.71	258.00	258.26	258.29	258.13	258.00	257.98	258.06
2020	258.08	258.01	257.89	257.81	257.74	258.04	258.23	258.12	258.25	258.09	258.05	258.13

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-3. Southern Indian Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.16	0.14	0.15	0.22	0.17	0.13	0.58	0.20	0.05	0.11	0.14	0.14
2009	0.18	0.14	0.16	0.18	0.52	0.71	0.06	0.18	0.08	0.08	0.10	0.02
2010	0.04	0.02	0.07	0.05	0.12	0.07	0.02	0.17	0.07	0.03	0.16	0.20
2011	0.19	0.15	0.22	0.16	0.26	0.28	0.40	0.23	0.07	0.11	0.09	0.16
2012	0.14	0.14	0.13	0.05	0.57	0.07	0.10	0.08	0.08	0.04	0.06	0.01
2013	0.05	0.07	0.09	0.13	0.14	0.03	0.05	0.15	0.10	0.14	0.06	0.08
2014	0.10	0.12	0.12	0.20	0.46	0.17	0.20	0.04	0.06	0.08	0.13	0.18
2015	0.19	0.17	0.20	0.11	0.21	0.24	0.17	0.08	0.15	0.04	0.14	0.22
2016	0.27	0.23	0.19	0.06	0.49	0.41	0.27	0.07	0.06	0.09	0.01	0.02
2017	0.05	0.05	0.06	0.11	0.57	0.32	0.07	0.10	0.09	0.18	0.02	0.04
2018	0.06	0.12	0.20	0.18	0.31	0.25	0.07	0.08	0.16	0.02	0.02	0.01
2019	0.07	0.14	0.22	0.17	0.19	0.32	0.13	0.06	0.15	0.12	0.08	0.05
2020	0.03	0.09	0.13	0.10	0.29	0.29	0.16	0.13	0.07	0.25	0.21	0.09

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-4. Rat Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	257.26	256.96	256.66	256.41	256.54	256.78	257.49	258.09	257.81	257.75	257.61	257.31
2009	256.96	256.61	256.24	256.07	256.98	257.94	258.26	258.06	258.04	257.84	257.84	257.66
2010	257.60	257.63	257.61	257.66	257.79	257.87	257.92	258.12	258.11	258.03	257.81	257.47
2011	257.15	256.84	256.51	256.47	257.07	257.39	257.80	258.12	258.05	258.04	257.86	257.64
2012	257.40	257.14	256.92	257.16	257.66	257.90	257.82	257.71	257.85	257.84	257.86	257.84
2013	257.78	257.71	257.61	257.49	257.58	257.77	257.86	257.91	257.83	258.00	257.91	257.77
2014	257.61	257.44	257.26	257.08	257.47	258.14	258.22	258.08	258.13	258.15	257.92	257.58
2015	257.28	256.96	256.67	256.62	257.03	257.34	257.59	257.75	257.91	258.00	257.84	257.49
2016	257.09	256.74	256.57	256.65	257.21	257.68	258.00	257.98	257.90	258.13	258.07	257.92
2017	257.79	257.70	257.62	257.57	258.20	258.35	258.12	257.92	257.63	257.82	257.96	257.86
2018	257.75	257.61	257.41	257.17	257.53	257.75	257.92	257.78	257.88	257.95	257.95	257.87
2019	257.78	257.63	257.40	257.19	257.34	257.57	257.90	257.98	257.83	257.64	257.58	257.61
2020	257.60	257.52	257.37	257.33	257.58	257.99	258.21	258.01	258.03	257.84	257.66	257.74

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-5. Rat Lake monthly average water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.26	0.31	0.31	0.13	0.20	0.45	0.84	0.38	0.10	0.14	0.22	0.32
2009	0.37	0.33	0.36	0.52	0.97	0.85	0.12	0.25	0.18	0.13	0.15	0.17
2010	0.04	0.02	0.02	0.11	0.30	0.18	0.23	0.26	0.11	0.10	0.39	0.30
2011	0.31	0.28	0.34	0.44	0.48	0.25	0.43	0.32	0.17	0.20	0.15	0.23
2012	0.25	0.23	0.15	0.38	0.45	0.16	0.13	0.09	0.12	0.12	0.04	0.04
2013	0.07	0.09	0.10	0.10	0.32	0.11	0.07	0.08	0.11	0.15	0.07	0.20
2014	0.15	0.16	0.17	0.17	0.91	0.34	0.21	0.10	0.09	0.16	0.34	0.26
2015	0.32	0.31	0.20	0.29	0.37	0.31	0.23	0.06	0.19	0.07	0.31	0.35
2016	0.39	0.27	0.07	0.33	0.57	0.42	0.19	0.16	0.12	0.21	0.14	0.16
2017	0.09	0.09	0.10	0.04	1.06	0.35	0.20	0.54	0.08	0.31	0.09	0.12
2018	0.08	0.18	0.23	0.20	0.33	0.33	0.09	0.17	0.23	0.04	0.07	0.08
2019	0.11	0.17	0.27	0.12	0.19	0.36	0.20	0.09	0.28	0.14	0.06	0.02
2020	0.05	0.11	0.15	0.06	0.53	0.28	0.20	0.17	0.14	0.28	0.10	0.10

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-6. Notigi Lake monthly water average level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	256.84	256.44	255.99	255.76	256.03	256.42	257.38	257.99	257.55	257.47	257.34	256.95
2009	256.51	256.02	255.47	255.47	256.90	257.90	258.24	258.05	257.97	257.59	257.60	257.35
2010	257.25	257.29	257.29	257.41	257.61	257.64	257.83	258.07	258.02	257.88	257.56	257.14
2011	256.77	256.35	255.90	256.13	257.04	257.37	257.77	258.10	258.02	257.90	257.63	257.34
2012	257.05	256.71	256.47	256.98	257.49	257.67	257.59	257.46	257.61	257.61	257.63	257.55
2013	257.47	257.35	257.26	257.18	257.37	257.60	257.77	257.80	257.61	257.81	257.71	257.52
2014	257.31	257.10	256.86	256.65	257.28	258.10	258.22	258.06	258.10	258.04	257.72	257.27
2015	256.90	256.49	256.12	256.23	256.86	257.21	257.47	257.65	257.83	257.90	257.67	257.20
2016	256.71	256.32	256.22	256.49	257.17	257.65	257.94	257.77	257.72	258.02	257.92	257.66
2017	257.49	257.37	257.26	257.28	258.15	258.33	258.01	257.70	257.25	257.48	257.64	257.49
2018	257.33	257.15	256.91	256.69	257.20	257.46	257.69	257.54	257.65	257.73	257.73	257.63
2019	257.50	257.32	257.06	256.89	257.09	257.29	257.67	257.77	257.61	257.40	257.32	257.30
2020	257.27	257.17	257.00	257.03	257.47	257.93	258.17	257.94	257.86	257.62	257.40	257.45

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Table 2.3-7. Notigi Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.31	0.45	0.44	0.28	0.22	0.77	0.98	0.59	0.09	0.15	0.25	0.45
2009	0.42	0.50	0.62	1.22	1.06	0.88	0.13	0.27	0.38	0.15	0.17	0.26
2010	0.08	0.05	0.09	0.14	0.42	0.29	0.34	0.29	0.09	0.14	0.50	0.34
2011	0.41	0.40	0.43	0.96	0.54	0.26	0.43	0.34	0.20	0.36	0.18	0.29
2012	0.34	0.30	0.23	0.55	0.37	0.19	0.14	0.11	0.15	0.14	0.11	0.08
2013	0.10	0.11	0.10	0.04	0.43	0.21	0.08	0.16	0.11	0.18	0.13	0.23
2014	0.19	0.21	0.24	0.14	1.18	0.44	0.25	0.11	0.11	0.25	0.47	0.31
2015	0.42	0.41	0.19	0.55	0.46	0.33	0.26	0.04	0.23	0.12	0.41	0.44
2016	0.45	0.27	0.06	0.55	0.60	0.42	0.19	0.25	0.23	0.24	0.22	0.26
2017	0.10	0.13	0.12	0.17	1.29	0.43	0.27	0.79	0.09	0.37	0.14	0.15
2018	0.13	0.22	0.24	0.37	0.38	0.48	0.11	0.20	0.27	0.06	0.10	0.12
2019	0.13	0.22	0.26	0.14	0.19	0.41	0.24	0.14	0.33	0.15	0.09	0.05
2020	0.08	0.14	0.16	0.16	0.71	0.30	0.22	0.18	0.23	0.29	0.08	0.15

Lower Variability Below 0.25 m	**Moderate Variability** 0.25 to 0.75 m	**Higher Variability** Above 0.75 m

Table 2.3-8. Granville Lake monthly average water level (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	259.87	259.81	259.80	259.76	259.93	260.29	260.76	260.98	260.24	259.94	259.87	259.91
2009	259.82	259.74	259.73	259.72	260.02	260.89	261.12	261.44	262.03	261.87	261.43	260.91
2010	260.62	260.47	260.32	260.19	260.19	260.10	259.81	259.73	260.00	260.06	259.90	259.78
2011	259.80	259.83	259.67	259.51	259.65	259.77	259.80	260.24	260.70	260.44	260.13	259.89
2012	259.91	259.90	259.81	259.79	260.33	260.84	261.03	260.64	260.41	260.33	260.47	260.62
2013	260.52	260.36	260.18	260.01	260.00	259.99	260.03	260.39	260.38	260.65	260.50	260.23
2014	260.10	260.02	260.01	259.81	260.12	260.65	260.65	260.52	260.22	260.13	260.01	259.89
2015	259.83	259.76	259.70	259.69	259.89	259.88	259.87	259.86	259.80	259.77	259.72	259.64
2016	259.51	259.37	259.28	259.22	259.61	259.83	259.86	260.25	260.01	259.83	259.98	260.31
2017	260.31	260.23	260.22	260.14	261.10	262.42	262.38	262.05	261.60	261.20	260.84	260.67
2018	260.53	260.39	260.23	260.06	260.51	261.00	261.14	261.55	261.86	261.86	261.39	
2019	260.62	260.48	260.28	260.09	260.43	260.78	260.84	260.66	260.48	260.35	260.60	260.68
2020	260.55	260.39	260.24	260.16	260.45	261.42	262.22	263.50	263.68	263.12	262.54	261.89

Lower Lower than 0.5 m below average	**Average** Within 0.5 m below and above average	**Higher** More than 0.5 m above average

Notes:

1. Blank cell indicates no data.

Table 2.3-9. Granville Lake monthly water level range (m).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	0.09	0.05	0.02	0.03	0.35	0.31	0.69	0.67	0.47	0.20	0.05	0.04
2009	0.12	0.05	0.05	0.06	0.84	0.58	0.15	0.58	0.28	0.31	0.57	0.40
2010	0.18	0.13	0.17	0.05	0.05	0.23	0.25	0.24	0.23	0.15	0.13	0.07
2011	0.06	0.07	0.20	0.10	0.31	0.10	0.27	0.71	0.15	0.31	0.28	0.14
2012	0.08	0.08	0.10	0.13	0.68	0.46	0.22	0.37	0.15	0.08	0.19	0.05
2013	0.15	0.16	0.16	0.16	0.13	0.11	0.30	0.20	0.15	0.24	0.29	0.19
2014	0.11	0.03	0.11	0.23	0.88	0.09	0.09	0.29	0.26	0.05	0.16	0.08
2015	0.04	0.08	0.03	0.09	0.20	0.09	0.04	0.06	0.05	0.04	0.06	0.10
2016	0.15	0.12	0.08	0.08	0.57	0.15	0.47	0.14	0.29	0.11	0.42	0.12
2017	0.06	0.06	0.06	0.08	2.15	0.21	0.13	0.48	0.37	0.43	0.26	0.13
2018	0.14	0.13	0.19	0.12	0.66	0.34	0.19	0.42	0.25	0.28	0.49	
2019	0.11	0.17	0.23	0.11	0.52	0.15	0.14	0.13	0.31	0.27	0.11	0.12
2020	0.13	0.14	0.14	0.08	0.99	0.51	1.32	0.73	0.34	0.62	0.53	0.60

Lower Variability	**Moderate Variability**	**Higher Variability**
Below 0.25 m	0.25 to 0.75 m	Above 0.75 m

Notes:

1. Blank cell indicates no data.

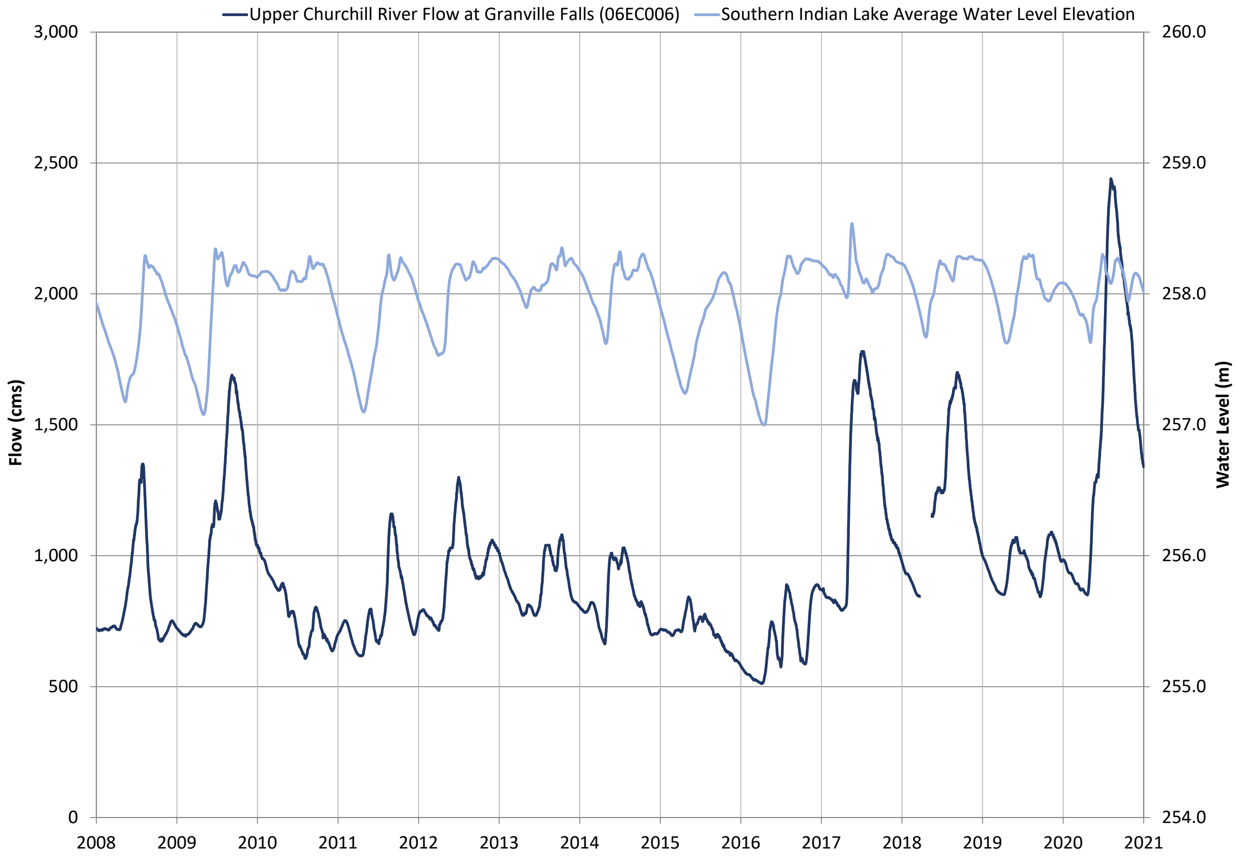


Figure 2.3-3. 2008-2020 Upper Churchill River daily mean flow and Southern Indian Lake daily mean water level.

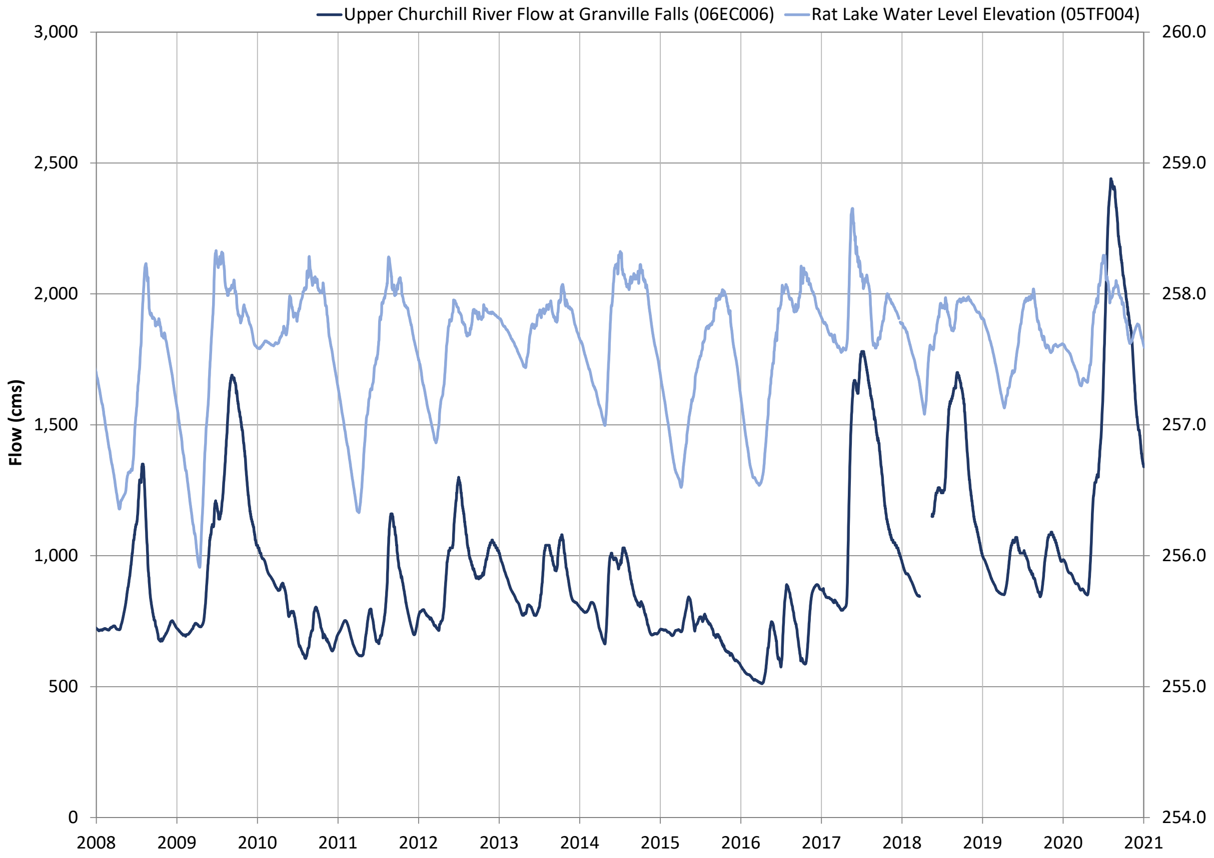


Figure 2.3-4. 2008-2020 Upper Churchill River daily mean flow and Rat Lake daily mean water level.

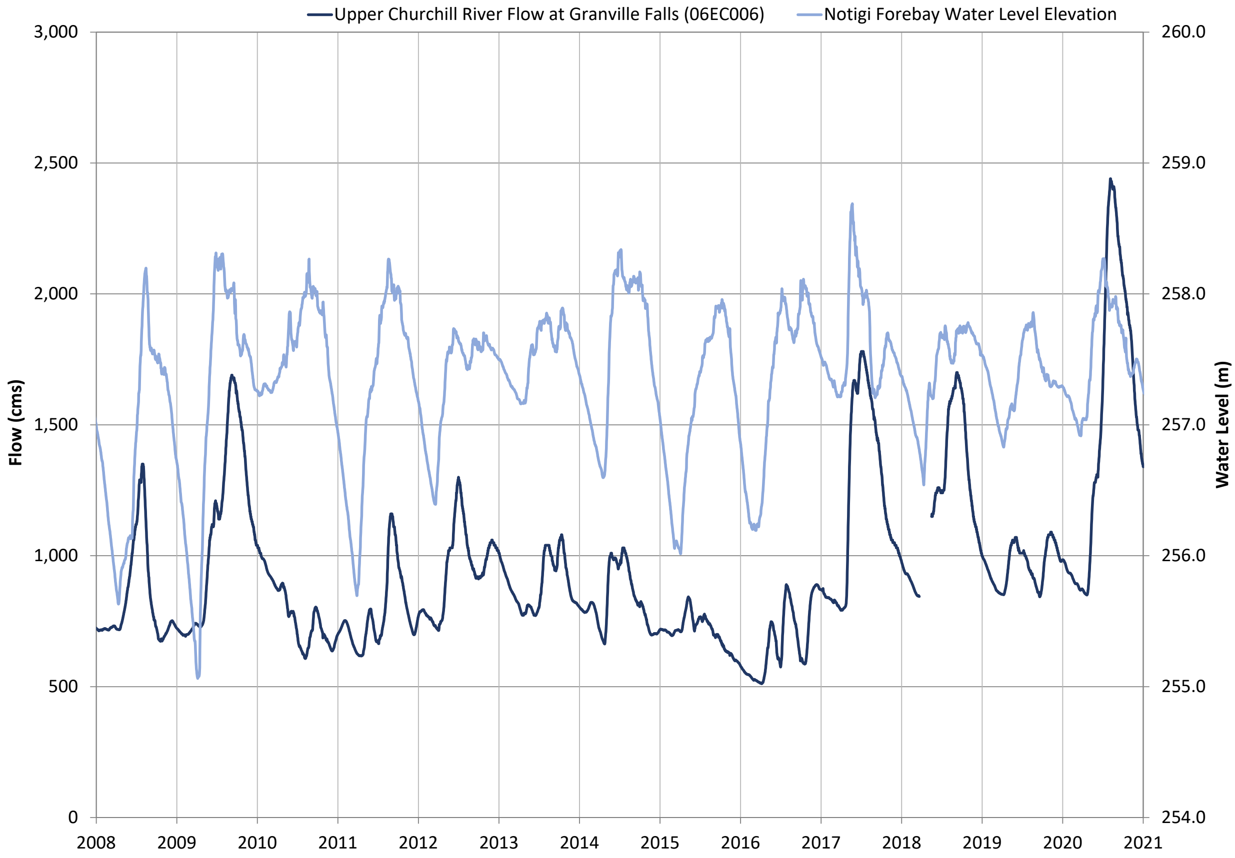


Figure 2.3-5. 2008-2020 Upper Churchill River daily mean flow and Notigi Lake daily mean water level.

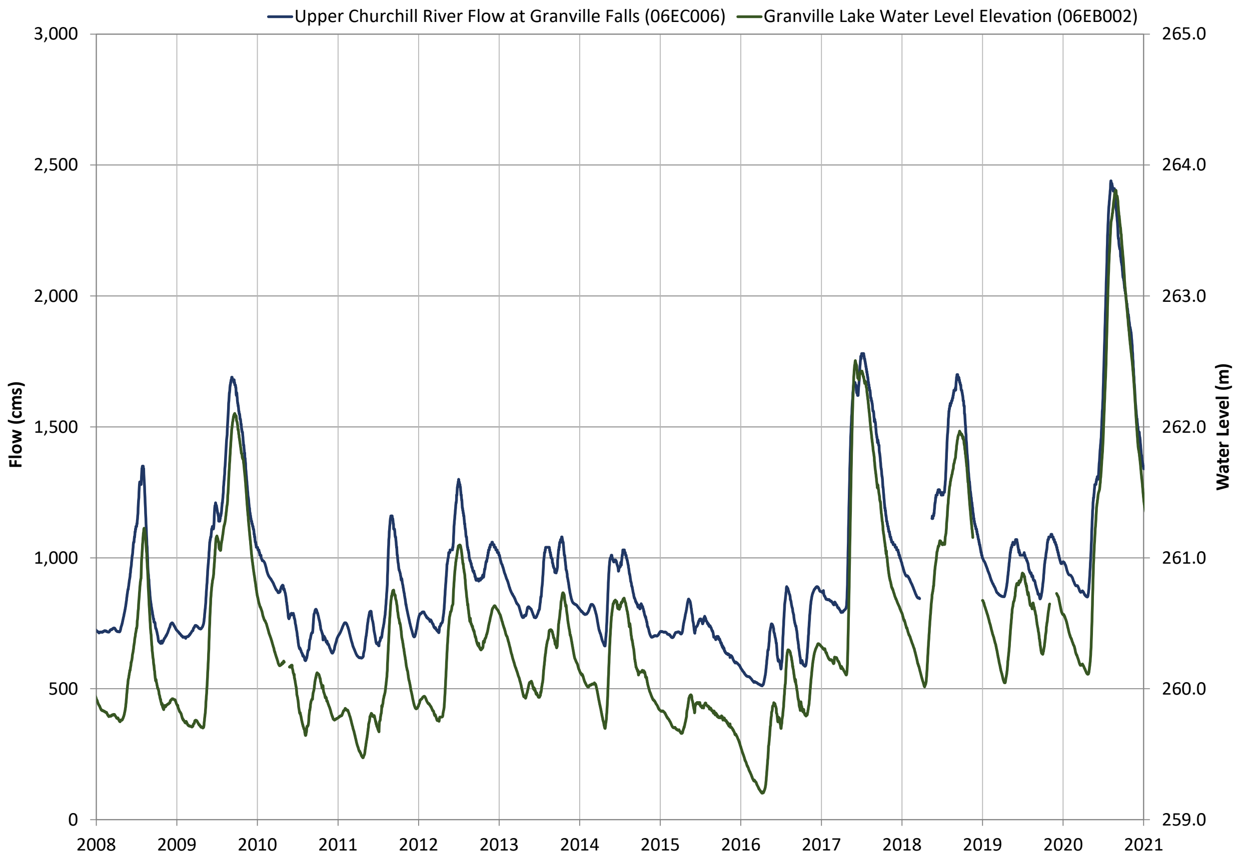


Figure 2.3-6. 2008-2020 Upper Churchill River daily mean flow and Granville Lake daily mean water level.

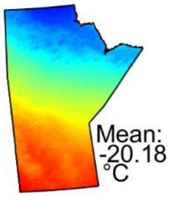
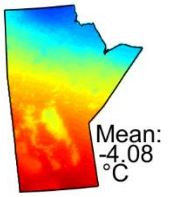
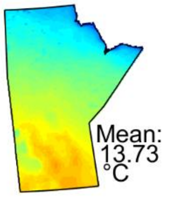
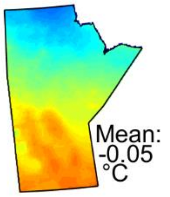
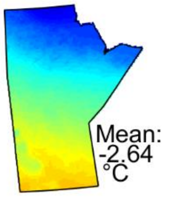
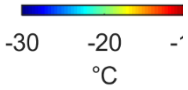
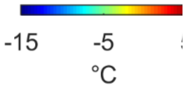
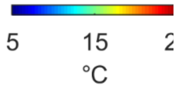
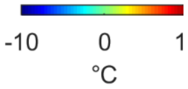
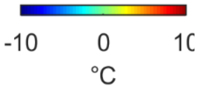
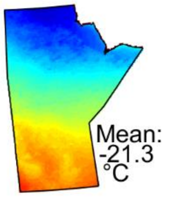
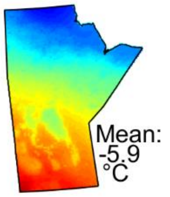
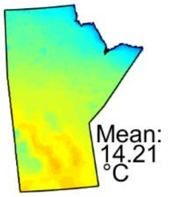
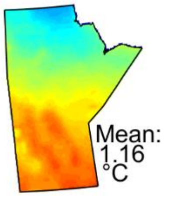
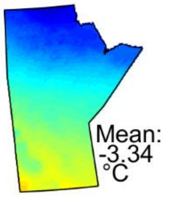
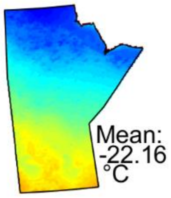
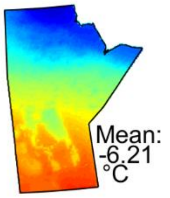
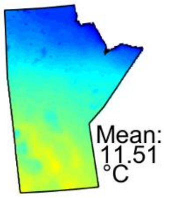
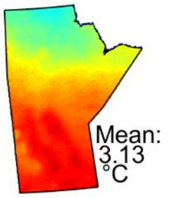
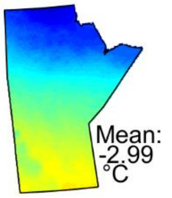
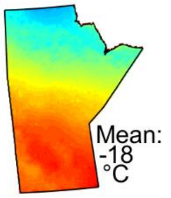
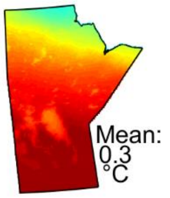
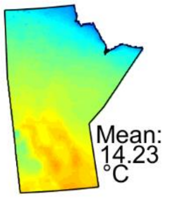
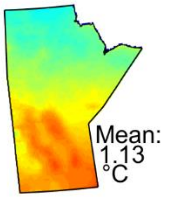
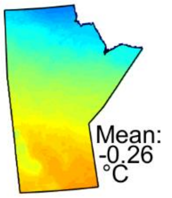
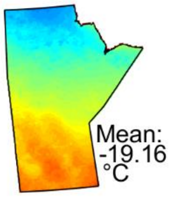
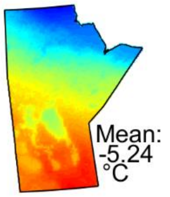
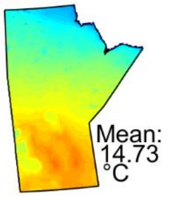
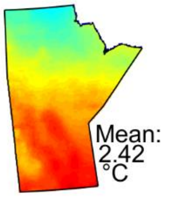
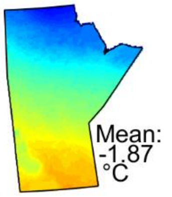
2.3.3 WATER TEMPERATURE

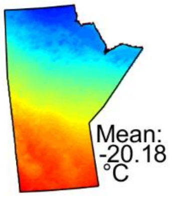
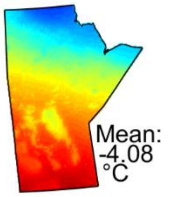
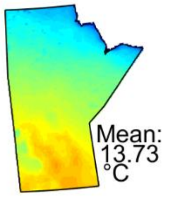
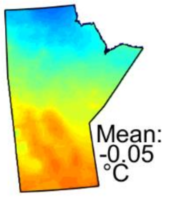
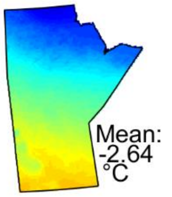
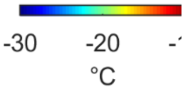
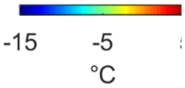
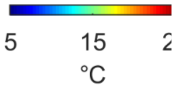
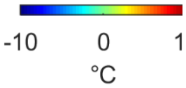
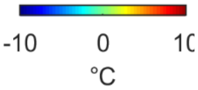
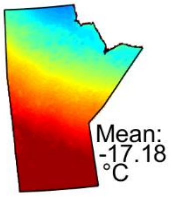
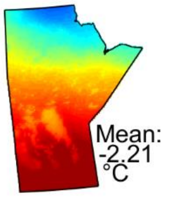
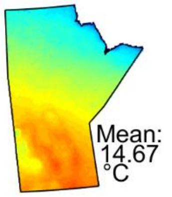
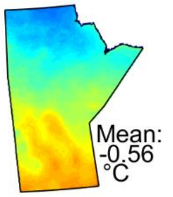
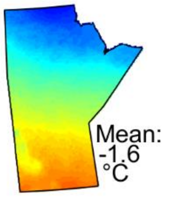
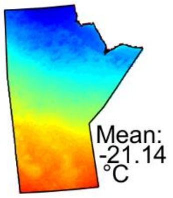
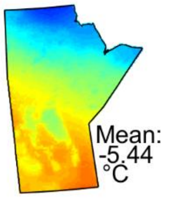
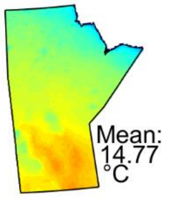
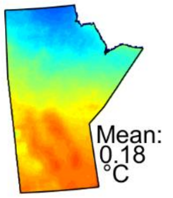
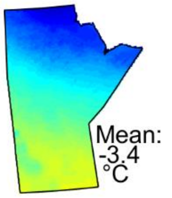
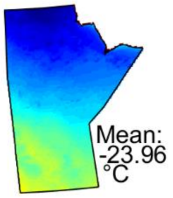
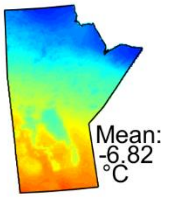
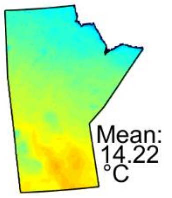
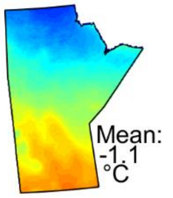
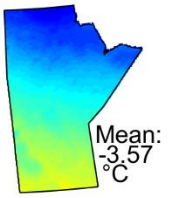
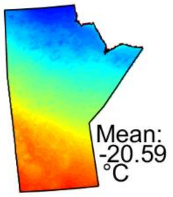
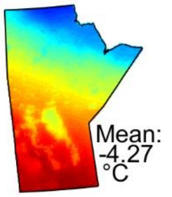
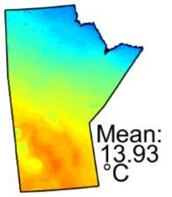
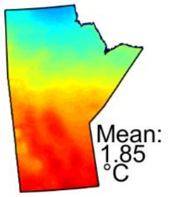
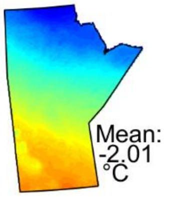
Continuous water temperature data are not available for this region during the period from 2008 to 2019. Continuous water temperature monitoring was initiated on the upper Churchill River near Leaf Rapids in 2020, after the monitoring period for this report and this data will be presented in the next reporting cycle.

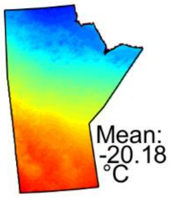
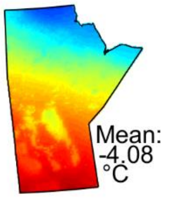
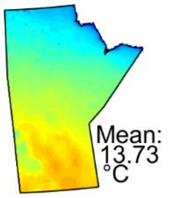
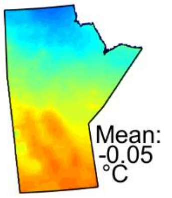
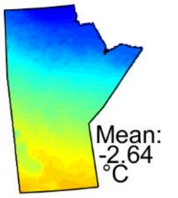
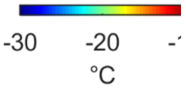
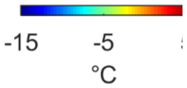
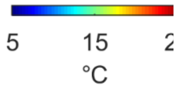
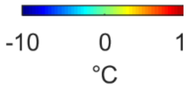
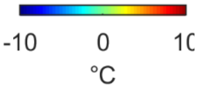
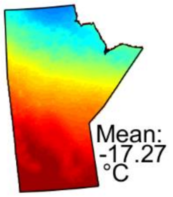
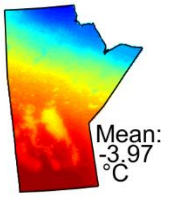
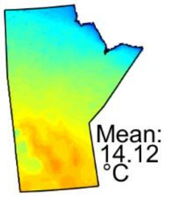
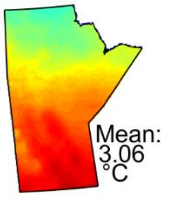
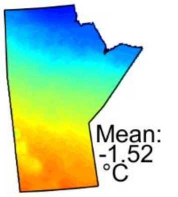
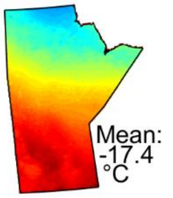
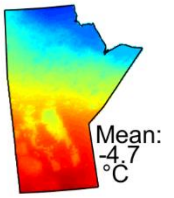
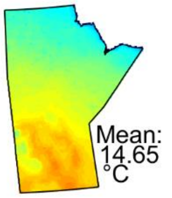
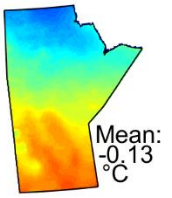
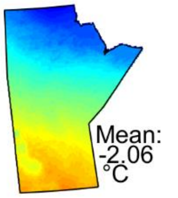
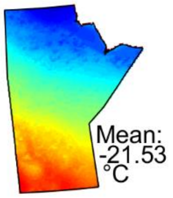
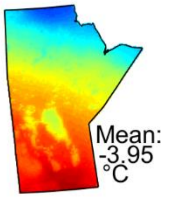
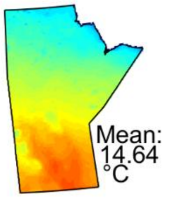
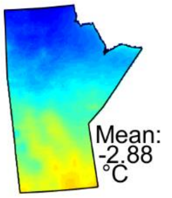
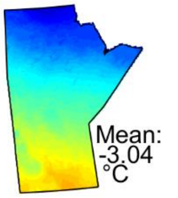
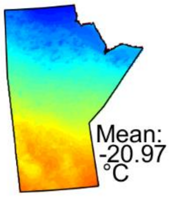
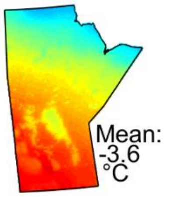
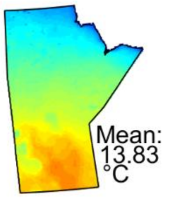
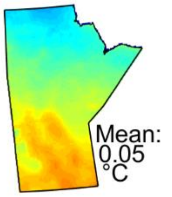
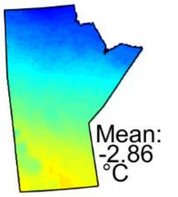
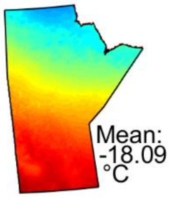
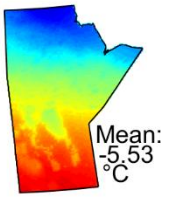
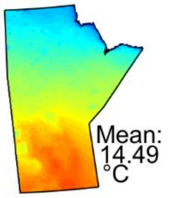
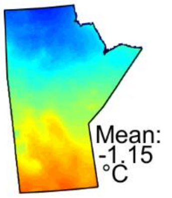
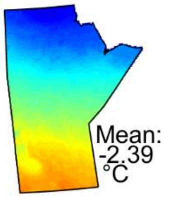
2.4 SEDIMENTATION

Sedimentation data are not available for this region during the period from 2008 to 2019. Continuous monitoring was initiated on the upper Churchill Rive near Leaf Rapids in 2020, after the monitoring period for this report and this data will be presented in the next reporting cycle.

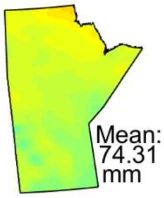
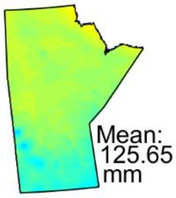
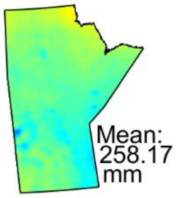
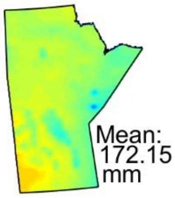
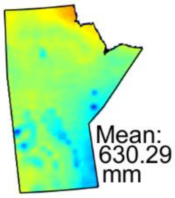
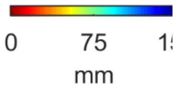
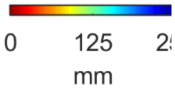
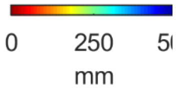
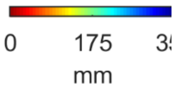
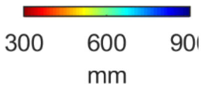
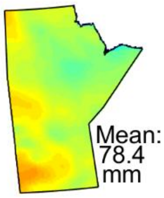
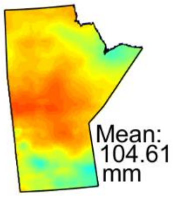
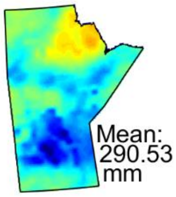
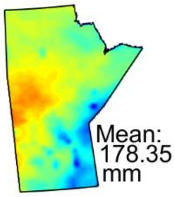
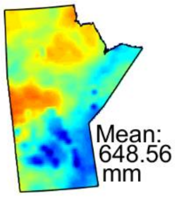
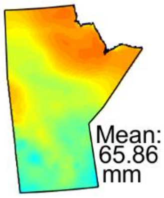
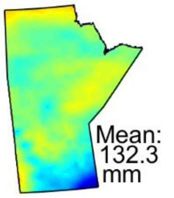
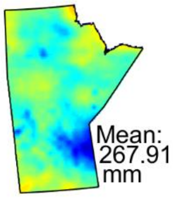
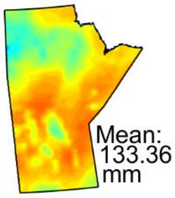
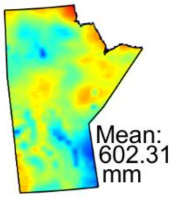
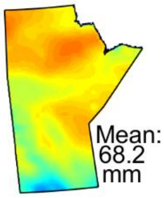
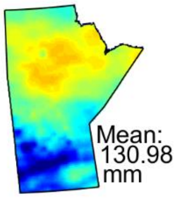
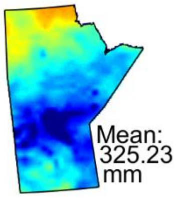
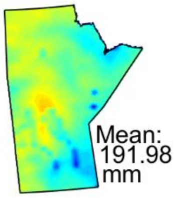
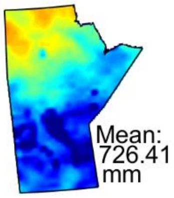
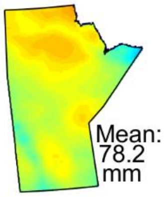
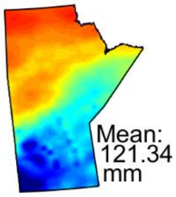
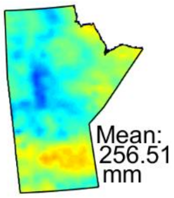
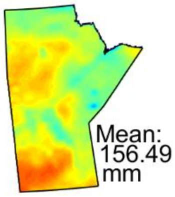
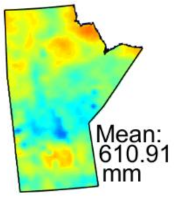
APPENDIX 2-1. SEASONAL AND ANNUAL TEMPERATURE NORMALS DERIVED FROM ERA5-LAND DATA

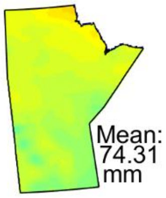
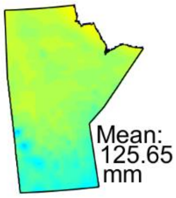
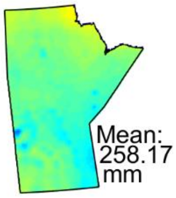
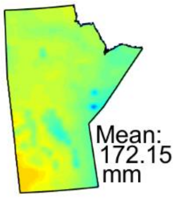
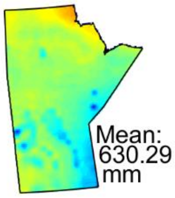
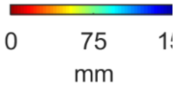
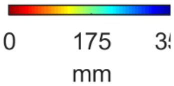
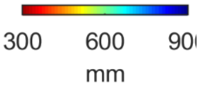
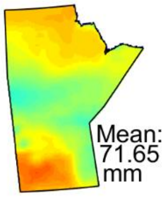
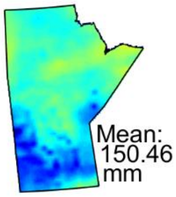
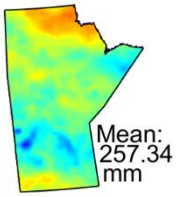
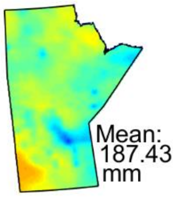
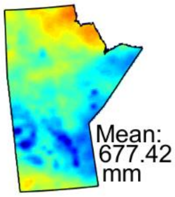
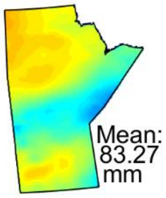
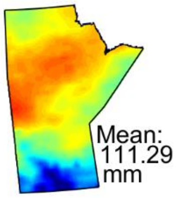
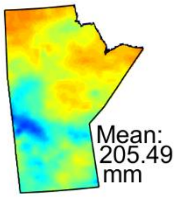
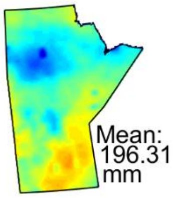
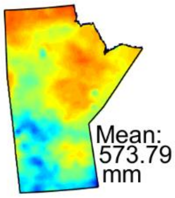
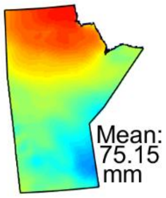
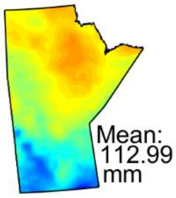
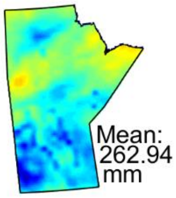
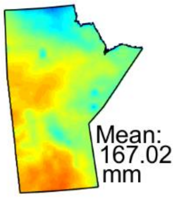
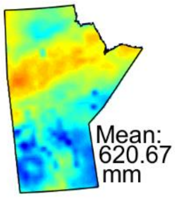
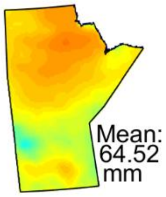
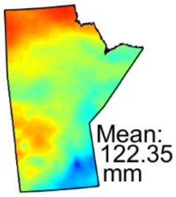
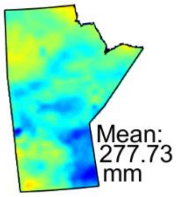
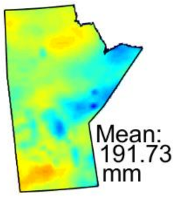
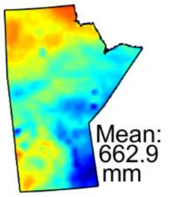
Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2008					
2009					
2010					
2011					

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2012					
2013					
2014					
2015					

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2016					
2017					
2018					
2019					
2020					

APPENDIX 2-2. SEASONAL AND PRECIPITATION NORMALS DERIVED FROM ERA5-LAND DATA

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2008					
2009					
2010					
2011					

Year	Winter (DJF)	Spring (MAM)	Summer (JJA)	Fall (SON)	Annual
Normals (1981-2010)					
					
2012					
2013					
2014					
2015					

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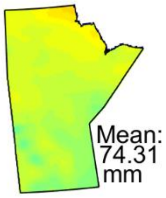
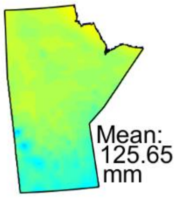
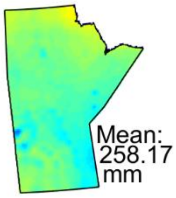
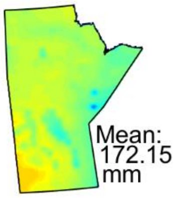
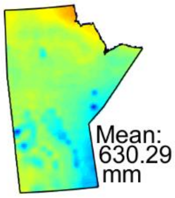
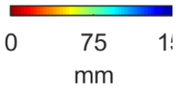
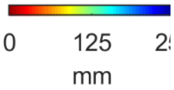
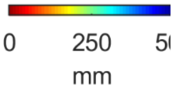
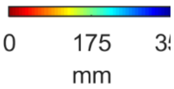
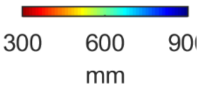
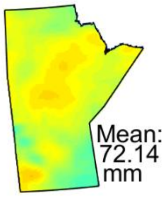
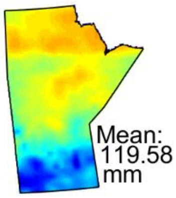
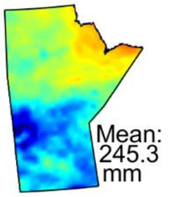
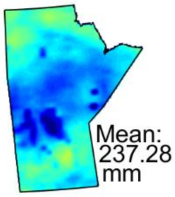
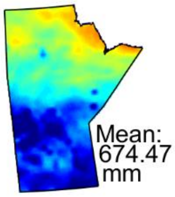
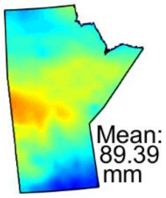
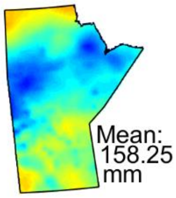
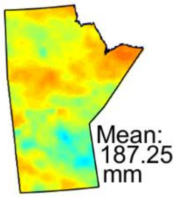
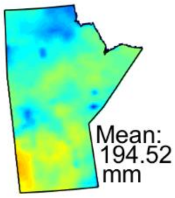
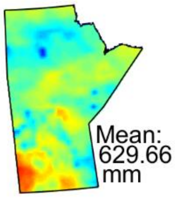
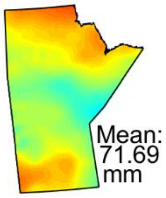
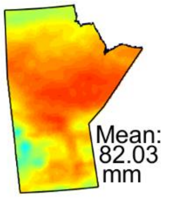
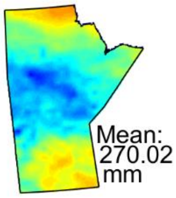
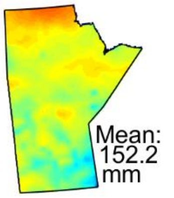
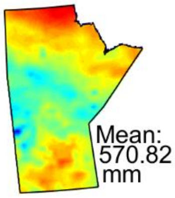
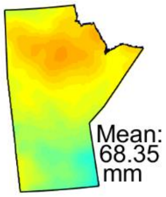
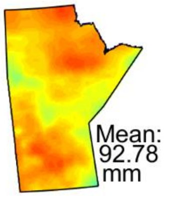
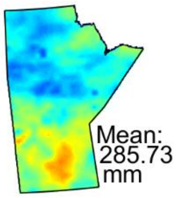
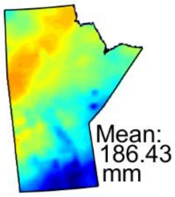
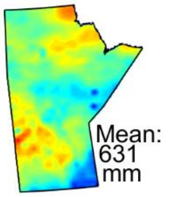
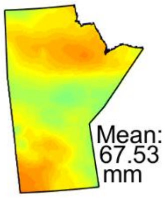
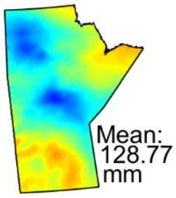
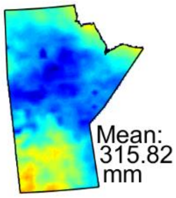
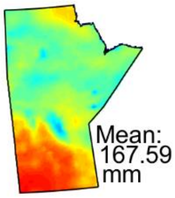
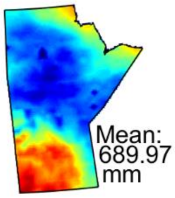
Normals (1981-2010)					
					
2016					
2017					
2018					
2019					
2020					

3.0 WATER QUALITY

3.1 INTRODUCTION

The following presents the results of water quality monitoring conducted from 2008 to 2019 in the Upper Churchill River Region. Six waterbodies and nine sites were monitored in the Upper Churchill River Region: one on-system annual site (Southern Indian Lake – Area 4); seven on-system rotational sites (Opachuanau Lake, Southern Indian Lake – Area 1, Southern Indian Lake – Area 6, Rat Lake, Central Mynarski Lake, Notigi Lake – East, and Notigi Lake – West); and one off-system annual site (Granville Lake; Table 3.1-1 and Figure 3.1-1). Annual sites are sampled each year, whereas rotational sites are sampled once every three years on a rotational basis and are therefore limited to three or four years of data for the 12-year period.

The CAMP water quality program includes four sampling periods (referred to as spring, summer, fall, and winter) per monitoring year (i.e., April-March) at a single location within each waterbody or area of a waterbody/river reach. Over the 12-year period, water quality sampling was conducted at each sampling location during each sampling period (i.e., n=48 for annual sites) as planned, although the sampling location in Southern Indian Lake – Area 4 was moved to the lee of the island as needed for safety and logistical reasons (Table 3.1-1; Appendix 3-1).

A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.3.

Three indicators (dissolved oxygen (DO); water clarity; and nutrients/trophic status) were selected for detailed reporting (Table 3.1-2). Metrics for these indicators include DO and its supporting metric temperature/stratification, Secchi disk depth, turbidity, total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN), and chlorophyll *a* (Table 3.1-2). A detailed description of these indicators is provided in CAMP (2024).

Table 3.1-1. 2008-2019 Water quality sampling inventory.

Waterbody/ Area	Sampling Year [1]											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SIL-4	●	●	●	●	●	●	●	●	●	●	●	●
OPACH				●			●			●		
SIL-1		●			●			●			●	
SIL-6			●			●			●			●
RAT			●			●			●			●
MYN				●			●			●		
NTG-E		●			●			●			●	
NTG-W		●			●			●			●	
GRV	●	●	●	●	●	●	●	●	●	●	●	●

Notes:

1. Sampling year is from April-March.

Table 3.1-2. Water quality indicators and metrics.

Indicator	Metric	Units
Dissolved Oxygen	• Dissolved oxygen (DO)	milligrams per litre (mg/L) and percent (%) saturation
	• Temperature/stratification [1]	°C
Water Clarity	• Secchi disk depth	m
	• Turbidity	Nephelometric turbidity units (NTU)
	• Total suspended solids (TSS)	mg/L
Nutrients and Trophic Status	• Total phosphorus (TP)	mg/L
	• Total nitrogen (TN)	mg/L
	• Chlorophyll *a*	micrograms per litre (µg/L)

Notes:

1. Supporting metric.

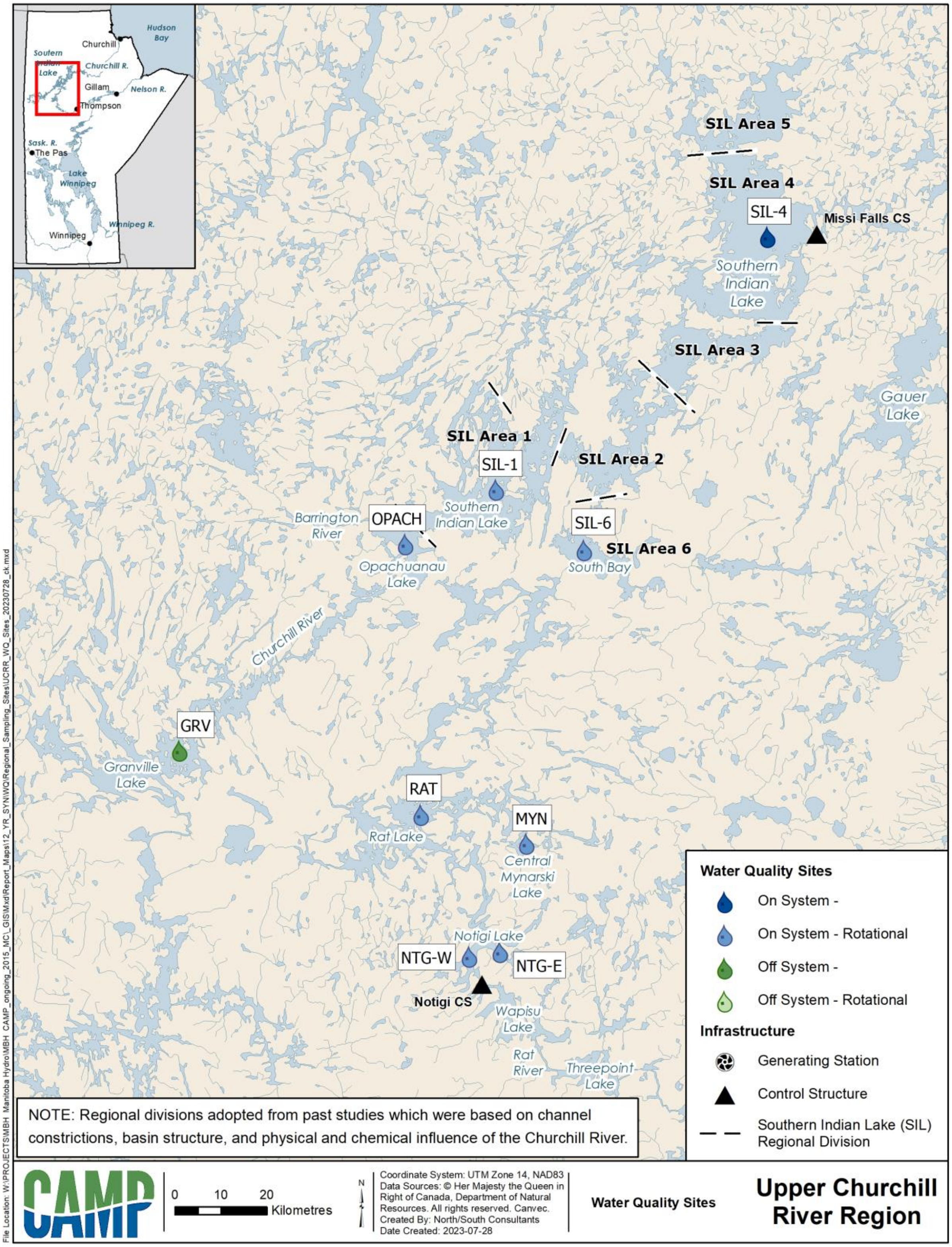


Figure 3.1-1. 2008-2019 Upper Churchill River Region water quality sites.

3.2 DISSOLVED OXYGEN

3.2.1 DISSOLVED OXYGEN

3.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Southern Indian Lake – Area 4 was well-oxygenated year-round and DO concentrations throughout the water column consistently met the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs) instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Manitoba Water Stewardship [MWS] 2011; Table 3.2-1).

Area 4 was thermally stratified during four spring sampling events (2008, 2012, 2013, and 2014) and one summer sampling event (2008) over the 12 years of monitoring (Table 3.2-1 and Figure 3.2-1).

DO concentrations were similar throughout the water column during each sampling period (Figure 3.2-2). During the open-water season, DO concentrations ranged from 8.84 to 14.95 mg/L at the surface and 7.98 to 15.21 mg/L near the bottom (maximum site water depth = 26.0 m). During the ice-cover season, DO concentrations ranged from 13.73 to 16.92 mg/L at the surface and 12.67 to 16.43 mg/L near the bottom (Table 3.2-2 and Figure 3.2-3).

DO concentrations varied between seasons with seasonal mean DO concentrations being higher in winter and spring when the water was cooler, and lower in the summer and fall when the water was warmer (Figure 3.2-4).

DO saturation was near 100% at both the surface and near the bottom during each season sampled (Figure 3.2-5). During the open-water season, surface DO saturation ranged from 91.4 to 120.5% with a mean of 101.6% and a median of 100.2% over the 12 years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 95.7 to 112.9% and were within or near the interquartile range (IQR) of 96.9 to 105.2%. Bottom DO saturation during the open-water season ranged from 78.5 to 121.4% with a mean of 97.2 and median of 95.8% over the 12 years of monitoring. Mean bottom DO saturation levels in the open-water season were similar from year to year ranging from 86.1 to 107.9% and were within or near the IQR of 92.7 to 102.1% (Table 3.2-2 and Figure 3.2-6).

During the ice-cover season, DO saturation at the surface ranged from 96.6 to 117.9% with a mean of 110.0% and a median of 110.6%. The IQR was 106.8 to 116.2%. Bottom DO saturation during the ice-cover season ranged from 90.6 to 115.0% with a mean of 102.7% and a median of 101.9%. The IQR was 97.2 to 109.4% (Table 3.2-2 and Figure 3.2-7).

ROTATIONAL SITES

Opachuanau Lake

Opachuanau Lake was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Opachuanau Lake was typically isothermal; however, there were two occurrences of thermal stratification near the surface (thermocline at 0-1 m) during the open-water season (spring 2017 and summer 2014; Table 3.2-1 and Figure 3.2-1).

DO concentrations were typically similar throughout the water column; however, DO decreased with water depth during one summer sampling event (2017) and during one fall sampling event (2014). DO concentrations near the bottom remained above the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life on both occasions (Figures 3.2-2 and 3.2-8).

During the open-water season, DO concentrations ranged from 8.02 to 12.85 mg/L at the surface and from 5.74 to 10.00 mg/L near the bottom (maximum site water depth = 15.5 m). During the ice-cover season, the DO concentration was 14.46 mg/L at the surface and 14.59 mg/L near the bottom in 2017 (Table 3.2-2 and Figure 3.2-8).

During the open-water season, surface DO saturation ranged from 89.5 to 122.7% with a mean of 100.3% and a median of 97.6% over the three years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 95.3 to 104.5% and were within or near the IQR of 94.3 to 102.9%. Bottom DO saturation during the open-water season ranged from 77.8 to 97.7% with a mean of 90.5% and a median of 91.1% over the three years of monitoring. Mean bottom DO saturation levels in the open-water season were similar from year to year ranging from 87.9 to 94.1% and were within or near the IQR of 90.9 to 93.3% (Table 3.2-2 and Figure 3.2-6).

During the ice-cover season, DO saturation was 101.6% at the surface and 102.5% near the bottom in 2017 (Table 3.2-2 and Figure 3.2-7).

Southern Indian Lake – Area 1

Southern Indian Lake – Area 1 was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Area 1 was typically isothermal; however, there was one occurrence of thermal stratification near the surface (thermocline at 1-2 m) in spring (2012; Table 3.2-1 and Figure 3.2-1).

DO concentrations were similar throughout the water column during each sampling period (Figure 3.2-2). During the open-water season, DO concentrations ranged from 8.12 to 13.26 mg/L at the surface and 8.03 to 13.47 mg/L near the bottom (maximum site water depth = 19.0 m). During the ice-cover season, DO concentrations ranged from 14.90 to 16.10 mg/L at the surface and 14.36 to 15.05 mg/L near the bottom (Table 3.2-2 and Figure 3.2-9).

During the open-water season, surface DO saturation ranged from 87.8 to 116.2% with a mean of 100.4% and a median of 100.0% over the four years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 92.2 to 107.2% and were within or near the IQR of 96.3 to 103.2%. Bottom DO saturation during the open-water season ranged from 87.0 to 112.1% with a mean of 97.4% and median of 95.4% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season were similar from year to year ranging from 89.7 to 101.3% and were within or near the IQR of 93.9 to 99.5% (Table 3.2-2 and Figure 3.2-6).

During the ice-cover season, DO saturation at the surface ranged from 104.5 to 119.2% with a mean of 112.3%. Bottom DO saturation during the ice-cover season ranged from 101.1 to 111.8% with a mean of 106.9% (Table 3.2-2 and Figure 3.2-7).

Southern Indian Lake – Area 6

Southern Indian Lake – Area 6 was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Area 6 was isothermal with the exception of one sampling event in each of the four years of monitoring. Specifically, stratification was observed in two spring sampling events (2010 and 2016), one summer sampling event (2013), and one winter sampling event (2019; Table 3.2-1 and Figure 3.2-1).

DO concentrations were typically similar throughout the water column; however, DO decreased with water depth during one summer sampling event (2013), one fall sampling event (2013), and during one winter sampling event (2019). DO concentrations near the bottom remained above the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life on all three occasions (Figures 3.2-2 and 3.2-10).

During the open-water season, DO concentrations ranged from 8.84 to 12.73 mg/L at the surface and 7.74 to 12.80 mg/L near the bottom (maximum site water depth = 16.2 m). During the ice-cover season, DO concentrations ranged from 13.20 to 15.48 mg/L at the surface and 10.62 to 14.56 mg/L near the bottom (Table 3.2-2 and Figure 3.2-10).

During the open-water season, surface DO saturation ranged from 93.6 to 118.5% with a mean of 101.7% and a median of 100.0% over the four years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 97.9 to 111.7% and were within or near the IQR of 95.0 to 105.2%. Bottom DO saturation during the open-water season ranged from 78.8 to 116.6% with a mean of 97.0% and median of 95.6% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season were similar from year to year ranging from 94.9 to 98.9% and were within the IQR of 93.2 to 101.3% (Table 3.2-2 and Figure 3.2-6).

During the ice-cover season, DO saturation at the surface ranged from 92.9 to 108.8% with a mean of 102.7%. Bottom DO saturation during the ice-cover season ranged from 77.4 to 104.0% with a mean of 94.3% (Table 3.2-2 and Figure 3.2-7).

Rat Lake

Rat Lake was well-oxygenated near the surface and DO concentrations near the surface met the MWQSOGs during all sampling periods. DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objective for cool- and cold-water aquatic life during one summer sampling event (2013) over the four years of monitoring (Table 3.2-1).

Rat Lake was isothermal with the exception of summer 2013 and winter 2013 when thermal stratification occurred near the bottom (Table 3.2-1 and Figure 3.2-1).

During the open-water season, Rat Lake was well-oxygenated near the surface. Typically DO concentrations were similar throughout the water column; however, DO decreased with water depth in some summers (Figure 3.2-2). Specifically, DO concentrations were lower near the bottom than at the surface in summer 2013 and 2019. DO concentrations near the bottom met MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life (5.0 and 4.0 mg/L, respectively) in summer 2019 but were below both objectives in summer 2013 (Table 3.2-1 and Figures 3.2-2 and 3.2-11). During the open-water season, DO concentrations ranged from 8.20 to 11.93 mg/L at the surface and 3.46 to 11.79 mg/L near the bottom (maximum site water depth = 18.8 m; Table 3.2-2 and Figure 3.2-11).

During the ice-cover season, DO concentrations were similar throughout the water column (Figure 3.2-2). DO concentrations ranged from 12.53 to 14.49 mg/L at the surface and 12.72 to 13.83 mg/L near the bottom (Table 3.2-2 and Figure 3.2-11).

During the open-water season, surface DO saturation ranged from 88.6 to 111.4% with a mean of 96.8% and a median of 95.8% over the four years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 92.3 to 100.6% and were within or near the IQR of 92.8 to 98.5%. Bottom DO saturation during the open-water season ranged from 33.0 to 103.1% with a mean of 85.1% and median of 89.2% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 67.4 to 89.1% and were within the IQR (83.9 to 94.4%) in three of four years. Mean DO saturation levels near the bottom were below the IQR in 2013 (Table 3.2-2 and Figure 3.2-12).

During the ice-cover season, DO saturation at the surface ranged from 89.6 to 102.2% with a mean of 97.2%. Bottom DO saturation during the ice-cover season ranged from 91.8 to 97.2% with a mean of 95.1% (Table 3.2-2 and Figure 3.2-13).

Central Mynarski Lake

Central Mynarski Lake was well-oxygenated near the surface and DO concentrations met the MWQSOGs during all open-water sampling periods. However, DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during several sampling events.

Central Mynarski Lake was thermally stratified during eight open-water sampling events and during one ice-cover sampling event over the three years of monitoring (Figure 3.2-1). Stratification was observed in each spring (2011, 2014, and 2017), each summer (2011, 2014, and 2017), two fall sampling events (2011 and 2014), and one winter sampling event (2017; Table 3.2-1).

During summer of each year[1], DO concentrations decreased down the water column to levels below the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life (5.0 and 4.0 mg/L, respectively) at approximately 6-10 m from the surface. DO concentrations below one or more of these objectives were also observed at depth in one spring sampling event (2011) and two fall sampling events (2011 and 2014) (Table 3.2-3 and Figure 3.2-2). During the open-water season, DO concentrations ranged from 8.45 to 10.92 mg/L at the surface and from 0.00 to 8.35 mg/L near the bottom (maximum site water depth = 19.3 m; Table 3.2-2 and Figure 3.2-14).

During the ice-cover season, DO concentrations decreased down the water column to levels below the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life (3.0 and 8.0 mg/L, respectively; Table 3.2-1 and Figure 3.2-2). In winter 2017, the DO concentration was 12.05 mg/L at the surface and 0.21 mg/L near the bottom (Table 3.2-2 and Figure 3.2-14).

During the open-water season, surface DO saturation ranged from 85.7 to 118.0% with a mean of 98.2% and a median of 94.3% over the three years of monitoring. Mean surface DO saturation levels in the open-water season ranged from 96.0 to 101.6% and were within the IQR of 93.1 to 105.1%. Bottom DO saturation during the open-water season ranged from 0.0 to 84.3% with a mean of 37.7% and a median of 38.6% over the three years of monitoring. Mean bottom DO

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[1] DO data from near the bottom are not available for summer 2014, fall 2011, and fall 2014. However, data from higher in the water column (10-14 m) show that DO concentrations at depth were below protection of aquatic life (PAL) objectives.

saturation levels in the open-water season were 32.8% in 2011 and 41.0% in 2017 and were within the IQR (12.2 to 53.3%) in both years (Table 3.2-2 and Figure 3.2-12).

During the ice-cover season, DO saturation was 86.0% at the surface and 1.7% near the bottom in 2017 (Table 3.2-2 and Figure 3.2-13).

Notigi Lake – East

Notigi Lake – East was well-oxygenated near the surface and DO concentrations near the surface met the MWQSOGs during all sampling periods. DO concentrations decreased with water depth and fell below the MWQSOGs instantaneous minimum objective for cold-water aquatic life during one winter sampling event (2018) over the four years of monitoring (Table 3.2-1).

Notigi Lake – East was isothermal with the exception of three spring sampling events, one summer sampling event, and one winter sampling event over the four years of monitoring. Specifically, stratification was observed in spring 2009, 2012, and 2018, summer 2012, and winter 2018 (Table 3.2-1 and Figure 3.2-1).

During the open-water season, the site was well-oxygenated and DO concentrations were similar throughout the water column (Figure 3.2-2). DO concentrations ranged from 7.92 to 13.17 mg/L at the surface and 8.20 to 12.58 mg/L near the bottom (maximum site water depth = 15.6 m; Table 3.2-2 and Figure 3.2-15).

During the ice-cover season, Notigi Lake – East was well-oxygenated near the surface. Typically DO concentrations were similar throughout the water column; however, DO decreased with water depth during one winter sampling event over the four years of monitoring (Figure 3.2-2). Specifically, DO concentrations near the bottom were below the MWQSOGs instantaneous minimum objective for cold-water aquatic life (8.0 mg/L) in winter 2018 (Table 3.2-1 and Figure 3.2-15). DO concentrations ranged from 13.08 to 13.82 mg/L at the surface and 3.52 to 11.81 mg/L near the bottom (Table 3.2-2 and Figure 3.2-15).

During the open-water season, surface DO saturation ranged from 83.5 to 122.9% with a mean of 97.8% and a median of 95.9% over the four years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 91.5 to 105.4% and were within or near the IQR of 89.6 to 104.0%. Bottom DO saturation during the open-water season ranged from 82.8 to 116.8% with a mean of 94.5% and median of 93.0% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 88.7 to 100.2% and were within of near the IQR of 90.9 to 94.6% (Table 3.2-2 and Figure 3.2-12).

During the ice-cover season, DO saturation at the surface ranged from 92.0 to 102.3% with a mean of 97.1%. Bottom DO saturation during the ice-cover season ranged from 26.5 to 90.0% with a mean of 66.5%. DO saturation near the bottom was lower in winter 2018 than in 2009 and 2012 (Table 3.2-2 and Figure 3.2-13).

Notigi Lake – West

Notigi Lake – West was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-1).

Notigi Lake – West was isothermal with the exception of two spring sampling events and one summer sampling event over the four years of monitoring. Specifically, stratification was observed in spring and summer 2009 and spring 2012 (Table 3.2-1 and Figure 3.2-1).

DO concentrations were similar throughout the water column during each sampling period (Figure 3.2-2). During the open-water season, DO concentrations ranged from 7.71 to 12.93 mg/L at the surface and 6.18 to 12.43 mg/L near the bottom (maximum site water depth = 20.6 m). During the ice-cover season, DO concentrations ranged from 13.13 to 13.89 mg/L at the surface and 12.93 to 13.46 mg/L near the bottom (Table 3.2-2 and Figure 3.2-16).

During the open-water season, surface DO saturation ranged from 84.2 to 123.2% with a mean of 96.9% and a median of 93.8% over the four years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 90.9 to 104.3% and were within or near the IQR of 91.1 to 102.0%. Bottom DO saturation during the open-water season ranged from 64.8 to 116.5% with a mean of 90.7% and median of 92.3% over the four years of monitoring. Mean bottom DO saturation levels in the open-water season ranged from 82.7 to 101.0% and were within of near the IQR of 85.6 to 94.1% (Table 3.2-2 and Figure 3.2-12).

During the ice-cover season, DO saturation at the surface ranged from 92.0 to 102.9% with a mean of 98.0%. Bottom DO saturation during the ice-cover season ranged from 92.4 to 99.6% with a mean of 96.0% (Table 3.2-2 and Figure 3.2-13).

3.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Granville Lake was well-oxygenated year-round and DO concentrations throughout the water column consistently met the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life during the open-water and ice-cover seasons (Table 3.2-3).

Granville Lake was typically isothermal; however, there were three occurrences of thermal stratification near the surface (thermocline 0-2 m) in spring (2008) and summer (2014 and 2015) (Table 3.2-3 and Figure 3.2-1).

DO concentrations were typically similar throughout the water column; however, DO concentrations were lower near the bottom than at the surface during two fall sampling events (2013 and 2015). DO concentrations near the bottom remained above the MWQSOGs instantaneous minimum objectives for cool- and cold-water aquatic life on both occasions (Figures 3.2-2 and 3.2-17).

During the open-water season, DO concentrations ranged from 7.83 to 11.97 mg/L at the surface and 7.53 to 11.57 mg/L near the bottom (maximum site water depth = 22.0 m). During the ice-cover season, DO concentrations ranged from 14.08 to 16.24 mg/L at the surface and 13.89 to 15.98 mg/L near the bottom (Table 3.2-2 and Figure 3.2-17).

DO concentrations varied between seasons with seasonal mean DO concentrations being higher in winter when the water was cooler, and lower in spring, summer, and fall when the water was warmer (Figure 3.2-18).

DO saturation was near 100% at both the surface and near the bottom during each season sampled (Figure 3.2-19). During the open-water season, surface DO saturation ranged from 86.9 to 117.0% with a mean of 100.6% and a median of 99.2% over the 12 years of monitoring. Mean surface DO saturation levels in the open-water season were similar from year to year ranging from 91.9 to 107.8% and were within or near the IQR of 97.0 to 103.4%. Bottom DO saturation during the open-water season ranged from 74.6 to 108.1% with a mean of 95.2 and median of 96.7% over the 12 years of monitoring. Mean bottom DO saturation levels in the open-water season were similar from year to year ranging from 89.1 to 100.5% and were within or near the IQR of 92.0 to 99.0% (Table 3.2-2 and Figure 3.2-20).

During the ice-cover season, DO saturation at the surface ranged from 97.5 to 118.2% with a mean of 110.3% and a median of 112.3%. The IQR was 105.9 to 117.1%. Bottom DO saturation during the ice-cover season ranged from 96.7 to 118.9% with a mean of 108.8% and a median of 109.2%. The IQR was 104.1 to 114.8% (Table 3.2-2 and Figure 3.2-20).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

Table 3.2-1. 2008-2019 On-system sites summary of thermal stratification and DO concentrations.

Metric	Sampling Year	Surface or Bottom	SIL-4				OPACH				SIL-1				SIL-6			
			Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover
			SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI
Thermal Stratification	2008		2008	2008	ND	No												
	2009		No	No	No	No					No	No	No	No				
	2010		No	No	No	No									2010	No	No	No
	2011		No	No	No	No	No	No	No	No								
	2012		2012	No	No	No					2012	No	No	No				
	2013		2013	No	No	No									No	2013	No	No
	2014		2014	No	No	No	No	2014	No	No								
	2015		No	No	No	No					No	No	No	No				
	2016		No	No	No	No									2016	No	No	No
	2017		No	No	No	No	2017	No	No	No								
	2018		No	No	No	No					No	No	No	No				
	2019		No	No	No	No									No	No	No	2019
DO met MWQSOGs PAL objectives	2008	Surface	Yes	Yes	ND	Yes												
		Bottom	Yes	Yes	ND	Yes												
	2009	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
	2010	Surface	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes
	2011	Surface	Yes	Yes	Yes	ND	Yes	Yes	Yes	ND								
		Bottom	Yes	Yes	Yes	ND	Yes	Yes	Yes	ND								
	2012	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
	2013	Surface	ND	Yes	ND	ND									Yes	Yes	Yes	ND
		Bottom	ND	Yes	ND	ND									Yes	Yes	Yes	ND
	2014	Surface	Yes	Yes	ND	ND	Yes	Yes	Yes	ND								
		Bottom	ND	Yes	ND	ND	Yes	Yes	Yes	ND								
	2015	Surface	ND	Yes	Yes	ND					Yes	Yes	Yes	ND				
		Bottom	ND	Yes	Yes	ND					Yes	Yes	Yes	ND				
	2016	Surface	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes
	2017	Surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes								
		Bottom	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes								
	2018	Surface	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
		Bottom	Yes	Yes	Yes	Yes					Yes	Yes	Yes	Yes				
	2019	Surface	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes									Yes	Yes	Yes	Yes

Table 3.2-1. continued.

Metric	Sampling Year	Surface or Bottom	RAT				MYN				NTG-E				NTG-W			
			Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover	Open-Water			Ice-Cover
			SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI	SP	SU	FA	WI
Thermal Stratification	2008																	
	2009										2009	No	No	No	2009	2009	No	No
	2010		No	No	No	No												
	2011						2011	2011	2011	No								
	2012										2012	2012	No	No	2012	No	No	No
	2013		No	2013	No	2013												
	2014						2014	2014	2014	No								
	2015										No	No	No	No	No	No	No	No
	2016		No	No	No	No												
	2017						2017	2017	No	2017								
	2018										2018	No	No	2018	No	No	No	No
	2019		No	No	No	No												
DO met MWQSOGs PAL objectives	2008	Surface																
		Bottom																
	2009	Surface									ND	ND	ND	Yes	ND	ND	ND	Yes
		Bottom									ND	ND	ND	Yes	ND	ND	ND	Yes
	2010	Surface	Yes	Yes	Yes	Yes												
		Bottom	Yes	Yes	Yes	Yes												
	2011	Surface					Yes	Yes	Yes	ND								
		Deep/Bottom					Yes	2011	2011/ND	ND								
	2012	Surface									Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom									Yes	ND	Yes	Yes	Yes	Yes	Yes	Yes
	2013	Surface	Yes	Yes	Yes	ND												
		Bottom	Yes	2013	ND	ND												
	2014	Surface					Yes	Yes	Yes	ND								
		Deep/Bottom					ND	2014/ND	2014/ND	ND								
	2015	Surface									Yes	Yes	Yes	ND	Yes	Yes	Yes	ND
		Bottom									Yes	Yes	Yes	ND	Yes	Yes	Yes	ND
	2016	Surface	Yes	Yes	Yes	Yes												
		Bottom	Yes	Yes	Yes	Yes												
	2017	Surface					Yes	Yes	Yes	Yes								
		Bottom					2017	2017	Yes	2017								
	2018	Surface									Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Bottom									Yes	Yes	Yes	2018	Yes	Yes	Yes	Yes
	2019	Surface	Yes	Yes	Yes	Yes												
		Bottom	Yes	Yes	Yes	Yes												

Notes:

1. SP = spring; SU = summer; FA = fall; WI = winter.
2. ND = No data.
3. MWQSOGs = Manitoba Water Quality Standards, Objectives, and Guidelines; PAL = Protection of aquatic life.
4. DO concentrations were compared to the most stringent MWQSOGs instantaneous minimum PAL objectives for each season; i.e., 5 mg/L for cool-water early life for the open-water season and 8 mg/L for cold-water early life the ice-cover season.
5. Cells with a year indicated denote instances of stratification or non-compliance with MWQSOGs instantaneous minimum objectives.
6. Bottom DO data are not available for MYN in summer 2014, fall 2011, and fall 2014; however, data from higher in the water column show that DO concentrations at depth did not meet PAL objectives.
7. ☐ = Sampling did not occur.

Table 3.2-2. 2008-2019 On-system sites DO, water depth, and ice thickness summary statistics.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
SIL-4	Mean	10.59	15.36	10.46	14.18	101.6	110.0	97.2	102.7	12.6	9.1	1.05
	Median	10.23	15.23	10.08	13.84	100.2	110.6	95.8	101.9	11.7	9.7	1.00
	Minimum	8.84	13.73	7.98	12.67	91.4	96.6	78.5	90.6	2.3	2.3	0.80
	Maximum	14.95	16.92	15.21	16.43	120.5	117.9	121.4	115.0	26.0	12.0	1.53
	SD	1.28	1.05	1.52	1.14	7.12	7.47	7.77	8.37	5.82	2.61	0.21
	SE	0.229	0.370	0.277	0.405	1.28	2.64	1.42	2.96	1.00	0.753	0.06
	Lower Quartile	9.66	14.79	9.55	13.66	96.9	106.8	92.7	97.2	8.8	9.4	0.87
	Upper Quartile	11.27	15.87	11.11	14.76	105.2	116.2	102.1	109.4	15.9	10.2	1.20
	n	31	8	30	8	31	8	30	8	34	12	12
	% Detections	100	100	100	100	100	100	100	100	-	-	-
OPACH	Mean	9.52	14.46	8.66	14.59	100.3	101.6	90.5	102.5	10.2	9.6	0.78
	Median	9.36	-	8.67	-	97.6	-	91.1	-	10.0	-	-
	Minimum	8.02	14.46	5.74	14.59	89.5	101.6	77.8	102.5	8.2	9.2	0.66
	Maximum	12.85	14.46	10.00	14.59	122.7	101.6	97.7	102.5	15.5	10.4	0.90
	SD	1.42	-	1.30	-	9.69	-	5.60	-	2.29	0.657	0.12
	SE	0.473	-	0.432	-	3.23	-	1.87	-	0.763	0.379	0.07
	Lower Quartile	8.79	-	8.41	-	94.3	-	90.9	-	8.6	-	-
	Upper Quartile	9.80	-	9.63	-	102.9	-	93.3	-	10.7	-	-
	n	9	1	9	1	9	1	9	1	9	3	3
	% Detections	100	100	100	100	100	100	100	100	-	-	-
SIL-1	Mean	10.12	15.43	10.13	14.61	100.4	112.3	97.4	106.9	15.1	13.9	0.88
	Median	9.51	-	9.48	-	100.0	-	95.4	-	15.0	-	-
	Minimum	8.12	14.90	8.03	14.36	87.8	104.5	87.0	101.1	7.0	13.2	0.63
	Maximum	13.26	16.10	13.47	15.05	116.2	119.2	112.1	111.8	19.0	14.4	1.15
	SD	1.63	0.613	1.81	0.380	8.38	7.41	7.82	5.41	3.11	0.501	0.22
	SE	0.471	0.354	0.522	0.219	2.42	4.28	2.26	3.12	0.899	0.250	0.11
	Lower Quartile	9.24	-	9.01	-	96.3	-	93.9	-	14.3	-	-
	Upper Quartile	10.55	-	10.69	-	103.2	-	99.5	-	17.2	-	-
	n	12	3	12	3	12	3	12	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Table 3.2-2. continued.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
SIL-6	Mean	10.31	14.45	10.03	13.05	101.7	102.7	97.0	94.3	11.0	11.0	0.64
	Median	9.86	-	9.72	-	100.0	-	95.6	-	11.1	-	-
	Minimum	8.84	13.20	7.74	10.62	93.6	92.9	78.8	77.4	8.0	10.5	0.57
	Maximum	12.73	15.48	12.80	14.56	118.5	108.8	116.6	104.0	16.2	11.6	0.75
	SD	1.32	1.16	1.41	2.13	8.57	8.56	9.19	14.7	2.02	0.557	0.08
	SE	0.380	0.668	0.407	1.23	2.47	4.94	2.65	8.46	0.584	0.278	0.04
	Lower Quartile	9.41	-	9.32	-	95.0	-	93.2	-	10.3	-	-
	Upper Quartile	10.86	-	10.80	-	105.2	-	101.3	-	11.3	-	-
	n	12	3	12	3	12	3	12	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-
RAT	Mean	9.53	13.61	8.69	13.17	96.8	97.2	85.1	95.1	15.8	14.5	0.73
	Median	9.24	-	8.98	-	95.8	-	89.2	-	16.6	-	-
	Minimum	8.20	12.53	3.46	12.72	88.6	89.6	33.0	91.8	13.2	11.2	0.68
	Maximum	11.93	14.49	11.79	13.83	111.4	102.2	103.1	97.2	18.8	17.3	0.82
	SD	1.14	1.00	2.28	0.584	6.56	6.72	19.3	2.86	1.95	2.91	0.06
	SE	0.329	0.575	0.688	0.337	1.89	3.88	5.82	1.65	0.564	1.45	0.03
	Lower Quartile	8.74	-	7.77	-	92.8	-	83.9	-	13.9	-	-
	Upper Quartile	9.84	-	9.98	-	98.5	-	94.4	-	17.2	-	-
	n	12	3	11	3	12	3	11	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-
MYN	Mean	9.31	12.05	4.06	0.21	98.2	86.0	37.7	1.7	17.8	16.8	0.75
	Median	9.21	-	4.57	-	94.3	-	38.6	-	17.7	-	-
	Minimum	8.45	12.05	0.00	0.21	85.7	86.0	0.0	1.7	16.3	16.4	0.70
	Maximum	10.92	12.05	8.35	0.21	118.0	86.0	84.3	1.7	19.3	17.4	0.79
	SD	0.783	-	3.41	-	10.2	-	33.5	-	0.930	0.527	0.05
	SE	0.261	-	1.53	-	3.39	-	15.0	-	0.310	0.304	0.03
	Lower Quartile	8.79	-	1.32	-	93.1	-	12.2	-	17.1	-	-
	Upper Quartile	9.42	-	6.04	-	105.1	-	53.3	-	18.3	-	-
	n	9	1	5	1	9	1	5	1	9	3	3
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Table 3.2-2. continued.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
NTG-E	Mean	9.69	13.33	9.63	8.75	97.8	97.1	94.5	66.5	15.0	14.3	0.70
	Median	9.30	-	9.12	-	95.9	-	93.0	-	15.1	-	-
	Minimum	7.92	13.08	8.20	3.52	83.5	92.0	82.8	26.5	14.4	13.7	0.68
	Maximum	13.17	13.82	12.58	11.81	122.9	102.3	116.8	90.0	15.6	15.0	0.72
	SD	1.64	0.424	1.49	4.55	11.7	5.15	9.82	34.8	0.405	0.580	0.02
	SE	0.545	0.245	0.527	2.63	3.91	2.97	3.47	20.1	0.117	0.290	0.01
	Lower Quartile	8.61	-	8.56	-	89.6	-	90.9	-	14.7	-	-
	Upper Quartile	10.52	-	10.31	-	104.0	-	94.6	-	15.1	-	-
	n	9	3	8	3	9	3	8	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-
NTG-W	Mean	9.60	13.47	9.18	13.17	96.9	98.0	90.7	96.0	19.8	19.4	0.69
	Median	9.01	-	8.86	-	93.8	-	92.3	-	20.0	-	-
	Minimum	7.71	13.13	6.18	12.93	84.2	92.0	64.8	92.4	18.0	18.4	0.63
	Maximum	12.93	13.89	12.43	13.46	123.2	102.9	116.5	99.6	20.6	20.5	0.76
	SD	1.59	0.387	1.82	0.269	11.7	5.54	13.7	3.63	0.743	0.896	0.06
	SE	0.529	0.224	0.606	0.155	3.91	3.20	4.57	2.09	0.214	0.448	0.03
	Lower Quartile	8.47	-	8.48	-	91.1	-	85.6	-	19.7	-	-
	Upper Quartile	10.55	-	9.89	-	102.0	-	94.1	-	20.2	-	-
	n	9	3	9	3	9	3	9	3	12	4	4
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Notes:

1. OW = Open-water season; IC = Ice-cover season
2. SD = standard deviation; SE = standard error; n = number of samples

Table 3.2-3. 2008-2019 Off-system sites summary of thermal stratification and DO concentrations.

Metric	Sampling Year	Surface or Bottom	GRV			
			Open-Water			Ice-Cover
			SP	SU	FA	WI
Thermal Stratification	2008		2008	No	No	No
	2009		No	No	No	No
	2010		No	No	No	No
	2011		No	No	No	No
	2012		No	No	No	No
	2013		No	No	No	No
	2014		No	2014	No	No
	2015		No	2015	No	No
	2016		No	No	No	No
	2017		No	No	No	No
	2018		No	No	No	No
	2019		No	No	No	No
DO met MWQSOGs PAL objectives	2008	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2009	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2010	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2011	Surface	Yes	Yes	Yes	ND
		Bottom	Yes	Yes	Yes	ND
	2012	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2013	Surface	Yes	Yes	Yes	ND
		Bottom	Yes	Yes	Yes	ND
	2014	Surface	Yes	Yes	ND	ND
		Bottom	Yes	Yes	ND	ND
	2015	Surface	Yes	Yes	Yes	ND
		Bottom	Yes	Yes	Yes	ND
	2016	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	ND	Yes	Yes
	2017	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2018	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes
	2019	Surface	Yes	Yes	Yes	Yes
		Bottom	Yes	Yes	Yes	Yes

Notes:

1. SP = spring; SU = summer; FA = fall; WI = winter; DO = dissolved oxygen; MWQSOG = Manitoba Water Quality Standards, Objectives, and Guidelines; PAL = Protection of Aquatic Life.
2. ND = No data.
3. PAL = Protection of aquatic life.
4. DO concentrations were compared to the most stringent MWQSOGs instantaneous minimum PAL objectives for each season; i.e., 5 mg/L for cool-water early life for the open-water season and 8 mg/L for cold-water early life the ice-cover season.
5. Cells with a year indicated denote instances of stratification or non-compliance with MWQSOGs instantaneous minimum objectives.

Table 3.2-4. 2008-2019 Off-system sites DO, water depth, and ice thickness summary statistics.

Site	Statistic	Dissolved Oxygen								Water Depth at Site (m)		Ice Thickness at Site (m)
		DO - Surface (mg/L)		DO - Bottom (mg/L)		DO Saturation - Surface (%)		DO Saturation - Bottom (%)				
		OW	IC	OW	IC	OW	IC	OW	IC	OW	IC	IC
GRV	Mean	9.67	15.39	9.31	15.10	100.6	110.3	95.2	108.8	10.5	7.3	0.74
	Median	9.83	15.70	9.38	15.14	99.2	112.3	96.7	109.2	9.5	7.3	0.74
	Minimum	7.83	14.08	7.53	13.89	86.9	97.5	74.6	96.7	5.1	3.7	0.53
	Maximum	11.97	16.24	11.57	15.98	117.0	118.2	108.1	118.9	22.0	10.8	1.10
	SD	0.904	0.798	0.973	0.752	6.56	8.17	7.07	7.96	3.665	1.74	0.15
	SE	0.153	0.282	0.167	0.266	1.11	2.89	1.21	2.81	0.619	0.501	0.04
	Lower Quartile	9.19	15.07	8.71	14.67	97.0	105.9	92.0	104.1	7.9	6.6	0.65
	Upper Quartile	10.11	15.89	9.80	15.73	103.4	117.1	99.0	114.8	12.0	7.9	0.80
	n	35	8	34	8	35	8	34	8	35	12	12
	% Detections	100	100	100	100	100	100	100	100	-	-	-

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

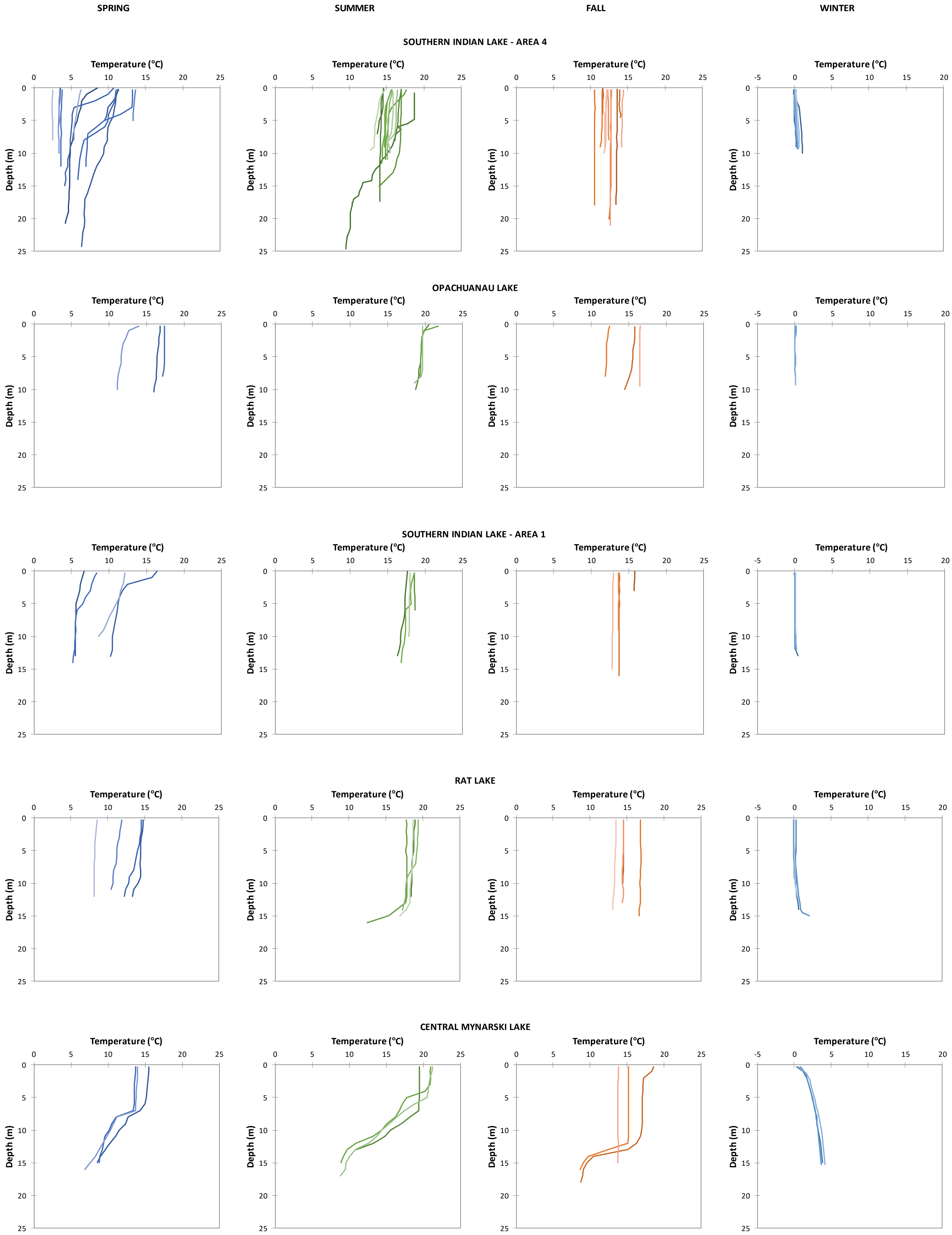


Figure 3.2-1. 2008-2019 On-system and off-system water temperature depth profiles.

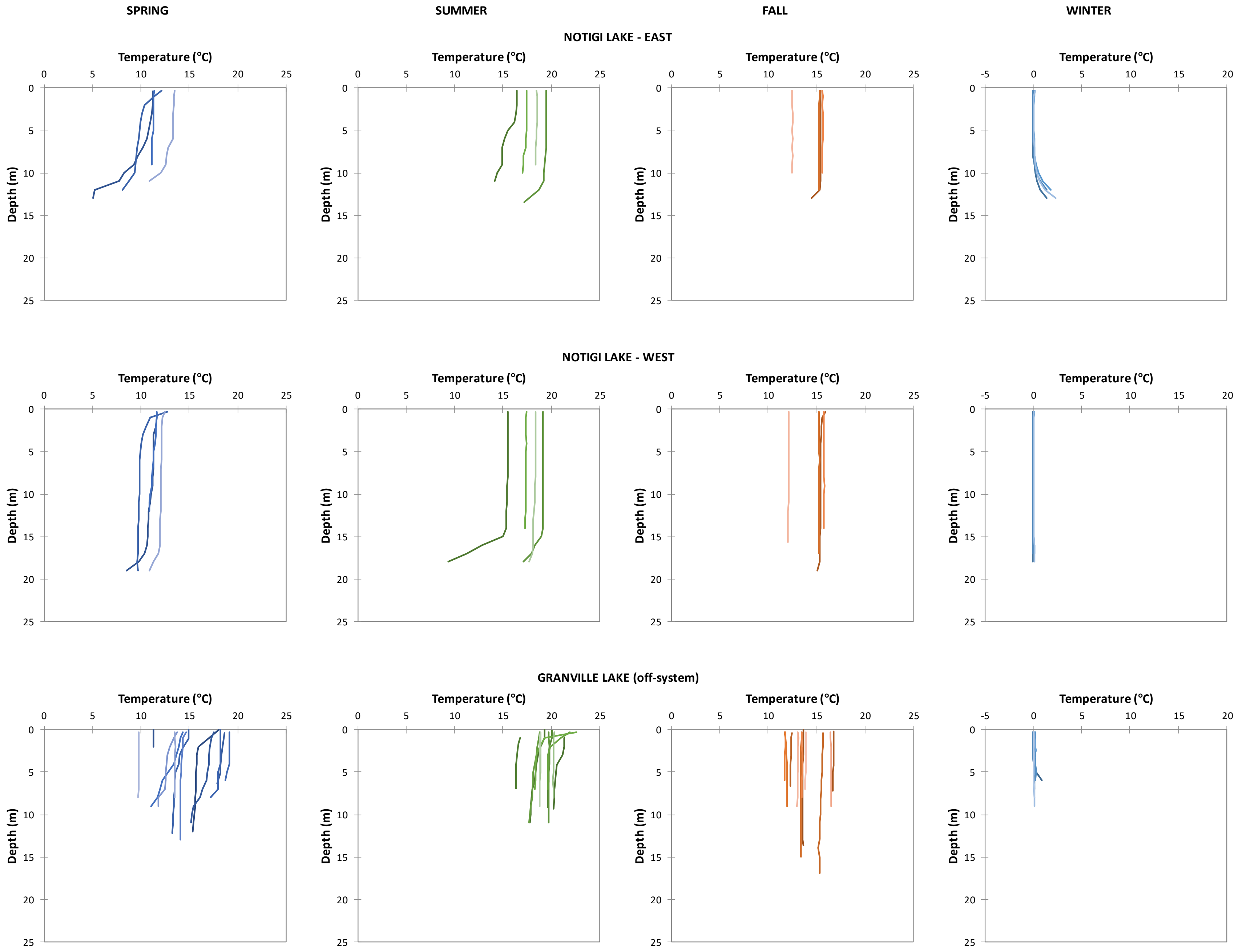


Figure 3.2-1. continued.

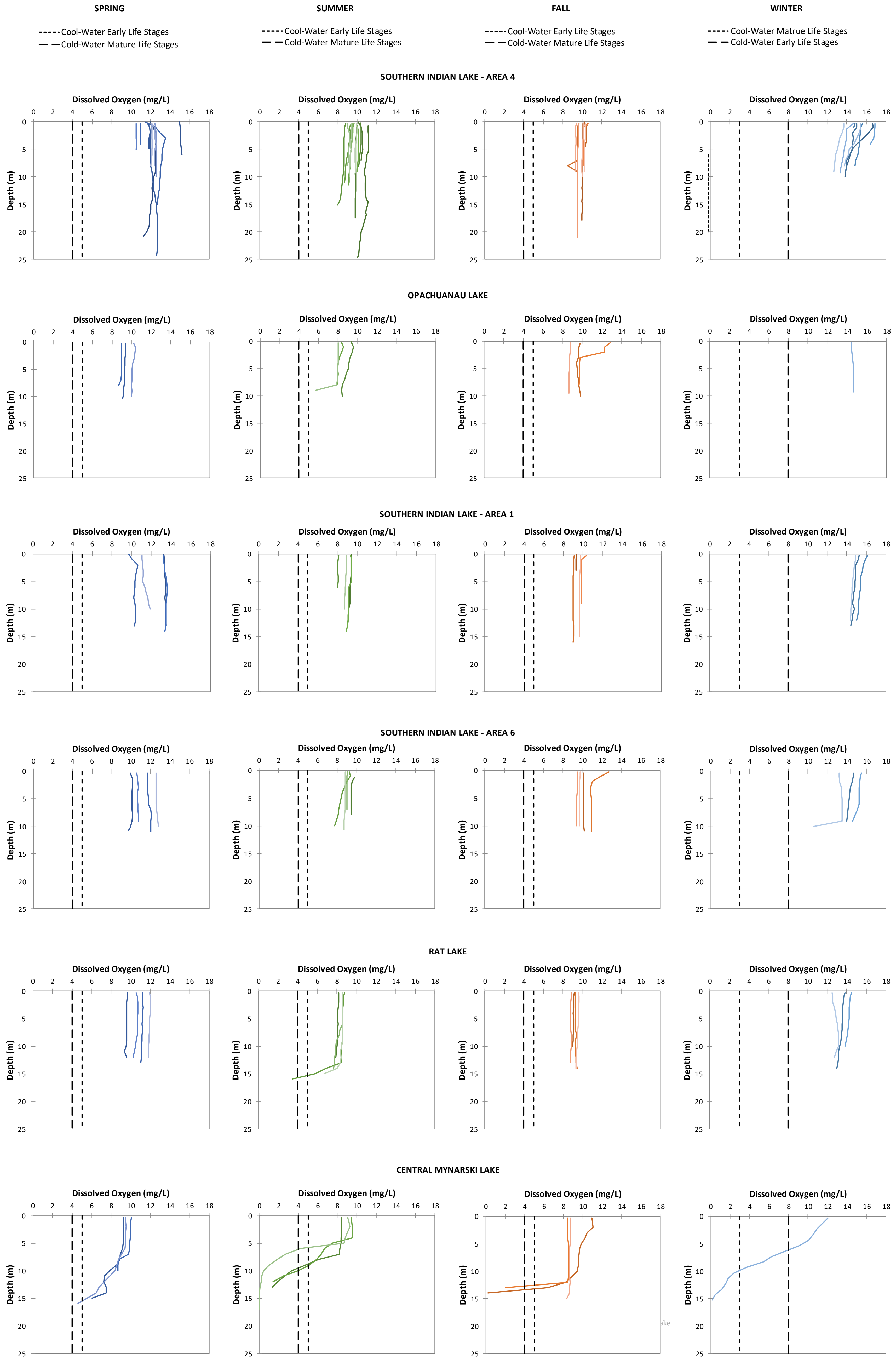


Figure 3.2-2. 2008-2019 On-system and off-system dissolved oxygen depth profiles and comparison to instantaneous minimum objectives for the protection of aquatic life.

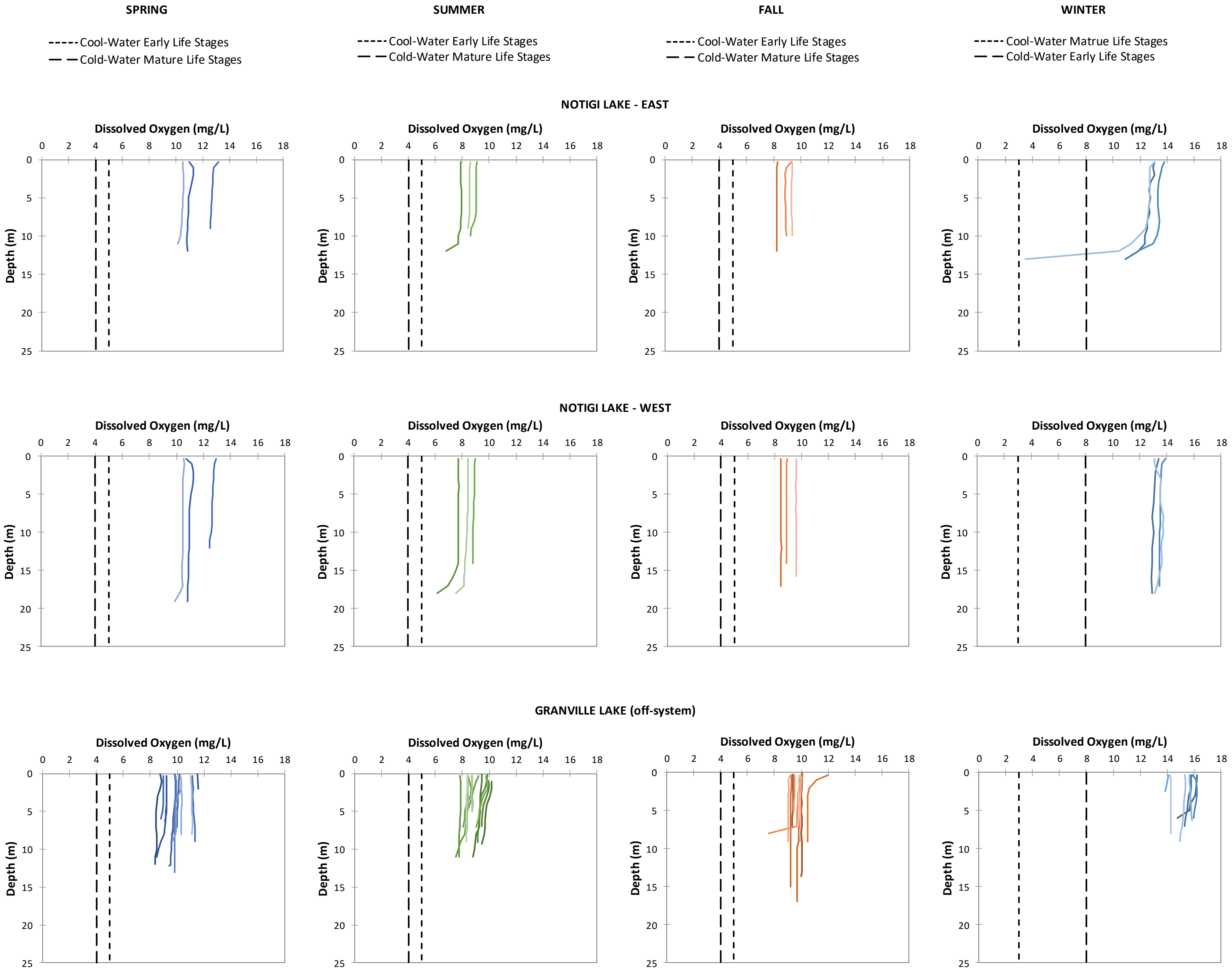


Figure 3.2-2. continued.

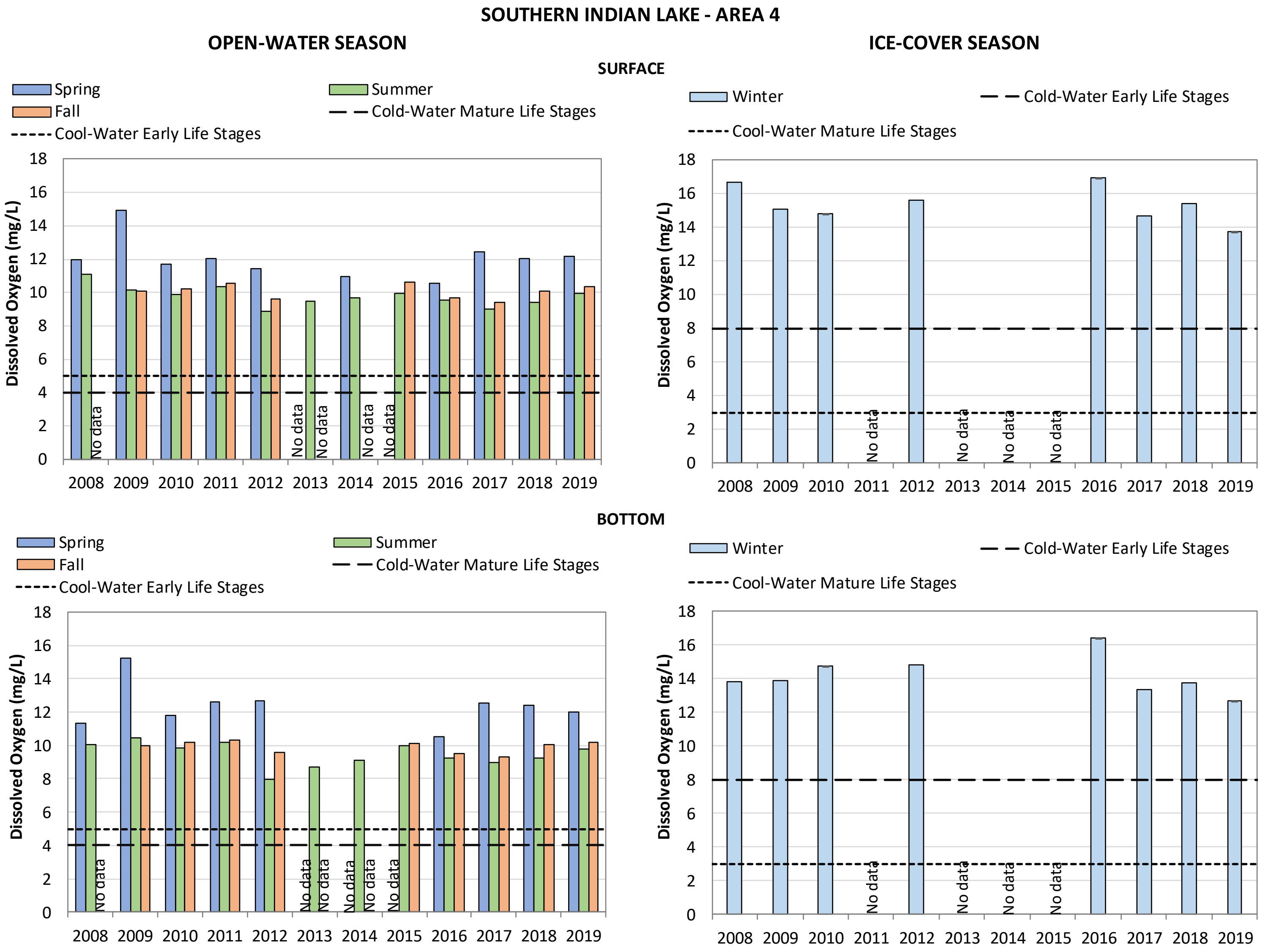


Figure 3.2-3. 2008-2019 Southern Indian Lake – Area 4 surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

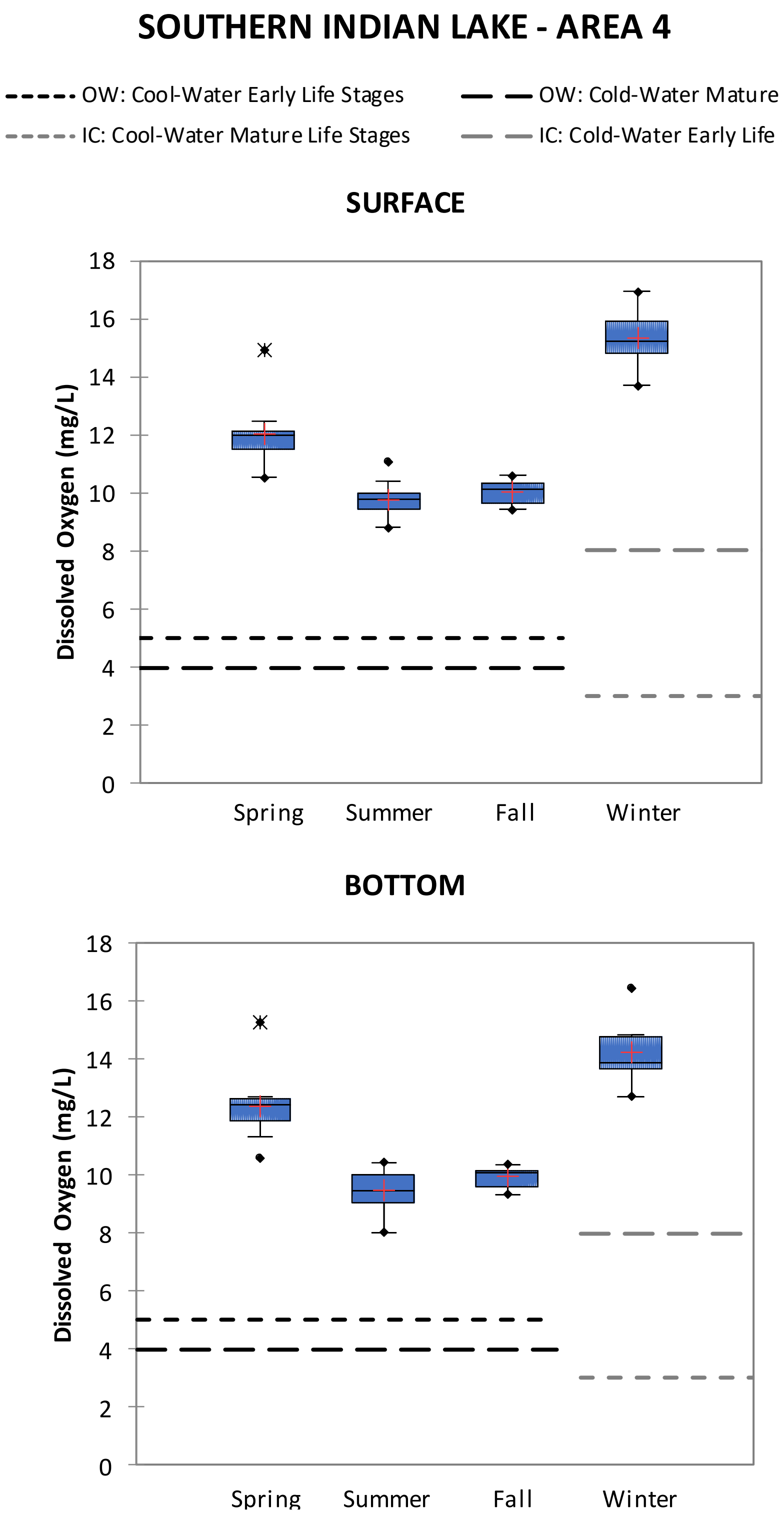


Figure 3.2-4. 2008-2019 On-system seasonal surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

SOUTHERN INDIAN LAKE - AREA 4

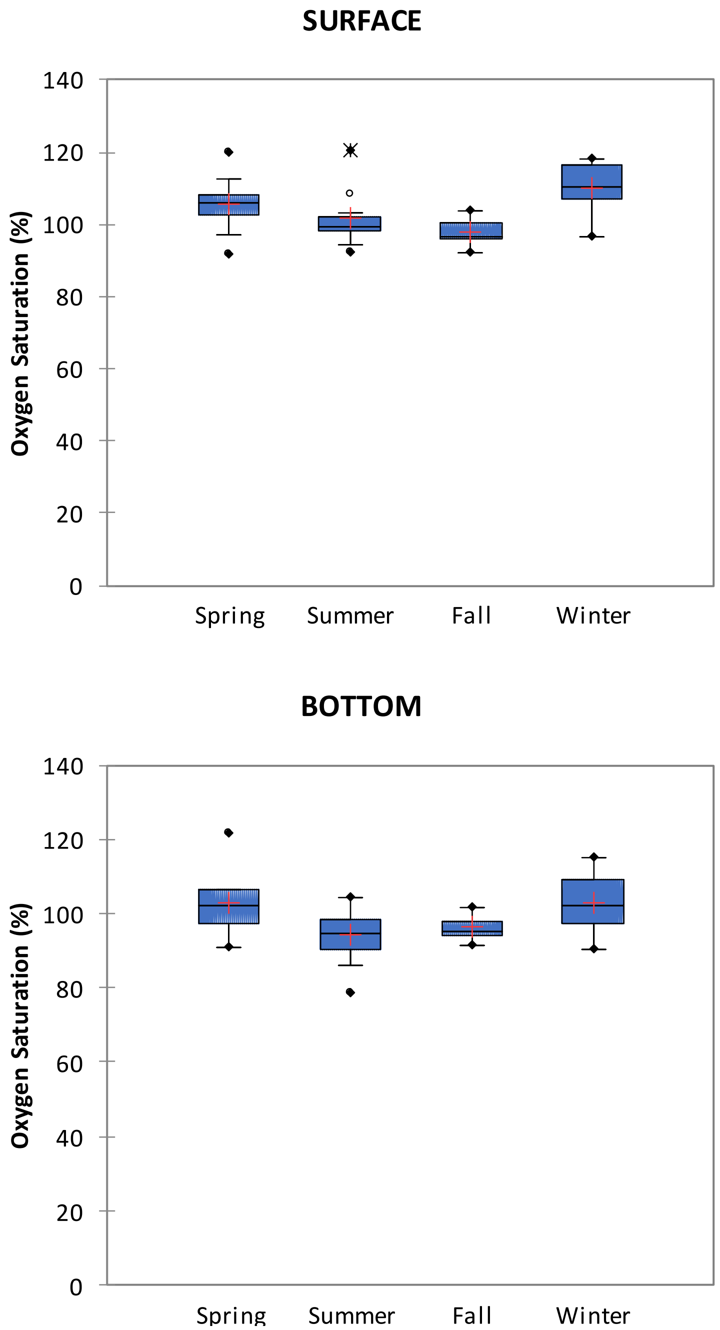
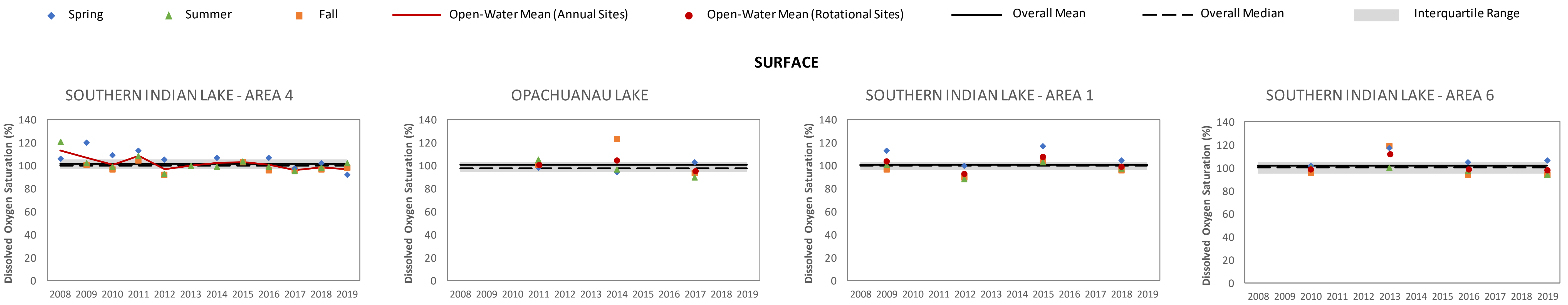


Figure 3.2-5. 2008-2019 On-system seasonal surface and bottom dissolved oxygen saturation.



BOTTOM

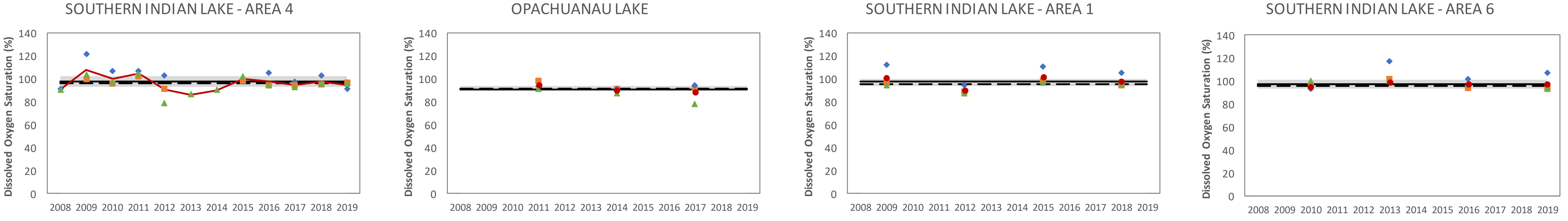


Figure 3.2-6. 2008-2019 Southern Indian and Opachuanau lakes open-water season surface and bottom dissolved oxgen saturation.

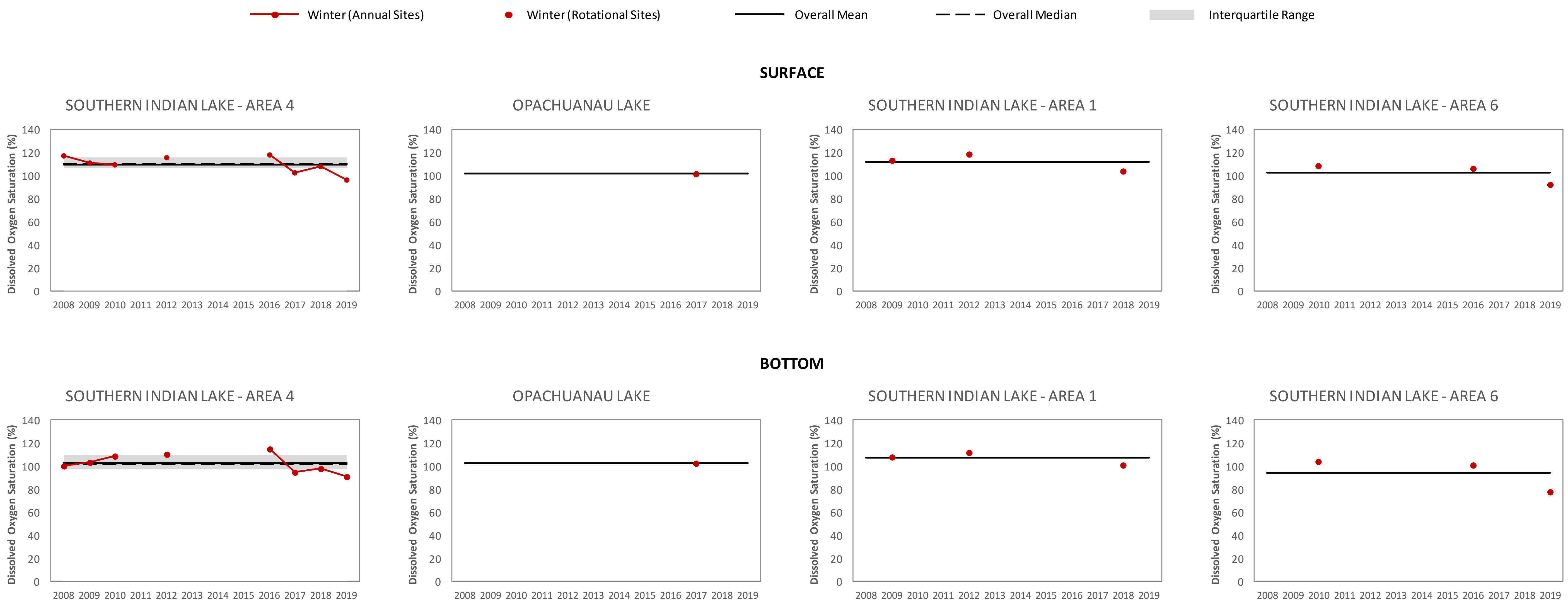


Figure 3.2-7. 2008-2019 Southern Indian and Opachuanau lakes ice-cover season surface and bottom dissolved oxgen saturation.

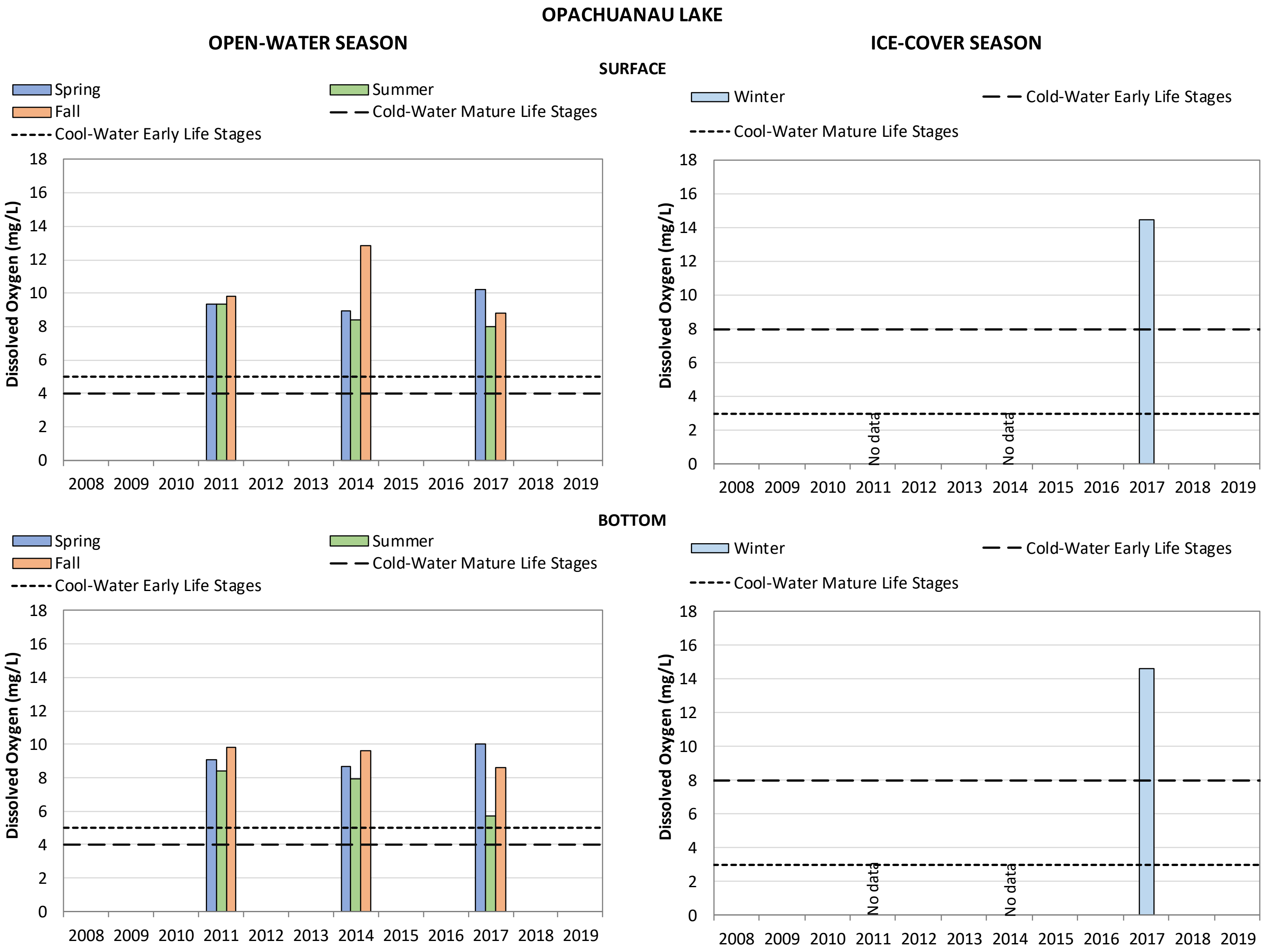


Figure 3.2-8. 2008-2019 Opachuanau Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

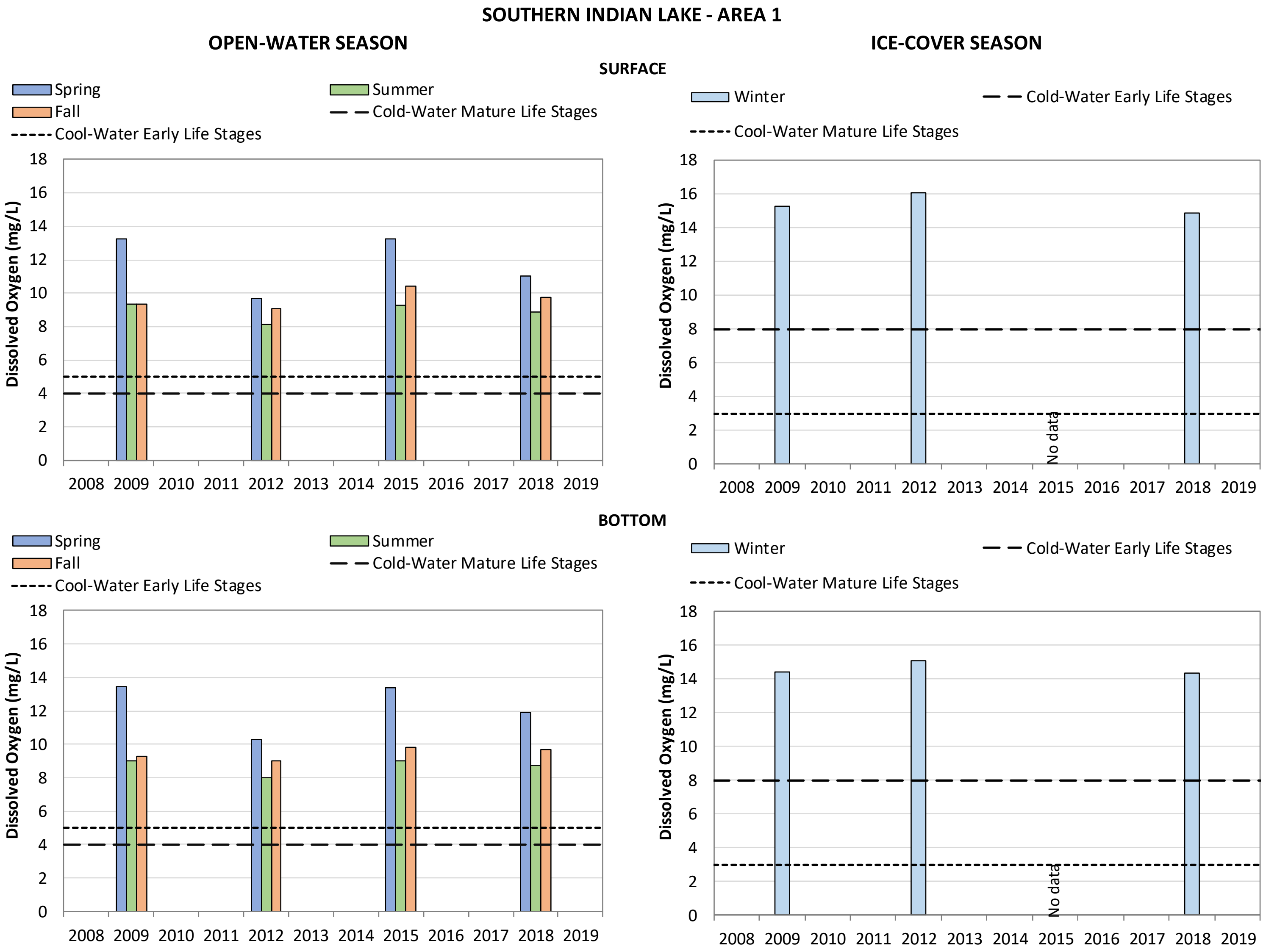


Figure 3.2-9. 2008-2019 Southern Indian Lake – Area 1 surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

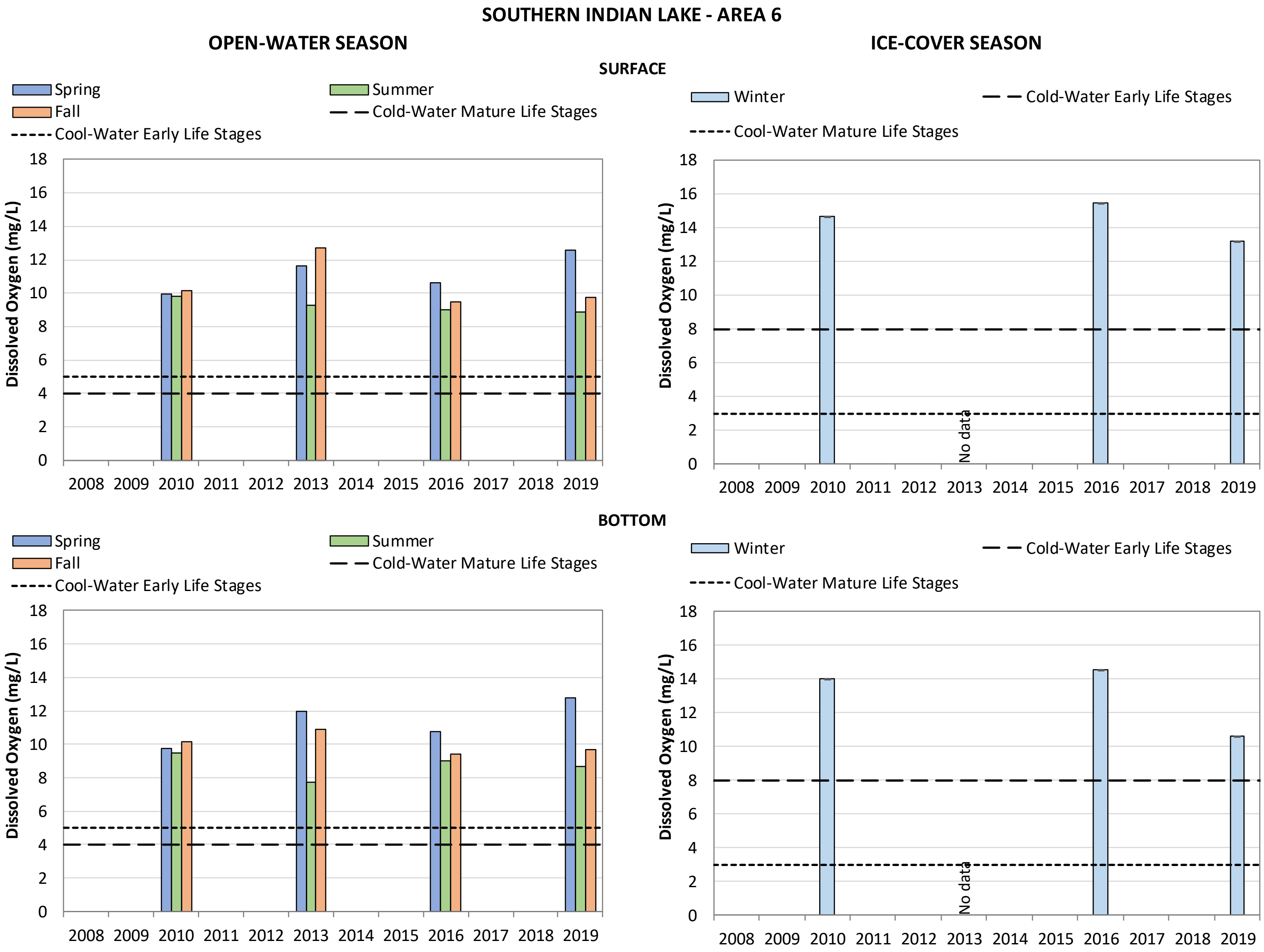


Figure 3.2-10. 2008-2019 Southern Indian Lake – Area 6 surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

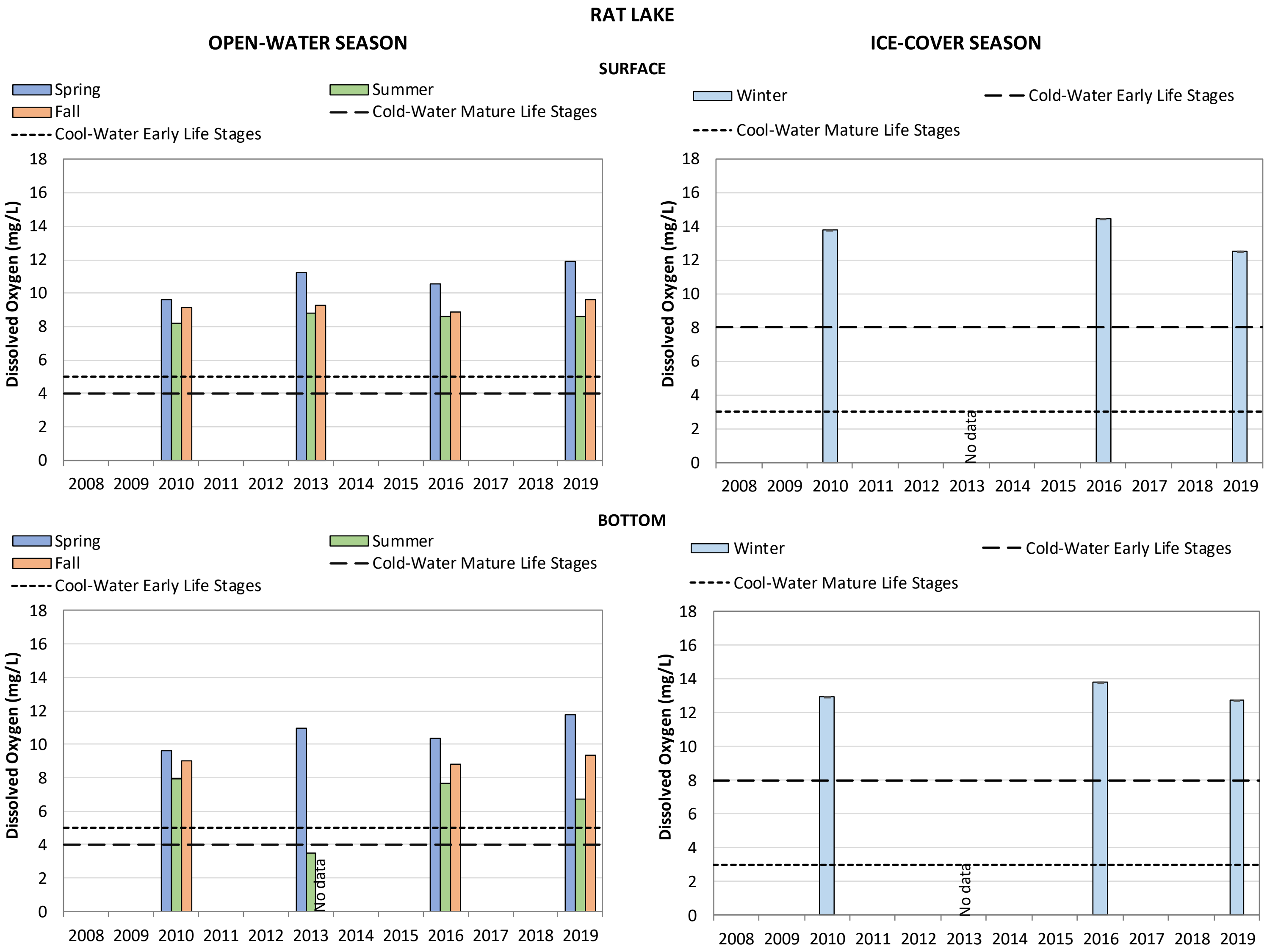


Figure 3.2-11. 2008-2019 Rat Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

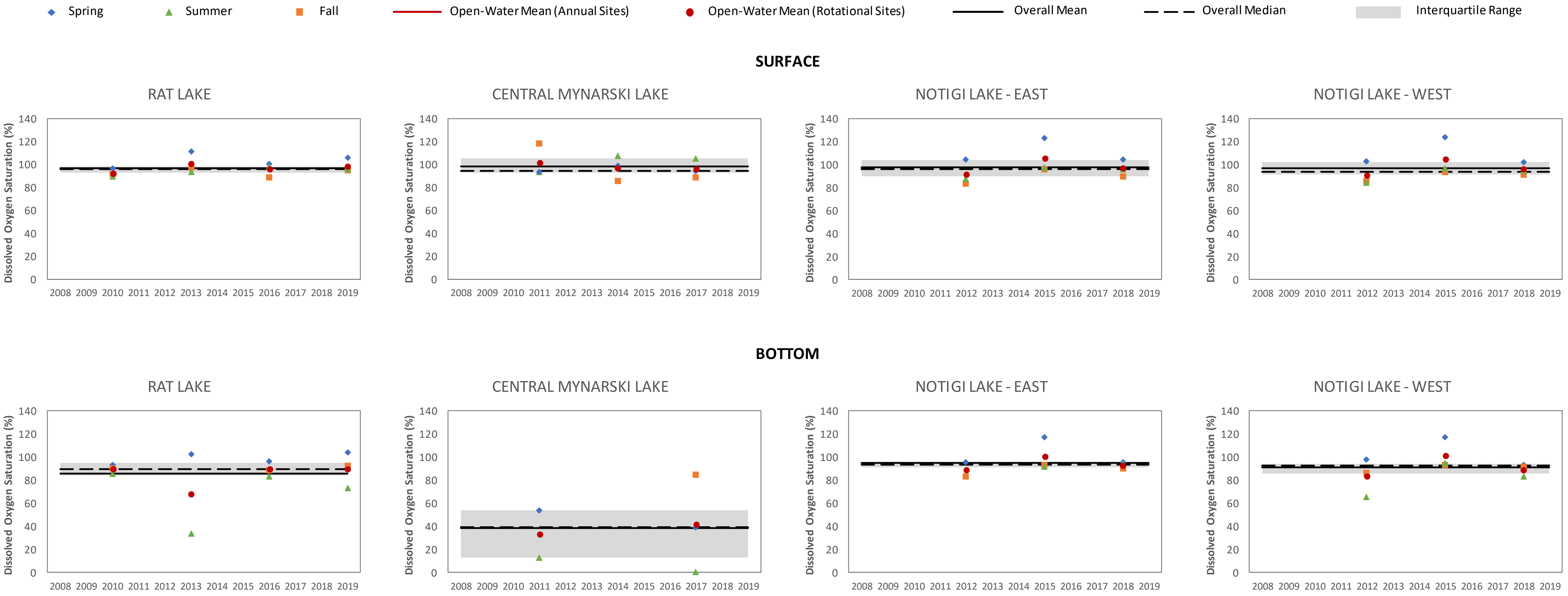


Figure 3.2-12. 2008-2019 Rat, Central Mynarski, and Notigi lakes sites open-water season surface and bottom dissolved oxgen saturation.

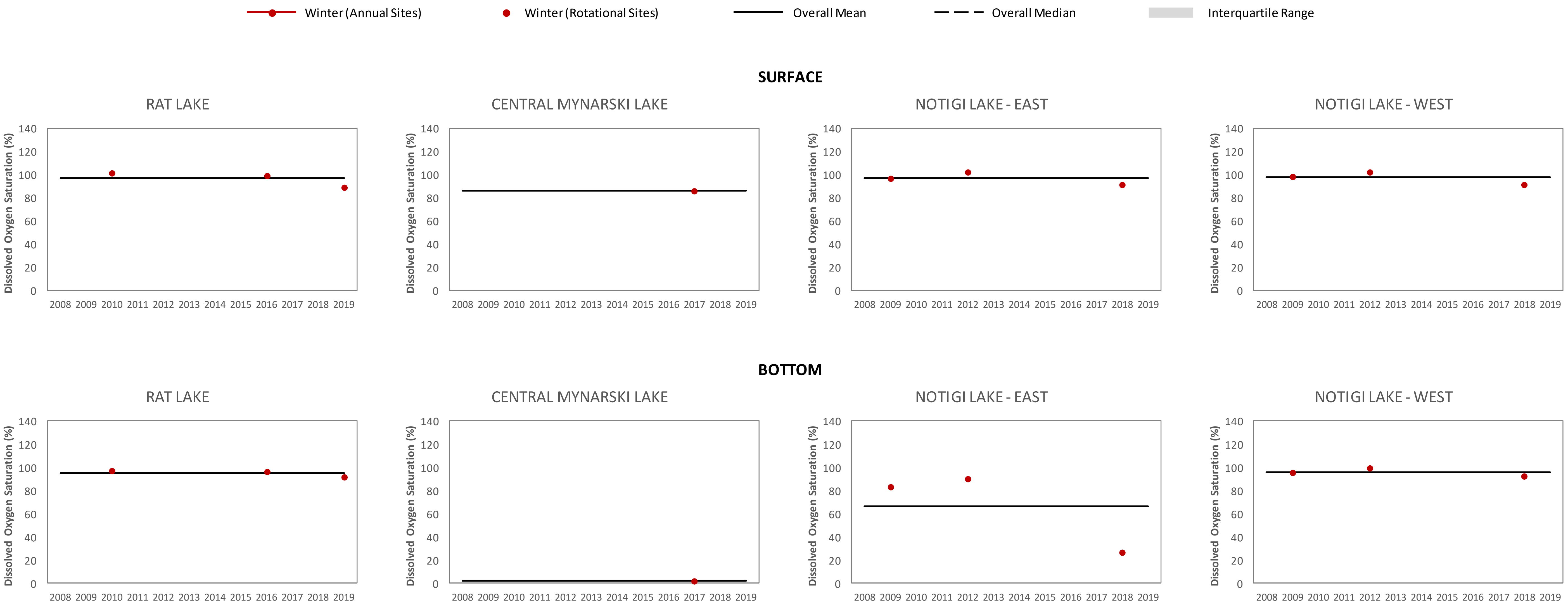


Figure 3.2-13. 2008-2019 Rat, Central Mynarski, and Notigi lakes ice-cover season surface and bottom dissolved oxgen saturation.

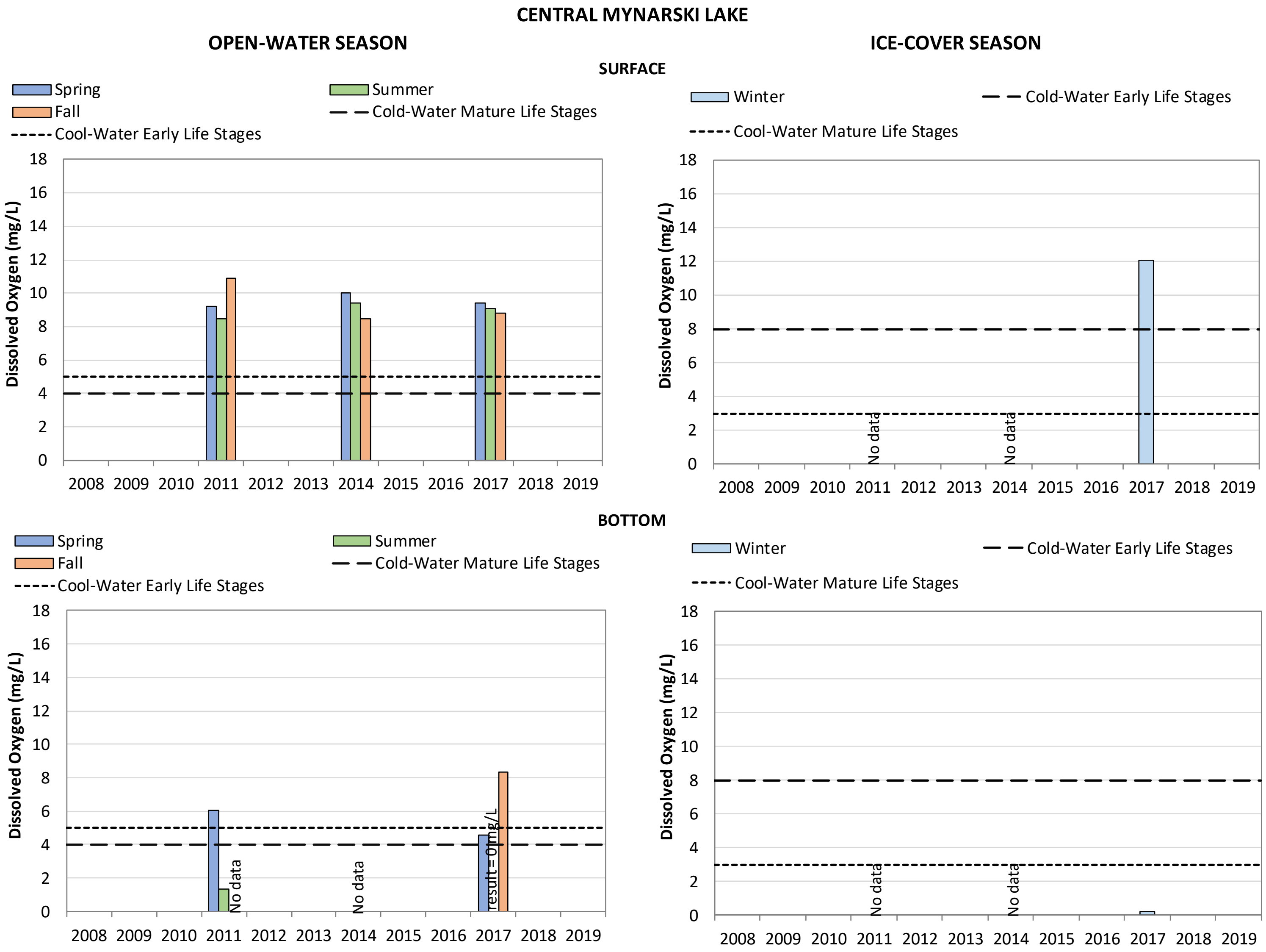


Figure 3.2-14. 2008-2019 Central Mynarski Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

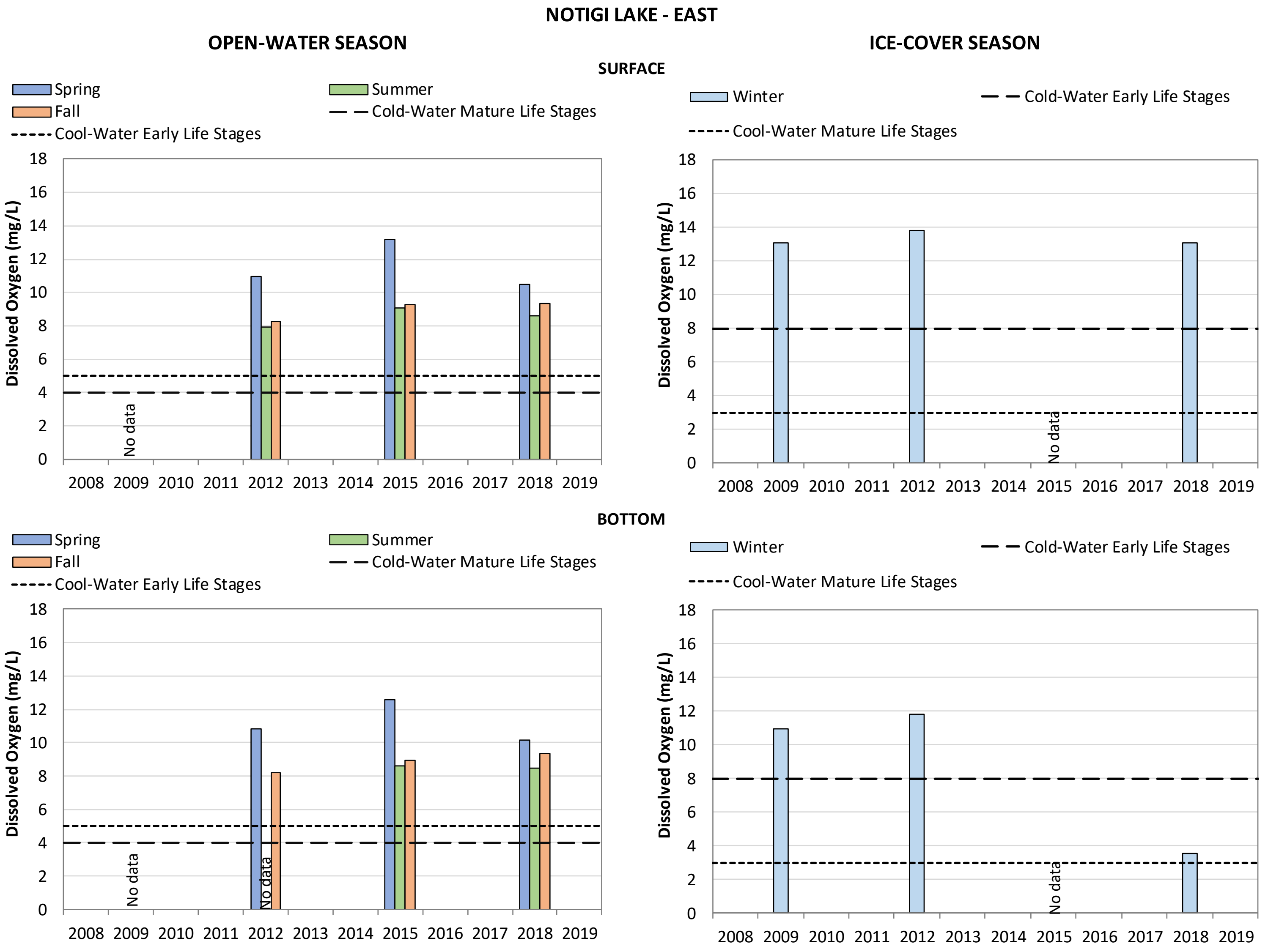


Figure 3.2-15. 2008-2019 Notigi Lake – East surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

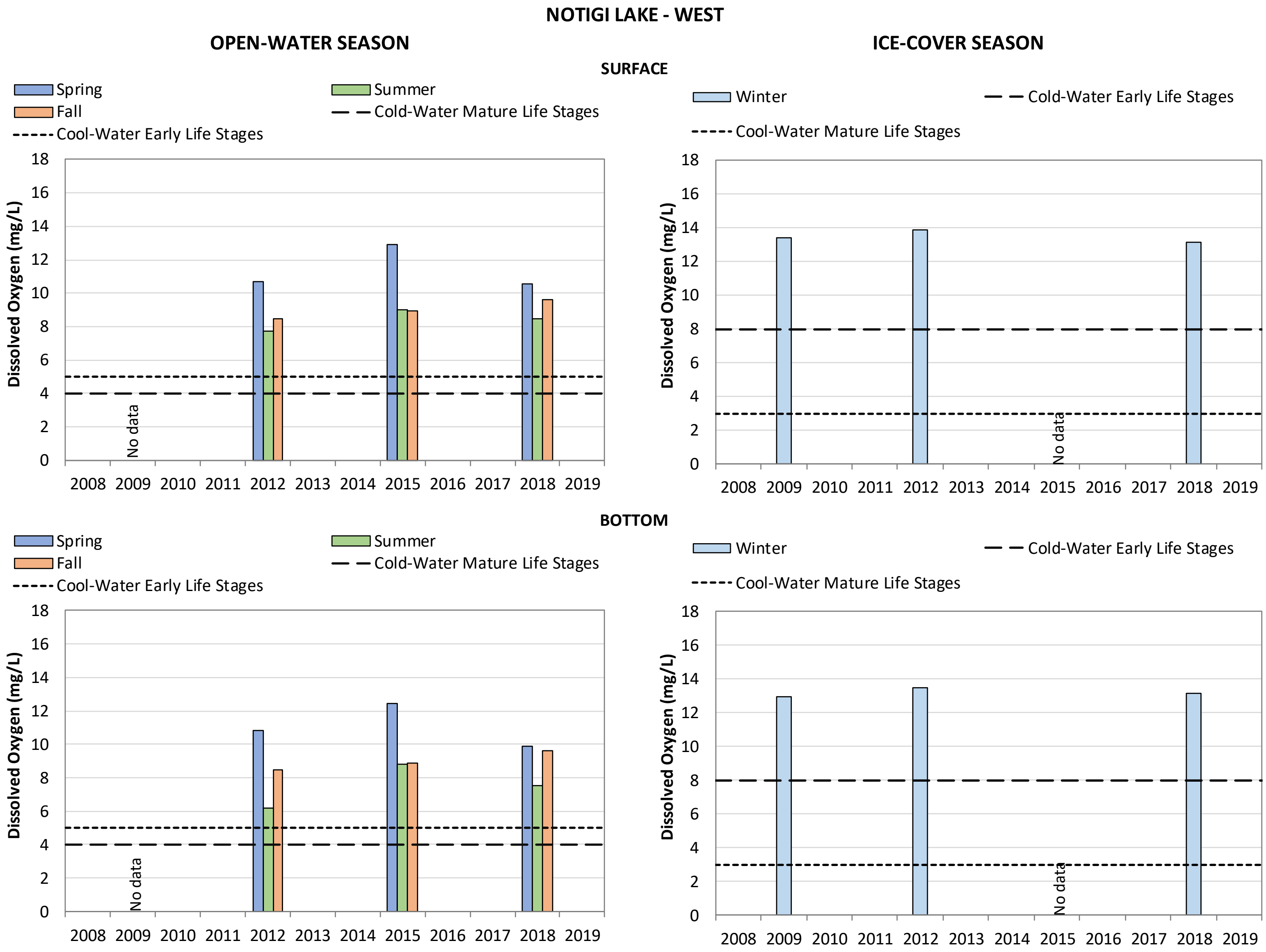
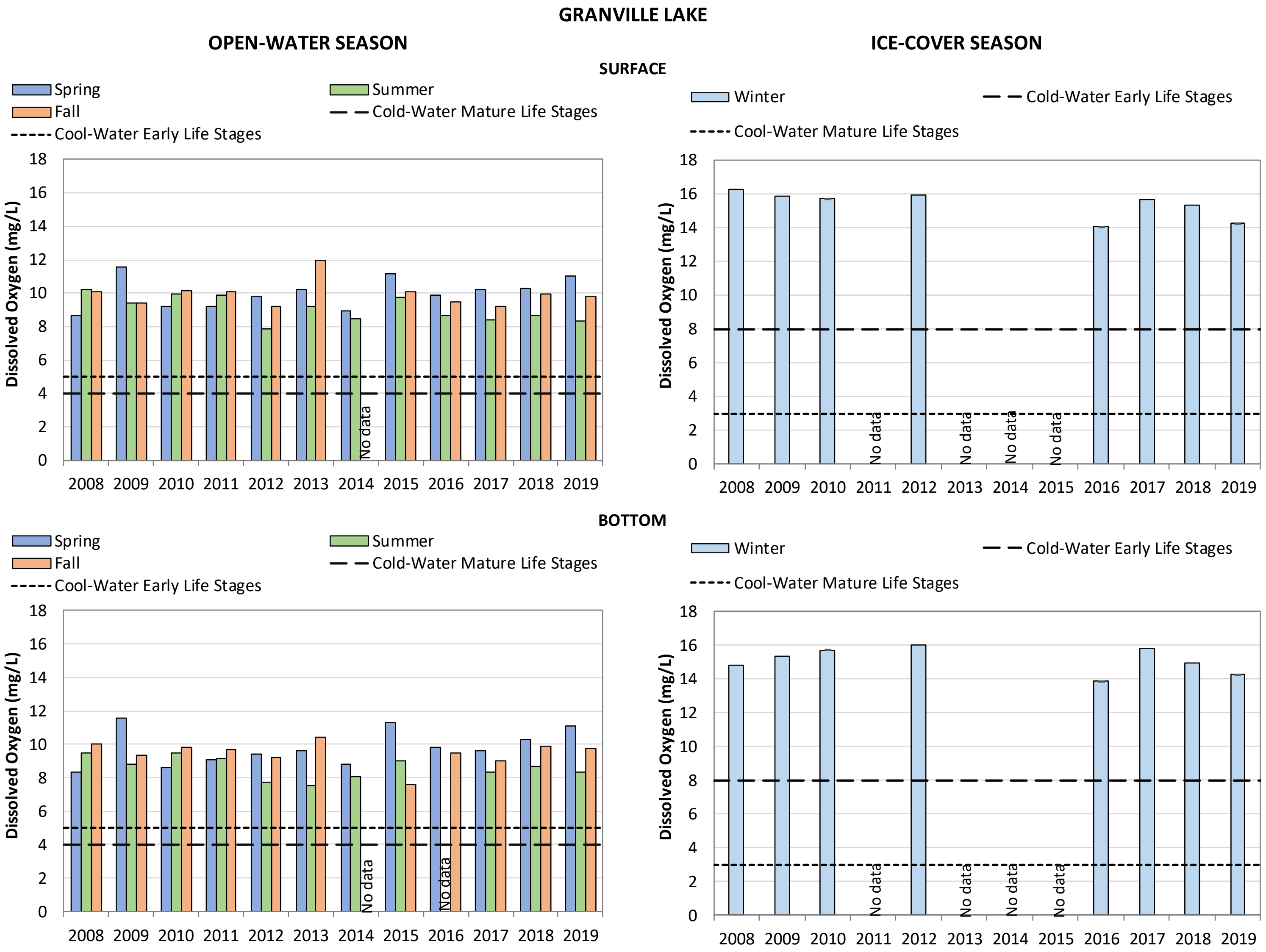


Figure 3.2-16. 2008-2019 Notigi Lake – West surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.



GRANVILLE LAKE

OPEN-WATER SEASON

ICE-COVER SEASON

SURFACE

BOTTOM

Figure 3.2-17. 2008-2019 Granville Lake surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

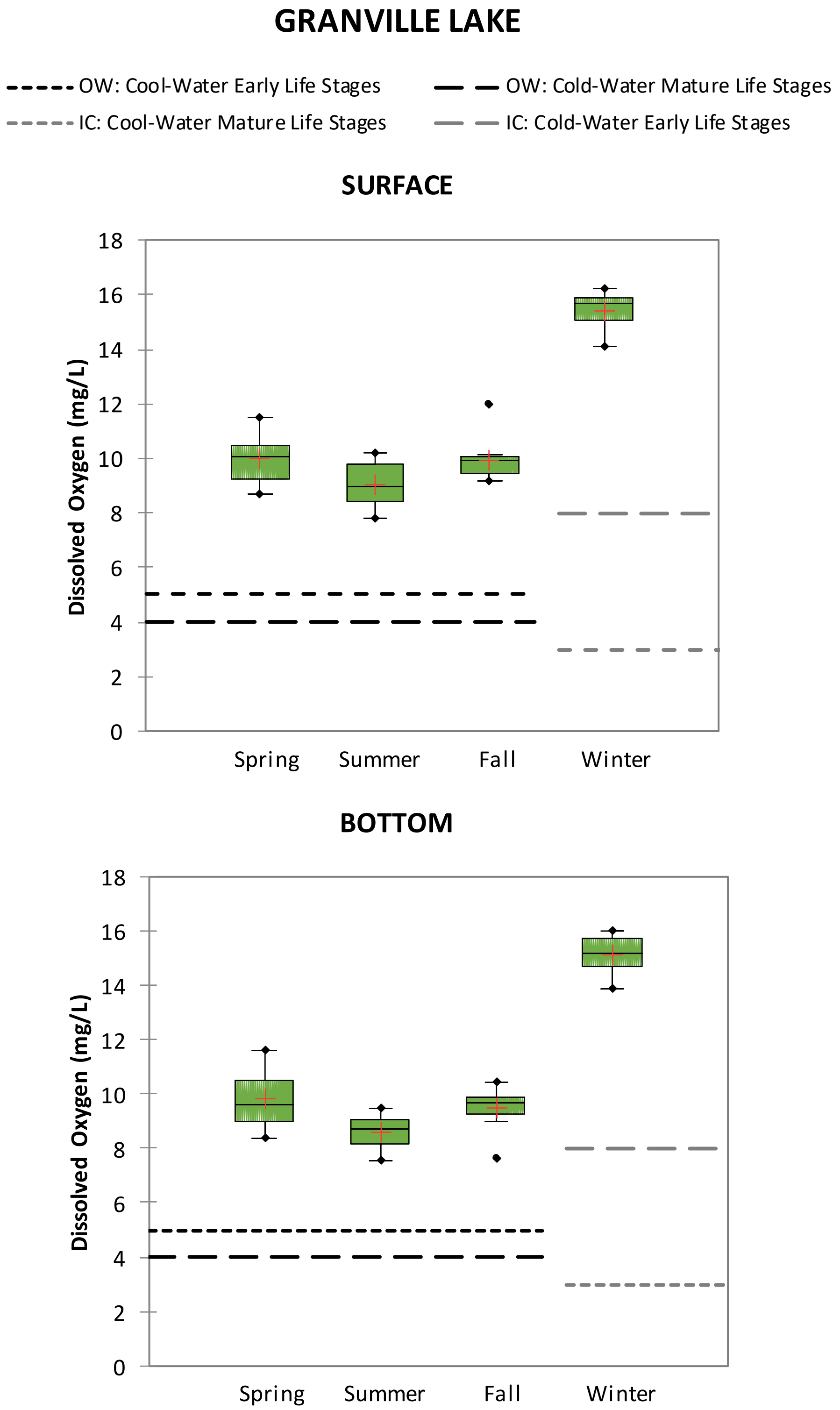


Figure 3.2-18. 2008-2019 Off-system seasonal surface and bottom dissolved oxygen concentrations with comparison to instantaneous minimum objectives for the protection of aquatic life.

GRANVILLE LAKE

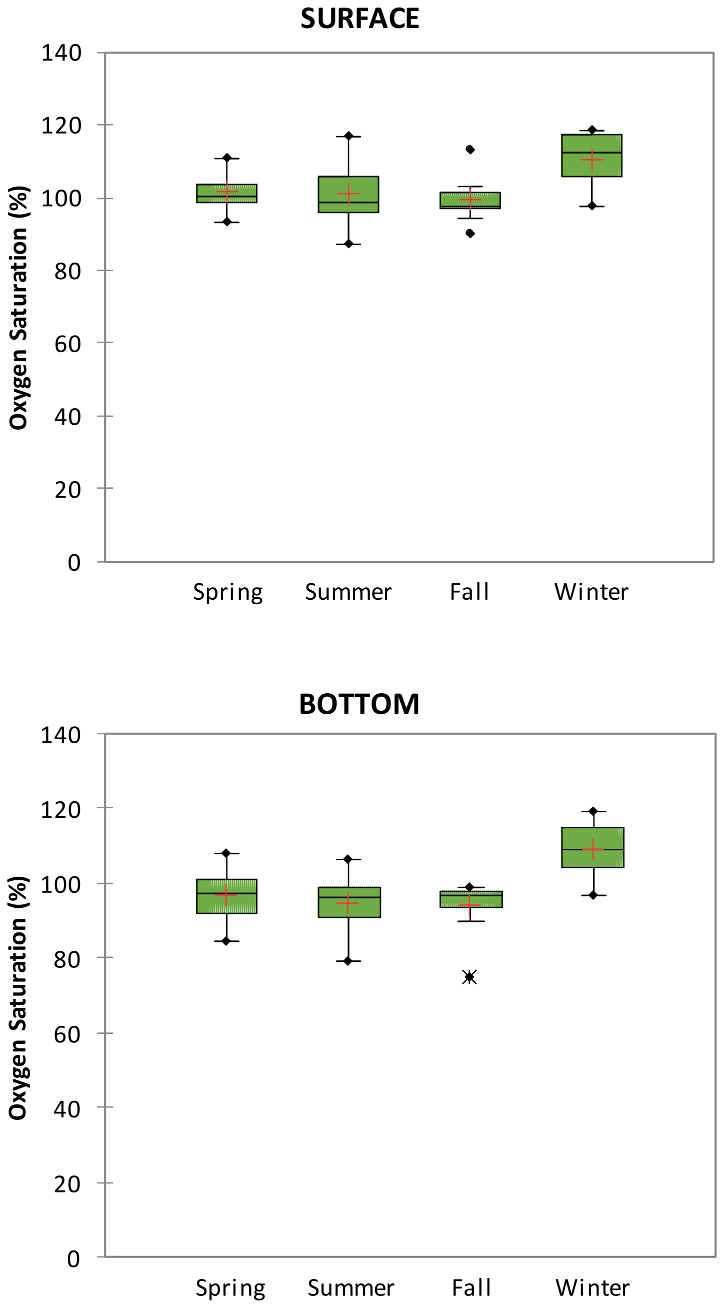


Figure 3.2-19. 2008-2019 Off-system seasonal surface and bottom dissolved oxygen saturation.

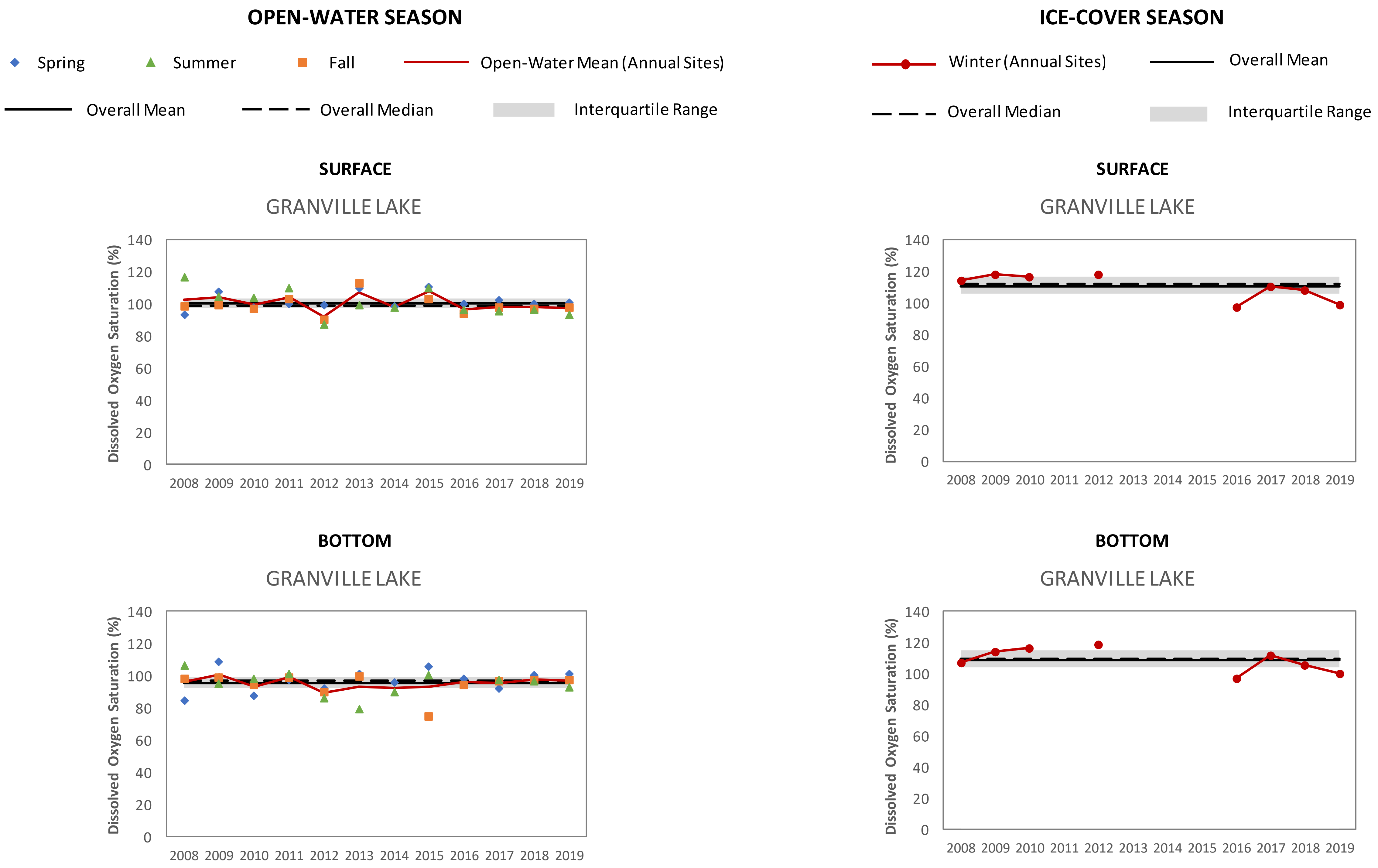


Figure 3.2-20. 2008-2019 Off-system open-water and ice-cover season surface and bottom dissolved oxygen saturation.

3.3 WATER CLARITY

3.3.1 SECCHI DISK DEPTH

3.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Secchi disk depth in Southern Indian Lake – Area 4 ranged from 0.55 to 2.82 m during the open-water season. The mean and median measurements for the 12 years of monitoring were 1.30 m and 1.14 m, respectively. Mean annual Secchi disk depths ranged from 0.63 to 1.98 m and were within the IQR (0.85 to 1.55 m) in seven of the 12 years of monitoring. Mean Secchi disk depths were below the IQR in 2010 and 2018 and above the IQR in 2008, 2009, and 2013 (Table 3.3-1 and Figure 3.3-1).

No clear seasonality was observed for Secchi disk depth in Southern Indian Lake – Area 4 over the 12 years of monitoring. However, the mean Secchi disk depth was lowest in fall (0.95 m) and highest in spring (1.48 m; Figure 3.3-2).

ROTATIONAL SITES

Opachuanau Lake

Secchi disk depth in Opachuanau Lake ranged from 0.35 to 1.10 m during the open-water season. The mean was 0.75 m, the median was 0.73 m, and the IQR was 0.65 to 0.85 m for the three years of monitoring. Mean annual Secchi disk depths ranged from 0.73 to 0.79 m and were within the IQR in all years (Table 3.3-1 and Figure 3.3-1).

Southern Indian Lake – Area 1

Secchi disk depth in Southern Indian Lake – Area 1 ranged from 0.50 to 1.65 m during the open-water season. The mean was 0.83 m, the median was 0.71 m, and the IQR was 0.54 to 0.97 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.58 to 0.97 m and were within the IQR all years (Table 3.3-1 and Figure 3.3-1).

Southern Indian Lake – Area 6

Secchi disk depth in Southern Indian Lake – Area 6 ranged from 0.45 to 1.35 m during the open-water season. The mean was 0.69 m, the median was 0.56 m, and the IQR was 0.52 to 0.72 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.55 to 0.84 m and were within the IQR in 2010 and 2016 and above the IQR in 2013 and 2019 (Table 3.3-1 and Figure 3.3-1).

Rat Lake

Secchi disk depth in Rat Lake ranged from 0.55 to 1.40 m during the open-water season. The mean was 0.93 m, the median was 0.88 m, and the IQR was 0.80 to 1.01 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.83 to 1.03 m and were within the IQR in three of the four years of monitoring. Mean Secchi disk depth was above the IQR in 2013 (Table 3.3-1 and Figure 3.3-1).

Central Mynarski Lake

Secchi disk depth in Central Mynarski Lake ranged from 0.75 to 2.80 m during the open-water season. The mean was 1.66 m, the median was 1.60 m, and the IQR was 1.10 to 1.98 m for the three years of monitoring. Mean annual Secchi disk depths ranged from 1.27 to 1.93 m and were within the IQR in all years (Table 3.3-1 and Figure 3.3-1).

Notigi Lake – East

Secchi disk depth in Notigi Lake – East ranged from 0.50 to 1.40 m during the open-water season. The mean was 1.06 m, the median was 1.13 m, and the IQR was 0.80 to 1.30 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.70 to 1.30 m and were within the IQR in three of the four years of monitoring. Mean Secchi disk depth was below the IQR in 2015 (Table 3.3-1 and Figure 3.3-1).

Notigi Lake – West

Secchi disk depth in Notigi Lake – West ranged from 0.50 to 1.30 m during the open-water season. The mean was 0.91 m, the median was 0.90 m, and the IQR was 0.80 to 0.96 m for the four years of monitoring. Mean annual Secchi disk depths ranged from 0.72 to 1.07 m and were within the IQR in 2018, below the IQR in 2015, and above the IQR in 2009 and 2012 (Table 3.3-1 and Figure 3.3-1).

3.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Secchi disk depth in Granville Lake ranged from 0.50 to 1.85 m during the open-water season. The mean and median measurements for the 12 years of monitoring were 1.14 m and 1.15 m, respectively. Mean annual Secchi disk depths ranged from 0.71 to 1.53 m and were within the IQR (0.93 to 1.32 m) in seven of the 12 years of monitoring. Mean Secchi disk depths were below the IQR in 2016 and 2018 and above the IQR in 2009, 2010, and 2012 (Table 3.3-2 and Figure 3.3-3).

No clear seasonality was observed for Secchi disk depth in Granville Lake over the 12 years of monitoring. However, the mean Secchi disk depth was lowest in summer (1.02 m) and highest in spring (1.32 m; Figure 3.3-4).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

Table 3.3-1. 2008-2019 On-system sites water clarity summary statistics.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
SIL-4	Mean	1.30	-	6.49	5.40	2.7	<2.0
	Median	1.14	-	6.09	4.15	2.5	<2.0
	Minimum	0.55	-	2.17	1.20	<2.0	<2.0
	Maximum	2.82	-	16.0	12.4	6.8	<2.0
	SD	0.603	-	3.33	3.76	1.61	-
	SE	0.103	-	0.555	1.08	0.27	-
	Lower Quartile	0.85	-	4.01	2.76	<2.0	<2.0
	Upper Quartile	1.55	-	9.31	6.99	3.6	<2.0
	n	34	-	36	12	36	12
	% Detections	100	-	100	100	67	0
OPACH	Mean	0.75	-	8.65	2.34	5.2	<2.0
	Median	0.73	-	9.78	-	5.2	-
	Minimum	0.35	-	4.24	2.04	2.4	<2.0
	Maximum	1.10	-	11.1	2.50	8.4	<2.0
	SD	0.224	-	2.24	0.262	1.91	-
	SE	0.075	-	0.747	0.151	0.64	-
	Lower Quartile	0.65	-	7.73	-	4.0	-
	Upper Quartile	0.85	-	10.1	-	6.2	-
	n	9	-	9	3	9	3
	% Detections	100	-	100	100	100	0
SIL-1	Mean	0.83	-	10.1	2.27	4.5	<2.0
	Median	0.71	-	11.3	-	4.2	-
	Minimum	0.50	-	3.33	2.07	<2.0	<2.0
	Maximum	1.65	-	16.0	2.50	8.4	<2.0
	SD	0.380	-	4.79	0.176	2.30	-
	SE	0.120	-	1.38	0.088	0.67	-
	Lower Quartile	0.54	-	5.72	-	3.0	-
	Upper Quartile	0.97	-	14.2	-	5.7	-
	n	10	-	12	4	12	4
	% Detections	100	-	100	100	92	0

Table 3.3-1. continued.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
SIL-6	Mean	0.69	-	13.3	4.81	5.5	<2.0
	Median	0.56	-	13.0	-	5.1	-
	Minimum	0.45	-	5.15	3.76	2.9	<2.0
	Maximum	1.35	-	23.3	5.33	10.0	<2.0
	SD	0.297	-	5.36	0.716	2.27	-
	SE	0.086	-	1.55	0.358	0.66	-
	Lower Quartile	0.52	-	9.53	-	3.5	-
	Upper Quartile	0.72	-	15.6	-	6.9	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	100	0
RAT	Mean	0.93	-	9.88	6.90	3.5	<2.0
	Median	0.88	-	8.95	-	3.3	-
	Minimum	0.55	-	4.91	4.99	<2.0	<2.0
	Maximum	1.40	-	19.0	8.30	5.7	3.6
	SD	0.262	-	3.92	1.38	1.38	-
	SE	0.076	-	1.13	0.692	0.40	-
	Lower Quartile	0.80	-	7.50	-	2.8	-
	Upper Quartile	1.01	-	11.2	-	4.0	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	92	25
MYN	Mean	1.66	-	4.38	1.28	4.1	<2.0
	Median	1.60	-	4.00	-	3.9	-
	Minimum	0.75	-	1.97	0.75	<2.0	<2.0
	Maximum	2.80	-	6.77	1.80	6.9	3.3
	SD	0.654	-	1.69	0.525	1.71	1.31
	SE	0.218	-	0.564	0.303	0.57	0.76
	Lower Quartile	1.10	-	3.70	-	3.6	-
	Upper Quartile	1.98	-	5.89	-	4.0	-
	n	9	-	9	3	9	3
	% Detections	100	-	100	100	89	33

Table 3.3-1. continued.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
NTG-E	Mean	1.06	-	8.19	7.39	<2.0	<2.0
	Median	1.13	-	8.16	-	<2.0	-
	Minimum	0.50	-	5.13	5.79	<2.0	<2.0
	Maximum	1.40	-	11.6	9.72	4.0	<2.0
	SD	0.280	-	1.73	1.67	1.16	-
	SE	0.081	-	0.499	0.833	0.34	-
	Lower Quartile	0.80	-	7.58	-	<2.0	-
	Upper Quartile	1.30	-	8.64	-	2.9	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	50	0
NTG-W	Mean	0.91	-	9.19	7.39	2.0	<2.0
	Median	0.90	-	9.14	-	2.2	-
	Minimum	0.50	-	5.54	5.71	<2.0	<2.0
	Maximum	1.30	-	13.2	9.35	3.2	2.4
	SD	0.212	-	2.14	1.52	0.943	-
	SE	0.061	-	0.617	0.761	0.27	-
	Lower Quartile	0.80	-	8.13	-	<2.0	-
	Upper Quartile	0.96	-	10.1	-	2.8	-
	n	12	-	12	4	12	4
	% Detections	100	-	100	100	58	25

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

Table 3.3-2. 2008-2019 Off-system sites water clarity metric summary statistics.

Site	Statistic	Secchi Disk Depth (m)		Turbidity (NTU)		TSS (mg/L)	
		OW	IC	OW	IC	OW	IC
GRV	Mean	1.14	-	5.68	2.28	4.7	<2.0
	Median	1.15	-	5.26	2.26	4.4	<2.0
	Minimum	0.50	-	2.82	1.30	<2.0	<2.0
	Maximum	1.85	-	11.0	3.67	10.6	4.0
	SD	0.326	-	2.10	0.591	1.82	1.01
	SE	0.056	-	0.350	0.171	0.30	0.29
	Lower Quartile	0.93	-	4.23	1.87	3.5	<2.0
	Upper Quartile	1.32	-	7.03	2.41	5.7	2.2
	n	34	-	36	12	36	12
	% Detections	100	-	100	100	97	50

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

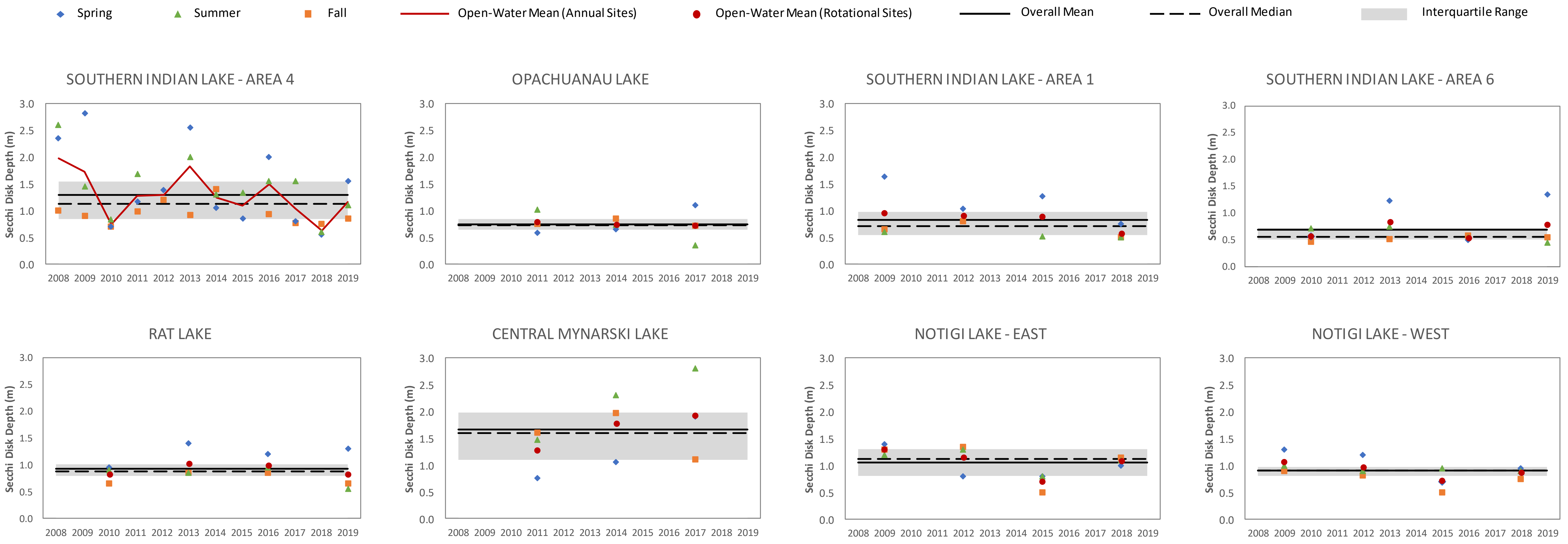


Figure 3.3-1. 2008-2019 On-system open-water season Secchi disk depths.

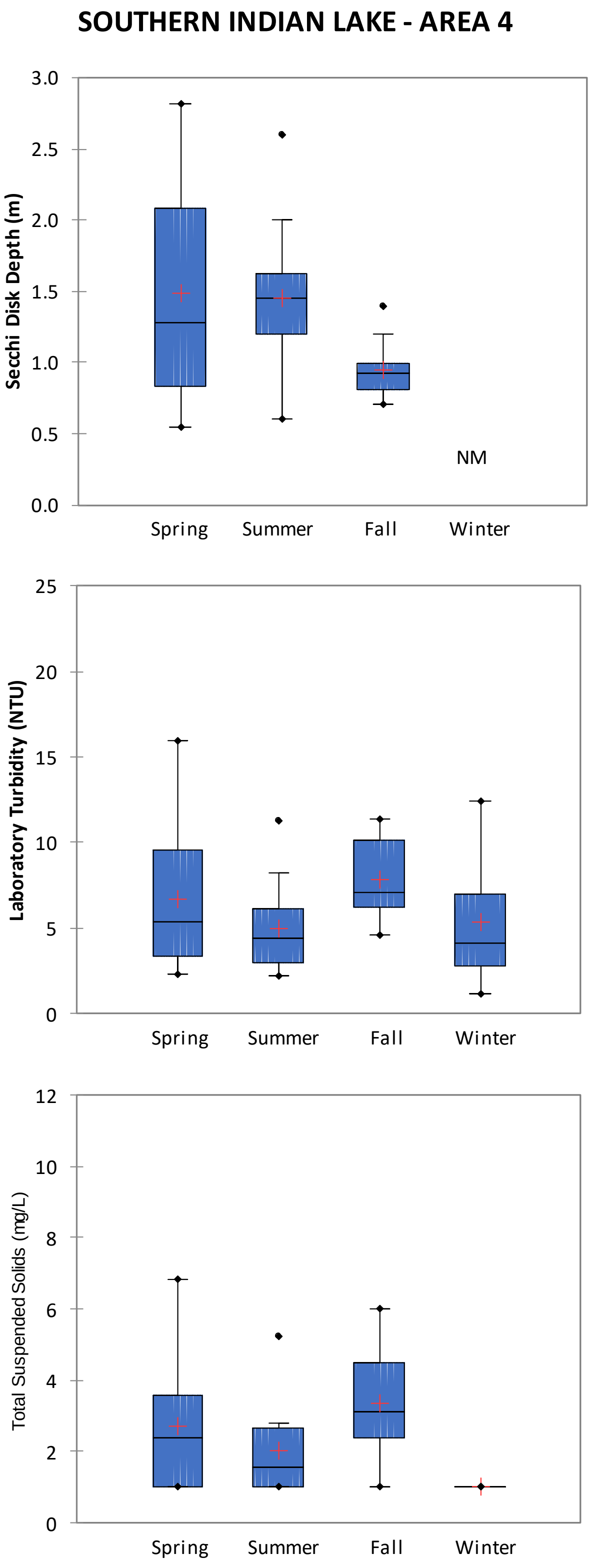


Figure 3.3-2. 2008-2019 On-system seasonal Secchi disk depth, turbidity, and TSS concentrations.

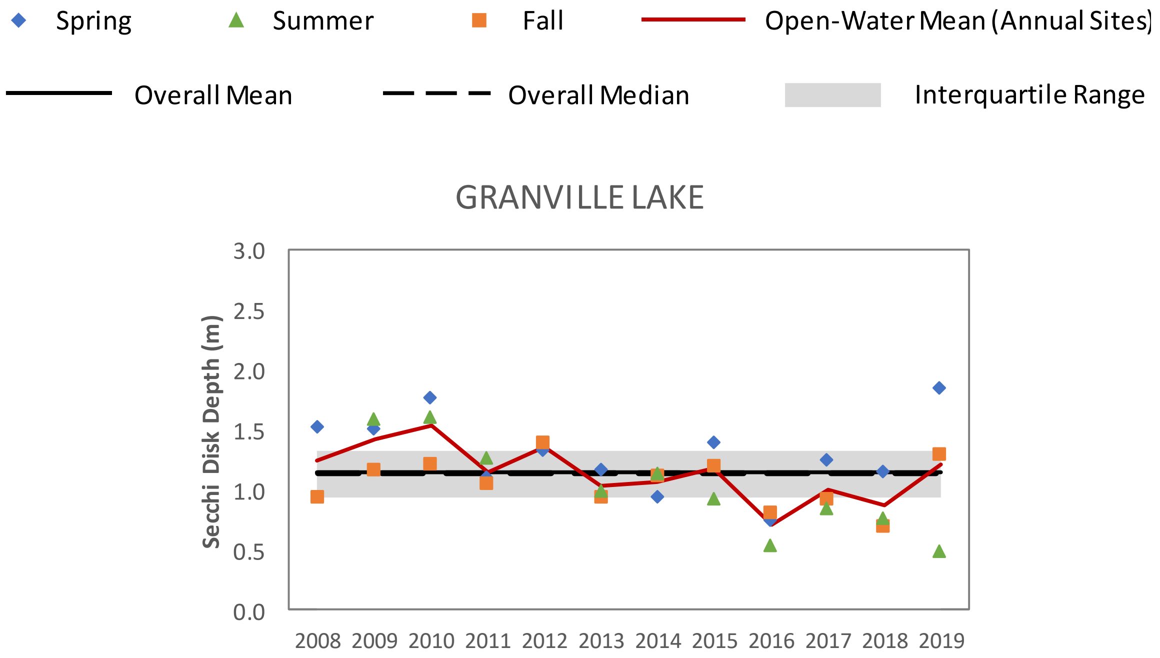


Figure 3.3-3. 2008-2019 Off-system open-water season Secchi disk depths.

GRANVILLE LAKE

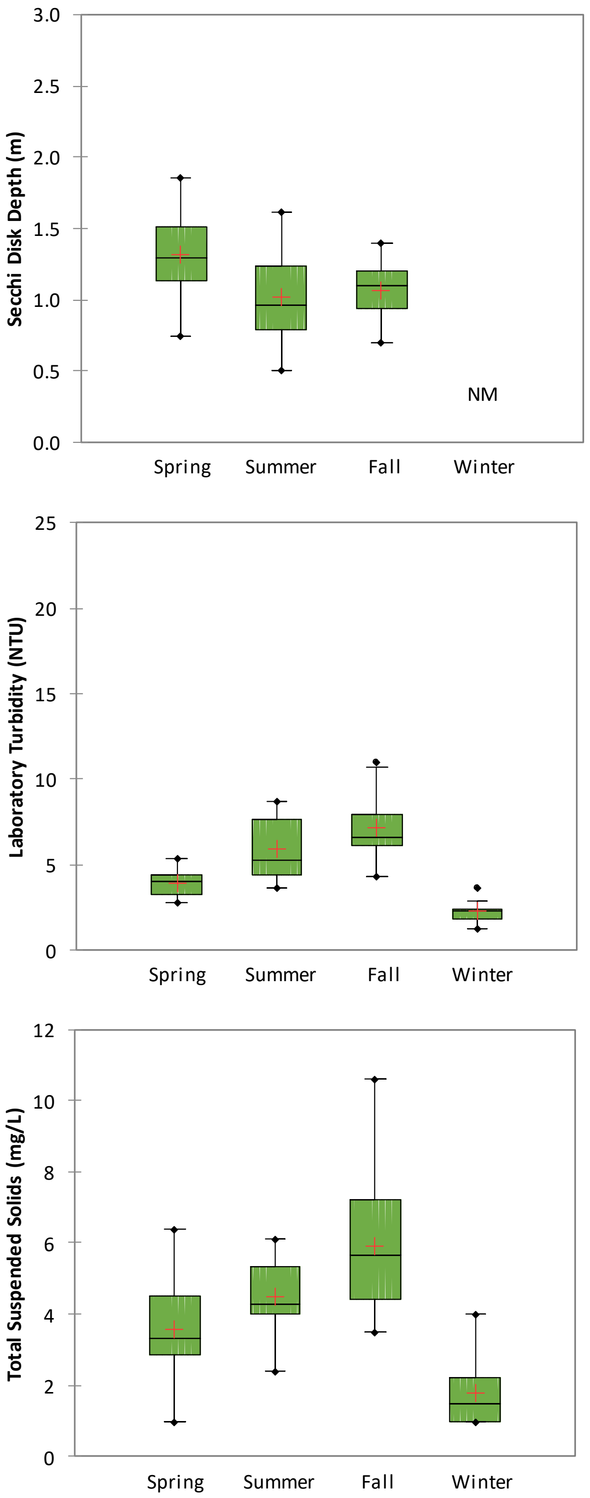


Figure 3.3-4. 2008-2019 Off-system seasonal Secchi disk depth, turbidity, and TSS concentrations.

3.3.2 TURBIDITY

3.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Turbidity in Southern Indian Lake – Area 4 ranged from 2.17 to 16.0 NTU during the open-water season. The mean and median turbidity for the 12 years of monitoring were 6.49 NTU and 6.09 NTU, respectively. Open-water season mean annual turbidity ranged from 3.61 to 12.6 NTU and was within the IQR (4.01 to 9.31 NTU) in six of the 12 years. Mean turbidity was below the IQR in 2008, 2012, 2013, and 2016 and above the IQR in 2010 and 2018 (Table 3.3-1 and Figure 3.3-5).

Turbidity in the ice-cover season ranged from 1.20 to 12.4 NTU, with a mean of 5.40 NTU and median of 4.15 NTU for the 12 years of monitoring. The IQR was 2.76 to 6.99 NTU (Table 3.3-1 and Figure 3.3 5).

No clear seasonality was observed for turbidity in Area 4 over 12 years of monitoring. However, the lowest mean turbidity occurred in summer (4.94 NTU) and the highest in fall (7.88 NTU; Figure 3.3-2).

ROTATIONAL SITES

Opachuanau Lake

Turbidity in Opachuanau Lake ranged from 4.24 to 11.1 NTU during the open-water season. The mean was 8.65 NTU, the median was 9.78 NTU, and the IQR was 7.73 to 10.1 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 8.04 to 9.57 NTU and was within the IQR in all years (Table 3.3-1 and Figure 3.3-5).

During the ice-cover season, turbidity ranged from 2.04 to 2.50 NTU, with a mean of 2.34 NTU (Table 3.3-1 and Figure 3.3-5).

Southern Indian Lake – Area 1

Turbidity in Southern Indian Lake – Area 1 ranged from 3.33 to 16.0 NTU during the open-water season. The mean was 10.1 NTU, the median was 11.3 NTU, and the IQR was 5.72 to 14.2 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 8.36 to 11.2 NTU and was within the IQR in all years (Table 3.3-1 and Figure 3.3-5).

During the ice-cover season, turbidity ranged from 2.07 to 2.50 NTU, with a mean of 2.27 NTU (Table 3.3-1 and Figure 3.3-5).

Southern Indian Lake – Area 6

Turbidity in Southern Indian Lake – Area 6 ranged from 5.15 to 23.3 NTU during the open-water season. The mean was 13.3 NTU, the median was 13.0 NTU, and the IQR was 9.53 to 15.6 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 9.68 to 14.7 NTU and was within the IQR in all years (Table 3.3-1 and Figure 3.3-5).

During the ice-cover season, turbidity ranged from 3.76 to 5.33 NTU, with a mean of 4.81 NTU (Table 3.3-1 and Figure 3.3-5).

Rat Lake

Turbidity in Rat Lake ranged from 4.91 to 19.0 NTU during the open-water season. The mean was 9.88 NTU, the median was 8.95 NTU, and the IQR was 7.50 to 11.2 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 8.33 to 13.2 NTU and was within the IQR in three of the four years of monitoring. Mean turbidity was above the IQR in 2019 (Table 3.3-1 and Figure 3.3-6).

During the ice-cover season, turbidity ranged from 4.99 to 8.30 NTU, with a mean of 6.90 NTU (Table 3.3-1 and Figure 3.3-6).

Central Mynarski Lake

Turbidity in Central Mynarski Lake ranged from 1.97 to 6.77 NTU during the open-water season. The mean was 4.38 NTU, the median was 4.00 NTU, and the IQR was 3.70 to 5.89 NTU for the three years of monitoring. Mean annual turbidity in the open-water season ranged from 3.30 to 5.68 NTU and was within the IQR in 2011 and 2017 and below the IQR in 2014 (Table 3.3-1 and Figure 3.3-6).

During the ice-cover season, turbidity ranged from 0.75 to 1.80 NTU, with a mean of 1.28 NTU (Table 3.3-1 and Figure 3.3-6).

Notigi Lake – East

Turbidity in Notigi Lake – East ranged from 5.13 to 11.6 NTU during the open-water season. The mean was 8.19 NTU, the median was 8.16 NTU, and the IQR was 7.58 to 8.64 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 6.98 to 10.4 NTU and was within the IQR in 2018, below the IQR in 2009 and 2012, and above the IQR in 2015 (Table 3.3-1 and Figure 3.3-6).

During the ice-cover season, turbidity ranged from 5.79 to 9.72 NTU, with a mean of 7.39 NTU (Table 3.3-1 and Figure 3.3-6).

Notigi Lake – West

Turbidity in Notigi Lake – West ranged from 5.54 to 13.2 NTU during the open-water season. The mean was 9.19 NTU, the median was 9.14 NTU, and the IQR was 8.13 to 10.1 NTU for the four years of monitoring. Mean annual turbidity in the open-water season ranged from 7.13 to 10.4 NTU and was within the IQR in 2009, below the IQR in 2012, and above the IQR in 2015 and 2018 (Table 3.3-1 and Figure 3.3-6).

During the ice-cover season, turbidity ranged from 5.71 to 9.35 NTU, with a mean of 7.39 NTU (Table 3.3-1 and Figure 3.3-6).

3.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Turbidity in Granville Lake ranged from 2.82 to 11.0 NTU during the open-water season. The mean and median turbidity for the 12 years of monitoring were 5.68 NTU and 5.26 NTU, respectively. Open-water season mean annual turbidity ranged from 3.80 to 7.18 NTU and was within the IQR (4.23 to 7.03) in 10 of the 12 years. Mean turbidity was below the IQR in 2010 and above the IQR in 2018 (Table 3.3-1 and Figure 3.3-7).

Turbidity in the ice-cover season ranged from 1.30 to 3.67 NTU, with a mean of 2.28 NTU and median of 2.26 NTU for the 12 years of monitoring. The IQR was 1.87 to 2.41 NTU (Table 3.3-1 and Figure 3.3-7).

Turbidity was lower in winter (mean = 2.28 NTU) than in the open-water season over the 12 years of monitoring. No clear seasonality was observed for turbidity during the open-water season; however, the lowest mean turbidity occurred in spring (3.93 NTU) and the highest in fall (7.21 NTU; Figure 3.3-4)

ROTATIONAL SITES

There are no off-system rotational sites in this region.

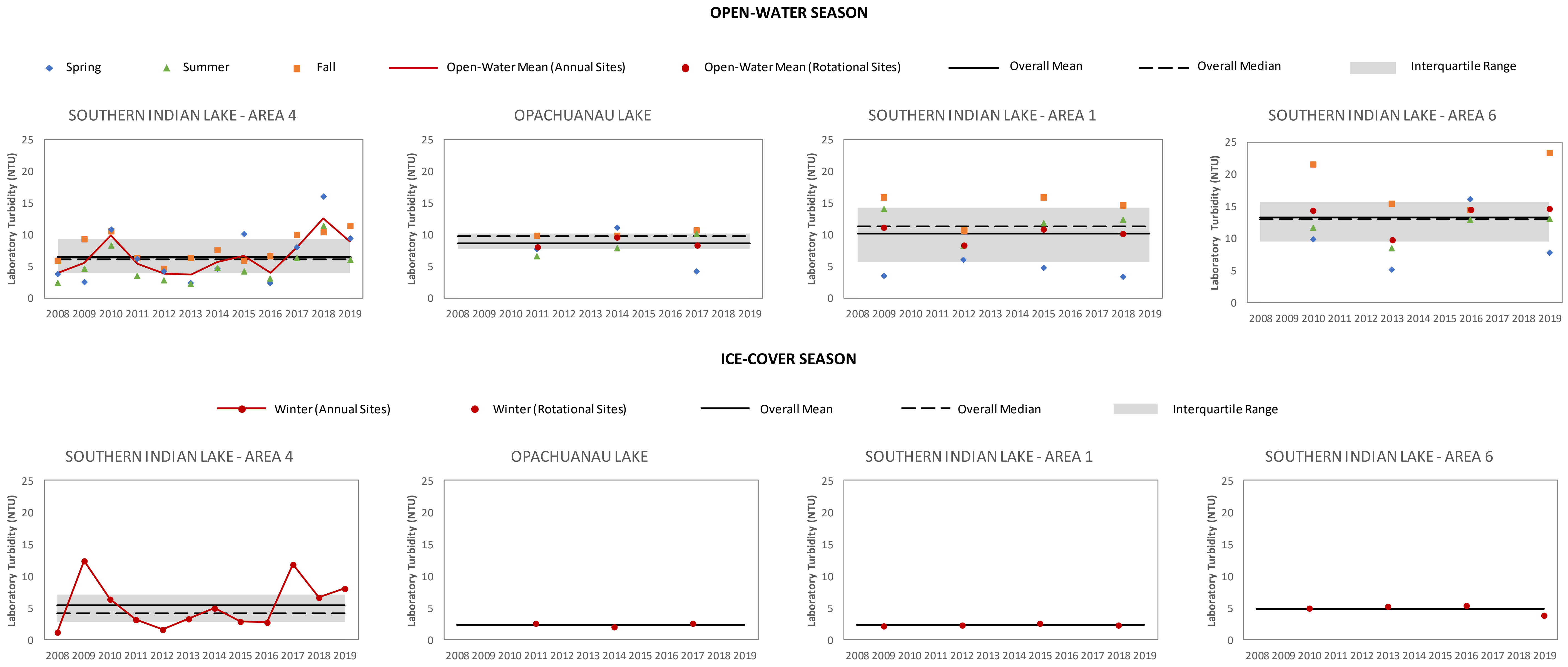
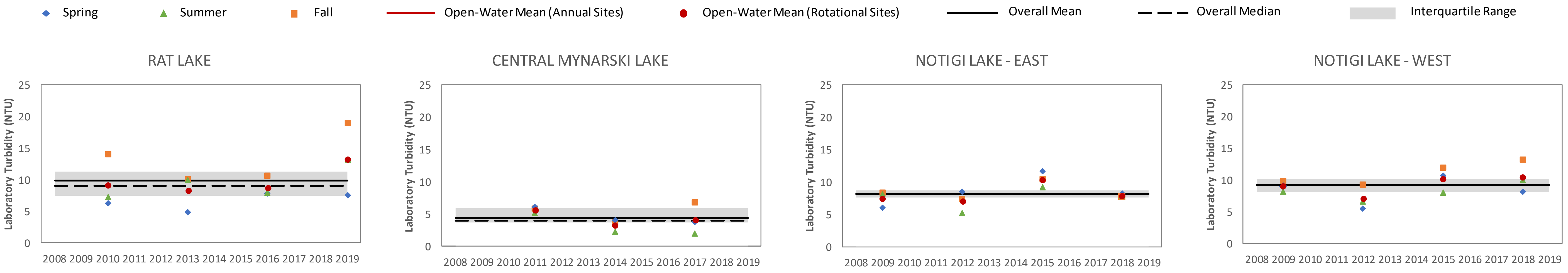


Figure 3.3-5. 2008-2019 Southern Indian and Opachuanau lakes open-water and ice-cover season turbidity levels.

OPEN-WATER SEASON



ICE-COVER SEASON

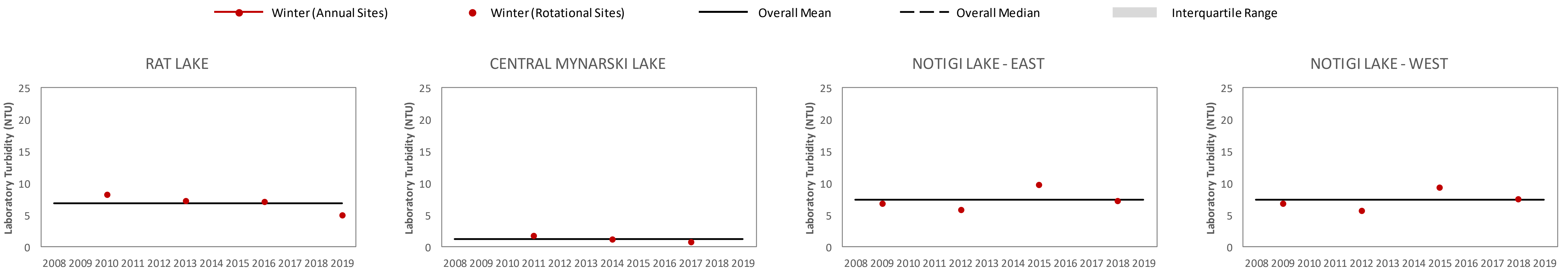
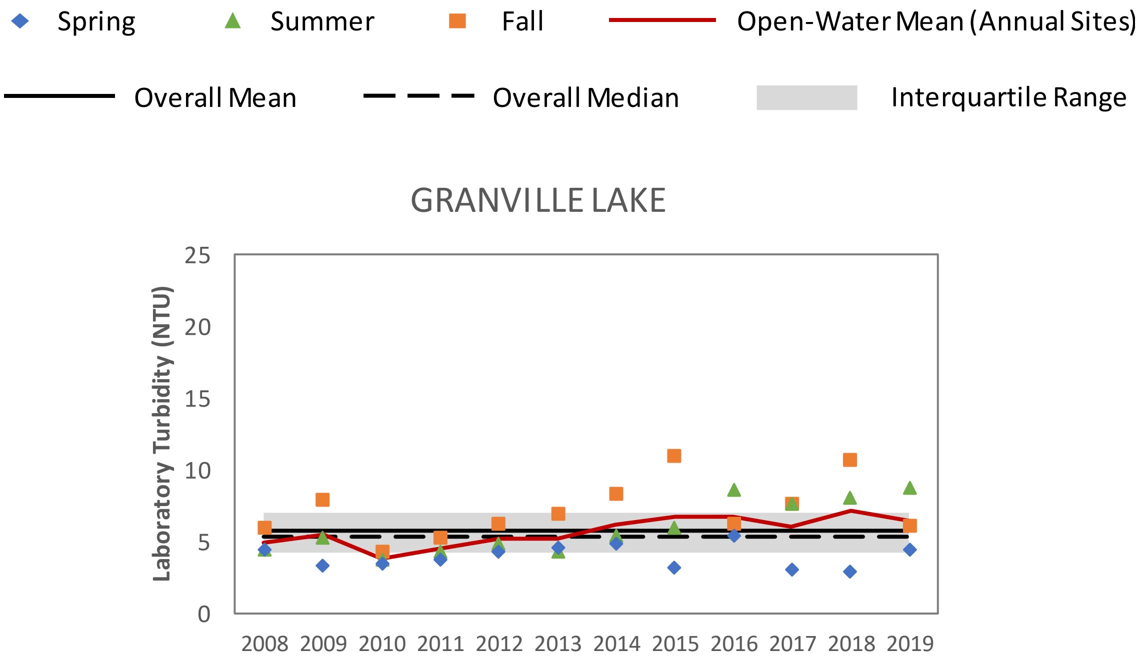


Figure 3.3-6. 2008-2019 Rat, Central Mynarski, and Notigi lakes open-water and ice-cover season turbidity levels.

OPEN-WATER SEASON



ICE-COVER SEASON

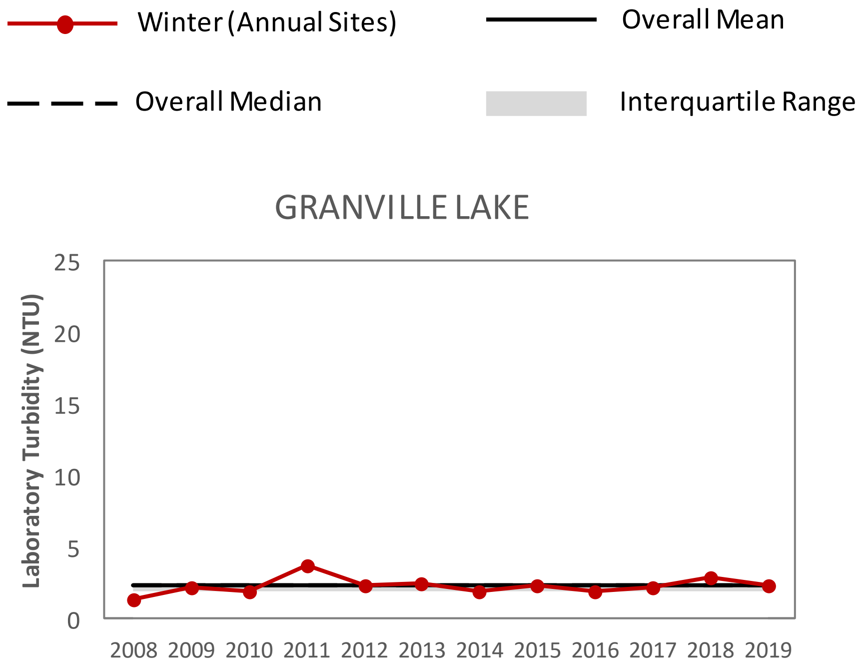


Figure 3.3-7. 2008-2019 Off-system open-water and ice-cover season turbidity levels.

3.3.3 TOTAL SUSPENDED SOLIDS

3.3.3.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

TSS concentrations in Southern Indian Lake – Area 4 ranged from <2.0 to 6.8 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 2.7 mg/L and 2.5 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from <2.0 to 5.5 mg/L and were within the IQR (<2.0 to 3.6 mg/L) in 10 of the 12 years. Mean TSS concentrations were above the IQR in 2010 and 2014. TSS concentrations were above the detection limit (DL; 2.0 mg/L) in two thirds of the samples collected in the open-water season (percent detections = 67; Table 3.3-1 and Figure 3.3-8).

TSS concentrations in the ice-cover season were consistently below the DL (2.0 mg/L) over the 12 years of monitoring (Table 3.3-1 and Figure 3.3-8).

TSS concentrations in Southern Indian Lake – Area 4 were lower in winter (mean = <2.0 mg/L), and more frequently below the DL, compared to the open-water season. No clear seasonality was observed for TSS concentrations in the open-water season; however, the lowest mean TSS concentration occurred in summer (<2.0 mg/L) and the highest in fall (3.4 mg/L; Figure 3.3-2).

ROTATIONAL SITES

Opachuanau Lake

TSS concentrations in Opachuanau Lake ranged from 2.4 to 8.4 mg/L during the open-water season. The mean and median were both 5.2 mg/L and the IQR was 4.0 to 6.2 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 4.6 to 5.7 mg/L and were within the IQR in all years. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (Table 3.3-1 and Figure 3.3-8).

TSS concentrations in the ice-cover season were consistently below the DL (2.0 mg/L) for the three years of monitoring (Table 3.3-1 and Figure 3.3-8).

Southern Indian Lake – Area 1

TSS concentrations in Southern Indian Lake – Area 1 ranged from <2.0 to 8.4 mg/L during the open-water season. The mean was 4.5 mg/L, the median was 4.2 mg/L and the IQR was 3.0 to 5.7 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 4.3 to 4.8 mg/L and were within the IQR in all years. TSS concentrations were typically above the DL (2.0 mg/L) during the open-water season (percent detections = 92; Table 3.3-1 and Figure 3.3-8).

TSS concentrations in the ice-cover season were consistently below the DL (2.0 mg/L) for the four years of monitoring (Table 3.3-1 and Figure 3.3-8).

Southern Indian Lake – Area 6

TSS concentrations in Southern Indian Lake – Area 6 ranged from 2.9 to 10.0 mg/L during the open-water season. The mean was 5.5 mg/L, the median was 5.1 mg/L and the IQR was 3.5 to 6.9 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 3.0 to 6.9 mg/L and were within the IQR in three of the four years of monitoring. The mean TSS concentration was below the IQR in 2019. TSS concentrations were consistently above the DL (2.0 mg/L) during the open-water season (Table 3.3-1 and Figure 3.3-8).

TSS concentrations in the ice-cover season were consistently below the DL (2.0 mg/L) for the four years of monitoring (Table 3.3-1 and Figure 3.3-8).

Rat Lake

TSS concentrations in Rat Lake ranged from <2.0 to 5.7 mg/L during the open-water season. The mean was 3.5 mg/L, the median was 3.3 mg/L and the IQR was 2.8 to 4.0 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 2.7 to 3.9 mg/L and were within the IQR in three of the four years of monitoring. The mean TSS concentration was below the IQR in 2010. TSS concentrations were typically above the DL (2.0 mg/L) during the open-water season (percent detections = 92; Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, TSS concentrations ranged from <2.0 to 3.6 mg/L, with a mean of <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in three of four samples collected in winter (percent detections = 25; Table 3.3-1 and Figure 3.3-9).

Central Mynarski Lake

TSS concentrations in Central Mynarski Lake ranged from <2.0 to 6.9 mg/L during the open-water season. The mean was 4.1 mg/L, the median was 3.9 mg/L and the IQR was 3.6 to 4.0 mg/L for the three years of monitoring. Mean annual TSS concentrations in the open-water season ranged from 3.7 to 4.7 mg/L and were within the IQR in 2014 and 2017 and above the IQR in 2011. TSS concentrations were typically above the DL (2.0 mg/L) during the open-water season (percent detections = 89; Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, TSS concentrations ranged from <2.0 to 3.3 mg/L, with a mean of <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in two of three samples collected in winter (percent detections = 33; Table 3.3-1 and Figure 3.3-9).

Notigi Lake – East

TSS concentrations in Notigi Lake – East ranged from <2.0 to 4.0 mg/L during the open-water season. The mean and median were both <2.0 mg/L and the IQR was <2.0 to 2.9 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from <2.0 to 2.9 mg/L and were within the IQR in all years. TSS concentrations were above the DL (2.0 mg/L) in half the samples collected during the open-water season (percent detections = 50; Table 3.3-1 and Figure 3.3-9).

TSS concentrations in the ice-cover season were consistently below the DL (2.0 mg/L) for the four years of monitoring (Table 3.3-1 and Figure 3.3-9).

Notigi Lake – West

TSS concentrations in Notigi Lake – West ranged from <2.0 to 3.2 mg/L during the open-water season. The mean was 2.0 mg/L, the median was 2.2 mg/L and the IQR was <2.0 to 2.8 mg/L for the four years of monitoring. Mean annual TSS concentrations in the open-water season ranged from <2.0 to 2.2 mg/L and were within the IQR in all years. TSS concentrations were above the DL (2.0 mg/L) in just over half the samples collected during the open-water season (percent detections = 58; Table 3.3-1 and Figure 3.3-9).

During the ice-cover season, TSS concentrations ranged from <2.0 to 2.4 mg/L, with a mean of <2.0 mg/L. TSS concentrations were below the DL (2.0 mg/L) in three of four samples collected in winter (percent detections = 25; Table 3.3-1 and Figure 3.3-9).

3.3.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

TSS concentrations in Granville Lake ranged from <2.0 to 10.6 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 4.7 mg/L and 4.4 mg/L, respectively. Open-water season mean annual TSS concentrations ranged from 3.5 to 5.5 mg/L and were within the IQR (3.5 to 5.7 mg/L) in all years. TSS concentrations were typically above the DL (2.0 mg/L) during the open-water season (percent detections = 97; Table 3.3-2 and Figure 3.3-10).

TSS concentrations in the ice-cover season ranged from <2.0 to 4.0 mg/L, both the mean and median were <2.0 mg/L, and the IQR was <2.0 to 2.2 mg/L for the 12 years of monitoring. TSS concentrations were below the DL (2.0 mg/L) in half the samples collected in winter (percent detections = 50; Table 3.3-2 and Figure 3.3-10).

TSS concentrations in Granville Lake were lower in winter (mean = <2.0 mg/L), and more frequently below the DL, compared to the open-water season. No clear seasonality was observed for TSS concentrations in the open-water season; however, the lowest mean TSS concentration occurred in spring (3.6 mg/L) and the highest in fall (5.9 mg/L; Figure 3.3-4).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

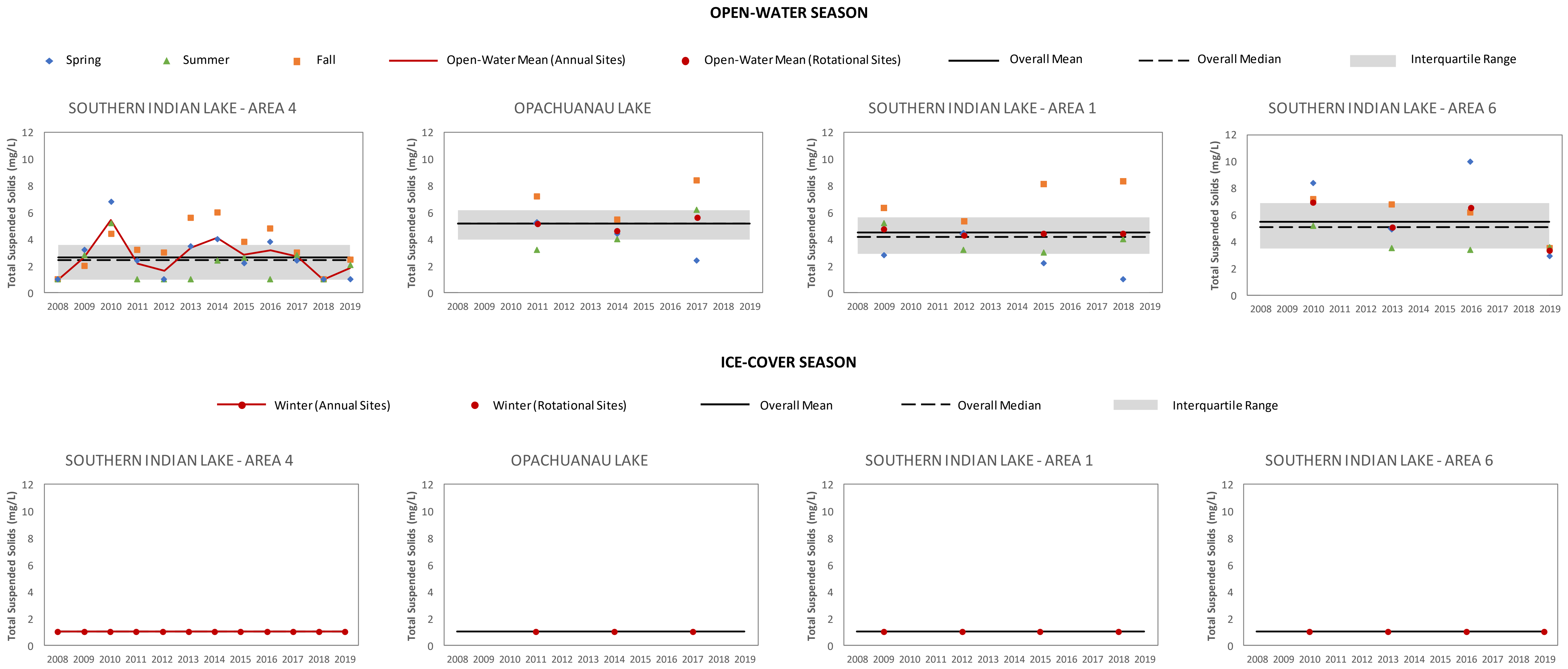
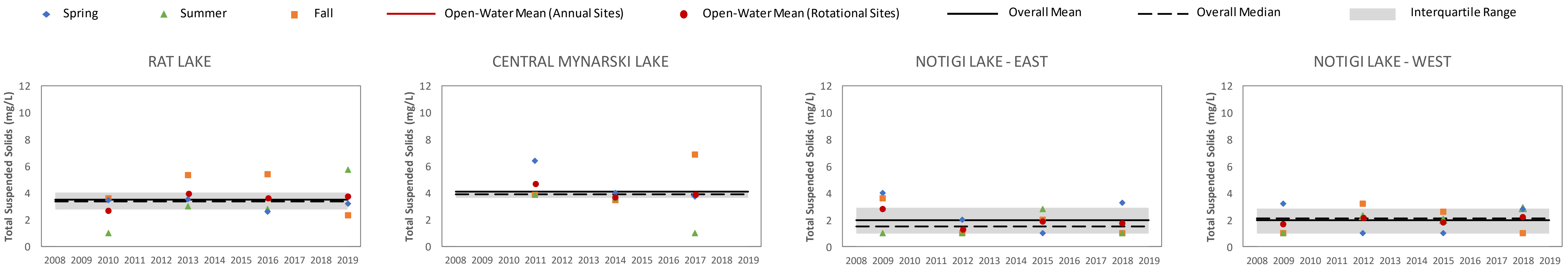


Figure 3.3-8. 2008-2019 Southern Indian and Opachuanau lakes open-water and ice-cover season TSS concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

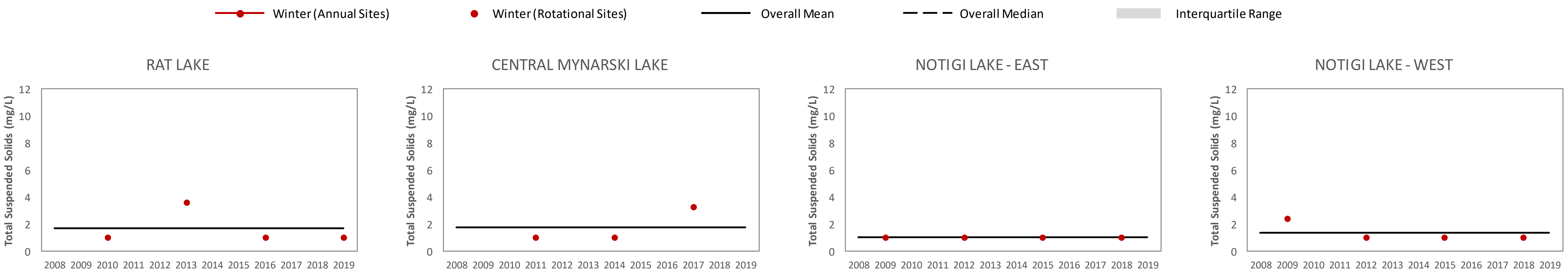
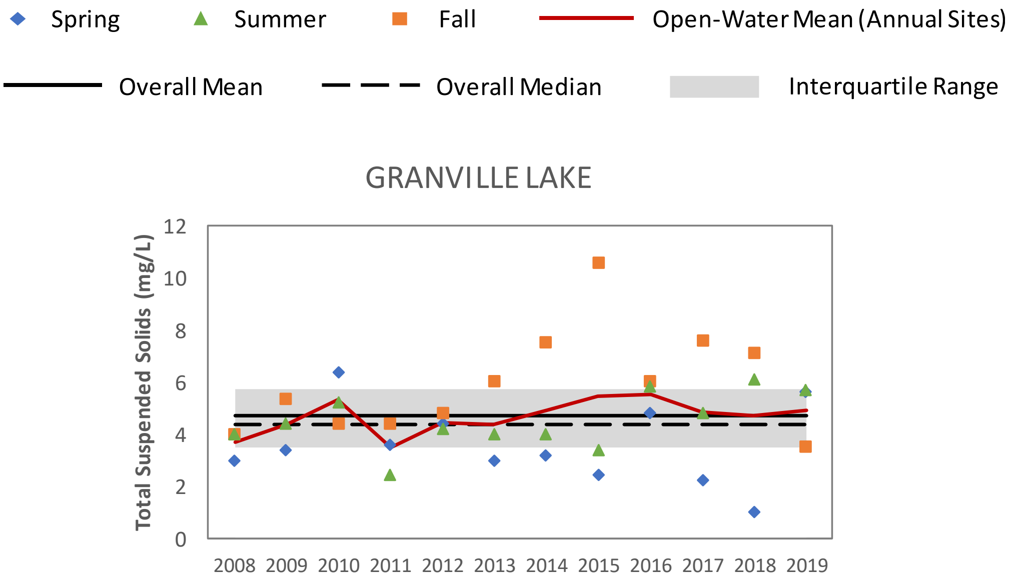


Figure 3.3-9. 2008-2019 Rat, Central Mynarski, and Notigi lakes open-water and ice-cover season TSS concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

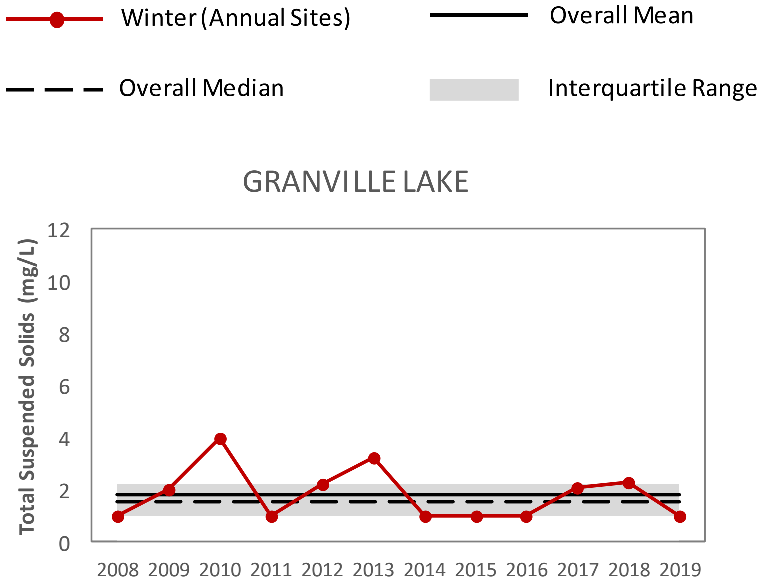


Figure 3.3-10. 2008-2019 Off-system open-water and ice-cover season TSS concentrations.

3.4 NUTRIENTS AND TROPHIC STATUS

3.4.1 TOTAL PHOSPHORUS

3.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

TP concentrations in Southern Indian Lake – Area 4 ranged from 0.004 to 0.025 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were both 0.014 mg/L. Open-water season mean annual TP concentrations ranged from 0.008 to 0.023 mg/L and were within the IQR (0.010 to 0.017 mg/L) in nine of the 12 years. Mean TP concentrations were below the IQR in 2013 and above the IQR in 2010 and 2018 (Table 3.4-1 and Figure 3.4-1).

TP concentrations in the ice-cover season ranged from 0.010 to 0.028 mg/L, with a mean of 0.016 mg/L and a median of 0.014 mg/L for the 12 years of monitoring. The IQR was 0.012 to 0.018 mg/L. TP concentrations were in or near the IQR except in 2009 and 2017 when they were above the IQR (Table 3.4-1 and Figure 3.4-1).

No clear seasonality was observed for TP in Southern Indian Lake – Area 4 over the 12 years of monitoring. However, mean TP concentrations were lowest in summer (0.011 mg/L) and highest in fall (0.017 mg/L; Figure 3.4-2).

Southern Indian Lake – Area 4 was mesotrophic (0.010 to 0.020 mg/L) on the basis of the 2008-2019 mean open-water season TP concentration (0.014 mg/L). Mean annual TP concentrations (0.008 to 0.023 mg/L) in the open-water season were within the mesotrophic range (0.010 to 0.020 mg/L) in 10 of the 12 years of monitoring. Mean TP concentrations were in the oligotrophic range (0.004 to 0.010 mg/L) in 2013 and in the meso-eutrophic range (0.020 to 0.035 mg/L) in 2010 (Table 3.4-2).

ROTATIONAL SITES

Opachuanau Lake

TP concentrations in Opachuanau Lake ranged from 0.014 to 0.027 mg/L during the open-water season. The mean was 0.021 mg/L, the median was 0.022 mg/L, and the IQR was 0.018 to 0.023 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.020 to 0.023 mg/L and were within the IQR in all three years (Table 3.4-1 and Figure 3.4-1).

During the ice-cover season, TP concentrations ranged from 0.014 to 0.018 mg/L, with a mean of 0.016 mg/L (Table 3.4-1 and Figure 3.4-1).

Opachuanau Lake was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.021 mg/L). Open-water season mean annual TP concentrations (0.020 to 0.023 mg/L) were also within the meso-eutrophic range in each year of monitoring (Table 3.4-2).

Southern Indian Lake – Area 1

TP concentrations in Southern Indian Lake – Area 1 ranged from 0.009 to 0.028 mg/L during the open-water season. The mean and median were both 0.020 mg/L and the IQR was 0.015 to 0.025 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.018 to 0.023 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-1).

During the ice-cover season, TP concentrations ranged from 0.011 to 0.014 mg/L, with a mean of 0.013 mg/L (Table 3.4-1 and Figure 3.4-1).

Southern Indian Lake – Area 1 was on the mesotrophic (0.010 to 0.020 mg/L) to meso-eutrophic (0.020 to 0.035 mg/L) boundary based on the mean of the open-water season TP concentrations for the four years of monitoring (0.020 mg/L). Open-water season mean annual TP concentrations (0.018 to 0.023 mg/L) were within the mesotrophic range (0.010 to 0.020 mg/L) in 2012, 2015, and 2018 and within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2009 (Table 3.4-2).

Southern Indian Lake – Area 6

TP concentrations in Southern Indian Lake – Area 6 ranged from 0.010 to 0.034 mg/L during the open-water season. The mean was 0.023 mg/L, median was 0.024 mg/L, and the IQR was 0.014 to 0.031 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.016 to 0.026 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-1).

During the ice-cover season, TP concentrations ranged from 0.015 to 0.023 mg/L, with a mean of 0.018 mg/L (Table 3.4-1 and Figure 3.4-1).

Southern Indian Lake – Area 6 was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.023 mg/L). Open-water season mean annual TP concentrations (0.016 to 0.026 mg/L) were also within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2010, 2016, and 2019 but were within the mesotrophic range (0.010 to 0.020 mg/L) in 2013 (Table 3.4-2).

Rat Lake

TP concentrations in Rat Lake ranged from 0.010 to 0.032 mg/L during the open-water season. The mean was 0.021 mg/L, median was 0.022 mg/L, and the IQR was 0.016 to 0.026 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.017 to 0.023 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-3).

During the ice-cover season, TP concentrations ranged from 0.020 to 0.021 mg/L, with a mean of 0.021 mg/L (Table 3.4-1 and Figure 3.4-3).

Rat Lake was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.021 mg/L). Open-water season mean annual TP concentrations (0.017 to 0.023 mg/L) were also within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2010, 2016, and 2019 but were within the mesotrophic range (0.010 to 0.020 mg/L) in 2013 (Table 3.4-2).

Central Mynarski Lake

TP concentrations in Central Mynarski Lake ranged from 0.012 to 0.045 mg/L during the open-water season. The mean was 0.021 mg/L, median was 0.017 mg/L, and the IQR was 0.015 to 0.023 mg/L for the three years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.017 to 0.027 mg/L and were within the IQR in 2011 and 2014 but above the IQR in 2017 (Table 3.4-1 and Figure 3.4-3).

During the ice-cover season, TP concentrations ranged from 0.011 to 0.024 mg/L, with a mean of 0.016 mg/L (Table 3.4-1 and Figure 3.4-3).

Central Mynarski Lake was meso-eutrophic (0.020 to 0.035 mg/L) based on the mean of the open-water season TP concentrations for the three years of monitoring (0.021 mg/L). Open-water season mean annual TP concentrations (0.017 to 0.027 mg/L) were also within the meso-eutrophic range (0.020 to 0.035 mg/L) in 2017 but were within the mesotrophic range (0.010 to 0.020 mg/L) in 2011 and 2014 (Table 3.4-2).

Notigi Lake – East

TP concentrations in Notigi Lake – East ranged from 0.008 to 0.021 mg/L during the open-water season. The mean was 0.016 mg/L, the median was 0.018 mg/L, and the IQR was 0.016 to 0.019 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.016 to 0.017 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-3).

During the ice-cover season, TP concentrations ranged from 0.016 to 0.024 mg/L, with a mean of 0.021 mg/L (Table 3.4-1 and Figure 3.4-3).

Notigi Lake – East was mesotrophic (0.010 to 0.020 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.016 mg/L). Open-water season mean annual TP concentrations (0.016 to 0.017 mg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Notigi Lake – West

TP concentrations in Notigi Lake – West ranged from 0.008 to 0.024 mg/L during the open-water season. The mean was 0.017 mg/L, the median was 0.016 mg/L, and the IQR was 0.015 to 0.019 mg/L for the four years of monitoring. Mean annual TP concentrations in the open-water season ranged from 0.015 to 0.018 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-3).

During the ice-cover season, TP concentrations ranged from 0.017 to 0.024 mg/L, with a mean of 0.021 mg/L (Table 3.4-1 and Figure 3.4-3).

Notigi Lake – East was mesotrophic (0.010 to 0.020 mg/L) based on the mean of the open-water season TP concentrations for the four years of monitoring (0.017 mg/L). Open-water season mean annual TP concentrations (0.015 to 0.018 mg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

3.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

TP concentrations in Granville Lake ranged from 0.009 to 0.031 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were both 0.019 mg/L. Open-water season mean annual TP concentrations ranged from 0.017 to 0.028 mg/L and were within the IQR (0.015 to 0.023 mg/L) in 11 of the 12 years. The exception was 2016 when the mean TP concentration was above the IQR (Table 3.4-3 and Figure 3.4-4).

TP concentrations in the ice-cover season ranged from 0.013 to 0.020 mg/L, with both a mean and median of 0.015 mg/L for the 12 years of monitoring. The IQR was 0.014 to 0.016 mg/L (Table 3.4-3 and Figure 3.4-4).

No clear seasonality was observed for TP in Granville Lake over the 12 years of monitoring. However, mean TP concentrations were lowest in winter (0.015 mg/L) and highest in fall (0.023 mg/L; Figure 3.4-5).

Granville Lake was mesotrophic (0.010 to 0.020 mg/L) based on the 2008-2019 mean open-water season TP concentration (0.019 mg/L). Mean annual TP concentrations (0.017 to 0.028 mg/L) in the open-water season were within the mesotrophic range (0.010 to 0.020 mg/L) in nine of the 12 years of monitoring. Mean TP concentrations were in the meso-eutrophic range (0.020 to 0.035 mg/L) in 2010, 2016, and 2017 (Table 3.4-4).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

Table 3.4-1. 2008-2019 On-system sites TP, TN, and chlorophyll *a* summary statistics.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll *a* (µg/L)	
		OW	IC	OW	IC	OW	IC
SIL-4	Mean	0.014	0.016	0.27	0.36	3.21	1.54
	Median	0.014	0.014	0.29	0.35	2.74	1.07
	Minimum	0.004	0.010	<0.20	<0.20	<0.60	<0.60
	Maximum	0.025	0.028	0.78	0.70	8.89	5.73
	SD	0.0052	0.0059	0.132	0.150	2.10	1.59
	SE	0.0009	0.0017	0.022	0.043	0.350	0.459
	Lower Quartile	0.010	0.012	0.22	0.28	1.72	<0.6
	Upper Quartile	0.017	0.018	0.33	0.39	3.94	1.77
	n	36	12	36	12	36	12
	% Detections	100	100	78	92	94	75
OPACH	Mean	0.021	0.016	0.36	0.40	4.89	<0.60
	Median	0.022	-	0.38	-	5.35	-
	Minimum	0.014	0.014	0.27	0.39	2.14	<0.60
	Maximum	0.027	0.018	0.45	0.42	7.06	0.89
	SD	0.0048	0.0017	0.071	0.017	1.79	-
	SE	0.0016	0.0010	0.024	0.010	0.596	-
	Lower Quartile	0.018	-	0.29	-	3.63	-
	Upper Quartile	0.023	-	0.42	-	6.30	-
	n	9	3	9	3	9	3
	% Detections	100	100	100	100	100	33
SIL-1	Mean	0.020	0.013	0.30	0.41	4.33	<0.60
	Median	0.020	-	0.30	-	3.84	-
	Minimum	0.009	0.011	<0.20	0.29	1.09	<0.60
	Maximum	0.028	0.014	0.43	0.48	14.0	0.63
	SD	0.0068	0.0017	0.117	0.084	3.41	-
	SE	0.0020	0.0008	0.034	0.042	0.984	-
	Lower Quartile	0.015	-	0.24	-	2.34	-
	Upper Quartile	0.025	-	0.40	-	5.04	-
	n	12	4	12	4	12	4
	% Detections	100	100	83	100	100	50

Table 3.4-1. continued.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll *a* (µg/L)	
		OW	IC	OW	IC	OW	IC
SIL-6	Mean	0.023	0.018	0.27	0.39	2.37	<0.60
	Median	0.024	-	0.34	-	2.58	-
	Minimum	0.010	0.015	<0.20	0.33	0.56	<0.60
	Maximum	0.034	0.023	0.40	0.44	3.44	<0.60
	SD	0.0091	0.0033	0.130	0.045	0.786	-
	SE	0.0026	0.0016	0.038	0.023	0.227	-
	Lower Quartile	0.014	-	<0.20	-	2.13	-
	Upper Quartile	0.031	-	0.38	-	2.75	-
	n	12	4	12	4	12	4
	% Detections	100	100	67	100	100	25
RAT	Mean	0.021	0.021	0.29	0.37	3.25	<0.60
	Median	0.022	-	0.30	-	3.06	-
	Minimum	0.010	0.020	<0.20	0.33	0.60	<0.60
	Maximum	0.032	0.021	0.38	0.40	7.60	<0.60
	SD	0.0073	0.0006	0.079	0.032	1.69	-
	SE	0.0021	0.0003	0.023	0.016	0.486	-
	Lower Quartile	0.016	-	0.28	-	2.54	-
	Upper Quartile	0.026	-	0.34	-	3.59	-
	n	12	4	12	4	12	4
	% Detections	100	100	92	100	100	25
MYN	Mean	0.021	0.016	0.50	0.46	8.98	0.67
	Median	0.017	-	0.49	-	4.20	-
	Minimum	0.012	0.011	0.35	0.44	2.86	<0.60
	Maximum	0.045	0.024	0.69	0.50	24.4	1.40
	SD	0.0105	0.0069	0.097	0.032	8.42	0.637
	SE	0.0035	0.0040	0.034	0.019	2.81	0.368
	Lower Quartile	0.015	-	0.46	-	3.25	-
	Upper Quartile	0.023	-	0.53	-	10.9	-
	n	9	3	8	3	9	3
	% Detections	100	100	100	100	100	33

Table 3.4-1. continued.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll *a* (µg/L)	
		OW	IC	OW	IC	OW	IC
NTG-E	Mean	0.016	0.021	0.29	0.38	2.87	<0.60
	Median	0.018	-	0.31	-	3.05	-
	Minimum	0.008	0.016	<0.20	0.32	1.60	<0.60
	Maximum	0.021	0.024	0.39	0.44	4.01	<0.60
	SD	0.0039	0.0032	0.077	0.051	0.685	-
	SE	0.0011	0.0016	0.022	0.025	0.198	-
	Lower Quartile	0.016	-	0.28	-	2.56	-
	Upper Quartile	0.019	-	0.34	-	3.24	-
	n	12	4	12	4	12	4
	% Detections	100	100	92	100	100	50
NTG-W	Mean	0.017	0.021	0.31	0.37	3.21	<0.60
	Median	0.016	-	0.33	-	3.37	-
	Minimum	0.008	0.017	<0.20	0.30	1.50	<0.60
	Maximum	0.024	0.024	0.41	0.44	4.60	<0.60
	SD	0.0042	0.0029	0.084	0.068	1.18	-
	SE	0.0012	0.0014	0.024	0.034	0.340	-
	Lower Quartile	0.015	-	0.27	-	2.07	-
	Upper Quartile	0.019	-	0.37	-	4.20	-
	n	12	4	12	4	12	4
	% Detections	100	100	92	100	100	50

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.
3. TN statistics for MYN exclude suspect value of 2.68 mg/L from spring 2014.

Table 3.4-2. 2008-2019 On-system trophic status based on TP, TN, and chlorophyll *a* open-water season mean concentrations.

Trophic Categories	Total Phosphorus (mg/L)								Total Nitrogen (mg/L)								Chlorophyll *a* (μg/L)							
Ultra-oligotrophic	<0.004																							
Oligotrophic	0.004-0.010								<0.350								<2.5							
Mesotrophic	0.010-0.020								0.350-0.650								2.5-8							
Meso-eutrophic	0.020-0.035																							
Eutrophic	0.035-0.100								0.651-1.20								8-25							
Hypereutrophic	> 0.100								>1.20								>25							
References	CCME (1999; updated to 2024)								Nürnberg (1996)								OECD (1982)							
Sampling Year	**SIL-4**	**OPACH**	**SIL-1**	**SIL-6**	**RAT**	**MYN**	**NTG-E**	**NTG-W**	**SIL-4**	**OPACH**	**SIL-1**	**SIL-6**	**RAT**	**MYN**	**NTG-E**	**NTG-W**	**SIL-4**	**OPACH**	**SIL-1**	**SIL-6**	**RAT**	**MYN**	**NTG-E**	**NTG-W**
2008	0.010	-	-	-	-	-	-	-	0.28	-	-	-	-	-	-	-	2.33	-	-	-	-	-	-	-
2009	0.012	-	0.023	-	-	-	0.017	0.015	<0.20	-	0.21	-	-	-	0.30	0.32	1.80	-	3.43	-	-	-	2.57	2.40
2010	0.023	-	-	0.026	0.023	-	-	-	0.30	-	-	0.33	0.30	-	-	-	3.19	-	-	1.65	1.59	-	-	-
2011	0.015	0.020	-	-	-	0.017	-	-	0.46	0.34	-	-	-	0.51	-	-	3.82	5.34	-	-	-	10.5	-	-
2012	0.012	-	0.018	-	-	-	0.016	0.016	0.25	-	0.32	-	-	-	0.30	0.38	3.01	-	3.40	-	-	-	2.75	3.20
2013	0.008	-	-	0.016	0.017	-	-	-	<0.20	-	-	<0.20	0.23	-	-	-	2.36	-	-	2.93	2.93	-	-	-
2014	0.013	0.020	-	-	-	0.019	-	-	0.28	0.37	-	-	-	0.48	-	-	3.22	4.93	-	-	-	6.04	-	-
2015	0.014	-	0.019	-	-	-	0.017	0.018	0.27	-	0.33	-	-	-	0.26	0.24	3.95	-	3.74	-	-	-	2.94	3.09
2016	0.011	-	-	0.026	0.021	-	-	-	0.20	-	-	0.29	0.30	-	-	-	1.56	-	-	2.48	3.18	-	-	-
2017	0.017	0.023	-	-	-	0.027	-	-	0.36	0.39	-	-	-	0.50	-	-	2.36	4.39	-	-	-	10.4	-	-
2018	0.019	-	0.018	-	-	-	0.016	0.018	0.27	-	0.33	-	-	-	0.32	0.31	6.30	-	6.75	-	-	-	3.21	4.16
2019	0.013	-	-	0.023	0.023	-	-	-	0.33	-	-	0.37	0.35	-	-	-	4.62	-	-	2.43	5.31	-	-	-
Overall (2008-2019)	0.014	0.021	0.020	0.023	0.021	0.021	0.016	0.017	0.27	0.36	0.30	0.27	0.29	0.50	0.29	0.31	3.21	4.89	4.33	2.37	3.25	8.98	2.87	3.21

Notes:

1. CCME = Canadian Council of Ministers of the Environment.
2. OECD = Organization for Economic Cooperation and Development.
3. TN values for MYN exclude suspect value of 2.68 mg/L from spring 2014.

Table 3.4-3. 2008-2019 Off-system sites TP, TN, and chlorophyll *a* summary statistics.

Site	Statistic	TP (mg/L)		TN (mg/L)		Chlorophyll *a* (µg/L)	
		OW	**IC**	**OW**	**IC**	**OW**	**IC**
GRV	Mean	0.019	0.015	0.35	0.39	4.64	1.15
	Median	0.019	0.015	0.38	0.39	4.39	<0.60
	Minimum	0.009	0.013	<0.20	0.31	1.00	<0.60
	Maximum	0.031	0.020	0.52	0.46	11.6	4.78
	SD	0.0060	0.0025	0.105	0.044	2.09	1.54
	SE	0.0010	0.0007	0.018	0.013	0.349	0.445
	Lower Quartile	0.015	0.014	0.30	0.36	3.23	<0.60
	Upper Quartile	0.023	0.016	0.43	0.41	5.97	0.95
	n	36	12	36	12	36	12
	% Detections	100	100	92	100	100	50

Notes:

1. OW = Open-water season; IC = Ice-cover season.
2. SD = standard deviation; SE = standard error; n = number of samples.

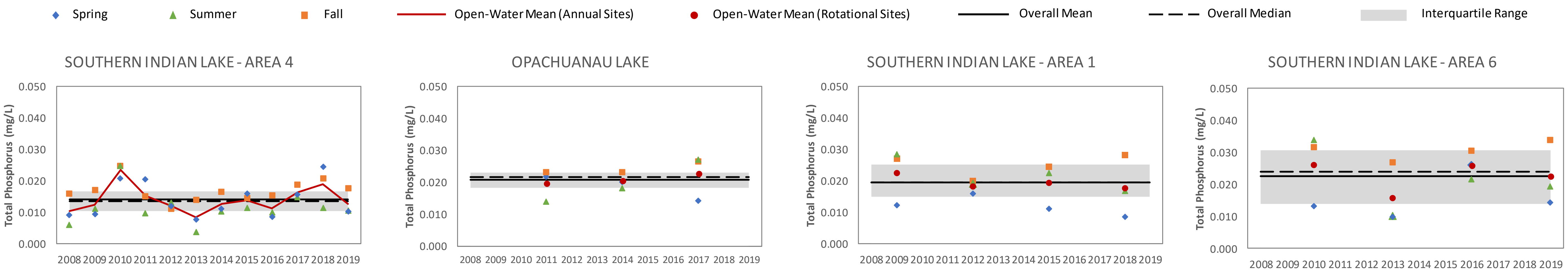
Table 3.4-4. 2008-2019 Off-system trophic status based on TP, TN, and chlorophyll *a* open-water season mean concentrations.

Trophic Categories	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Chlorophyll *a* (µg/L)
Ultra-oligotrophic	<0.004		
Oligotrophic	0.004-0.010	<0.350	<2.5
Mesotrophic	0.010-0.020	0.350-0.650	2.5-8
Meso-eutrophic	0.020-0.035		
Eutrophic	0.035-0.100	0.651-1.20	8-25
Hypereutrophic	> 0.100	>1.20	>25
References	CCME (1999; updated to 2024)	Nürnberg (1996)	OECD (1982)
Sampling Year	**GRV**	**GRV**	**GRV**
2008	0.017	0.38	4.33
2009	0.017	0.21	3.43
2010	0.022	0.39	4.18
2011	0.018	0.46	5.92
2012	0.017	0.33	5.30
2013	0.017	0.30	5.41
2014	0.019	0.39	4.72
2015	0.018	0.40	3.97
2016	0.028	0.37	4.20
2017	0.022	0.30	3.12
2018	0.017	0.35	6.43
2019	0.018	0.37	4.68
Overall (2008-2019)	0.019	0.35	4.64

Notes:

1. CCME = Canadian Council of Ministers of the Environment.
2. OECD = Organization for Economic Cooperation and Development.

OPEN-WATER SEASON



ICE-COVER SEASON

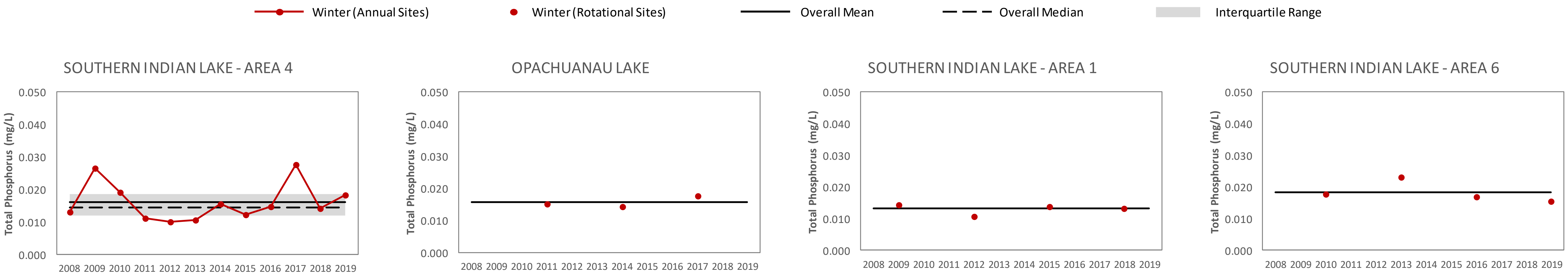
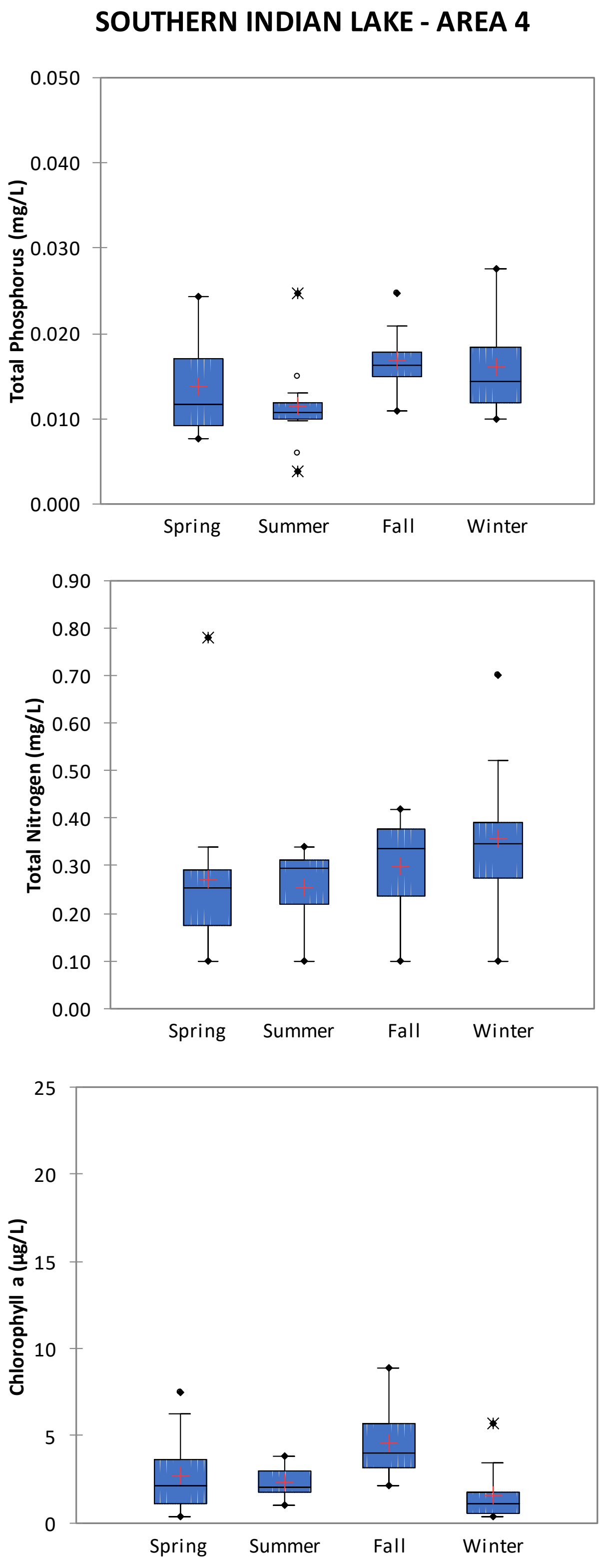


Figure 3.4-1. 2008-2019 Southern Indian and Opachuanau lakes open-water and ice-cover season TP concentrations.



SOUTHERN INDIAN LAKE - AREA 4

Figure 3.4-2. 2008-2019 On-system seasonal total phosphorus, total nitrogen, and chlorophyll *a* concentrations.

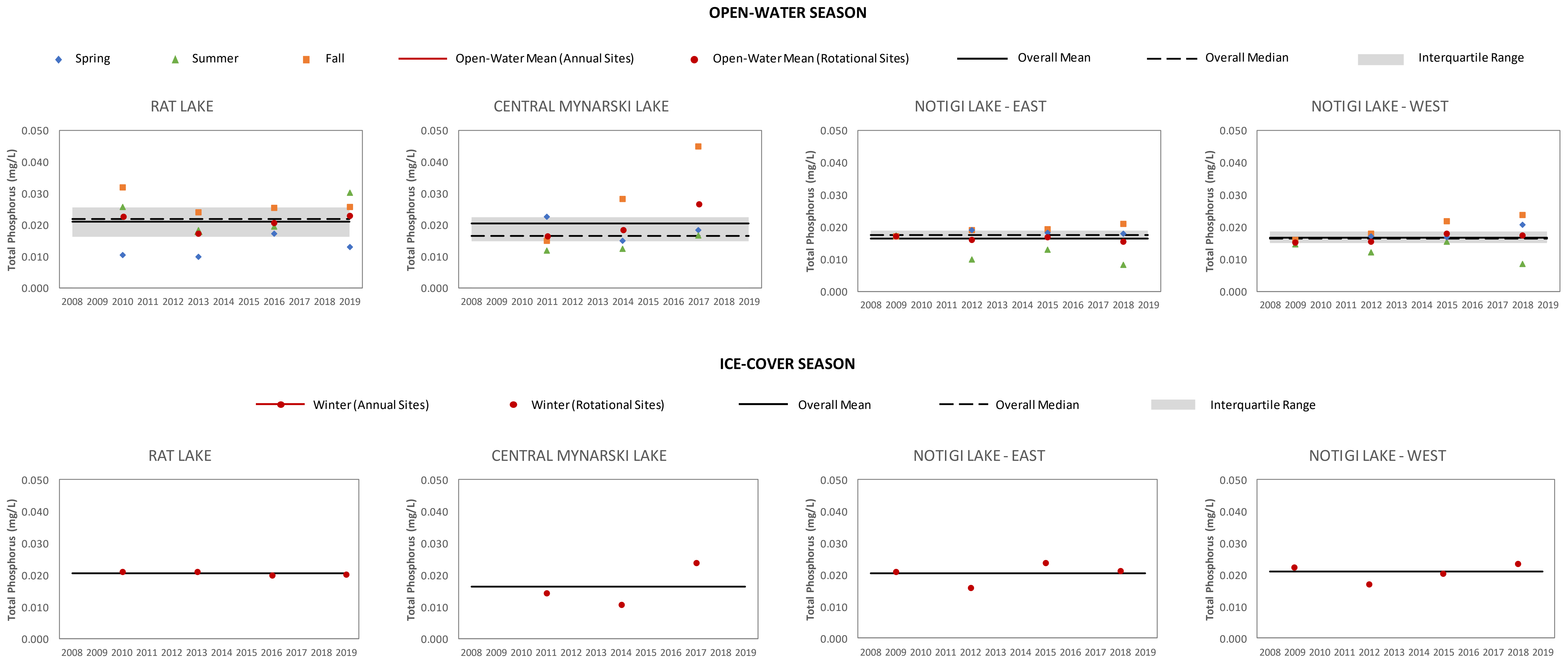
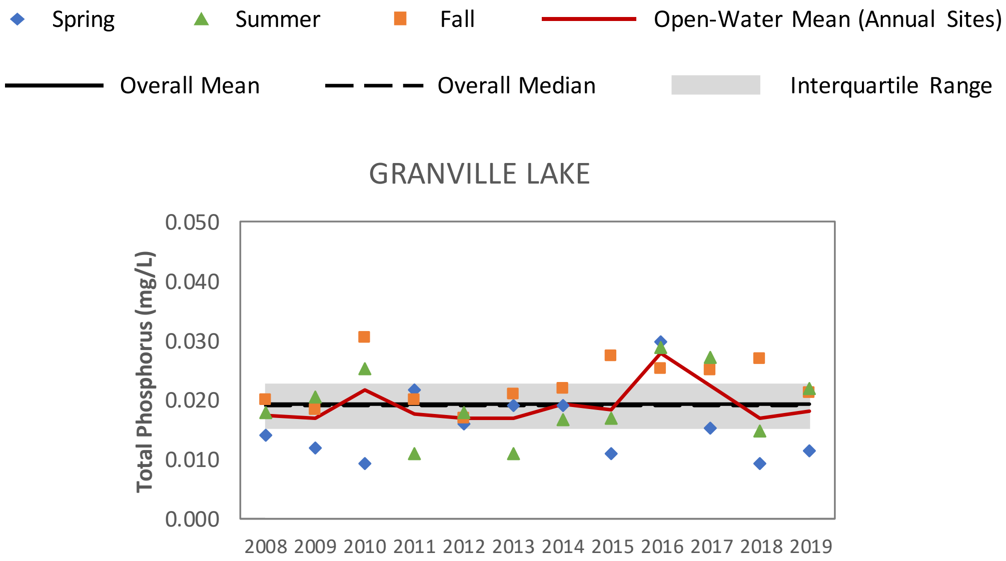


Figure 3.4-3. 2008-2019 Rat, Central Mynarski, and Notigi lakes open-water and ice-cover season TP concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

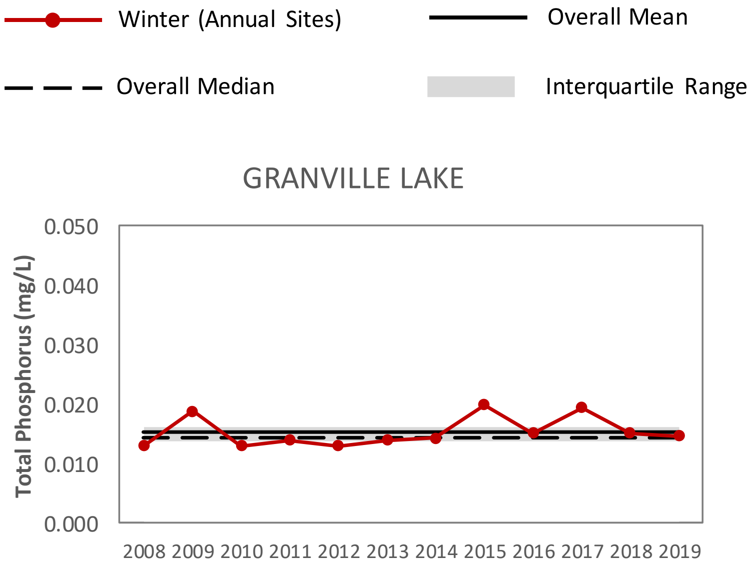


Figure 3.4-4. 2008-2019 Off-system open-water and ice-cover season TP concentrations.

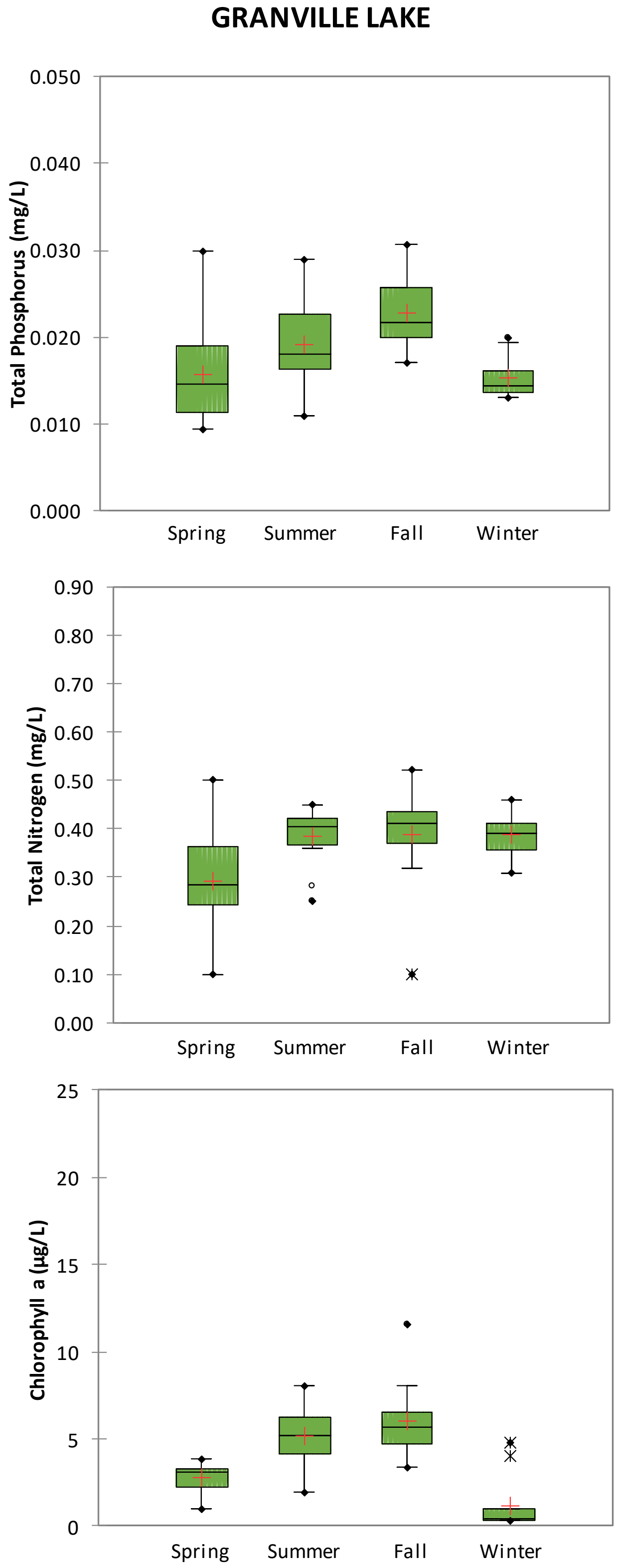


Figure 3.4-5. 2008-2019 Off-system seasonal total phosphorus, total nitrogen, and chlorophyll *a* concentrations.

3.4.2 TOTAL NITROGEN

3.4.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

TN concentrations in Southern Indian Lake – Area 4 ranged from <0.20 to 0.78 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 0.27 mg/L and 0.29 mg/L, respectively. Open-water season mean annual TN concentrations ranged from <0.20 to 0.46 mg/L and were within the IQR (0.22 to 0.33 mg/L) in eight of the 12 years. Mean TN concentrations were below the IQR in 2009 and 2013 and above the IQR in 2011 and 2017 (Table 3.4-1 and Figure 3.4-6).

TN concentrations in the ice-cover season ranged from <0.20 to 0.70 mg/L, with a mean of 0.36 mg/L and a median of 0.35 mg/L for the 12 years of monitoring. The IQR was 0.28 to 0.39 mg/L. TN concentrations were typically within or near the IQR but were below the IQR in 2016 and above the IQR in 2009 and 2013 (Table 3.4-1 and Figure 3.4-6).

No clear seasonality was observed for TN in Southern Indian Lake – Area 4 over the 12 years of monitoring. However, mean TN concentrations were lowest in summer (0.25 mg/L) and highest in winter (0.36 mg/L; Figure 3.4-2).

Southern Indian Lake – Area 4 was oligotrophic (<0.350 mg/L) based on the 2008-2019 mean open-water season TN concentration (0.27 mg/L). Mean annual TN concentrations (<0.20 to 0.46 mg/L) in the open-water season were within the oligotrophic range (i.e., <0.350 mg/L) in 10 of the 12 years of monitoring. Mean TN concentrations were in the mesotrophic range (0.350 to 0.650 mg/L) in 2011 and 2017 (Table 3.4-2).

ROTATIONAL SITES

Opachuanau Lake

TN concentrations in Opachuanau Lake ranged from 0.27 to 0.45 mg/L during the open-water season. The mean was 0.36 mg/L, the median was 0.38 mg/L, and the IQR was 0.29 to 0.42 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.34 to 0.39 mg/L and were within the IQR in all three years (Table 3.4-1 and Figure 3.4-6).

During the ice-cover season, TN concentrations ranged from 0.39 to 0.42 mg/L, with a mean of 0.40 mg/L (Table 3.4-1 and Figure 3.4-6).

Opachuanau Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.36 mg/L). Open-water season mean annual TN concentrations (0.34 to 0.39 mg/L) were also within the mesotrophic range in 2014 and 2017 but were in the oligotrophic range (i.e.,<0.350 mg/L) in 2011 (Table 3.4-2).

Southern Indian Lake – Area 1

TN concentrations in Southern Indian Lake – Area 1 ranged from <0.20 to 0.43 mg/L during the open-water season. The mean and median were both 0.30 mg/L and the IQR was 0.24 to 0.40 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.21 to 0.33 mg/L and were within the IQR in three of the four years. The mean TN concentration was below the IQR in 2009 (Table 3.4-1 and Figure 3.4-6).

During the ice-cover season, TN concentrations ranged from 0.29 to 0.48 mg/L, with a mean of 0.41 mg/L (Table 3.4-1 and Figure 3.4-6).

Southern Indian Lake – Area 1 was oligotrophic (<0.350 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.30 mg/L). Open-water season mean annual TN concentrations (0.21 to 0.33 mg/L) were also within the oligotrophic range in each year of monitoring (Table 3.4-2).

Southern Indian Lake – Area 6

TN concentrations in Southern Indian Lake – Area 6 ranged from <0.20 to 0.40 mg/L during the open-water season. The mean was 0.27 mg/L, median was 0.34 mg/L, and the IQR was <0.20 to 0.38 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from <0.20 to 0.37 mg/L and were within the IQR in all four years (Table 3.4-1 and Figure 3.4-6).

During the ice-cover season, TN concentrations ranged from 0.33 to 0.44 mg/L, with a mean of 0.39 mg/L (Table 3.4-1 and Figure 3.4-6).

Southern Indian Lake – Area 6 was oligotrophic (<0.350 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.27 mg/L). Open-water season mean annual TN concentrations (0.016 to 0.026 mg/L) were also within the oligotrophic range (<0.350 mg/L) in three of the four years of monitoring; however, the open-water mean TN concentration was within the mesotrophic range (0.350 to 0.650 mg/L) in 2019 (Table 3.4-2).

Rat Lake

TN concentrations in Rat Lake ranged from <0.20 to 0.38 mg/L during the open-water season. The mean was 0.29 mg/L, median was 0.30 mg/L, and the IQR was 0.28 to 0.34 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.23 to 0.35 mg/L and were within the IQR in 2010 and 2016 but below the IQR in 2013 and above the IQR in 2019 (Table 3.4-1 and Figure 3.4-7).

During the ice-cover season, TN concentrations ranged from 0.33 to 0.40 mg/L, with a mean of 0.37 mg/L (Table 3.4-1 and Figure 3.4-7).

Rat Lake was oligotrophic (<0.350 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.29 mg/L). Open-water season mean annual TN concentrations (0.017 to 0.023 mg/L) were also within the meso-eutrophic range (0.020 to 0.035 mg/L) in three of the four years of monitoring; however, the open-water mean TN concentration was within the mesotrophic range (0.350 to 0.650 mg/L) in 2019 (Table 3.4-2).

Central Mynarski Lake

TN concentrations in Central Mynarski Lake ranged from 0.35 to 0.69 mg/L during the open-water season. The mean was 0.50 mg/L, median was 0.49 mg/L, and the IQR was 0.46 to 0.53 mg/L for the three years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.48 to 0.51 mg/L and were within the IQR in all three years (Table 3.4-1 and Figure 3.4-7).[2]

During the ice-cover season, TN concentrations ranged from 0.44 to 0.50 mg/L, with a mean of 0.46 mg/L (Table 3.4-1 and Figure 3.4-7).

Central Mynarski Lake was mesotrophic (0.350 to 0.650 mg/L) based on the mean of the open-water season TN concentrations for the three years of monitoring (0.50 mg/L). Open-water season

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[2] A suspect TN value of 2.68 mg/L from spring 2014 has been excluded from the data reported for the open-water season.

mean annual TN concentrations (0.48 to 0.51 mg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Notigi Lake – East

TN concentrations in Notigi Lake – East ranged from <0.20 to 0.39 mg/L during the open-water season. The mean was 0.29 mg/L, the median was 0.31 mg/L, and the IQR was 0.28 to 0.34 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.26 to 0.32 mg/L and were within the IQR in three of the four years. The exception was 2015 when the mean TN concentration was below the IQR (Table 3.4-1 and Figure 3.4-7).

During the ice-cover season, TN concentrations ranged from 0.32 to 0.44 mg/L, with a mean of 0.38 mg/L (Table 3.4-1 and Figure 3.4-7).

Notigi Lake – East was oligotrophic (<0.350 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.29 mg/L). Open-water season mean annual TN concentrations (0.26 to 0.32 mg/L) were also within the oligotrophic range in each year of monitoring (Table 3.4-2).

Notigi Lake – West

TN concentrations in Notigi Lake – West ranged from <0.20 to 0.41 mg/L during the open-water season. The mean was 0.31 mg/L, the median was 0.33 mg/L, and the IQR was 0.27 to 0.37 mg/L for the four years of monitoring. Mean annual TN concentrations in the open-water season ranged from 0.24 to 0.38 mg/L and were within the IQR in 2009 and 2018 but were below the IQR in 2015 and above the IQR in 2012 (Table 3.4-1 and Figure 3.4-7).

During the ice-cover season, TN concentrations ranged from 0.30 to 0.44 mg/L, with a mean of 0.37 mg/L (Table 3.4-1 and Figure 3.4-7).

Notigi Lake – East was oligotrophic (<0.350 mg/L) based on the mean of the open-water season TN concentrations for the four years of monitoring (0.31 mg/L). Open-water season mean annual TN concentrations (0.24 to 0.38 mg/L) were also within the oligotrophic range in three of the four years of monitoring; however, the open-water mean TN concentration was within the mesotrophic range (0.350 to 0.650 mg/L) in 2012 (Table 3.4-2).

3.4.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

TN concentrations in Granville Lake ranged from <0.20 to 0.52 mg/L during the open-water season. The mean and median concentrations for the 12 years of monitoring were 0.35 mg/L and 0.38 mg/L, respectively. Open-water season mean annual TN concentrations ranged from 0.21 to 0.46 mg/L and were within the IQR (0.30 to 0.43 mg/L) in 10 of the 12 years. Mean TN concentrations were below the IQR in 2009 and above the IQR in 2011 (Table 3.4-3 and Figure 3.4-8).

TN concentrations in the ice-cover season ranged from 0.31 to 0.46 mg/L, with both a mean and median of 0.39 mg/L for the 12 years of monitoring. The IQR was 0.36 to 0.41 mg/L (Table 3.4-3 and Figure 3.4-8).

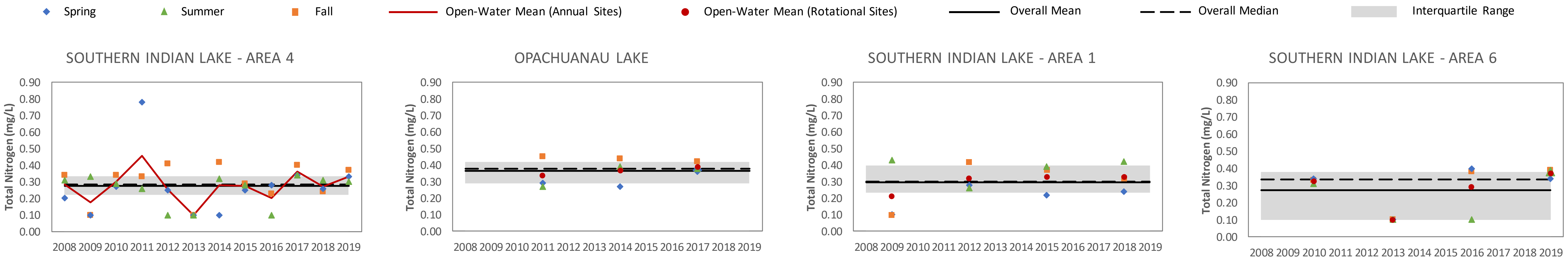
No clear seasonality was observed for TN in Granville Lake over the 12 years of monitoring. However, mean TN concentrations were lowest in spring (0.29 mg/L) and highest in fall and winter (0.39 mg/L for both; Figure 3.4-5).

Granville Lake was mesotrophic (0.350 to 0.650 mg/L) based on the 2008-2019 mean open-water season TN concentration (0.35 mg/L). Mean annual TN concentrations (0.21 to 0.46 mg/L) in the open-water season were within the mesotrophic range (0.350 to 0.650 mg/L) in eight of the 12 years of monitoring. Mean TN concentrations were in the oligotrophic range (<0.350 mg/L) in 2009, 2012, 2013, and 2017 (Table 3.4-4).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

OPEN-WATER SEASON



ICE-COVER SEASON

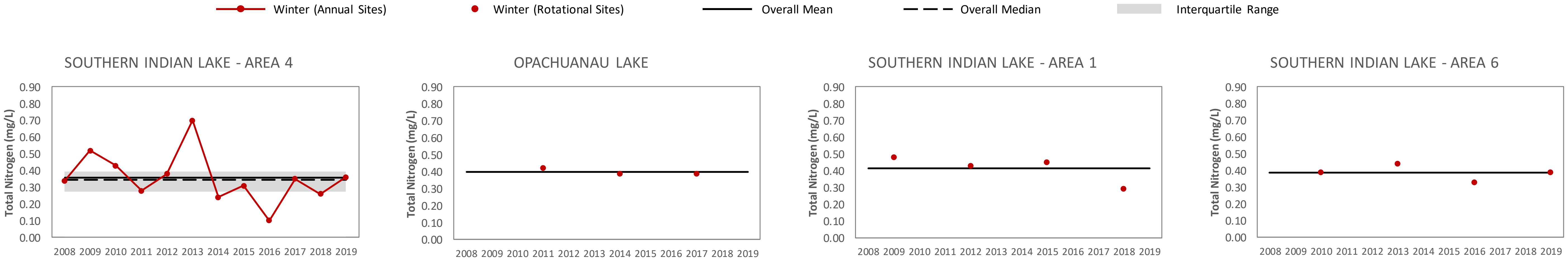
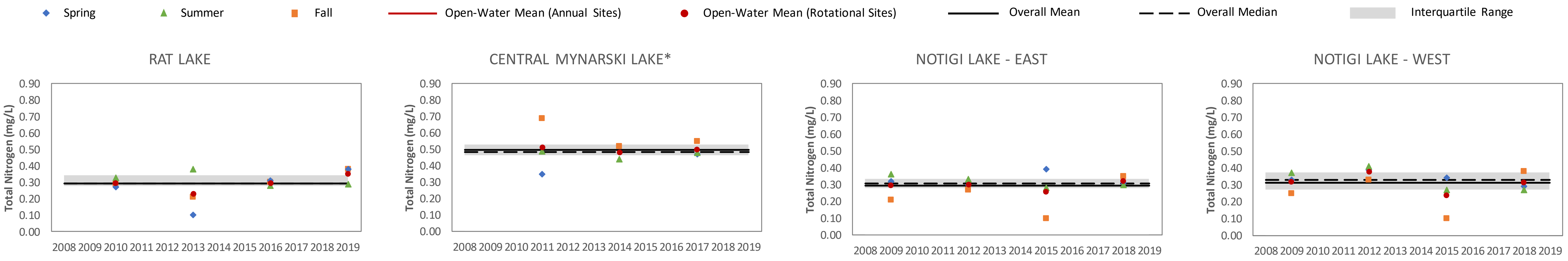
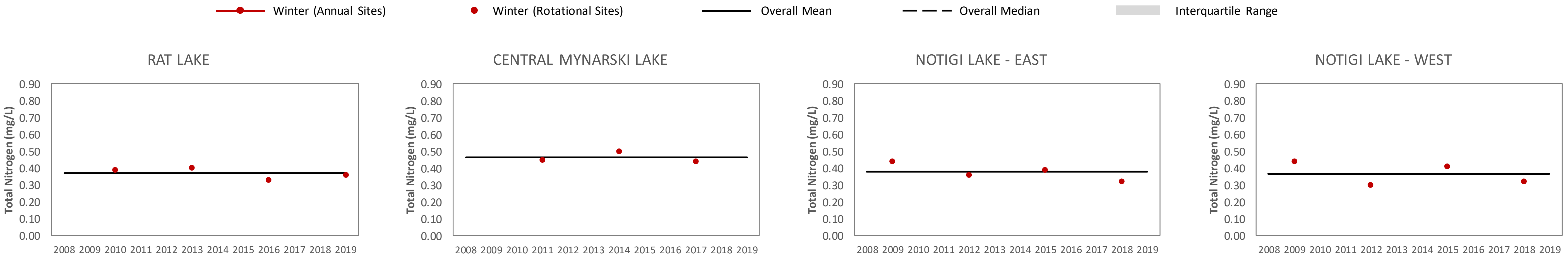


Figure 3.4-6. 2008-2019 Southern Indian and Opachuanau lakes open-water and ice-cover season TN concentrations.

OPEN-WATER SEASON



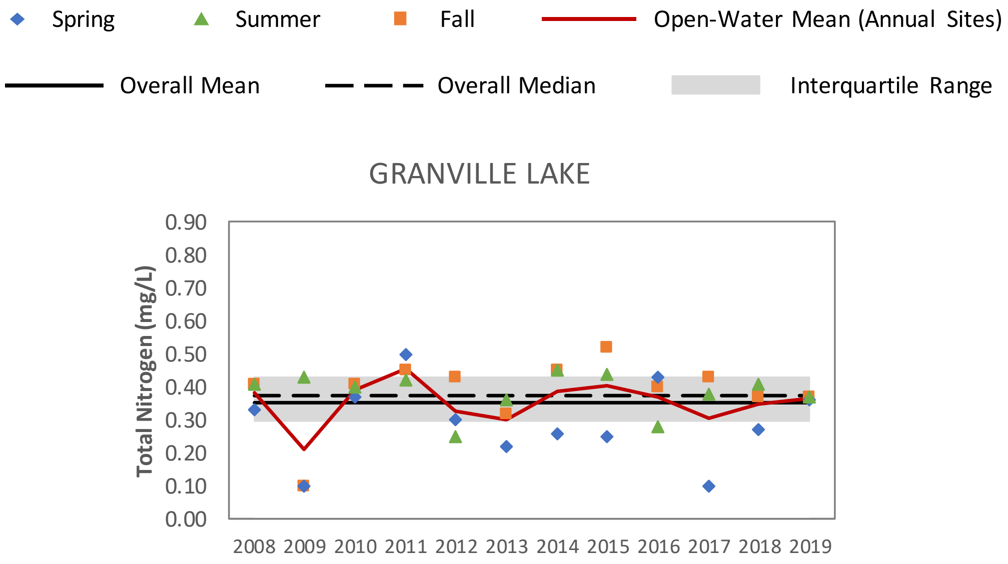
ICE-COVER SEASON



*Excludes suspect value of 2.68 mg/L at MYN from spring 2014.

Figure 3.4-7. 2008-2019 Rat, Central Mynarski, and Notigi lakes open-water and ice-cover season TN concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

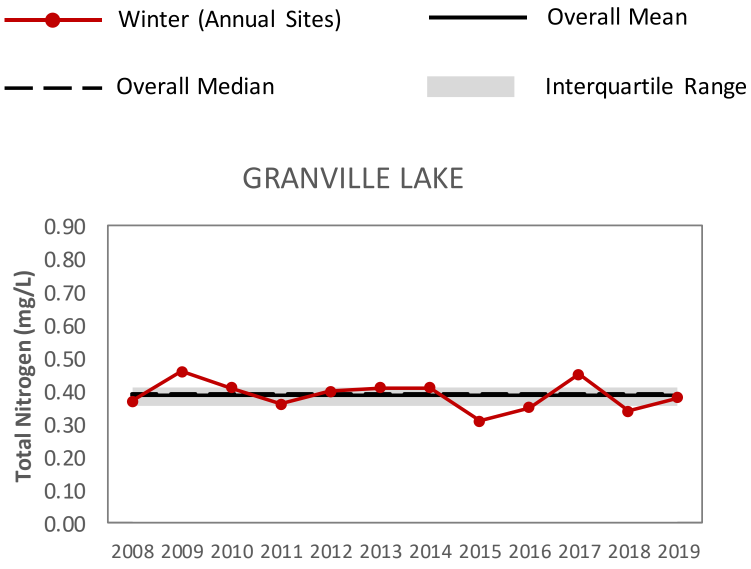


Figure 3.4-8. 2008-2019 Off-system open-water and ice-cover season TN concentrations.

3.4.3 CHLOROPHYLL *A*

3.4.3.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Chlorophyll *a* concentrations in Southern Indian Lake – Area 4 ranged from <0.60 to 8.89 µg/L during the open-water season. The mean and median for the 12 years of monitoring were 3.21 µg/L and 2.74 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 1.56 to 6.30 µg/L and were within the IQR (1.72 to 3.94 µg/L) in eight of the 12 years. Mean chlorophyll *a* concentrations were below the IQR in 2016 and above the IQR in 2015, 2018, and 2019 (Table 3.4-1 and Figure 3.4-9).

Chlorophyll *a* concentrations in the ice-cover season ranged from <0.60 to 5.73 µg/L, with a mean of 1.54 µg/L and median of 1.07 µg/L for the 12 years of monitoring. The IQR was <0.60 to 1.77 µg/L. Chlorophyll *a* concentrations were typically within or near the IQR but were above the IQR in 2014 and 2016 (Table 3.4-1 and Figure 3.4-9).

No clear seasonality was observed for chlorophyll *a* concentrations Southern Indian Lake – Area 4 over the 12 years of monitoring. However, mean chlorophyll *a* concentrations were lowest in winter (1.54 µg/L) and highest in fall (4.60 µg/L; Figure 3.4-2).

Southern Indian Lake – Area 4 was mesotrophic (2.5 to 8 µg/L) on the basis of the 2008-2019 mean open-water season chlorophyll *a* concentration (3.21 µg/L). Mean annual chlorophyll *a* concentrations (1.56 to 6.30 µg/L) in the open-water season were also within the mesotrophic range in seven of the 12 years of monitoring. However, mean chlorophyll *a* concentrations were within the oligotrophic range (<2.5 µg/L) in 2008, 2009, 2013, 2016, and 2017 (Table 3.4-2).

ROTATIONAL SITES

Opachuanau Lake

Chlorophyll *a* concentrations in Opachuanau Lake ranged from 2.14 to 7.06 µg/L during the open-water season. The mean was 4.89 µg/L, the median was 5.35 µg/L, and the IQR was 3.63 to 6.30 µg/L for the three years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 4.39 to 5.34 µg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-9).

Chlorophyll *a* concentrations were below the DL (0.60 µg/L) in two of three sampling events in the ice-cover season (percent detection = 33). The chlorophyll *a* concentration in winter 2014 was 0.89 µg/L. The mean was <0.60 µg/L for the three years of monitoring (Table 3.4-1 and Figure 3.4-9).

Opachuanau Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (4.89 µg/L). Open-water season mean annual chlorophyll *a* concentrations (4.39 to 5.34 µg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Southern Indian Lake – Area 1

Chlorophyll *a* concentrations in Southern Indian Lake – Area 1 ranged from 1.09 to 14.0 µg/L during the open-water season. The mean was 4.33 µg/L, the median was 3.84 µg/L, and the IQR was 2.34 to 5.04 µg/L for the four years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 3.40 to 6.75 µg/L and were within the IQR in three of the four years. The mean chlorophyll *a* concentration was above the IQR in 2018 (Table 3.4-1 and Figure 3.4-9).

Chlorophyll *a* concentrations ranged from <0.60 to 0.63 µg/L during the ice-cover season. The mean chlorophyll *a* concentration for the four years of monitoring was <0.60 µg/L (Table 3.4-1 and Figure 3.4-9). Chlorophyll *a* concentrations were below the DL (0.020-0.60 µg/L) in two of the four years of monitoring (percent detection = 50).

Southern Indian Lake – Area 1 was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (4.33 µg/L). Open-water season mean annual chlorophyll *a* concentrations (3.40 to 6.75 µg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Southern Indian Lake – Area 6

Chlorophyll *a* concentrations in Southern Indian Lake – Area 6 ranged from 0.56 to 3.44 µg/L during the open-water season. The mean was 2.37 µg/L, the median was 2.58 µg/L, and the IQR was 2.13 to 2.75 µg/L for the four years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 1.65 to 2.93 µg/L and were within the IQR in 2016 and

2019 but were below the IQR in 2010 and above the IQR in 2013. Chlorophyll *a* concentrations were consistently above the DL (0.010-0.60 µg/L) during the open-water season (percent detections = 100; Table 3.4-1 and Figure 3.4-9)

Chlorophyll *a* concentrations were typically below the DL (0.10-0.60 µg/L) during the ice-cover season (percent detection = 25) and all concentrations were less than 0.60 µg/L. The mean chlorophyll *a* concentration for the four years of monitoring was <0.60 µg/L (Table 3.4-1 and Figure 3.4-9).

Southern Indian Lake – Area 6 was oligotrophic (<2.5 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (2.37 µg/L). Open-water season mean annual chlorophyll *a* concentrations (1.65 to 2.93 µg/L) were also within the oligotrophic range in three of the four years. The exception was 2013 when the mean open-water chlorophyll *a* concentration was in the mesotrophic range (2.5 to 8 µg/L; Table 3.4-2).

Rat Lake

Chlorophyll *a* concentrations in Rat Lake ranged from 0.60 to 7.60 µg/L during the open-water season. The mean was 3.25 µg/L, the median was 3.06 µg/L, and the IQR was 2.54 to 3.59 µg/L for the four years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 1.59 to 5.31 µg/L and were within the IQR in 2013 and 2016 but were below the IQR in 2010 and above the IQR in 2019 (Table 3.4-1 and Figure 3.4-10)

Chlorophyll *a* concentrations were typically below the DL (0.10-0.60 µg/L) during the ice-cover season (percent detection = 25) and all concentrations were less than 0.60 µg/L. The mean chlorophyll *a* concentration for the four years of monitoring was <0.60 µg/L (Table 3.4-1 and Figure 3.4-10).

Rat Lake was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (3.25 µg/L). Open-water season mean annual chlorophyll *a* concentrations (1.59 to 5.31 µg/L) were also within the mesotrophic range in three of the four years. The exception was 2010 when the mean open-water chlorophyll *a* concentration was in the oligotrophic range (<2.5 µg/L; Table 3.4-2).

Central Mynarski Lake

Chlorophyll *a* concentrations in Central Mynarski Lake ranged from 2.86 to 24.4 µg/L during the open-water season. The mean was 8.98 µg/L, the median was 4.20 µg/L, and the IQR was 3.25 to

10.9 µg/L for the three years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 6.04 to 10.5 µg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-10)

Chlorophyll *a* concentrations were below the DL (0.60 µg/L) in two of three sampling events in the ice-cover season (percent detection = 33). The chlorophyll *a* concentration in winter 2011 was 1.40 µg/L. The mean was 0.67 µg/L for the three years of monitoring (Table 3.4-1 and Figure 3.4-9).

Central Mynarski Lake was eutrophic (8 to 25 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the three years of monitoring (8.98 µg/L). Open-water season mean annual chlorophyll *a* concentrations (6.04 to 10.5 µg/L) were also within the mesotrophic range in 2011 and 2017 but were within the mesotrophic range (2.5 to 8 µg/L) in 2014 (Table 3.4-2).

Notigi Lake – East

Chlorophyll *a* concentrations in Notigi Lake – East ranged from 1.60 to 4.01 µg/L during the open-water season. The mean was 2.87 µg/L, the median was 3.05 µg/L, and the IQR was 2.56 to 3.24 µg/L for the four years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 2.57 to 3.21 µg/L and were within the IQR in all years (Table 3.4-1 and Figure 3.4-10)

Chlorophyll *a* concentrations were below the DL (0.10-0.60 µg/L) in two of four sampling events in the ice-cover season (percent detection = 50) and all concentrations were less than 0.60 µg/L. The mean chlorophyll *a* concentration for the four years of monitoring was <0.60 µg/L (Table 3.4-1 and Figure 3.4-10).

Notigi Lake – East was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (2.87 µg/L). Open-water season mean annual chlorophyll *a* concentrations (2.57 to 3.21 µg/L) were also within the mesotrophic range in each year of monitoring (Table 3.4-2).

Notigi Lake – West

Chlorophyll *a* concentrations in Notigi Lake – West ranged from 1.50 to 4.60 µg/L during the open-water season. The mean was 3.21 µg/L, the median was 3.37 µg/L, and the IQR was 2.07 to 4.20 µg/L for the four years of monitoring. Mean annual chlorophyll *a* concentrations in the open-water season ranged from 2.40 to 4.16 µg/L and were within the IQR in three of the four years. The mean chlorophyll *a* concentration was above the IQR in 2018 (Table 3.4-1 and Figure 3.4-10)

Chlorophyll *a* concentrations were below the DL (0.10-0.60 µg/L) in two of four sampling events in the ice-cover season (percent detection = 50) and all concentrations were less than 0.60 µg/L. The mean chlorophyll *a* concentration for the four years of monitoring was <0.60 µg/L (Table 3.4-1 and Figure 3.4-10).

Notigi Lake – West was mesotrophic (2.5 to 8 µg/L) based on the mean of the open-water season chlorophyll *a* concentrations for the four years of monitoring (3.21 µg/L). Open-water season mean annual chlorophyll *a* concentrations (2.40 to 4.16 µg/L) were also within the mesotrophic range in three of the four years. The exception was 2009 when the mean open-water chlorophyll *a* concentration was in the oligotrophic range (<2.5 µg/L; Table 3.4-2).

3.4.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Chlorophyll *a* concentrations in Granville Lake ranged from 1.00 to 11.6 µg/L during the open-water season. The mean and median for the 12 years of monitoring were 4.64 µg/L and 4.39 µg/L, respectively. Open-water season mean annual chlorophyll *a* concentrations ranged from 3.12 to 6.43 µg/L and were within the IQR (3.23 to 5.97 µg/L) in 10 of the 12 years. Mean chlorophyll *a* concentrations were below the IQR in 2017 and above the 2018 (Table 3.4-3 and Figure 3.4-11).

Chlorophyll *a* concentrations in the ice-cover season ranged from <0.60 to 4.78 µg/L, with a mean of 1.15 µg/L and median of <0.60 µg/L for the 12 years of monitoring. The IQR was <0.60 to 0.95 µg/L. Chlorophyll *a* concentrations were typically within or near the IQR but were above the IQR in 2008 and 2018 (Table 3.4-3 and Figure 3.4-11).

Chlorophyll *a* concentrations were lower in the winter (mean = 1.15 µg/L), often below the DL (0.030-1.0 µg/L; percent detection = 50), compared to the open-water season (Table 3.4-1). On average, chlorophyll *a* concentrations during the open-water season were lower in spring (2.78 µg/L) than in summer (5.15 µg/L) and fall (6.00 µg/L; Figure 3.4-5).

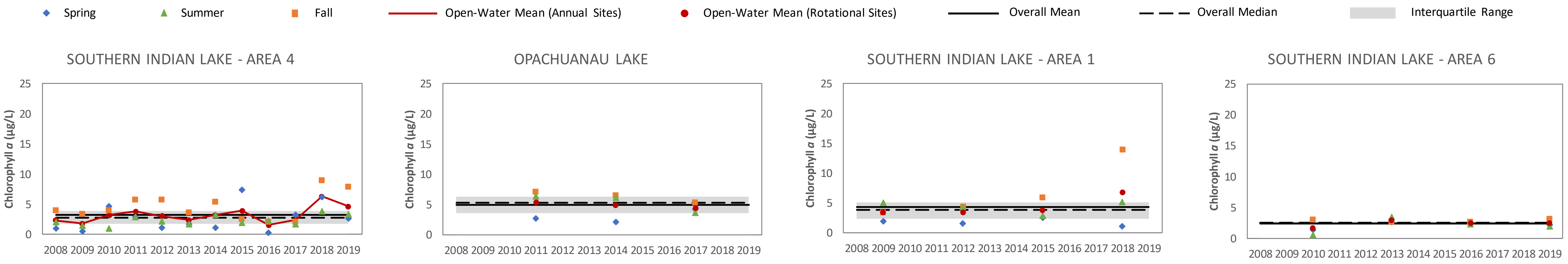
Granville Lake was mesotrophic (<2.5 to 8 µg/L) based on the 2008-2019 mean open-water season chlorophyll *a* concentration (4.64 µg/L). Mean annual chlorophyll *a* concentrations (3.12 to

6.43 µg/L) in the open-water season were also within the mesotrophic range in each year of monitoring (Table 3.4-4).

ROTATIONAL SITES

There are no off-system rotational sites in this region.

OPEN-WATER SEASON



ICE-COVER SEASON

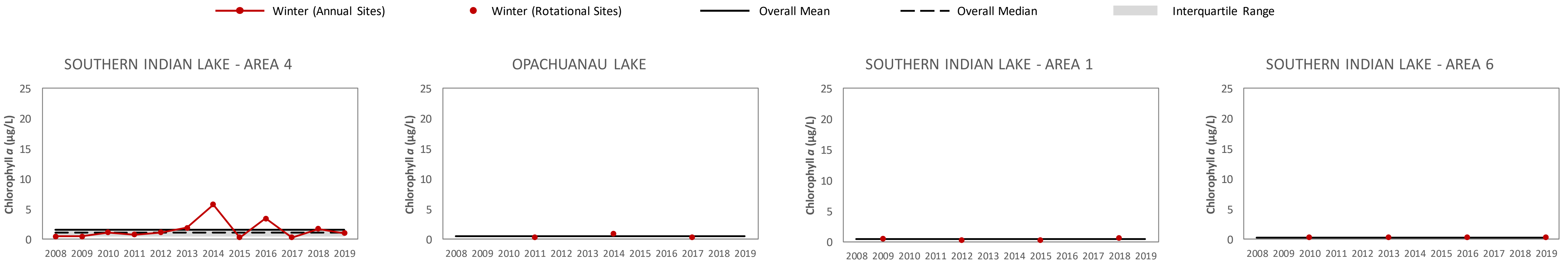


Figure 3.4-9. 2008-2019 Southern Indian and Opachuanau lakes open-water and ice-cover season chlorophyll *a* concentrations.

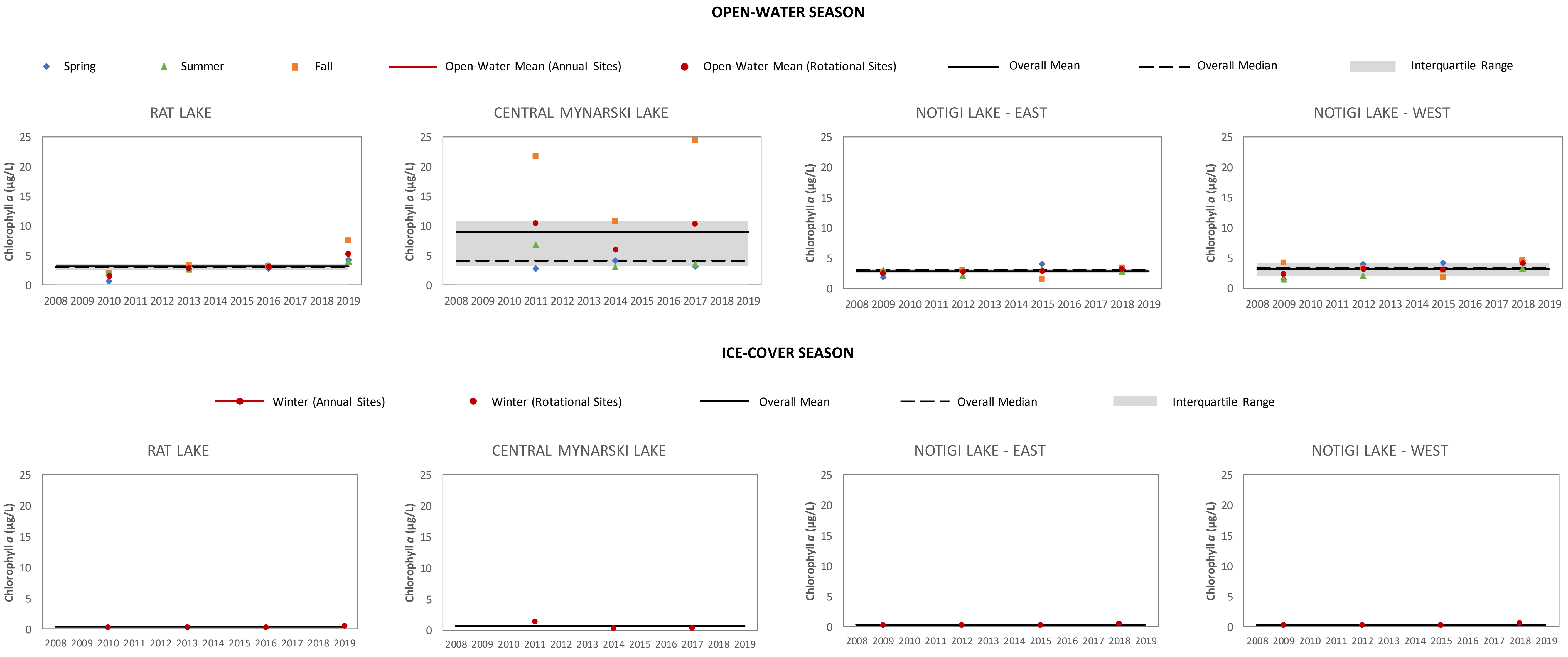
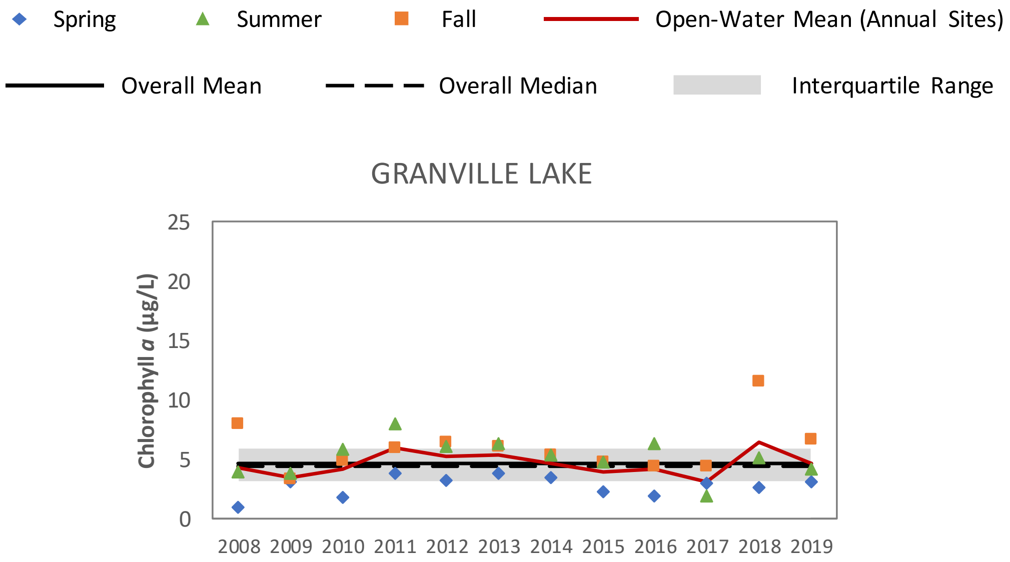


Figure 3.4-10. 2008-2019 Rat, Central Mynarski, and Notigi lakes open-water and ice-cover season chlorophyll *a* concentrations.

OPEN-WATER SEASON



ICE-COVER SEASON

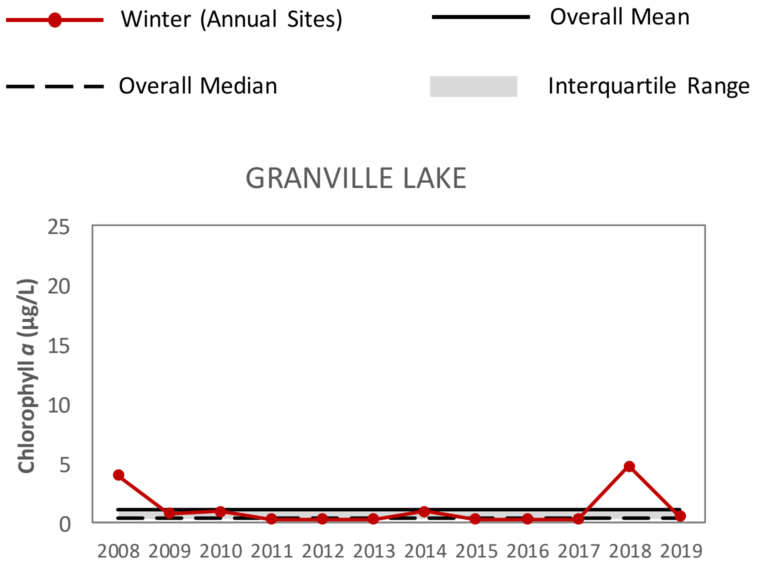


Figure 3.4-11. 2008-2019 Off-system open-water and ice-cover season chlorophyll *a* concentrations.

APPENDIX 3-1. WATER QUALITY SAMPLING SITES: 2008-2019

Figure A3-1-1. Spring water quality sampling locations: Southern Indian Lake – Area 4.

Figure A3-1-2. Summer water quality sampling locations: Southern Indian Lake – Area 4.

Figure A3-1-3. Fall water quality sampling locations: Southern Indian Lake – Area 4.

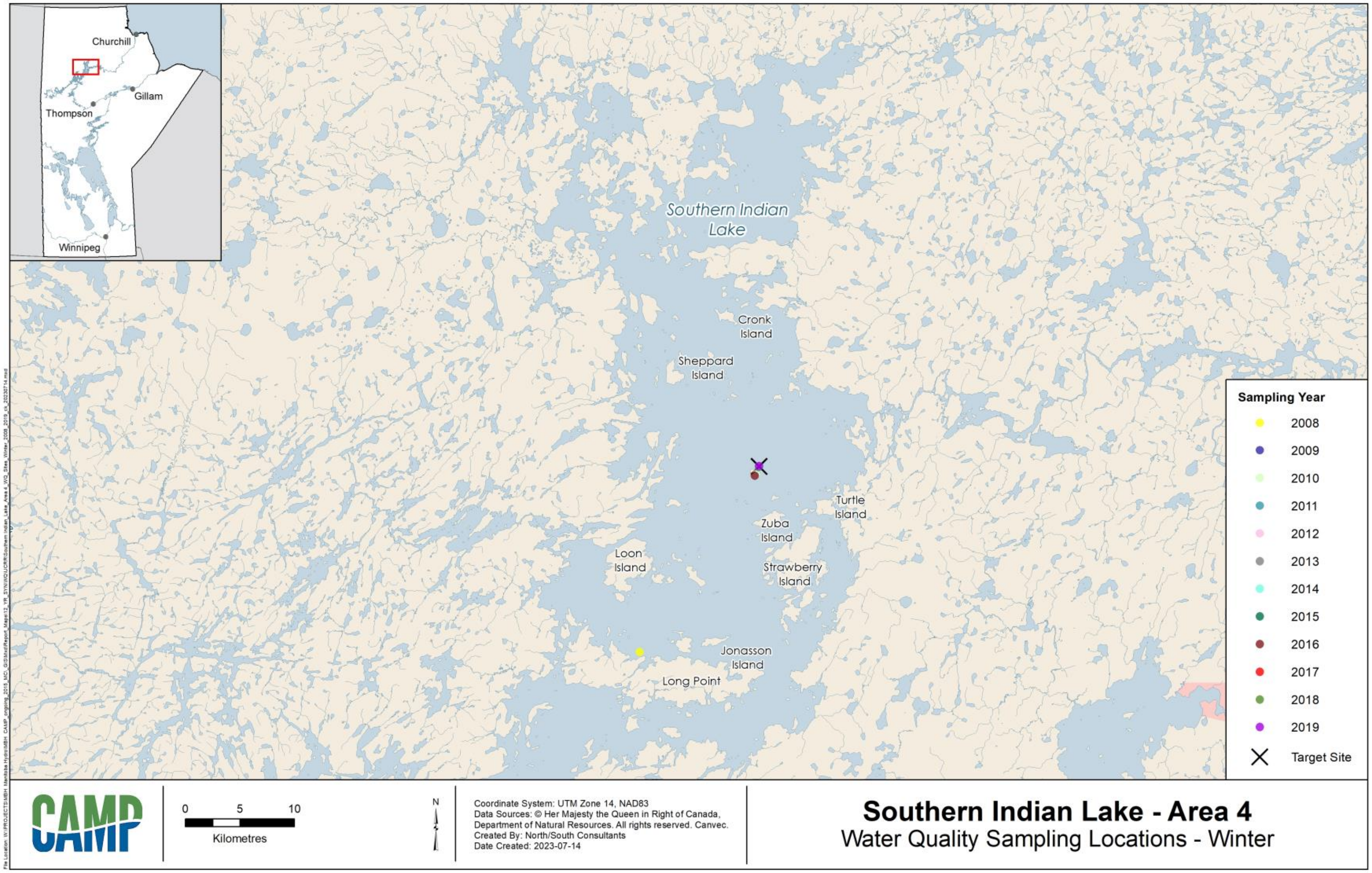


Figure A3-1-4. Winter water quality sampling locations: Southern Indian Lake – Area 4.

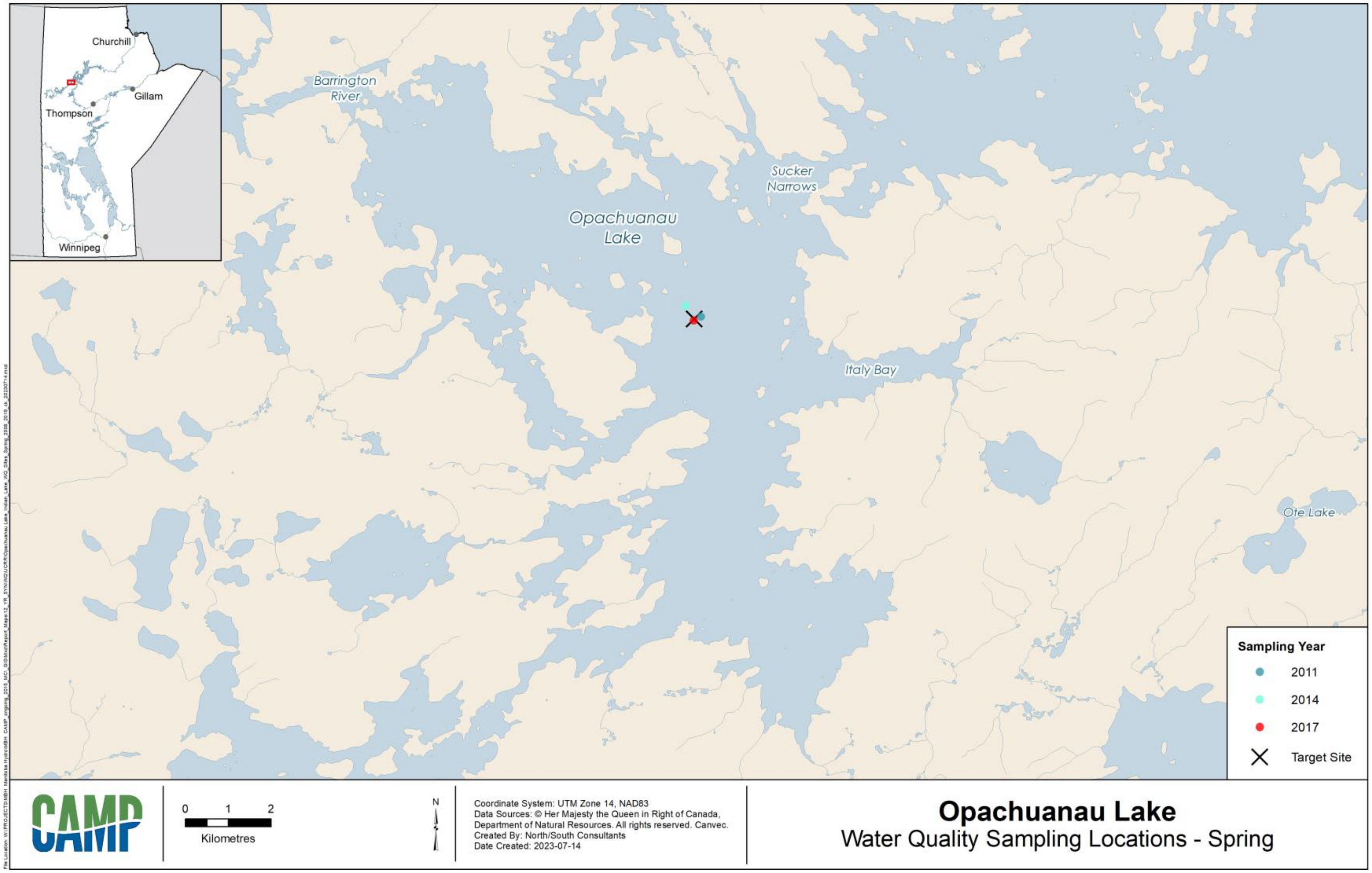


Figure A3-1-5. Spring water quality sampling locations: Opachuanau Lake.

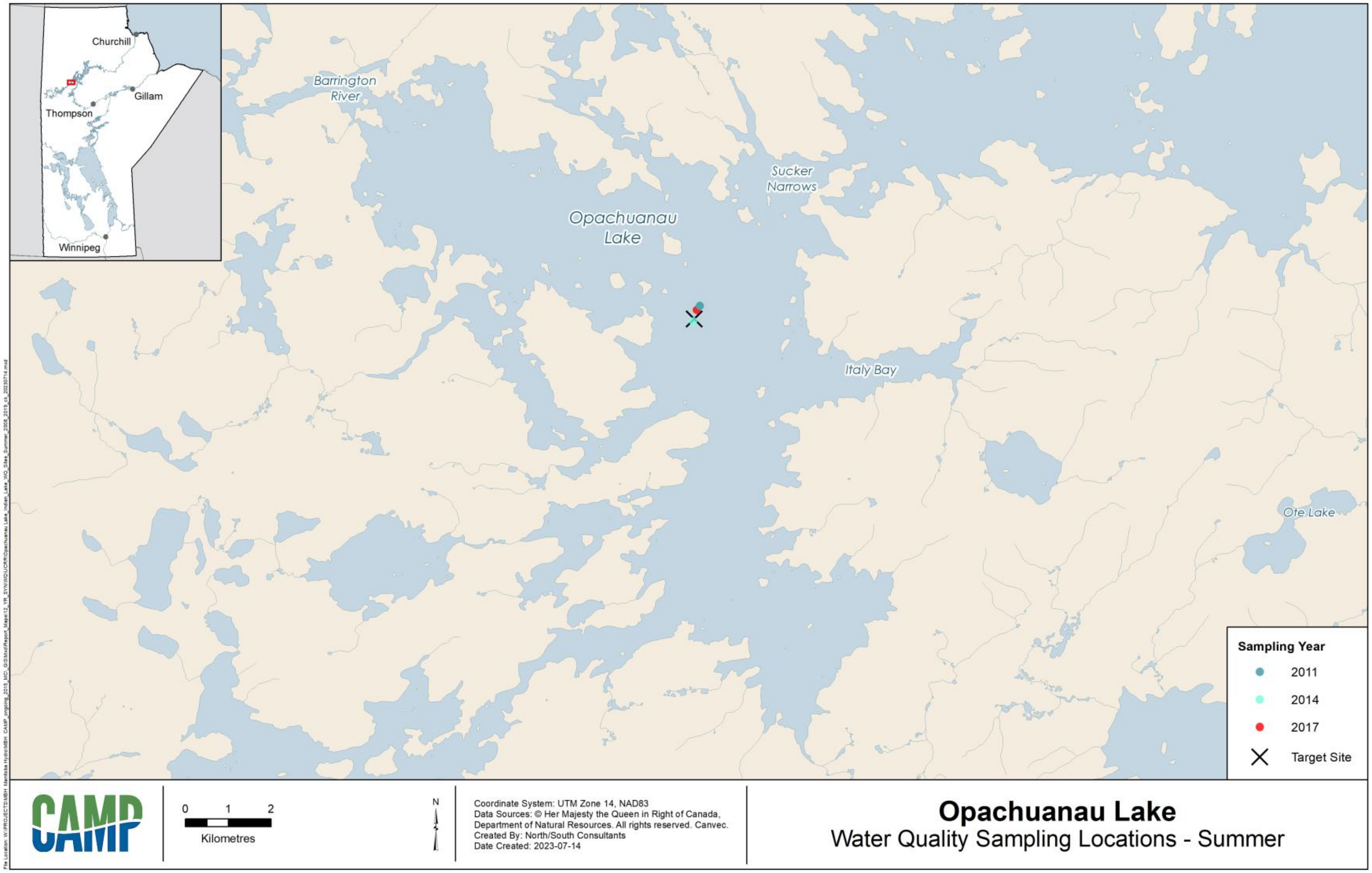


Figure A3-1-6. Summer water quality sampling locations: Opachuanau Lake.

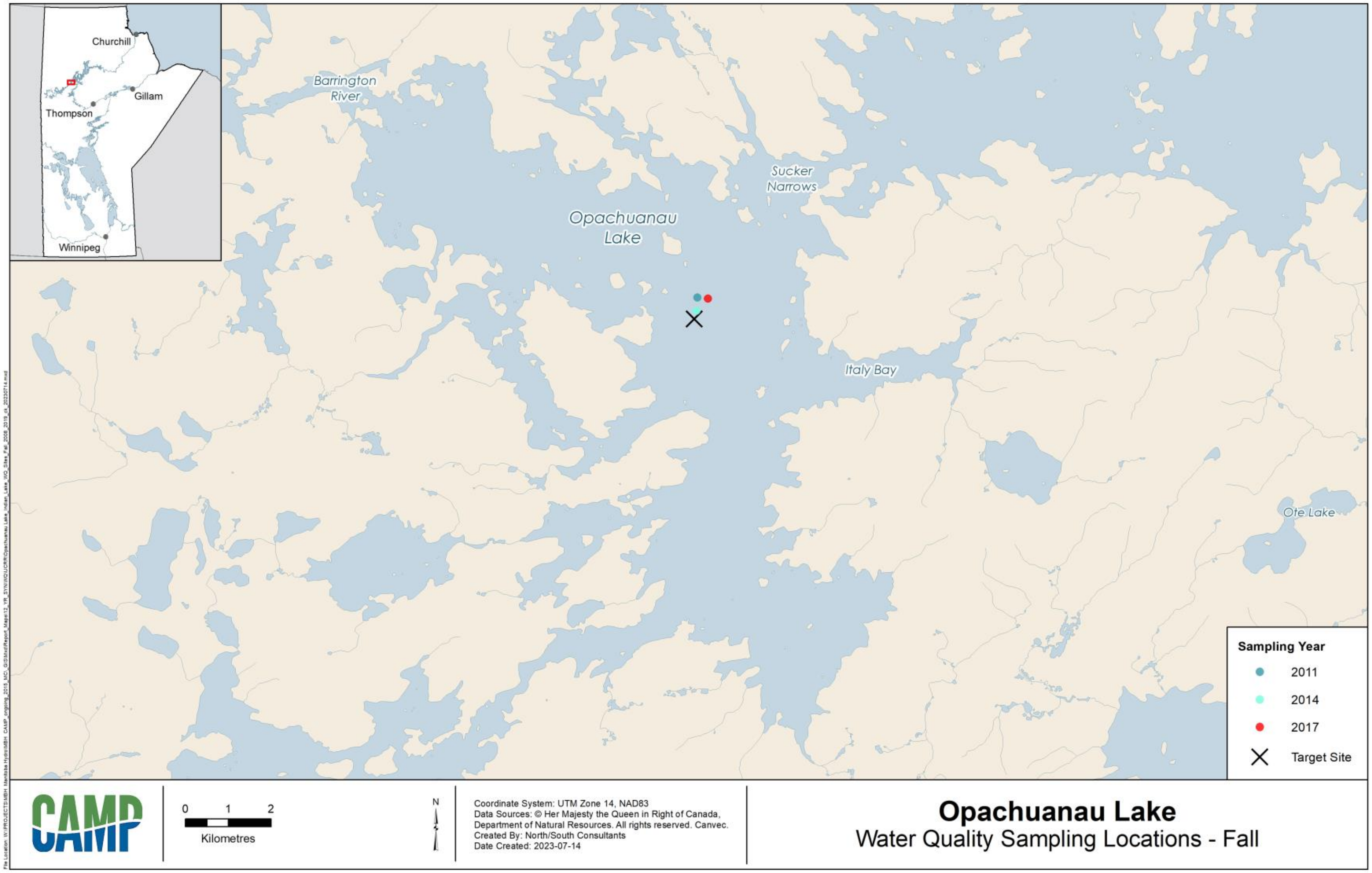


Figure A3-1-7. Fall water quality sampling locations: Opachuanau Lake.

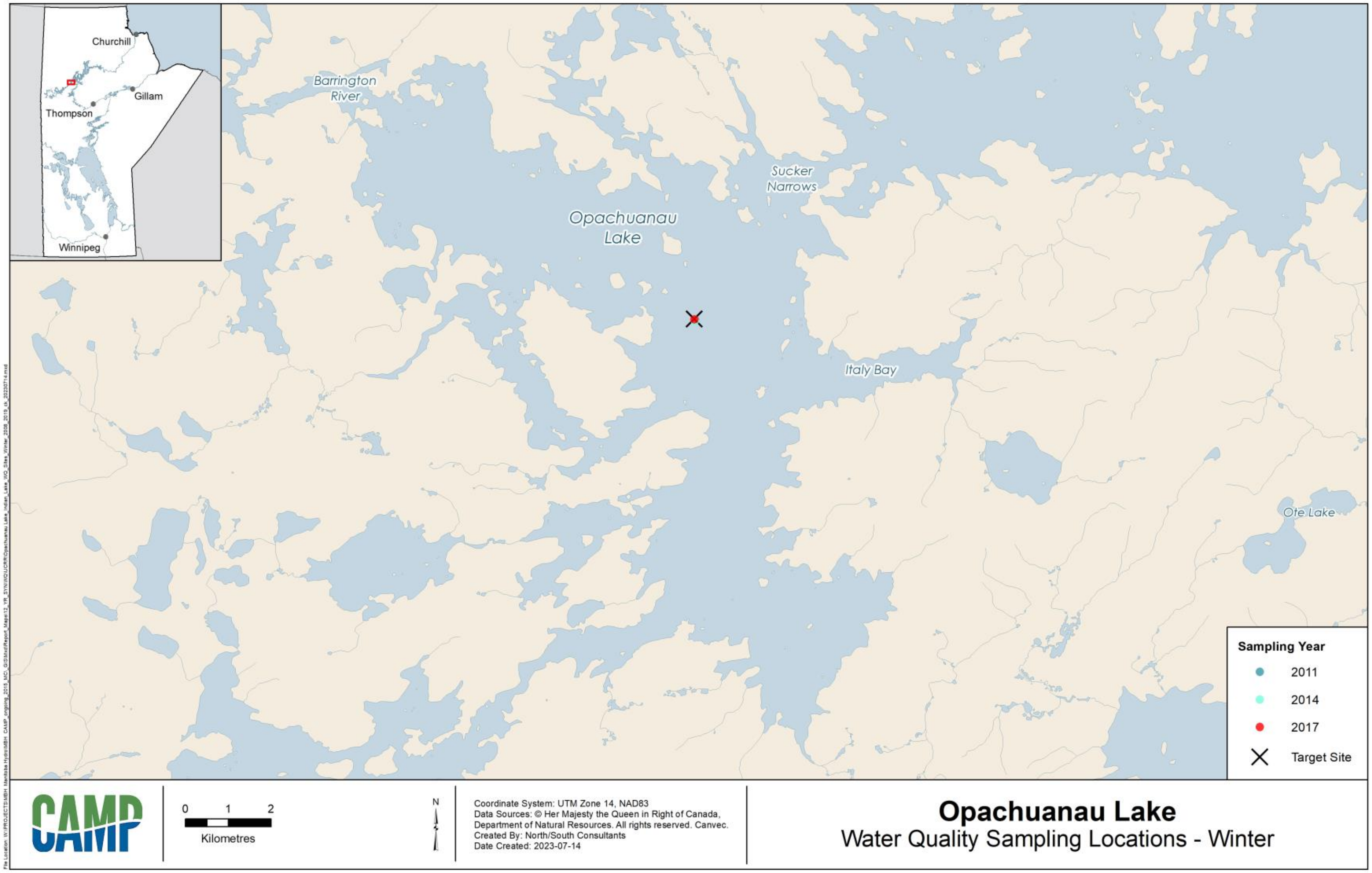


Figure A3-1-8. Winter water quality sampling locations: Opachuanau Lake.

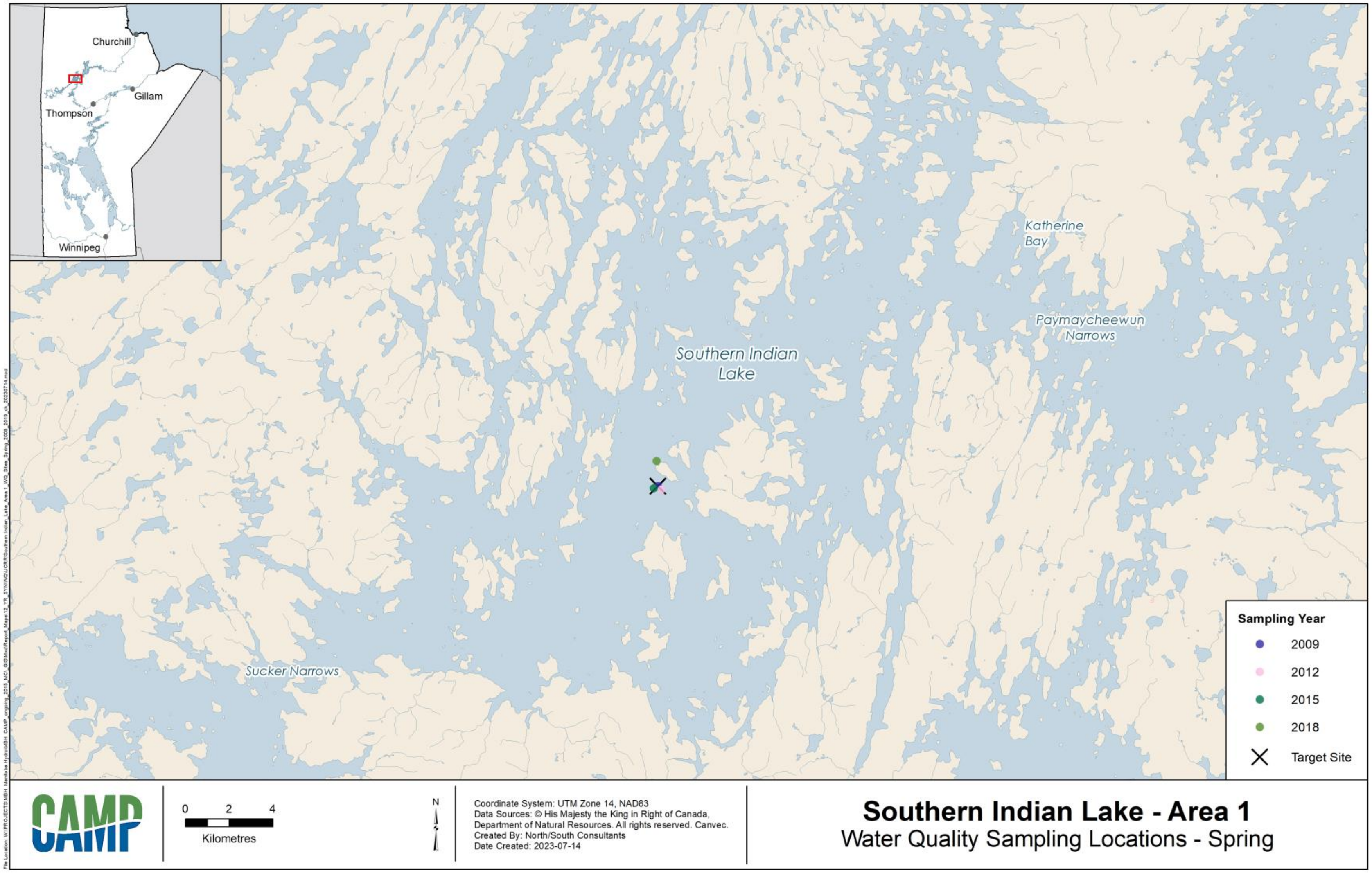


Figure A3-1-9. Spring water quality sampling locations: Southern Indian Lake – Area 1.

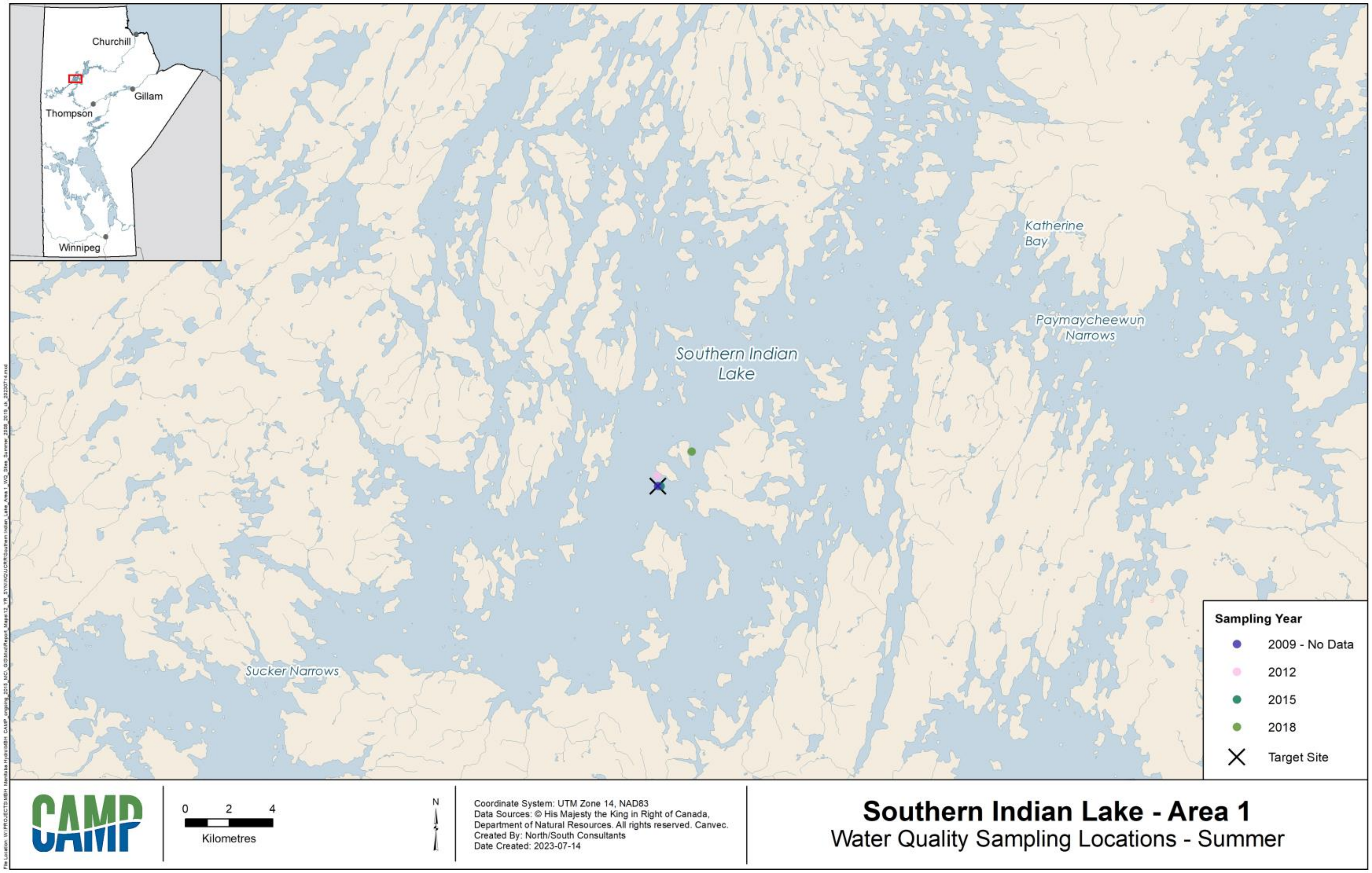


Figure A3-1-10. Summer water quality sampling locations: Southern Indian Lake – Area 1.

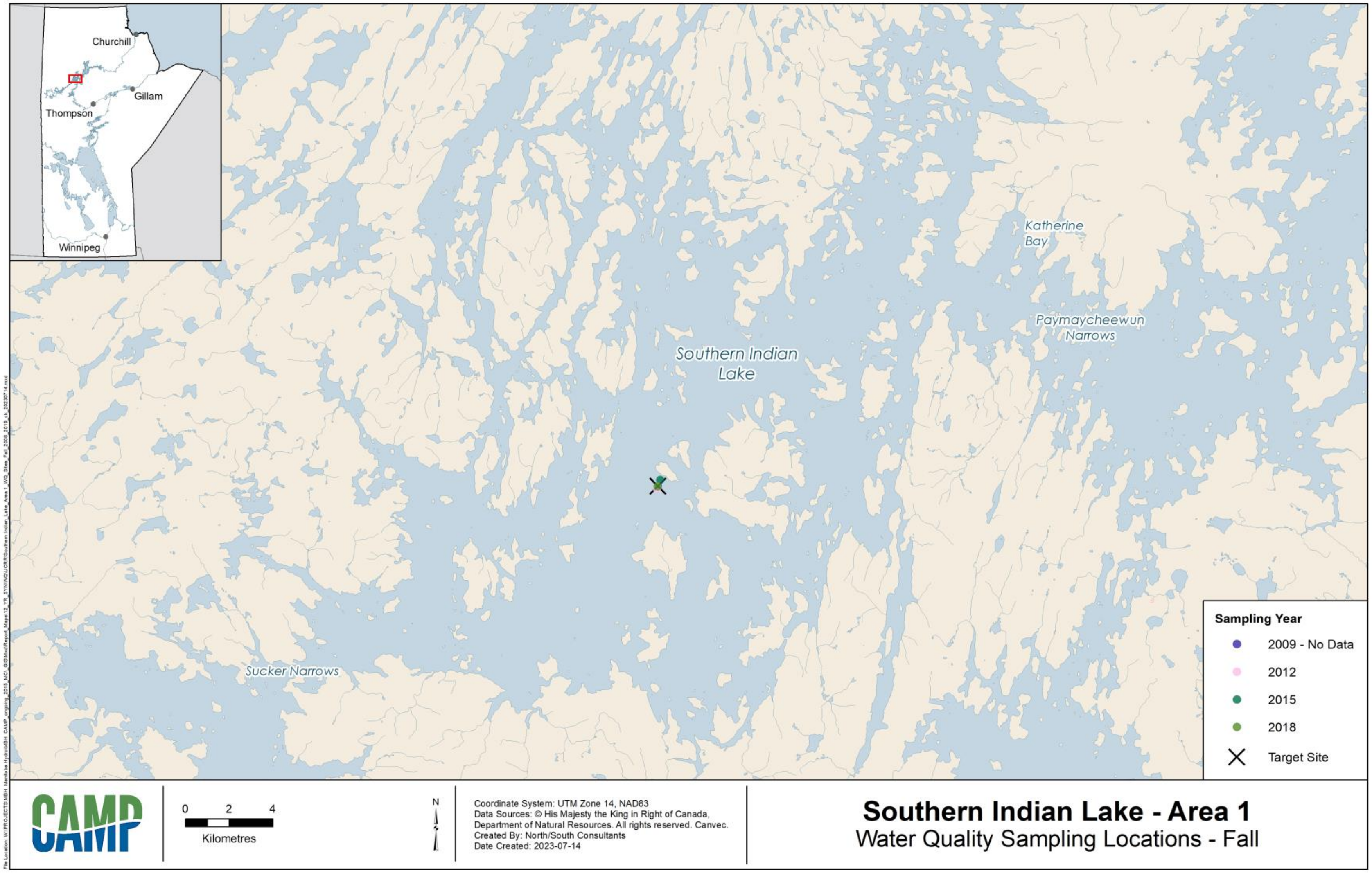


Figure A3-1-11. Fall water quality sampling locations: Southern Indian Lake – Area 1.

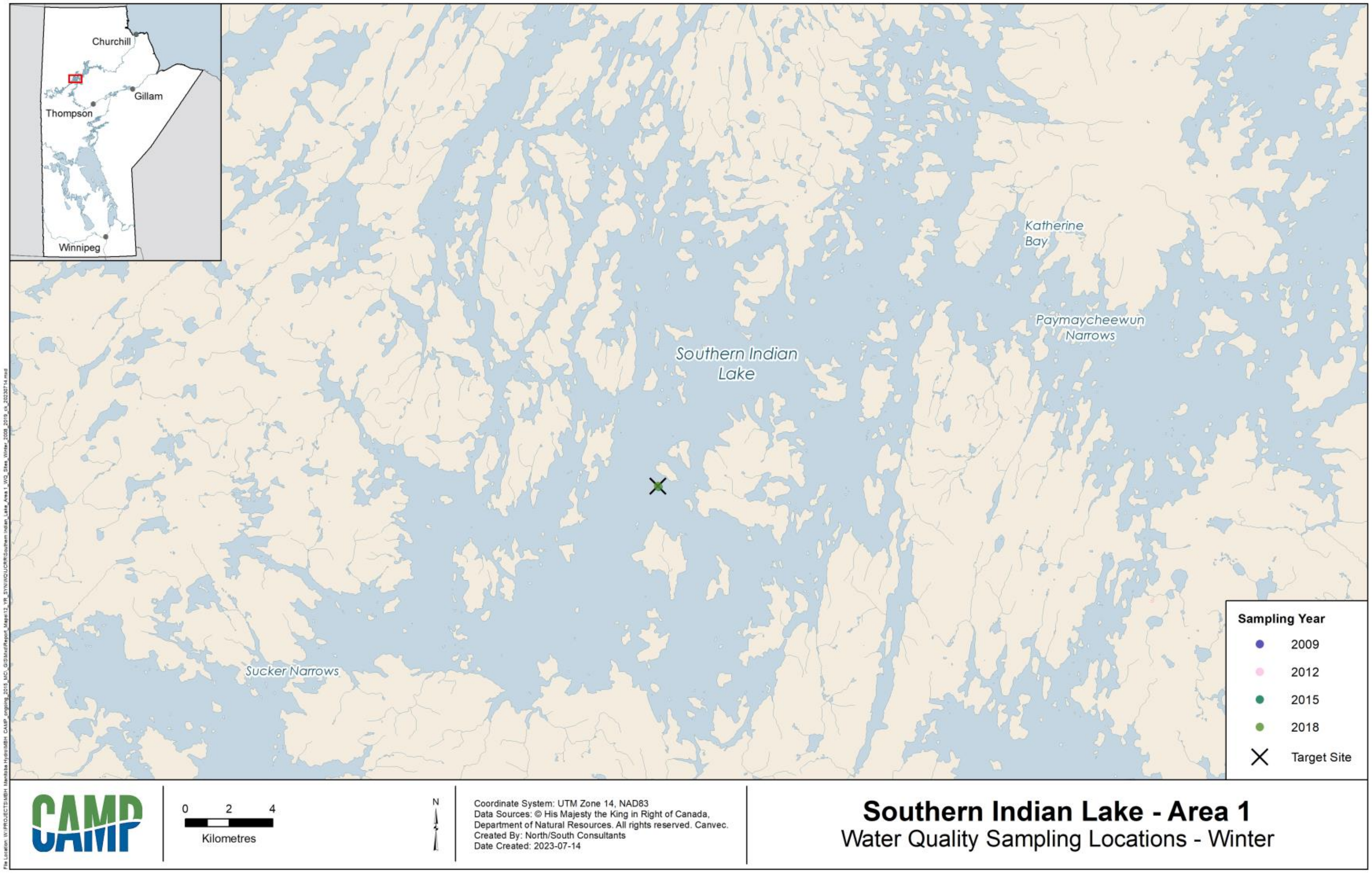


Figure A3-1-12. Winter water quality sampling locations: Southern Indian Lake – Area 1.

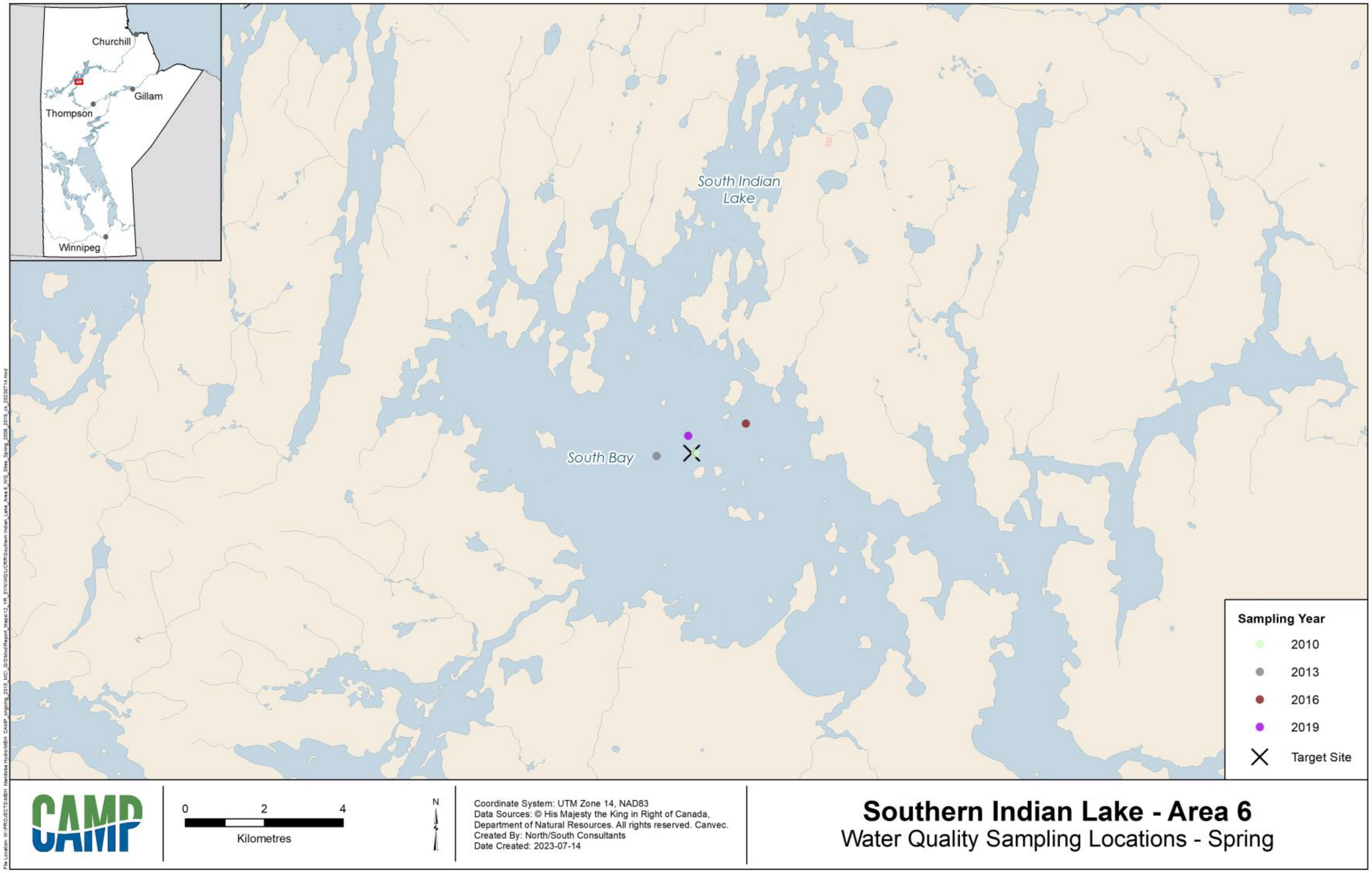


Figure A3-1-13. Spring water quality sampling locations: Southern Indian Lake – Area 6.

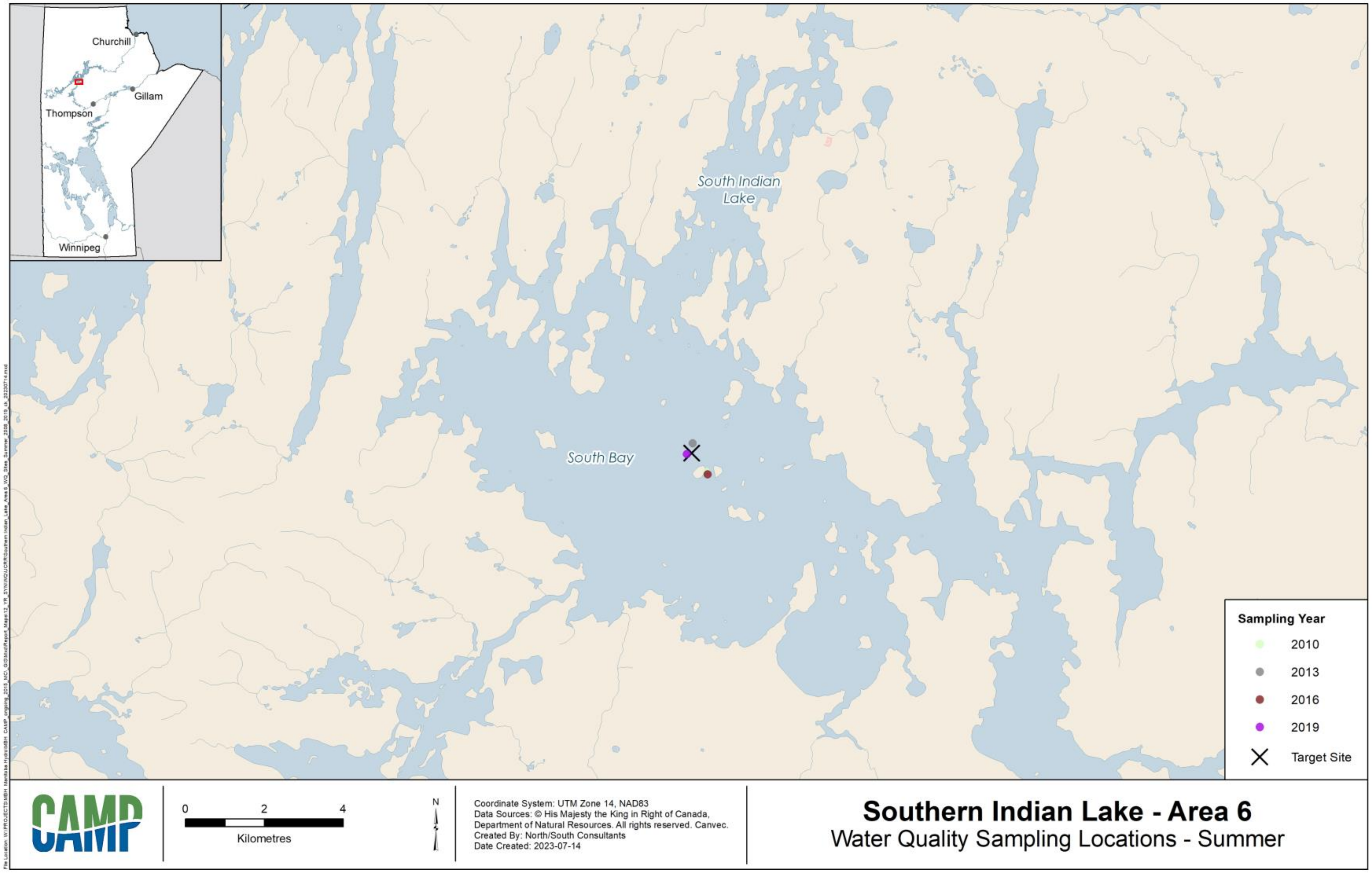


Figure A3-1-14. Summer water quality sampling locations: Southern Indian Lake – Area 6.

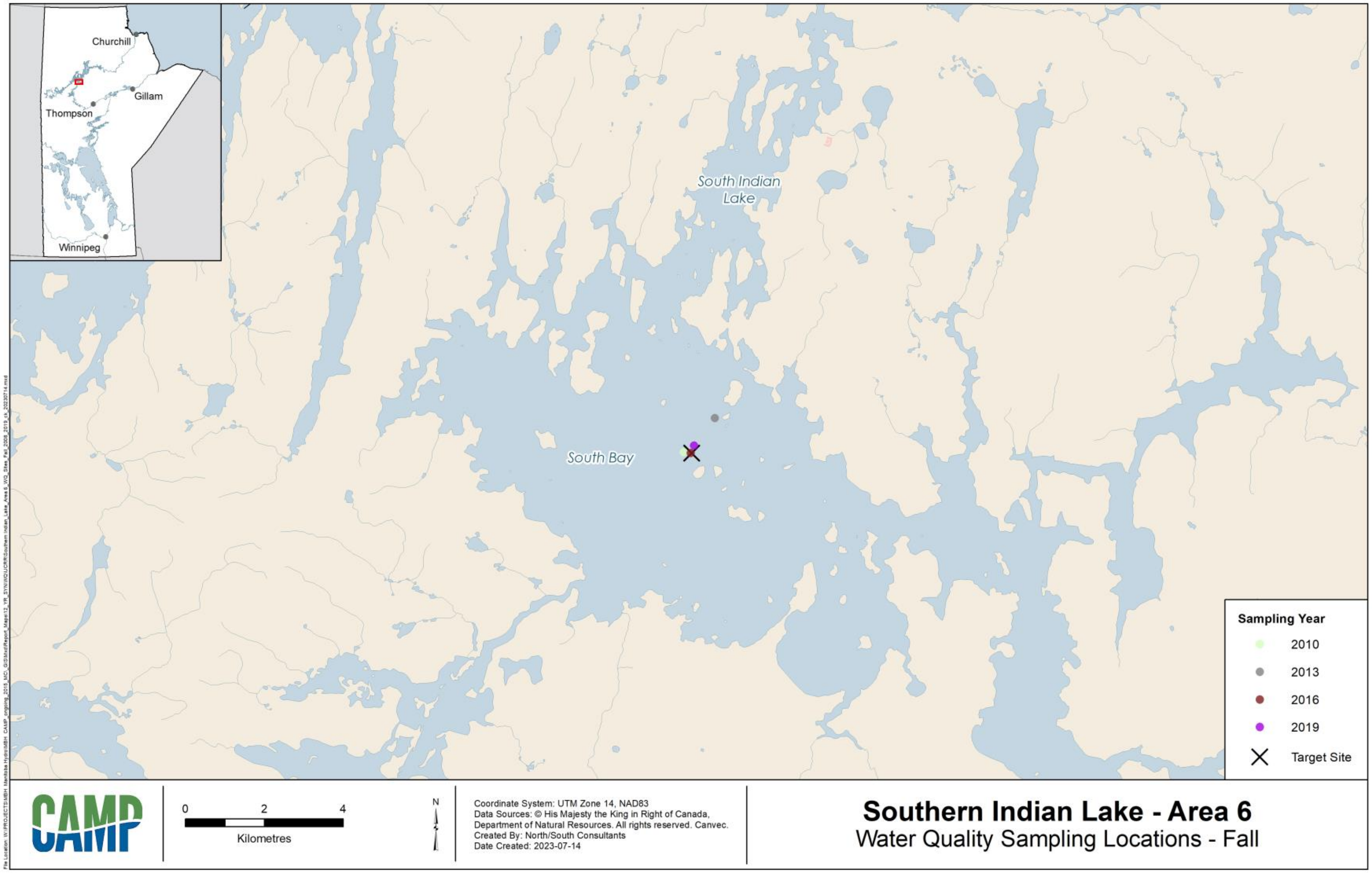


Figure A3-1-15. Fall water quality sampling locations: Southern Indian Lake – Area 6.

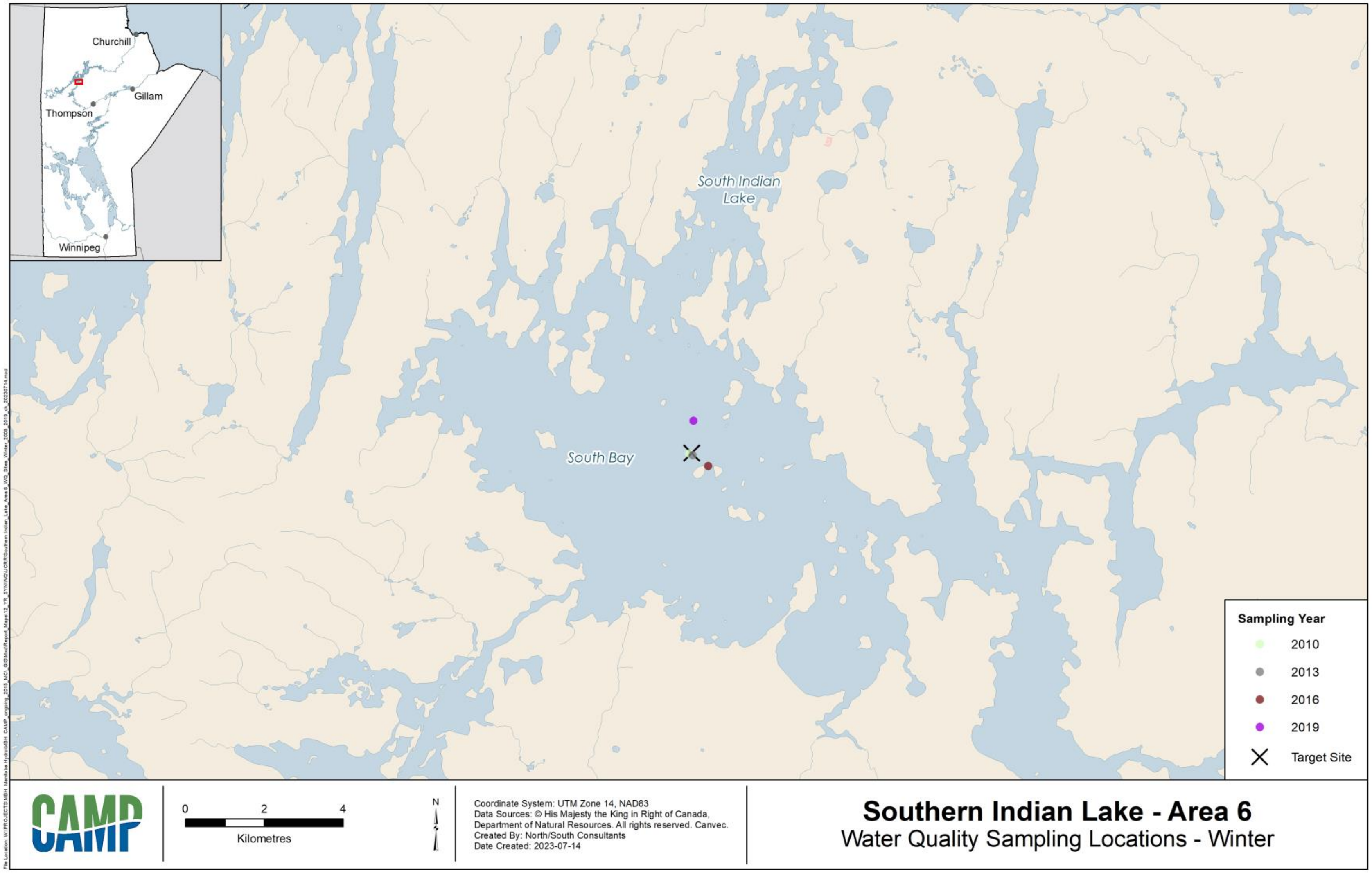


Figure A3-1-16. Winter water quality sampling locations: Southern Indian Lake – Area 6.

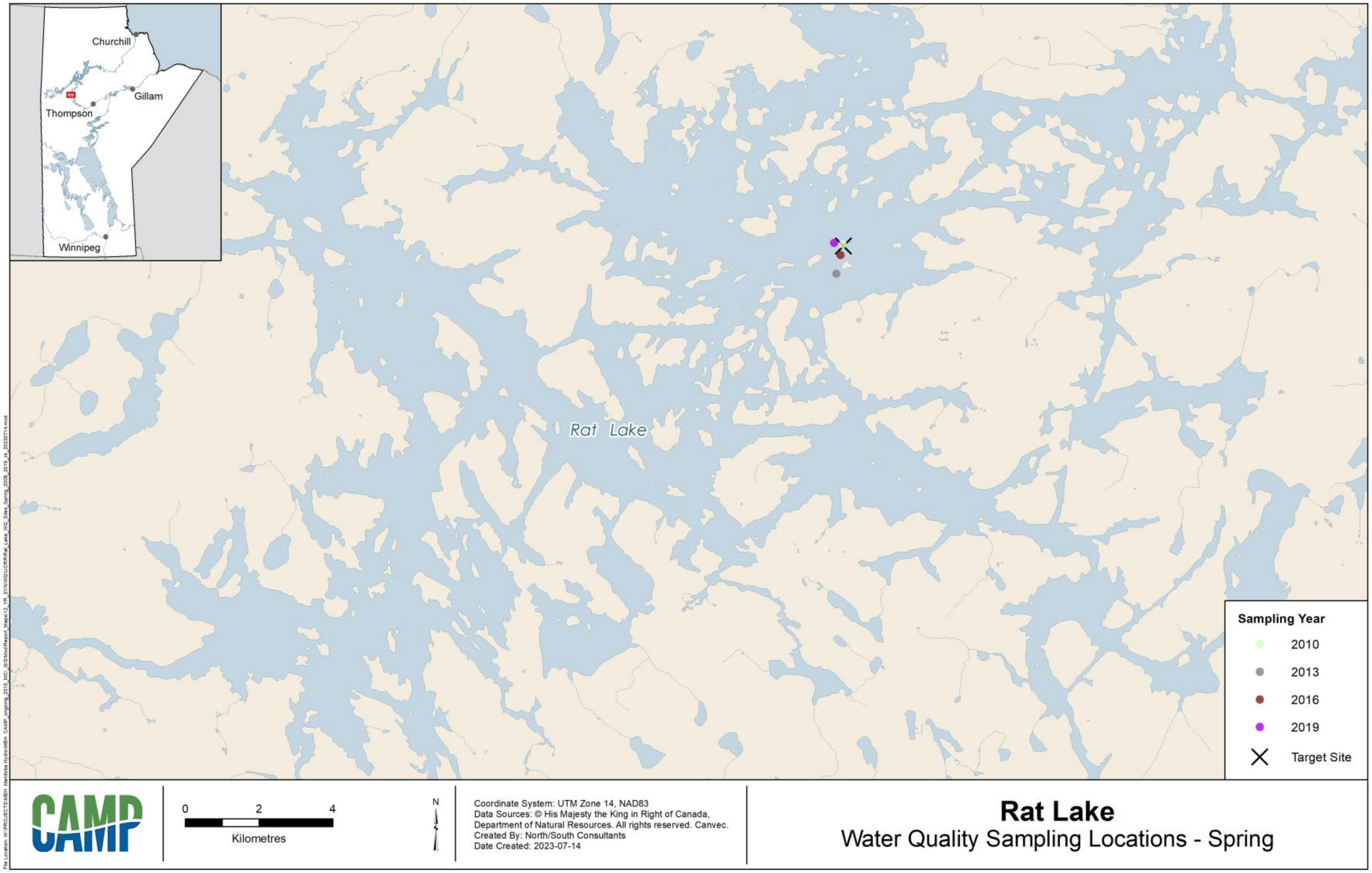


Figure A3-1-17. Spring water quality sampling locations: Rat Lake.

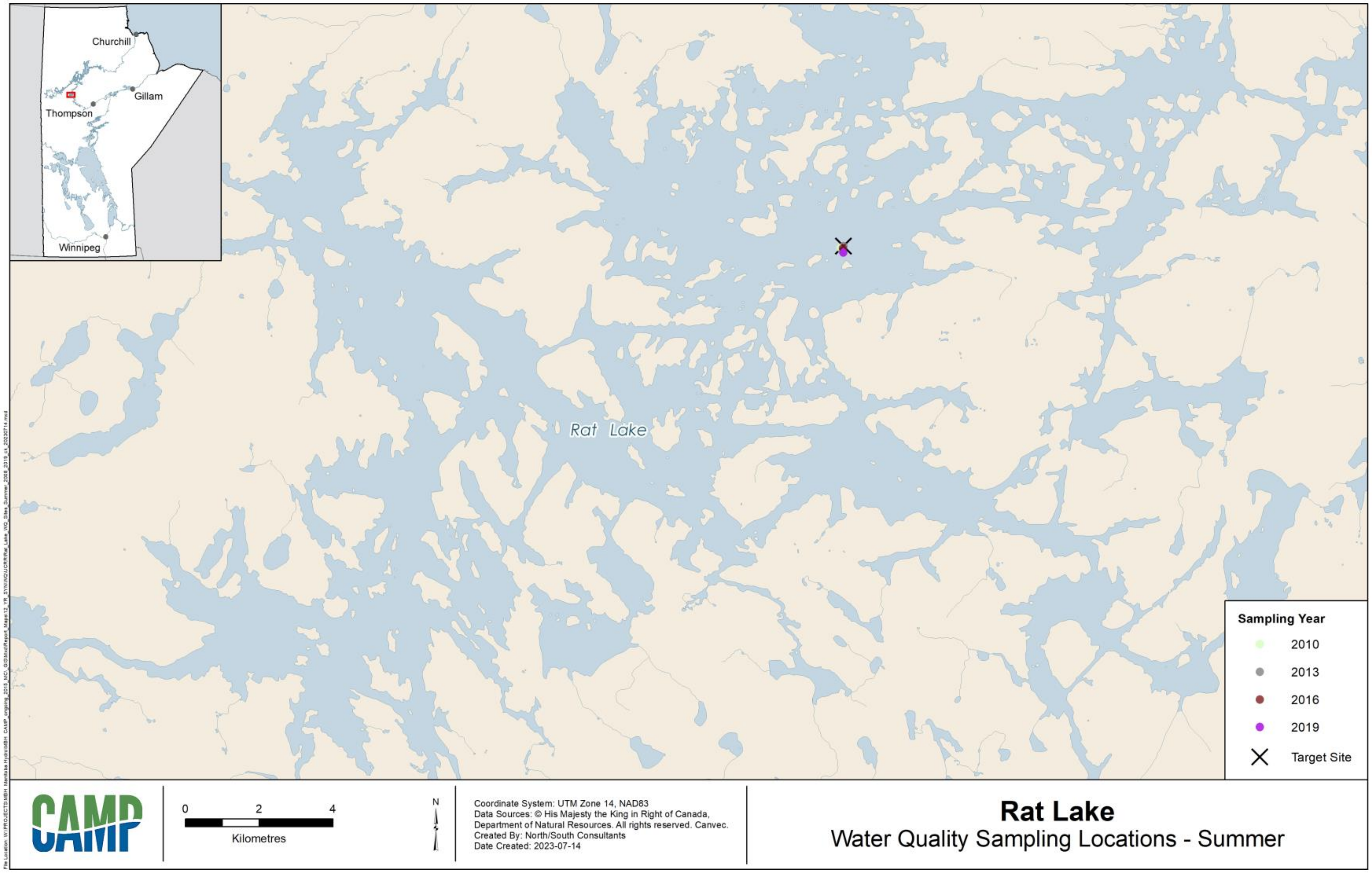


Figure A3-1-18. Summer water quality sampling locations: Rat Lake.

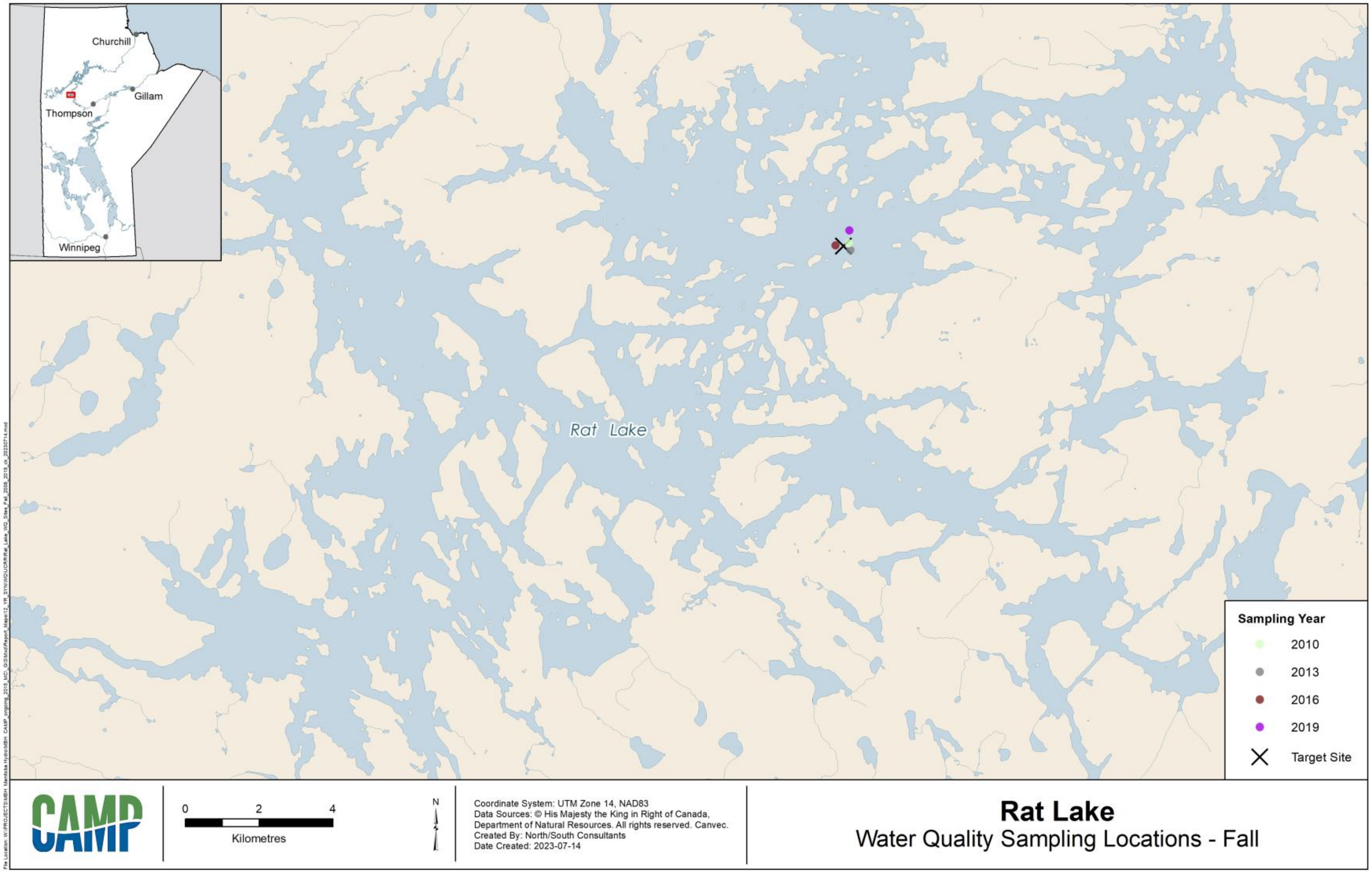


Figure A3-1-19. Fall water quality sampling locations: Rat Lake.

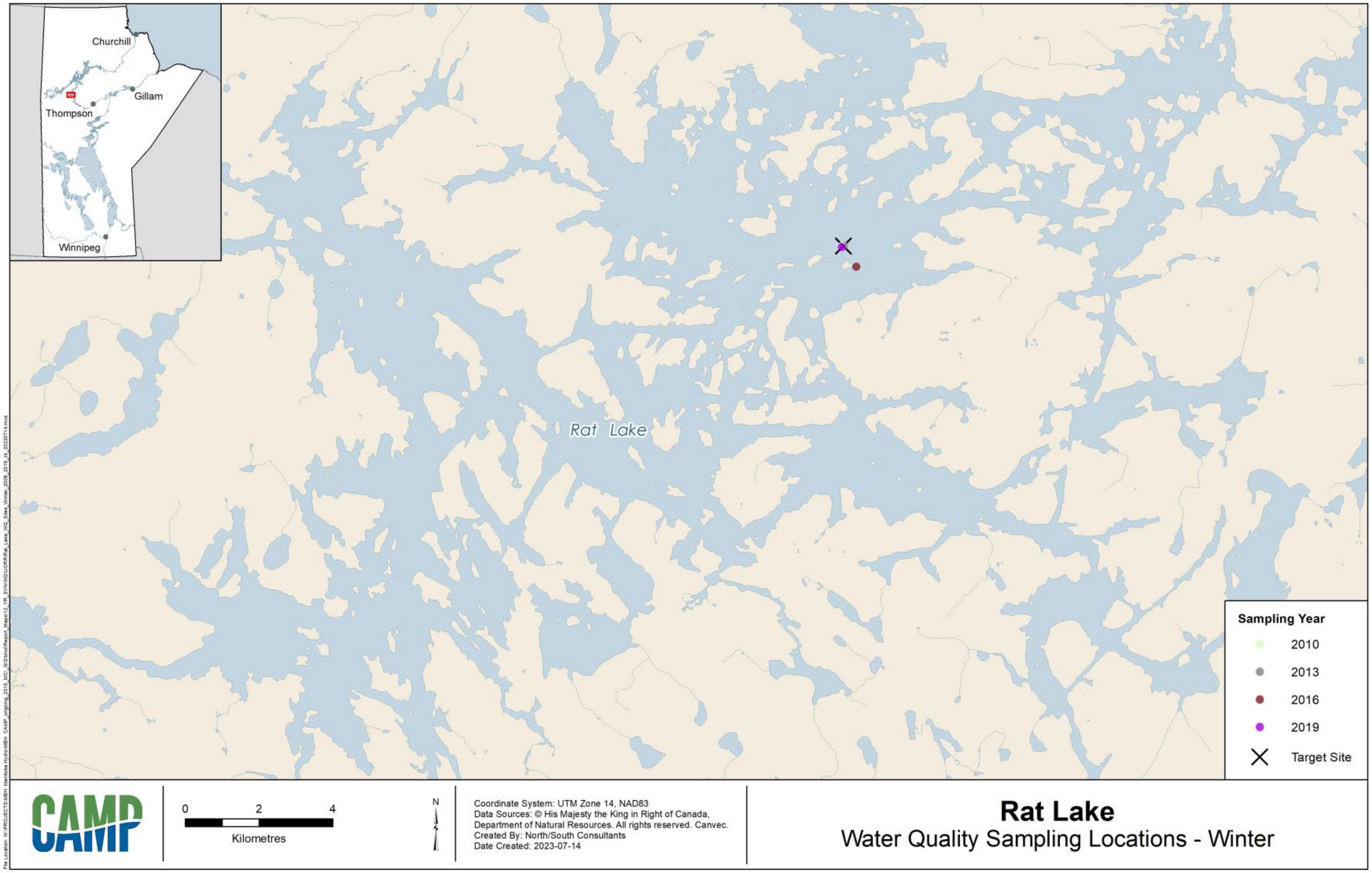


Figure A3-1-20. Winter water quality sampling locations: Rat Lake.

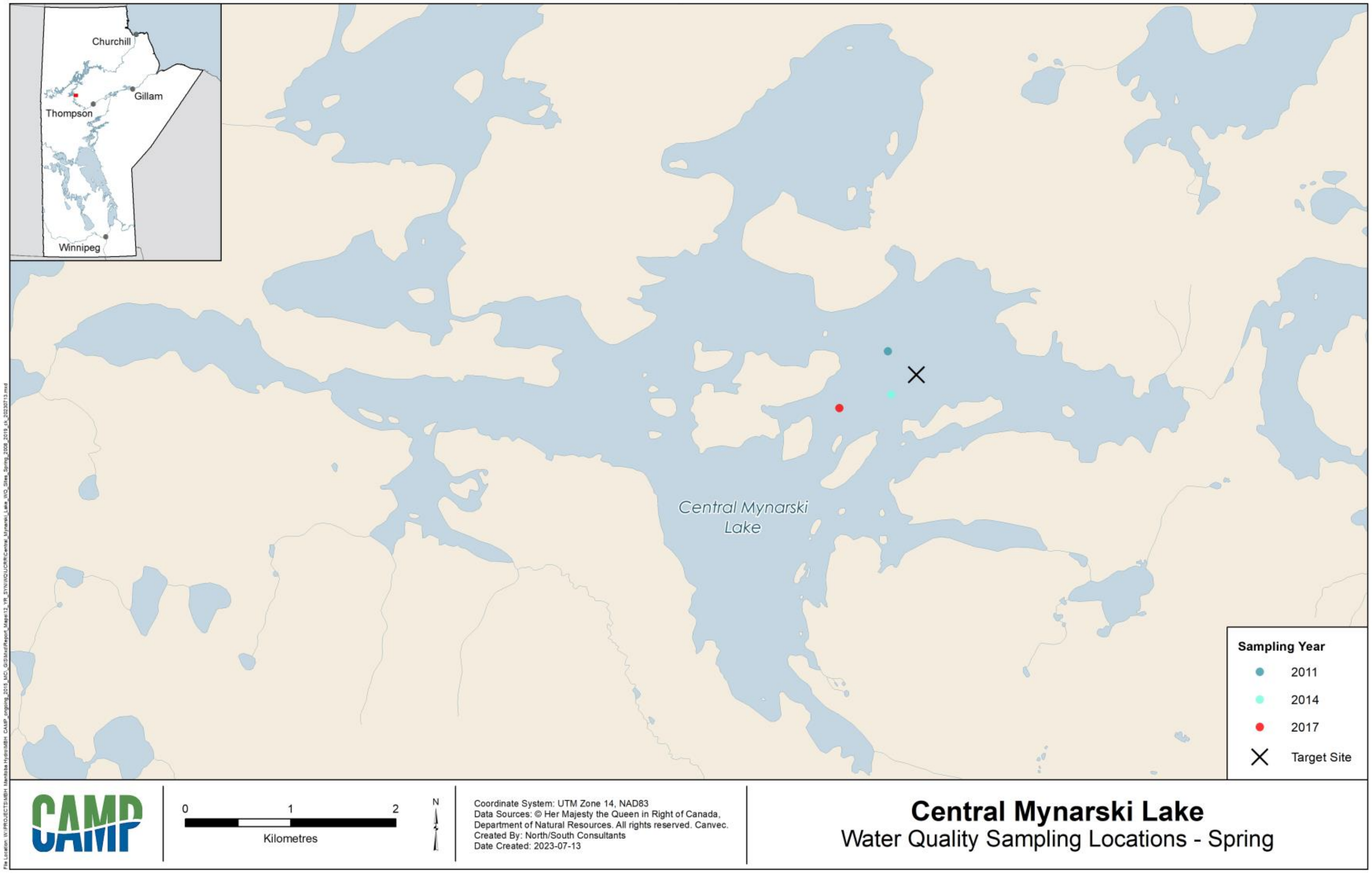


Figure A3-1-21. Spring water quality sampling locations: Central Mynarski Lake.

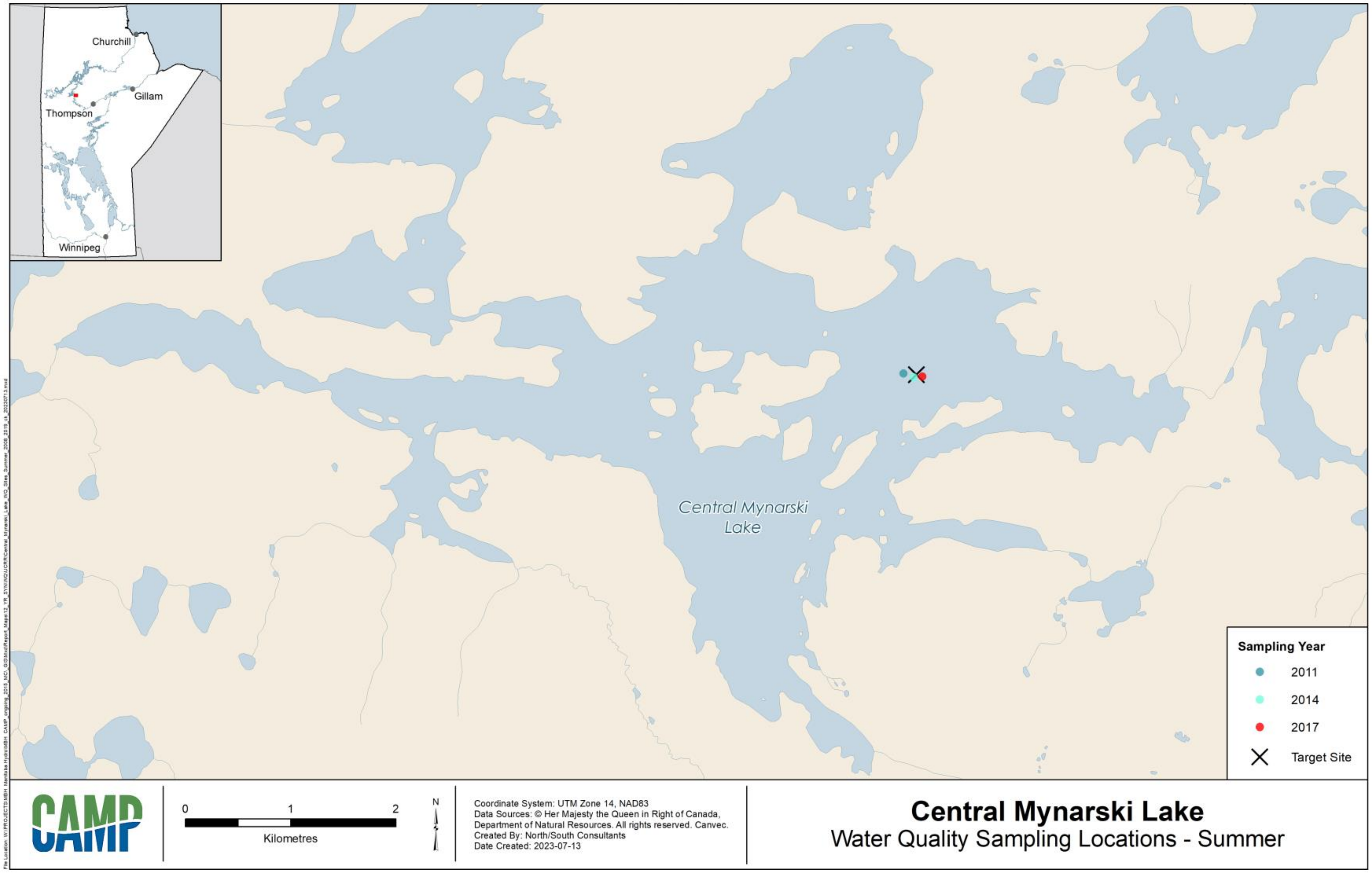


Figure A3-1-22. Summer water quality sampling locations: Central Mynarski Lake.

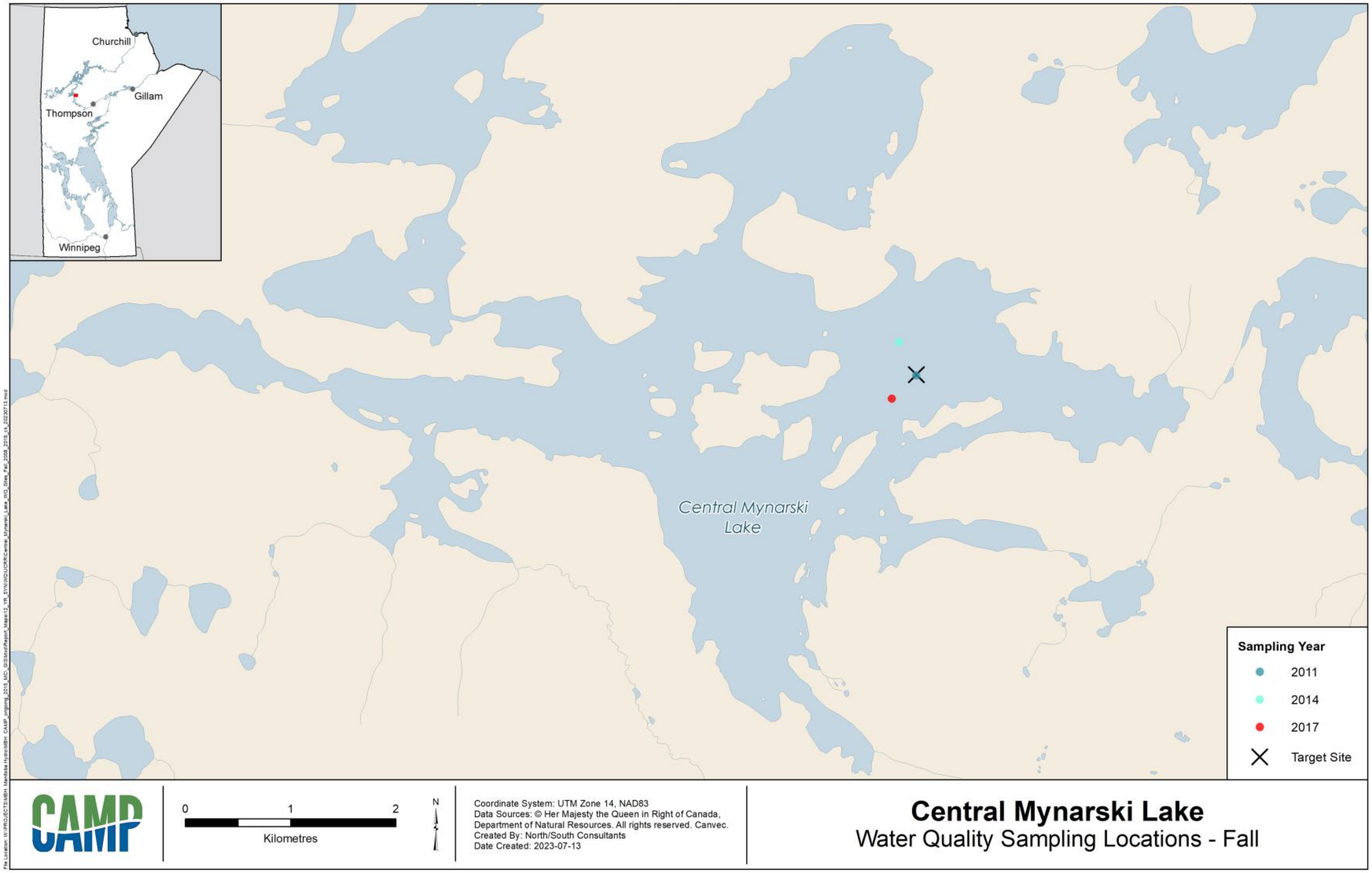


Figure A3-1-23. Fall water quality sampling locations: Central Mynarski Lake.

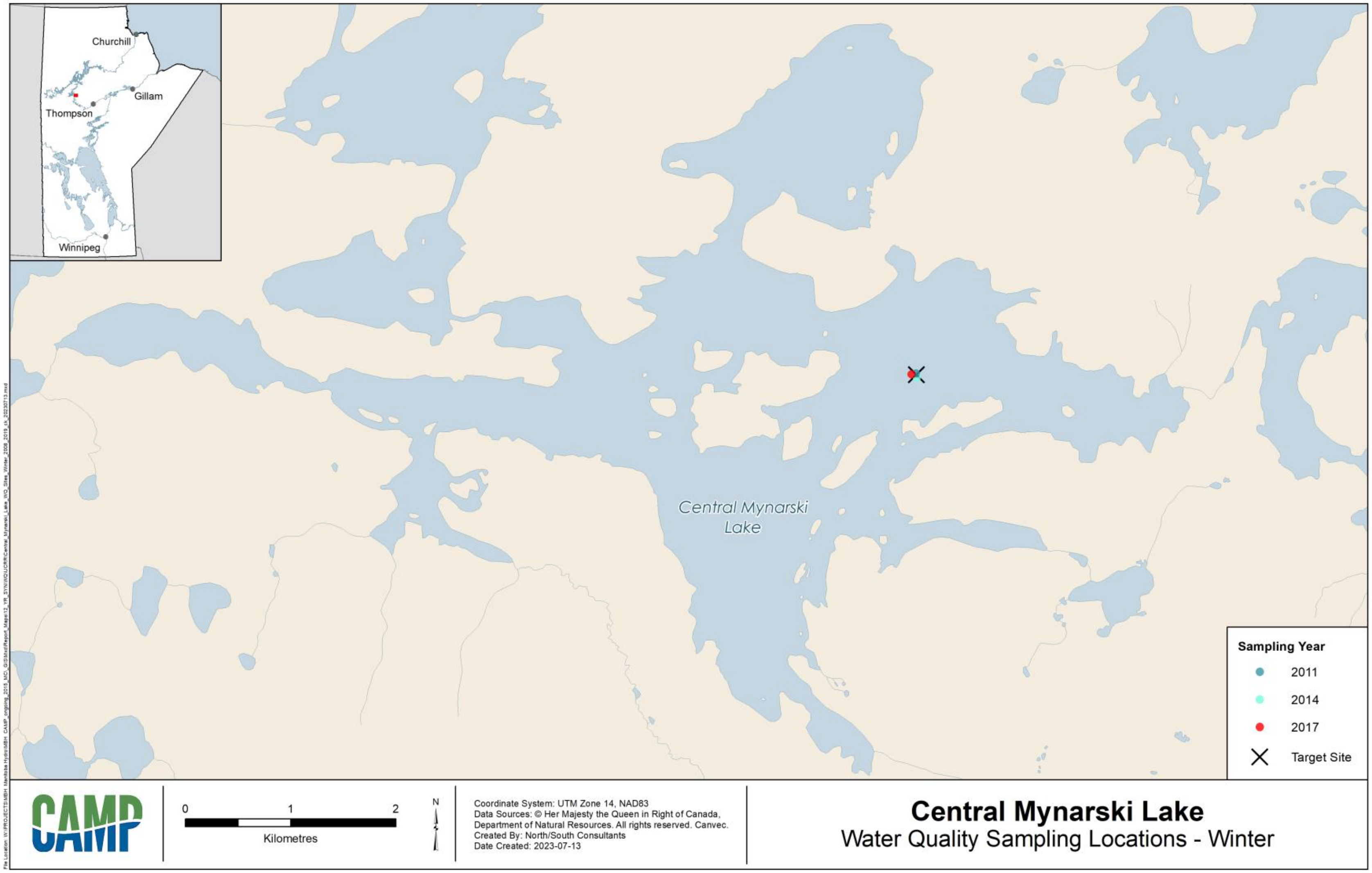


Figure A3-1-24. Winter water quality sampling locations: Central Mynarski Lake.

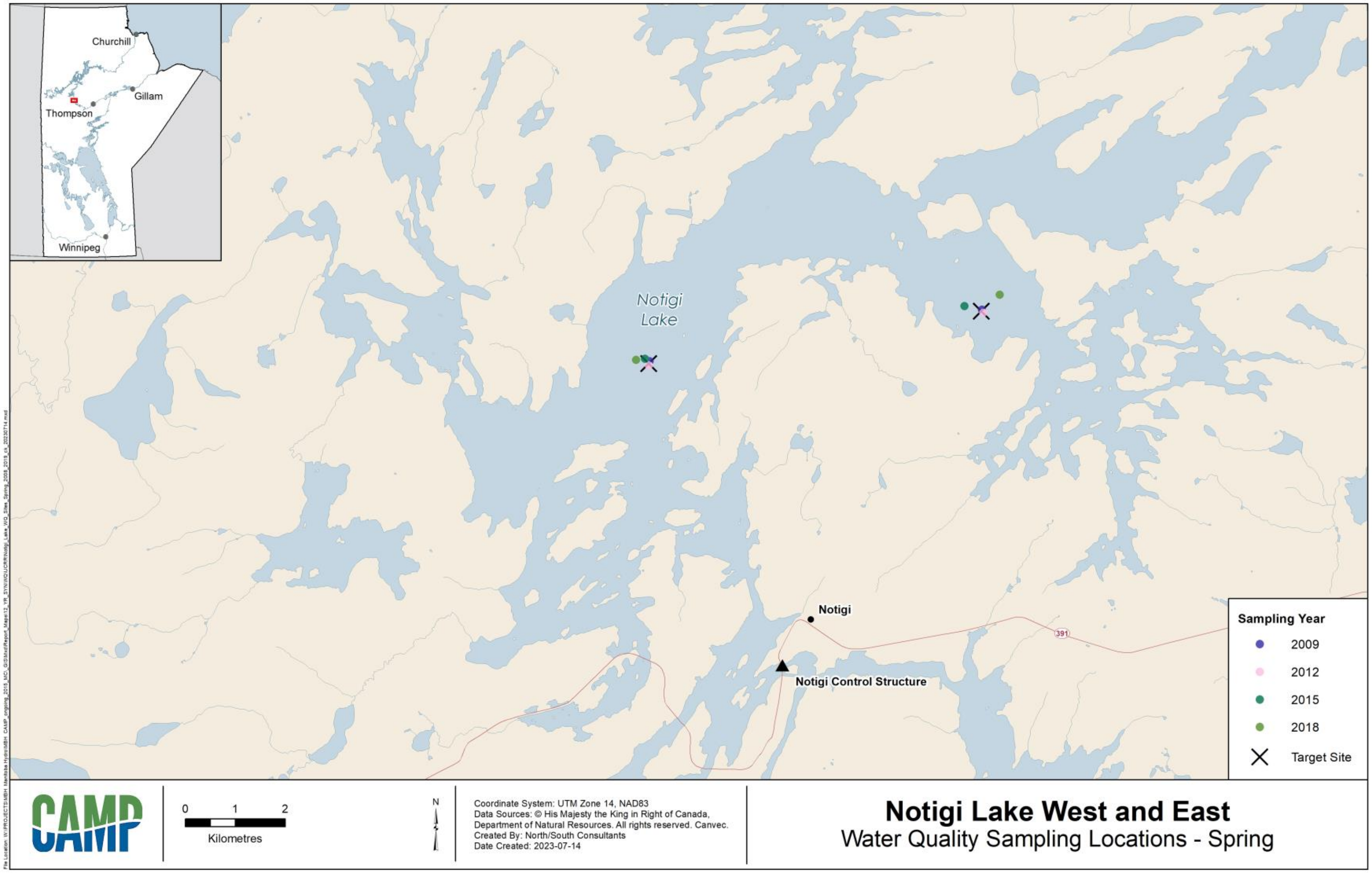
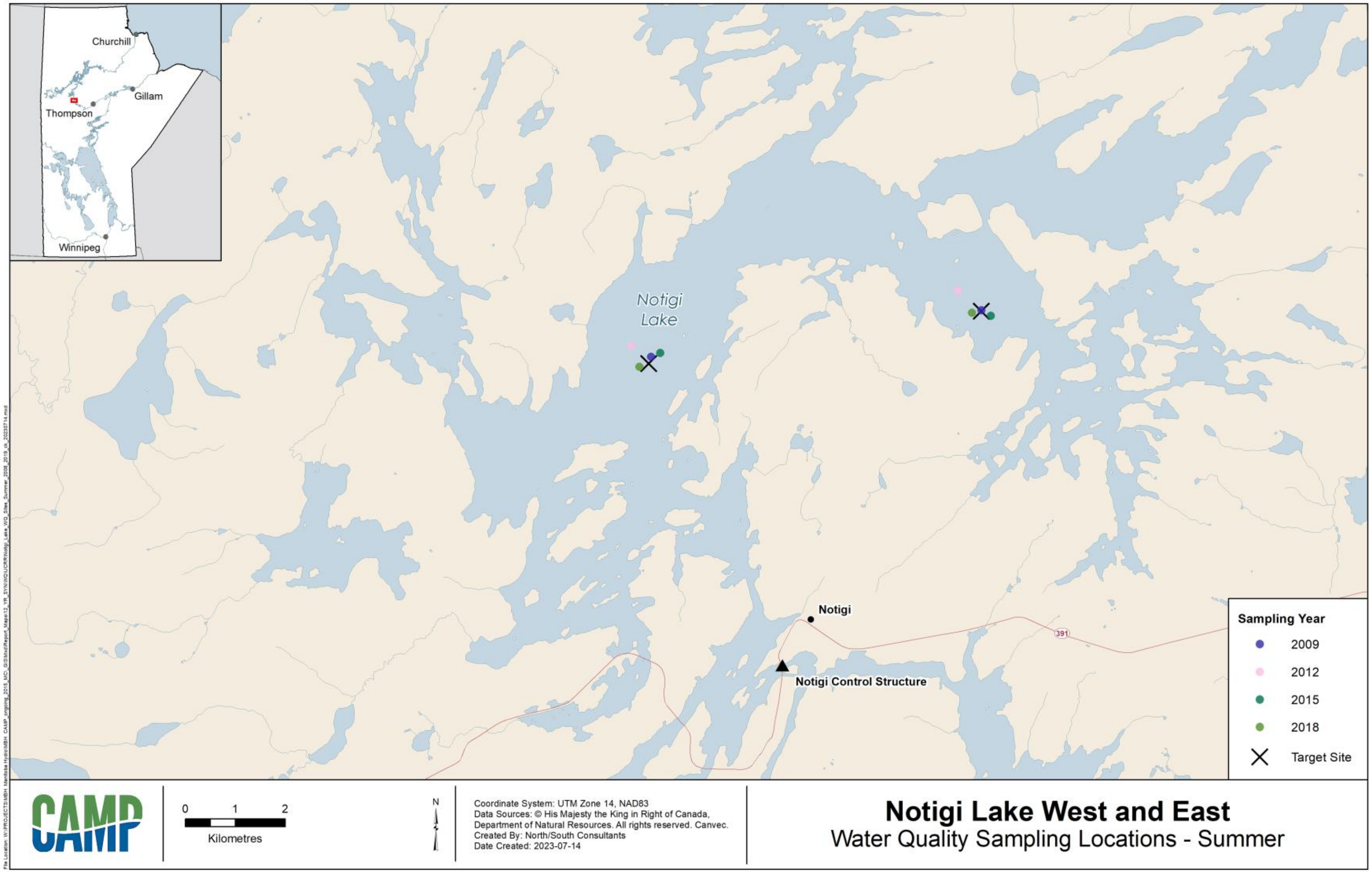


Figure A3-1-25. Spring water quality sampling locations: Notigi Lake.



Coordinate System: UTM Zone 14, NAD83
Data Sources: © His Majesty the King in Right of Canada, Department of Natural Resources. All rights reserved. Canvec.
Created By: North/South Consultants
Date Created: 2023-07-14

Figure A3-1-26. Summer water quality sampling locations: Notigi Lake.

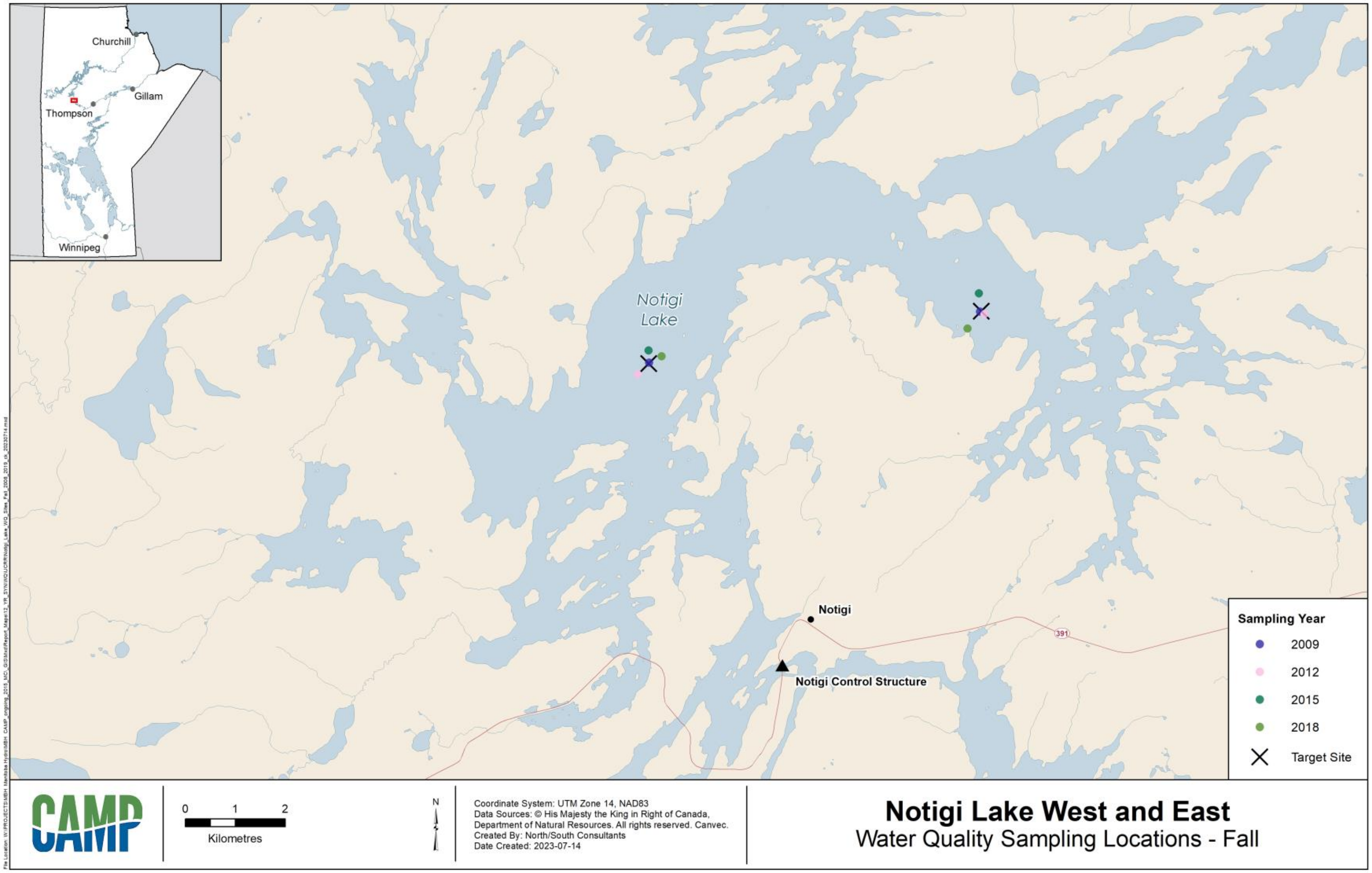


Figure A3-1-27. Fall water quality sampling locations: Notigi Lake.

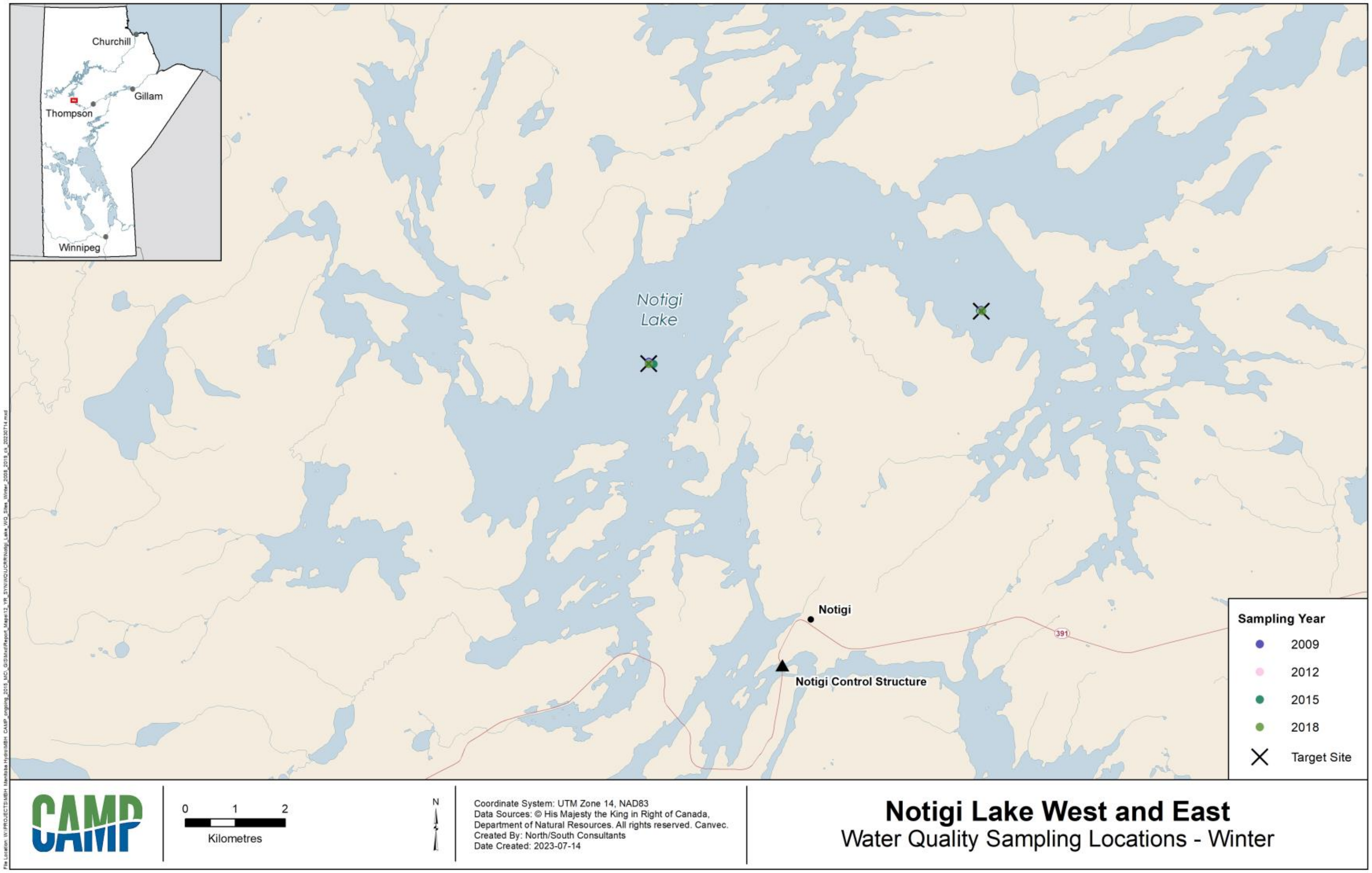


Figure A3-1-28. Winter water quality sampling locations: Notigi Lake.

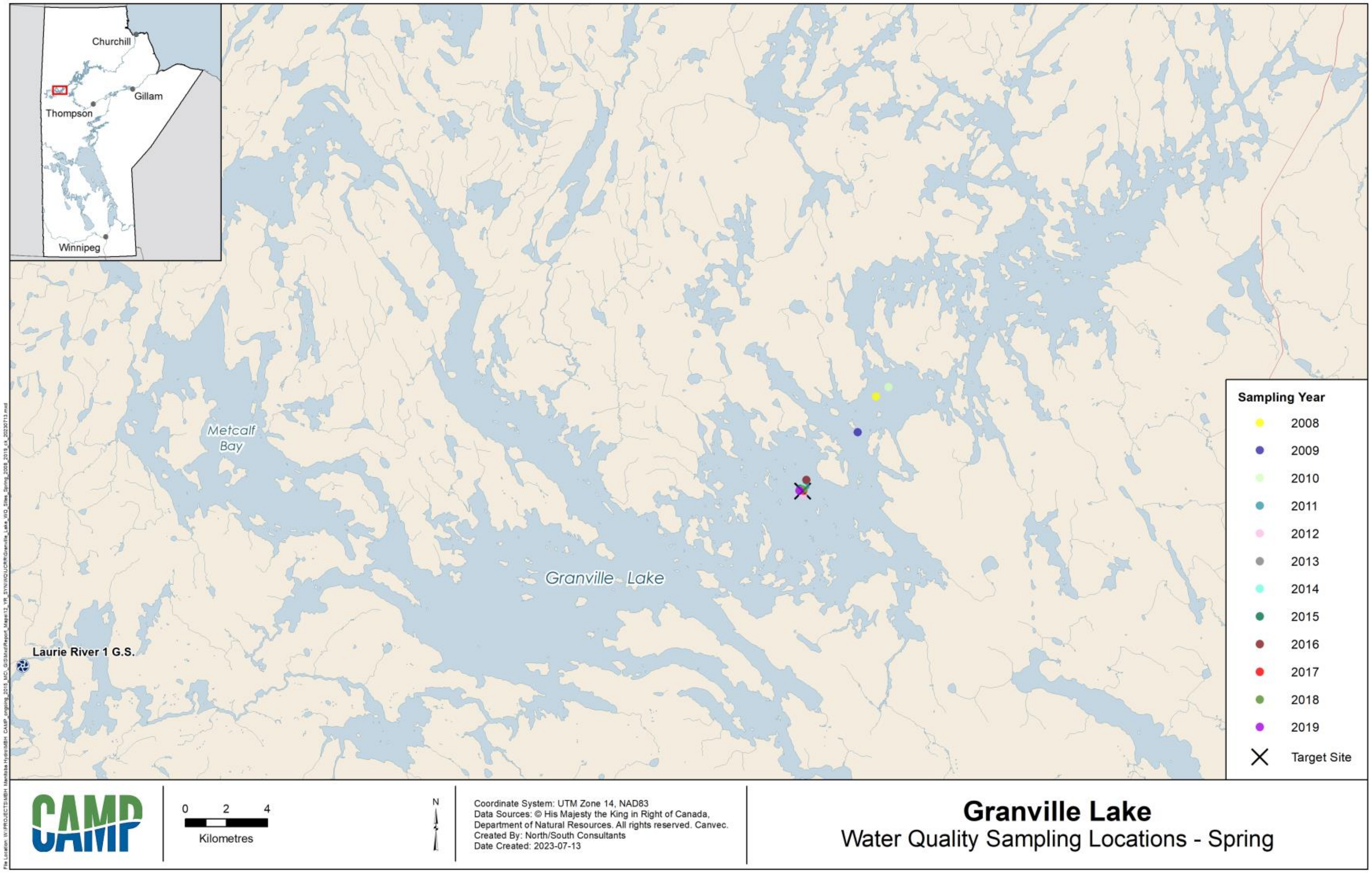


Figure A3-1-29. Spring water quality sampling locations: Granville Lake.

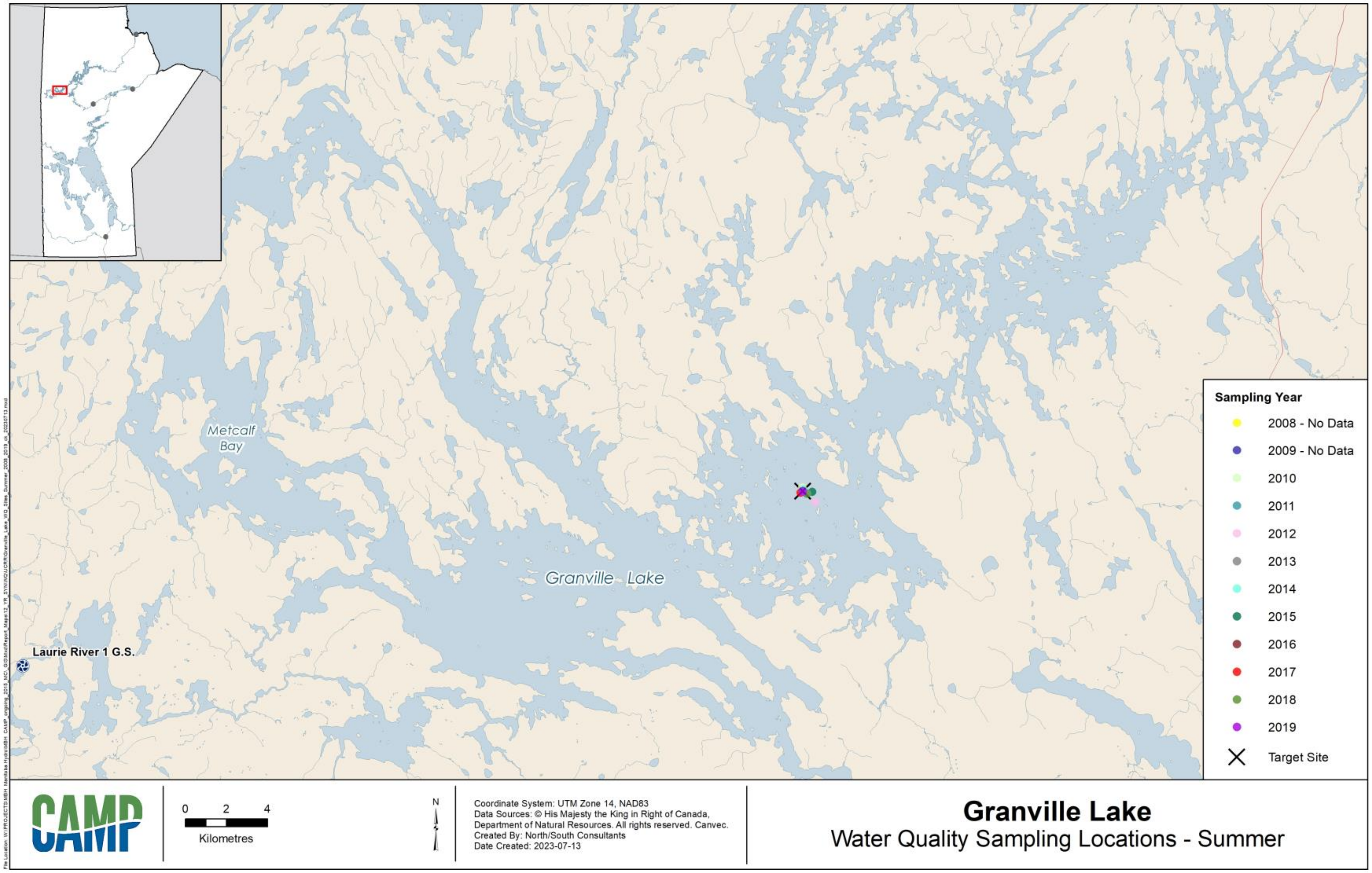


Figure A3-1-30. Summer water quality sampling locations: Granville Lake.

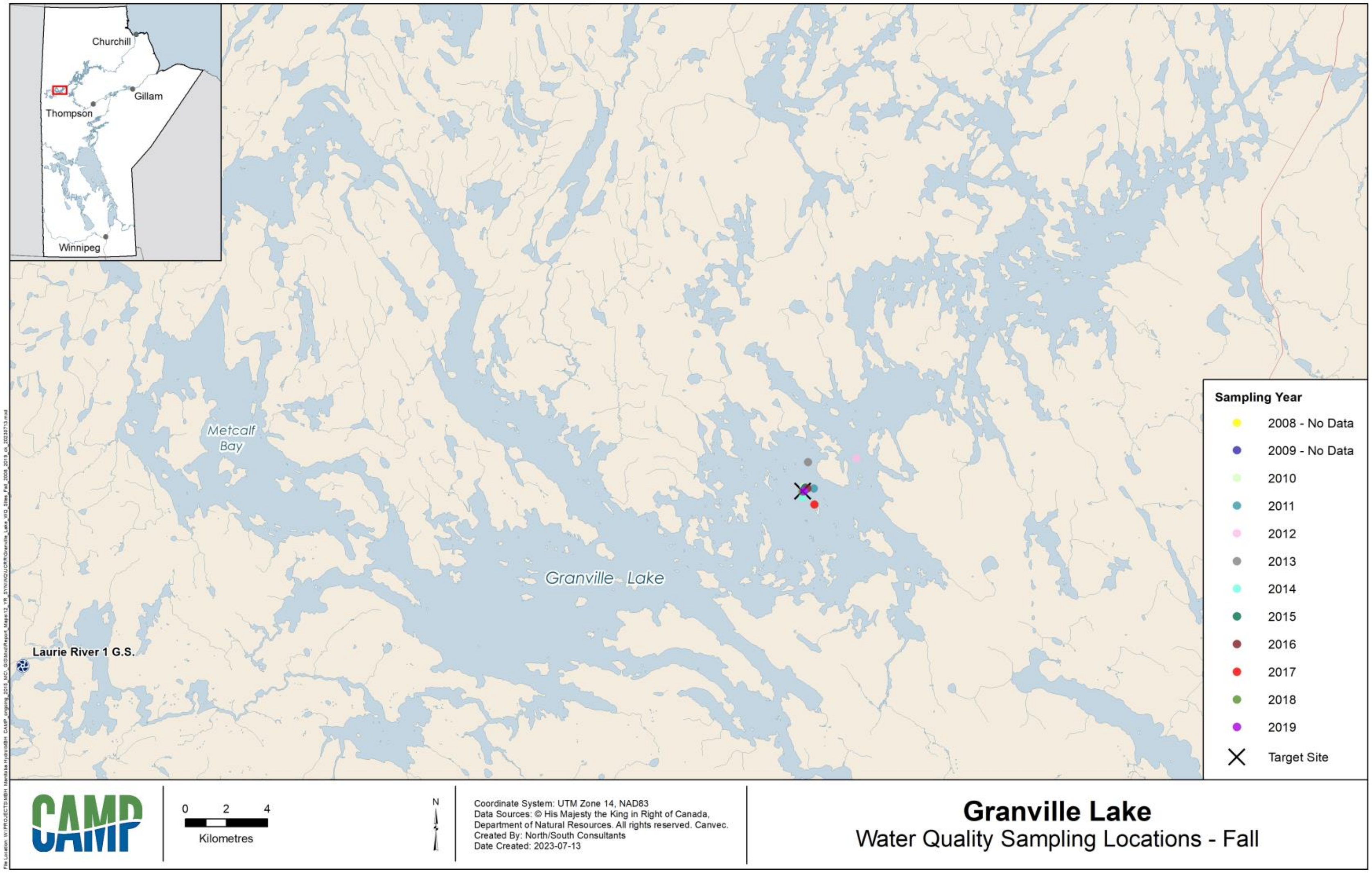


Figure A3-1-31. Fall water quality sampling locations: Granville Lake.

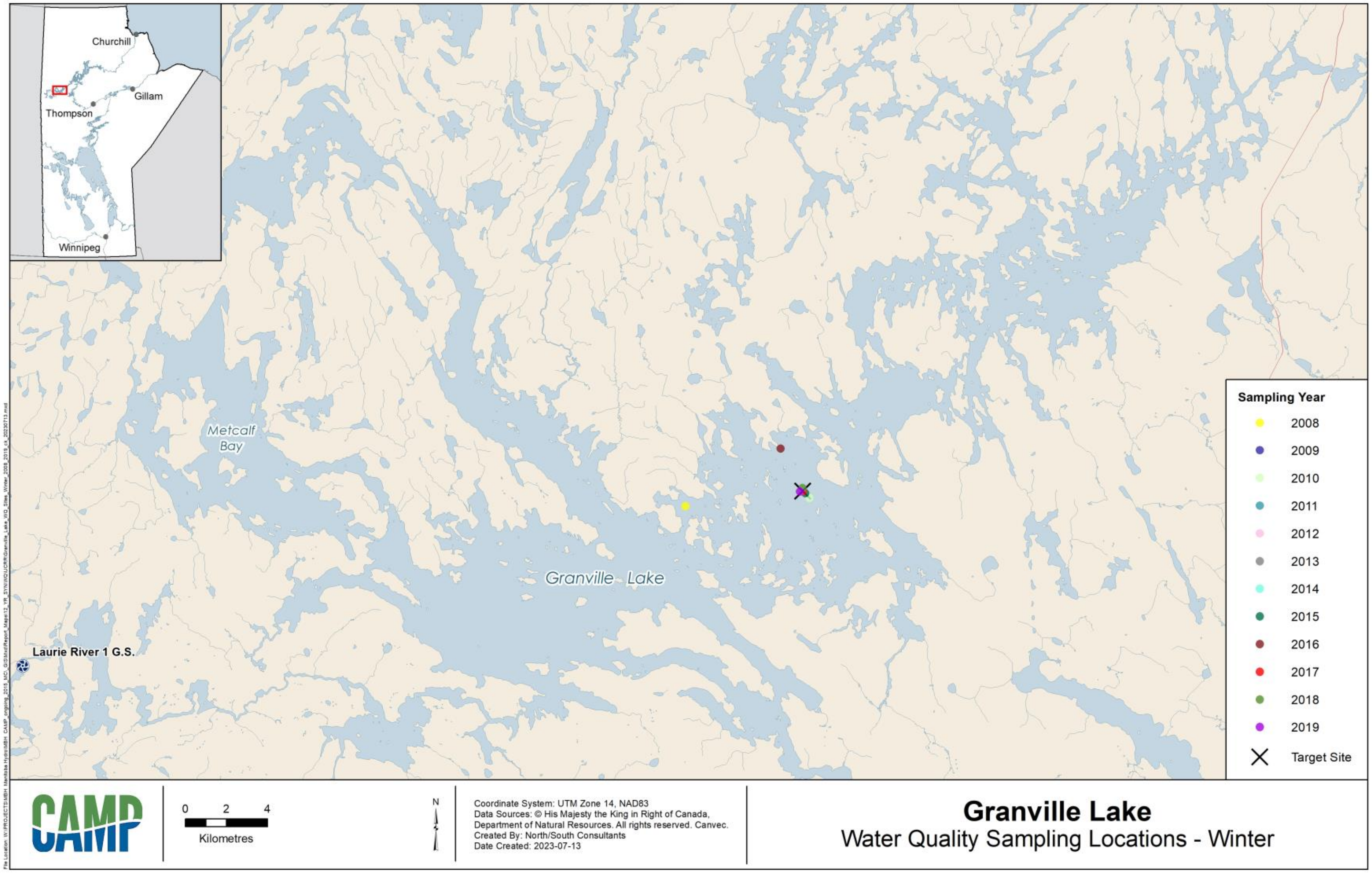


Figure A3-1-32. Winter water quality sampling locations: Granville Lake.

4.0 BENTHIC INVERTEBRATES

4.1 INTRODUCTION

The following presents the results of the benthic invertebrate community monitoring conducted from 2010-2019 in the Upper Churchill River Region. The 2008 and 2009 benthic invertebrate datasets were excluded due to a significant change in the sampling design in 2010.

Eight waterbodies were monitored in the Upper Churchill River Region: one on-system annual site (Southern Indian Lake – Area 4) and six on-system rotational sites (Southern Indian Lake – Area 1, Southern Indian Lake – Area 6, Opachuanau Lake, Rat Lake, Central Mynarski Lake and Notigi Lake); and one off-system annual site (Granville Lake; Table 4.1-1 and Figure 4.1-1).

Two sampling polygons (nearshore [NS] and offshore [OS]) defined by water depth, flow, and substrate composition were sampled in each waterbody in late summer/fall per year (Appendix 4-1). Five benthic invertebrate samples were collected in each polygon for a total of ten invertebrate samples per waterbody per year. Five sediment samples were also collected in each polygon (where possible) to provide supporting information on substrate composition, total organic carbon (TOC), and texture. Dominant substrate type(s) and sediment analysis results are presented in Appendix 4-2. Sampling was completed at most sites as planned over the period of 2010-2019, with the following exception:

- In 2010, the Southern Indian Lake – Area 4 nearshore polygon was sampled with a benthic grab instead of a kick net sampler due to site safety concerns at the time. Abundance units in 2010 are no. per m^2 and therefore not directly comparable to the other monitoring years (2011 to 2019).

Four benthic invertebrate indicators (abundance, community composition, taxonomic richness, and diversity) were selected for detailed reporting (Table 4.1-2). Metrics for these indicators that are presented herein include: total invertebrate abundance or total invertebrate density; the Ephemeroptera, Plecoptera, and Trichoptera (EPT) Index; the Oligochaeta and Chironomidae (O+C) Index; total taxa richness; EPT taxa richness; and Hill's effective richness (Hill's Index). A detailed description of these indicators is provided in CAMP (2024).

A detailed description of the program design and sampling methods are provided Technical Document 1, Section 2.4.

Table 4.1-1. 2010 to 2019 Benthic invertebrate sampling inventory.

Site	Sampling Year											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SIL-4	-[1]	-[1]	●[2]	●	●	●	●	●	●	●	●	●
OPACH				●			●			●		
SIL-1		-[1]			●			●			●	
SIL-6			●			●			●			●
RAT			●			●			●			●
MYN-CEN				●			●			●		
NTG		-[1]			●			●			●	
GRV	-[1]	-[1]	●	●	●	●	●	●	●	●	●	●

Notes:

1. Dataset excluded from analysis and reporting due to change in sampling design in 2010.
2. SIL-4 nearshore polygon sampled with benthic grab due to site safety concerns; units are no. per m^2.

Table 4.1-2. Benthic invertebrate indicators and metrics.

Indicators	Metrics	Units
Abundance	• Total Invertebrate Abundance	Number (no.) per sample
	• Total Invertebrate Density	no. per square metre (m^2)
Community Composition	• Relative Proportions of Major Invertebrate Groups	%
	• EPT Index	%
	• O+C Index	%
Taxonomic Richness	• Total Taxa Richness	no. of families
	• EPT Taxa Richness	no. of families
Diversity	• Hill’s Effective Richness (Hill's Index)	value

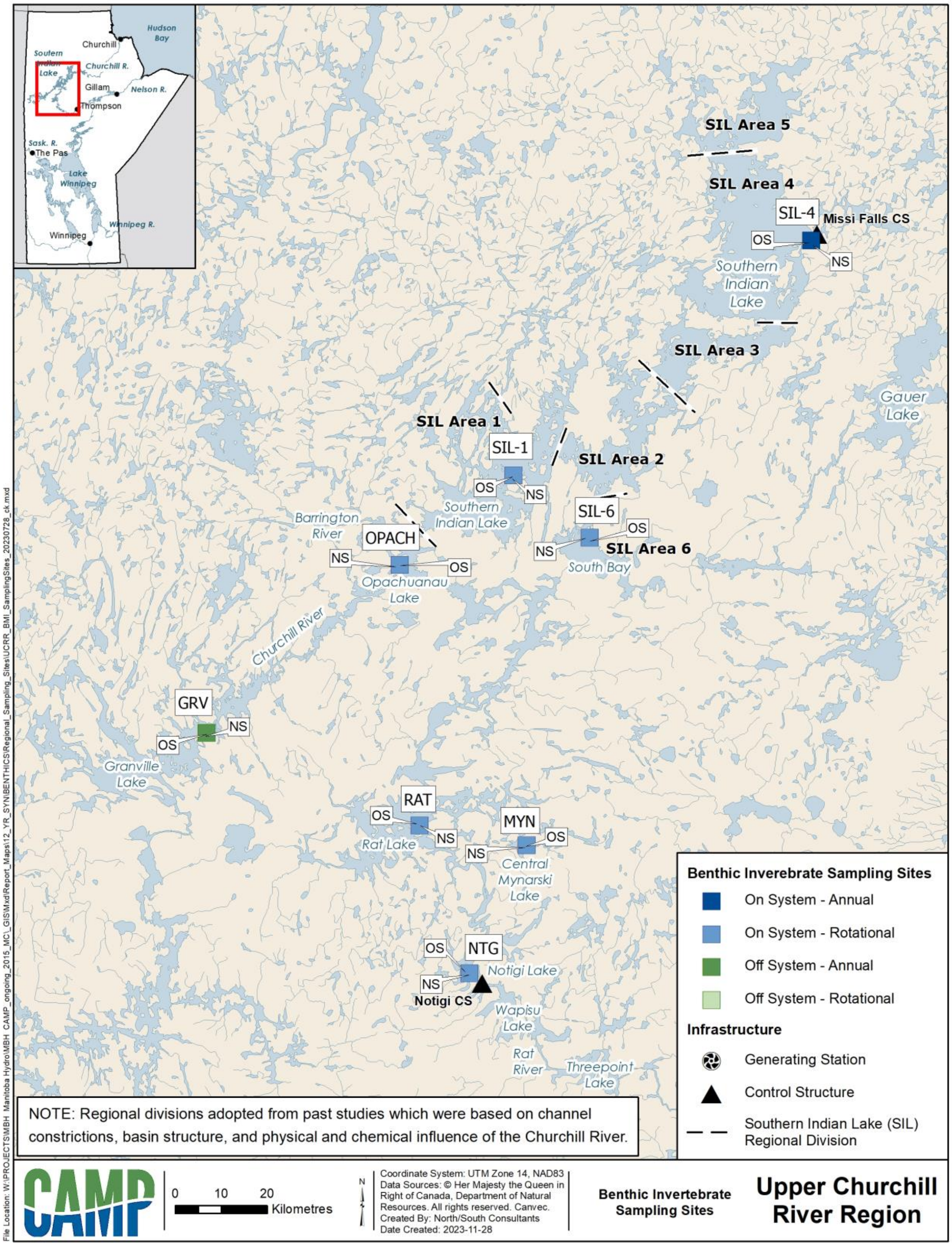


Figure 4.1-1. 2010-2019 Benthic invertebrate nearshore (NS) and offshore (OS) sampling sites.

4.2 ABUNDANCE

4.2.1 TOTAL INVERTEBRATE ABUNDANCE

4.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean abundance over nine years of monitoring (2011 to 2019) ranged from 313 invertebrates per sample (2011) to 1,888 invertebrates per sample (2014; Figure 4.2-1). The overall mean abundance was 1,296 invertebrates per sample, the overall median abundance was 1,164 invertebrates per sample, and the IQR was 469 to 1,789 invertebrates per sample. Annual means were below the IQR in 2011 and above the IQR in 2014.

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean abundance (density) in 2010 was 4,764 invertebrates per m^2 (Figure 4.2-1).

Offshore Habitat

Annual mean abundance (density) over the ten years of monitoring ranged from 491 invertebrates per m^2 (2011) to 2,857 invertebrates per m^2 (2015; Figure 4.2-2). The overall mean abundance was 1,238 invertebrates per m^2, the overall median abundance was 1,039 invertebrates per m^2, and the IQR was 610 to 1,602 invertebrates per m^2. Annual means were below the IQR in 2011 and 2016, and above the IQR from 2013. 2014, and 2015.

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 275 invertebrates per sample (2011) to 1,503 invertebrates per sample (2017; Figure 4.2-1). The overall mean abundance was 897 invertebrates per sample, the overall median abundance was 770 invertebrates per sample, and the IQR was 281 to 1,230 invertebrates per sample. Annual means were below the IQR in 2011, and above the IQR in 2017.

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 1,899 invertebrates per m^2 (2011) to 2,684 invertebrates per m^2 (2014; Figure 4.2-2). The overall mean abundance was 2,240 invertebrates per m^2, the overall median abundance was 2,207 invertebrates per m^2, and the IQR was 1,955 to 2,489 invertebrates per m^2. Annual means were below the IQR in 2011, and above the IQR in 2014.

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 1,342 invertebrates per sample (2012) to 4,464 invertebrates per sample (2018; Figure 4.2-1). The overall mean abundance was 3,192 invertebrates per sample, the overall median abundance was 3,085 invertebrates per sample, and the IQR was 1,250 to 4,658 invertebrates per sample. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 300 invertebrates per m^2 (2012) to 984 invertebrates per m^2 (2018; Figure 4.2-2). The overall mean abundance was 694 invertebrates per m^2, the overall median abundance was 765 invertebrates per m^2, and the IQR was 418 to 923 invertebrates per m^2. Annual means were below the IQR in 2012, and above the IQR in 2018.

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean abundance over the four years of monitoring ranged from 165 invertebrates per sample (2016) to 618 invertebrates per sample (2013; Figure 4.2-1). The overall mean abundance was 354 invertebrates per sample, the overall median abundance was 304 invertebrates per sample, and the IQR was 171 to 398 invertebrates per sample. Annual means were below the IQR in 2016, and above the IQR in 2013.

Offshore Habitat

Annual mean abundance (density) over the four years of monitoring ranged from 643 invertebrates per m^2 (2010) to 2,155 invertebrates per m^2 (2019; Figure 4.2-2). The overall mean abundance was 1,594 invertebrates per m^2, the overall median abundance was 1,796 invertebrates per m^2, and the IQR was 1,115 to 1,937 invertebrates per m^2. Annual means were below the IQR in 2010, and above the IQR in 2016 and 2019.

Rat Lake

Nearshore Habitat

Annual mean abundance over the four years of monitoring ranged from 729 invertebrates per sample (2010) to 3,939 invertebrates per sample (2016; Figure 4.2-1). The overall mean abundance was 2,563 invertebrates per sample, the overall median abundance was 2,414 invertebrates per sample, and the IQR was 1,219 to 3,658 invertebrates per sample. Annual means were below the IQR in 2010, and above the IQR in 2016.

Offshore Habitat

Annual mean abundance (density) over the four years of monitoring ranged from 155 invertebrates per m^2 (2010) to 501 invertebrates per m^2 (2013; Figure 4.2-2). The overall mean abundance was 339 invertebrates per m^2, the overall median abundance was 101 invertebrates per m^2, and the IQR was 29 to 534 invertebrates per m^2. Annual means for all years fell within the IQR.

Central Mynarski Lake

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 557 invertebrates per sample (2011) to 1,587 invertebrates per sample (2017; Figure 4.2-1). The overall mean abundance was 966 invertebrates per sample, the overall median abundance was 805 invertebrates per sample, and the IQR was 560 to 1,224 invertebrates per sample. Annual means were below the IQR in 2011, and above the IQR in 2017.

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 1,656 invertebrates per m^2 (2011) to 3,419 invertebrates per m^2 (2017; Figure 4.2-2). The overall mean abundance was 2,559 invertebrates per m^2, the overall median abundance was 2,785 invertebrates per m^2, and the IQR was 1,998 to 3,427 invertebrates per m^2. Annual means were within the IQR, except in 2011 (below).

Notigi Lake

Nearshore Habitat

Annual mean abundance over the three years of monitoring ranged from 850 invertebrates per sample (2015) to 3,159 invertebrates per sample (2018; Figure 4.2-1). The overall mean abundance was 1,778 invertebrates per sample, the overall median abundance was 1,394 invertebrates per sample, and the IQR was 931 to 2,663 invertebrates per sample. Annual means were below the IQR in 2015, and above the IQR in 2018.

Offshore Habitat

Annual mean abundance (density) over the three years of monitoring ranged from 920 invertebrates per m^2 (2012) to 3,226 invertebrates per m^2 (2015; Figure 4.2-2). The overall mean abundance was 2,203 invertebrates per m^2, the overall median abundance was 2,539 invertebrates per m^2, and the IQR was 1,205 to 2,893 invertebrates per m^2. Annual means were below the IQR in 2012, and above the IQR in 2015.

4.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean abundance over the ten years of monitoring ranged from 258 invertebrates per sample (2011) to 5,995 invertebrates per sample (2019; Figure 4.2-1). The overall mean abundance was 2,118 invertebrates per sample, the overall median abundance was 1,474 invertebrates per sample, and the IQR was 896 to 2,631 invertebrates per sample. Annual means were below the IQR in 2011, and above the IQR in 2017, 2018, and 2019.

Offshore Habitat

Annual mean abundance (density) over the ten years of monitoring ranged from 721 invertebrates per m^2 (2012) to 4,317 invertebrates per m^2 (2015; Figure 4.2-2). The overall mean abundance was 2,649 invertebrates per m^2, the overall median abundance was 2,691 invertebrates per m^2, and the IQR was 1,619 to 3,730 invertebrates per m^2. Annual means were below the IQR in 2011 and 2012, and above the IQR in 2015.

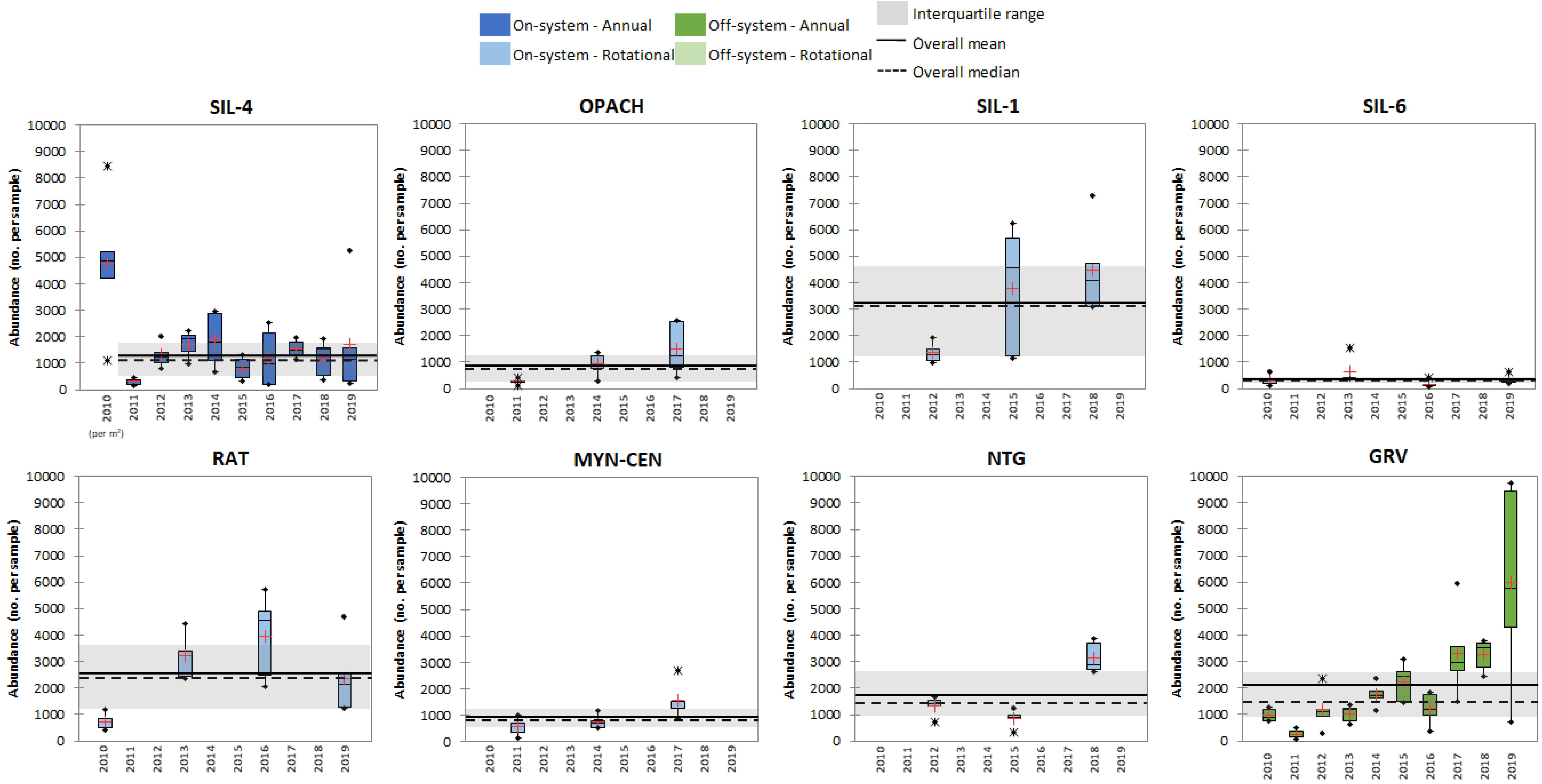


Figure 4.2-1. 2010 to 2019 Nearshore benthic invertebrate abundance (total no. per sample; SIL-4 2010 density, no. per m^2).

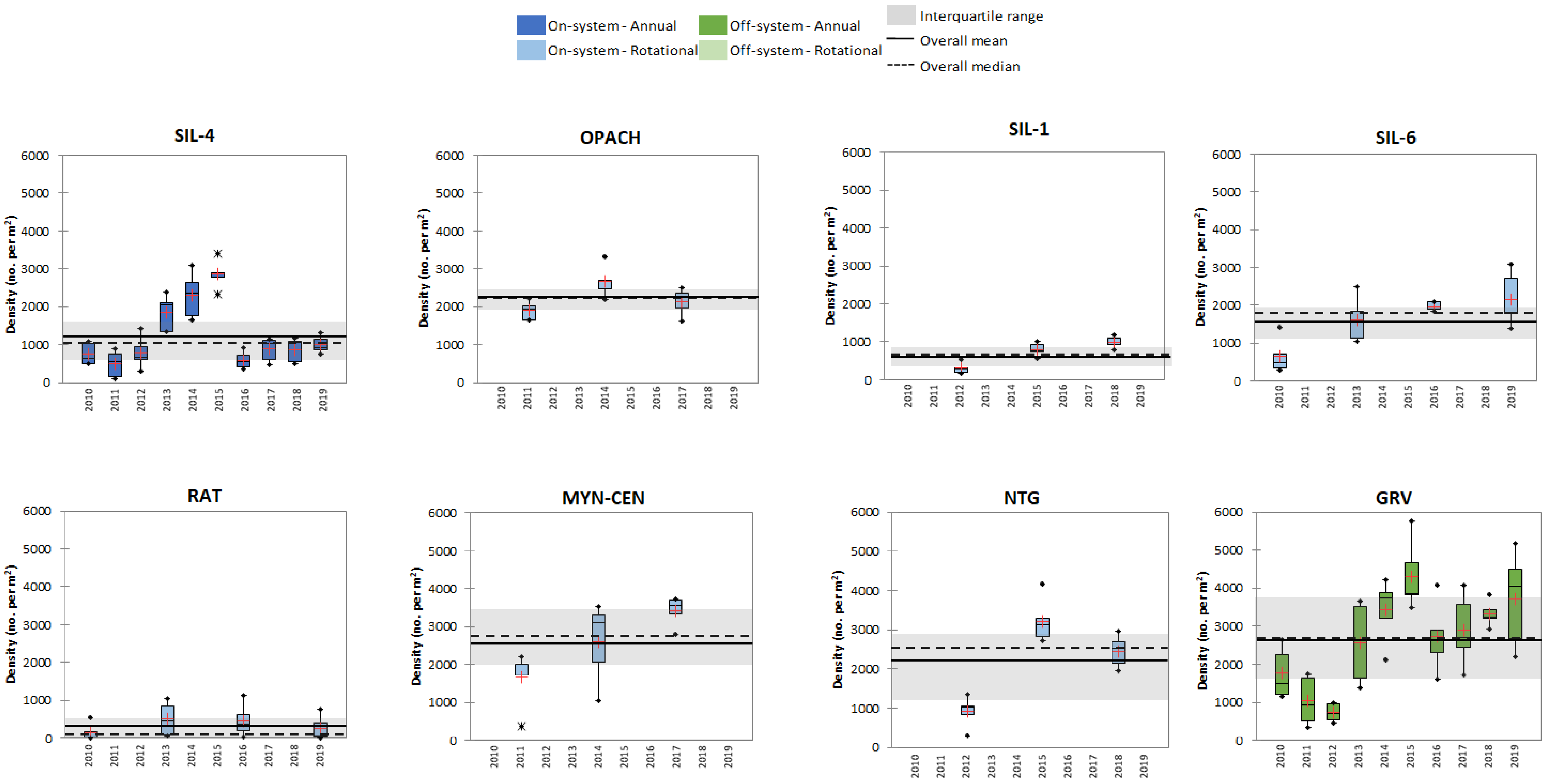


Figure 4.2-2. 2010 to 2019 Offshore benthic invertebrate abundance (density, total no. per m^2).

4.3 COMMUNITY COMPOSITION

4.3.1 RELATIVE ABUNDANCE

4.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Benthic invertebrate community composition varied over the ten years of monitoring (2010 to 2019; Table 4.3-1). Chironomidae (non-biting midges) was the dominant taxon in 2010 (61%), 2014 (58%), 2015 (31%), and 2016 (60%). Oligochaeta (aquatic segmented worms) dominated in 2011 (48%), followed by Chironomidae (25%). Oligochaeta (30%) and Chironomidae (28%) were nearly co-dominant in 2012. Corixidae (water boatmen) was the dominant invertebrate group in 2013 (31%) and 2017 (28%). Oligochaeta (40%) and Chironomidae (41%) were also nearly co-dominant in 2019.

Even though the 2010 data is not directly comparable to 2011 to 2019, the 2010 benthic invertebrate community composition was similar to 2014 and 2016 (Table 4.3-1).

Offshore Habitat

Benthic invertebrate community composition varied over the ten years of monitoring (2010 to 2019; Table 4.3-2). Chironomidae (non-biting midges) was the dominant taxon in 2010 (57%), 2012 (53%), 2013 (59%), 2014 (53%), 2018 (66%), and 2019 (45%). Oligochaeta (aquatic segmented worms, 39%), Amphipoda (freshwater shrimps, 28%, mainly Pontoporeiidae), and Chironomidae (26%) dominated in 2011. Amphipoda (Pontoporeiidae, 55%) was the dominant taxon in 2015. Amphipoda (mainly Pontoporeiidae), Chironomidae, and to a lesser extent Bivalvia (clams, Sphaeriidae) dominated in 2016 and 2017.

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2011, 2014, and 2017; Table 4.3-3). Oligochaeta (aquatic segmented worms, 23%), Amphipoda (freshwater shrimps, Hyalellidae, 18%), Ephemeroptera (mayflies, 18%, mainly Baetidae), and Corixidae (water boatmen, 18%) dominated in 2011. Amphipoda was the dominant taxon in 2014 (42%, mainly Hyalellidae). Oligochaeta was the dominant taxon in 2017 (38%).

Offshore Habitat

Amphipoda (freshwater shrimps, mainly Pontoporeiidae) dominated the benthic invertebrate community composition over the three years of monitoring (2011, 2014, and 2017; Table 4.3-4). Among those years, mean annual relative abundances of Amphipoda ranged from 72% (2017) to 78% (2011).

Southern Indian Lake – Area 1

Nearshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2012, 2015, and 2018; Table 4.3-5). Gastropoda (snails, 27%, mainly Lymnaeidae) and Corixidae (water boatmen, 29%) were nearly co-dominant in 2012. Chironomidae (non-biting midges, 52%) dominated in 2015, followed by Oligochaeta (aquatic segmented worms, 27%). Oligochaeta (22%), Gastropoda (32%, mainly Lymnaeidae and Planorbidae) and Chironomidae (27%) dominated in 2018.

Offshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2012, 2015, and 2018; Table 4.3-6). Amphipoda (freshwater shrimps, Pontoporeiidae, 32%), Chironomidae (non-biting midges 29%), and Ephemeroptera (mayflies, Ephemeridae, 24%) were the dominant taxa in 2012. Amphipoda (55%, mainly Pontoporeiidae) dominated in 2015. Amphipoda (40%, mainly Pontoporeiidae) and Chironomidae (35%) were the dominant invertebrate groups in 2018.

Southern Indian Lake – Area 6

Nearshore Habitat

Benthic invertebrate community composition varied over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-7). Corixidae (water boatmen, 57%) dominated in 2010 and 2019. Amphipoda (freshwater shrimps, Hyalellidae, 35%) and Gastropoda (snails, 31%, mainly Lymnaeidae) were nearly co-dominant in 2013. Amphipoda (26%, mainly Hyalellidae) and Corixidae (28%) were nearly co-dominant in 2016.

Offshore Habitat

Amphipoda (freshwater shrimps, mainly Pontoporeiidae) dominated the benthic invertebrate community composition over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-8). Among those years, mean annual relative abundances of Amphipoda ranged from 47% (2016) to 86% (2019).

Rat Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-9). Amphipoda (freshwater shrimps, 27%, mainly Hyalellidae) and Corixidae (water boatmen, 25%) were nearly co-dominant in 2010. Amphipoda (18%, mainly Hyalellidae), Chironomidae (non-biting midges, 20%), and Ephemeroptera (mayflies, 21%, mainly Baetidae) were nearly co-dominant in 2013. Amphipoda (mainly Hyalellidae) was the dominant taxon in 2016 (33%) and 2019 (31%).

Offshore Habitat

Chironomidae (non-biting midges) and/or Ephemeroptera (mayflies, mainly Ephemeridae) dominated the benthic invertebrate community composition over the four years of monitoring (2010, 2013, 2016, and 2019; Table 4.3-10). Mean annual relative abundances of Chironomidae were highest in 2010 (58%), 2013 (58%), and 2019 (48%). Ephemeroptera (Ephemeridae) was the dominant taxon in 2016 (52%).

Central Mynarski Lake

Nearshore Habitat

Chironomidae (non-biting midges) and/or Corixidae (water boatmen) dominated the benthic invertebrate community composition over the three years of monitoring (2011, 2014, and 2017; Table 4.3-11). Among those years, mean annual relative abundances of Chironomidae ranged from 32% (2014) to 48% (2017), and mean annual relative abundances of Corixidae ranged from 13% (2017) to 35% (2011).

Offshore Habitat

Chironomidae (non-biting midges) dominated the benthic invertebrate community composition over the three years of monitoring (2011, 2014, and 2017; Table 4.3-12). Among those years, mean annual relative abundances of Chironomidae ranged from 40% (2017) to 46% (2014).

Notigi Lake

Nearshore Habitat

Amphipoda (freshwater shrimps, mainly Hyalellidae) dominated the benthic invertebrate community composition over the three years of monitoring (2012, 2015, and 2018; Table 4.3-13). Among those years, mean annual relative abundances of Amphipoda ranged from 35% (2015) to 41% (2018). Oligochaeta (aquatic segmented worms) was the second dominant taxon in 2012 (29%) and 2015 (21%). Chironomidae (non-biting midges) was the second dominant taxon in 2018 (24%).

Offshore Habitat

Benthic invertebrate community composition varied over the three years of monitoring (2012, 2015, and 2018; Table 4.3-14). Chironomidae (non-biting midges, 30%) and Ephemeroptera (mayflies, 37%, mainly Ephemeridae) were the dominant taxa in 2012. Amphipoda (freshwater shrimps, mainly Pontoporeiidae) dominated in 2015 (86%) and 2018 (64%).

4.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Benthic invertebrate community composition varied over the ten years of monitoring (2010 to 2019; Table 4.3-15). Corixidae (water boatmen) was the dominant taxon in 2010 (78%), 2011 (38%), and 2014 (48%). Gastropoda (snails, 28%, mainly Lymnaeidae and Valvatidae) and Chironomidae (non-biting midges, 32%) were the dominant taxa in 2012. Chironomidae was the dominant taxon in 2013 (45%), 2015 (41%), 2016 (74%), and 2017 (46%). Gastropoda (27%, mainly Planorbidae and Valvatidae) and Chironomidae (35%) were dominant in 2018. Oligochaeta (aquatic segmented worms, 45%) and Chironomidae (35%) dominated in 2019.

Offshore Habitat

Amphipoda (freshwater shrimps, Pontoporeiidae) dominated the benthic invertebrate community composition over the ten years of monitoring (2010 to 2019; Table 4.3-16). Among those years, mean annual relative abundances of Amphipoda ranged from 34% (2010) to 85% (2019).

Table 4.3-1. 2010 to 2019 Southern Indian Lake – Area 4 nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010[1]	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	16%	48%	30%	14%	11%	16%	20%	8%	37%	40%
Amphipoda	2%	6%	14%	13%	14%	7%	8%	10%	8%	6%
Bivalvia	3%	<1%	2%	1%	<1%	5%	3%	7%	1%	<1%
Gastropoda	2%	4%	5%	15%	2%	12%	4%	16%	10%	6%
Ceratopogonidae	10%	<1%	1%	1%	<1%	1%	<1%	<1%	2%	<1%
Chironomidae	61%	25%	28%	19%	58%	31%	60%	16%	17%	41%
Other Diptera	2%	<1%	<1%	1%	<1%	1%	<1%	1%	1%	<1%
Ephemeroptera	3%	2%	6%	2%	5%	6%	1%	6%	2%	1%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	1%	2%	4%	3%	1%	7%	1%	3%	2%	1%
Corixidae	<1%	10%	9%	31%	7%	8%	2%	28%	20%	3%
Coleoptera	<1%	1%	1%	<1%	<1%	1%	<1%	<1%	<1%	<1%
All other taxa	1%	1%	1%	2%	1%	3%	1%	2%	1%	2%

Notes:

1. Nearshore polygon sampled with benthic grab due to site safety concerns; units are no. per m^2.

Table 4.3-2. 2010 to 2019 Southern Indian Lake – Area 4 offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	8%	39%	18%	17%	14%	7%	14%	3%	12%	20%
Amphipoda	28%	28%	21%	14%	24%	55%	33%	39%	4%	20%
Bivalvia	5%	4%	4%	6%	8%	7%	22%	15%	8%	9%
Gastropoda	1%	2%	1%	1%	1%	1%	<1%	2%	4%	1%
Ceratopogonidae	0%	1%	1%	<1%	<1%	<1%	1%	0%	<1%	<1%
Chironomidae	57%	26%	53%	59%	53%	29%	29%	37%	66%	45%
Other Diptera	0%	0%	0%	0%	<1%	0%	0%	0%	0%	0%
Ephemeroptera	0%	0%	0%	1%	1%	<1%	0%	2%	4%	2%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	0%	1%	0%	0%	0%	0%	0%	0%	0%	<1%
Corixidae	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Coleoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
All other taxa	1%	0%	2%	1%	<1%	1%	<1%	2%	2%	2%

Table 4.3-3. 2010 to 2019 Opachuanau Lake nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	23%	26%	38%
Amphipoda	18%	42%	25%
Bivalvia	1%	1%	<1%
Gastropoda	3%	5%	3%
Ceratopogonidae	1%	<1%	<1%
Chironomidae	15%	9%	13%
Other Diptera	1%	<1%	0%
Ephemeroptera	18%	8%	10%
Plecoptera	0%	0%	0%
Trichoptera	2%	1%	1%
Corixidae	18%	4%	9%
Coleoptera	<1%	1%	<1%
All other taxa	1%	2%	1%

Table 4.3-4. 2010 to 2019 Opachuanau Lake offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	0%	<1%	<1%
Amphipoda	78%	76%	72%
Bivalvia	3%	2%	4%
Gastropoda	0%	0%	0%
Ceratopogonidae	0%	1%	1%
Chironomidae	6%	10%	10%
Other Diptera	0%	0%	0%
Ephemeroptera	5%	5%	12%
Plecoptera	0%	0%	0%
Trichoptera	0%	0%	0%
Corixidae	0%	0%	0%
Coleoptera	0%	0%	0%
All other taxa	8%	6%	<1%

Table 4.3-5. 2010 to 2019 Southern Indian Lake – Area 1 nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	**2012**	**2015**	**2018**
Oligochaeta	5%	27%	22%
Amphipoda	19%	3%	5%
Bivalvia	<1%	1%	<1%
Gastropoda	27%	8%	32%
Ceratopogonidae	<1%	<1%	<1%
Chironomidae	10%	52%	27%
Other Diptera	<1%	<1%	0%
Ephemeroptera	3%	1%	3%
Plecoptera	0%	0%	0%
Trichoptera	5%	3%	2%
Corixidae	29%	4%	9%
Coleoptera	1%	1%	<1%
All other taxa	1%	1%	<1%

Table 4.3-6. 2010 to 2019 Southern Indian Lake – Area 1 offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	**2012**	**2015**	**2018**
Oligochaeta	2%	<1%	1%
Amphipoda	32%	55%	40%
Bivalvia	1%	1%	0%
Gastropoda	2%	0%	<1%
Ceratopogonidae	6%	<1%	2%
Chironomidae	29%	30%	35%
Other Diptera	0%	0%	0%
Ephemeroptera	24%	12%	19%
Plecoptera	0%	0%	0%
Trichoptera	2%	0%	1%
Corixidae	0%	0%	0%
Coleoptera	0%	0%	0%
All other taxa	3%	1%	2%

Table 4.3-7. 2010 to 2019 Southern Indian Lake – Area 6 nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	6%	6%	7%	3%
Amphipoda	13%	35%	26%	12%
Bivalvia	<1%	2%	<1%	<1%
Gastropoda	16%	31%	18%	18%
Ceratopogonidae	0%	0%	0%	<1%
Chironomidae	1%	3%	12%	3%
Other Diptera	0%	1%	1%	<1%
Ephemeroptera	3%	5%	5%	2%
Plecoptera	0%	0%	0%	0%
Trichoptera	3%	3%	2%	3%
Corixidae	57%	12%	28%	57%
Coleoptera	1%	2%	1%	<1%
All other taxa	<1%	<1%	1%	1%

Table 4.3-8. 2010 to 2019 Southern Indian Lake – Area 6 offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	<1%	5%	1%	<1%
Amphipoda	54%	48%	47%	86%
Bivalvia	5%	9%	16%	3%
Gastropoda	3%	1%	3%	0%
Ceratopogonidae	2%	1%	<1%	<1%
Chironomidae	23%	21%	7%	9%
Other Diptera	0%	0%	0%	0%
Ephemeroptera	9%	14%	25%	<1%
Plecoptera	0%	0%	0%	0%
Trichoptera	0%	<1%	<1%	0%
Corixidae	0%	0%	0%	0%
Coleoptera	0%	0%	0%	0%
All other taxa	3%	1%	1%	<1%

Table 4.3-9. 2010 to 2019 Rat Lake nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	15%	9%	4%	2%
Amphipoda	27%	18%	33%	31%
Bivalvia	8%	7%	1%	2%
Gastropoda	1%	4%	3%	2%
Ceratopogonidae	1%	2%	1%	1%
Chironomidae	13%	20%	22%	8%
Other Diptera	<1%	1%	<1%	<1%
Ephemeroptera	5%	21%	13%	17%
Plecoptera	0%	0%	0%	0%
Trichoptera	2%	9%	6%	20%
Corixidae	25%	7%	15%	15%
Coleoptera	1%	1%	1%	1%
All other taxa	2%	1%	<1%	1%

Table 4.3-10. 2010 to 2019 Rat Lake offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2010	2013	2016	2019
Oligochaeta	5%	24%	8%	5%
Amphipoda	2%	1%	2%	14%
Bivalvia	5%	3%	10%	8%
Gastropoda	0%	2%	1%	0%
Ceratopogonidae	0%	1%	0%	0%
Chironomidae	58%	58%	26%	48%
Other Diptera	0%	0%	0%	3%
Ephemeroptera	30%	4%	52%	22%
Plecoptera	0%	0%	0%	0%
Trichoptera	0%	6%	0%	0%
Corixidae	0%	0%	0%	0%
Coleoptera	0%	0%	0%	0%
All other taxa	0%	1%	1%	0%

Table 4.3-11. 2010 to 2019 Central Mynarski Lake nearshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	11%	10%	15%
Amphipoda	4%	8%	5%
Bivalvia	<1%	2%	1%
Gastropoda	2%	5%	5%
Ceratopogonidae	<1%	1%	<1%
Chironomidae	33%	32%	48%
Other Diptera	<1%	4%	2%
Ephemeroptera	5%	11%	6%
Plecoptera	0%	0%	0%
Trichoptera	7%	6%	5%
Corixidae	35%	20%	13%
Coleoptera	2%	1%	<1%
All other taxa	<1%	1%	1%

Table 4.3-12. 2010 to 2019 Central Mynarski Lake offshore benthic invertebrate relative abundance.

■ 0% ■ <1% to 15% ■ >15% to 25% ■ >25% to 50% ■ >50%

Invertebrate Taxa	2011	2014	2017
Oligochaeta	21%	27%	23%
Amphipoda	21%	11%	9%
Bivalvia	2%	6%	5%
Gastropoda	0%	1%	<1%
Ceratopogonidae	1%	<1%	<1%
Chironomidae	45%	46%	40%
Other Diptera	1%	3%	17%
Ephemeroptera	7%	3%	3%
Plecoptera	0%	0%	0%
Trichoptera	1%	<1%	0%
Corixidae	0%	0%	0%
Coleoptera	0%	0%	0%
All other taxa	1%	2%	3%

Table 4.3-13. 2010 to 2019 Notigi Lake nearshore benthic invertebrate relative abundance.

▨ 0% ▨ <1% to 15% ▨ >15% to 25% ▨ >25% to 50% ▨ >50%

Invertebrate Taxa	2012	2015	2018
Oligochaeta	29%	21%	11%
Amphipoda	36%	35%	41%
Bivalvia	<1%	1%	4%
Gastropoda	1%	<1%	2%
Ceratopogonidae	1%	2%	3%
Chironomidae	6%	15%	24%
Other Diptera	<1%	0%	<1%
Ephemeroptera	7%	3%	5%
Plecoptera	0%	0%	0%
Trichoptera	1%	1%	2%
Corixidae	19%	17%	7%
Coleoptera	1%	3%	<1%
All other taxa	<1%	1%	1%

Table 4.3-14. 2010 to 2019 Notigi Lake offshore benthic invertebrate relative abundance.

▨ 0% ▨ <1% to 15% ▨ >15% to 25% ▨ >25% to 50% ▨ >50%

Invertebrate Taxa	2012	2015	2018
Oligochaeta	2%	<1%	<1%
Amphipoda	24%	86%	64%
Bivalvia	4%	1%	2%
Gastropoda	<1%	0%	<1%
Ceratopogonidae	0%	<1%	<1%
Chironomidae	30%	8%	18%
Other Diptera	0%	0%	0%
Ephemeroptera	37%	4%	13%
Plecoptera	0%	0%	0%
Trichoptera	1%	<1%	<1%
Corixidae	1%	0%	<1%
Coleoptera	0%	0%	0%
All other taxa	1%	<1%	2%

Table 4.3-15. 2010 to 2019 Granville Lake nearshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	4%	9%	23%	18%	9%	9%	10%	29%	14%	45%
Amphipoda	3%	9%	1%	2%	1%	2%	2%	10%	8%	5%
Bivalvia	0%	<1%	<1%	<1%	0%	<1%	<1%	0%	0%	0%
Gastropoda	5%	21%	28%	19%	14%	25%	9%	2%	27%	10%
Ceratopogonidae	0%	0%	<1%	<1%	0%	<1%	<1%	0%	0%	0%
Chironomidae	9%	19%	32%	45%	24%	41%	74%	46%	35%	35%
Other Diptera	0%	0%	<1%	<1%	<1%	0%	0%	0%	0%	0%
Ephemeroptera	1%	1%	1%	3%	1%	<1%	<1%	5%	2%	1%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	1%	2%	3%	6%	1%	1%	1%	1%	1%	<1%
Corixidae	78%	38%	12%	2%	48%	21%	2%	5%	5%	2%
Coleoptera	<1%	0%	0%	<1%	<1%	<1%	<1%	<1%	<1%	0%
All other taxa	<1%	1%	1%	4%	<1%	<1%	1%	4%	7%	1%

Table 4.3-16. 2010 to 2019 Granville Lake offshore benthic invertebrate relative abundance.

0% <1% to 15% >15% to 25% >25% to 50% >50%

Invertebrate Taxa	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Oligochaeta	<1%	0%	0%	<1%	0%	<1%	<1%	<1%	1%	<1%
Amphipoda	34%	63%	46%	63%	77%	79%	63%	66%	58%	85%
Bivalvia	11%	5%	9%	8%	5%	6%	7%	7%	14%	6%
Gastropoda	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Ceratopogonidae	3%	0%	1%	<1%	<1%	<1%	1%	<1%	<1%	<1%
Chironomidae	26%	8%	12%	14%	11%	10%	9%	15%	13%	7%
Other Diptera	<1%	0%	<1%	<1%	<1%	<1%	<1%	1%	1%	0%
Ephemeroptera	23%	22%	28%	11%	5%	4%	17%	9%	10%	1%
Plecoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Trichoptera	1%	1%	2%	2%	<1%	<1%	2%	1%	2%	<1%
Corixidae	1%	1%	0%	0%	0%	<1%	<1%	0%	0%	<1%
Coleoptera	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
All other taxa	2%	1%	1%	<1%	<1%	<1%	1%	<1%	1%	1%

4.3.2 EPT INDEX

4.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean EPT Index over nine years of monitoring (2011 to 2019) ranged from 2% (2016 and 2019) to 13% (2015; Figure 4.3-1). The overall mean was 6%, the overall median was 4%, and the IQR was less than 3% to 8%. Annual means were below the IQR in 2016 and 2019, and above the IQR in 2012, 2015 and 2017.

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean EPT Index in 2010 was 6% (Figure 4.3-1).

Offshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 0% (2010 to 2012, 2015 and 2016) to 4% (2018; Figure 4.3-2). The overall mean was 1%, the overall median was 0%, and the IQR was 0% to 1%. Annual means were within the IQR, except in 2017, 2018, and 2019 (above).

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 10% (2014) to 22% (2011; Figure 4.3-1). The overall mean was 15%, the overall median was 12%, and the IQR was 9% to 23%. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 5% (2011 and 2014) to 12% (2017; Figure 4.3-2). The overall mean was 8%, the overall median was 6%, and the IQR was 4% to 10%. Annual means were within the IQR, except in 2017 (above).

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 5% (2015) to 9% (2012; Figure 4.3-1). The overall mean was 6%, the overall median was 5%, and the IQR was 3% to 7%. Annual means were within the IQR, except in 2012 (above).

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 11% (2015) to 28% (2012; Figure 4.3-2). The overall mean was 20%, the overall median was 15%, and the IQR was 12% to 25%. Annual means were below the IQR in 2015, and above the IQR in 2012.

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 5% (2016) to 7% (2013; Figure 4.3-1). The overall mean was 6%, the overall median was 5%, and the IQR was 3% to 9%. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 0% (2019) to 25% (2016; Figure 4.3-2). The overall mean was 13%, the overall median was 13%, and the IQR was 5% to 19%. Annual means were below the IQR in 2019, and above the IQR in 2016.

Rat Lake

Nearshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 7% (2010) to 31% (2019; Figure 4.3-1). The overall mean was 21%, the overall median was 19%, and the IQR was 11% to 28%. Annual means were below the IQR in 2010, and above the IQR in 2013 and 2019.

Offshore Habitat

Annual mean EPT Index over the four years of monitoring ranged from 6% (2013) to 30% (2016; Figure 4.3-2). The overall mean was 13%, the overall median was 0%, and the IQR was 0% to 19%. Annual means were within the IQR, except in 2016 (above).

Central Mynarski Lake

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 10% (2017) to 17% (2014; Figure 4.3-1). The overall mean was 13%, the overall median was 11%, and the IQR was 9% to 16%. Annual means were within the IQR, except in 2014 (above).

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 3% (2014 and 2017) to 8% (2011; Figure 4.3-2). The overall mean was 5%, the overall median was 4%, and the IQR was 3% to 6%. Annual means were below the IQR in 2014, and above the IQR in 2011.

Notigi Lake

Nearshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 4% (2015) to 8% (2012; Figure 4.3-1). The overall mean and median were 6%, and the IQR was 4% to 9%. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean EPT Index over the three years of monitoring ranged from 4% (2015) to 41% (2012; Figure 4.3-2). The overall mean was 20%, the overall median was 11%, and the IQR was 6% to 32%. Annual means were below the IQR in 2015, and above the IQR in 2012.

4.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 1% (2010 and 2019) to 10% (2013; Figure 4.3-1). The overall mean was 3%, the overall median was 2%, and the IQR was 1% to 4%. Annual means were within the IQR, except in 2012, 2013 and 2017 (above).

Offshore Habitat

Annual mean EPT Index over the ten years of monitoring ranged from 1% (2019) to 35% (2012; Figure 4.3-2). The overall mean was 15%, the overall median was 13%, and the IQR was 6% to 18%. Annual means were below the IQR in 2014, 2015 and 2019, and above the IQR in 2010, 2011, 2012, and 2016.

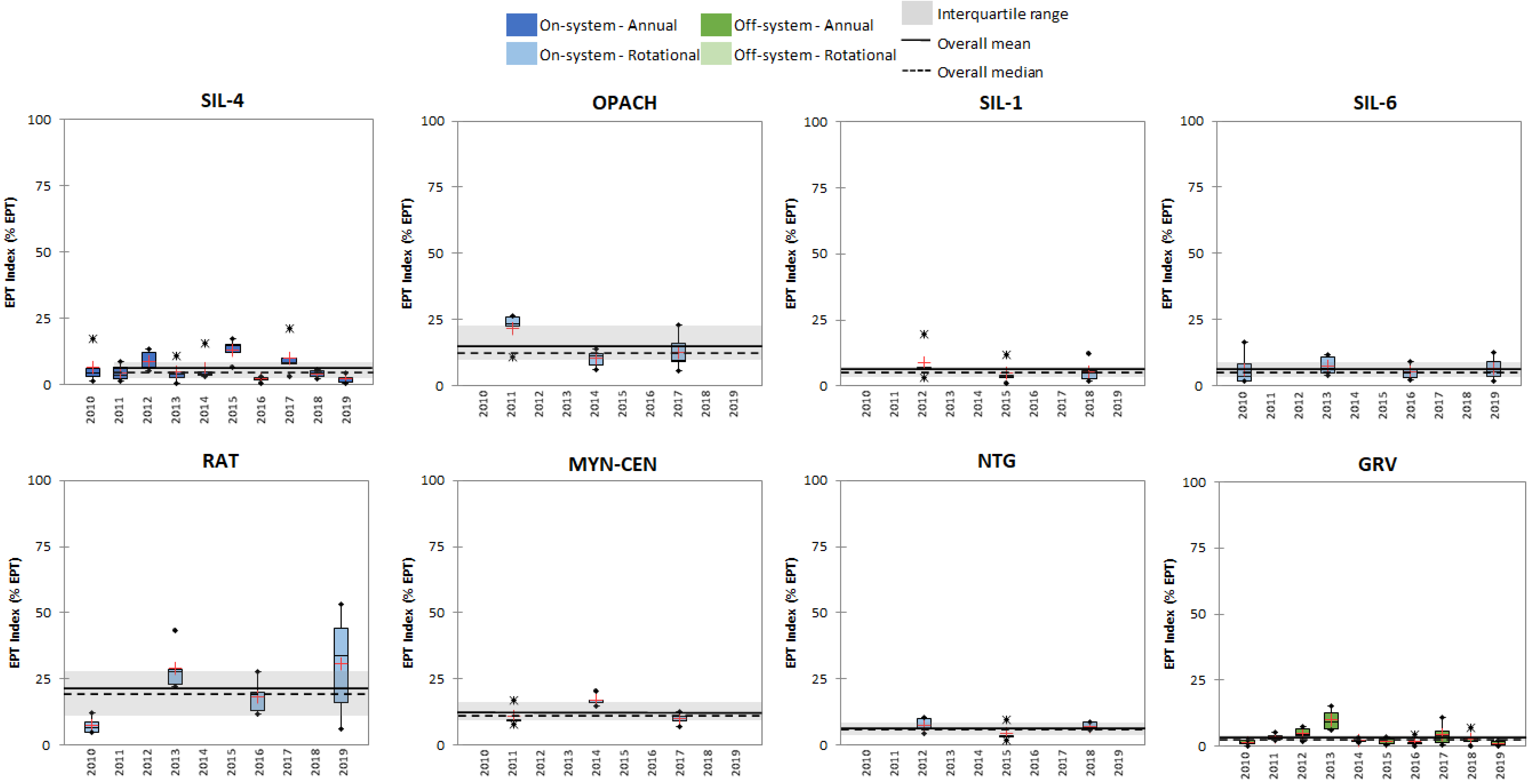


Figure 4.3-1. 2010 to 2019 Nearshore benthic invertebrate EPT Index.

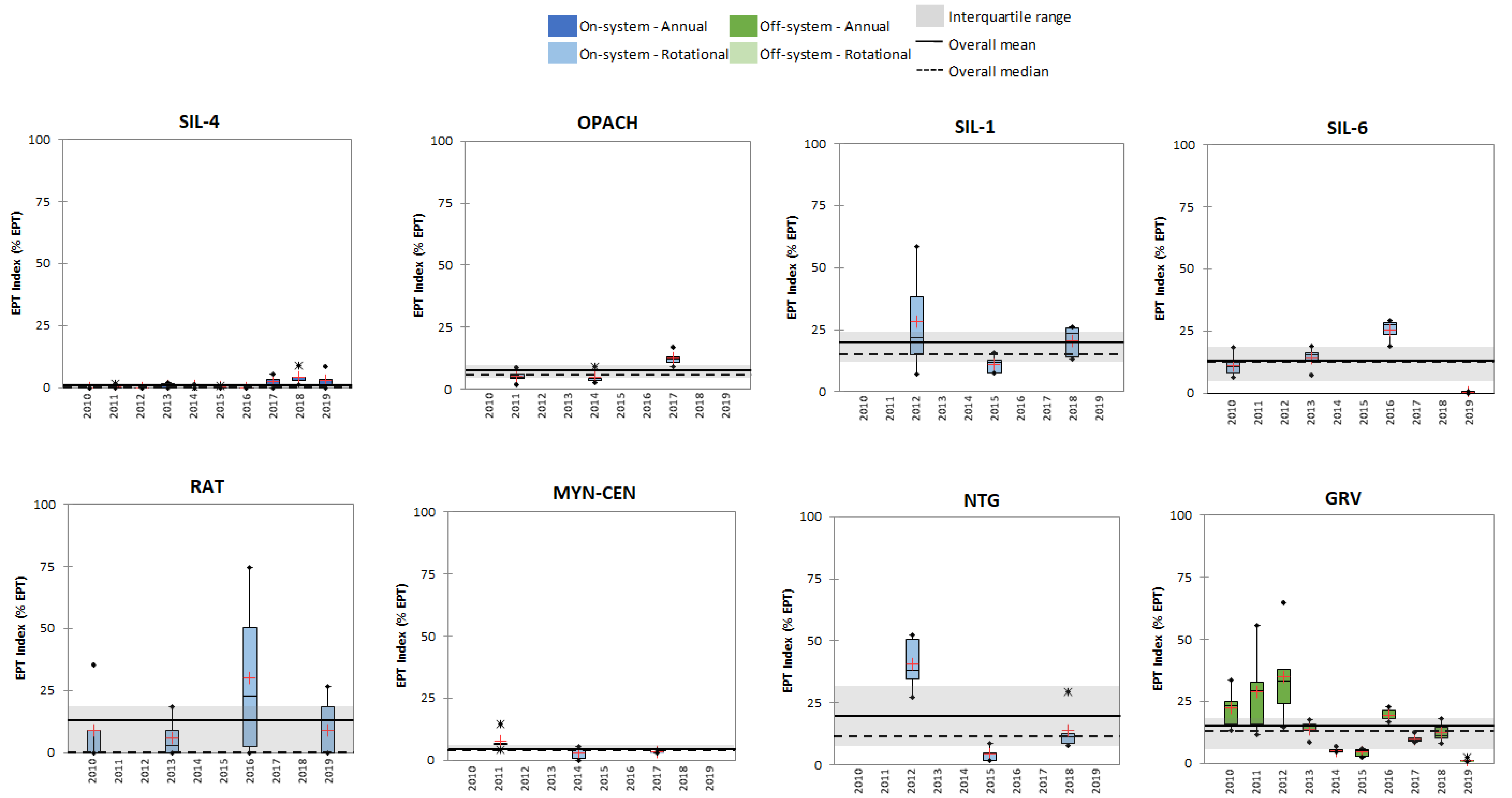


Figure 4.3-2. 2010 to 2019 Offshore benthic invertebrate EPT Index.

4.3.3 O+C INDEX

4.3.3.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean O+C Index over nine years of monitoring (2011 to 2019) ranged from 25% (2017) to 74% (2016; Figure 4.3-3). The overall mean and median were 55% and the IQR was 41% to 74%. Annual means were within the IQR, except in 2013 and 2017 (below).

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean O+C Index in 2010 was 76% (Figure 4.3-3).

Offshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 36% (2015) to 80% (2018; Figure 4.3-4). The overall mean was 61%, the overall median was 66%, and the IQR was 45% to 74%. Annual means were below the IQR in 2015, 2016, and 2017, and above the IQR in 2013 and 2018.

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 38% (2011 and 2014) to 48% (2017; Figure 4.3-3). The overall mean was 42%, the overall median was 40%, and the IQR was 35% to 46%. Annual means were within the IQR, except in 2017 (above).

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 6% (2011) to 11% (2014 and 2017; Figure 4.3-4). The overall mean was 9%, the overall median was 10%, and the IQR was 5% to 12%. Annual means for all years fell within the IQR.

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 15% (2012) to 74% (2015; Figure 4.3-3). The overall mean was 45%, the overall median was 44%, and the IQR was 21% to 72%. Annual means were below the IQR in 2012, and above the IQR in 2015.

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 30% (2012) to 36% (2018; Figure 4.3-4). The overall mean was 32%, the overall median was 29%, and the IQR was 24% to 38%. Annual means for all years fell within the IQR.

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 5% (2010) to 17% (2016; Figure 4.3-3). The overall mean was 9%, the overall median was 7%, and the IQR was 4% to 12%. Annual means were within the IQR, except in 2016 (above).

Offshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 7% (2016) to 27% (2013; Figure 4.3-4). The overall mean was 17%, the overall median was 12%, and the IQR was 8% to 24%. Annual means were below the IQR in 2016, and above the IQR in 2013.

Rat Lake

Nearshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 12% (2019) to 30% (2013; Figure 4.3-3). The overall mean was 23%, the overall median was 22%, and the IQR was 18% to 31%. Annual means were within the IQR, except in 2019 (below).

Offshore Habitat

Annual mean O+C Index over the four years of monitoring ranged from 45% (2019) to 85% (2013; Figure 4.3-4). The overall mean was 64%, the overall median was 69%, and the IQR was 50% to 92%. Annual means were within the IQR, except in 2019 (below).

Central Mynarski Lake

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 40% (2014) to 61% (2017; Figure 4.3-3). The overall mean was 48%, the overall median was 43%, and the IQR was 36% to 60%. Annual means were within the IQR, except in 2017 (above).

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 62% (2017) to 73% (2014; Figure 4.3-4). The overall mean was 68%, the overall median was 69%, and the IQR was 66% to 76%. Annual means were within the IQR, except in 2017 (below).

Notigi Lake

Nearshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 33% (2012) to 40% (2015; Figure 4.3-3). The overall mean was 36%, the overall median was 35%, and the IQR was 30% to 44%. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean O+C Index over the three years of monitoring ranged from 9% (2015) to 29% (2012; Figure 4.3-4). The overall mean was 19%, the overall median was 18%, and the IQR was 11% to 21%. Annual means were below the IQR in 2015, and above the IQR in 2012.

4.3.3.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 12% (2010) to 82% (2016; Figure 4.3-3). The overall mean was 52%, the overall median was 55%, and the IQR was 29% to 74%. Annual means were below the IQR in 2010 and 2011, and above the IQR in 2016, 2017 and 2019.

Offshore Habitat

Annual mean O+C Index over the ten years of monitoring ranged from 7% (2019) to 27% (2010; Figure 4.3-4). The overall mean was 13%, the overall median was 11%, and the IQR was 9% to 14%. Annual means were below the IQR in 2019, and above the IQR in 2010, 2013 and 2017.

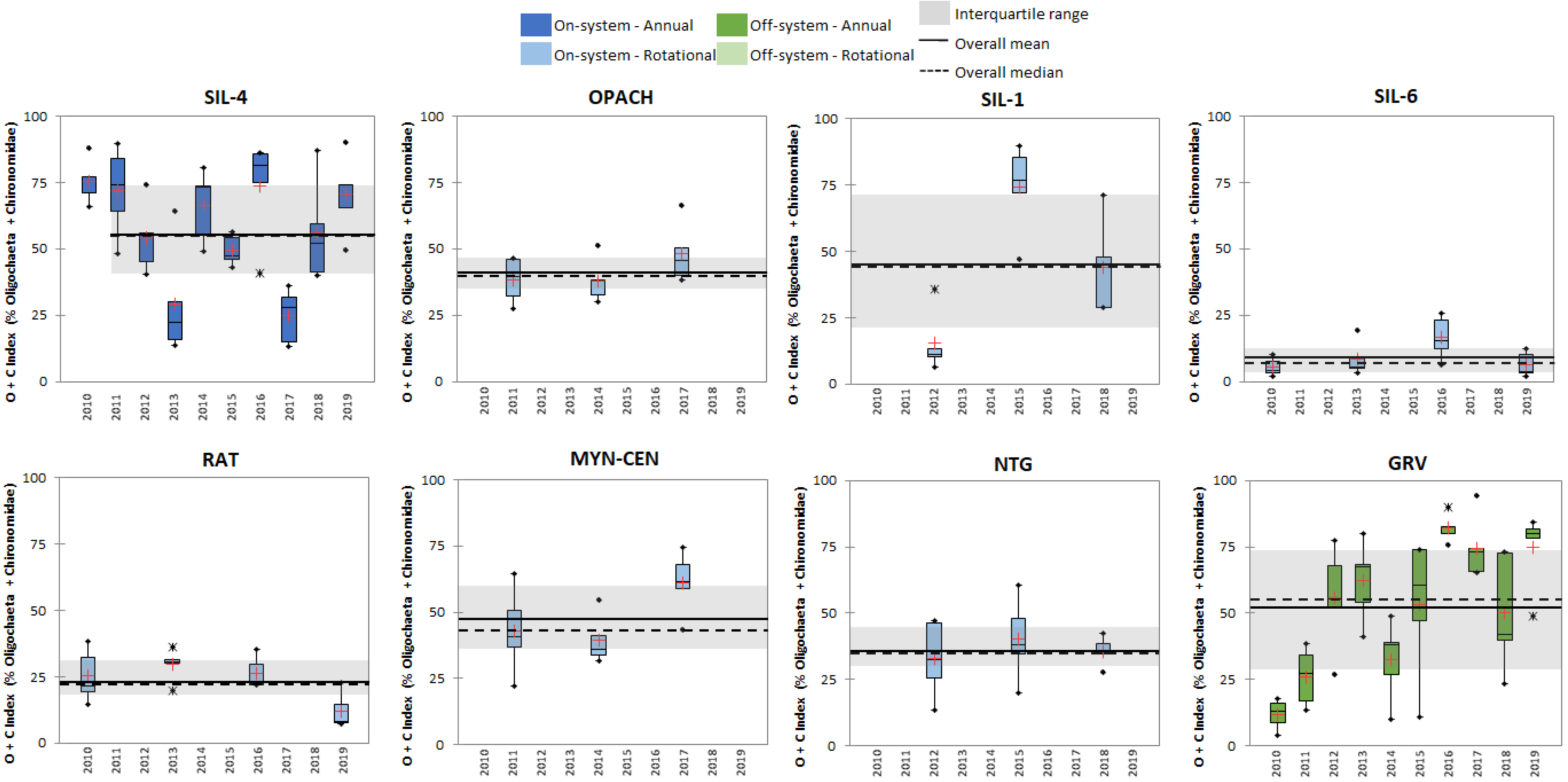


Figure 4.3-3. 2010 to 2019 Nearshore benthic invertebrate O+C Index.

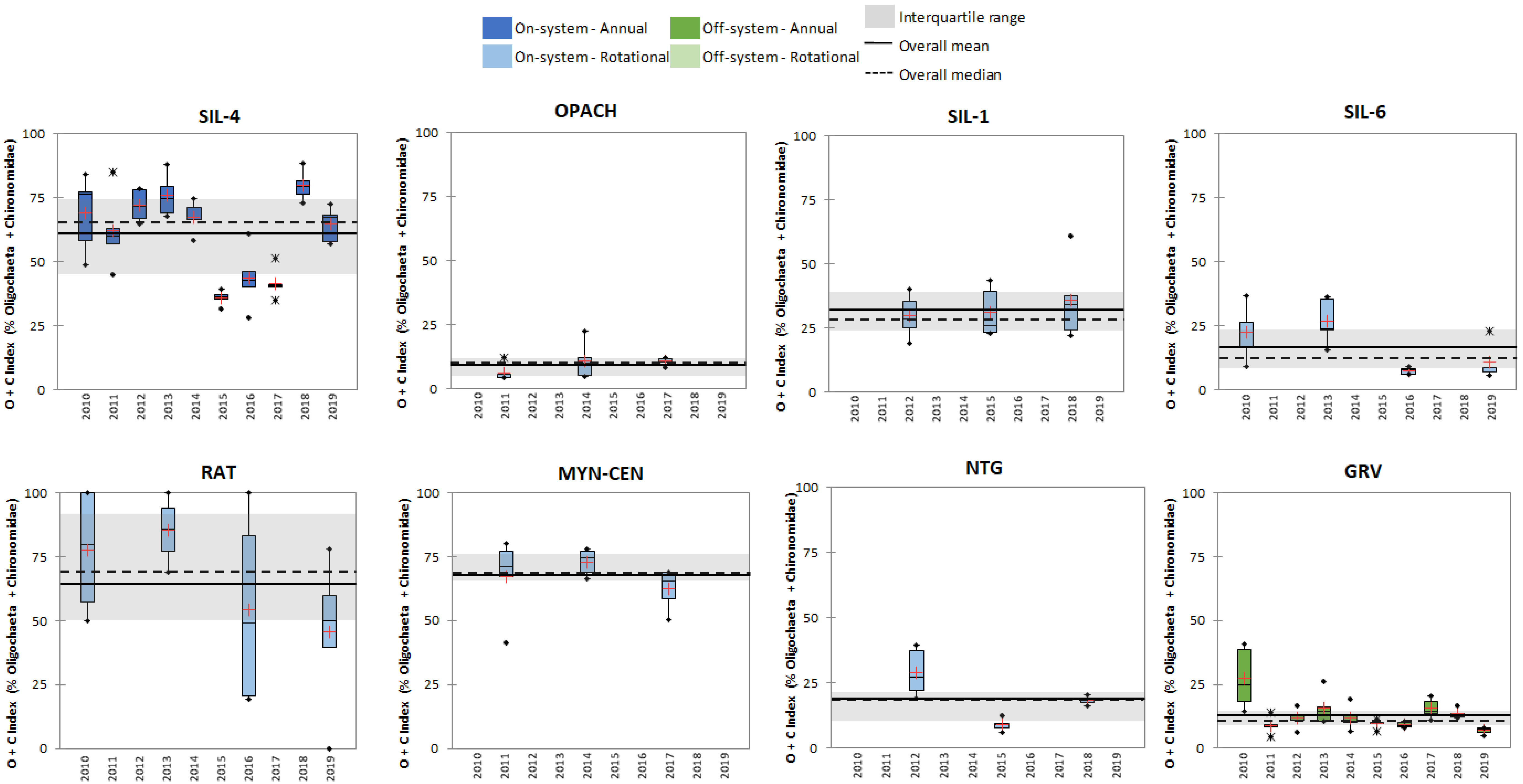


Figure 4.3-4. 2010 to 2019 Offshore benthic invertebrate O+C Index .

4.4 RICHNESS

4.4.1 TOTAL TAXA RICHNESS

4.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean total taxa richness over nine years of monitoring (2011 to 2019) ranged from 13 families (2011) to 22 families (2015; Figure 4.4-1). The overall mean was 18 families, the overall median was 19 families, and the IQR was 14 to 21. Annual means were below the IQR in 2011 and above the IQR in 2015.

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean total taxa richness in 2010 was less than 14 (Figure 4.4-1).

Offshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from more than four families (2010 and 2011) to less than seven families (2013 and 2014; Figure 4.4-2). The overall mean was less than six families, the overall median was six families, and the IQR was 4 to 7 families. Annual means were within the IQR, except in 2018 (above).

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from 17 families (2014) to 18 families (2011 and 2017; Figure 4.4-1). The overall mean and median were 18 families, and the IQR was 15 to 21 families. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from four families (2011) to seven families (2014; Figure 4.4-2). The overall mean and median were five families, and the IQR was 5 to 7 families. Annual means were within the IQR, except in 2011 (below).

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from 17 families (2015 and 2018) to 18 families (2012; Figure 4.4-1). The overall mean was 17 families, the overall median was 19 families, and the IQR was 14 to 21 families. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from less than five families (2015) to more than six families (2018; Figure 4.4-2). The overall mean was more than five families, the overall median was five families, and the IQR was 5 to 6 families. Annual means were below the IQR in 2015, and above the IQR in 2018.

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from 12 families (2010 and 2016) to 18 families (2013; Figure 4.4-1). The overall mean and median were 14 families, and the IQR was 11 to 17 families. Annual means were within the IQR, except in 2013 (above).

Offshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from more than four families (2019) to less than eight families (2013; Figure 4.4-2). The overall mean was more than six families, the overall median was six families, and the IQR was 5 to 7 families. Annual means were below the IQR in 2019, and above the IQR in 2013 and 2016.

Rat Lake

Nearshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from 18 families (2010 and 2019) to 23 families (2013; Figure 4.4-1). The overall mean and median were 20 families, and the IQR was 18 to 22 families. Annual means were below the IQR in 2019, and above the IQR in 2013.

Offshore Habitat

Annual mean total taxa richness over the four years of monitoring ranged from more than two families (2010) to five families (2013; Figure 4.4-2). The overall mean was more than three families, the overall median was three families, and the IQR was 2 to 5 families. Annual means for all years fell within the IQR.

Central Mynarski Lake

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from 16 families (2011) to 23 families (2014; Figure 4.4-1). The overall mean and median were 20 families, and the IQR was 17 to 24 families. Annual means were within the IQR, except in 2011 (below).

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring was between less than eight (2011) and more than eight families (2017; Figure 4.4-2). The overall mean was more than eight families, the overall median was nine families, and the IQR was 7 to 9 families. Annual means for all years fell within the IQR.

Notigi Lake

Nearshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from 14 families (2012) to 20 families (2018; Figure 4.4-1). The overall mean was 17 families, the overall median was 18 families, and the IQR was 14 to 19 families. Annual means were within the IQR, except in 2018 (above).

Offshore Habitat

Annual mean total taxa richness over the three years of monitoring ranged from less than six families (2015) to seven families (2012; Figure 4.4-2). The overall mean was more than six families, the overall median was seven families, and the IQR was more than 5 to 7 families. Annual means for all years fell within the IQR.

4.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from 11 families (2010 and 2019) to 14 families (2013 and 2015; Figure 4.4-1). The overall mean and median were 13 families, and the IQR was 11 to 14 families. Annual means were below the IQR in 2010, and above the IQR in 2013.

Offshore Habitat

Annual mean total taxa richness over the ten years of monitoring ranged from more than five families (2011) to less than nine families (2018; Figure 4.4-2). The overall mean was less than seven families, the overall median was seven families, and the IQR was 6 to 8 families. Annual means were below the IQR in 2011 and 2012, and above the IQR in 2018.

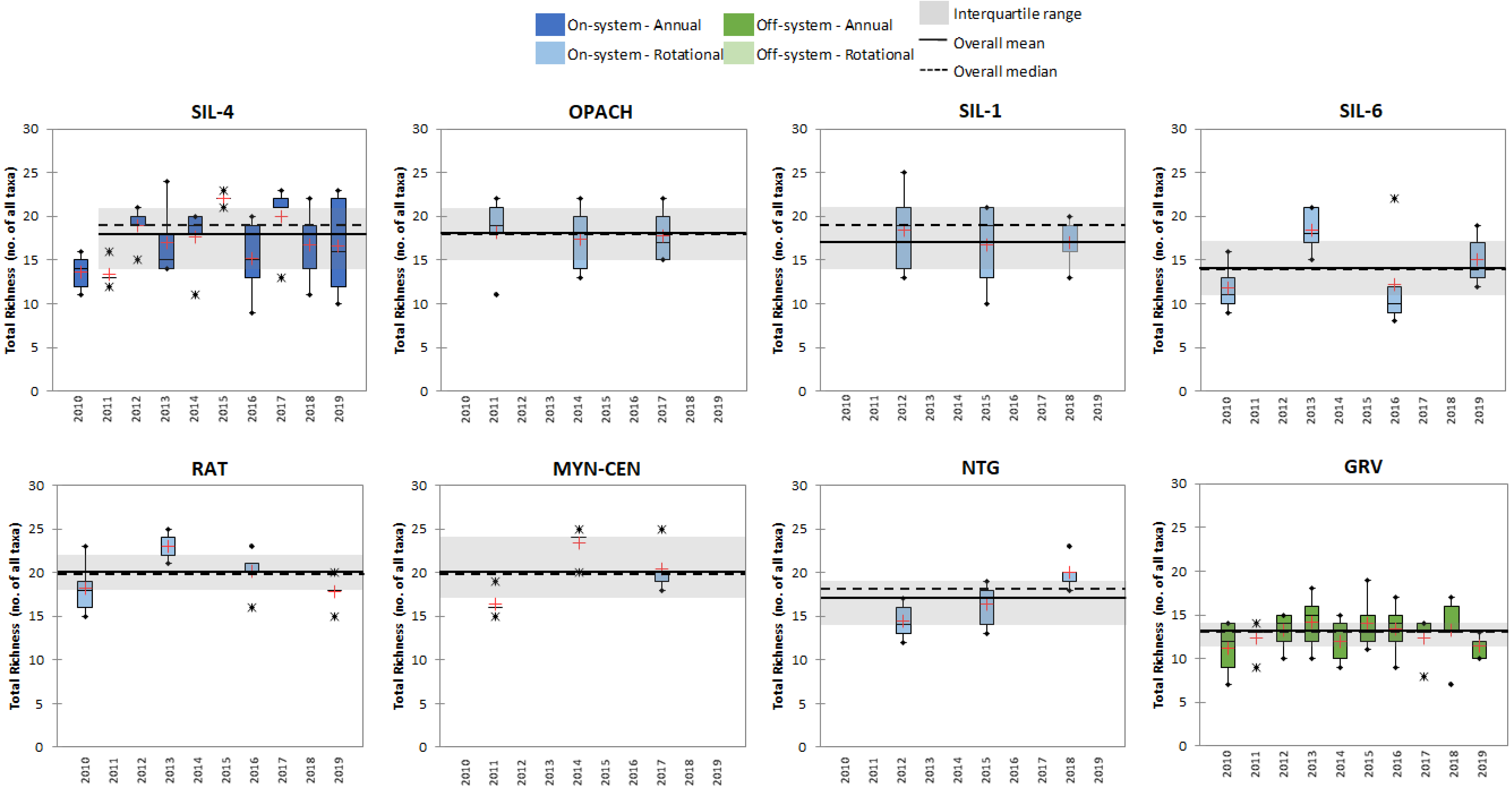


Figure 4.4-1. 2010 to 2019 Nearshore benthic invertebrate total richness (family-level).

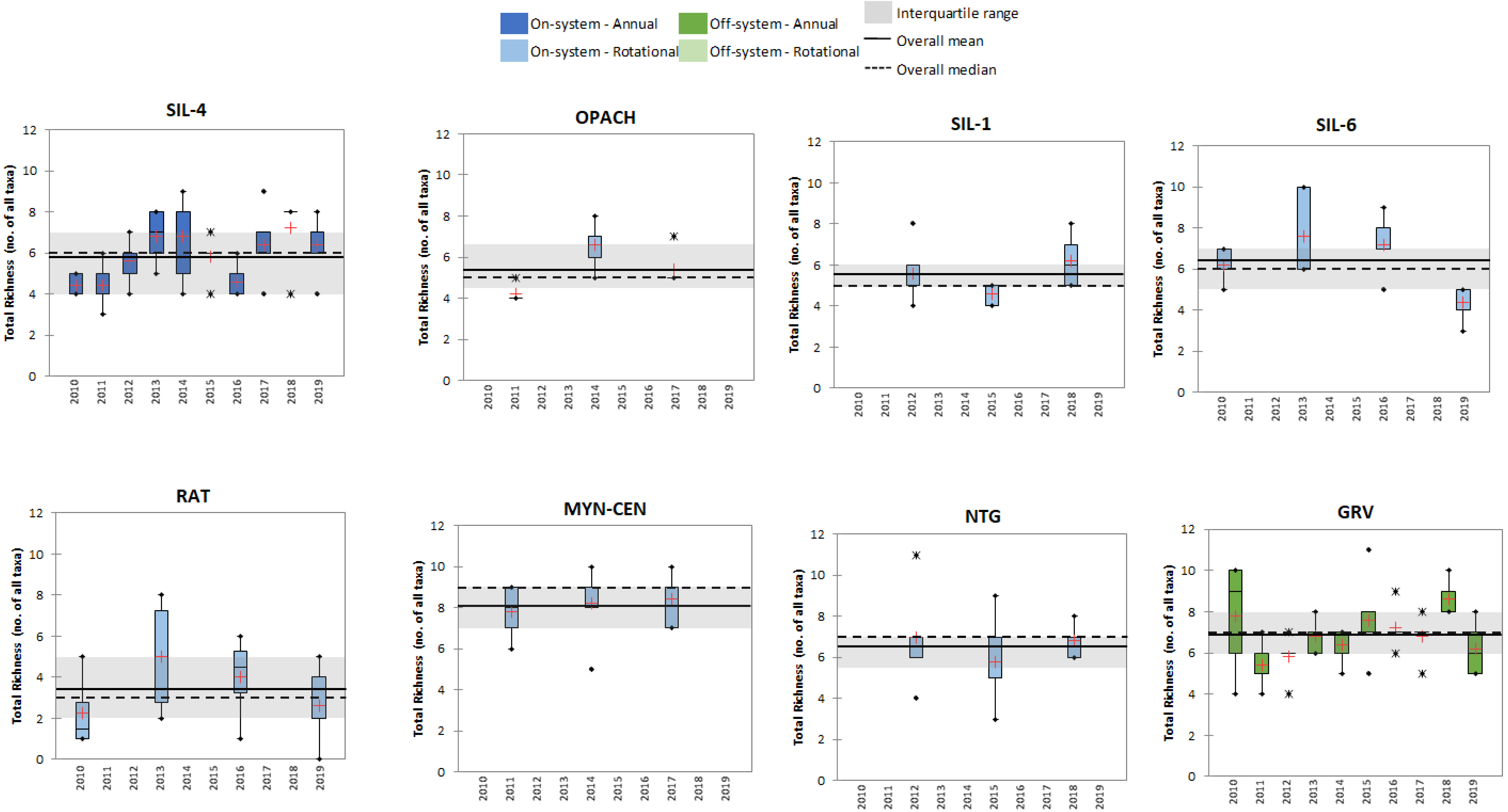


Figure 4.4-2. 2010 to 2019 Offshore benthic invertebrate total richness (family-level).

4.4.2 EPT TAXA RICHNESS

4.4.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean EPT taxa richness over nine years of monitoring (2011 to 2019) ranged from less than four families (2016) to seven families (2017; Figure 4.4-3). The overall mean was less than five families, the overall median was five families, and the IQR was 4 to 6. Annual means were below the IQR in 2016 and above the IQR in 2017.

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean EPT taxa richness in 2010 was less than 4 (Figure 4.4-3).

Offshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from zero (2010, 2012, 2013, and 2016) to one family (2018 and 2019; Figure 4.4-4). The overall mean was less than one family, the overall median was zero, and the IQR was 0 to 1 family. Annual means for all years fell within the IQR.

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from five families (2014) to seven families (2011; Figure 4.4-3). The overall mean was more than six families, the overall median was six families, and the IQR was 5 to 8 families. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring was one family (2011, 2014 and 2017; Figure 4.4-4). The overall mean and median were one family, and the IQR was within 1 family. Annual means for all years fell within the IQR.

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from less than five families (2015) to six families (2018; Figure 4.4-3). The overall mean and median were five families, and the IQR was less than 5 to 7 families. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from one family (2012 and 2015) to less than two families (2018; Figure 4.4-4). The overall mean was more than one family, the overall median was one family, and the IQR was 1 to more than 1 family. Annual means were within the IQR, except in 2018 (above).

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from less than three families (2016) to more than seven families (2013; Figure 4.4-3). The overall mean was more than four families, the overall median was four families, and the IQR was 2 to 7 families. Annual means were within the IQR, except in 2013 (above).

Offshore Habitat

Annual mean EPT taxa richness over the four years of monitoring was between less than one (2019) and more than one family (2013 and 2016; Figure 4.4-4). The overall mean and median were one family, and the IQR was 1 family. Annual means were below the IQR in 2019, and above the IQR in 2013 and 2016.

Rat Lake

Nearshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from less than six families (2010, 2016 and 2019) to less than nine families (2013; Figure 4.4-3). The overall mean and median were six families, and the IQR was 5 to 8 families. Annual means were within the IQR, except in 2013 (above).

Offshore Habitat

Annual mean EPT taxa richness over the four years of monitoring ranged from less than one family (2010, 2016, and 2019) to more than one family (2013; Figure 4.4-4). The overall mean was less than one family, the overall median was zero, and the IQR was 0 to 1 family. Annual means were within the IQR, except in 2013 (above).

Central Mynarski Lake

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from less than six families (2011) to more than eight families (2014; Figure 4.4-3). The overall mean and median were seven families, and the IQR was 6 to 8 families. Annual means were below the IQR in 2011, and above the IQR in 2014.

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from one family (2017) to less than two families (2011; Figure 4.4-4). The overall mean was more than one family, the overall median was one family, and the IQR was 1 to 2 families. Annual means for all years fell within the IQR.

Notigi Lake

Nearshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from more than four families (2012) to more than six families (2018; Figure 4.4-3). The overall mean was more than five families, the overall median was five families, and the IQR was 4 to 6 families. Annual means were within the IQR, except in 2018 (above).

Offshore Habitat

Annual mean EPT taxa richness over the three years of monitoring ranged from more than one family (2015 and 2018) to more than two families (2012; Figure 4.4-4). The overall mean was less than two families, the overall median was one family, and the IQR was 1 to 2 families. Annual means were within the IQR, except in 2012 (above).

4.4.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from less than three families (2019) to more than four families (2013 and 2017; Figure 4.4-3). The overall mean was less than four families, the overall median were four families, and the IQR was 3 to less than 5 families. Annual means were within the IQR, except in 2019 (below).

Offshore Habitat

Annual mean EPT taxa richness over the ten years of monitoring ranged from more than one family (2011, 2014 and 2019) to two families (2016 and 2018; Figure 4.4-4). The overall mean was less than two families, the overall median was two families, and the IQR was 1 to 2 families. Annual means for all years fell within the IQR.

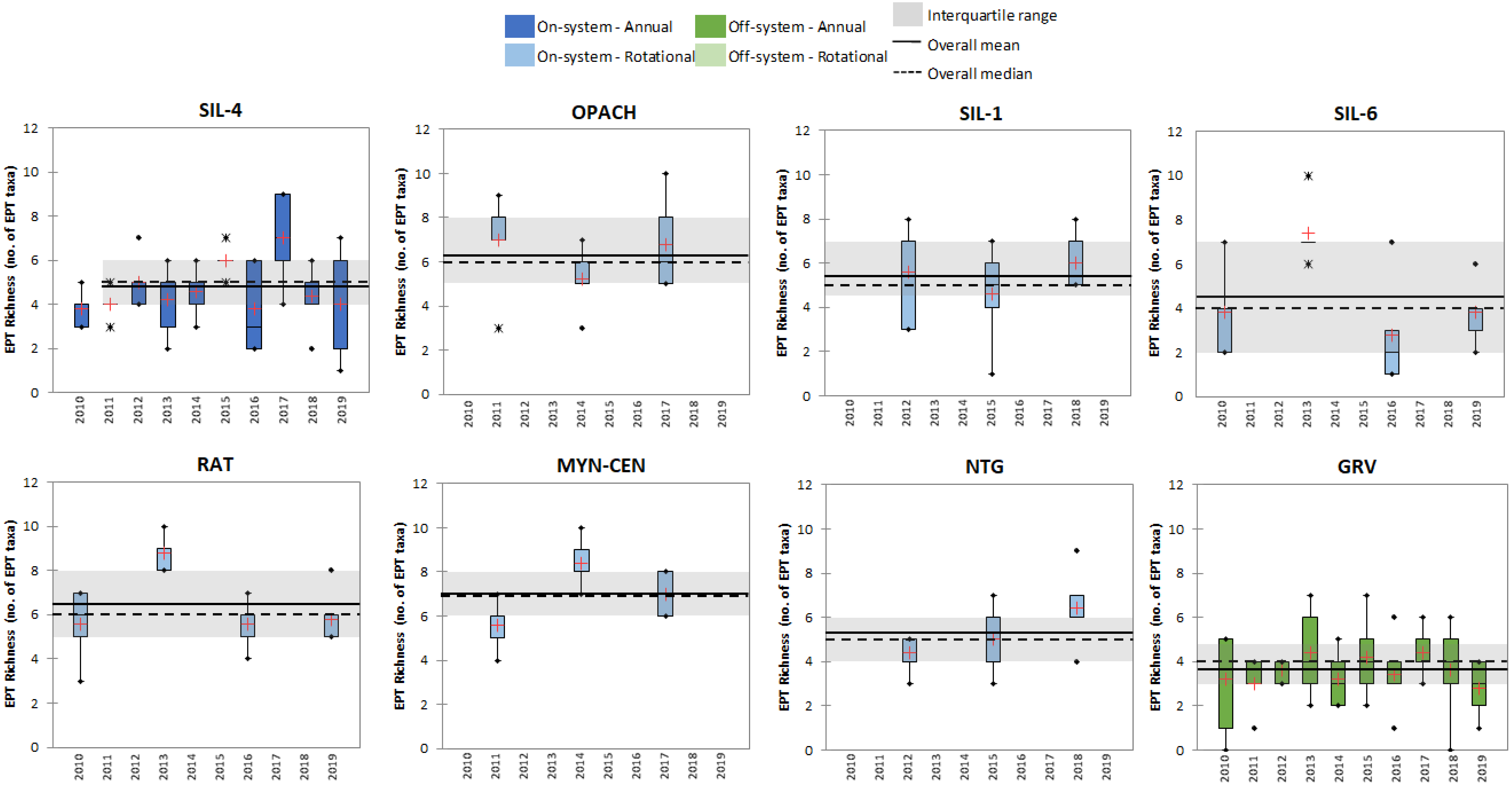


Figure 4.4-3. 2010 to 2019 Nearshore benthic invertebrate EPT richness (family-level).

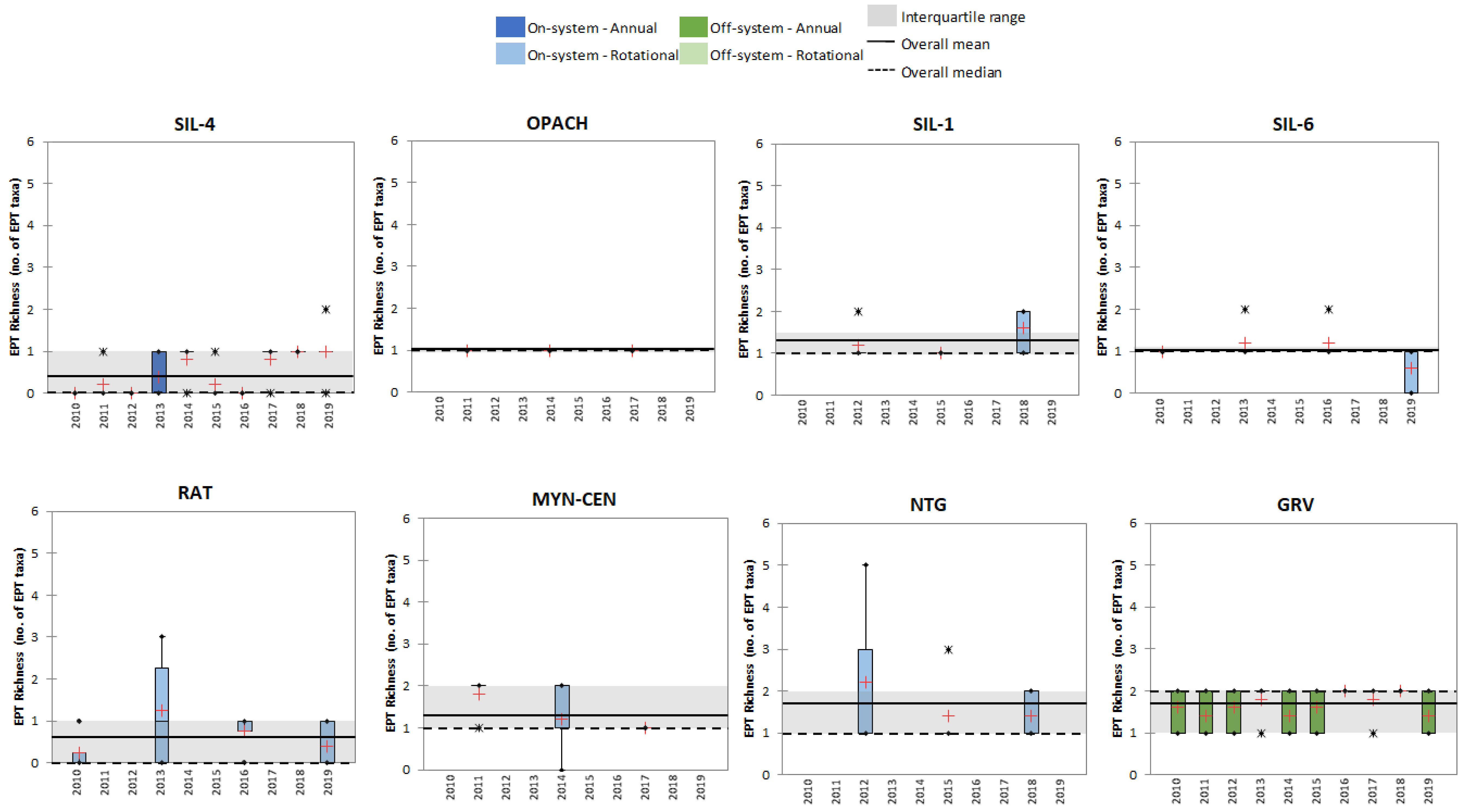


Figure 4.4-4. 2010 to 2019 Offshore benthic invertebrate EPT richness (family-level).

4.5 DIVERSITY

4.5.1 HILL'S EFFECTIVE RICHNESS

4.5.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake – Area 4

Nearshore Habitat

Annual mean Hill's effective richness (Hill's index) over nine years of monitoring (2011 to 2019) ranged from more than four (2014 and 2016) to more than nine (2015; Figure 4.5-1). The overall mean was six, the overall median was less than six, and the IQR was less than 4 to less than 8. Annual means were within the IQR, except 2015 and 2017 (above).

The 2010 data is not directly comparable to 2011 to 2019 and therefore reported separately. Annual mean Hill's index in 2010 was less than 4 (Figure 4.5-1).

Offshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from three (2010 to 2015 and 2018) to four (2016, 2017 and 2019; Figure 4.5-2). The overall mean and median were more than three, and the IQR was 3 to less than 4. Annual means were below the IQR in 2010, and above the IQR in 2017 and 2019.

ROTATIONAL SITES

Opachuanau Lake

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than six (2014 and 2017) to more than seven (2011; Figure 4.5-1). The overall mean and median were more than six, and the IQR was 5 to less than 7. Annual means were within the IQR, except in 2011 (above).

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from two (2011 and 2014) to less than three (2017; Figure 4.5-2). The overall mean and median were two, and the IQR was less than 2 to less than 3. Annual means for all years fell within the IQR.

Southern Indian Lake – Area 1

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than five (2015) to more than seven (2018; Figure 4.5-1). The overall mean was more than six, the overall median was more than seven, and the IQR was less than 5 to less than 8. Annual means were within the IQR, except in 2015 (below).

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than three (2015) to four (2012; Figure 4.5-2). The overall mean was less than four, the overall median was more than three, and the IQR was 3 to less than 4. Annual means were below the IQR in 2015, and above the IQR in 2012.

Southern Indian Lake – Area 6

Nearshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from less than four (2010) to more than six (2013; Figure 4.5-1). The overall mean and median were more than five, and the IQR was less than 4 to more than 6. Annual means for all years fell within the IQR.

Offshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from less than two (2019) to more than four (2013; Figure 4.5-2). The overall mean was more than three, the overall median was less than four, and the IQR was less than 3 to more than 4. Annual means were below the IQR in 2019, and above the IQR in 2013.

Rat Lake

Nearshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from more than six (2019) to less than ten (2013; Figure 4.5-1). The overall mean and median were more than seven, and the IQR was more than 6 to more than 8. Annual means were below the IQR in 2019, and above the IQR in 2013.

Offshore Habitat

Annual mean Hill's index over the four years of monitoring ranged from less than two (2010) to less than three (2013 and 2016; Figure 4.5-2). The overall mean and median were more than two, and the IQR was less than 2 to less than 3. Annual means were within the IQR, except in 2013 (above).

Central Mynarski Lake

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from five (2011) to less than nine (2014; Figure 4.5-1). The overall mean and median were less than seven, and the IQR was less than 5 to more than 7. Annual means were within the IQR, except in 2014 (above).

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than four (2011) to less than five (2017; Figure 4.5-2). The overall mean and median were more than four, and the IQR was less than 4 to less than 5. Annual means were below the IQR in 2011, and above the IQR in 2017.

Notigi Lake

Nearshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than five (2012) to more than six (2018; Figure 4.5-1). The overall mean and median were less than six, and the IQR was more than 5 to less than 6. Annual means were below the IQR in 2012, and above the IQR in 2018.

Offshore Habitat

Annual mean Hill's index over the three years of monitoring ranged from less than two (2015) to less than four (2012; Figure 4.5-2). The overall mean and median were less than three, and the IQR was 2 to less than 4. Annual means were within the IQR, except in 2012 (above).

4.5.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Nearshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from more than two (2010) to six (2018; Figure 4.5-1). The overall mean was less than five, the overall median was more than four, and the IQR was less than 4 to less than 6. Annual means were below the IQR in 2010 and 2016, and above the IQR in 2011, 2013 and 2018.

Offshore Habitat

Annual mean Hill's index over the ten years of monitoring ranged from less than two (2019) to more than four (2010; Figure 4.5-2). The overall mean was more than three, the median was three, and the IQR was more than 2 to less than 4. Annual means were below the IQR in 2015 and 2019, and above the IQR in 2010.

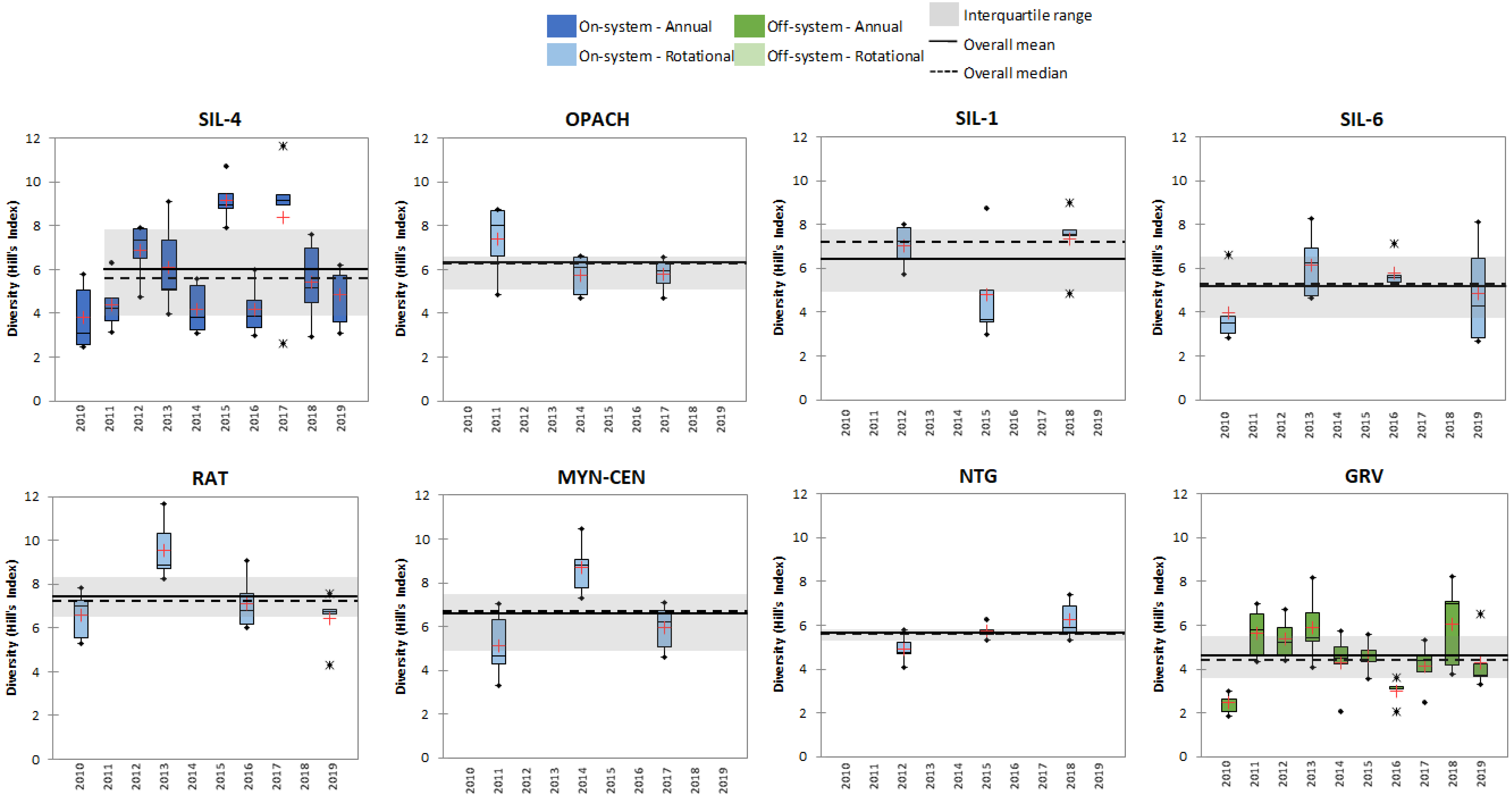


Figure 4.5-1. 2010 to 2019 Nearshore benthic invertebrate diversity (Hill's Index to family-level).

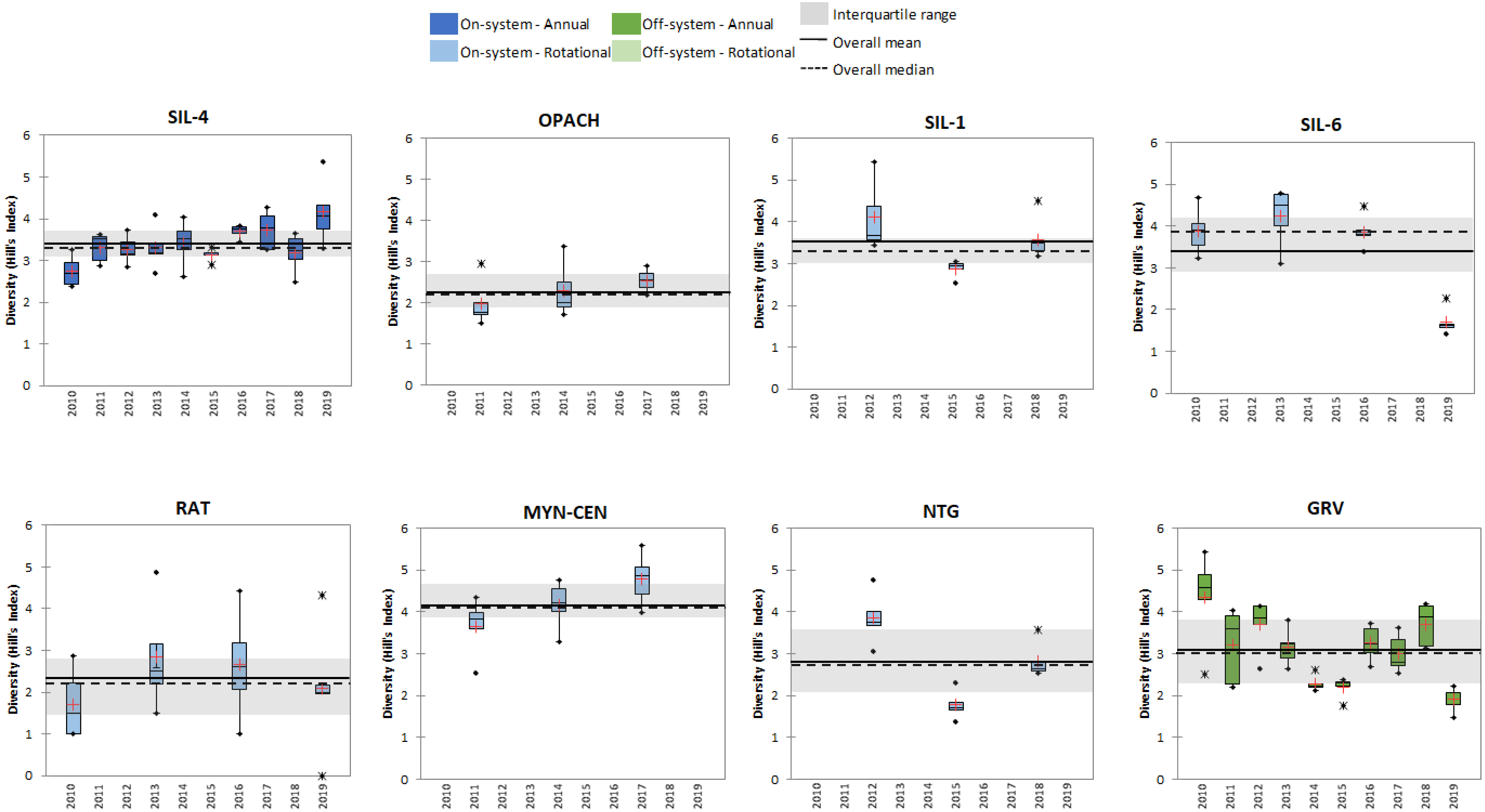


Figure 4.5-2. 2010 to 2019 Offshore benthic invertebrate diversity (Hill's Index to family-level).

APPENDIX 4-1. BENTHIC INVERTEBRATE NEARFSHORE AND OFFSHORE SAMPLING SITES: 2008-2019

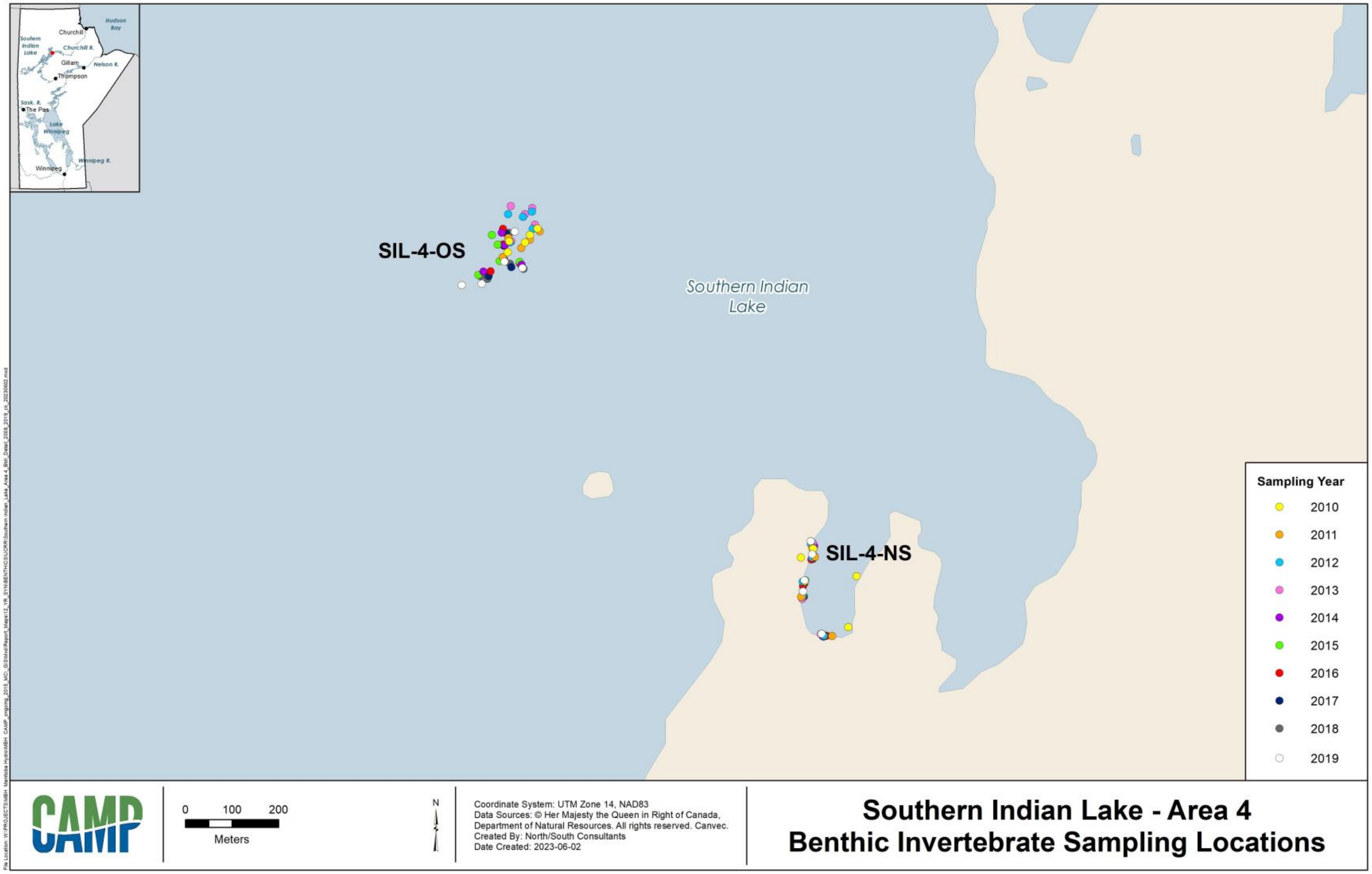


Figure A4-1-1. 2010 to 2019 Southern Indian Lake – Area 4 nearshore (NS) and offshore (OS) benthic invertebrate sampling sites. 2010 NS sampled with benthic grab due to site safety concerns.

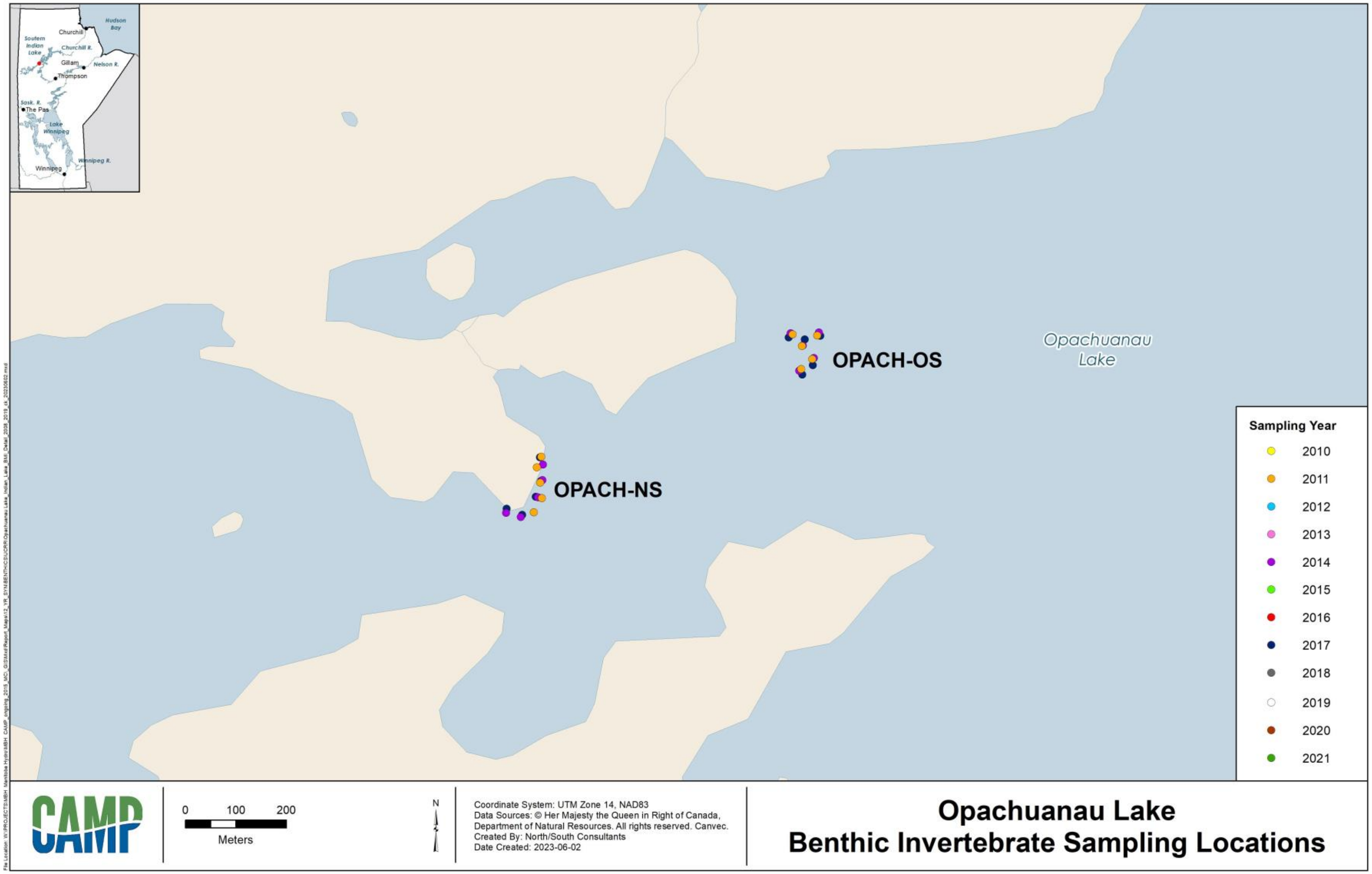


Figure A4-1-2. 2010 to 2019 Opachuanau Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

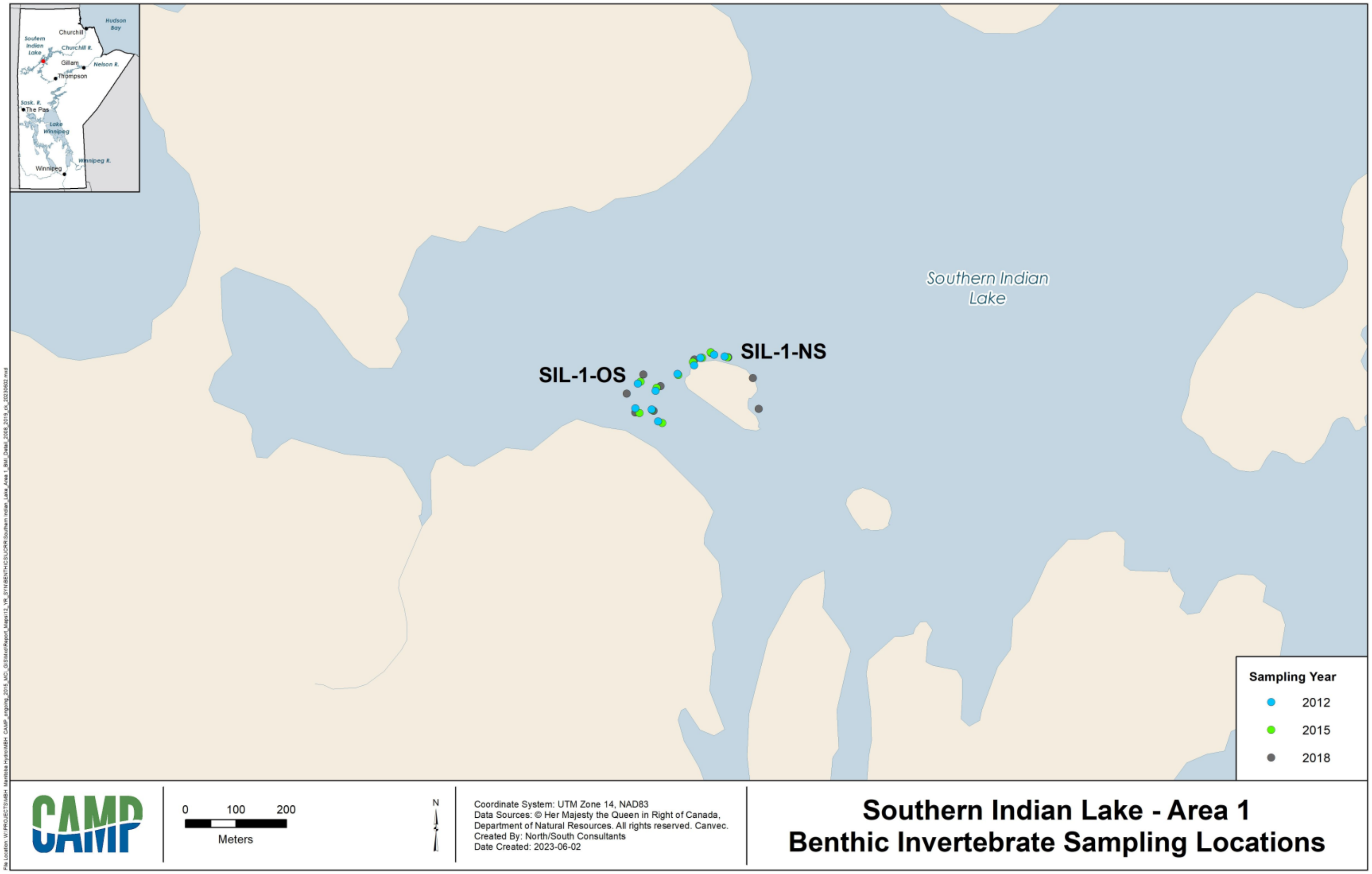


Figure A4-1-3. 2010 to 2019 Southern Indian Lake – Area 1 nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

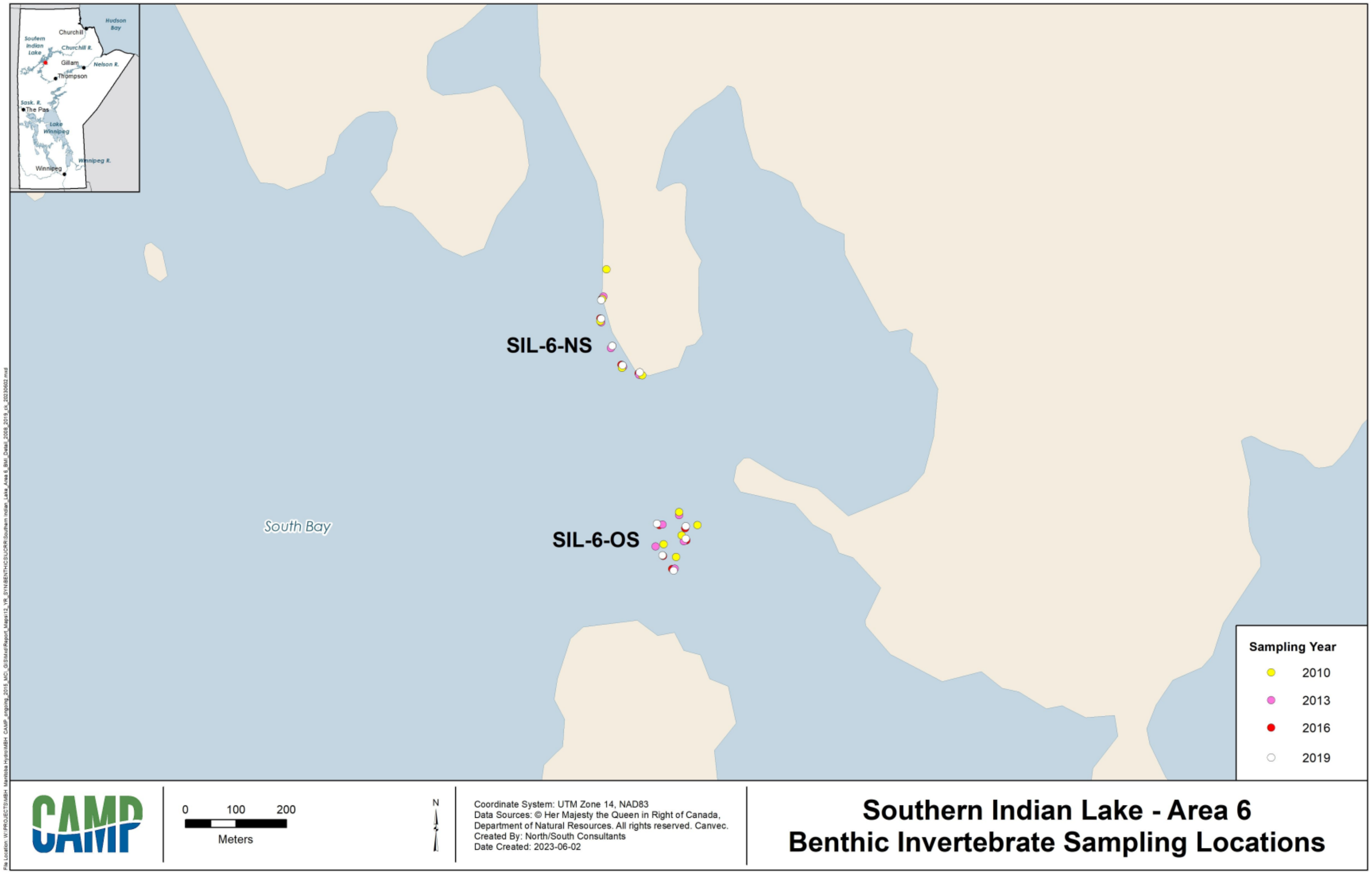


Figure A4-1-4. 2010 to 2019 Southern Indian Lake – Area 6 nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

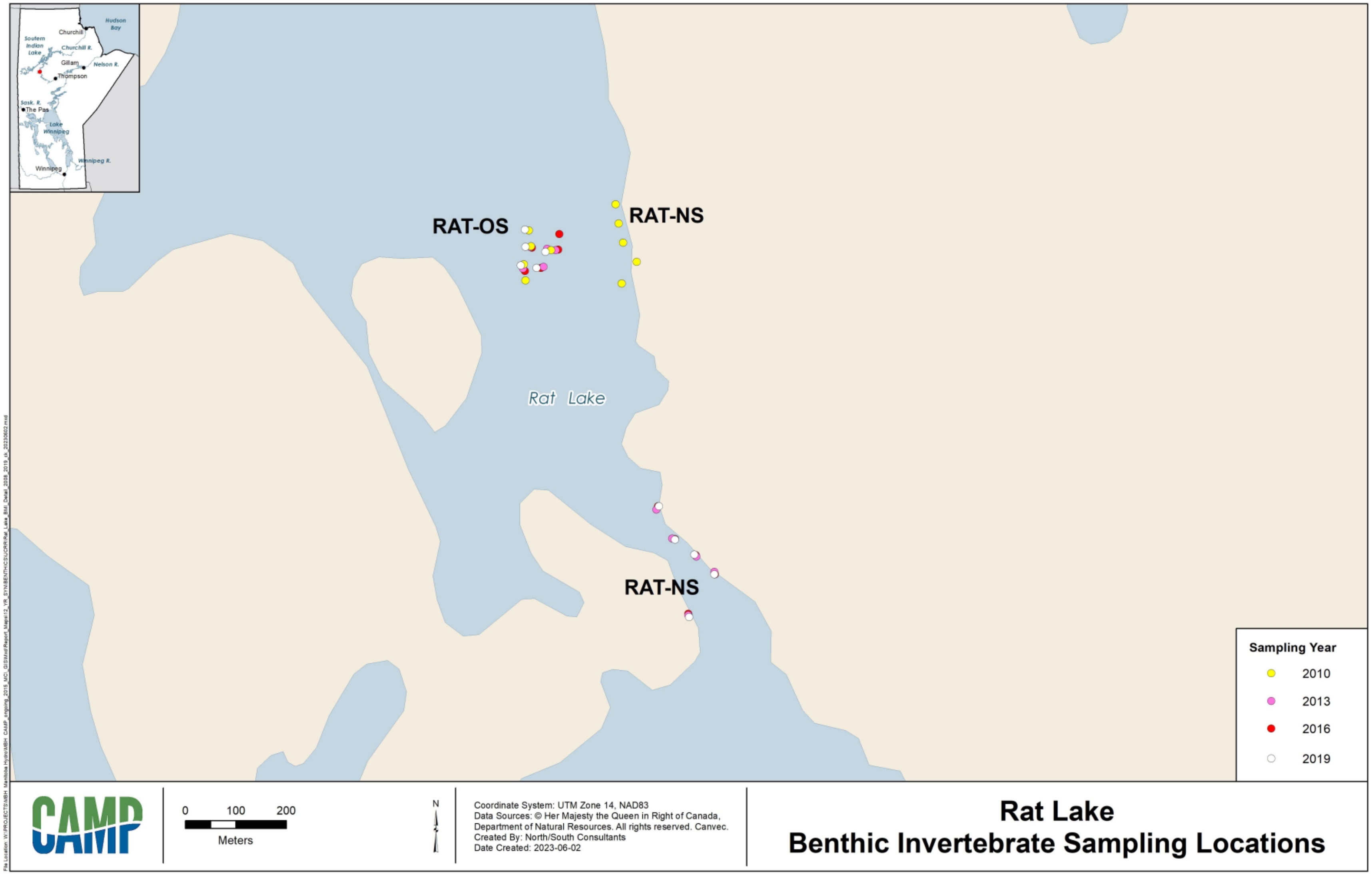


Figure A4-1-5. 2010 to 2019 Rat Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

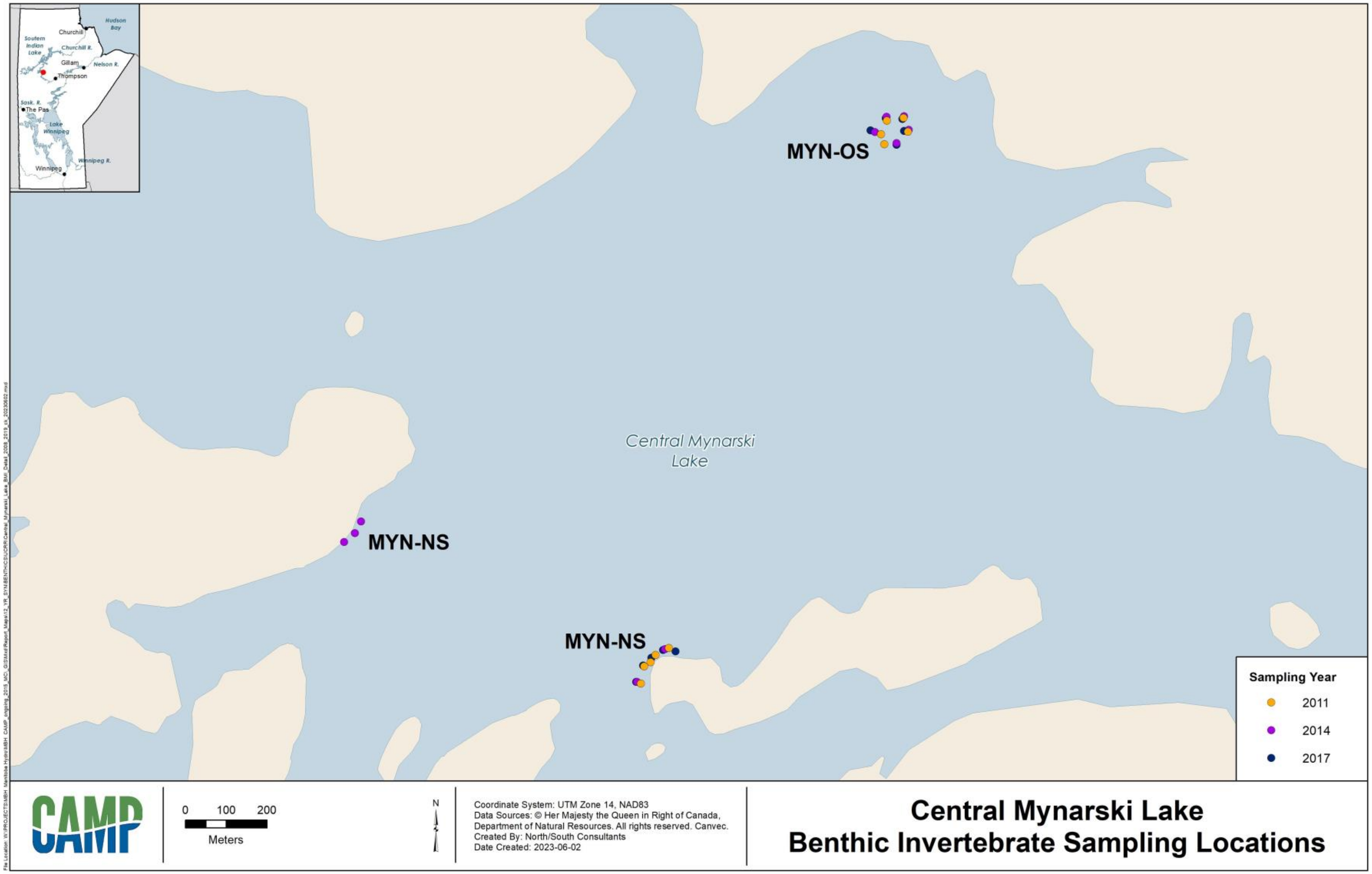


Figure A4-1-6. 2010 to 2019 Central Mynarski Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

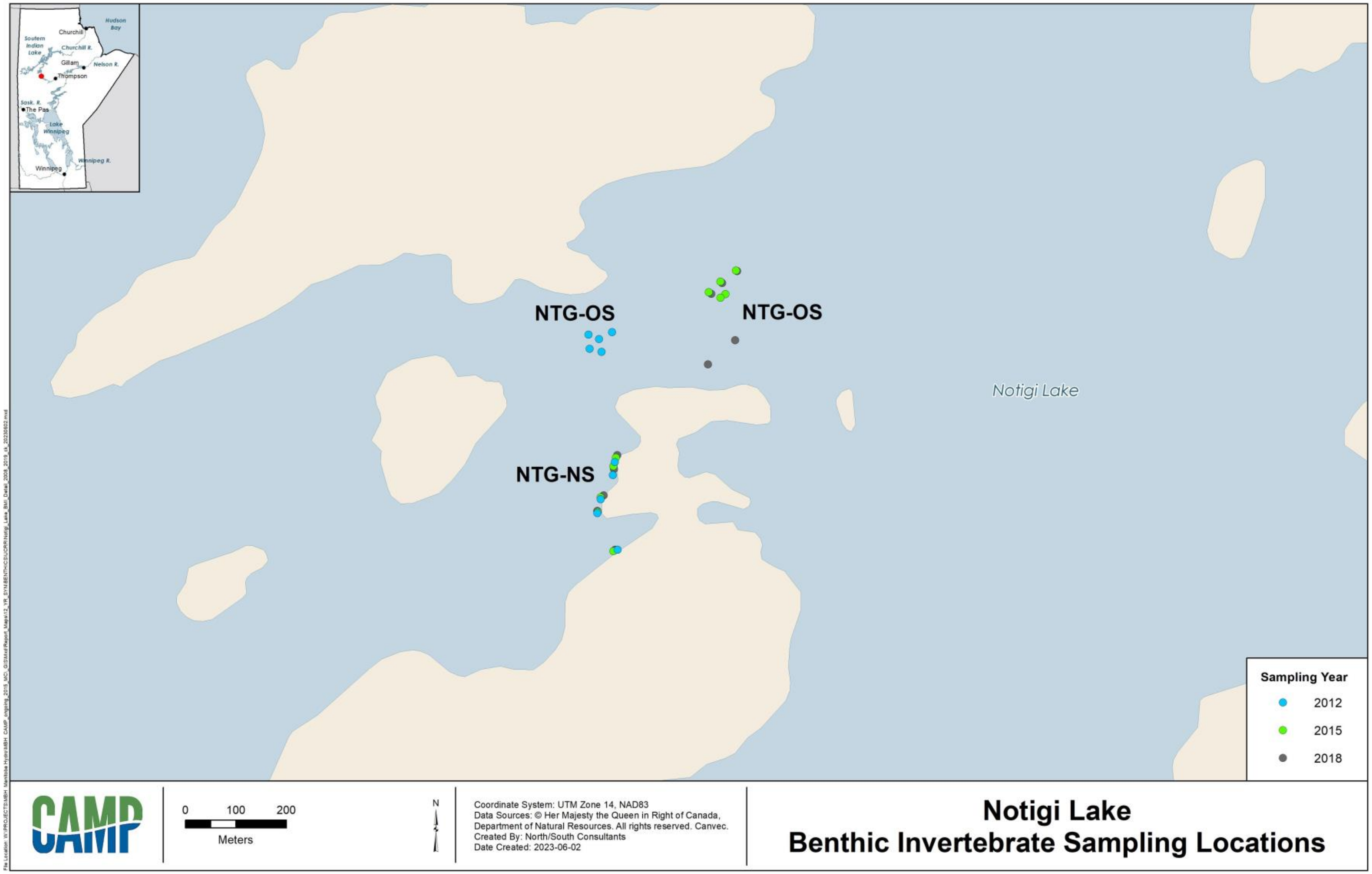


Figure A4-1-7. 2010 to 2019 Notigi Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

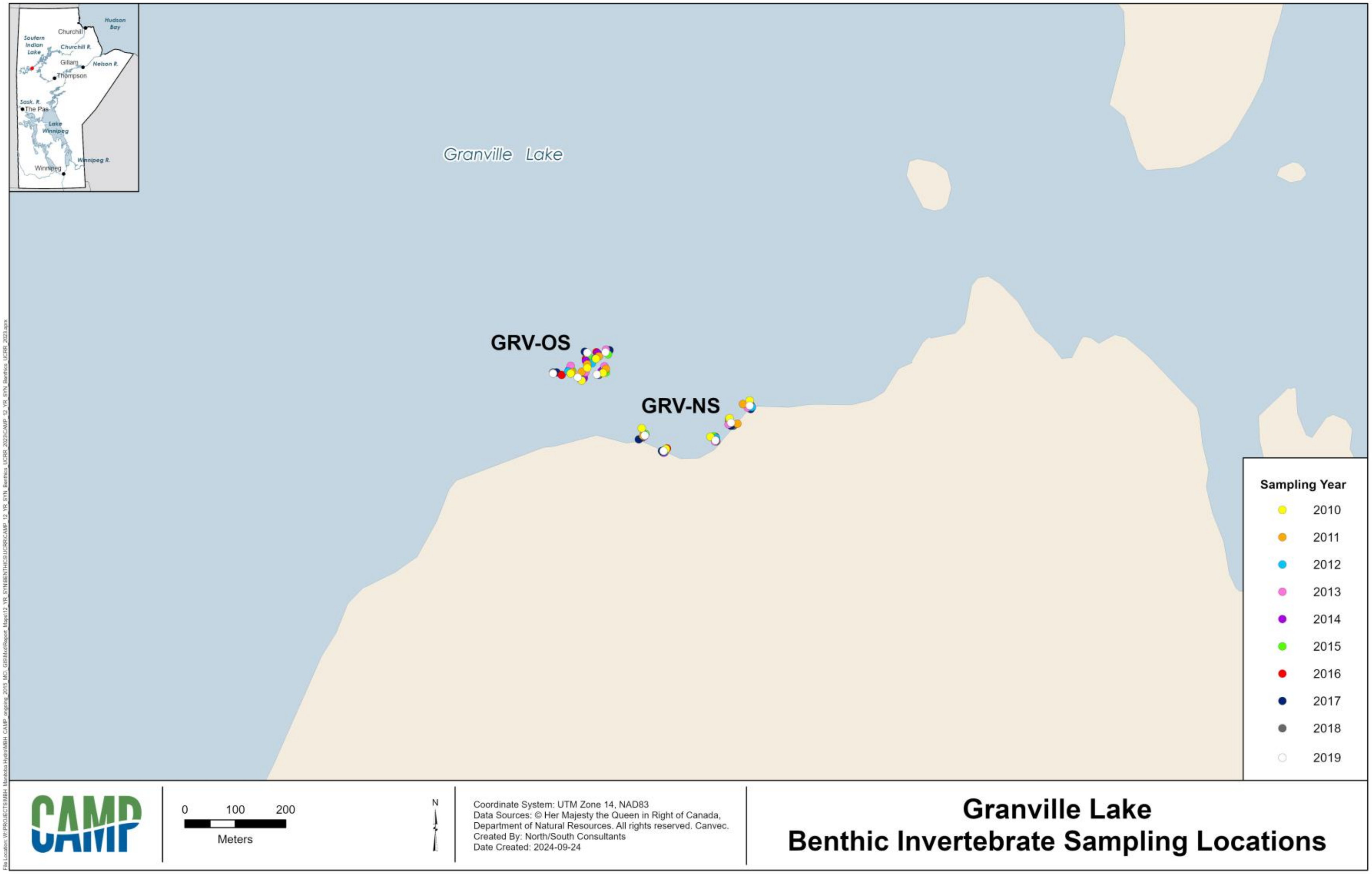


Figure A4-1-8. 2010 to 2019 Granville Lake nearshore (NS) and offshore (OS) benthic invertebrate sampling sites.

APPENDIX 4-2. BENTHIC INVERTEBRATE NEARSHORE AND OFFSHORE SUPPORTING SUBSTRATE DATA BY YEAR

Table A4-2-1. 2010 to 2019 Southern Indian Lake – Area 4 nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010[1]	hard	no sample	-	-	-	-	-
2011	hard and organics	0.7	77.5	11.0	11.6	0.7	Sand
2012	fines, coarse, and hard	0.8	61.4	9.3	29.4	0.6	Sand
2013	fines	0.4	86.6	8.4	5.1	0.3	Sand
2014	hard, coarse, and fines	0.4	60.4	20.0	19.7	0.3	Sandy loam
2015	fines, coarse, and hard	0.3	99.8	-	0.2	-	Sand
2016	fines and hard	0.7	81.8	24.6	10.7	1.1	Sand
2017	hard and fines	0.9	99.1	-	-	-	Sand
2018	hard, coarse, and fines	0.2	100.0	-	-	0.2	Sand
2019	hard, coarse, fines, and organics	0.2	99.3	-	-	0.3	Sand

Notes:

1. Nearshore polygon sampled with benthic grab due to site safety concerns.
2. TOC = Total organic carbon.

Table A4-2-2. 2010 to 2019 Southern Indian Lake – Area 4 offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines and coarse	9.0	76.8	12.5	10.7	0.7	Sandy loam
2011	fines and coarse	9.3	70.0	12.3	17.8	0.8	Sandy loam
2012	fines	9.1	81.1	8.6	10.3	0.5	Sand / Loamy sand
2013	fines	9.2	77.7	11.1	11.2	0.5	Sandy loam
2014	fines and coarse	9.3	68.7	16.2	15.1	0.8	Sandy loam
2015	fines and coarse	9.3	71.1	16.2	12.6	0.6	Sandy loam
2016	fines	9.6	81.4	14.6	4.0	0.7	Sandy loam
2017	fines	9.2	67.1	16.7	16.2	0.7	Sandy loam
2018	fines and coarse	9.4	64.0	21.9	14.1	1.1	Sandy loam
2019	fines, coarse, and organics	9.8	57.9	23.0	19.1	1.1	Sandy loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-3. 2010 to 2019 Opachuanau Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	hard and coarse	1.0	39.9	19.7	40.4	0.6	Sandy loam
2014	hard, coarse, and fines	0.6	46.4	16.2	37.3	0.5	Loamy sand
2017	hard	0.4	5.0	61.1	33.9	0.9	Silty clay loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-4. 2010 to 2019 Opachuanau Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2011	fines	9.0	1.0	39.1	59.9	2.0	Silty clay
2014	fines	8.8	1.1	50.9	48.1	2.2	Silty clay
2017	fines	8.9	-	49.2	50.1	2.0	Silty clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-5. 2010 to 2019 Southern Indian Lake – Area 1 nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	hard and organics	0.5	33.1	19.0	48.0	1.9	Clay
2015	hard, coarse, fines, and organics	no sample	-	-	-	-	-
2018	hard	no sample	-	-	-	-	-

Notes:

1. TOC = Total organic carbon.

Table A4-2-6. 2010 to 2019 Southern Indian Lake – Area 1 offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	fines	7.0	21.3	28.3	50.4	1.0	Clay
2015	fines	6.7	5.6	61.2	33.2	0.7	Silty clay
2018	fines and coarse	6.7	3.4	43.3	54.4	1.0	Silty clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-7. 2010 to 2019 Southern Indian Lake – Area 6 nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	hard and coarse	no sample	-	-	-	-	-
2013	hard	0.6	96.4	2.1	1.6	-	Sand
2016	coarse and hard	no sample	-	-	-	-	-
2019	hard, coarse, fines, and organics	no sample	-	-	-	-	-

Notes:

1. TOC = Total organic carbon.

Table A4-2-8. 2010 to 2019 Southern Indian Lake – Area 6 offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines	9.1	0.5	43.7	55.8	1.2	Silty clay
2013	fines	9.2	0.4	47.5	52.1	0.8	Silty clay
2016	fines	9.3	-	60.3	39.3	1.0	Silt clay loam/ silty clay
2019	fines	9.2	-	47.4	52.4	0.8	Silty clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-9. 2010 to 2019 Rat Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	organics and fines	0.8	1.6	27.8	70.6	7.8	Clay
2013	fines	0.5	12.5	21.2	66.4	0.8	Clay
2016	fines	0.6	12.3	43.7	44.1	1.2	Clay
2019	fines	0.3	25.8	28.6	45.5	1.1	Clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-10. 2010 to 2019 Rat Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines and organics	7.9	0.2	34.9	64.9	3.8	Clay
2013	fines	7.5	0.1	32.5	67.4	1.9	Clay
2016	fines	7.5	-	34.0	65.9	1.2	Clay
2019	fines	8.4	-	34.5	65.5	1.6	Clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-11. 2010 to 2019 Central Mynarski Lake nearshore supporting benthic substrate data.

Year	**Dominant Substrate**	**Sample Water Depth (m)**	**Supporting Substrate Analysis**				
			Mean Particle Size (%)			**Mean TOC (%)**	**Texture**
			Sand	**Silt**	**Clay**		
2011	hard and fines	no sample	-	-	-	-	-
2014	fines, hard, and coarse	1.1	8.7	33.1	58.2	0.5	-
2017	coarse	0.5	15.9	13.9	70.2	0.9	Clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-12. 2010 to 2019 Central Mynarski Lake offshore supporting benthic substrate data.

Year	**Dominant Substrate**	**Sample Water Depth (m)**	**Supporting Substrate Analysis**				
			Mean Particle Size (%)			**Mean TOC (%)**	**Texture**
			Sand	**Silt**	**Clay**		
2011	fines	6.8	84.2	4.0	11.8	0.6	Loamy sand
2014	fines and coarse	6.6	82.1	7.0	10.9	0.7	Sandy loam
2017	fines	6.6	80.5	7.3	12.2	0.6	Sandy loam

Notes:

1. TOC = Total organic carbon.

Table A4-2-13. 2010 to 2019 Notigi Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	fines and organics	0.4	11.7	66.0	22.2	1.6	Silt loam
2015	fines, organics, and coarse	0.3	3.1	66.7	30.1	0.4	Silt loam
2018	fines and organics	0.2	5.6	45.5	48.9	0.7	Silty clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-14. 2010 to 2019 Notigi Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2012	organics and fines	7.1	0.8	41.7	57.5	7.9	Silty clay
2015	fines and organics	9.6	0.5	48.7	51.1	2.6	Silty clay
2018	fines and organics	9.3	-	49.3	50.6	4.3	Silty clay

Notes:

1. TOC = Total organic carbon.

Table A4-2-15. 2010 to 2019 Granville Lake nearshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	hard	no sample	-	-	-	-	-
2011	hard	no sample	-	-	-	-	-
2012	hard	no sample	-	-	-	-	-
2013	hard	no sample	-	-	-	-	-
2014	hard	no sample	-	-	-	-	-
2015	hard	no sample	-	-	-	-	-
2016	hard	no sample	-	-	-	-	-
2017	hard	no sample	-	-	-	-	-
2018	hard	no sample	-	-	-	-	-
2019	hard	no sample	-	-	-	-	-

Notes:

1. TOC = Total organic carbon.

Table A4-2-16. 2010 to 2019 Granville Lake offshore supporting benthic substrate data.

Year	Dominant Substrate	Sample Water Depth (m)	Supporting Substrate Analysis				
			Mean Particle Size (%)			Mean TOC (%)	Texture
			Sand	Silt	Clay		
2010	fines and organics	9.1	5.1	76.4	18.5	2.7	Silt loam
2011	fines	9.7	3.1	49.1	47.8	2.1	Silty clay
2012	fines and coarse	9.7	2.1	52.1	45.8	2.3	Silty clay
2013	fines	9.8	1.8	45.0	53.3	2.2	Silty clay
2014	fines	9.9	2.3	42.8	54.9	2.5	Silty clay
2015	fines	9.2	1.5	46.5	52.1	2.4	Silty clay
2016	fines	9.4	8.3	46.7	48.1	2.2	Silty clay
2017	fines	11.3	4.4	45.6	51.4	2.5	Silty clay
2018	fines	11.1	3.0	52.1	45.9	2.7	Silty clay
2019	fines and organics	10.2	3.6	45.2	52.4	2.4	Silty clay

Notes:

1. TOC = Total organic carbon.

5.0 FISH COMMUNITY

5.1 INTRODUCTION

The following presents the results of fish community monitoring conducted from 2008 to 2019 in the Upper Churchill River Region. Eight waterbodies were monitored in the Upper Churchill River Region: one on-system annual site (Southern Indian Lake - Area 4); six on-system rotational sites (Opachuanau Lake, Southern Indian Lake - Area 1, Southern Indian Lake - Area 6, Rat Lake, Mynarski Lake, and Notigi Lake); and one off-system annual site (Granville Lake; Table 5.1-1 and Figure 5.1-1).

There were no departures from the planned field sampling during the 12-year period.

Monitoring targets both small-bodied fish species (i.e., forage fish) and large-bodied fish species (e.g., fish targeted in subsistence, commercial, and/or recreational fisheries). Within a given waterbody, sampling was conducted at approximately the same time of year during each year of monitoring. Standard gang index gill nets (GN; 51, 76, 95, 108, and 127 mm stretched mesh panels) were set at each site and a small mesh index gillnet gang (SN; 16, 20, and 25 mm bar measure panels) was attached to the end of the standard gang at approximately every third site (Appendix 5-1). Gill nets were set for approximately 24 hours (h). All fish captured at each site were counted by mesh size and species. Individual metrics (e.g., length, weight, deformities, erosion, lesions, and tumours [DELTs], sex and maturity, age) were collected for species of management interest (i.e., "target" species). These include: Lake Whitefish (*Coregonus clupeaformis*), Walleye (*Sander vitreus*) and Northern Pike (*Esox lucius*) from all waterbodies in all years; Sauger (*S. canadensis*) from Notigi in all years, and the rest of the waterbodies starting in 2017; and White Sucker (*Catostomus commersonii*) from all waterbodies starting in 2010. All other species were bulk weighed.

Five fish community indicators (abundance, condition, growth, recruitment, and community diversity) were selected for detailed reporting (Table 5.1-2). Metrics for these indicators that are presented herein include: catch-per-unit-effort (CPUE); Fulton's condition factor (KF); relative weight (Wr); fork length-at-age (FLA); relative year-class strength (RYCS); Hill's effective species richness (Hill's index); and relative species abundance (RSA; Table 5.1-2).

A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.5.

Table 5.1-1. 2008-2019 Inventory of fish community sampling.

Waterbody/Area	Sampling Year											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
SIL-4	●	●	●	●	●	●	●	●	●	●	●	●
OPACH				●			●			●		
SIL-1		●			●			●			●	
SIL-6			●			●			●			●
RAT			●			●			●			●
MYN				●			●			●		
NOT		●			●			●			●	
GRV	●	●	●	●	●	●	●	●	●	●	●	●

Table 5.1-2. Fish community indicators and metrics.

Indicator	Metric	Units
Abundance	• Catch-Per-Unit-Effort (CPUE)	# fish/30 m/24 hour (h) # fish/100 m/24 h
Condition	• Fulton's Condition Factor (KF)	-
	• Relative Weight (Wr)	-
Growth	• Fork Length-At-Age (FLA)	mm
Recruitment	• Relative Year-Class Strength (RYCS)	-
Diversity	• Hill's Effective Species Richness	species
	• Relative Species Abundance (RSA)[1]	%

Notes:

1. Supporting metric.

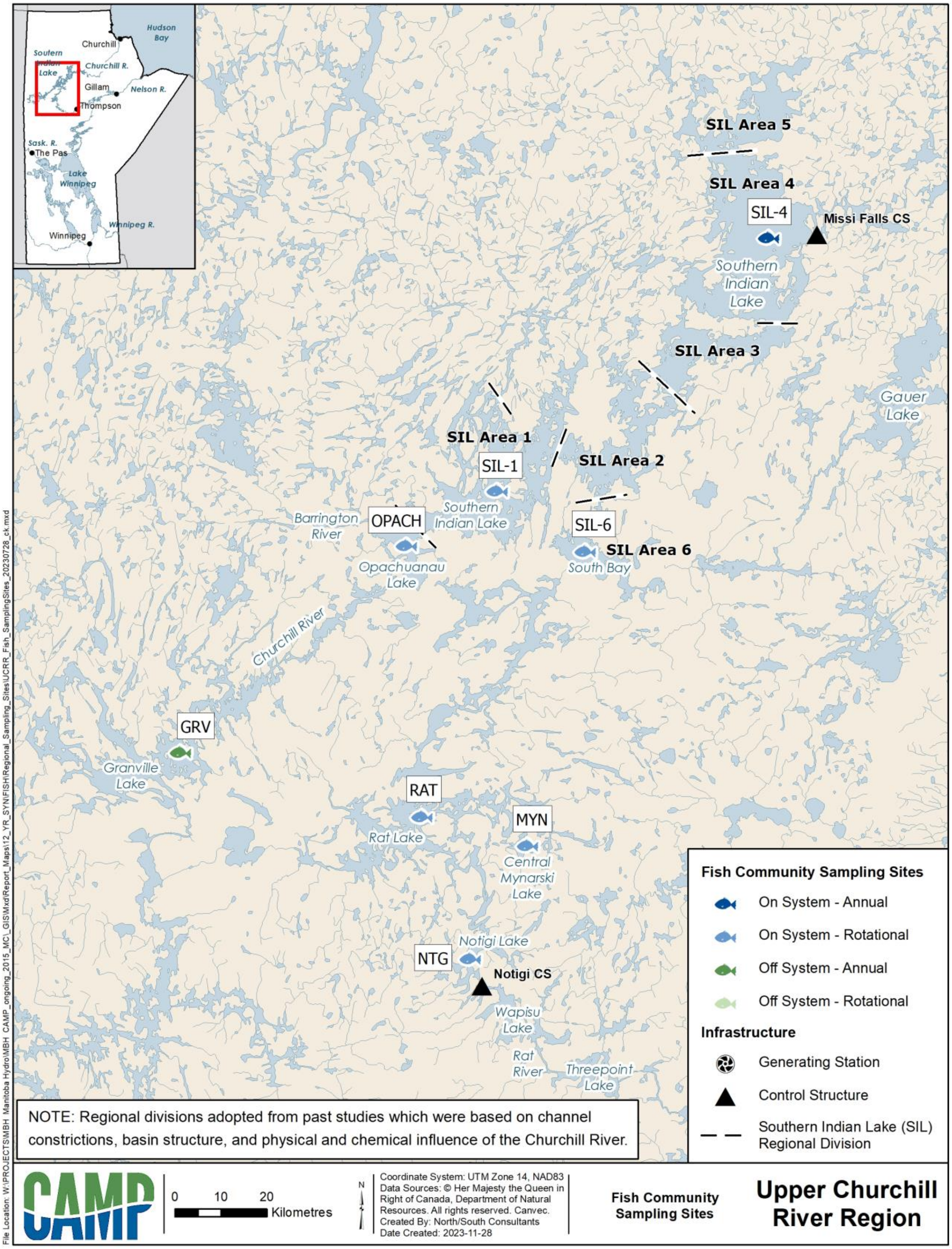


Figure 5.1-1. 2008-2019 Fish community sampling sites.

5.2 ABUNDANCE

5.2.1 CATCH-PER-UNIT-EFFORT

5.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

Standard Gang Index Gill Nets

The annual mean CPUE varied over the 12 years of monitoring from a high of 82.1 in 2008 to a low of 36.9 fish/100 m/24 h in 2010 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 51.1, the median was 47.0, and the IQR was 45.3-55.4 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2010, 2015 and 2018 when it was below the IQR, and in 2008, 2011 and 2017 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the 12 years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 8.4 in 2009 to a high of 35.1 fish/30 m/24 h in 2017 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 19.9, the median was 19.8, and the IQR was 10.6-27.5 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2009, 2018, and 2019 when it was below the IQR and in 2014, 2016, and 2017 when it was above the IQR.

Lake Whitefish

The annual mean CPUE over the 12 years of monitoring varied up to about five-fold from year-to-year, ranging from a low of 6.0 in 2018 to a high of 28.0 fish/100 m/24 h in 2008 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 11.5, the median was 8.7 and the IQR was 7.6-12.8 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2012, 2013 and 2018 when it was below the IQR, and in 2008, 2011, and 2017 when it was above the IQR.

Northern Pike

The annual mean CPUE over the 12 years of monitoring varied up to about seven-fold from year-to-year, ranging from a low of 1.0 in 2017 to a high of 7.5 fish/100 m/24 h in 2009 (Table 5.2-1; Figure 5.2-4).

The overall mean and median CPUE was 3.8, and the IQR was 3.3-4.3 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2010, 2017 and 2018 when it was below the IQR and in 2008, 2009 and 2013 when it was above the IQR.

Sauger

Catches of Sauger were relatively low in Southern Indian Lake - Area 4 over the 12 years of monitoring, with the annual mean CPUE ranging from a low of 0.05 in 2009 to a high of 1.9 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 0.8, the median was 0.9, and the IQR was 0.2-1.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2008, 2009 and 2010 when it was below the IQR and in 2014, 2016, and 2018 when it was above the IQR.

Walleye

Catches of Walleye were initially low over the 12 years of monitoring, with no Walleye captured within the first two years of sampling. The annual mean CPUE gradually increased from a low of 0.0 in 2008 and 2009, to a high 5.5 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 2.2, the median was 2.1, and the IQR was 0.5-3.6 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2008, 2009, and 2011 when it was below the IQR, and in 2016, 2017 and 2019 when it was above the IQR.

White Sucker

Catches of White Sucker were relatively low in Southern Indian Lake over the 12 years of monitoring, with the annual mean ranging from a low of 0.05 in 2009 to a high of 1.5 fish/100 m/24 h in 2013 (Table 5.2-1; Figure 5.2-7).

The overall mean and median CPUE was 0.6, and the IQR was 0.4-0.8 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was below the IQR in 2009, 2011 and 2018 and was above the IQR in 2012, 2013 and 2014.

ROTATIONAL SITES

Opachuanau Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the three years of monitoring was generally similar among years, with the mean ranging from a low of 57.9 in 2017 to a high of 69.4 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 63.8, the median was 64.0, and the IQR was 61.0-66.7 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was below the IQR in 2017 and was above the IQR in 2014.

Small Mesh Index Gill Nets

The annual mean CPUE over the three years of monitoring ranged from a low of 37.2 in 2011 to a high of 53.6 fish/30 m/24 h in 2014 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 44.5, the median was 42.6, and the IQR was 39.9-48.1 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2011 and was above the IQR in 2014.

Lake Whitefish

The annual mean CPUE over the three years of monitoring varied by up to about two-fold, with the mean ranging from a low of 4.9 in 2017 to high of 7.5 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 6.3, the median was 6.4, and the IQR was 5.7-7.0 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was below the IQR in 2017 and above the IQR in 2014 (Table 5.2-1; Figure 5.2-3).

Northern Pike

Catches of Northern Pike were relatively low in Opachuanau Lake over the three years of monitoring, with the annual mean ranging from a low of 0.5 in 2011 and 2017 to a high of 1.0 fish/100 m/24 in 2014 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 0.7, the median was 0.5 and the IQR was 0.5-0.7 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was marginally below the IQR in 2011 and above the IQR in 2014.

Sauger

The annual mean CPUE over the three years of monitoring varied by up to about two-fold, with the mean ranging from a low of 7.1 in 2011 to a high of 15.7 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 10.7, the median was 9.2, and the IQR was 8.2-12.5 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was below the IQR in 2011 and was above the IQR in 2014.

Walleye

The annual mean CPUE over the three years of monitoring ranged from a low of 4.0 in 2011 to a high of 5.2 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-6).

The overall mean and median CPUE were 4.6, and the IQR was 4.3-4.9 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was marginally below the IQR in 2011 and above the IQR in 2017.

White Sucker

Catches of White Sucker over the three years of monitoring ranged from a low of 34.1 in 2017 to a high of 41.1 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 36.9, the median was 35.4, and the IQR was 34.8-38.2 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was marginally below the IQR in 2017 and was above the IQR in 2011.

Southern Indian Lake - Area 1

Standard Gang Index Gill Nets

The annual mean CPUE for Southern Indian Lake - Area 1 over the four years of monitoring ranged from a low of 30.3 in 2009 to a high of 49.1 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 41.0, the median was 42.4, and the IQR was 36.1-47.3 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2018 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the three years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 2.0 in 2015 to a high of 12.6 fish/30 m/24 h in 2018 (Table 5.2-1; Figure 5.2-2). Small mesh gangs were not set at target locations in 2009 (Appendix 5-1).

The overall mean CPUE was 6.8, the median was 5.8, and the IQR was 3.9-9.2 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2015 when it was below the IQR and in 2018 when it was above the IQR.

Lake Whitefish

The annual mean CPUE over the four years of monitoring was relatively similar, with the mean CPUE ranging from a low of 7.2 in 2009 to a high of 9.6 fish/100 m/24 h in 2012 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 8.2, the median was 8.0, and the IQR was 7.3-8.9 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2012 when it was above the IQR.

Northern Pike

Catches of Northern Pike were relatively low in Southern Indian Lake - Area 1 over the four years of monitoring, with the annual mean CPUE ranging from a low of 0.4 in 2018 to a high of 3.7 fish/100 m/24 h in 2015 (Table 5.2-1; Figure 5.2-4).

The overall mean and median CPUE were 2.0 and the IQR was 1.4-2.6 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2018 when it was below the IQR and in 2015 when it was above the IQR.

Sauger

The annual mean CPUE over the four years of monitoring was relatively similar, with the mean CPUE ranging from a low of 4.5 in 2009 to a high of 6.9 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 6.0, the median was 6.2, and the IQR was 5.3 – 6.8 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2018 when it was marginally above the IQR.

Walleye

The annual mean CPUE over the four years of monitoring varied by up to about five-fold, with the mean ranging from a low of 0.9 in 2009 to a high of 4.1 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 2.3, the median was 2.1, and the IQR was 1.5-2.8 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2018 when it was above the IQR.

White Sucker

The annual mean CPUE over the four years of monitoring varied by up to eight-fold, with the mean ranging from a low of 2.1 in 2009 to a high of 16.8 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 8.8, the median was 8.2, and the IQR was 5.4-11.5 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2009 when it was below the IQR and in 2018 when it was above the IQR.

Southern Indian Lake - Area 6

Standard Gang Index Gill Nets

The annual mean CPUE over the four years of monitoring varied by up to about two-fold, with the mean ranging from a low of 35.5 in 2010 to a high of 54.7 fish/100 m/24 h in 2016 and 2019 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 48.1, the median was 51.0 and the IQR was 44.3-54.7 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the four years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 52.6 in 2010 to a high of 140.8 fish/30 m/24 h in 2013 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 81.9, the median was 67.1, and the IQR was 55.9-93.1 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Lake Whitefish

The annual mean CPUE over the four years of monitoring varied by up to about three-fold, with the mean ranging from a low of 2.0 in 2016 to a high of 6.4 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-3).

The overall mean was 3.9, the median was 3.6, and the IQR was 2.3-5.2 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2016 when it was below the IQR and in 2019 when it was above the IQR.

Northern Pike

The annual mean CPUE over the four years of monitoring varied by up to about nine-fold, with the mean ranging from a low of 0.5 in 2019 to a high of 5.6 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 2.9, the median was 2.7, and the IQR was 1.7-3.8 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2019 when it was below the IQR and in 2016 when it was above the IQR.

Sauger

The annual mean CPUE over the four years of monitoring varied by up to about two-fold, with the mean ranging from a low of 12.8 in 2010 to a high of 23.9 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 19.9, the median was 21.4, and the IQR was 18.7-22.5 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2019 when it was above the IQR.

Walleye

Catches of Walleye were relatively low in Southern Indian Lake - Area 6 over the four years of monitoring, with the annual mean CPUE ranging from a low of 0.2 in 2019 to a high of 2.1 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 0.8, the median was 0.5 and the IQR was 0.4-1.0 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2019 when it was below the IQR and in 2016 when it was above the IQR.

White Sucker

The annual mean CPUE over the four years of monitoring varied by up to about four-fold, with the mean ranging from a low of 2.8 in 2013 to a high of 12.3 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 6.8, the median was 6.1, and the IQR was 3.3-9.6 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2013 when it was below the IQR and 2019 when it was above the IQR.

Rat Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the four years of monitoring varied by up to about two-fold, with the mean ranging from a low of 22.9 in 2010 to a high of 42.2 fish/100 m/24 h in 2013 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 35.7, the median was 38.8, and the IQR was 34.3-40.1 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the four years of monitoring was slightly more variable than in the standard gangs, with the mean ranging from a low of 27.7 in 2010 to a high of 69.0 fish/30 m/24 h in 2013 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 51.3, the median was 54.2, and the IQR was 39.3-66.1 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were relatively low in Rat Lake over the four years of monitoring, with the annual mean CPUE ranging from a low of 0.1 in 2013 to a high of 1.8 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 0.9, the median was 0.8, and the IQR was 0.3-1.3 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2013 when it was below the IQR and in 2016 when it was above the IQR.

Northern Pike

The annual mean CPUE over the four years of monitoring ranged from a low of 2.3 in 2010 to a high of 3.6 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-4).

The overall mean was 3.0, the median was 3.1 and the IQR was 0.5-2.8 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2016 when it was above the IQR.

Sauger

The annual mean CPUE over the four years of monitoring ranged from a low of 3.3 in 2010 to a high of 5.1 fish/100 m/24 h in 2016 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 4.0, the median was 3.9, and the IQR was 3.6-4.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and 2016 when it was above the IQR.

Walleye

The annual mean CPUE over the four years of monitoring varied by up to about five-fold, with the mean ranging from a low of 2.5 in 2010 to a high of 13.8 fish/100 m/24 h in 2013 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 7.2, the median was 6.3, and the IQR was 3.9-9.5 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

White Sucker

The annual mean CPUE over the four years of monitoring varied by up to about three-fold, with the mean ranging from a low of 4.7 in 2010 to a high of 16.5 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 11.5, the median was 12.5, and the IQR was 8.9-15.1 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2010 when it was below the IQR and 2019 when it was above the IQR.

Mynarski Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the three years of monitoring ranged from a low of 59.7 in 2011 to a high of 72.4 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 66.7, the median was 68.0, and the IQR was 63.8-70.2 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the three years of monitoring was more variable than in the standard gangs, with the mean increasing from a low of 74.7 in 2011 to a high of 204.4 fish/30 m/24 h in 2017 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 146.7 the median was 160.9, and the IQR was 117.8-182.7 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2011when it was below the IQR and in 2017 when it was above the IQR.

Lake Whitefish

Catches of Lake Whitefish were low in Mynarski Lake over the three years of monitoring, with the annual mean CPUE ranging from a low of 0 in 2011 to a high of 1.1 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-3).

The overall mean and median CPUE were 0.6 and the IQR was 0.3-0.9 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2011 when it was below the IQR and in 2014 when it was above the IQR.

Northern Pike

Catches of Northern Pike over the three years of monitoring ranged from a low of 5.5 in 2017 to a high of 7.5 fish/100 m/24 h in 2011 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 6.3, the median was 5.9 and the IQR was 5.7-6.7 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2017 when it was below the IQR and in 2011 when it was above the IQR.

Sauger

Sauger were not captured in Mynarski Lake over the three years of monitoring (Table 5.2-1).

Walleye

The annual mean CPUE over the three years of monitoring ranged from a low of 11.3 in 2017 to a high of 17.9 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 14.2, the median was 13.2, and the IQR was 12.3-15.6 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2017 when it was below the IQR and in 2014 when it was above the IQR.

White Sucker

The annual mean CPUE over the three years of monitoring were relatively similar, with the mean ranging from a low of 18.2 in 2014 to a high of 22.9 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 20.6, the median was 20.7, and the IQR was 19.5-21.8 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2014 when it was below the IQR and 2017 when it was above the IQR.

Notigi Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the four years of monitoring were relatively similar, ranging from a low of 23.3 in 2012 to a high of 33.2 fish/100 m/24 h in 2015 (Table 5.2-1; Figure 5.2-1).

The overall mean and median CPUE was 28.2, and the IQR was 23.6-32.8 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE was marginally below the IQR in 2012 and was above the IQR in 2015.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the four years of monitoring was much more variable than the standard gangs, ranging from a low of 6.5 in 2012 to a high of 105.7 fish/30 m/24 h in 2018 (Table 5.2-1; Figure 5.2-2).

The overall mean CPUE was 57.5, the median was 59.0, and the IQR was 29.8-86.7 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE was below the IQR in 2012 and was above the IQR in 2018.

Lake Whitefish

Catches of Lake Whitefish were relatively low in Notigi Lake over the four years of monitoring, with the annual mean CPUE ranging from a low of 0.4 in 2009 to a high of 1.8 fish/100 /24 h in 2012 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 0.8, the median was 0.6 and the IQR was 0.4-1.0 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE was below the IQR in 2009 and above the IQR in 2012.

Northern Pike

The annual mean CPUE over the four years of monitoring varied by up to about three-fold, with the mean ranging from a low of 1.7 in 2018 to a high of 5.3 fish/100 m/24 in 2009 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 4.1, the median was 4.7 and the IQR was 3.9-4.9 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE was below the IQR in 2018 and above the IQR in 2009.

Sauger

The annual mean CPUE over the four years of monitoring varied by up to about four-fold, with the annual mean ranging from a low of 1.2 in 2009 to a high of 5.0 fish/100 m/24 h in 2018 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 3.2, the median was 3.3, and the IQR was 2.8-3.7 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE was below the IQR in 2009 and was above the IQR in 2018.

Walleye

The annual mean CPUE over the four years of monitoring ranged from a low of 4.3 in 2009 to a high of 6.6 fish/100 m/24 h in 2012 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 5.8, the median was 6.3, and the IQR was 5.6-6.5 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE was below the IQR in 2009 and marginally above the IQR in 2012.

White Sucker

The overall mean CPUE over the four years of monitoring varied by up to about four-fold, with the annual mean ranging from a low of 4.0 in 2012 to a high of 16.7 fish/100 m/24 h in 2009 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 9.5, the median was 8.6, and the IQR was 6.1-11.9 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE was below the IQR in 2012 and above the IQR in 2009.

5.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Standard Gang Index Gill Nets

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold, with the mean ranging from a low of 67.0 in 2013 to a high of 112.5 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-1).

The overall mean CPUE was 84.1, the median was 83.1, and the IQR was 75.4-92.2 fish/100 m/24 h (Figure 5.2-1). The annual mean CPUE fell within the overall IQR except in 2011, 2013, and 2017 when it was below the IQR and in 2015, 2016, and 2019 when it was above the IQR.

Small Mesh Index Gill Nets

The annual mean CPUE in the small mesh gangs over the 11 years of monitoring was more variable than in the standard gangs, with the mean ranging from a low of 37.8 in 2017 to a high of 205.1 fish/30 m/24 h in 2008 (Table 5.2-1; Figure 5.2-2). Small mesh gangs were not set at target locations in 2009.

The overall mean CPUE was 89.9, the median was 83.4, and the IQR was 67.2-94.4 fish/30 m/24 h (Figure 5.2-2). The annual mean CPUE fell within the overall IQR except in 2011, 2015, and 2017 when it was below the IQR and in 2008, 2010, and 2019 when it was above the IQR.

Lake Whitefish

The annual mean CPUE over the 12 years of monitoring varied by about up to four-fold, with the mean ranging from a low of 1.8 in 2012 and 2013 to a high of 7.7 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-3).

The overall mean CPUE was 3.6, the median was 3.3, and the IQR was 2.2-4.1 fish/100 m/24 h (Figure 5.2-3). The annual mean CPUE fell within the overall IQR except in 2008, 2012 and 2013 when it was below the IQR and in 2009, 2014 and 2017 when it was above the IQR.

Northern Pike

The annual mean CPUE over the 12 years of monitoring varied by up to about three-fold, with the mean ranging from a low of 1.5 in 2017 to a high of 4.8 fish/100 m/24 h in 2014 (Table 5.2-1; Figure 5.2-4).

The overall mean CPUE was 3.0, the median was 3.2 and the IQR was 2.2-3.6 fish/100 m/24 h (Figure 5.2-4). The annual mean CPUE fell within the overall IQR except in 2017, 2018 and 2019 when it was below the IQR and in 2008, 2010, 2014 when it was above the IQR.

Sauger

The annual mean CPUE over the 12 years of monitoring varied by up to about three-fold, with the mean ranging from a low of 4.7 in 2010 to a high of 14.9 fish/100 m/24 h in 2017 (Table 5.2-1; Figure 5.2-5).

The overall mean CPUE was 10.6, the median was 11.3, and the IQR was 9.2-12.3 fish/100 m/24 h (Figure 5.2-5). The annual mean CPUE fell within the overall IQR except in 2008, 2010, and 2011 when it was below the IQR and 2015, 2017 and 2018 when it was above the IQR.

Walleye

The annual mean CPUE over the 12 years of monitoring varied by up to about 27-fold, with the mean ranging from a low of 0.8 in 2009 to a high of 21.9 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-6).

The overall mean CPUE was 11.1, the median was 12.2, and the IQR was 7.7-14.5 fish/100 m/24 h (Figure 5.2-6). The annual mean CPUE fell within the overall IQR except in 2009, 2011, and 2017 when it was below the IQR and in 2013, 2015, 2019 when it was above the IQR.

White Sucker

The annual mean CPUE over the 12 years of monitoring varied by up to about two-fold, with the mean ranging from a low of 30.7 in 2013 to a high of 69.5 fish/100 m/24 h in 2019 (Table 5.2-1; Figure 5.2-7).

The overall mean CPUE was 48.6, the median was 47.7, and the IQR was 43.6-53.3 fish/100 m/24 h (Figure 5.2-7). The annual mean CPUE fell within the overall IQR except in 2013, 2014, and 2017 when it was below the IQR and 2012, 2016, and 2019 when it was above the IQR.

Table 5.2-1. 2008-2019 Catch-per-unit-effort.

Waterbody	Year	Small Mesh Catch[1]				Total Catch[2]				LKWH[2]			NRPK[2]			SAUG[2]			WALL[2]			WHSC[2]		
		n_S[3]	n_F[4]	Mean	SE	n_S	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
SIL-4	2008	4	46	14.4	4.1	24	1767	82.1	5.7	607	28.0	4.4	166	7.5	2.0	2	0.1	0.1	0	-	-	12	0.6	0.5
	2009	1	7	8.4	0.0	23	1150	55.2	5.2	250	11.8	1.8	102	4.8	1.3	1	0.05	0.0	0	-	-	1	0.0	0.0
	2010	2	20	10.7	0.8	18	662	36.9	4.5	150	8.3	1.2	52	3.0	1.4	2	0.1	0.1	12	0.7	0.4	7	0.4	0.3
	2011	3	57	21.4	3.4	23	1329	56.1	3.9	374	16.0	3.4	102	4.2	1.0	6	0.3	0.1	1	0.0	0.0	7	0.3	0.1
	2012	7	170	26.8	5.5	23	1085	45.6	5.2	174	7.3	1.9	95	3.9	1.0	9	0.4	0.2	28	1.0	0.5	25	1.0	0.4
	2013	7	146	22.5	7.4	24	1205	46.8	3.4	186	7.2	1.9	114	4.5	1.0	19	0.8	0.2	37	1.5	0.7	39	1.5	0.5
	2014	7	210	31.8	6.2	24	1164	46.6	4.1	220	9.0	2.8	92	3.7	0.7	33	1.3	0.4	67	2.6	0.9	21	0.9	0.5
	2015	7	120	18.3	5.0	23	1086	44.5	3.4	188	7.7	2.1	91	3.8	0.8	24	1.0	0.4	89	3.6	1.3	15	0.6	0.2
	2016	7	184	29.6	5.8	24	1286	54.5	3.8	260	10.9	3.0	94	4.1	0.8	42	1.9	0.5	87	3.8	1.3	17	0.8	0.6
	2017	7	219	35.1	12.9	24	1346	58.8	4.7	383	17.3	2.7	25	1.0	0.4	25	1.0	0.4	112	4.6	2.1	14	0.6	0.3
	2018	7	51	9.3	4.8	24	883	38.7	4.2	134	6.0	1.3	26	1.1	0.4	34	1.6	0.5	74	3.3	1.4	2	0.1	0.1
	2019	5	46	10.5	2.6	18	866	47.3	4.4	143	8.1	2.8	65	3.4	1.1	23	1.2	0.5	106	5.5	2.3	9	0.5	0.2
OPACH	2011	4	135	37.2	14.4	11	740	64.0	8.5	78	6.4	3.6	6	0.5	0.3	83	7.1	1.8	46	4.0	1.6	470	41.1	7.9
	2014	4	218	53.6	16.4	11	855	69.4	10.1	97	7.5	3.3	12	1.0	0.4	193	15.7	6.0	56	4.6	1.4	434	35.4	7.4
	2017	4	147	42.6	9.5	11	666	57.9	6.4	47	4.9	2.3	6	0.5	0.2	102	9.2	1.5	63	5.2	2.2	404	34.1	5.2
SIL-1	2009	0	-	-	-	8	191	30.3	3.4	44	7.2	2.7	11	1.7	1.0	30	4.5	2.6	6	0.9	0.8	14	2.1	0.6
	2012	3	17	5.8	2.3	12	587	46.8	4.5	117	9.6	2.5	29	2.3	1.1	74	5.7	1.9	32	2.4	1.4	127	9.8	2.6
	2015	3	7	2.0	1.4	12	504	38.0	4.3	96	7.4	1.7	49	3.7	1.2	91	6.8	3.0	23	1.7	1.0	89	6.5	2.8
	2018	3	44	12.6	10.6	12	549	49.1	5.5	92	8.7	3.1	4	0.4	0.3	79	6.9	2.1	46	4.1	2.2	196	16.8	5.4
SIL-6	2010	4	179	52.6	3.5	12	423	35.5	5.0	28	2.3	0.4	26	2.1	0.7	154	12.8	2.7	5	0.4	0.2	42	3.4	0.5
	2013	4	532	140.8	61.2	12	608	47.3	4.4	62	4.8	1.1	41	3.2	0.6	285	22.1	3.5	8	0.6	0.3	36	2.8	0.8
	2016	4	287	77.3	8.0	12	719	54.7	4.2	26	2.0	0.5	74	5.6	0.6	272	20.7	2.5	27	2.1	0.6	114	8.7	1.9
	2019	4	184	57.0	12.8	12	620	54.7	4.2	73	6.4	1.3	6	0.5	0.2	271	23.9	2.7	2	0.2	0.1	139	12.3	1.7
RAT	2010	3	59	27.7	12.7	9	195	22.9	3.6	3	0.4	0.2	21	2.3	0.5	28	3.3	1.6	22	2.5	0.7	46	4.7	1.5
	2013	3	181	69.0	27.3	9	375	42.2	5.2	1	0.1	0.1	29	3.2	1.3	33	3.8	2.0	123	13.8	2.9	129	14.6	3.1
	2016	3	126	43.2	16.8	9	390	39.4	5.1	18	1.8	1.4	34	3.6	1.4	51	5.1	2.0	80	8.1	2.3	100	10.3	2.4
	2019	3	179	65.1	29.9	9	349	38.2	6.8	10	1.2	0.5	28	3.0	1.1	35	4.1	1.7	41	4.4	1.7	158	16.5	6.3

Table 5.2-1. continued.

Waterbody	Year	Small Mesh Catch[1]				Total Catch[2]				LKWH[2]			NRPK[2]			SAUG[2]			WALL[2]			WHSC[2]		
		n_S[3]	n_F[4]	Mean	SE	n_S	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
MYN	2011	3	206	74.7	6.1	9	575	59.7	8.9	0	-	-	72	7.5	1.3	0	-	-	128	13.2	3.3	198	20.7	5.2
	2014	3	377	160.9	65.4	9	573	68.0	8.8	9	1.1	0.8	49	5.9	1.4	0	-	-	140	17.9	7.4	151	18.2	4.4
	2017	3	541	204.4	34.9	9	679	72.4	13.9	6	0.6	0.3	51	5.5	1.9	0	-	-	105	11.3	5.7	213	22.9	6.6
NOT	2009	3	111	37.6	14.6	10	344	32.7	6.6	4	0.4	0.3	56	5.3	1.6	13	1.2	0.4	44	4.3	1.7	174	16.7	4.5
	2012	3	18	6.5	2.3	10	247	23.3	2.7	19	1.8	1.7	49	4.6	0.9	35	3.3	0.8	70	6.6	1.6	43	4.0	1.0
	2015	3	219	80.4	39.6	10	348	33.2	3.3	7	0.7	0.6	51	4.8	1.5	35	3.3	0.9	64	6.0	1.6	109	10.3	1.9
	2018	3	303	105.7	38.6	10	258	23.7	2.3	5	0.5	0.3	18	1.7	0.5	55	5.0	1.2	70	6.5	2.0	75	6.9	2.0
GRV	2008	1	172	205.1	-	11	853	85.3	11.4	20	2.1	0.8	43	4.1	0.6	93	9.1	1.6	83	8.9	4.0	528	53.1	10.3
	2009	0	-	-	-	11	838	75.7	6.7	65	6.0	3.0	35	3.1	0.9	135	12.2	2.2	8	0.8	0.4	492	44.4	8.1
	2010	3	290	108.3	21.3	12	934	76.5	6.0	47	4.1	1.5	46	3.7	0.5	54	4.6	1.3	151	11.9	4.3	567	46.4	6.3
	2011	4	243	66.5	23.0	12	935	73.9	4.4	34	2.8	1.4	42	3.3	0.7	84	6.7	1.9	35	2.7	1.0	661	52.0	5.4
	2012	4	326	86.1	27.4	12	1166	92.1	5.5	23	1.8	0.8	30	2.4	0.6	116	9.2	1.6	165	13.2	4.5	747	58.9	7.1
	2013	4	339	91.6	26.9	12	804	67.0	7.1	22	1.8	0.7	44	3.5	0.6	142	11.7	2.1	178	15.6	4.9	373	30.7	4.9
	2014	4	295	83.4	43.8	12	1088	84.6	4.4	58	4.3	2.4	62	4.8	0.8	135	10.6	3.5	161	12.5	3.8	528	41.1	5.4
	2015	4	225	62.5	26.7	12	1121	92.8	5.8	48	3.8	1.8	44	3.6	0.6	148	12.6	4.5	208	17.4	4.6	547	45.0	6.3
	2016	4	242	68.0	15.2	12	1112	92.5	5.9	46	4.1	2.1	35	2.8	0.9	135	11.2	2.8	165	14.2	3.4	653	53.9	5.4
	2017	4	138	37.8	8.0	12	907	74.6	5.3	93	7.7	3.4	19	1.5	0.5	185	14.9	2.5	54	4.4	1.1	470	39.2	6.6
	2018	4	260	82.7	17.6	12	877	81.7	5.7	26	2.4	1.0	18	1.6	0.3	142	13.3	3.0	108	10.1	1.8	526	48.9	5.8
	2019	4	276	97.3	29.2	12	1112	112.5	10.0	21	2.2	0.8	17	1.7	0.7	111	11.4	1.8	214	21.9	5.7	692	69.5	9.3

Notes:

1. fish/30 m/24 h.
2. fish/100 m/24 h.
3. nS = number of sites fished (excludes sets >36 h).
4. nF = number of fish caught.
5. SE = standard error.

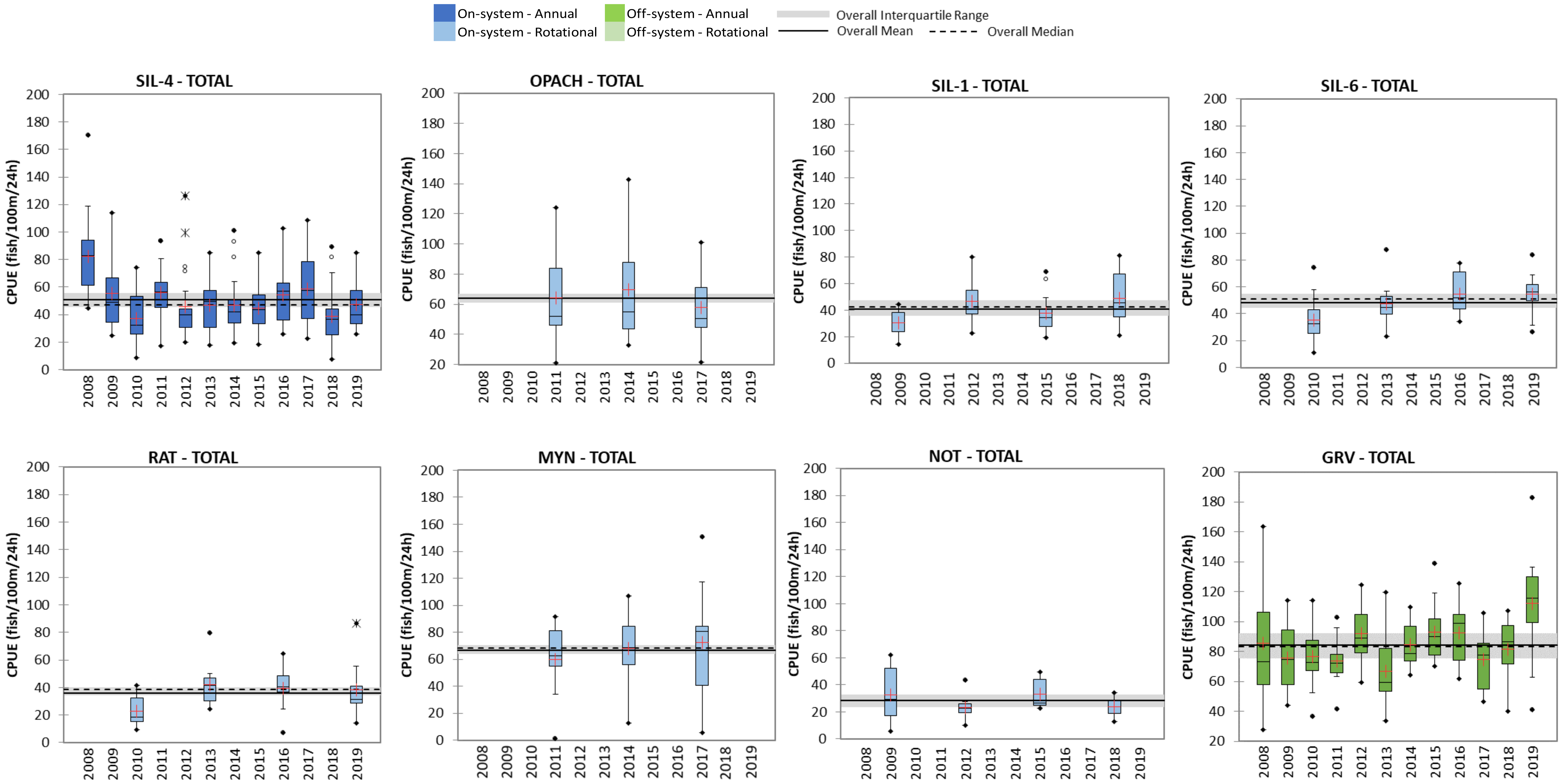


Figure 5.2-1. 2008-2019 Catch-per-unit-effort (CPUE) of standard gang index gill nets.

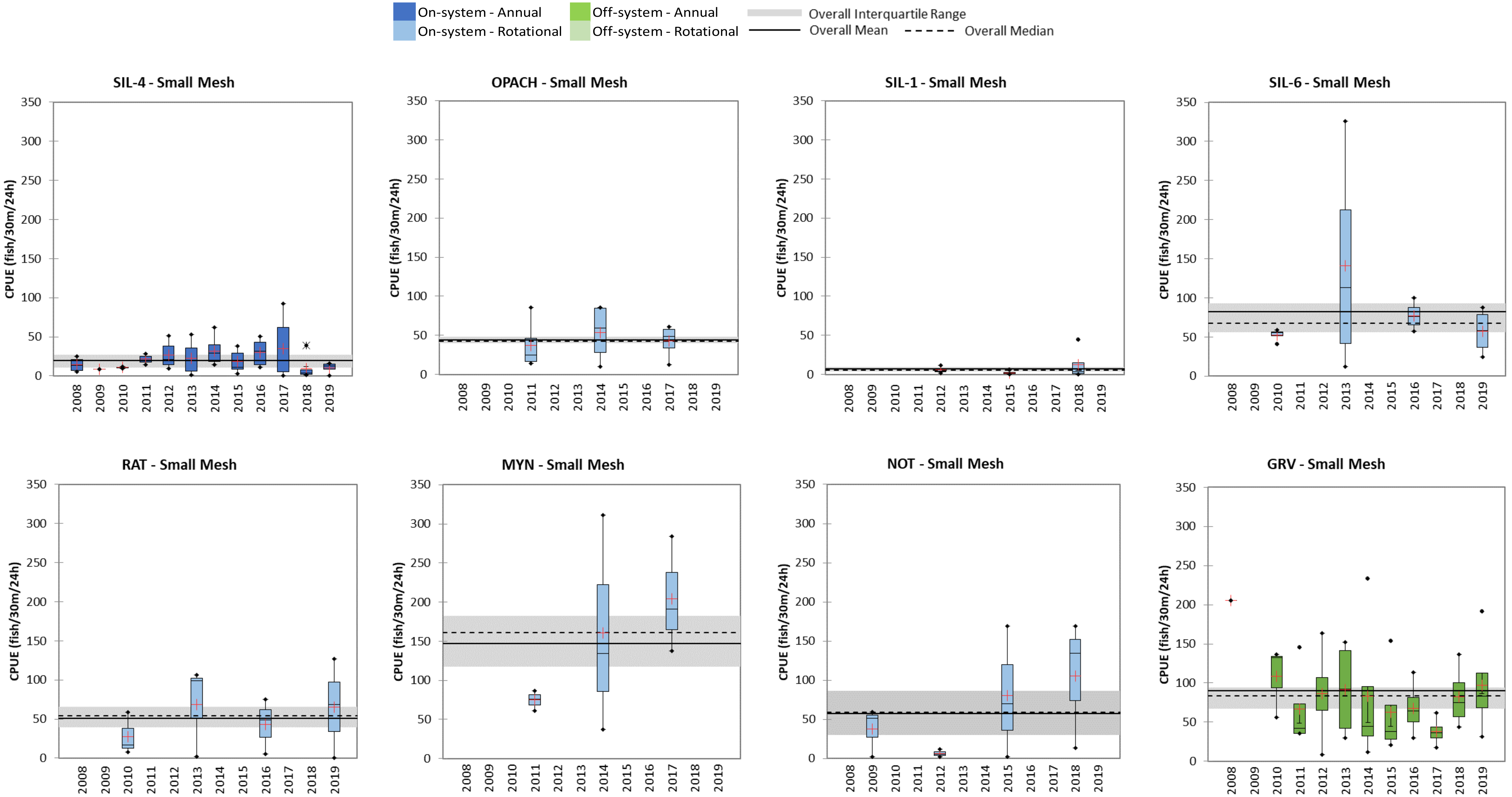


Figure 5.2-2. 2008-2019 Catch-per-unit-effort (CPUE) of small mesh index gill nets.

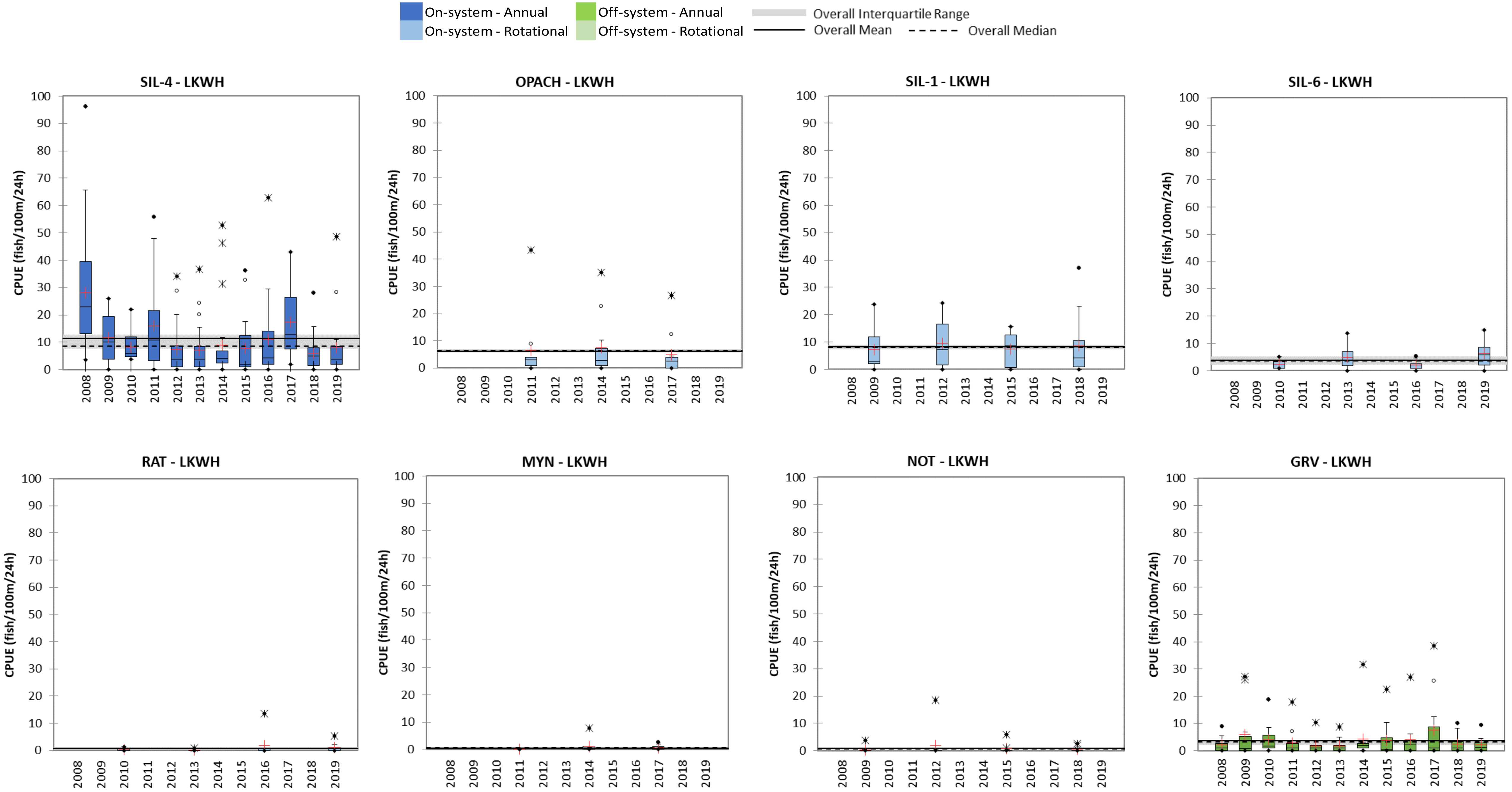


Figure 5.2-3. 2008-2019 Catch-per-unit-effort (CPUE) of Lake Whitefish.

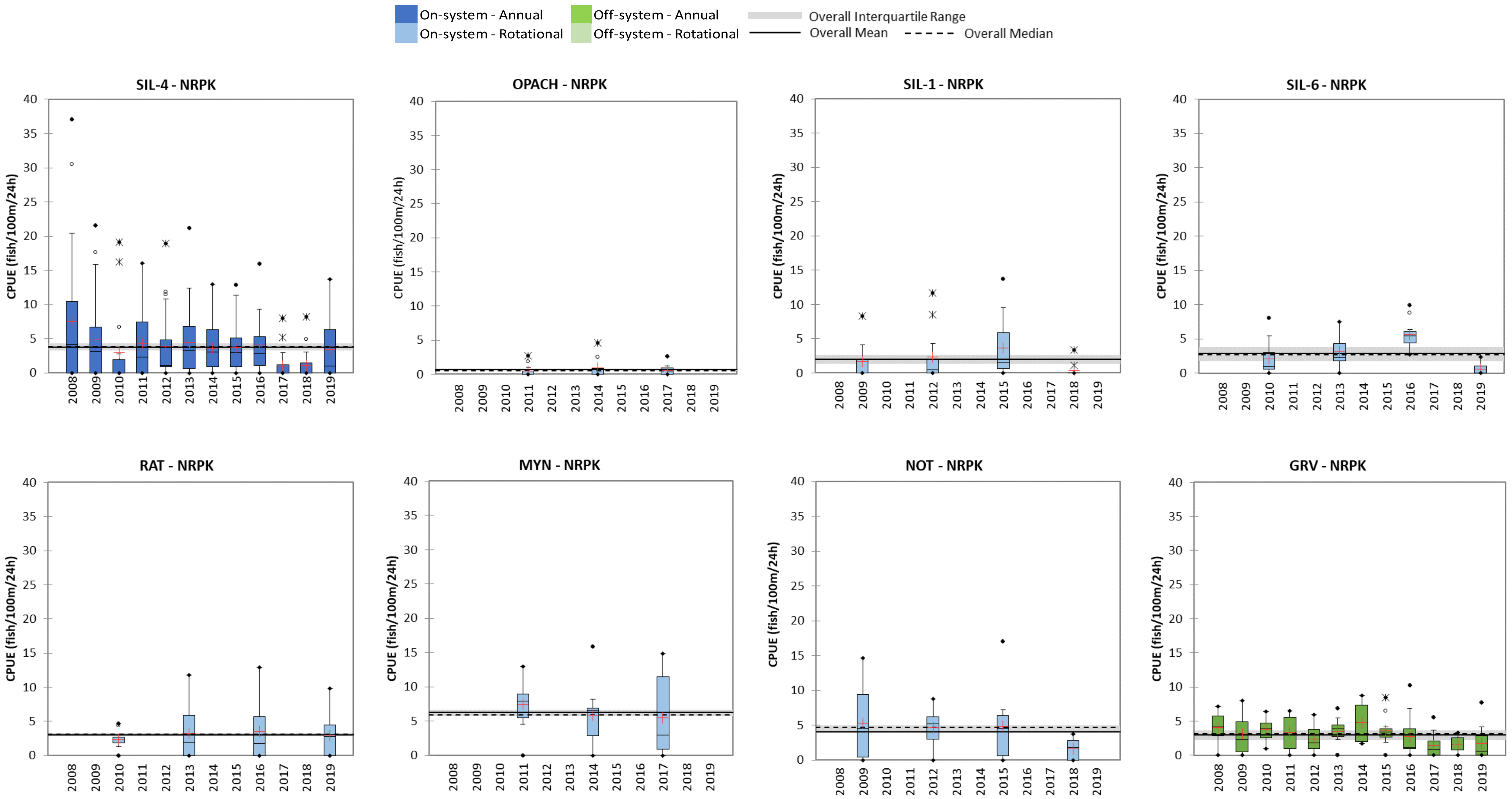


Figure 5.2-4. 2008-2019 Catch-per-unit-effort (CPUE) of Northern Pike.

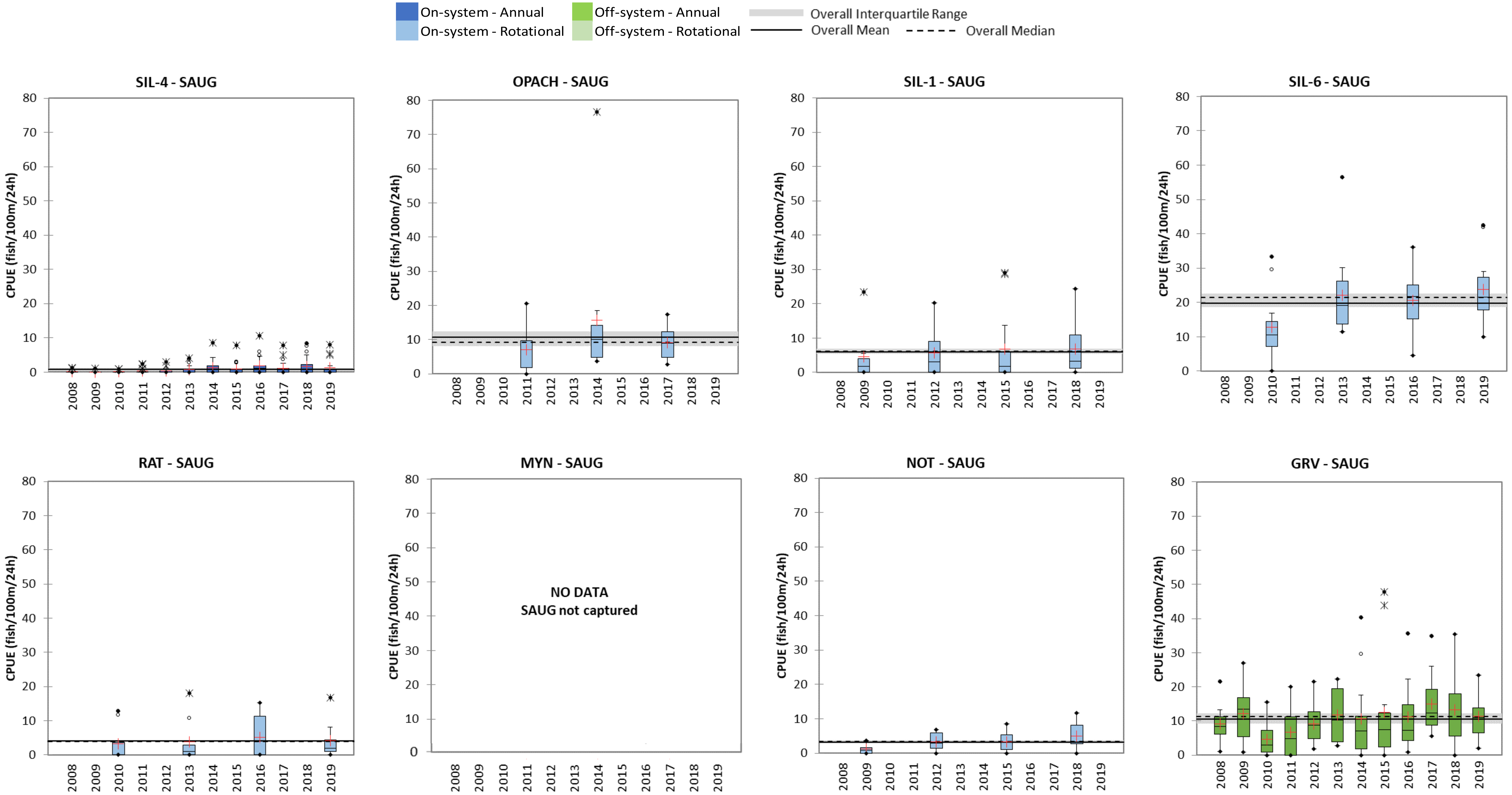


Figure 5.2-5. 2008-2019 Catch-per-unit-effort (CPUE) of Sauger.

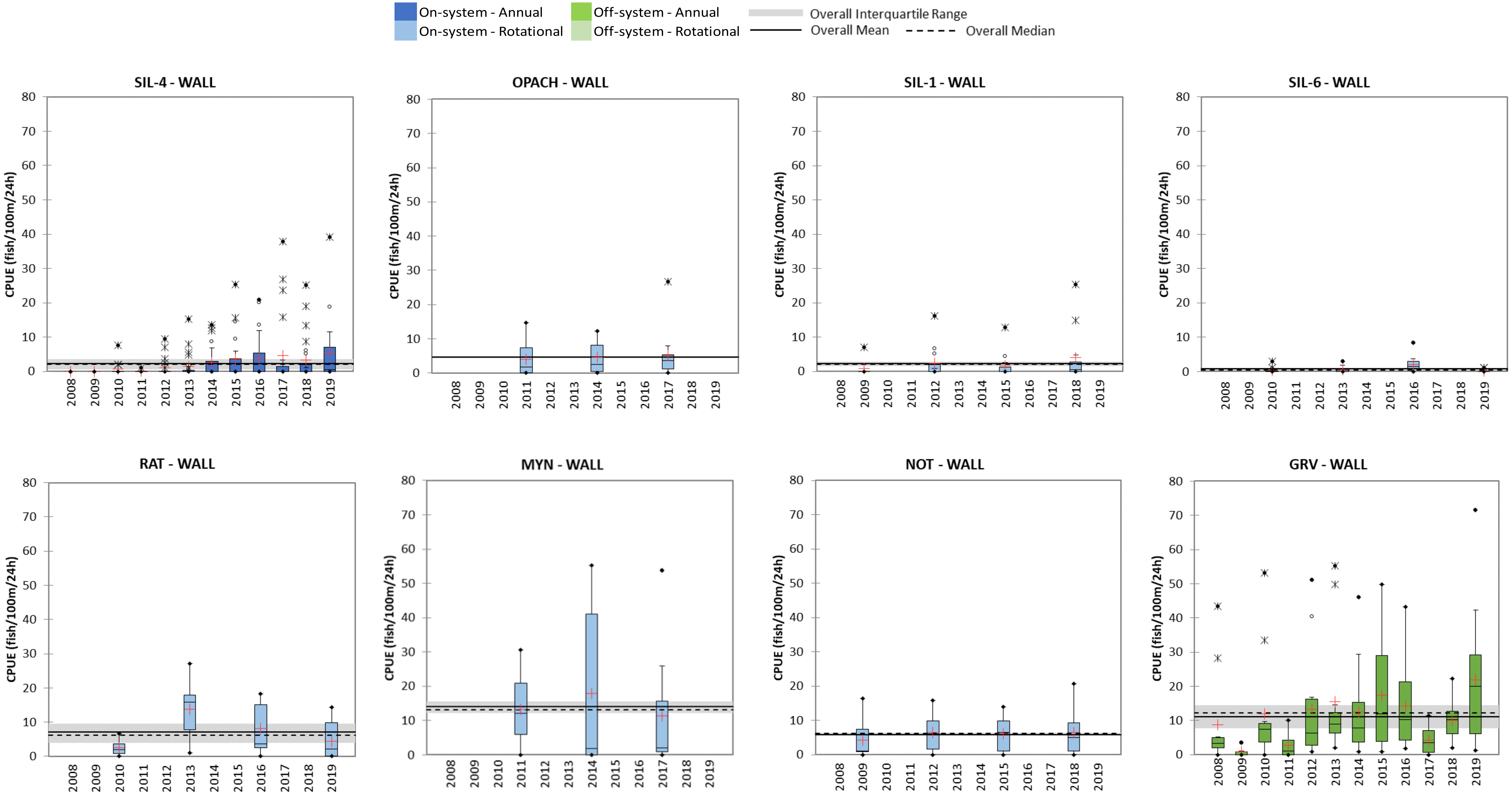


Figure 5.2-6. 2008-2019 Catch-per-unit-effort (CPUE) of Walleye.

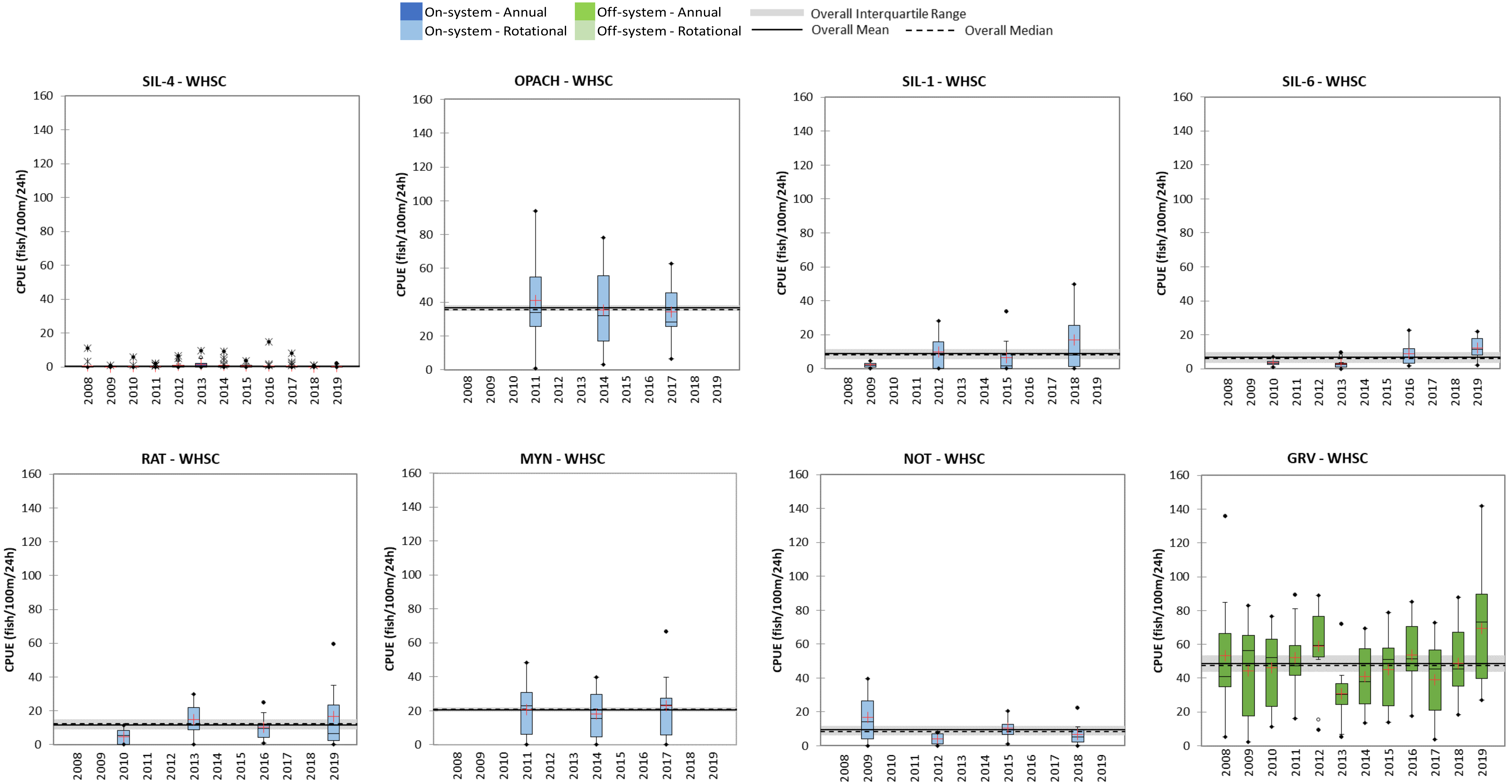


Figure 5.2-7. 2008-2019 Catch-per-unit-effort (CPUE) of White Sucker.

5.3 CONDITION

5.3.1 FULTON’S CONDITION FACTOR

5.3.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.24 in 2018 to a high of 1.44 in 2017 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.34, the median was 1.33 and the IQR was 1.28-1.35 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2018 when it was below the IQR and in 2008 and 2017 when it was above the ICR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the 12 years of monitoring that it was a target species ranged from a low of 0.64 in 2018 to a high of 0.70 in 2011 (Table 5.3-1; Figure 5.3-2).

The overall mean was 0.67, the median was 0.66 and the IQR was 0.66-0.68 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2016, 2018 and 2019 when it was below the IQR and in 2009 and 2011 when it was above the IQR.

Sauger

Sauger was not a target species in Southern Indian Lake - Area 4 until 2017; the annual mean KF of Sauger between 200 and 349 mm in fork length over three years of monitoring ranged from a low of 0.86 in 2019 to a high of 1.03 in 2018 (Table 5.3-1; Figure 5.3-3).

The overall mean KF was 0.96, the median was 1.01 and the IQR was 0.94-1.02 (Figure 5.3-3). The annual mean KF fell within the overall IQR except in 2019 when it was below the IQR and in 2018, when it was above the IQR.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.06 in 2019 to a high of 1.22 in 2010 (Table 5.3-1; Figure 5.3-4). Walleye were not captured in Southern Indian Lake - Area 4 in 2008, 2009 or 2011.

The overall mean and median KF were 1.12 and the IQR was 1.12-1.20 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2010 when it was above the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the 10 years of monitoring that it was a target species ranged from a low of 1.44 in 2012 to a high of 1.63 in 2016 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.53, the median was 1.52, and the IQR was 1.50-1.52 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2010 and 2012 when it was below the IQR and in 2015 and 2016 when it was above the IQR.

ROTATIONAL SITES

Opachuanau Lake

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.46 in 2017 to a high of 1.54 in 2014 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.52, the median was 1.53 and the IQR was 1.50-1.54 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2017 when it was below the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the three years of monitoring ranged from a low of 0.64 in 2011 to a high of 0.71 in 2014 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.68, the median was 0.67 and the IQR was 0.65-0.69 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2011 when it was marginally below the IQR and in 2014 when it was above the IQR.

Sauger

Sauger was not a target species in Opachuanau Lake until 2017; the annual mean KF of Sauger between 200 and 349 mm in fork length during one year of monitoring was 0.93 in 2017 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.08 in 2017 to a high of 1.16 in 2011 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.11 and the IQR was 1.10-1.13 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2017 when it was below the IQR and in 2011 when it was above the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm fork length over the three years of monitoring ranged from a low of 1.52 in 2017 to a high of 1.62 in 2014 (Table 5.3-1; Figure 5.3-5).

The overall mean and median KF were 1.57 and the IQR was 1.55-1.60 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2017 when it was below the IQR and in 2014 when it was above the IQR.

Southern Indian Lake - Area 1

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.49 in 2018 to a high of 1.71 in 2009 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.58, the median was 1.60 and the IQR was 1.56-1.64 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2018 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.64 in 2012 and 2018 to a high of 0.65 in 2009 and 2015 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.64, median was 0.65 and the IQR was 0.64-0.65 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR in all years.

Sauger

Sauger between 200 and 349 mm in fork length had an annual mean KF of 0.90 in 2018 (Table 5.3-1; Figure 5.3-3). Sauger was not a target species in Southern Indian Lake Are 1 prior to 2017.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.08 in 2012 to a high of 1.14 in 2009 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.10, the median was 1.09, and the IQR was 1.09-1.11 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2012 when it was marginally below the IQR and in 2009 when it was above the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm fork length over the three years of monitoring that it was a target species ranged from a low of 1.56 in 2012 to a high of 1.69 in 2015 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.63, the median was 1.65 and the IQR was 1.60-1.67 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2012 when it was below the IQR and in 2015 when it was above the IQR.

Southern Indian Lake - Area 6

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm fork length over the four years of monitoring ranged from a low of 1.55 in 2016 to a high of 1.58 in 2019 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.57, the median was 1.56 and the IQR was 1.56-1.57 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2016 when it was marginally below the IQR and in 2019 when it was marginally above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.61 in 2016 to a high of 0.68 in 2013 (Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.64, the median was 0.63 and the IQR was 0.62-0.66 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2016 when it was below the IQR and 2013 when it was above the IQR.

Sauger

The annual mean KF of Sauger between 200 and 349 mm in fork length during one year of monitoring was 0.89 in 2019 (Table 5.3-1; Figure 5.3-3). Sauger was not a target species in Southern Indian Lake - Area 6 prior to 2017.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.04 in 2010 to a high of 1.10 in 2013 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.07 and the IQR was 1.06-1.08 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.58 in 2016 and 2019 to a high of 1.68 in 2010 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.60, the median was 1.59, and the IQR was 1.58-1.62 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2010 when it was above the IQR.

Rat Lake

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm fork length over the four years of monitoring ranged from a low of 1.77 in 2016 to a high of 2.02 in 2013 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.84, the median was 1.98 and the IQR was 1.88-2.00 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2016 when it was below the IQR and in 2013 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.63 in 2010 and 2019 to a high of 0.65 in 2016 (Table 5.3-1; Figure 5.3-2).

The overall mean and median KF were 0.64and the IQR was 0.63-0.64 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR except in 2016 when it was marginally above the IQR.

Sauger

The annual mean KF of Sauger between 200 and 349 mm in fork length during one year of monitoring was 0.86 in 2019 (Table 5.3-1; Figure 5.3-3). Sauger was not a target species in Rat Lake prior to 2017.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.06 in 2010 and 2019 to a high of 1.07 in 2013 and 2016 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.06 and the IQR was 1.06-1.07 (Figure 5.3-4). The annual mean KF was equal to or fell within the overall IQR in all four years.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.56 in 2019 to a high of 1.59 in 2010 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.57, the median was 1.58, and the IQR was 1.57-1.58 (Figure 5.3-5). The annual mean KF was equal to or fell within the overall IQR except in 2010 when it was above the IQR.

Mynarski Lake

Lake Whitefish

Aside from 2011 when no Lake Whitefish were caught, the annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.59 in 2014 to a high of 1.69 in 2017 (Table 5.3-1; Figure 5.3-1).

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the three years of monitoring ranged from a low of 0.64 in 2011 to a high of 0.68 in 2017 (Table 5.3-1; Figure 5.3-2).

The overall mean and median KF was 0.66, , and the IQR was 0.65-0.67 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2011 when it was marginally below the IQR and in 2017 when it was above the IQR.

Sauger

Sauger were not captured in Mynarski Lake since it became a target species in 2017 (Table 5.3-1).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.05 in 2011 to a high of 1.12 in 2014 and 2017 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.10, the median was 1.12 and the IQR was 1.08-1.12 (Figure 5.3-4). The annual mean KF was equal to or fell within the overall IQR except in 2011 when it was below the IQR.

White Sucker

The annual mean KF of White Sucker between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.47 in 2011 to a high of 1.57 in 2017 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.53, the median was 1.56, and the IQR was 1.51-1.56 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was marginally above the IQR.

Notigi Lake

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.46 in 2012 to a high of 2.04 in 2009 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.71, the median was 1.92 and the IQR was 1.79-1.96 (Figure 5.3-1). The annual mean KF fell within the overall IQR except in 2012 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the four years of monitoring ranged from a low of 0.62 in 2009 to a high of 0.65 in 2015 (Table 5.3-1; Figure 5.3-2).

The overall mean and median KF were 0.64 and the IQR was 0.63-0.64 (Figure 5.3-2). The annual mean KF was equal to or fell within the overall IQR except in 2009 when it was below the IQR and in 2015 when it was above the IQR.

Sauger

Sauger was not a target species in Notigi Lake until 2017; the annual mean KF of Sauger between 200 and 349 mm in fork length was 0.94 in 2018 (Table 5.3-1; Figure 5.3-3).

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the four years of monitoring ranged from a low of 1.03 in 2012 and 2015 to a high of 1.07 in 2018 (Table 5.3-1; Figure 5.3-4).

The overall mean and median KF were 1.04 and the IQR was 1.03-1.06 (Figure 5.3-4). The annual mean KF was equal to or fell within the overall IQR except in 2018 when it was marginally above the IQR.

White Sucker

White Sucker was not a target species in Notigi Lake until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the three years of monitoring ranged from a low of 1.54 in 2012 to a high of 1.60 in 2018 (Table 5.3-1; Figure 5.3-5).

The overall mean and median KF were 1.58 and the IQR was 1.56-1.61 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2012 when it was below the IQR and in 2009 when it was marginally above the IQR.

5.3.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Lake Whitefish

The annual mean KF of Lake Whitefish between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.41 in 2018 to a high of 1.70 in 2009 (Table 5.3-1; Figure 5.3-1).

The overall mean KF was 1.58, the median was 1.56, and the IQR was 1.51-1.66 (Figure 5.3-1). The annual mean KF was equal to or fell within the overall IQR except in 2013 and 2018 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean KF of Northern Pike between 400 and 699 mm in fork length over the 12 years of monitoring ranged from a low of 0.64 in 2018 to a high of 0.70 in 2009 and 2011(Table 5.3-1; Figure 5.3-2).

The overall mean KF was 0.67, the median was 0.66, and the IQR was 0.66-0.68 (Figure 5.3-2). The annual mean KF fell within the overall IQR except in 2016, 2018 and 2019 when it was below the IQR and in 2009, 2011 and 2013 when it was above the IQR.

Sauger

Sauger was not a target species in Granville Lake until 2017; over the three years of monitoring the annual mean KF of Sauger between 200 and 349 mm in fork length ranged from a low of 0.88 in 2018 to a high of 0.91 in 2017 (Table 5.3-1; Figure 5.3-3).

The overall mean and median KF were 0.90 and the IQR was 0.89-0.90 (Figure 5.3-3). The annual mean KF fell within the overall IQR except in 2018 when it was below the IQR and in 2017 when it was above the IQR.

Walleye

The annual mean KF of Walleye between 300 and 499 mm in fork length over the 12 years of monitoring ranged from a low of 1.04 in 2018 to a high of 1.16 in 2011 (Table 5.3-1; Figure 5.3-4).

The overall mean KF was 1.11, the median was 1.12 and the IQR was 1.11-1.13 (Figure 5.3-4). The annual mean KF fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2009 and 2011 when it was above the IQR.

White Sucker

White Sucker was not a target species in Granville Lake until 2010; the annual mean KF of White Sucker between 300 and 499 mm in fork length over the 10 years of monitoring ranged from a low of 1.47 in 2013 to a high of 1.62 in 2015 (Table 5.3-1; Figure 5.3-5).

The overall mean KF was 1.56, the median was 1.55 and the IQR was 1.54-1.59 (Figure 5.3-5). The annual mean KF fell within the overall IQR except in 2013 and 2018 when it was below the IQR and in 2011 and 2015 when it was above the IQR.

Table 5.3-1. 2008-2019 Fulton's condition factor of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL			WHSC		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
SIL-4	2008	458	1.37	0.01	-	-	-				-	-	-			
	2009	180	1.33	0.01	94	0.65	0.01				-	-	-			
	2010	104	1.28	0.01	46	0.71	0.01				10	1.22	0.03	7	1.45	0.04
	2011	296	1.28	0.01	87	0.67	0.01				-	-	-	7	1.52	0.03
	2012	125	1.28	0.01	82	0.67	0.01				18	1.20	0.02	13	1.44	0.04
	2013	141	1.34	0.01	99	0.66	0.01				28	1.12	0.02	24	1.52	0.04
	2014	158	1.33	0.01	82	0.65	0.01				49	1.12	0.01	13	1.52	0.03
	2015	133	1.35	0.01	84	0.67	0.01				66	1.12	0.01	14	1.57	0.02
	2016	177	1.36	0.01	85	0.67	0.01				26	1.20	0.04	12	1.63	0.04
	2017	309	1.44	0.01	22	0.67	0.01	23	1.01	0.02	51	1.13	0.01	6	1.52	0.04
	2018	97	1.24	0.02	21	0.69	0.01	30	1.03	0.02	38	1.10	0.02	2	1.49	0.10
	2019	190	1.28	0.01	72	0.60	0.01	39	0.86	0.01	83	1.06	0.01	7	1.51	0.06
OPACH	2011	59	1.53	0.01	6	0.64	0.02				39	1.16	0.02	438	1.57	0.01
	2014	60	1.54	0.02	10	0.71	0.03				51	1.11	0.01	398	1.62	0.01
	2017	35	1.46	0.03	5	0.67	0.01	98	0.93	0.01	58	1.08	0.01	391	1.52	0.01
SIL-1	2009	35	1.71	0.03	8	0.65	0.02				6	1.14	0.04			
	2012	80	1.58	0.01	25	0.64	0.01				31	1.08	0.02	106	1.56	0.01
	2015	72	1.62	0.01	45	0.65	0.01				20	1.09	0.02	69	1.69	0.02
	2018	78	1.49	0.01	3	0.64	0.00	79	0.90	0.01	44	1.10	0.02	185	1.65	0.01
SIL-6	2010	19	1.56	0.03	23	0.65	0.01				2	1.04	0.02	40	1.68	0.02
	2013	31	1.57	0.03	37	0.68	0.02				8	1.10	0.01	31	1.60	0.03
	2016	17	1.55	0.03	68	0.61	0.01				24	1.07	0.02	106	1.58	0.01
	2019	49	1.58	0.02	5	0.62	0.05	251	0.89	0.01	2	1.07	0.06	125	1.58	0.01
RAT	2010	-	-	-	12	0.63	0.02				14	1.06	0.02	43	1.59	0.02
	2013	1	2.02	-	11	0.64	0.02				113	1.07	0.01	122	1.58	0.01
	2016	16	1.77	0.05	14	0.65	0.02				49	1.07	0.01	96	1.57	0.01
	2019	7	1.98	0.11	10	0.63	0.01	33	0.86	0.01	34	1.06	0.01	152	1.56	0.01
MYN	2011	-	-	-	60	0.64	0.01				68	1.05	0.01	181	1.47	0.01
	2014	9	1.59	0.03	39	0.66	0.01				109	1.12	0.01	140	1.56	0.01
	2017	6	1.69	0.04	31	0.68	0.01				92	1.12	0.01	171	1.57	0.01
NOT	2009	3	2.04	0.13	21	0.62	0.01				38	1.06	0.01			
	2012	13	1.46	0.03	22	0.64	0.01				67	1.03	0.01	40	1.54	0.02
	2015	7	1.90	0.06	23	0.65	0.02				49	1.03	0.01	106	1.57	0.01
	2018	4	1.94	0.08	6	0.64	0.02	54	0.94	0.02	65	1.07	0.01	70	1.60	0.02
GRV	2008	6	1.66	0.04	-	-	-				42	1.11	0.02			
	2009	44	1.70	0.02	29	0.70	0.01				7	1.15	0.02			
	2010	25	1.51	0.02	39	0.67	0.01				108	1.13	0.01	522	1.57	0.01
	2011	17	1.51	0.03	35	0.70	0.01				33	1.16	0.01	606	1.60	0.00
	2012	16	1.58	0.03	28	0.66	0.02				141	1.11	0.01	650	1.54	0.00
	2013	12	1.50	0.03	43	0.69	0.01				159	1.12	0.01	282	1.47	0.01
	2014	45	1.66	0.02	58	0.67	0.01				154	1.13	0.01	427	1.59	0.01
	2015	41	1.66	0.02	41	0.66	0.01				178	1.12	0.01	485	1.62	0.01
	2016	39	1.52	0.02	34	0.65	0.01				143	1.12	0.01	599	1.54	0.00
	2017	67	1.55	0.02	17	0.66	0.02	154	0.91	0.01	45	1.11	0.01	428	1.54	0.01
	2018	18	1.41	0.06	17	0.64	0.01	132	0.88	0.01	87	1.04	0.01	483	1.53	0.01
	2019	13	1.60	0.05	17	0.65	0.02	100	0.90	0.01	194	1.08	0.01	617	1.57	0.00

Notes:

1. nF = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates a species was not a target species in that year.
4. "-" = no fish measured for fork length.

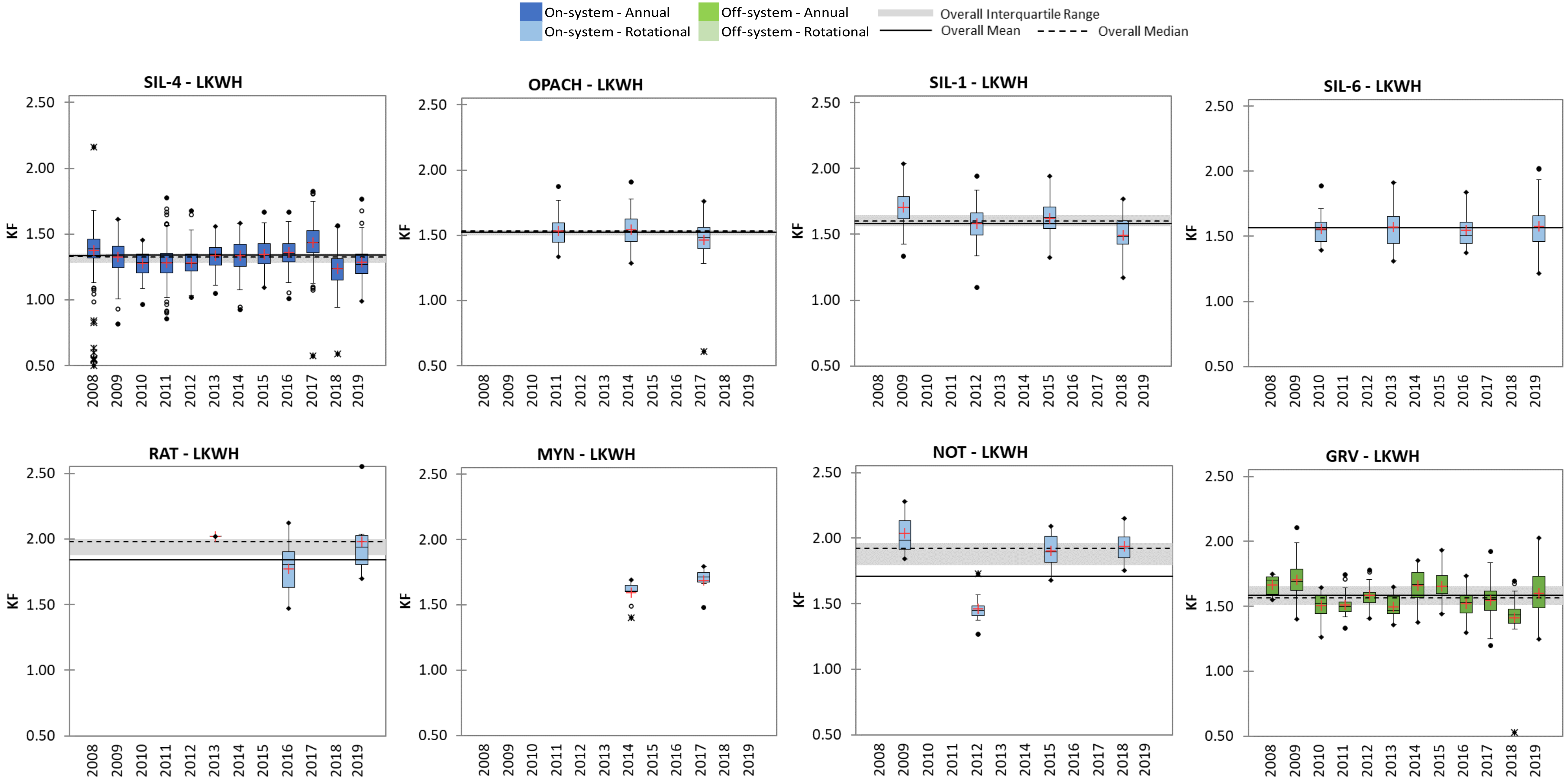


Figure 5.3-1. 2008-2019 Fulton's condition factor (KF) of Lake Whitefish.

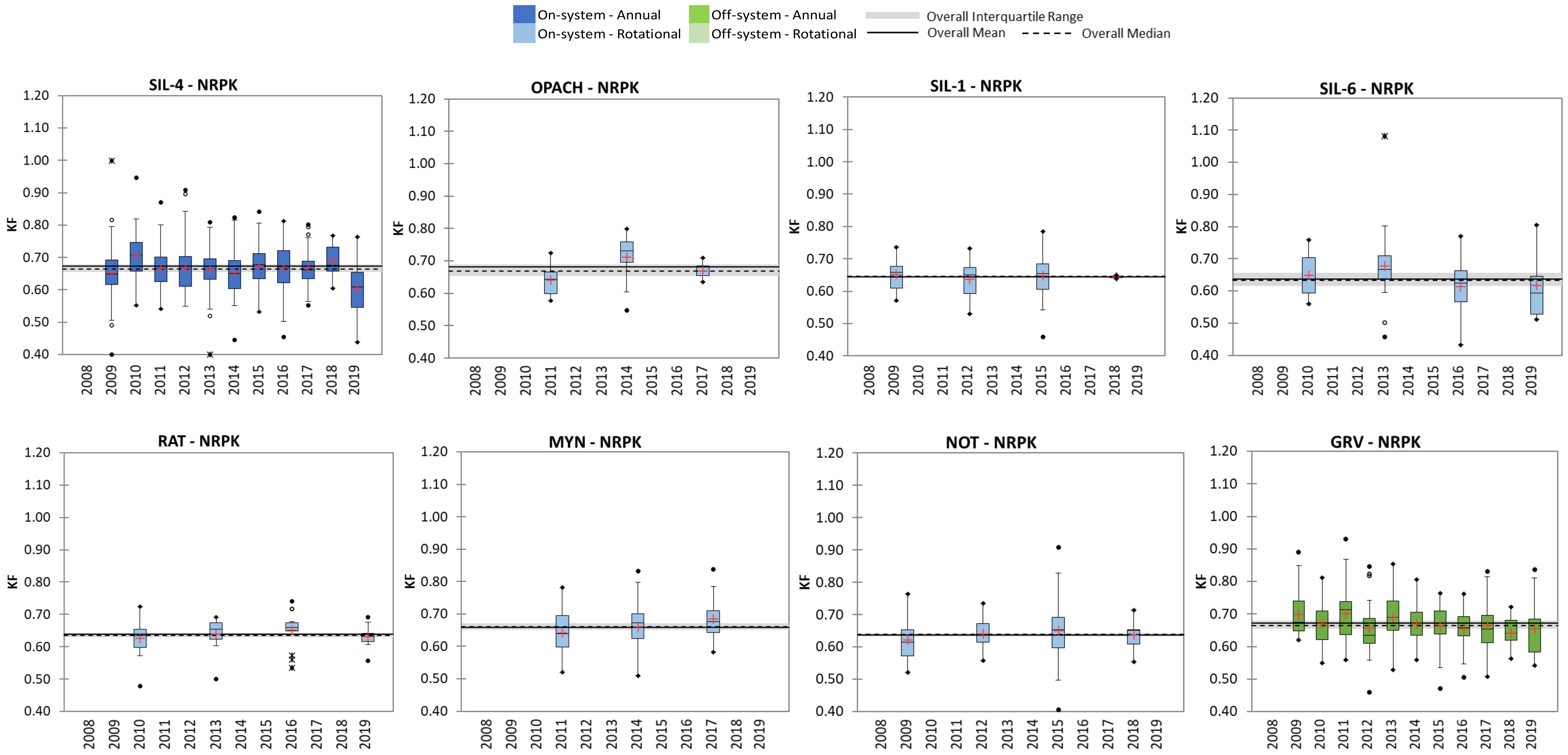


Figure 5.3-2. 2008-2019 Fulton's condition factor (KF) of Northern Pike.

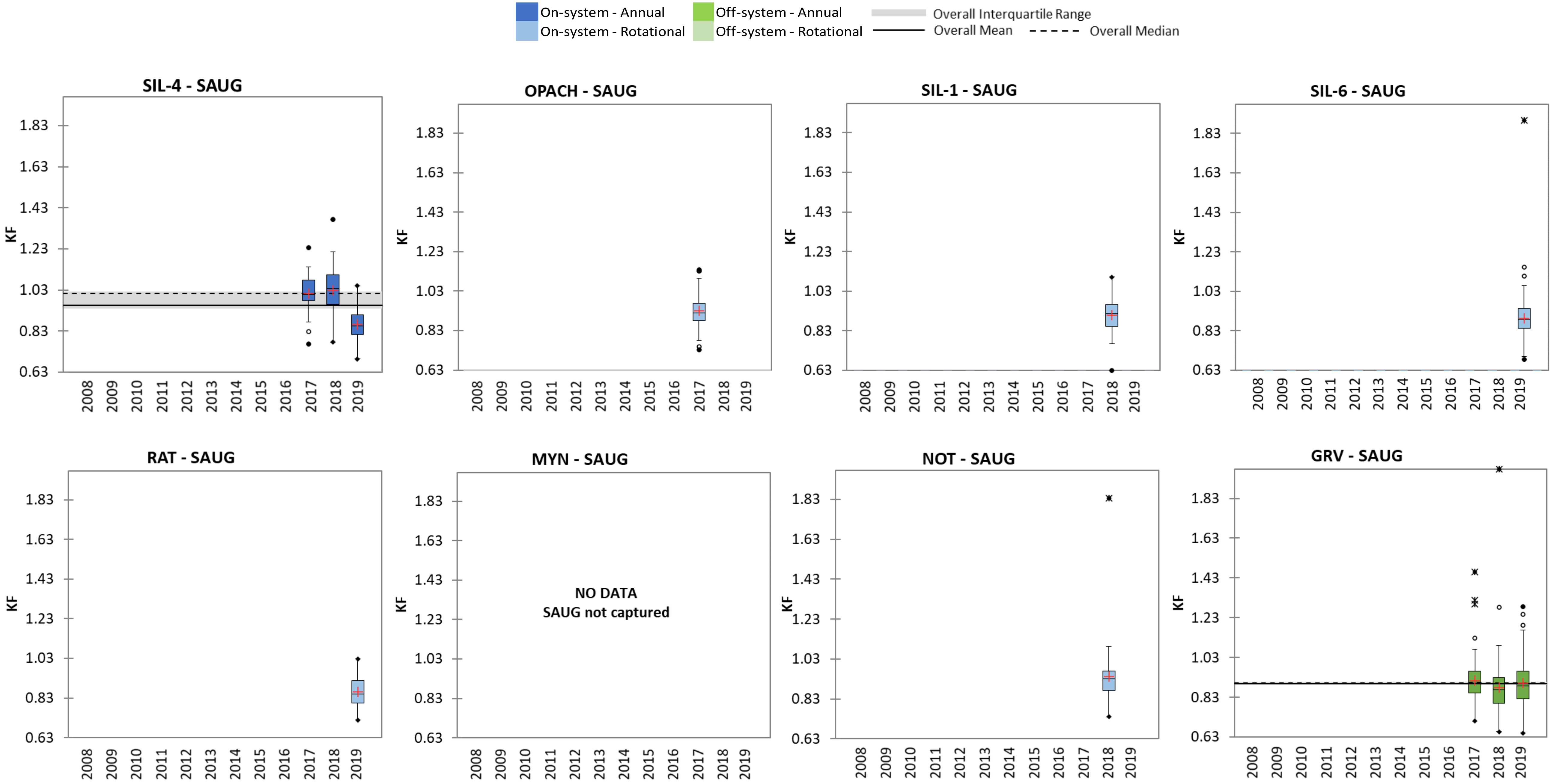


Figure 5.3-3. 2008-2019 Fulton's condition factor (KF) of Sauger.

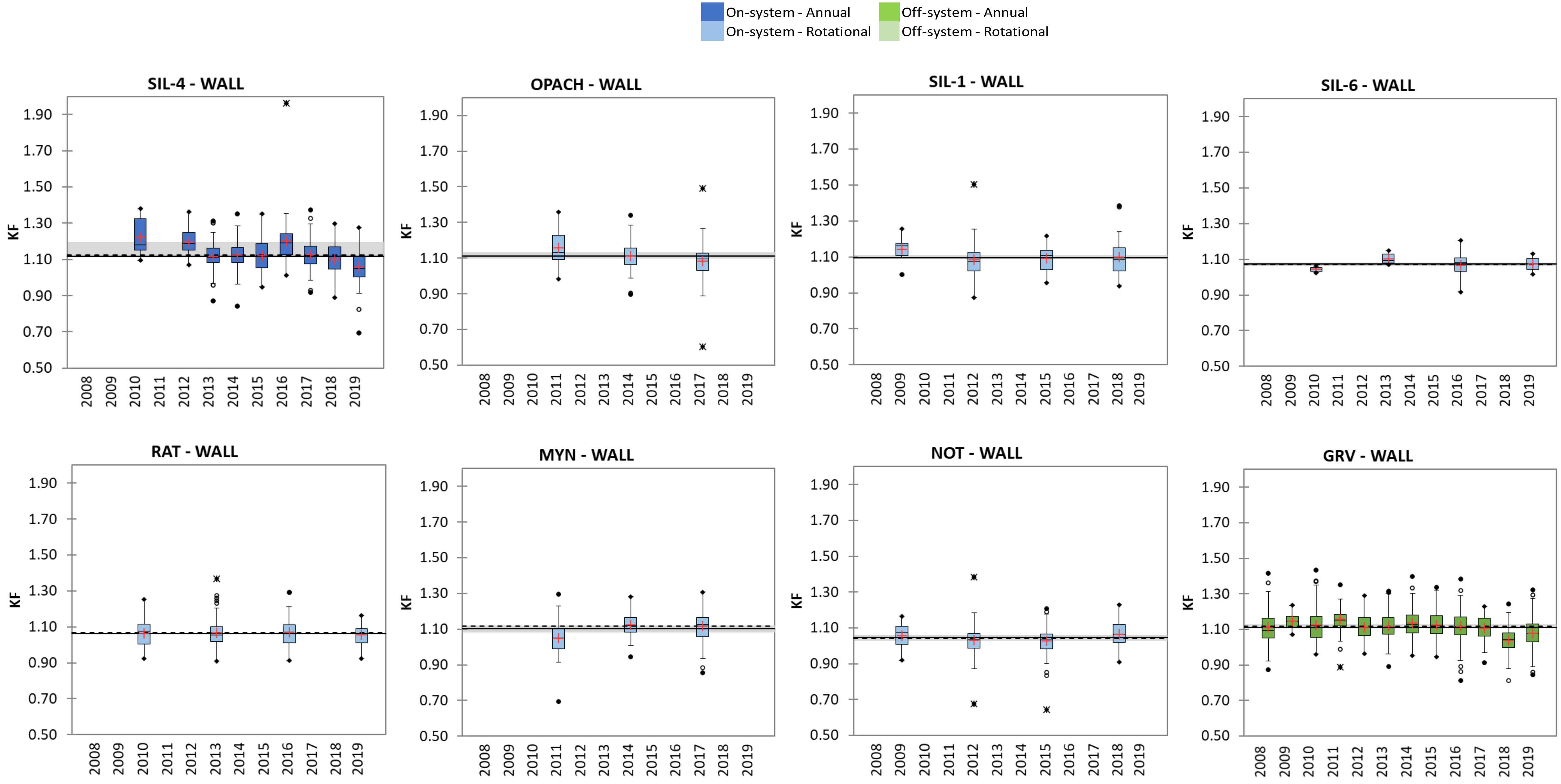


Figure 5.3-4. 2008-2019 Fulton's condition factor (KF) of Walleye.

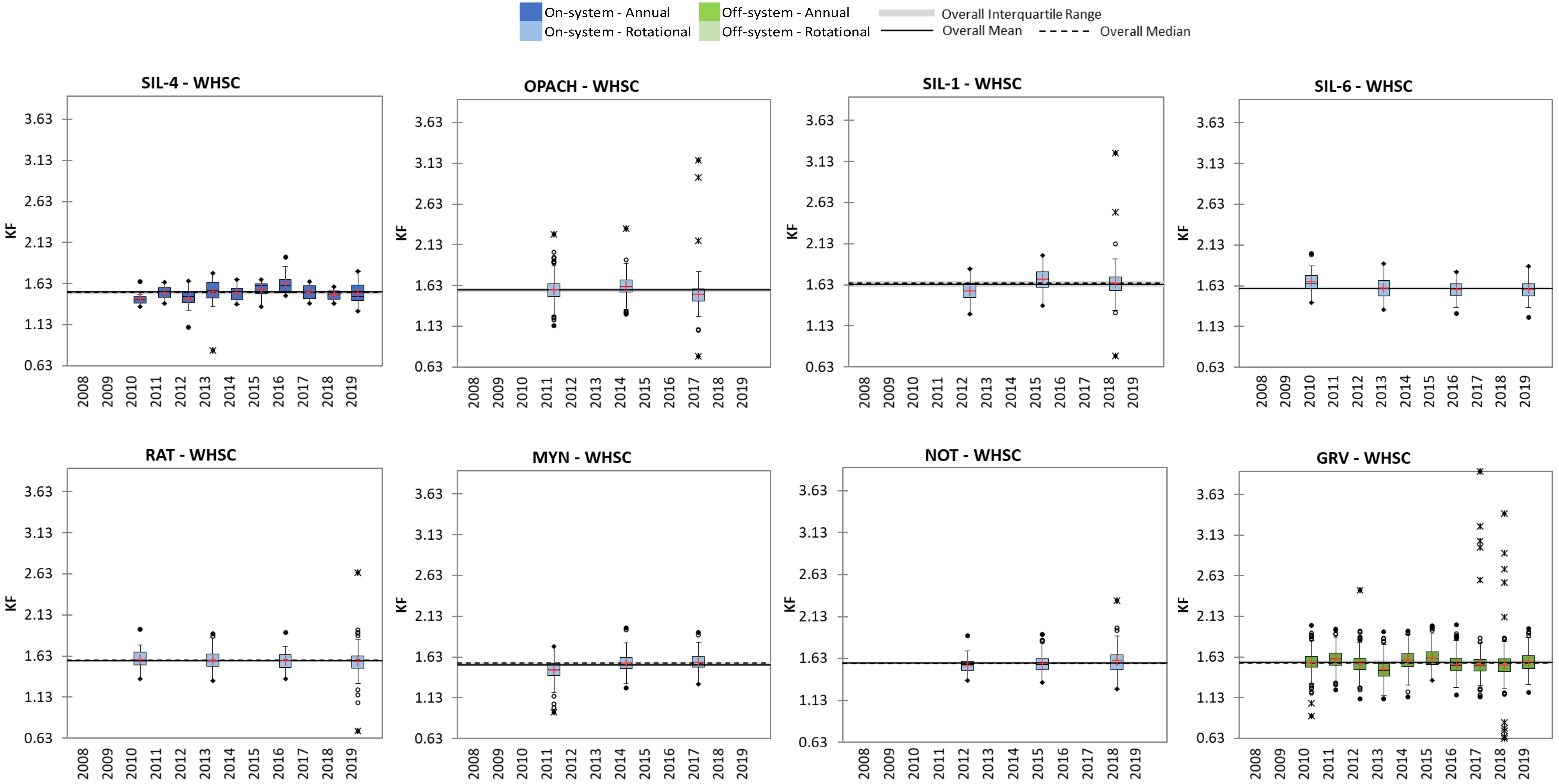


Figure 5.3-5. 2008-2019 Fulton's condition factor (KF) of White Sucker.

5.3.2 RELATIVE WEIGHT

5.3.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm and less than 701 mm in total length over the 12 years of monitoring ranged from a low of 86 in 2018 to a high of 99 in 2017 (Table 5.3-2; Figure 5.3-6).

The overall mean and median Wr were 94 and the IQR was 91-95 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2010, 2018, and 2019 when it was below the IQR and in 2008, 2016, and 2017 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the 12 years of monitoring ranged from a low of 75 in 2019 to a high of 92 in 2018 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 82 and the IQR was 81-83 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2009 and 2019 when it was below the IQR and in 2010, 2016, and 2018 when it was above the IQR.

Sauger

The annual mean Wr of Sauger greater than 69 mm in total length over the three years of monitoring that it was a target species ranged from a low of 82 in 2019 to a high of 97 in 2018 (Table 5.3-2; Figure 5.3-8).

The overall mean and median Wr was 91 and the IQR was 87-94 (Figure 5.3-8). The annual mean Wr fell within the overall IQR except in 2019 when it was below the IQR and in 2018 when it was above the IQR.

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the 12 years of monitoring ranged from a low of 84 in 2019 to a high of 99 in 2012 (Table 5.3-2; Figure 5.3-9).

The overall mean and median Wr were 89 and the IQR was 88-93 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2019 when it was below the IQR and in 2010, 2012, and 2013 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the 10 years of monitoring that it was a target species ranged from a low of 91 in 2017 to a high of 101 in 2015 and 2016 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 95, the median was 94 and the IQR was 93-98 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR except in 2017 when it was below the IQR and in 2015 and 2016 when it was above the IQR.

ROTATIONAL SITES

Opachuanau Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the three years of monitoring ranged from a low of 101 in 2017 to a high of 110 in 2014 (Table 5.3-2; Figure 5.3-6).

The overall mean and median Wr were 107 and the IQR was 104-108 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2017 when it was below the IQR and in 2014 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the three years of monitoring ranged from a low of 80 in 2011 to a high of 86 in 2014 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 847, the median was 82, and the IQR was 81-84 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2011 when it was below the IQR and in 2014 when it was above the IQR.

Sauger

Sauger was not a target species in Opachuanau Lake until 2017; Sauger greater than 69 mm in total length over the three years of monitoring had an annual mean Wr of 87 in 2017 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the three years of monitoring ranged from a low of 84 in 2017 to a high of 93 in 2011 (Table 5.3-2; Figure 5.3-9).

The overall mean and median Wr were 88, and the IQR was 86-91 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2017 when it was below the IQR and in 2011 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring ranged from a low of 98 in 2017 to a high of 104 in 2014 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 101, the median was 102, and the IQR was 100-103 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2017 when it was below the IQR and in 2014 when it was above the IQR.

Southern Indian Lake - Area 1

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the four years of monitoring ranged from a low of 104 in 2018 to a high of 118 in 2009 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 110, the median was 112, and the IQR was 108-115 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2018 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 79 in 2012 to a high of 87 in 2018 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 80, the median was 81, and the IQR was 80-84 (Figure 5.3-7). The annual mean Wr was equal to or fell within the overall IQR except in 2012 when it was marginally below the IQR and in 2018 when it was above the IQR.

Sauger

Sauger was not a target species in Opachuanau Lake until 2017; Sauger greater than 69 mm in total length had an annual mean Wr of 87 in 2018 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 87 in 2012 to a high of 92 in 2009 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 88, the median was 89, and the IQR was 88-90 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2012 when it was below the IQR and in 2009 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring that it was a target species ranged from a low of 99 in 2012 to a high of 108 in 2015 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 104, the median was 105, and the IQR was 102-107 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2012 when it was below the IQR and in 2015 when it was above the IQR.

Southern Indian Lake - Area 6

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the four years of monitoring ranged from a low of 107 in 2019 to a high of 112 in 2010 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 109, the median was 110, and the IQR was 108-111 (Figure 5.3-6). The annual mean Wr was equal to or fell within the overall IQR except in 2019 when it was below the IQR and in 2010 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 74 in 2019 to a high of 85 in 2013 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 79, the median was 78, and the IQR was 75-82 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2019 when it was marginally below the IQR and in 2013 when it was above the IQR.

Sauger

Sauger was not a target species in Southern Indian Lake - Area 6 until 2017; the annual mean Wr of Sauger greater than 69 mm in total length was 83 in 2019 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 83 in 2019 to a high of 88 in 2010 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 85, the median was 86, and the IQR was 84-87 (Figure 5.3-9). The annual mean Wr fell within the overall IQR except in 2019 when it was marginally below the IQR and in 2010 when it was marginally above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the four years of monitoring ranged from a low of 102 in 2016 and 2019 to a high of 107 in 2010 (Table 5.3-2; Figure 5.3-10).

The overall mean and median Wr were 103 and the IQR was 102-105 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR except in 2010 when it was above the IQR.

Rat Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the four years of monitoring ranged from a low of 120 in 2010 to a high of 137 in 2013 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 125, the median was 126, and the IQR was 122-131 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 80 in 2010 to a high of 83 in 2013 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 82 and the IQR was 81-82 (Figure 5.3-7). The annual mean Wr was equal to or fell within the overall IQR except in 2010 when it was marginally below the IQR and in 2013 when it was marginally above the IQR.

Sauger

Sauger was not a target species in Rat Lake until 2017; Sauger greater than 69 mm in total length had an annual mean Wr of 82 in 2019 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 85 in 2010, 2013 and 2019 to a high of 87 in 2016 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 86, the median was 85, and the IQR was 85-86 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2016 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the four years of monitoring ranged from a low of 101 in 2019 to a high of 102 in 2010, 2013 and 2016 (Table 5.3-2; Figure 5.3-10).

The overall mean, median and IQR for Wr were the same value of 102 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR except in 2019 when it was marginally below the IQR.

Mynarski Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the three years of monitoring ranged from a low of 112 in 2014 to a high of 116 in 2017 (Table 5.3-2; Figure 5.3-6).

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the three years of monitoring ranged from a low of 80 in 2011 to a high of 88 in 2017 (Table 5.3-2; Figure 5.3-7).

The overall mean Wr was 83, the median was 84, and the IQR was 82-86 (Figure 5.3-7). The annual mean Wr fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQ

Sauger

Sauger was not a target species in Mynarski Lake until 2017 and was not captured in the one year (2017) it was monitored (Table 5.3-2).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the three years of monitoring ranged from a low of 85 in 2011 to a high of 92 in 2014 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 90, the median was 91 and the IQR was 88-92 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2011 when it was below the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring ranged from a low of 94 in 2011 to a high of 101 in 2017 (Table 5.3-2; Figure 5.3-10).

The overall mean Wr was 98, the median was 100 and the IQR was 97-100 (Figure 5.3-10). The annual mean Wr fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was marginally above the IQR.

Notigi Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the four years of monitoring ranged from a low of 104 in 2012 to a high of 138 in 2009 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 118, the median was 134 and the IQR was 125-136 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2012 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the four years of monitoring ranged from a low of 80 in 2009 and 2018 to a high of 81 in 2012 and 2015 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 81 and the IQR was 80-81 (Figure 5.3-7). The annual mean Wr was equal to or fell within the overall IQR in all four years.

Sauger

Sauger was not a target species in Notigi Lake until 2017; the annual mean Wr of Sauger greater than 69 mm in total length was 88 in 2018 (Table 5.3-2; Figure 5.3-8).

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the four years of monitoring ranged from a low of 82 in 2012 and 2015 to a high of 87 in 2009 (Table 5.3-2; Figure 5.3-9).

The overall mean and median Wr were 84 and the IQR was 82-86 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2009 when it was above the IQR.

White Sucker

Whit Sucker did not become a target species in Notigi Lake until 2010; the annual mean Wr of White Sucker greater than 99 mm in total length over the three years of monitoring ranged from a low of 99 in 2012 to a high of 103 in 2018. (Table 5.3-2; Figure 5.3-10).

The overall mean and median Wr were 101 and the IQR was 100-102 (Figure 5.3-10). The annual mean Wr fell within the overall IQR in all years except 2012 when it was below the IQR and in 2018 when it was above the IQR.

5.3.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Lake Whitefish

The annual mean Wr of Lake Whitefish greater than 99 mm in total length over the 12 years of monitoring ranged from a low of 96 in 2018 to a high of 115 in 2014 and 2015 (Table 5.3-2; Figure 5.3-6).

The overall mean Wr was 109, the median was 108 and the IQR was 105-113 (Figure 5.3-6). The annual mean Wr fell within the overall IQR except in 2010, 2011 and 2018 when it was below the IQR and in 2009, 2014 and 2015 when it was above the IQR.

Northern Pike

The annual mean Wr of Northern Pike greater than 99 mm in total length over the 12 years of monitoring ranged from a low of 80 in 2016 and 2019 to a high of 87 in 2009 and 2011 (Table 5.3-2; Figure 5.3-7).

The overall mean and median Wr were 83 and the IQR was 82-85 (Figure 5.3-7). The annual mean Wr were equal to or fell within the overall IQR except in 2015, 2016 and 2019 when it was below the IQR and in 2009 and 2011 when it was above the IQR.

Sauger

The annual mean Wr of Sauger greater than 69 mm in total length over the three years of monitoring that it was a target species ranged from a low of 83 in 2018 to a high of 84 in 2017 and 2019 (Table 5.3-2; Figure 5.3-8). Sauger was not a target species in Granville Lake prior to 2017.

The overall mean and median Wr was 84 and the IQR was 83-84 (Figure 5.3-8). The annual mean Wr was equal to or fell within the overall IQR in all three years.

Walleye

The annual mean Wr of Walleye greater than 29 mm in total length over the 12 years of monitoring ranged from a low of 82 in 2018 to a high of 92 in 2011 (Table 5.3-2; Figure 5.3-9).

The overall mean Wr was 88, the median was 89, and the IQR was 88-90 (Figure 5.3-9). The annual mean Wr was equal to or fell within the overall IQR except in 2018 and 2019 when it was below the IQR and in 2011 and 2014 when it was above the IQR.

White Sucker

The annual mean Wr of White Sucker greater than 99 mm in total length over the 10 years of monitoring that it was a target species ranged from a low of 97 in 2013 to a high of 104 in 2015 (Table 5.3-2; Figure 5.3-10).

The overall mean and median Wr were 100 and the IQR was 99-102 (Figure 5.3-10). The annual mean Wr was equal to or fell within the overall IQR except in 2013 and 2018 when it was below the IQR and in 2011, 2014 and 2015 when it was above the IQR.

Table 5.3-2. 2008-2019 Relative weight of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL			WHSC		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
SIL-4	2008	605	96	0.5	-	-	-				-	-	-			
	2009	240	94	0.6	97	80	1.0				-	-	-			
	2010	149	90	0.7	51	87	1.1				12	98	2.0	7	94	2.7
	2011	373	91	0.5	98	83	0.8				1	88		7	98	2.0
	2012	177	91	0.6	98	82	1.0				40	99	5.2	24	93	1.8
	2013	185	95	0.6	120	82	0.7				48	94	3.5	38	94	1.8
	2014	224	94	0.6	95	81	0.9				87	88	0.9	21	93	1.8
	2015	191	94	0.5	97	83	0.9				111	88	0.7	15	101	1.4
	2016	261	96	0.5	101	84	1.3				116	89	1.0	17	101	2.8
	2017	385	99	0.5	26	82	1.6	34	91	2.4	175	88	0.9	14	91	2.5
	2018	135	86	0.9	26	92	7.5	35	97	2.0	93	90	0.8	2	96	7.1
	2019	240	89	0.6	82	75	1.3	47	82	1.1	124	84	0.7	11	92	3.3
OPACH	2011	77	107	1.0	6	80	2.8				46	93	1.4	455	102	0.4
	2014	102	110	0.8	13	86	2.6				64	88	0.9	433	104	0.4
	2017	47	101	1.9	6	82	1.5	195	87	1.0	78	84	1.2	405	98	0.5
SIL-1	2009	43	118	1.7	10	83	2.7				6	92	3.1			
	2012	117	110	0.9	28	79	1.5				32	87	1.6	126	99	0.7
	2015	96	114	0.9	49	80	1.1				23	89	1.6	88	108	0.9
	2018	92	104	1.0	4	87	6.8	102	87	0.8	47	88	1.2	196	105	1.0
SIL-6	2010	29	112	1.7	28	81	1.4				7	88	4.3	42	107	1.4
	2013	63	108	1.2	49	85	1.7				8	87	1.0	31	104	1.6
	2016	26	111	2.1	77	76	1.0				41	84	1.0	112	102	0.6
	2019	75	107	1.3	7	74	4.7	343	83	0.5	4	83	3.6	139	102	0.7
RAT	2010	3	120	8.2	22	80	1.4				25	85	1.2	46	102	1.4
	2013	1	137	-	39	83	1.1				134	85	0.6	129	102	0.7
	2016	18	123	2.8	35	82	1.2				87	87	0.8	101	102	0.7
	2019	10	129	6.1	32	82	1.4	35	82	1.7	56	85	1.4	157	101	0.9
MYN	2011	-	-	-	72	80	0.9	-	-	-	128	85	0.8	198	94	0.6
	2014	9	112	1.9	52	84	1.6	-	-	-	182	92	0.7	151	100	0.6
	2017	6	116	3.0	55	88	1.0	-	-	-	130	91	1.4	214	101	0.5
NOT	2009	4	138	5.9	56	80	1.5				44	87	1.6			
	2012	19	104	1.6	50	81	1.4				72	82	0.9	43	99	1.3
	2015	7	132	3.4	58	81	1.3				78	82	0.9	109	101	0.7
	2018	5	135	4.7	22	80	1.5	59	88	1.8	78	86	0.6	75	103	1.2
GRV	2008	20	110	1.9	-	-	-				46	89	1.2			
	2009	64	114	1.4	33	87	1.3				8	88	3.7			
	2010	47	104	1.3	48	84	1.3				149	89	0.6	564	100	0.3
	2011	34	104	1.1	42	87	1.5				35	92	1.2	661	103	0.3
	2012	24	112	1.4	34	83	2.1				166	90	0.5	736	100	0.3
	2013	22	108	1.7	48	85	1.2				205	89	0.5	368	97	0.5
	2014	61	115	1.1	63	83	0.8				165	91	0.6	528	103	0.3
	2015	48	115	1.1	47	81	1.1				217	90	0.5	546	104	0.3
	2016	48	106	1.0	36	80	1.2				188	89	0.6	657	99	0.3
	2017	93	106	1.0	19	83	2.2	244	84	0.7	57	89	0.8	470	99	0.6
	2018	26	96	2.9	21	83	4.2	185	83	0.9	139	82	1.0	531	98	0.6
	2019	21	108	2.7	17	80	2.5	192	84	0.6	233	86	0.5	694	100	0.3

Notes:

1. nF = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates a species was not a target species in that year.
4. "-" = no fish measured for fork length.

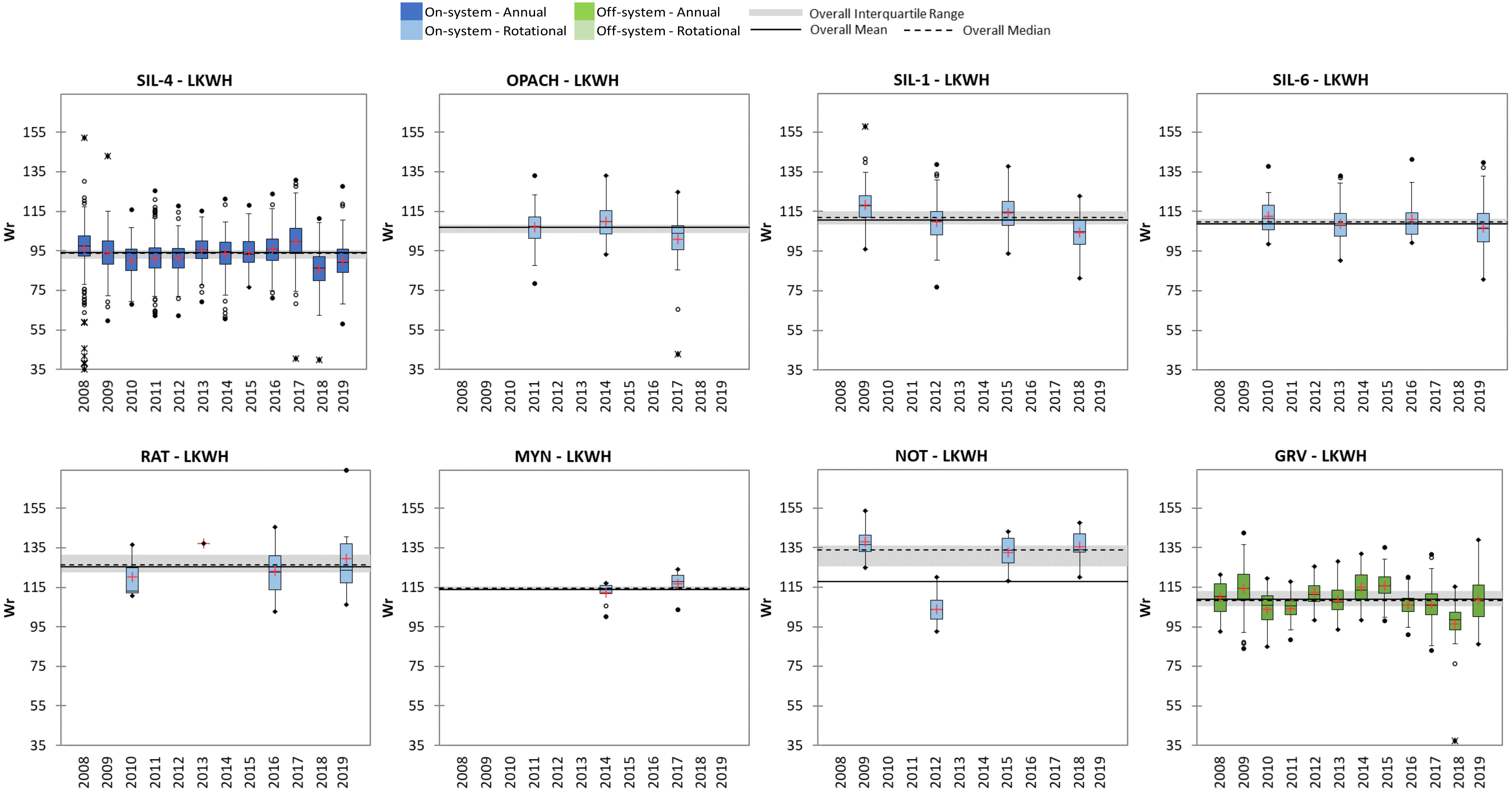


Figure 5.3-6. 2008-2019 Relative weight (Wr) of Lake Whitefish.

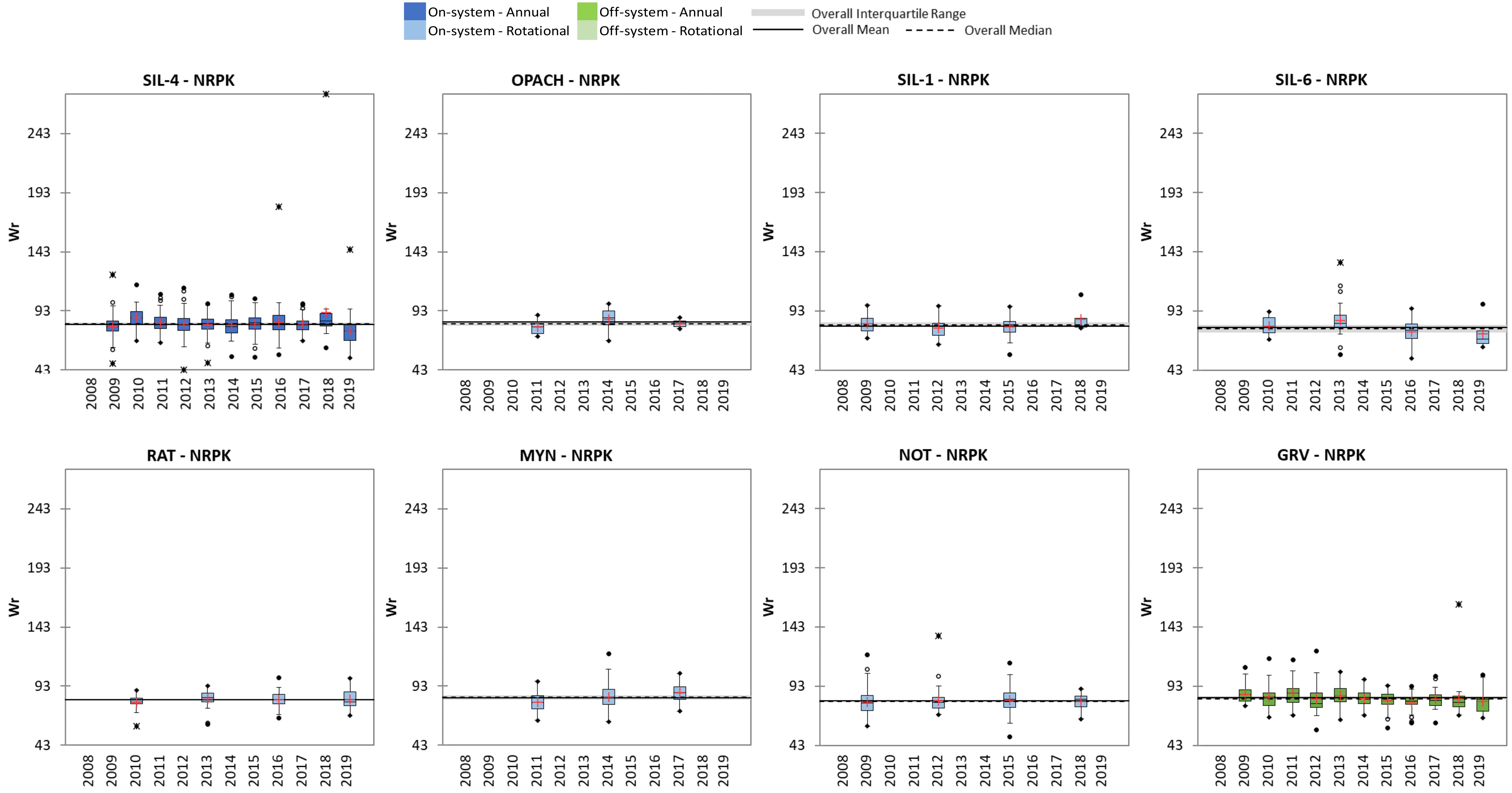


Figure 5.3-7. 2008-2019 Relative weight (Wr) of Northern Pike.

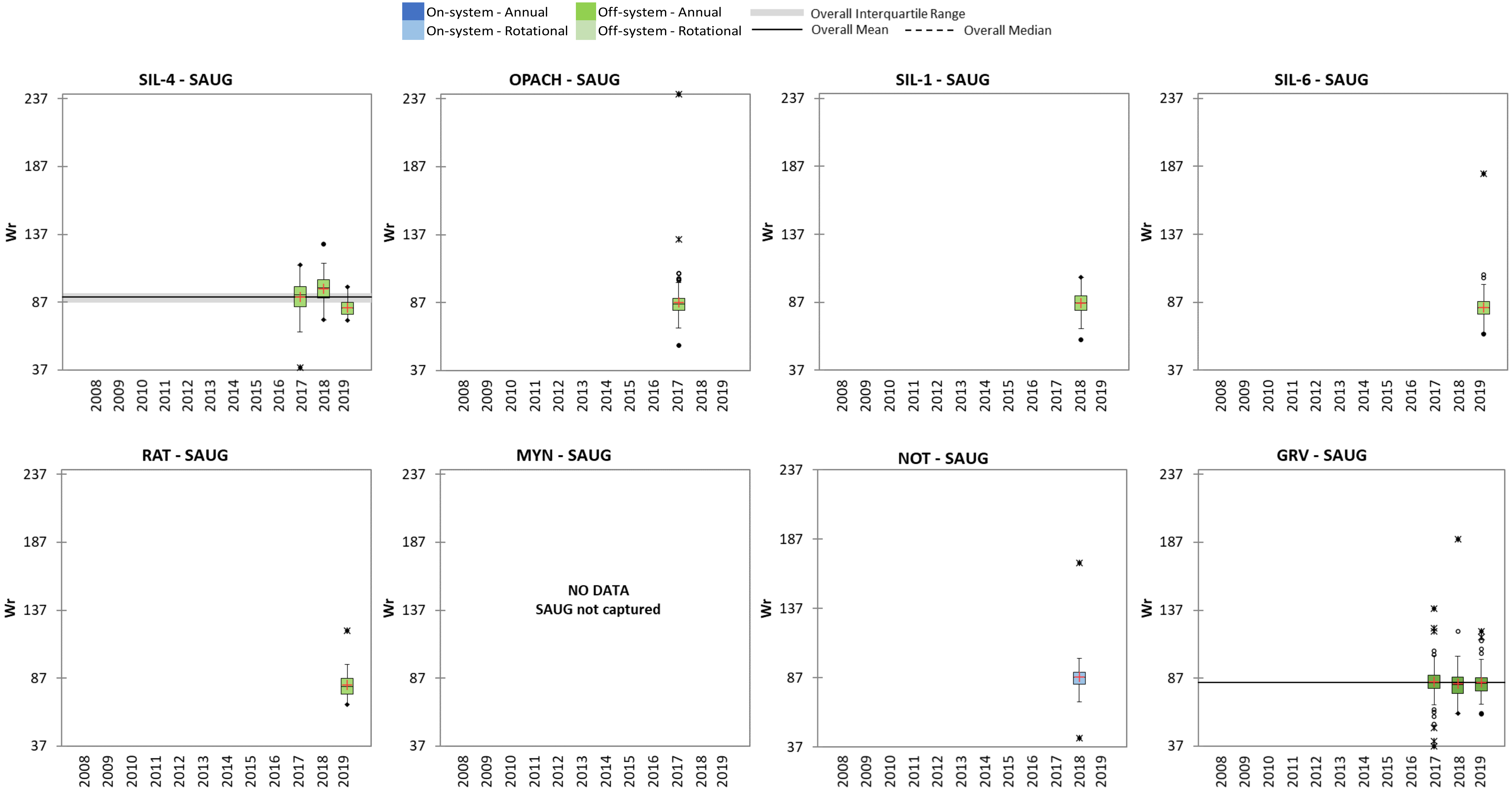


Figure 5.3-8. 2008-2019 Relative weight (Wr) of Sauger.

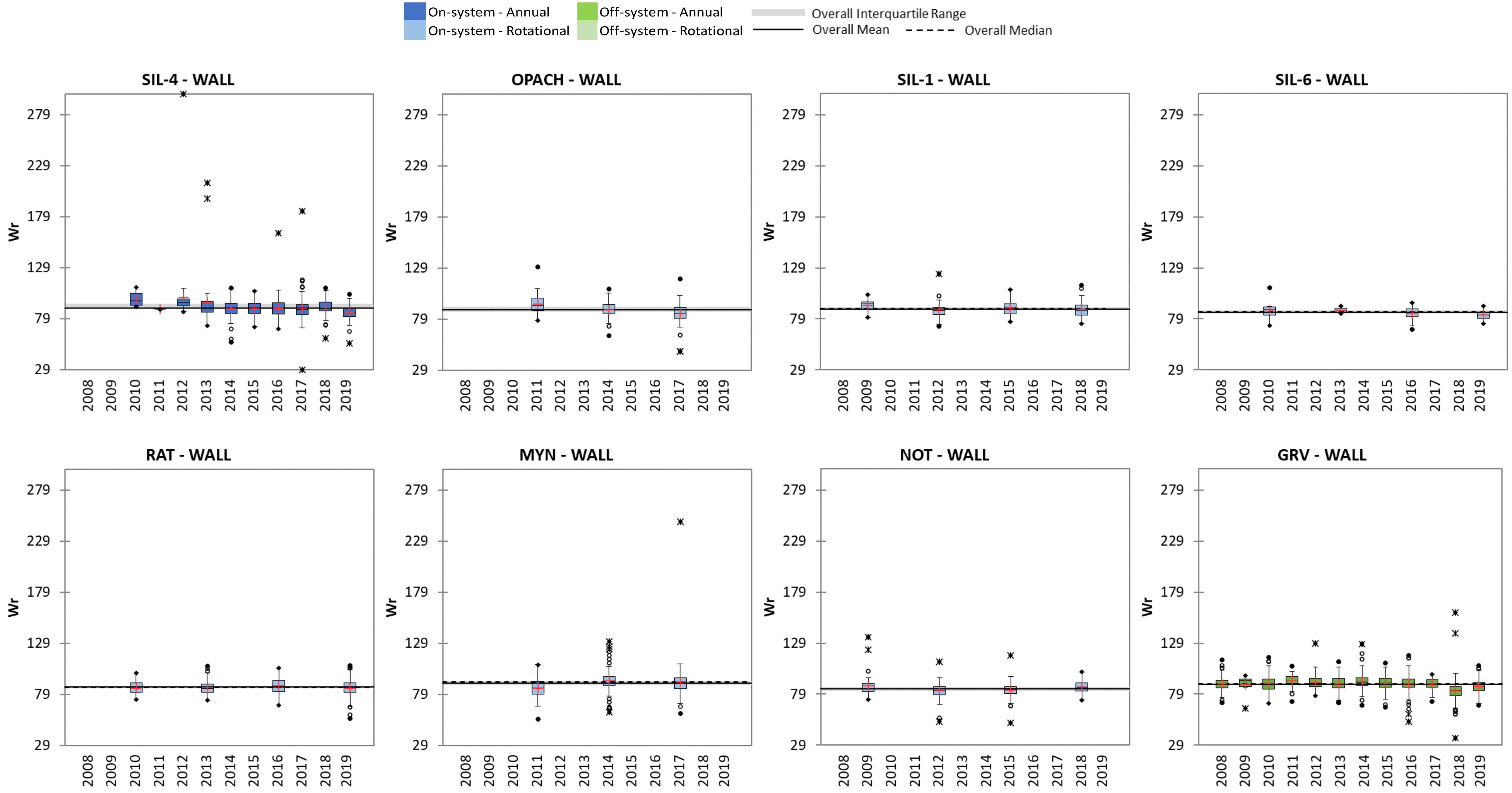


Figure 5.3-9. 2008-2019 Relative weight (Wr) of Walleye.

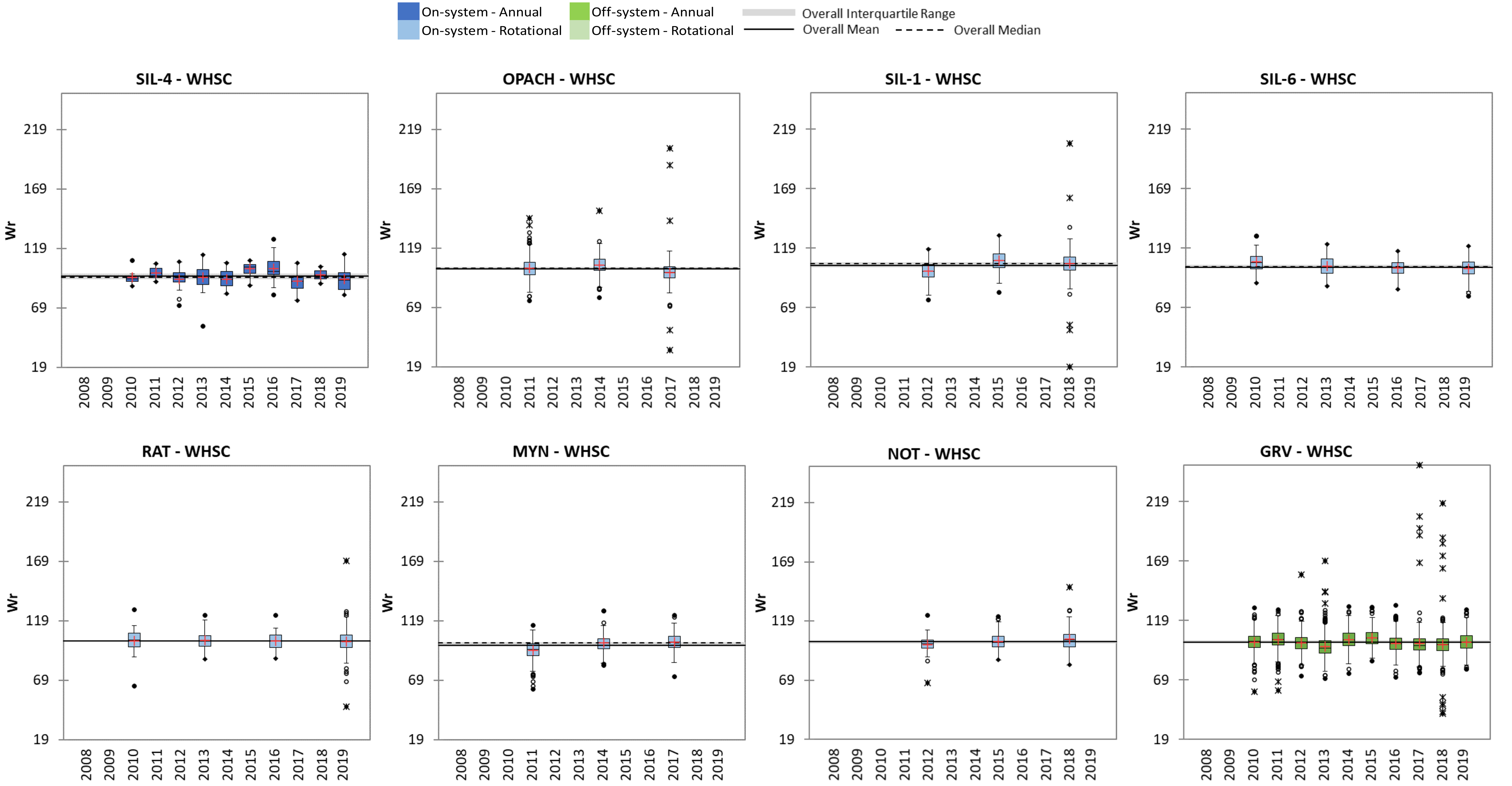


Figure 5.3-10. 2008-2019 Relative weight (Wr) of White Sucker.

5.4 GROWTH

5.4.1 LENGTH-AT-AGE

5.4.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the 12 years of monitoring ranged from a low of 190 in 2009 to a high of 261 mm in 2012 (Table 5.4-1; Figure 5.4-1).

The overall mean FLA was 220, the median was 217, and the IQR was 208-230 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2009, 2011 and 2019 when it was below the IQR and in 2012, 2013, and 2017 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the 12 years of monitoring ranged from a low of 399 in 2011 to a high of 506 mm in 2019 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 453, the median was 458, and the IQR was 426-468 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2011, 2012 and 2014 when it was below the IQR and in 2015, 2018, and 2019 when it was above the IQR.

Sauger

Sauger was not a target species in Southern Indian Lake - Area 4 until 2017; 3-year-old Sauger were not captured over the three years of monitoring. (Table 5.4-1).

Walleye

The annual mean FLA of 3-year-old Walleye over the 12 years of monitoring ranged from a low of 203 in 2017 to a high of 292 mm in 2013 (Table 5.4-1; Figure 5.4-4).

The overall mean and median FLA was 219 and the IQR was 210-234 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2017 and 2019 when it was below the IQR and in 2013 and 2014 when it was above the IQR.

White Sucker

White Sucker are not aged as part of CAMP.

ROTATIONAL SITES

Opachuanau Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the three years of monitoring ranged from a low of 257 in 2011 to a high of 290 mm in 2017 (Table 5.4-1; Figure 5.4-1).

The overall mean FLA was 278, the median was 280, and the IQR was 268-285 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the three years of monitoring ranged from a low of 443 in 2011 to a high of 557 mm in 2017 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 479, the median was 462, and the IQR was 453-510 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

Sauger

Over the three years of monitoring, Sauger was only a target species in Opachuanau Lake in 2017. In this year,3-year-old Sauger had a mean FLA of 169 mm (Table 5.4-1; Figure 5.4-3).

Walleye

The FLA of one 3-year-old Walleye captured in 2011 was 150 mm, and one captured in 2017 was 178 mm (Table 5.4-1; Figure 5.4-4).

There were too few 3-year-old Walleye captured in Opachuanau Lake over the three years of monitoring to calculate the overall metrics.

White Sucker

White Sucker are not aged as part of CAMP.

Southern Indian Lake - Area 1

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the four years of monitoring ranged from a low of 245 in 2018 to a high of 288 mm in 2009 (Table 5.4-1; Figure 5.4-1).

The overall mean FLA was 273, the median was 277, and the IQR was 267-281 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2018 when it was below the IQR and in 2009 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring ranged from a low of 452 in 2018 to a high of 527 mm in 2015 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 508, the median was 480, and the IQR was 466-504 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2018 when it was below the IQR and in 2015 when it was above the IQR.

Sauger

Sauger was not a target species in Southern Indian Lake - Area 1 until 2017; the annual mean FLA of 3-year-old Sauger was 173 mm in 2018 (Table 5.4-1; Figure 5.4-3).

Walleye

The FLA of one 3-year-old Walleye was 236 mm in 2015 (Table 5.4-1; Figure 5.4-4).

There were too few 3-year-old Walleye captured in Southern Indian Lake - Area 1 over the four years of monitoring to calculate the overall metrics.

White Sucker

White Sucker are not aged as part of CAMP.

Southern Indian Lake - Area 6

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the four years of monitoring ranged from a low of 305 in 2019 to a high of 318 mm in 2010 (Table 5.4-1; Figure 5.4-1).

The overall mean FLA was 310, the median was 308, and the IQR was 306-312 mm (Figure 5.4-1). The annual mean FLA was equal to or fell within the overall IQR except in 2019 when it was marginally below the IQR and in 2010 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring ranged from a low of 422 in 2010 to a high of 496 mm in 2013 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 469, the median was 467, and the IQR was 444-481 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

Sauger

Sauger was not a target species in Southern Indian Lake - Area 6 until 2017; the annual mean FLA of 3-year-old Sauger was 161 mm in 2019 (Table 5.4-1; Figure 5.4-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the four years of monitoring ranged from a low of 154 in 2019 to a high of 192 mm in 2016 (Table 5.4-1; Figure 5.4-4).

There were too few 3-year-old Walleye captured in Southern Indian Lake - Area 6 to calculate the overall metrics.

White Sucker

White Sucker are not aged as part of CAMP.

Rat Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish was 348 mm in 2016 (Table 5.4-1; Figure 5.4-1).

There were too few 4-year-old Lake Whitefish captured in Rat Lake over the four years of monitoring to calculate the overall metrics.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring ranged from a low of 372 in 2013 to a high of 476 mm in 2019 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 411, the median was 408, and the IQR was 398-426 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

Sauger

Sauger was not a target species in Rat Lake until 2017; the annual mean FLA of 3-year-old Sauger was 138 mm in 2019 (Table 5.4-1; Figure 5.4-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the four years of monitoring ranged from a low of 219 in 2010 to a high of 256 mm in 2013 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 235, the median was 228, and the IQR was 222-239 mm (Figure 5.4-4). The annual mean FLA was equal to or fell within the overall IQR except in 2010 when it was below the IQR and in 2013 when it was above the IQR.

White Sucker

White Sucker are not aged as part of CAMP.

Mynarski Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish was 348 mm in 2014 (Table 5.4-1; Figure 5.4-1).

There were too few 4-year-old Lake Whitefish captured in Mynarski Lake over the three years of monitoring to calculate the overall metrics.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the three years of monitoring ranged from a low of 393 in 2011 to a high of 464 mm in 2017 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 444, the median was 458, and the IQR was 426-461 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2011 when it was below the IQR and in 2017 when it was above the IQR.

Sauger

Over the three years of monitoring, Sauger was only a target species in Mynarski Lake in 2017. Three-year-old Sauger were not captured in 2017 (Table 5.4-1).

Walleye

The annual mean FLA of 3-year-old Walleye over the three years of monitoring ranged from a low of 200 in 2011 to a high of 229 mm in 2014 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 221, the median was 225, and the IQR was 212-227 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2011 when it was below the IQR and in 2014 when it was above the IQR.

White Sucker

White Sucker are not aged as part of CAMP.

Notigi Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish was 315 mm in 2012 (Table 5.4-1; Figure 5.4-1).

There were too few 4-year-old Lake Whitefish captured in Notigi Lake over the four years of monitoring to calculate the overall metrics.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the four years of monitoring ranged from a low of 386 in 2009 to a high of 460 mm in 2018 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 394, the median was 396, and the IQR was 392-413 mm (Figure 5.4-2). The annual mean FLA fell within the overall IQR except in 2009 when it was below the IQR and in 2018 when it was above the IQR.

Sauger

Sauger was not a target species in Notigi Lake until 2017; three-year old Sauger were not captured in Notigi Lake in 2018. (Table 5.4-3).

Walleye

The annual mean FLA of 3-year-old Walleye over the four years of monitoring ranged from a low of 229 in 2018 to a high of 266 mm in 2015 (Table 5.4-1; Figure 5.4-4).

There were too few 3-year-old Sauger captured in Notigi Lake to calculate the overall metrics.

White Sucker

White Sucker are not aged as part of CAMP.

5.4.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Lake Whitefish

The annual mean FLA of 4-year-old Lake Whitefish over the 12 years of monitoring ranged from a low of 246 in 2018 to a high of 341 mm in 2014 (Table 5.4-1; Figure 5.4-1).

The overall mean FLA was 289, the median was 285, and the IQR was 268-303 mm (Figure 5.4-1). The annual mean FLA fell within the overall IQR except in 2013, 2017, and 2018 when it was below the IQR and in 2009, 2012, and 2014 when it was above the IQR.

Northern Pike

The annual mean FLA of 4-year-old Northern Pike over the 12 years of monitoring ranged from a low of 414 in 2009 to a high of 522 mm in 2014 (Table 5.4-1; Figure 5.4-2).

The overall mean FLA was 492, the median was 485, and the IQR was 471-503 mm (Figure 5.4-2). The annual mean FLA was equal to or fell within the overall IQR except in 2009 and 2011 when it was below the IQR and in 2014 and 2015 when it was above the IQR.

Sauger

The annual mean FLA of 3-year-old Sauger in the three years it was a target species ranged from a low of 197 mm in 2019 to a high of 2017 in 2018 (Table 5.4-1; Figure 5.4-3).

The overall mean and median FLA were 203 and the IQR was 200-210 (Figure 5.4-3). The annual mean FLA fell within the IQR except in 2019 when it was below the IQR and in 2018 when it was above the IQR.

Walleye

The annual mean FLA of 3-year-old Walleye over the 12 years of monitoring ranged from a low of 219 in 2018 to a high of 295 mm in 2014 (Table 5.4-1; Figure 5.4-4).

The overall mean FLA was 253, the median was 243, and the IQR was 230-258 mm (Figure 5.4-4). The annual mean FLA fell within the overall IQR except in 2011, 2017, and 2018 when it was below the IQR and in 2010 and 2014 when it was above the IQR.

White Sucker

White Sucker are not aged as part of CAMP.

Table 5.4-1. 2008-2019 Fork length-at-age of target species.

Waterbody	Year	LKWH			NRPK			SAUG			WALL		
		n_F[1]	Mean	SE[2]	n_F	Mean	SE	n_F	Mean	SE	n_F	Mean	SE
SIL-4	2008	12	218	7	-	-	-				-	-	-
	2009	1	190	-	1	438	-				-	-	-
	2010	1	215	-	1	460	-				-	-	-
	2011	9	196	3	6	399	10				-	-	-
	2012	3	261	23	8	414	12				-	-	-
	2013	1	238	-	3	451	17				1	292	-
	2014	13	215	4	2	404	2				9	245	7
	2015	19	229	5	9	492	12				24	222	4
	2016	11	210	3	9	458	16				17	212	4
	2017	15	233	6	7	463	9	-	-	-	16	203	6
	2018	8	224	5	3	473	9	-	-	-	3	219	8
	2019	3	203	5	4	506	21	-	-	-	1	208	-
OPACH	2011	4	257	18	2	443	27				1	150	-
	2014	30	280	4	5	462	22				-	-	-
	2017	3	290	24	2	557	3	16	169	2	1	178	-
SIL-1	2009	5	288	23	-	-	-				-	-	-
	2012	6	274	9	2	480	2				-	-	-
	2015	6	279	11	6	527	14				1	236	-
	2018	4	245	12	1	452		7	173	4	-	-	-
SIL-6	2010	10	318	9	2	422	40				-	-	-
	2013	9	310	5	4	496	26				-	-	-
	2016	13	306	6	6	467	27				2	192	44
	2019	11	305	6	-	-	-	8	161	4	1	154	-
RAT	2010	-	-	-	3	407	27				1	219	-
	2013	-	-	-	12	372	13				4	256	23
	2016	3	348	35	16	409	14				13	234	8
	2019	-	-	-	8	476	12	2	138	3	5	222	3
MYN	2011	-	-	-	8	393	14				2	200	0
	2014	5	348	10	9	458	22				4	229	7
	2017	-	-	-	14	464	10	-	-	-	2	225	33
NOT	2009	-	-	-	16	386	8				-	-	-
	2012	4	315	6	16	394	10				-	-	-
	2015	-	-	-	14	398	11				19	266	5
	2018	-	-	-	1	460	-	-	-	-	3	229	10
GRV	2009	8	306	16	4	414	25				-	-	-
	2010	8	294	13	3	471	22				4	260	8
	2011	10	269	9	3	442	15				1	228	-
	2012	1	338		4	485	16				5	234	5
	2013	2	267	23	12	472	15				13	256	4
	2014	6	341	18	17	522	9				6	295	22
	2015	3	291	2	6	518	12				29	258	7
	2016	8	280	14	10	503	9				6	236	7
	2017	6	256	18	-	-	-	9	203	8	5	223	7
	2018	1	246	-	4	496	10	7	217	7	2	219	11
	2019	-	-	-	-	-	-	13	197	3	8	250	5

Notes:

1. nF = number of fish measured for length and weight.
2. SE = standard error.
3. Grey shading indicates that a species was not a target species in that year.
4. “-” = no fish measured for fork length or age

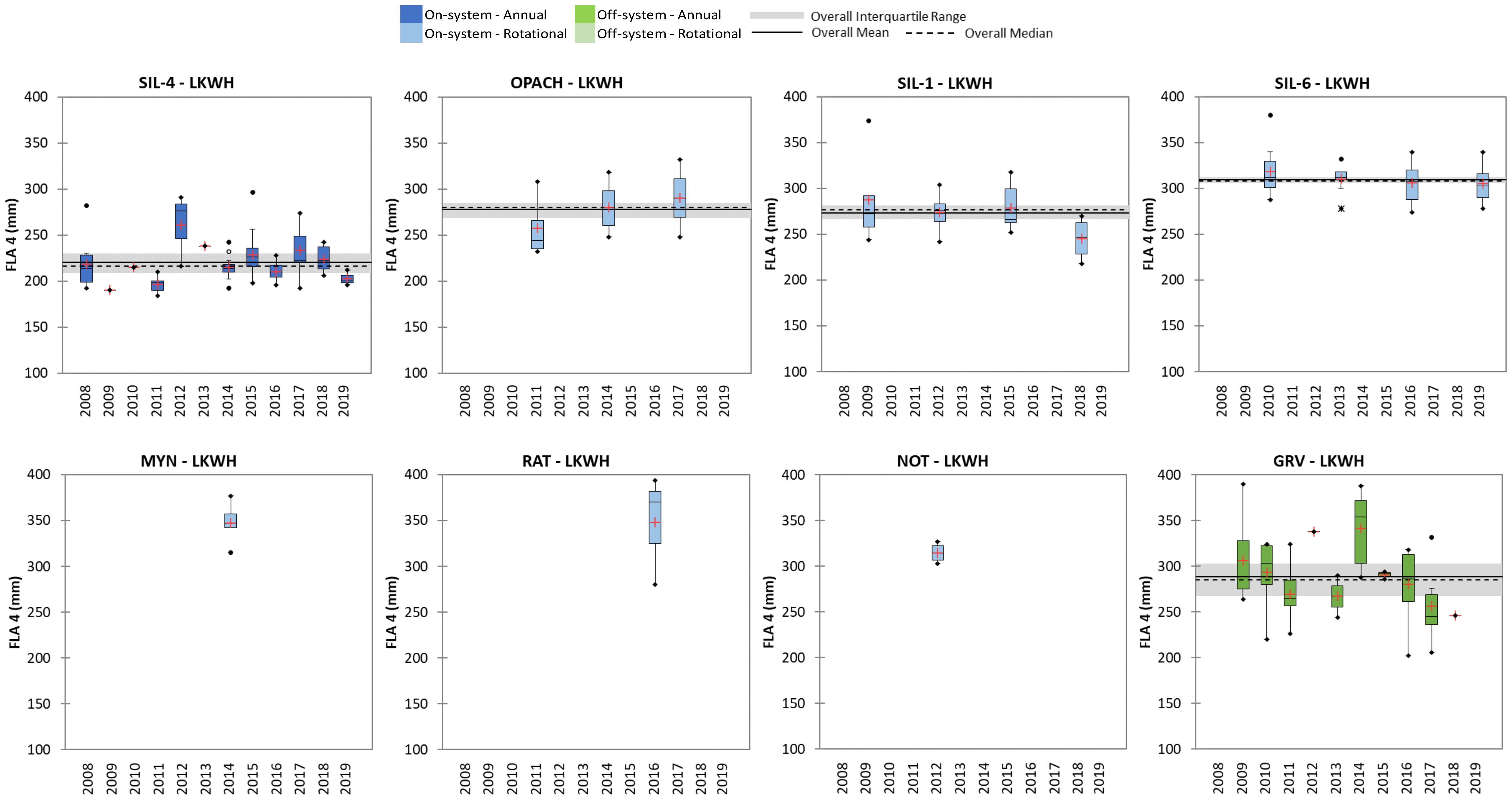


Figure 5.4-1. 2008-2019 Fork length-at-age (FLA) 4 of Lake Whitefish.

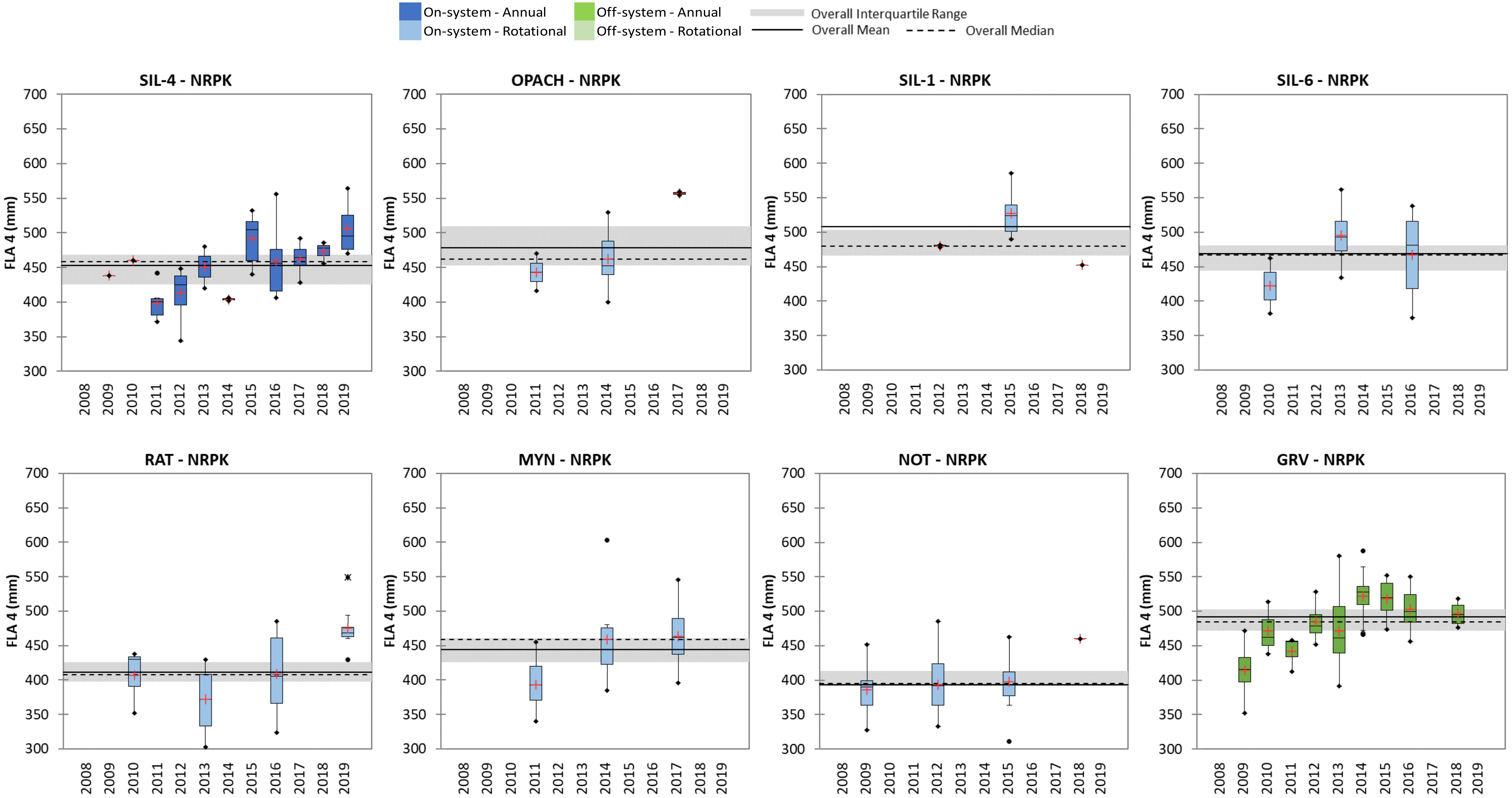


Figure 5.4-2. 2008-2019 Fork length-at-age (FLA) 4 of Northern Pike.

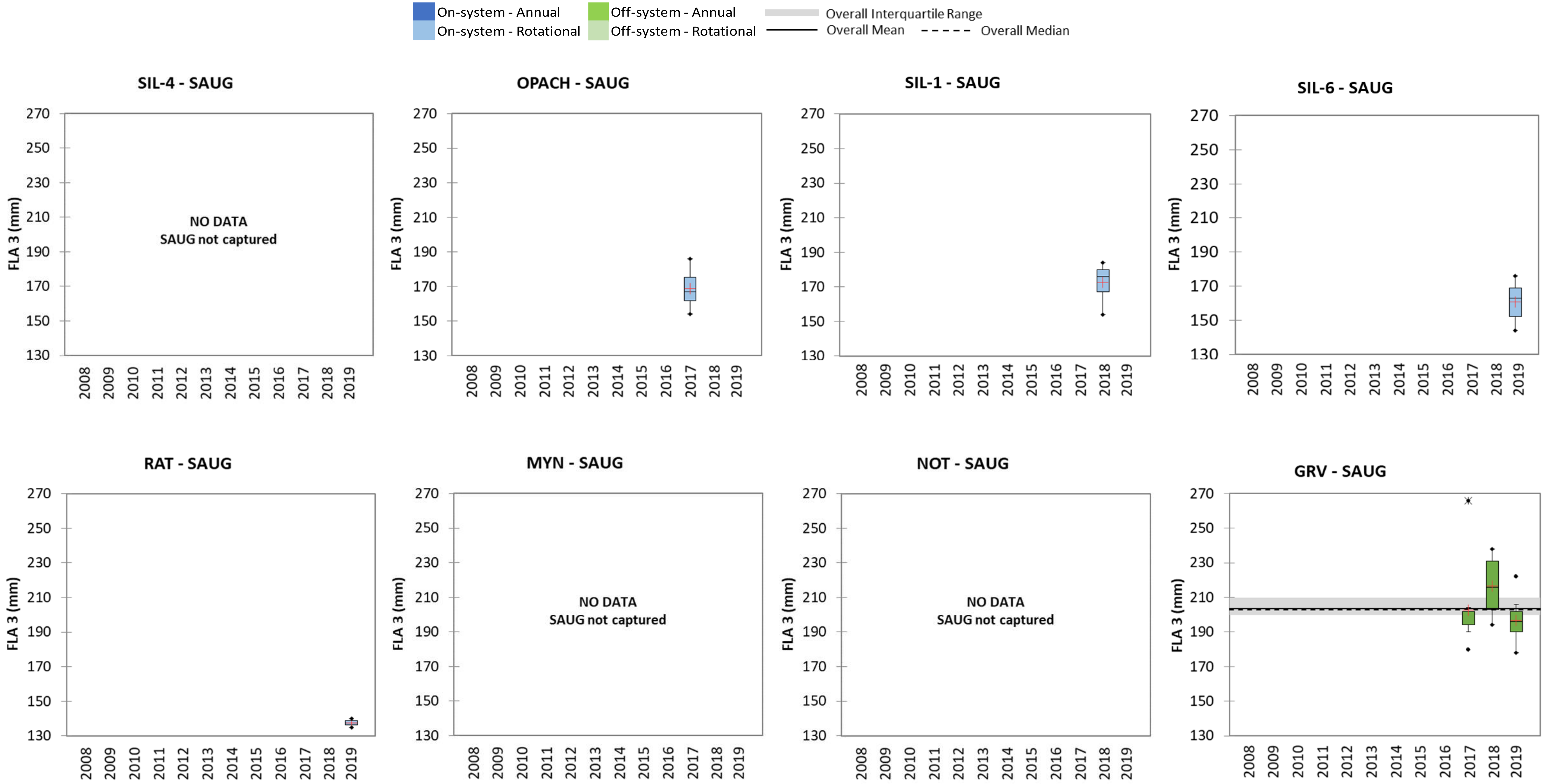


Figure 5.4-3. 2008-2019 Fork length-at-age (FLA) 3 of Sauger.

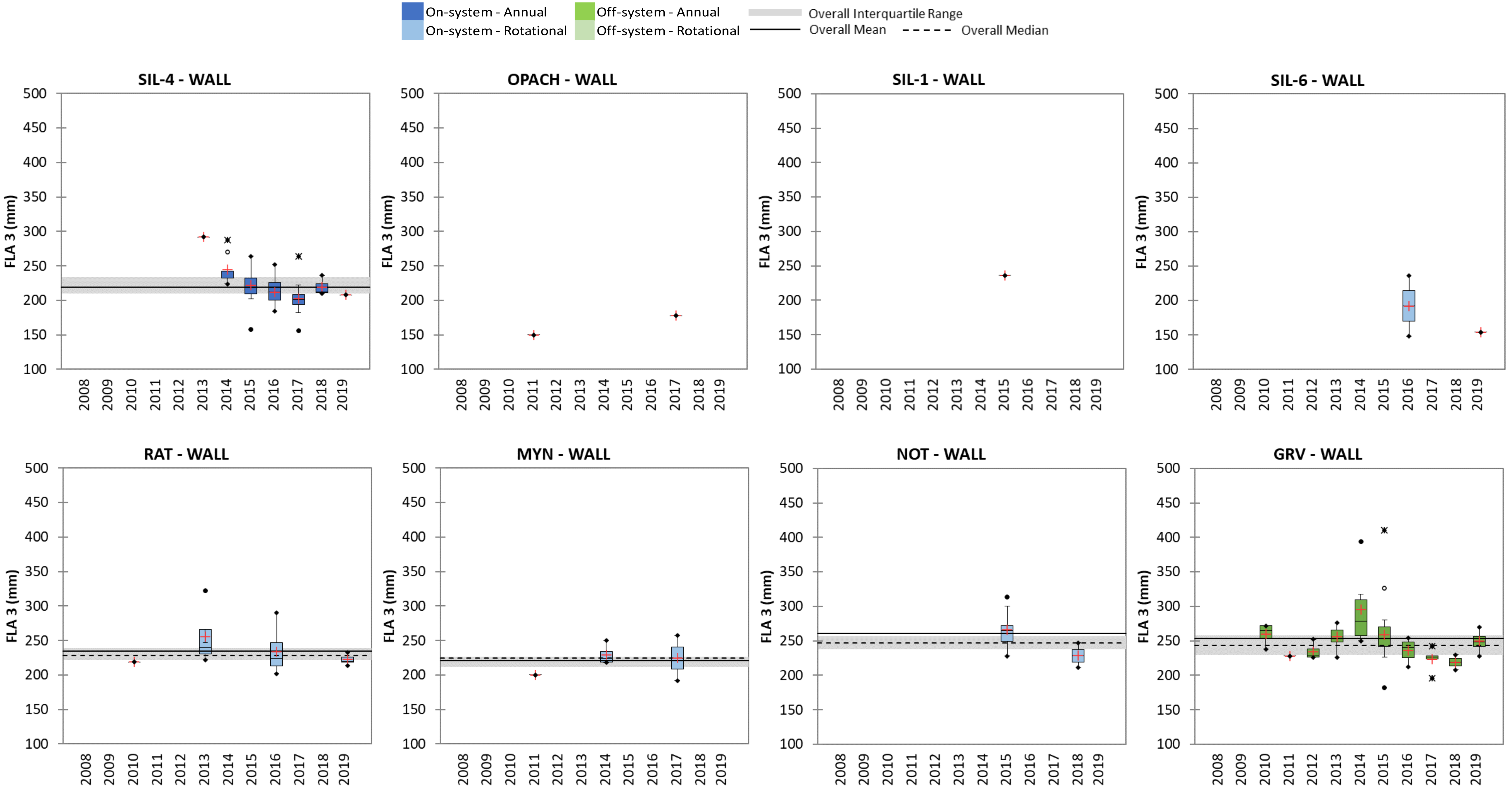


Figure 5.4-4. 2008-2019 Fork length-at-age (FLA) 3 of Walleye.

5.5 RECRUITMENT

5.5.1 RELATIVE YEAR-CLASS STRENGTH

5.5.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

Lake Whitefish

The RYCS of Lake Whitefish over the 12 years of monitoring ranged from a low of 10 for the 2009 cohort to a high of 238 for the 2011 cohort (Figure 5.5-1). There were no missing cohorts from 2002-2014. Particularly strong cohorts (>100) were produced in eight out of the 12 years (2003, 2007 and 2010-2014). Weak cohorts (<50) were produced in 2005 and 2009.

Northern Pike

The RYCS of Northern Pike over the 12 years of monitoring ranged from a low of 57 for the 2004 cohort to a high of 160 for the 2013 cohort (Figure 5.5-2). There were no missing cohorts from 2002-2014. Particularly strong cohorts (>100) were produced in 2007 and from 2012-2014.

Sauger

Over the three years of monitoring that it was a target species, age data for Sauger was insufficient to allow year-class strength determination. Not enough Sauger were captured over the three years of monitoring that it was a target species to complete a RYCS analysis.

Walleye

The RYCS of Walleye over the 12 years of monitoring ranged from a low of 9 for the 2009 cohort to a high of 227 for the 2012 cohort (Figure 5.5-4). There were no missing cohorts from 2002-2014. Strong cohorts (>100) were produced over a two-year period from 2007-2008 and again from 2012-2013. Particularly weak cohorts were produced over a three-year period from 2002-2004, a two-year period from 2009-2010 and again in 2014.

White Sucker

White Sucker are not aged as part of CAMP.

ROTATIONAL SITES

RYCS analysis requires data be collected in at least three consecutive years and therefore cannot be conducted for rotational waterbodies.

5.5.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

Lake Whitefish

The RYCS of Lake Whitefish over the 12 years of monitoring ranged from a low of 41 for the 2008 cohort to a high of 170 for the 2006 cohort (Figure 5.5-1). There were no missing cohorts from 2002-2014. Strong cohorts (>100) were produced in over half of the years (2002, 2005, 2006, 2007, 2009, 2010, 2012, and 2014) and particularly weak cohorts (<50) produced in two years (2004 and 2008).

Northern Pike

The RYCS of Northern Pike over the 12 years of monitoring ranged from a low of 55 for the 2003 cohort to a high of 142 for the 2012 cohort (Figure 5.5-2). There were no missing cohorts from 2002-2014. Strong cohorts were produced in half the years, (2002, 2006, 2008, 2010, 2012 and 2014).

Sauger

The RYCS of Sauger over the three years of monitoring that it was a target species, ranged from a low of 13 for the 2009 cohort to a high of 119 for the 2012 cohort (Figure 5.5-3). Seven cohorts (2002-2008) were missing from 2002-2014. Particularly weak cohorts were produced in 2009, 2011 and 2013, and only the 2012 cohort was particularly strong (>100).

Walleye

The RYCS of Walleye over the 12 years of monitoring ranged from a low of 9 for the 2004 cohort to a high of 199 for the 2012 cohort (Figure 5.5-4). There were no missing cohorts from 2002-2014. Particularly weak cohorts (<50) were produced in 2004 and 2009. Strong cohorts (>100) were produced in 2005, 2006, 2010, 2012 and 2014.

White Sucker

White Sucker are not aged as part of CAMP.

ROTATIONAL SITES

RYCS analysis requires data be collected in at least three consecutive years and therefore cannot be conducted for rotational waterbodies.

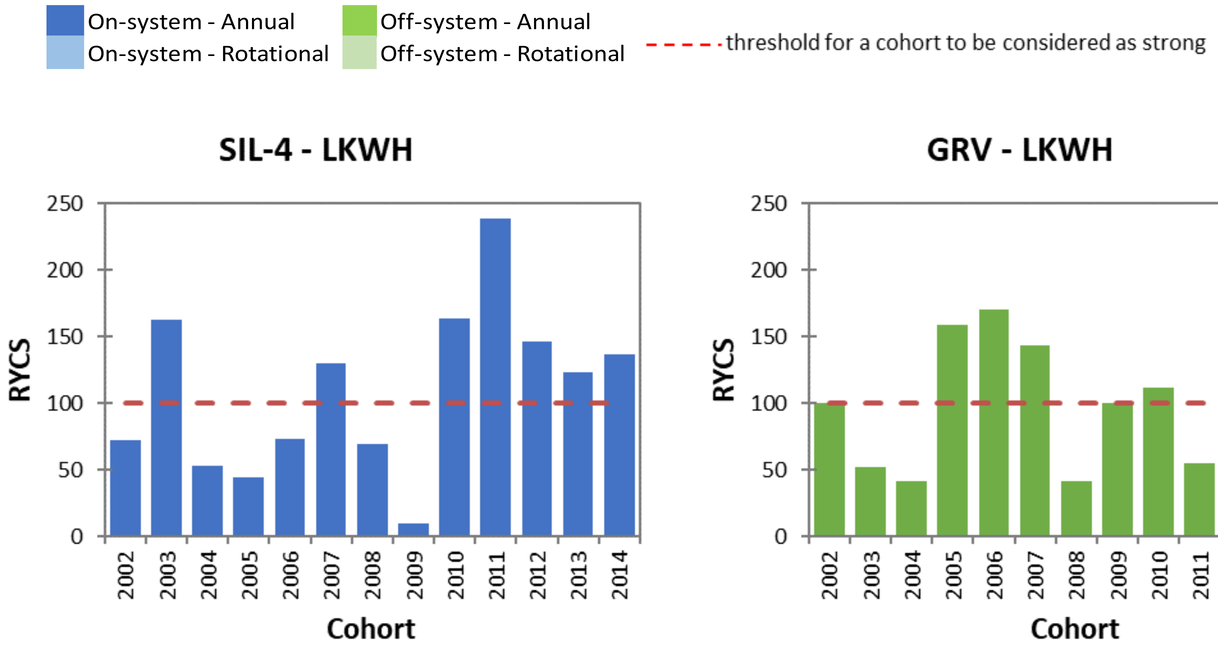


Figure 5.5-1. Relative year-class strength (RYCS) of Lake Whitefish.

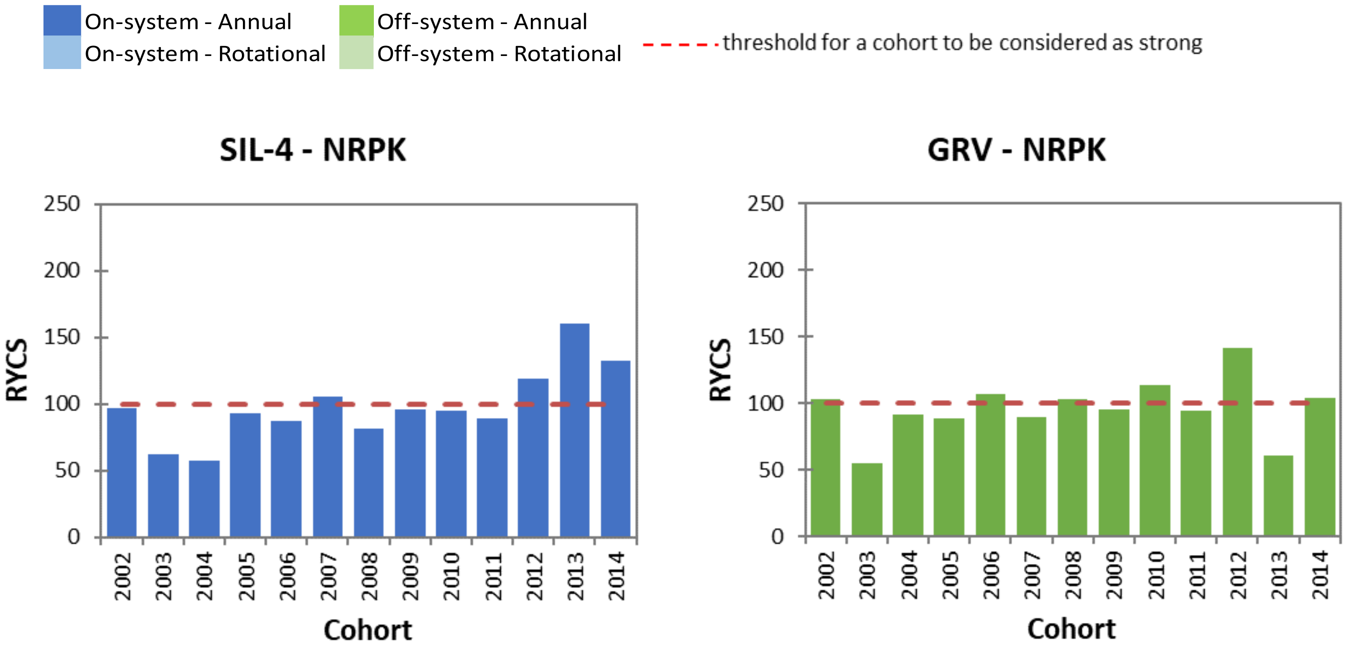


Figure 5.5-2. Relative year-class strength (RYCS) of Northern Pike.

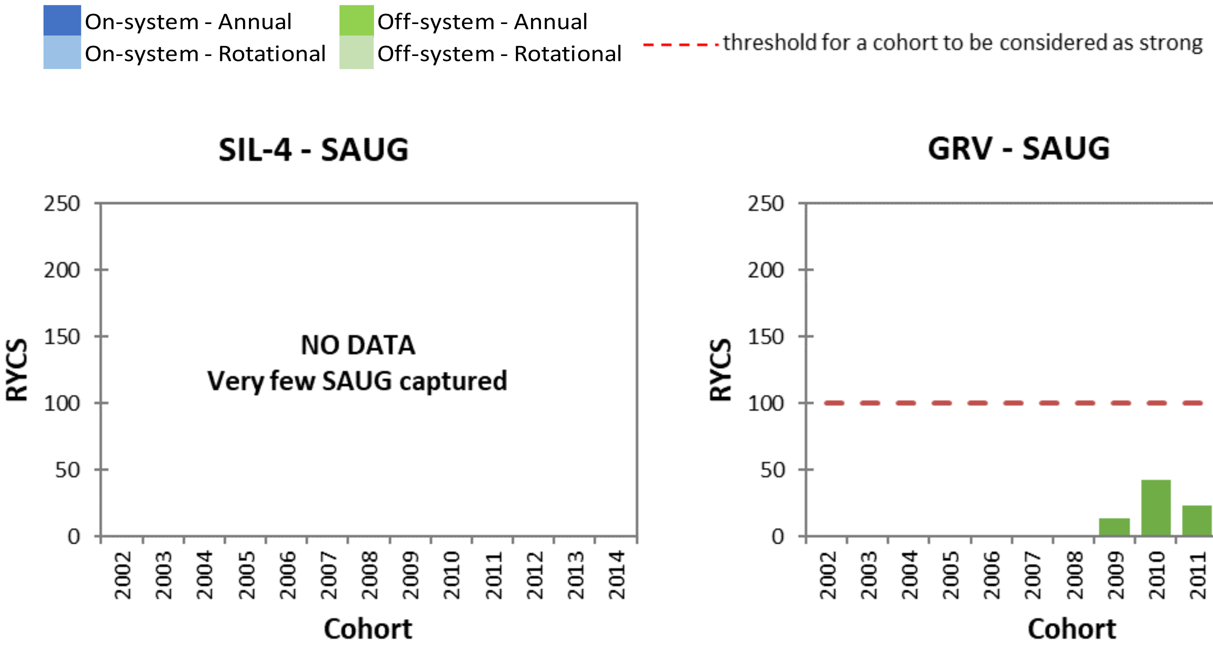


Figure 5.5-3. Relative year-class strength (RYCS) of Sauger.

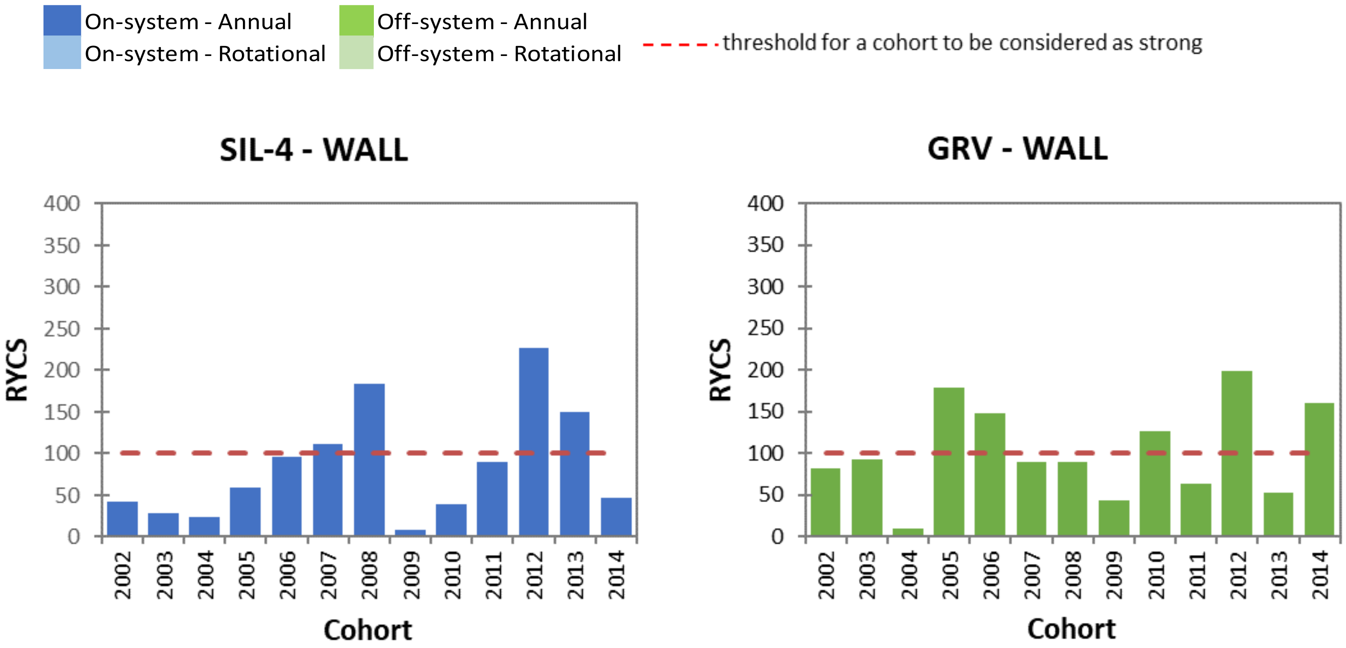


Figure 5.5-4. Relative year-class strength (RYCS) of Walleye.

5.6 DIVERSITY

5.6.1 RELATIVE SPECIES ABUNDANCE

5.6.1.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

A total of 16 fish species were captured in the combined standard and small mesh gangs at Southern Indian Lake - Area 4 over 12 years of monitoring (Table 5.6-1) with the number of species caught each year ranging from 7-14 (Tables 5.6-2 and 5.6-3).

Standard Gang Index Gill Nets

Lake Whitefish were the most frequently captured species at Southern Indian Lake - Area 4 over 12 years of monitoring, accounting for an average of 40% of the catch (Table 5.6-2). The annual RSA for Lake Whitefish ranged from a low of 17% in 2019 to a high of 70% in 2008. Longnose Sucker (*Catostomus catostomus*) was the only other species that accounted for >25% of the catch in one year (2019).

Small Mesh Index Gill Nets

The most common species captured in Southern Indian Lake - Area 4 over 12 years of monitoring was Walleye, which accounted for an average of 25% of the catch (Table 5.6-3). The annual RSA for Walleye ranged from a low of 0% from 2008-2011 to a high of 67% in 2017. Three other species accounted for >25% of the catch in some years: Cisco (*Coregonus artedi*) from 2008-2011 and again in 2019; Lake Whitefish in 2009; and Burbot (*Lota lota*) in 2009.

ROTATIONAL SITES

Opachuanau Lake

A total of 12 fish species were captured in the combined standard and small mesh gangs at Opachuanau Lake over three years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 11-12 (Tables 5.6-4 and 5.6-5).

Standard Gang Index Gill Nets

The catch in standard gangs set in Opachuanau Lake over three years of monitoring was dominated by White Sucker, which accounted for an average of >50% of the catch (Table 5.6-4). The annual RSA of White Sucker ranged from a low of 62% in 2017 to a high of 71% in 2011.

Small Mesh Index Gill Nets

The most common species captured in Opachuanau Lake over three years of monitoring was Sauger, which accounted for an average of >25% of the catch (Table 5.6-5). The annual RSA for Sauger ranged from a low of 13% in 2014 to a high of 79% in 2017. Walleye accounted for >25% of the catch in 2014.

Southern Indian Lake - Area 1

A total of 11 fish species were captured in the combined standard and small mesh gangs at Southern Indian Lake - Area 1 over four years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 8-11 (Tables 5.6-6 and 5.6-7).

Standard Gang Index Gill Nets

Lake Whitefish and White Sucker were the most frequently captured species at Southern Indian Lake - Area 1 over four years of monitoring, accounting for an average of >25% of the catch (Table 5.6-6). The annual RSA for Lake Whitefish ranged from a low of 19% in 2018 to a high of 36% in 2009. The annual RSA for White Sucker ranged from a low of 8% in 2009 to a high of 41% in 2018.

Small Mesh Index Gill Nets

The most common species captured in Southern Indian Lake - Area 1 over four years of monitoring was Sauger, which accounted for an average of >25% of the catch (Table 5.6-7). The annual RSA for Sauger ranged from a low of 0% in 2009 to a high of 77% in 2018. Three other species accounted for >25% of the catch in some years, Cisco in 2012, Burbot in 2012, and Slimy Sculpin (*Cottus cognatus*) 2015.

Southern Indian Lake - Area 6

A total of 13 fish species were captured in the combined standard and small mesh gangs at Southern Indian Lake - Area 6 over four years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 12-13 (Tables 5.6-8 and 5.6-9).

Standard Gang Index Gill Nets

The catch in standard gangs set in Southern Indian Lake - Area 6 over four years of monitoring were not dominated by any one species, with none of the species accounting for an average of >25% of the catch (Table 5.6-8). Three species accounted for >25% of the catch in some years, Lake Whitefish in 2013, Sauger in 2019, and White Sucker in 2016.

Small Mesh Index Gill Nets

The most common species captured in Southern Indian Lake - Area 6 over four years of monitoring was Sauger, which accounted for an average of >25% of the catch (Table 5.6-9). The annual RSA for Sauger ranged from a low of 11% in 2016 to a high of 81% in 2019. Two other species (Northern Pike in 2013 and Walleye in 2016) accounted for >25% of the catch in some years,

Rat Lake

A total of 13 fish species were captured in the combined standard and small mesh gangs at Rat Lake over four years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 12-13 (Tables 5.6-10 and 5.6-11).

Standard Gang Index Gill Nets

The catch in standard gangs set in Rat Lake over four years of monitoring was dominated by White Sucker, accounting for an average of >25% of the catch (Table 5.6-10). Walleye accounted for >25% in 2013 and 2016.

Small Mesh Index Gill Nets

The most common species captured in Rat Lake over four years of monitoring was Walleye, which accounted for an average of >25% of the catch (Table 5.6-11). The annual RSA for Walleye ranged from a low of 24% in 2010 to a high of 58% in 2019. Northern Pike accounted for >25% of the catch in 2013.

Mynarski Lake

A total of 11 fish species were captured in the combined standard and small mesh gangs at Mynarski Lake over three years of monitoring (Table 5.6-1), with the same number of species (n = 10) captured each year (Tables 5.6-12 and 5.6-13). Sauger were not captured at Mynarski Lake.

Standard Gang Index Gill Nets

Walleye and White Sucker were the most frequently captured species at Mynarski Lake over three years of monitoring, accounting for an average of >25% of the catch (Table 5.6-12). The annual RSA for Walleye ranged from a low of 25% in 2017 to a high of 36% in 2014. The annual RSA for White Sucker ranged from a low of 39% in 2014 to a high of 50% in 2017.

Small Mesh Index Gill Nets

The most common species captured in Mynarski Lake over three years of monitoring was Walleye, which accounted for an average of >50% of the catch (Table 5.6-13). The annual RSA for Walleye ranged from a low of 17% in 2011 to a high of 78% in 2014.

Notigi Lake

A total of 14 fish species were captured in the combined standard and small mesh gangs at Notigi Lake over four years of monitoring (Table 5.6-1) with the number of species caught each year ranging from 12-14 (Tables 5.6-14 and 5.6-15).

Standard Gang Index Gill Nets

Walleye and White Sucker were the most frequently captured species at Notigi Lake over four years of monitoring, accounting for an average of >25% of the catch (Table 5.6-14). The annual RSA for Walleye ranged from a low of 23% in 2015 to a high of 30% in 2012. The annual RSA for White Sucker ranged from a low of 18% in 2012 to a high of 40% in 2015. Northern Pike accounted for >25% in 2009.

Small Mesh Index Gill Nets

The most common species captured in Notigi Lake over four years of monitoring was Walleye, which accounted for an average of >25% of the catch (Table 5.6-15). The annual RSA for Walleye ranged from a low of 13% in 2009 to a high of 47% in 2015.

5.6.1.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

A total of 17 fish species were captured in the combined standard and small mesh gangs at Granville Lake over 12 years of monitoring (Table 5.6-1), with the number of species caught each year ranging from 10-15 (Tables 5.6-16 and 5.6-17).

Standard Gang Index Gill Nets

White Sucker were the most frequently captured species at Granville Lake over 12 years of monitoring, accounting for an average of >50% of the catch (Table 5.6-16). The annual RSA for White Sucker ranged from a low of 21% in 2009 to a high of 80% in 2011. Two other species accounted for >25% of the catch in some years (Lake Whitefish in 2009 and Walleye in 2008 and 2013).

Small Mesh Index Gill Nets

The catch in small mesh gangs set in Granville Lake over 12 years of monitoring were not dominated by any one species, with none of the species accounting for an average of >25% of the catch (Table 5.6-17). Three species accounted for >25% of the catch in some years, Yellow Perch (*Perca flavescens*) in 2013 and 2016, Sauger in 2017, 2018 and 2019, and Walleye in 2013, 2015, 2016, and 2018.

Table 5.6-1. 2008-2019 Inventory of fish species.

Family	Species	Abbreviation	Status[1]	Target	SIL-4	OPACH	SIL-1	SIL-6	RAT	MYN	NOT	GRV
Hiodontidae	Mooneye	MOON	Native									●
	Goldeye	GOLD	Native									●
Cyprinidae	Emerald Shiner	EMSH	Native		●	●		●	●	●	●	●
	Lake Chub	LKCH	Native		●							
	Spottail Shiner	SPSH	Native		●	●		●	●	●	●	●
Catostomidae	Longnose Sucker	LNSC	Native		●	●	●	●	●		●	●
	White Sucker	WHSC	Native	●	●	●	●	●	●	●	●	●
	Shorthead Redhorse	SHRD	Native									●
Esocidae	Northern Pike	NRPK	Native	●	●	●	●	●	●	●	●	●
Salmonidae	Cisco	CISC	Native		●	●	●	●	●	●	●	●
	Lake Whitefish	LKWH	Native	●	●	●	●	●	●	●	●	●
Percopsidae	Trout-perch	TRPR	Native		●	●	●	●	●	●	●	●
Gadidae	Burbot	BURB	Native		●	●	●	●	●	●	●	●
Cottidae	Mottled Sculpin	MTSC	Native		●		●	●				
	Slimy Sculpin	SLSC	Native		●						●	●
	Spoonhead Sculpin	SPSC	Native		●				●	●		●
Percidae	Yellow Perch	YLPR	Native		●	●	●	●	●	●	●	●
	Logperch	LGPR	Native								●	
	Sauger	SAUG	Native	●	●	●	●	●	●		●	●
	Walleye	WALL	Native	●	●	●	●	●	●	●	●	●

Notes:

1. Assigned from Stewart and Watkinson (2004).

Table 5.6-2. 2008-2019 Relative species abundance in standard gang index gill nets in Southern Indian Lake - Area 4.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Target	LKWH	70%	45%	42%	54%	34%	33%	36%	32%	37%	48%	29%	17%	40%
	NRPK	5%	18%	15%	15%	19%	20%	15%	15%	14%	3%	6%	8%	13%
	SAUG	0.2%	0.2%	1%	1%	1%	2%	3%	2%	3%	3%	7%	3%	2%
	WALL	0%	0%	3%	0.1%	6%	6%	11%	15%	13%	14%	16%	12%	8%
	WHSC	0.3%	0.2%	2%	1%	5%	7%	3%	3%	3%	2%	0.4%	1%	2%
Mooneyes	GOLD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	MOON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Suckers	LNSC	9%	16%	19%	13%	19%	16%	15%	17%	15%	12%	23%	39%	18%
	SHRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Coregonids	CISC	8%	10%	8%	8%	10%	10%	9%	10%	10%	10%	6%	12%	9%
Trout-perch	TRPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.01%
Codfishes	BURB	7%	10%	10%	9%	7%	6%	7%	6%	5%	9%	13%	9%	8%
Sculpins	MTSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Perch	YLPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0%	0.01%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 5.6-3. 2008-2019 Relative species abundance in small mesh index gill nets in Southern Indian Lake - Area 4.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Minnows	LKCH	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	0%	0%	0.3%
	EMSH	0%	0%	0%	0%	0%	7%	2%	2%	1%	2%	3%	0%	1%
	SPSH	0%	0%	0%	0%	4%	2%	5%	2%	0%	0%	3%	0%	1%
Suckers	LNSC	13%	0%	25%	18%	8%	2%	7%	2%	7%	1%	5%	3%	8%
	SHRD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%	0%	0%	0%	2%	0%	1%	0%	0%	0.2%
Pikes	NRPK	13%	0%	0%	18%	10%	15%	5%	11%	9%	1%	0%	3%	7%
Coregonids	CISC	50%	33%	50%	27%	13%	15%	8%	12%	9%	6%	11%	35%	23%
	LKWH	13%	33%	0%	9%	12%	0%	11%	5%	17%	2%	3%	3%	9%
Trout-perch	TRPR	13%	0%	0%	18%	13%	15%	11%	11%	9%	4%	14%	9%	10%
Codfishes	BURB	0%	33%	0%	0%	4%	0%	3%	4%	1%	2%	3%	15%	5%
Sculpins	MTSC	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0.3%
	SLSC	0%	0%	0%	0%	0%	5%	0%	4%	1%	2%	5%	3%	2%
	SPSC	0%	0%	0%	9%	0%	0%	10%	2%	4%	2%	0%	3%	2%
Perch	YLPR	0%	0%	0%	0%	2%	5%	0%	0%	0%	0%	0%	0%	1%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SAUG	0%	0%	25%	0%	8%	5%	3%	5%	6%	9%	3%	6%	6%
	WALL	0%	0%	0%	0%	23%	29%	33%	39%	37%	67%	51%	21%	25%

Table 5.6-4. 2008-2019 Relative species abundance in standard gang index gill nets in Opachuanau Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Target	LKWH	12%	15%	7%	11%
	NRPK	1%	2%	1%	1%
	SAUG	3%	5%	16%	8%
	WALL	7%	8%	10%	8%
	WHSC	71%	65%	62%	66%
Mooneyes	GOLD	0%	0%	0%	0%
	MOON	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%
Suckers	LNSC	2%	2%	1%	2%
	SHRD	0%	0%	0%	0%
Coregonids	CISC	2%	1%	2%	2%
Trout-perch	TRPR	0%	0%	0%	0%
Codfishes	BURB	2%	2%	1%	1%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%
Perch	YLPR	1%	0.5%	0.3%	0.5%
	LGPR	0%	0%	0%	0%

Table 5.6-5. 2008-2019 Relative species abundance in small mesh index gill nets in Opachuanau Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Minnows	LKCH	0%	0%	0%	0%
	EMSH	14%	3%	2%	6%
	SPSH	9%	6%	0%	5%
Suckers	LNSC	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%
	WHSC	0%	3%	1%	1%
Pikes	NRPK	0%	3%	0%	1%
Coregonids	CISC	18%	10%	2%	10%
	LKWH	9%	16%	0%	8%
Trout-perch	TRPR	14%	13%	3%	10%
Codfishes	BURB	5%	0%	0%	2%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%
Perch	YLPR	5%	6%	0%	4%
	LGPR	0%	0%	0%	0%
	SAUG	18%	13%	79%	37%
	WALL	9%	26%	13%	16%

Table 5.6-6. 2008-2019 Relative species abundance in standard gang index gill nets in Southern Indian Lake - Area 1.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2012	2015	2018	Mean
Target	LKWH	36%	29%	28%	19%	28%
	NRPK	9%	7%	14%	1%	8%
	SAUG	7%	4%	3%	16%	7%
	WALL	5%	8%	7%	10%	7%
	WHSC	8%	32%	26%	41%	27%
Mooneyes	GOLD	0%	0%	0%	0%	0%
	MOON	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
Suckers	LNSC	11%	7%	9%	6%	8%
	SHRD	0%	0%	0%	0%	0%
Coregonids	CISC	10%	7%	7%	4%	7%
Trout-perch	TRPR	0%	0%	0%	0%	0%
Codfishes	BURB	14%	5%	6%	5%	7%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	0%	0.3%	0.3%	0%	0.1%
	LGPR	0%	0%	0%	0%	0%

Table 5.6-7. 2008-2019 Relative species abundance in small mesh index gill nets in Southern Indian Lake - Area 1.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2012	2015	2018	Mean
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
Suckers	LNSC	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%	0%
Pikes	NRPK	0%	0%	0%	0%	0%
Coregonids	CISC	0%	50%	20%	7%	19%
	LKWH	0%	0%	0%	0%	0%
Trout-perch	TRPR	0%	0%	20%	3%	6%
Codfishes	BURB	0%	33%	0%	7%	10%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	40%	0%	10%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	0%	0%	0%	3%	1%
	LGPR	0%	0%	0%	0%	0%
	SAUG	0%	17%	20%	77%	28%
	WALL	0%	0%	0%	3%	1%

Table 5.6-8. 2008-2019 Relative species abundance in standard gang index gill nets in Southern Indian Lake - Area 6.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Target	LKWH	15%	25%	8%	12%	15%
	NRPK	14%	17%	21%	1%	13%
	SAUG	13%	16%	11%	44%	21%
	WALL	3%	3%	8%	0.3%	4%
	WHSC	22%	13%	32%	22%	23%
Mooneyes	GOLD	0%	0%	0%	0%	0%
	MOON	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
Suckers	LNSC	11%	4%	6%	2%	6%
	SHRD	0%	0%	0%	0%	0%
Coregonids	CISC	18%	16%	11%	14%	15%
Trout-perch	TRPR	0%	0%	1%	0%	0.1%
Codfishes	BURB	4%	5%	1%	4%	4%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	1%	0.4%	1%	0.2%	1%
	LGPR	0%	0%	0%	0%	0%

Table 5.6-9. 2008-2019 Relative species abundance in small mesh index gill nets in Southern Indian Lake - Area 6.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	10%	7%	9%	1%	7%
	SPSH	5%	11%	6%	1%	6%
Suckers	LNSC	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%	0%
Pikes	NRPK	10%	29%	9%	1%	12%
Coregonids	CISC	20%	14%	11%	7%	13%
	LKWH	5%	4%	0%	2%	3%
Trout-perch	TRPR	20%	14%	11%	4%	13%
Codfishes	BURB	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	3%	0%	1%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	0%	7%	0%	0%	2%
	LGPR	0%	0%	0%	0%	0%
	SAUG	20%	14%	11%	81%	32%
	WALL	10%	0%	40%	2%	13%

Table 5.6-10. 2008-2019 Relative species abundance in standard gang index gill nets in Rat Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	**Species**	**2010**	**2013**	**2016**	**2019**	**Mean**
Target	LKWH	2%	0.3%	6%	3%	3%
	NRPK	15%	9%	12%	9%	11%
	SAUG	4%	2%	4%	11%	5%
	WALL	16%	39%	28%	13%	24%
	WHSC	34%	41%	35%	51%	40%
Mooneyes	GOLD	0%	0%	0%	0%	0%
	MOON	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
Suckers	LNSC	5%	4%	6%	3%	5%
	SHRD	0%	0%	0%	0%	0%
Coregonids	CISC	19%	3%	7%	6%	9%
Trout-perch	TRPR	0%	0%	0%	0%	0%
Codfishes	BURB	2%	1%	1%	3%	2%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	2%	1%	0.4%	1%	1%
	LGPR	0%	0%	0%	0%	0%

Table 5.6-11. 2008-2019 Relative species abundance in small mesh index gill nets in Rat Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2010	2013	2016	2019	Mean
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	12%	6%	10%	8%	9%
	SPSH	12%	6%	10%	8%	9%
Suckers	LNSC	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%
	WHSC	0%	0%	5%	4%	2%
Pikes	NRPK	12%	29%	5%	15%	15%
Coregonids	CISC	18%	3%	10%	4%	8%
	LKWH	0%	0%	0%	0%	0%
Trout-perch	TRPR	6%	6%	14%	4%	7%
Codfishes	BURB	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	5%	0%	1%
Perch	YLPR	6%	12%	10%	0%	7%
	LGPR	0%	0%	0%	0%	0%
	SAUG	12%	3%	0%	0%	4%
	WALL	24%	35%	33%	58%	37%

Table 5.6-12. 2008-2019 Relative species abundance in standard gang index gill nets in Mynarski Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Target	LKWH	0%	2%	1%	1%
	NRPK	16%	13%	12%	14%
	SAUG	0%	0%	0%	0%
	WALL	29%	36%	25%	30%
	WHSC	45%	39%	50%	45%
Mooneyes	GOLD	0%	0%	0%	0%
	MOON	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%
Suckers	LNSC	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%
Coregonids	CISC	8%	9%	9%	9%
Trout-perch	TRPR	0%	0%	0%	0%
Codfishes	BURB	0.5%	0.3%	1%	1%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%
Perch	YLPR	1%	1%	2%	1%
	LGPR	0%	0%	0%	0%

Table 5.6-13. 2008-2019 Relative species abundance in small mesh index gill nets in Mynarski Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2011	2014	2017	Mean
Minnows	LKCH	0%	0%	0%	0%
	EMSH	17%	6%	7%	10%
	SPSH	17%	6%	7%	10%
Suckers	LNSC	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%
	WHSC	11%	0%	5%	5%
Pikes	NRPK	17%	6%	9%	11%
Coregonids	CISC	0%	2%	0%	1%
	LKWH	0%	0%	0%	0%
Trout-perch	TRPR	6%	2%	7%	5%
Codfishes	BURB	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%
	SPSC	6%	0%	0%	2%
Perch	YLPR	11%	2%	7%	7%
	LGPR	0%	0%	0%	0%
	SAUG	0%	0%	0%	0%
	WALL	17%	78%	58%	51%

Table 5.6-14. 2008-2019 Relative species abundance in standard gang index gill nets in Notigi Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2012	2015	2018	Mean
Target	LKWH	2%	8%	3%	2%	4%
	NRPK	31%	21%	19%	7%	19%
	SAUG	7%	15%	4%	22%	12%
	WALL	24%	30%	23%	28%	26%
	WHSC	20%	18%	40%	30%	27%
Mooneyes	GOLD	0%	0%	0%	0%	0%
	MOON	0%	0%	0%	0%	0%
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%
	SPSH	0%	0%	0%	0%	0%
Suckers	LNSC	3%	2%	4%	3%	3%
	SHRD	0%	0%	0%	0%	0%
Coregonids	CISC	5%	3%	3%	3%	4%
Trout-perch	TRPR	0%	0%	0%	0%	0%
Codfishes	BURB	3%	1%	1%	0%	1%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	5%	2%	4%	3%	4%
	LGPR	0%	0%	0%	0%	0%

Table 5.6-15. 2008-2019 Relative species abundance in small mesh index gill nets in Notigi Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2009	2012	2015	2018	Mean
Minnows	LKCH	0%	0%	0%	0%	0%
	EMSH	19%	10%	7%	8%	11%
	SPSH	13%	10%	7%	8%	9%
Suckers	LNSC	0%	0%	0%	0%	0%
	SHRD	0%	0%	0%	0%	0%
	WHSC	0%	0%	0%	0%	0%
Pikes	NRPK	13%	10%	23%	17%	16%
Coregonids	CISC	6%	0%	3%	4%	3%
	LKWH	0%	0%	0%	0%	0%
Trout-perch	TRPR	13%	20%	3%	4%	10%
Codfishes	BURB	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%
	SLSC	0%	10%	0%	0%	3%
	SPSC	0%	0%	0%	0%	0%
Perch	YLPR	13%	0%	7%	4%	6%
	LGPR	0%	10%	0%	4%	4%
	SAUG	13%	10%	3%	17%	11%
	WALL	13%	20%	47%	33%	28%

Table 5.6-16. 2008-2019 Relative species abundance in standard gang index gill nets in Granville Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Target	LKWH	8%	29%	5%	4%	2%	3%	7%	5%	5%	11%	3%	2%	7%
	NRPK	10%	16%	5%	5%	3%	7%	7%	5%	4%	2%	2%	2%	6%
	SAUG	8%	11%	2%	2%	2%	4%	2%	2%	2%	21%	17%	10%	7%
	WALL	35%	4%	17%	4%	16%	27%	18%	23%	17%	6%	13%	19%	17%
	WHSC	22%	21%	65%	80%	73%	55%	60%	60%	68%	55%	62%	62%	57%
Mooneyes	GOLD	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0%	0.01%
	MOON	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0%	0%	0%	0.01%
Minnows	LKCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0.01%
	SPSH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Suckers	LNSC	4%	5%	1%	2%	1%	1%	1%	1%	1%	2%	1%	2%	2%
	SHRD	0%	1%	0.3%	1%	0.3%	0.4%	0%	0.4%	0.1%	0%	0%	1%	0.4%
Coregonids	CISC	5%	4%	2%	1%	0%	1%	2%	2%	1%	1%	1%	0%	2%
Trout-perch	TRPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Codfishes	BURB	5%	6%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0.5%	2%
Sculpins	MTSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SPSC	0%	0%	0%	0%	0%	0%	0%	0.1%	0%	0%	0%	0%	0.01%
Perch	YLPR	3%	3%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Table 5.6-17. 2008-2019 Relative species abundance in standard gang index gill nets in Granville Lake.

0%	>0-5%	>5-10%	>10-25%	>25-50%	>50%

Group	Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
Minnows	LKCH	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	EMSH	17%	0%	12%	13%	13%	6%	10%	11%	6%	0%	2%	1%	7%
	SPSH	17%	0%	8%	8%	13%	6%	10%	11%	4%	0%	2%	2%	7%
Suckers	LNSC	0%	0%	4%	4%	0%	0%	0%	0%	0%	0%	0%	0%	1%
	SHRD	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0.4%
	WHSC	0%	0%	4%	8%	3%	3%	3%	0%	6%	3%	5%	1%	3%
Pikes	NRPK	0%	0%	8%	0%	16%	6%	3%	9%	1%	0%	3%	0%	4%
Coregonids	CISC	17%	0%	12%	17%	13%	4%	14%	9%	6%	3%	3%	4%	8%
	LKWH	0%	0%	0%	4%	3%	0%	10%	0%	3%	0%	0%	0%	2%
Trout-perch	TRPR	17%	0%	12%	17%	13%	4%	14%	11%	4%	6%	4%	3%	9%
Codfishes	BURB	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sculpins	MTSC	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SLSC	0%	0%	4%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0.5%
	SPSC	0%	0%	0%	0%	0%	0%	0%	3%	0%	1%	0%	1%	0.4%
Perch	YLPR	17%	0%	12%	13%	9%	28%	7%	9%	29%	1%	4%	16%	12%
	LGPR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SAUG	17%	0%	12%	17%	13%	4%	14%	11%	6%	82%	44%	58%	23%
	WALL	0%	0%	8%	0%	6%	38%	14%	26%	34%	4%	32%	14%	15%

5.6.2 HILL'S EFFECTIVE RICHNESS

5.6.2.1 ON-SYSTEM SITES

ANNUAL SITES

Southern Indian Lake - Area 4

The Hill's effective species richness over the 12 years of monitoring ranged from a low of 4.6 in 2009 to a high of 7.3 species in 2014 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 5.9, the median was 6.1, and the IQR was 5.0-6.6 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2008, 2009, and 2011 when it was below the IQR and in 2014, 2015, and 2017 when it was above the IQR.

ROTATIONAL SITES

Opachuanau Lake

The Hill's effective species richness over the three years of monitoring ranged from a low of 4.4 in 2017 to a high of 5.6 species in 2014 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 4.9, the median was 4.5, and the IQR was 4.5-5.1 species (Figure 5.6-1). The annual mean Hill's index value was below the IQR in 2017 and was above the IQR in 2014.

Southern Indian Lake - Area 1

The Hill's effective species richness over the four years of monitoring ranged from a low of 6.4 in 2018 to a high of 7.7 species in 2015 (Table 5.6-18; Figure 5.6-1).

The overall mean and median Hill's index values were 7.1 and the IQR was 6.9-7.4 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2018 when it was below the IQR and in 2015 when it was above the IQR.

Southern Indian Lake - Area 6

The Hill's effective species richness over the four years of monitoring ranged from a low of 5.2 in 2019 to a high of 7.5 species in 2016 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 6.2, the median was 6.1, and the IQR was 5.5-6.8 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2019 when it was below the IQR and in 2016 when it was above the IQR.

Rat Lake

The Hill's effective species richness over the four years of monitoring ranged from a low of 7.0 in 2013 to a high of 8.9 species in 2016 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 7.8, the median was 7.6, and the IQR was 7.2-8.2 species (Figure 5.6-1). The annual mean Hill's index value was below the IQR in 2013 and was above the IQR in 2016.

Mynarski Lake

The Hill's effective species richness over the three years of monitoring ranged from a low of 5.7 in 2011 to a high of 6.0 species in 2014 (Table 5.6-18; Figure 5.6-1).

The overall mean and median Hill's index values were 5.8 and the IQR was 5.8-5.9 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2011 when it was marginally below the IQR and in 2014 when it was marginally above the IQR.

Notigi Lake

The Hill's effective species richness over the four years of monitoring ranged from a low of 6.7 in 2009 to a high of 8.1 species in 2015 (Table 5.6-18; Figure 5.6-1).

The overall mean and median Hill's index values were 7.5 and the IQR was 7.1-7.8 species (Figure 5.6-1). The annual mean Hill's index value was below the IQR in 2009 and was above the IQR in 2015.

5.6.2.2 OFF-SYSTEM SITES

ANNUAL SITES

Granville Lake

The Hill's effective species richness over the 12 years of monitoring ranged from a low of 4.1 in 2009 to a high of 7.1 species in 2014 (Table 5.6-18; Figure 5.6-1).

The overall mean Hill's index value was 5.8, the median was 5.5, and the IQR was 5.2-6.4 species (Figure 5.6-1). The annual mean Hill's index value fell within the overall IQR except in 2009 and 2019 when it was below the IQR and in 2013, 2014 and 2015 when it was above the IQR.

Table 5.6-18. 2008-2019 Hill's effective species richness.

Waterbody	Year	n_F[1]	n_{spp}[2]	Value
SIL-4	2008	1813	8	4.7
	2009	1157	7	4.6
	2010	682	8	5.1
	2011	1386	10	4.8
	2012	1255	12	6.2
	2013	1351	13	6.6
	2014	1374	13	7.3
	2015	1206	14	7.0
	2016	1470	12	6.3
	2017	1565	13	6.7
	2018	934	12	5.6
	2019	912	11	6.1
OPACH	2011	875	12	4.5
	2014	1073	12	5.6
	2017	813	11	4.4
SIL-1	2009	191	8	7.0
	2012	604	9	7.3
	2015	512	11	7.7
	2018	593	10	6.4
SIL-6	2010	602	12	5.6
	2013	1140	12	6.6
	2016	1006	13	7.5
	2019	804	12	5.2
RAT	2010	254	12	8.0
	2013	556	12	7.0
	2016	516	13	8.9
	2019	528	12	7.2
MYN	2011	781	10	5.7
	2014	950	10	6.0
	2017	1220	10	5.8
NOT	2009	455	12	6.7
	2012	265	14	7.7
	2015	567	12	8.1
	2018	561	12	7.3

Table 5.6-18. 2008-2019 Hill's effective species richness.

Waterbody	**Year**	**n_F[1]**	**n_{spp}[2]**	**Value**
GRV	2008	1025	12	5.6
	2009	838	10	4.1
	2010	1224	14	6.3
	2011	1178	13	5.2
	2012	1492	13	5.5
	2013	1143	14	7.0
	2014	1383	12	7.1
	2015	1346	15	6.8
	2016	1354	13	5.5
	2017	1045	12	5.2
	2018	1137	13	5.9
	2019	1388	14	5.1

Notes:

1. n_F = number of fish caught in standard and small mesh gill nets.
2. n_{spp} = number of species caught in standard and small mesh gill nets.

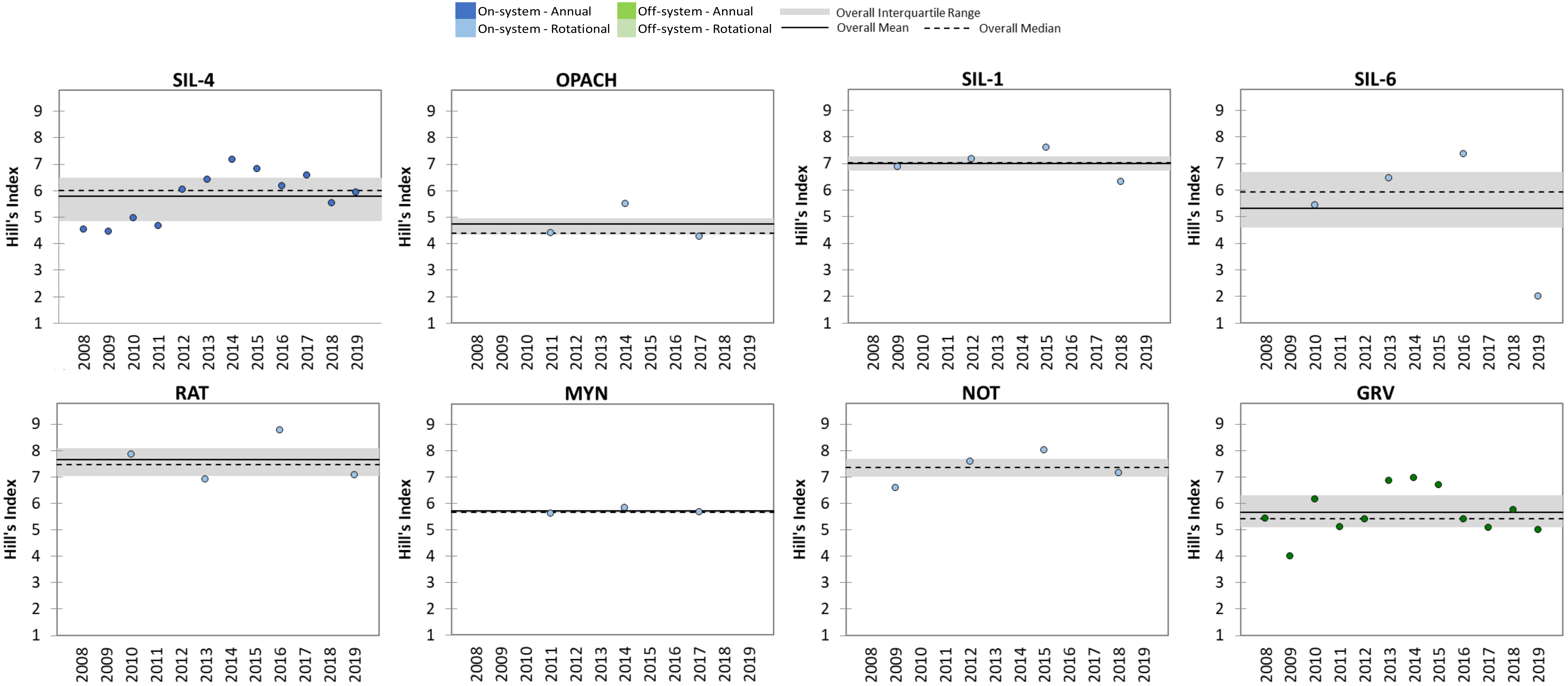


Figure 5.6-1. 2008-2019 Hill's effective species richness.

APPENDIX 5-1. GILLNETTING SITE INFORMATION AND LOCATIONS

The following is a summary of sampling locations over the 12 years of monitoring in the Upper Churchill River Region:

Southern Indian Lake - Area 4

- Gill nets were set at the target locations in all 12 years with the following exceptions:
    - GN/SN-03 was not set in 2009.
    - SN-03 was not set in 2008 and 2010.
    - GN/SN-06, GN-08, GN-10, GN-17, GN-20, and GN-22 were not set in 2010.
    - SN-06 was not set in 2009 and 2011.
    - SN-09 was not set in 2008 and 2009.
    - Three gillnet sites were set at the wrong location and were excluded from analysis, including GN/SN-15 in 2011, GN-01 in 2012, and GN-16 in 2015.
    - SN-15 was not set in 2010.
    - SN-18 was not set in 2009 and 2010.
    - SN-21 was not set in 2009 and 2010 and was set in the wrong location in 2011.
    - SN-24 was not set in 2008, 2009, and 2011.

Opachuanau Lake

- Gill nets were set at the target locations in all three years.

Southern Indian Lake - Area 1

- Gill nets were set at the target locations in all four years with the following exceptions:
    - The target location for GN-01, GN-02, GN/SN-03, and GN-04 was moved after 2009; therefore, these sites were excluded from the analysis in 2009.
    - SN-03 and SN-12 were not selected as target locations until 2010.
    - The target locations for GN-01, GN-02, GN/SN-03 and GN-04 were set as GN-13, GN-14, GN/SN-15, and GN-16 in 2012.

Southern Indian Lake - Area 6

- Gill nets were set at the target locations in all four years.

Rat Lake

- Gill nets were set at the target locations in all four years.

Central Mynarski Lake

- Gill nets were set at the target locations in all three years.

Notigi Lake

- Gill nets were set at the target locations in all four years.

Granville Lake

- Gill nets were set at the target locations in all 12 years with the following exceptions:
    - The target location of GN-02 was set as GN-14 in 2008.
    - SN-03, SN-06, and SN-12 were not set in 2008 and 2009.
    - SN-09 was not set in 2009.
    - GN-08 was not set in 2008.
    - GN-04 was not set in 2009.

Table A5-1-1. 2008-2019 Set information for gillnetting sites.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-01	14	548005	6357053	23-Jul-08	16.7	8.4	6.0	17.8
	GN-02	14	542809	6358537	23-Jul-08	17.0	14.1	14.6	17.2
	GN-03	14	543360	6360803	23-Jul-08	17.3	15.9	10.3	18.7
	GN-04	14	542453	6360030	23-Jul-08	18.2	21.5	13.4	18.1
	GN-05	14	537526	6362743	24-Jul-08	18.0	30.9	25.7	16.0
	GN-06	14	533961	6364346	24-Jul-08	18.5	16.7	8.1	17.0
	GN-07	14	531399	6365708	24-Jul-08	19.2	17.4	15.6	17.3
	GN-08	14	530657	6369731	24-Jul-08	19.6	13.1	12.9	17.4
	GN-09	14	533770	6371217	26-Jul-08	22.9	13.3	13.2	17.8
	GN-10	14	537243	6368027	26-Jul-08	21.5	11.6	13.4	17.4
	GN-11	14	538208	6366210	26-Jul-08	19.2	9.1	6.0	15.8
	GN-12	14	542154	6363938	26-Jul-08	17.2	20.4	20.6	15.4
	GN-13	14	531189	6359290	26-Jul-08	17.9	20.8	21.0	15.8
	GN-14	14	11-Jul-63	6356161	26-Jul-08	18.4	17.5	18.2	15.5
	GN-15	14	534511	6350634	26-Jul-08	19.3	19.4	19.4	14.9
	GN-16	14	526131	6345042	28-Jul-08	22.2	16.8	17.1	14.5
	GN-17	14	525779	6339304	28-Jul-08	22.7	20.7	19.8	14.2
	GN-18	14	529683	6338614	28-Jul-08	20.7	-	19.7	-
	GN-19	14	533161	6338337	28-Jul-08	21.1	19.8	19.8	13.8
	GN-20	14	542786	6338209	27-Jul-08	17.4	15.8	17.6	17.3
	GN-21	14	537367	6343772	27-Jul-08	15.0	18.9	18.8	18.1
	GN-22	14	540279	6345038	24-Jul-08	18.1	20.8	20.9	14.1
	GN-23	14	540360	6347989	24-Jul-08	17.2	12.4	17.9	14.7
	GN-24	14	541062	6353125	24-Jul-08	16.7	10.0	13.6	14.2

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	SN-06	14	533961	6364346	24-Jul-08	18.5	16.7	8.1	17.0
	SN-15	14	534511	6350634	26-Jul-08	19.3	18.2	19.4	14.9
	SN-18	14	529683	6338614	28-Jul-08	20.7	-	19.7	-
	SN-21	14	537367	6343772	27-Jul-08	15.0	18.9	18.8	18.1
	GN-01	14	548163	6357169	07-Aug-09	17.0	6.6	-	17.7
	GN-02	14	542809	6358537	07-Aug-09	16.6	14.1	-	17.2
	GN-04	14	542453	6360030	07-Aug-09	17.8	21.5	-	18.1
	GN-05	14	537415	6362855	08-Aug-09	22.5	25.7	-	15.8
	GN-06	14	533961	6364346	06-Aug-09	21.8	16.7	8.1	17.0
	GN-07	14	531399	6365708	08-Aug-09	20.4	17.4	15.6	17.3
	GN-08	14	530657	6369731	08-Aug-09	19.7	13.1	12.9	17.4
	GN-09	14	533770	6371217	07-Aug-09	21.0	13.3	13.2	17.8
	GN-10	14	537243	6368027	07-Aug-09	16.7	11.6	13.4	17.4
	GN-11	14	538208	6366208	07-Aug-09	16.5	9.1	6.0	15.8
	GN-12	14	542154	6363938	07-Aug-09	18.4	20.4	20.6	15.4
	GN-13	14	531189	6359290	09-Aug-09	19.8	20.8	21.0	15.8
	GN-14	14	534543	6356161	09-Aug-09	20.7	17.5	18.2	15.5
	GN-15	14	534504	6350533	09-Aug-09	19.9	-	-	-
	GN-16	14	526131	6345042	17-Sep-09	18.7	16.8	17.1	14.5
	GN-17	14	525779	6339304	17-Sep-09	19.3	20.7	19.8	14.2
	GN-18	14	529683	6338614	17-Sep-09	17.4	-	19.7	-
	GN-19	14	533161	6338337	18-Sep-09	16.6	19.8	19.5	13.8
	GN-20	14	542786	6338209	18-Sep-09	19.4	15.8	17.6	17.3
	GN-21	14	537367	6343772	18-Sep-09	15.8	18.9	18.8	18.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-22	14	540279	6345038	08-Aug-09	25.9	20.8	20.9	14.1
	GN-23	14	540360	6347989	08-Aug-09	24.6	12.4	17.9	14.7
	GN-24	14	541062	6353125	08-Aug-09	24.4	10.0	13.6	14.2
	SN-15	14	534504	6350533	09-Aug-09	19.9	-	-	-
	GN-01	14	548098	6357076	19-Sep-10	20.7	13.7	6.6	6.4
	GN-02	14	542837	6358657	19-Sep-10	22.2	12.3	17.0	6.9
	GN-03	14	543452	6360862	19-Sep-10	23.4	12.7	16.2	7.1
	GN-04	14	542546	6360352	22-Sep-10	19.4	22.6	21.5	9.9
	GN-05	14	537511	6362781	21-Sep-10	24.4	28.4	25.2	6.0
	GN-07	14	531297	6366069	21-Sep-10	22.0	6.7	6.8	6.0
	GN-09	14	533673	6371159	20-Sep-10	22.3	15.3	16.0	5.0
	GN-11	14	538238	6366562	20-Sep-10	21.9	2.7	4.5	5.0
	GN-12	14	542057	6363950	20-Sep-10	21.7	20.0	21.4	5.0
	GN-13	14	531213	6359406	21-Sep-10	21.1	20.1	21.9	6.0
	GN-14	14	534563	6356038	21-Sep-10	22.5	17.2	17.1	9.9
	GN-15	14	534479	6350515	21-Sep-10	22.2	19.4	18.9	9.7
	GN-16	14	526121	6345049	20-Sep-10	22.4	17.2	17.1	9.8
	GN-18	14	529785	6338701	20-Sep-10	22.3	11.0	20.7	9.7
	GN-19	14	533072	6338372	20-Sep-10	22.0	20.2	20.2	9.6
	GN-21	14	537315	6343724	19-Sep-10	22.9	21.9	22.0	9.7
	GN-23	14	540311	6347912	19-Sep-10	22.7	16.3	16.3	9.8
	GN-24	14	541122	6353116	21-Sep-10	22.7	9.8	4.7	9.9
	SN-09	14	533673	6371159	20-Sep-10	22.3	15.3	16.0	5.0
	SN-24	14	541122	6353116	21-Sep-10	22.7	9.8	4.7	9.9

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-01	14	547913	6357185	09-Aug-11	18.1	19.4	11.6	17.4
	GN-02	14	542870	6358562	09-Aug-11	17.6	14.9	17.8	17.5
	GN-03	14	543483	6360791	09-Aug-11	18.0	16.1	11.3	16.5
	GN-04	14	542651	6360366	09-Aug-11	20.6	21.9	19.8	17.8
	GN-05	14	537404	6362861	11-Aug-11	24.4	22.7	28.6	16.1
	GN-06	14	533904	6364447	11-Aug-11	24.8	8.4	17.6	16.3
	GN-07	14	531422	6365717	12-Aug-11	21.9	15.8	15.2	17.0
	GN-08	14	530679	6369674	12-Aug-11	21.4	12.8	13.4	17.0
	GN-09	14	533789	6371223	11-Aug-11	25.4	12.8	14.9	16.0
	GN-10	14	537304	6368016	11-Aug-11	24.3	9.4	13.4	16.0
	GN-11	14	538251	6366514	10-Aug-11	20.8	6.1	3.9	17.0
	GN-12	14	542064	6363942	10-Aug-11	19.7	20.4	20.4	16.3
	GN-13	14	531206	6359378	12-Aug-11	22.4	20.7	18.6	17.5
	GN-14	14	534531	6356089	13-Aug-11	23.0	17.1	19.8	18.0
	GN-16	14	526013	6344964	13-Aug-11	21.1	17.9	18.9	18.0
	GN-17	14	525909	6339336	12-Aug-11	21.6	19.8	21.3	17.4
	GN-18	14	529732	6338605	12-Aug-11	21.9	19.2	14.5	17.4
	GN-19	14	533188	6338343	12-Aug-11	22.2	20.5	21.1	17.5
	GN-20	14	542770	6338193	13-Aug-11	22.0	16.0	15.8	17.7
	GN-21	14	537379	6343796	13-Aug-11	23.0	19.7	20.7	17.5
	GN-22	14	540292	6345002	13-Aug-11	23.3	20.9	20.9	17.3
	GN-23	14	540288	6348009	10-Aug-11	17.9	13.9	13.4	16.9
	GN-24	14	541087	6353267	10-Aug-11	19.6	15.2	13.4	16.4
	SN-03	14	543483	6360791	09-Aug-11	18.0	16.1	11.3	16.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	SN-09	14	533789	6371223	11-Aug-11	25.4	12.8	14.9	16.0
	SN-18	14	529732	6338605	12-Aug-11	21.9	19.2	14.5	17.4
	GN-02	14	542870	6358562	12-Aug-12	23.3	12.4	14.2	16.5
	GN-03	14	543483	6360791	12-Aug-12	19.6	10.5	14.0	16.8
	GN-04	14	542718	6360314	13-Aug-12	17.8	21.8	15.7	17.3
	GN-05	14	537404	6362861	13-Aug-12	22.0	25.9	29.7	16.3
	GN-06	14	533868	6364425	17-Aug-12	17.7	8.6	12.6	16.3
	GN-07	14	531400	6365719	17-Aug-12	18.8	15.6	17.1	15.7
	GN-08	14	530662	6369695	16-Aug-12	28.5	15.0	14.1	15.7
	GN-09	14	533601	6371362	16-Aug-12	28.7	15.7	15.0	15.3
	GN-10	14	537232	6368042	13-Aug-12	22.0	10.4	13.6	16.4
	GN-11	14	538251	6366514	13-Aug-12	24.9	4.8	4.6	16.2
	GN-12	14	542064	6363942	13-Aug-12	23.8	20.8	20.9	16.6
	GN-13	14	531164	6359397	16-Aug-12	21.5	19.8	21.9	15.1
	GN-14	14	534531	6356089	16-Aug-12	21.3	18.8	20.1	15.1
	GN-15	14	534485	6350496	16-Aug-12	20.5	19.6	18.6	15.2
	GN-16	14	526010	6344969	17-Aug-12	22.2	20.8	19.4	15.0
	GN-17	14	525895	6339394	17-Aug-12	22.5	21.7	20.0	15.3
	GN-18	14	529826	6338633	17-Aug-12	23.3	12.0	12.4	15.4
	GN-19	14	533228	6338369	18-Aug-12	21.4	20.6	20.8	16.9
	GN-20	14	542734	6338210	19-Aug-12	24.0	16.2	15.6	18.8
	GN-21	14	537320	6343773	18-Aug-12	21.5	19.7	19.9	17.0
	GN-22	14	540285	6345012	18-Aug-12	22.6	21.7	21.9	16.7
	GN-23	14	540251	6348013	18-Aug-12	21.8	13.6	18.3	19.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-24	14	541113	6353243	18-Aug-12	21.7	11.4	15.3	18.6
	SN-03	14	543480	6360734	12-Aug-12	19.6	10.5	15.2	16.8
	SN-06	14	533856	6364460	17-Aug-12	18.2	8.1	12.6	16.3
	SN-09	14	533586	6371391	16-Aug-12	28.7	15.7	14.1	15.3
	SN-15	14	534487	6350458	16-Aug-12	20.5	19.5	18.6	15.2
	SN-18	14	529794	6338621	17-Aug-12	23.3	16.4	12.4	15.4
	SN-21	14	537357	6343796	18-Aug-12	21.5	19.9	19.9	17.0
	SN-24	14	541138	6353273	18-Aug-12	21.7	11.4	15.8	18.6
	GN-01	14	547962	6357172	20-Aug-13	22.9	17.9	10.5	15.9
	GN-02	14	542958	6358592	20-Aug-13	23.5	15.9	13.7	21.3
	GN-03	14	543541	6360773	20-Aug-13	22.2	15.8	10.6	15.8
	GN-04	14	542648	6360341	20-Aug-13	22.9	22.5	17.3	15.7
	GN-05	14	537316	6362880	22-Aug-13	22.3	6.6	27.8	21.3
	GN-06	14	533853	6364442	22-Aug-13	22.6	8.6	17.6	21.3
	GN-07	14	531427	6365739	22-Aug-13	21.9	16.2	14.3	16.1
	GN-08	14	530687	6369685	22-Aug-13	22.7	13.9	13.4	15.3
	GN-09	14	533730	6371196	21-Aug-13	21.6	14.1	15.2	15.1
	GN-10	14	537251	6368038	21-Aug-13	20.9	12.6	13.5	15.4
	GN-11	14	538253	6366519	21-Aug-13	21.9	4.3	5.5	15.3
	GN-12	14	542087	6363919	21-Aug-13	21.5	20.8	20.8	15.7
	GN-13	14	531281	6359398	23-Aug-13	22.4	22.6	22.0	21.2
	GN-14	14	534565	6356098	23-Aug-13	22.7	18.7	20.8	21.1
	GN-15	14	534463	6350501	23-Aug-13	21.8	19.4	18.7	14.9
	GN-16	14	525994	6344997	23-Aug-13	22.3	18.8	18.4	14.9

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-17	14	525834	6339412	24-Aug-13	24.0	19.0	21.2	15.5
	GN-18	14	529911	6338434	24-Aug-13	23.1	16.9	12.0	15.4
	GN-19	14	533254	6338311	25-Aug-13	23.5	20.7	20.2	15.5
	GN-20	14	542770	6338228	25-Aug-13	22.4	15.9	16.0	15.9
	GN-21	14	537396	6343782	25-Aug-13	23.0	20.0	19.9	21.4
	GN-22	14	540265	6344986	25-Aug-13	22.6	21.8	22.0	21.3
	GN-23	14	540275	6348009	24-Aug-13	22.8	18.9	14.4	21.5
	GN-24	14	541047	6353265	24-Aug-13	22.5	15.6	10.5	21.3
	SN-03	14	543568	6360734	20-Aug-13	22.2	16.8	10.6	15.8
	SN-06	14	533819	6364452	22-Aug-13	22.6	7.9	17.6	21.3
	SN-09	14	533760	6371260	21-Aug-13	21.6	13.8	15.2	15.1
	SN-15	14	534443	6350465	23-Aug-13	21.8	19.6	18.7	14.9
	SN-18	14	529913	6338398	24-Aug-13	23.1	19.2	12.0	15.4
	SN-21	14	537433	6343790	25-Aug-13	23.0	20.2	19.9	21.4
	SN-24	14	541054	6353303	24-Aug-13	22.5	17.5	10.5	21.3
	GN-01	14	547916	6357180	21-Aug-14	30.2	18.5	12.1	15.8
	GN-02	14	542881	6358538	21-Aug-14	31.0	13.2	16.3	15.4
	GN-03	14	543509	6360782	21-Aug-14	30.0	14.6	11.4	15.4
	GN-04	14	542681	6360358	21-Aug-14	30.0	22.3	18.5	15.4
	GN-05	14	537344	6362825	25-Aug-14	21.8	6.9	27.4	14.5
	GN-06	14	533920	6364477	25-Aug-14	23.1	6.2	16.1	14.7
	GN-07	14	531542	6365703	24-Aug-14	23.7	15.9	16.0	15.1
	GN-08	14	530674	6369673	24-Aug-14	22.9	14.0	13.4	15.2
	GN-09	14	533722	6371205	23-Aug-14	21.7	14.0	14.9	15.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-10	14	537308	6368037	23-Aug-14	21.6	10.2	13.2	15.2
	GN-11	14	538247	6366507	22-Aug-14	17.8	4.6	7.0	15.2
	GN-12	14	542086	6363913	22-Aug-14	17.4	20.6	20.3	15.1
	GN-13	14	531219	6359412	25-Aug-14	19.7	20.4	18.4	14.7
	GN-14	14	534455	6355998	25-Aug-14	20.7	18.2	21.1	14.5
	GN-15	14	534353	6350502	25-Aug-14	22.1	13.7	18.8	14.4
	GN-16	14	526003	6344956	23-Aug-14	20.8	19.4	19.8	15.0
	GN-17	14	525920	6339320	23-Aug-14	21.4	19.9	20.9	15.0
	GN-18	14	529728	6338601	23-Aug-14	22.3	19.2	11.5	14.9
	GN-19	14	533173	6338335	24-Aug-14	22.2	20.1	19.7	14.5
	GN-20	14	542759	6338140	24-Aug-14	18.7	16.2	15.9	14.9
	GN-21	14	537332	6343807	24-Aug-14	20.2	19.4	19.2	14.5
	GN-22	14	540383	6344912	22-Aug-14	17.8	21.0	21.1	14.8
	GN-23	14	540269	6348009	22-Aug-14	18.6	15.7	13.6	14.9
	GN-24	14	541061	6353212	22-Aug-14	19.7	14.2	8.0	15.0
	SN-03	14	543516	6360739	21-Aug-14	30.0	17.0	11.4	15.4
	SN-06	14	533889	6364498	25-Aug-14	23.1	6.2	16.1	14.7
	SN-09	14	533759	6371217	23-Aug-14	21.7	13.6	14.9	15.5
	SN-15	14	534326	6350476	25-Aug-14	22.1	11.5	18.8	14.4
	SN-18	14	529686	6338594	23-Aug-14	22.3	20.0	11.5	14.9
	SN-21	14	537339	6343811	24-Aug-14	20.2	19.3	19.2	14.5
	SN-24	14	541071	6353239	22-Aug-14	19.7	13.8	8.0	15.0
	GN-01	14	547923	6357138	19-Aug-15	21.6	18.4	10.7	14.1
	GN-02	14	542863	6358582	19-Aug-15	21.5	15.4	16.1	14.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-03	14	543490	6360792	19-Aug-15	21.2	12.2	11.2	14.1
	GN-04	14	542621	6360260	19-Aug-15	22.0	22.5	17.6	13.9
	GN-05	14	537513	6362789	21-Aug-15	21.6	28.7	17.9	14.0
	GN-06	14	533908	6364404	21-Aug-15	23.2	18.0	7.3	14.1
	GN-07	14	531394	6365709	21-Aug-15	21.4	15.9	16.4	14.0
	GN-08	14	530655	6369734	21-Aug-15	22.9	13.3	13.1	13.9
	GN-09	14	533547	6371185	20-Aug-15	22.6	14.7	15.4	14.1
	GN-10	14	537287	6368004	20-Aug-15	22.1	8.2	12.8	14.0
	GN-11	14	538110	6366417	20-Aug-15	23.2	4.6	6.0	14.1
	GN-12	14	542068	6363968	20-Aug-15	22.7	20.2	20.4	13.8
	GN-13	14	531119	6359280	22-Aug-15	21.5	17.6	20.8	14.0
	GN-14	14	534387	6356100	22-Aug-15	21.3	22.6	21.5	14.1
	GN-15	14	534476	6350572	22-Aug-15	21.9	18.7	16.0	14.1
	GN-17	14	525809	6339270	23-Aug-15	22.5	20.6	19.7	14.2
	GN-18	14	529532	6338627	24-Aug-15	22.5	20.2	19.8	14.6
	GN-19	14	533175	6338335	24-Aug-15	22.8	19.8	19.5	14.7
	GN-20	14	542752	6338155	24-Aug-15	23.2	21.8	21.3	14.4
	GN-21	14	537357	6343719	24-Aug-15	22.8	26.9	26.2	14.2
	GN-22	14	540279	6345007	23-Aug-15	21.7	29.1	29.4	14.2
	GN-23	14	540365	6347882	23-Aug-15	23.0	17.8	21.1	14.1
	GN-24	14	540883	6353114	22-Aug-15	21.8	14.2	15.8	14.2
	SN-03	14	543510	6360752	19-Aug-15	21.2	16.0	11.2	14.1
	SN-06	14	533974	6364361	21-Aug-15	23.2	18.0	7.3	14.1
	SN-09	14	533521	6371217	20-Aug-15	22.6	14.3	15.4	14.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	SN-15	14	534474	6350536	22-Aug-15	21.9	19.0	16.0	14.1
	SN-18	14	529492	6338620	24-Aug-15	22.5	20.4	19.8	14.6
	SN-21	14	537367	6343776	24-Aug-15	22.8	26.5	26.2	14.2
	SN-24	14	541062	6353127	22-Aug-15	21.8	14.2	15.8	14.2
	GN-01	14	547885	6357151	08-Aug-16	17.9	18.6	13.5	15.1
	GN-02	14	542934	6358553	08-Aug-16	18.0	13.9	16.1	14.9
	GN-03	14	543486	6360771	08-Aug-16	18.0	16.1	11.6	14.9
	GN-04	14	542652	6360351	08-Aug-16	18.0	22.9	-	14.9
	GN-05	14	537445	6362869	10-Aug-16	22.3	26.9	27.2	15.0
	GN-06	14	534031	6364478	10-Aug-16	22.0	13.7	16.8	15.3
	GN-07	14	531429	6365685	10-Aug-16	21.9	16.3	15.8	15.3
	GN-08	14	530655	6369621	09-Aug-16	18.1	14.0	13.6	15.0
	GN-09	14	533781	6371180	10-Aug-16	22.0	13.4	15.3	16.1
	GN-10	14	537230	6368022	09-Aug-16	17.8	12.3	13.8	14.9
	GN-11	14	538251	6366506	09-Aug-16	18.5	4.8	5.6	14.7
	GN-12	14	542076	6363945	09-Aug-16	18.4	20.5	20.6	14.8
	GN-13	14	531217	6359348	11-Aug-16	22.5	21.6	19.1	15.5
	GN-14	14	534547	6356079	11-Aug-16	21.8	18.3	21.4	15.9
	GN-15	14	534450	6350450	11-Aug-16	22.7	19.6	19.2	15.5
	GN-16	14	525968	6344966	12-Aug-16	22.1	19.7	19.7	16.4
	GN-17	14	525892	6339324	12-Aug-16	22.6	19.9	17.4	15.8
	GN-18	14	529740	6338623	13-Aug-16	23.0	18.3	12.3	16.0
	GN-19	14	533186	6338357	13-Aug-16	23.3	20.1	19.7	15.7
	GN-20	14	542790	6338172	13-Aug-16	24.0	16.8	16.1	15.8

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-21	14	537393	6343782	13-Aug-16	23.4	19.5	19.4	15.7
	GN-22	14	540303	6345007	12-Aug-16	22.4	21.4	21.4	15.7
	GN-23	14	540295	6348044	12-Aug-16	23.1	14.8	15.6	15.7
	GN-24	14	541071	6353243	11-Aug-16	21.7	14.7	10.6	15.7
	SN-03	14	543482	6360737	08-Aug-16	18.0	16.8	16.1	14.9
	SN-06	14	534047	6364510	10-Aug-16	22.0	11.0	13.7	15.3
	SN-09	14	533805	6371206	10-Aug-16	22.0	12.8	13.4	16.1
	SN-15	14	534440	6350412	11-Aug-16	22.7	18.3	19.6	15.5
	SN-18	14	529683	6338613	13-Aug-16	23.0	19.7	18.2	16.0
	SN-21	14	537419	6343807	13-Aug-16	23.4	19.5	19.5	15.7
	SN-24	14	541087	6353277	11-Aug-16	21.7	15.6	14.7	15.7
	GN-01	14	547966	6357144	22-Aug-17	16.5	9.4	17.3	17.7
	GN-02	14	542855	6358576	22-Aug-17	16.8	-	14.9	17.6
	GN-03	14	543392	6360829	22-Aug-17	16.5	17.0	3.5	17.6
	GN-04	14	542820	6360279	26-Aug-17	19.0	20.3	18.6	16.7
	GN-05	14	537391	6362739	26-Aug-17	20.1	13.3	25.6	16.4
	GN-06	14	533988	6364539	24-Aug-17	24.0	16.2	10.9	16.7
	GN-07	14	531424	6365686	24-Aug-17	24.0	15.0	15.8	16.8
	GN-08	14	530682	6369671	24-Aug-17	22.6	13.1	13.5	16.7
	GN-09	14	533671	6371235	24-Aug-17	22.7	15.0	14.1	16.7
	GN-10	14	537261	6368086	23-Aug-17	19.0	13.3	11.7	18.0
	GN-11	14	538255	6366512	23-Aug-17	18.2	4.2	4.4	18.4
	GN-12	14	542095	6363910	23-Aug-17	17.3	20.6	20.3	18.2
	GN-13	14	531206	6359378	27-Aug-17	21.5	22.6	26.8	15.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-14	14	534591	6356004	27-Aug-17	22.5	16.3	15.0	15.7
	GN-15	14	534485	6350540	27-Aug-17	23.3	17.3	18.8	15.7
	GN-16	14	525809	6345091	25-Aug-17	17.6	19.4	18.1	16.1
	GN-17	14	525946	6339302	25-Aug-17	17.5	20.9	19.6	16.2
	GN-18	14	529736	6338631	25-Aug-17	17.7	15.3	18.0	16.0
	GN-19	14	533186	6338354	25-Aug-17	18.1	19.8	19.9	16.1
	GN-20	14	542765	6338184	28-Aug-17	21.6	15.4	15.8	16.7
	GN-21	14	537399	6343777	28-Aug-17	22.7	18.8	18.9	16.3
	GN-22	14	540208	6345131	26-Aug-17	21.3	21.1	20.9	16.7
	GN-23	14	540326	6348093	26-Aug-17	22.0	13.0	16.8	16.7
	GN-24	14	541087	6353267	27-Aug-17	21.2	13.9	20.1	16.3
	SN-03	14	543388	6360865	22-Aug-17	16.5	13.5	12.4	17.6
	SN-06	14	533988	6364576	24-Aug-17	24.0	10.9	10.7	16.7
	SN-09	14	533677	6371273	24-Aug-17	22.7	14.1	14.0	16.7
	SN-15	14	534485	6350540	27-Aug-17	23.3	18.8	18.9	15.7
	SN-18	14	529739	6338592	25-Aug-17	17.7	18.0	19.1	16.0
	SN-21	14	537434	6343784	28-Aug-17	22.7	18.9	19.1	16.3
	SN-24	14	541100	6353314	27-Aug-17	21.2	20.1	22.8	16.3
	GN-01	14	547874	6357159	25-Aug-18	16.4	19.0	15.7	-
	GN-02	14	542892	6358534	25-Aug-18	15.9	13.5	13.1	-
	GN-03	14	543457	6360683	25-Aug-18	14.2	17.3	12.3	-
	GN-04	14	542675	6360358	26-Aug-18	19.0	21.9	18.2	13.7
	GN-05	14	537373	6362875	24-Aug-18	16.4	11.4	27.0	15.4
	GN-06	14	533892	6364424	24-Aug-18	17.7	10.4	15.5	15.4

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-07	14	531429	6365623	24-Aug-18	19.1	16.1	15.8	15.4
	GN-08	14	530633	6369637	25-Aug-18	20.3	13.9	14.0	-
	GN-09	14	533793	6371257	25-Aug-18	20.8	12.5	14.0	-
	GN-10	14	537193	6367934	25-Aug-18	21.4	12.8	8.8	-
	GN-11	14	538241	6366483	26-Aug-18	20.5	3.5	5.5	13.7
	GN-12	14	542057	6363948	26-Aug-18	19.6	20.3	20.5	13.7
	GN-13	14	531216	6359372	24-Aug-18	21.9	21.6	19.1	-
	GN-14	14	534419	6356118	24-Aug-18	23.2	18.3	21.4	-
	GN-15	14	534454	6350550	24-Aug-18	24.4	19.1	15.1	15.4
	GN-16	14	526027	6344960	23-Aug-18	21.9	19.7	19.7	14.5
	GN-17	14	525936	6339315	23-Aug-18	21.9	19.9	17.4	14.6
	GN-18	14	529862	6338599	23-Aug-18	21.2	-	12.3	14.7
	GN-19	14	533186	6338385	23-Aug-18	22.4	20.1	19.6	15.7
	GN-20	14	542770	6338193	23-Aug-18	21.6	16.7	16.4	15.7
	GN-21	14	537384	6343765	23-Aug-18	21.5	18.8	18.8	15.7
	GN-22	14	540432	6345070	26-Aug-18	21.7	14.8	15.6	14.2
	GN-23	14	540413	6347905	26-Aug-18	22.0	-	-	14.1
	GN-24	14	541254	6353220	26-Aug-18	22.5	-	-	14.2
	SN-03	14	543457	6360656	25-Aug-18	14.2	18.0	17.3	-
	SN-06	14	533880	6364445	24-Aug-18	17.7	7.8	10.4	15.4
	SN-09	14	533853	6371267	25-Aug-18	20.8	10.9	12.5	-
	SN-15	14	534453	6350519	24-Aug-18	24.4	19.2	19.1	15.4
	SN-18	14	529687	6338578	23-Aug-18	21.2	19.7	-	14.7
	SN-21	14	537409	6343788	23-Aug-18	21.5	18.9	18.8	15.7

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	SN-24	14	541105	6353315	26-Aug-18	22.5	-	-	14.2
	GN-01	14	547907	6357194	16-Aug-19	40.3	18	6.5	14.2
	GN-02	14	542860	6358633	15-Aug-19	22.0	16.7	9.2	14.6
	GN-03	14	543478	6360794	16-Aug-19	42.6	14.4	17.4	14.2
	GN-04	14	542518	6360389	16-Aug-19	45.0	22	22.2	14.2
	GN-05	14	537377	6362876	18-Aug-19	23.0	10.4	7.3	13.5
	GN-06	14	533811	6364452	19-Aug-19	21.3	8	16.3	12.0
	GN-07	14	531313	6365770	19-Aug-19	22.6	16.7	16.6	12.9
	GN-08	14	530540	6369745	19-Aug-19	20.5	13.4	14.1	13.0
	GN-09	14	533608	6371160	19-Aug-19	22.2	15.1	14.9	13.0
	GN-10	14	537189	6368094	19-Aug-19	23.8	13.4	11.7	13.0
	GN-11	14	538248	6366505	18-Aug-19	21.6	4.9	4.9	13.5
	GN-12	14	542036	6363920	18-Aug-19	21.0	20.7	20.6	13.5
	GN-13	14	531178	6359425	19-Aug-19	23.8	21.1	22.4	12.7
	GN-14	14	534511	6356260	18-Aug-19	21.9	18.7	22.5	13.0
	GN-15	14	534416	6350413	18-Aug-19	20.5	21.4	20.8	13.0
	GN-16	14	525908	6344940	18-Aug-19	22.3	21.8	17.2	12.9
	GN-17	14	525926	6339351	16-Aug-19	44.9	20.5	20	13.5
	GN-18	14	529783	6338724	16-Aug-19	44.5	12.3	21.4	13.7
	GN-19	14	533053	6338330	16-Aug-19	44.1	20.3	20.8	13.8
	GN-20	14	542830	6338280	15-Aug-19	19.6	17	17.4	15.0
	GN-21	14	537298	6343836	15-Aug-19	19.0	19.8	19.6	14.8
	GN-22	14	540182	6345012	15-Aug-19	19.4	21.6	21.6	15.3
	GN-23	14	540290	6348059	15-Aug-19	19.2	16.8	17.2	15.7

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-4	GN-24	14	540956	6353195	15-Aug-19	20.2	15.7	15.5	14.7
	SN-03	14	543342	6360765	16-Aug-19	42.6	17.4	17.4	14.2
	SN-06	14	533965	6364399	19-Aug-19	21.3	16.3	17.2	12.0
	SN-09	14	533582	6371190	19-Aug-19	22.2	14.9	15.1	13.0
	SN-15	14	534407	6350390	18-Aug-19	20.5	22	21.4	13.0
	SN-18	14	529843	6338758	16-Aug-19	44.5	10.8	12.3	13.7
	SN-21	14	537390	6343720	15-Aug-19	19.0	19.6	19.6	14.8
	SN-24	14	541099	6353275	15-Aug-19	20.2	16.7	15.5	14.7
OPACH	GN-01	14	459558	6287632	05-Aug-11	22.1	7.2	7.5	18.6
	GN-02	14	464884	6288102	05-Aug-11	21.3	12.3	22.7	18.4
	GN-03	14	464258	6285006	05-Aug-11	21.0	19.4	23.7	18.2
	GN-04	14	462320	6282318	05-Aug-11	21.0	8.3	6.3	19.2
	GN-05	14	462522	6279354	06-Aug-11	22.7	2.4	10.2	18.6
	GN-06	14	464510	6283081	06-Aug-11	21.1	8.0	8.1	19.1
	GN-07	14	466010	6279963	07-Aug-11	23.5	6.3	5.4	18.4
	GN-08	14	464953	6276892	07-Aug-11	23.3	3.5	5.2	18.6
	GN-09	14	457690	6290289	06-Aug-11	24.2	7.5	7.5	19.0
	GN-11	14	463706	6284913	07-Aug-11	24.2	26.1	28.0	18.9
	GN-12	14	463873	6285604	07-Aug-11	21.2	16.3	15.4	19.0
	SN-03	14	464258	6285006	05-Aug-11	21.0	19.4	23.7	18.2
	SN-06	14	464510	6283081	06-Aug-11	21.1	8.0	8.1	19.1
	SN-09	14	457690	6290289	06-Aug-11	24.2	7.5	7.5	19.0
	SN-12	14	463873	6285604	07-Aug-11	21.2	16.3	15.4	19.0
	GN-01	14	459549	6287633	15-Aug-14	23.2	7.4	7.6	18.2

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
OPACH	GN-02	14	464860	6288127	16-Aug-14	22.5	24.4	23.3	18.2
	GN-03	14	464260	6285021	17-Aug-14	22.5	18.8	22.1	19.0
	GN-04	14	462342	6282325	14-Aug-14	21.8	7.1	8.2	19.2
	GN-05	14	462519	6279369	14-Aug-14	23.8	9.5	15.3	19.2
	GN-06	14	464526	6283108	14-Aug-14	23.8	8.2	9.6	19.0
	GN-07	14	466002	6279957	17-Aug-14	22.7	6.0	6.2	18.7
	GN-08	14	465012	6276998	17-Aug-14	22.9	5.4	4.7	18.6
	GN-09	14	457702	6290288	15-Aug-14	25.0	5.4	7.0	18.0
	GN-11	14	463664	6284990	16-Aug-14	25.6	26.5	25.4	18.8
	GN-12	14	463898	6285622	16-Aug-14	25.0	15.5	14.5	18.5
	SN-03	14	464246	6284988	17-Aug-14	22.5	16.5	18.8	19.0
	SN-06	14	464553	6283091	14-Aug-14	23.8	8.4	8.2	19.0
	SN-09	14	457669	6290328	15-Aug-14	25.0	5.9	5.4	18.0
	SN-12	14	463876	6285598	16-Aug-14	25.0	15.1	15.5	18.5
	GN-01	14	459544	6287639	10-Aug-17	21.9	7.4	7.3	20.2
	GN-02	14	464893	6288161	09-Aug-17	23.3	23.4	13.5	20.6
	GN-03	14	464277	6285013	08-Aug-17	16.9	22.1	17.2	20.1
	GN-04	14	462319	6282310	30-Jul-17	23.6	-	-	20.1
	GN-05	14	462530	6279380	30-Jul-17	23.1	15.9	9.7	20.6
	GN-06	14	464556	6283066	30-Jul-17	24.4	8.6	8.3	20.3
	GN-07	14	466053	6279986	31-Jul-17	23.4	5.9	6.3	20.2
	GN-08	14	454920	6276934	31-Jul-17	23.6	5.4	4.5	20.5
	GN-09	14	457714	6290292	31-Jul-17	20.7	6.8	-	-
	GN-11	14	463690	6284933	08-Aug-17	16.5	27.9	24.3	20.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
OPACH	GN-12	14	463901	6285609	09-Aug-17	23.0	14.1	15.0	20.5
	SN-03	14	464284	6284944	08-Aug-17	16.9	11.4	22.1	20.1
	SN-06	14	415570	6239198	30-Jul-17	24.4	8.6	8.2	20.3
	SN-09	14	457660	6290341	31-Jul-17	20.7	6.8	6.4	-
	SN-12	14	463873	6285583	09-Aug-17	23.0	14.1	15.1	20.5
SIL-1	GN-05	14	494724	6307726	27-Jul-09	15.9	-	-	15.2
	GN-06	14	496048	6312355	27-Jul-09	16.5	-	-	14.8
	GN-07	14	485006	6303778	28-Jul-09	17.7	-	-	-
	GN-08	14	483715	6298245	28-Jul-09	17.8	-	-	-
	GN-09	14	490108	6296218	28-Jul-09	17.8	-	-	-
	GN-10	14	490740	6305162	28-Jul-09	15.6	-	-	15.0
	GN-11	14	487114	6309751	28-Jul-09	15.3	-	-	15.7
	GN-12	14	481245	6308770	28-Jul-09	15.9	-	-	-
	GN-05	14	494769	6307700	02-Aug-12	18.6	21.2	15.4	18.6
	GN-06	14	496110	6312437	02-Aug-12	18.4	18.6	19.3	18.5
	GN-07	14	484964	6303808	03-Aug-12	22.2	4.5	6.5	18.5
	GN-08	14	483709	6298181	04-Aug-12	24.2	8.0	7.8	18.6
	GN-09	14	490176	6296222	04-Aug-12	22.8	24.1	6.3	18.7
	GN-10	14	490778	6305143	03-Aug-12	22.2	22.6	20.2	18.2
	GN-11	14	487107	6309762	03-Aug-12	21.6	9.5	9.3	18.5
	GN-12	14	481255	6308796	04-Aug-12	23.3	20.1	19.6	19.0
	GN-13	14	471379	6293632	06-Aug-12	21.7	14.7	14.9	19.1
	GN-14	14	477401	6296117	05-Aug-12	23.3	8.4	7.2	19.1
	GN-15	14	478140	6294420	05-Aug-12	23.5	13.4	14.1	20.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-1	GN-16	14	483158	6292038	05-Aug-12	23.5	13.4	13.4	18.6
	SN-09	14	490202	6296201	04-Aug-12	22.8	24.1	6.3	18.7
	SN-12	14	481261	6308830	04-Aug-12	23.3	19.9	19.6	19.0
	SN-15	14	478106	6294427	05-Aug-12	23.5	13.0	14.1	20.1
	GN-01	14	471182	6293773	26-Jul-15	23.4	13.6	13.7	18.4
	GN-02	14	477275	6296105	25-Jul-15	24.3	6.3	8.2	17.9
	GN-03	14	478095	6294414	25-Jul-15	23.9	12.6	13.3	18.1
	GN-04	14	483253	6292112	27-Jul-15	22.9	13.1	13.1	17.6
	GN-05	14	494715	6307750	26-Jul-15	21.2	14.2	18.2	18.2
	GN-06	14	496058	6312394	27-Jul-15	24.0	20.2	9.6	18.5
	GN-07	14	485026	6303780	25-Jul-15	22.9	4.1	4.2	18.2
	GN-08	14	483738	6298271	27-Jul-15	23.6	8.1	8.6	18.6
	GN-09	14	490222	6296253	27-Jul-15	22.5	24.2	9.0	17.3
	GN-10	14	490721	6305145	25-Jul-15	23.1	21.4	21.2	17.8
	GN-11	14	487075	6309773	26-Jul-15	22.9	9.1	8.9	19.5
	GN-12	14	481237	6308715	26-Jul-15	21.8	18.7	19.0	17.6
	SN-03	14	478063	6294434	25-Jul-15	23.9	12.4	13.3	18.1
	SN-09	14	490253	6296224	27-Jul-15	22.5	23.6	9.0	17.3
	SN-12	14	481251	6308760	26-Jul-15	21.8	18.6	19.0	17.6
	GN-01	14	471401	6293627	20-Aug-18	20.7	14.5	14.5	17.5
	GN-02	14	477416	6296063	20-Aug-18	21.1	6.4	8.6	17.3
	GN-03	14	478035	6294452	20-Aug-18	21.2	-	12.8	17.3
	GN-04	14	483123	6292046	12-Aug-18	20.2	13.4	13.4	18.7
	GN-05	14	494822	6307613	20-Aug-18	20.0	18.7	18.9	16.6

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-1	GN-06	14	496018	6312445	20-Aug-18	18.9	-	15.6	16.5
	GN-07	14	484963	6303820	13-Aug-18	19.0	4.5	4.7	18.8
	GN-08	14	483694	6298174	12-Aug-18	19.7	9.2	8.2	18.7
	GN-09	14	490193	6296193	12-Aug-18	20.7	23.0	13.0	19.0
	GN-10	14	490753	6305314	20-Aug-18	19.0	19.8	21.0	17.0
	GN-11	14	487068	6309788	13-Aug-18	17.7	9.6	9.4	18.8
	GN-12	14	481227	6308817	13-Aug-18	16.4	-	18.9	18.7
	SN-03	14	478094	6294422	20-Aug-18	21.2	13.2	-	17.3
	SN-09	14	490212	6296169	12-Aug-18	20.7	23.4	23.0	19.0
	SN-12	14	481247	6308862	13-Aug-18	16.4	19.1	-	18.7
SIL-6	GN-01	14	499199	6286626	06-Aug-10	18.8	12.0	12.5	18.4
	GN-02	14	496668	6286380	06-Aug-10	19.1	12.2	11.2	18.3
	GN-03	14	498522	6283199	06-Aug-10	20.4	10.0	10.0	18.6
	GN-04	14	499762	6281322	07-Aug-10	23.3	3.7	10.0	18.4
	GN-05	14	501803	6282683	07-Aug-10	21.6	9.6	9.5	18.2
	GN-06	14	503191	6286060	07-Aug-10	20.7	8.2	9.9	18.5
	GN-07	14	502633	6281522	08-Aug-10	22.9	8.7	8.6	18.1
	GN-08	14	504727	6283947	08-Aug-10	24.8	8.3	6.2	18.6
	GN-09	14	500746	6285383	08-Aug-10	21.4	11.4	11.4	18.5
	GN-10	14	505687	6281881	09-Aug-10	20.7	5.5	5.4	18.6
	GN-11	14	504698	6280375	09-Aug-10	20.3	4.7	4.6	18.4
	GN-12	14	506880	6283330	09-Aug-10	19.3	7.0	7.2	18.5
	SN-03	14	498522	6283199	06-Aug-10	20.4	10.0	10.0	18.6
	SN-06	14	503191	6286060	07-Aug-10	20.7	8.2	9.9	18.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-6	SN-09	14	500746	6285383	08-Aug-10	21.4	11.4	11.4	18.5
	SN-12	14	506880	6283330	09-Aug-10	19.3	7.01	7.16	18.5
	GN-01	14	499206	6286623	13-Aug-13	21.9	11.7	12.3	16.9
	GN-02	14	496650	6286386	13-Aug-13	21.8	12.0	11.2	18.2
	GN-03	14	498530	6283223	13-Aug-13	22.0	10.0	10.0	18.1
	GN-04	14	499762	6281332	13-Aug-13	21.7	6.4	9.6	18.2
	GN-05	14	501761	6282699	14-Aug-13	22.9	9.6	9.4	17.9
	GN-06	14	503200	6286108	14-Aug-13	23.0	8.0	8.2	19.0
	GN-07	14	502599	6281476	14-Aug-13	23.3	8.6	8.5	17.6
	GN-08	14	504746	6284019	15-Aug-13	22.7	8.3	5.1	18.2
	GN-09	14	500765	6285361	14-Aug-13	22.6	11.3	11.3	17.8
	GN-10	14	505773	6281886	15-Aug-13	23.0	5.4	5.3	18.4
	GN-11	14	504761	6280388	15-Aug-13	22.8	4.6	4.6	18.1
	GN-12	14	506879	6283344	15-Aug-13	22.3	6.4	7.0	18.2
	SN-03	14	498620	6283310	13-Aug-13	22.0	10.0	10.0	18.1
	SN-06	14	503235	6286129	14-Aug-13	23.0	7.9	8.2	19.0
	SN-09	14	500802	6285359	14-Aug-13	22.6	11.3	11.3	17.8
	SN-12	14	506902	6283370	15-Aug-13	22.3	5.8	7	18.2
	GN-01	14	499212	6286606	23-Jul-16	24.1	11.9	12.2	16.2
	GN-02	14	496655	6286375	23-Jul-16	23.7	12.1	11.1	16.0
	GN-03	14	498496	6283164	24-Jul-16	22.9	10.0	10.1	16.3
	GN-04	14	499768	6281339	26-Jul-16	23.1	5.9	9.7	16.0
	GN-05	14	501801	6282680	24-Jul-16	23.6	9.6	9.4	17.1
	GN-06	14	503178	6286011	25-Jul-16	21.1	6.2	8.5	17.3

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-6	GN-07	14	502692	6281494	25-Jul-16	23.0	8.7	7.0	16.2
	GN-08	14	504708	6283955	24-Jul-16	23.8	8.3	11.4	17.1
	GN-09	14	500722	6285367	24-Jul-16	23.1	11.5	5.3	16.8
	GN-10	14	505685	6281907	26-Jul-16	22.1	5.5	4.8	16.9
	GN-11	14	504687	6280369	25-Jul-16	22.7	4.7	7.1	17.8
	GN-12	14	506906	6283237	25-Jul-16	22.0	7.3	4.4	17.5
	SN-03	14	498470	6283137	24-Jul-16	22.9	9.9	10.0	16.3
	SN-06	14	503207	6286040	25-Jul-16	21.1	8.2	8.2	17.3
	SN-09	14	500764	6285389	24-Jul-16	23.1	11.3	11.5	16.8
	SN-12	14	506928	6283212	25-Jul-16	22.0	7.3	7.3	17.5
	GN-01	14	499196	6286610	12-Aug-19	18.8	12.0	12.8	16.0
	GN-02	14	496663	6286361	12-Aug-19	19.1	11.1	12.4	16.0
	GN-03	14	498512	6283115	12-Aug-19	19.3	10.2	10.2	16.0
	GN-04	14	499720	6281331	12-Aug-19	18.8	9.9	10.0	16.0
	GN-05	14	501792	6282670	12-Aug-19	18.8	9.8	9.8	16.0
	GN-06	14	503251	6285942	12-Aug-19	20.0	8.6	8.3	16.0
	GN-07	14	502753	6281563	13-Aug-19	22.5	8.6	8.7	16.4
	GN-08	14	504861	6283995	13-Aug-19	21.3	8.3	8.3	16.4
	GN-09	14	500825	6285486	13-Aug-19	21.8	11.3	11.3	16.8
	GN-10	14	505677	6281842	13-Aug-19	18.9	5.6	5.6	16.0
	GN-11	14	504689	6280323	13-Aug-19	19.6	4.8	4.8	15.7
	GN-12	14	506968	6283409	13-Aug-19	18.0	5.9	2.8	16.5
	SN-03	14	498512	6283115	12-Aug-19	19.3	10.2	10.2	16.0
	SN-06	14	503265	6285911	12-Aug-19	20.0	8.7	8.6	16.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
SIL-6	SN-09	14	500847	6285513	13-Aug-19	21.8	11.1	11.3	16.8
	SN-12	14	506902	6283293	13-Aug-19	18.0	7.0	5.9	16.5
RAT	GN-01	14	457611	6224524	20-Jul-10	15.6	20.5	10.0	19.5
	GN-02	14	462567	6225347	20-Jul-10	16.3	14.5	11.5	19.5
	GN-03	14	461628	6224305	20-Jul-10	15.6	4.0	1.5	19.5
	GN-04	14	463681	6222542	21-Jul-10	23.3	8.0	6.0	18.5
	GN-05	14	465283	6221935	21-Jul-10	23.0	12.0	7.0	18.5
	GN-06	14	464403	6221796	21-Jul-10	22.4	7.0	2.5	18.5
	GN-07	14	463711	6225919	21-Jul-10	23.9	3.5	1.0	18.5
	GN-08	14	465472	6224538	22-Jul-10	22.7	6.5	1.5	18.5
	GN-09	14	464648	6225178	22-Jul-10	22.9	5.5	1.0	18.5
	SN-01	14	457611	6224524	20-Jul-10	15.6	20.5	20.5	19.5
	SN-03	14	461628	6224305	20-Jul-10	15.6	4.0	4.0	19.5
	SN-06	14	464403	6221796	21-Jul-10	22.4	7.0	7.0	18.5
	GN-01	14	457683	6224494	23-Jul-13	21.3	19.9	20.1	18.0
	GN-02	14	462589	6225355	22-Jul-13	19.8	14.4	11.2	20.0
	GN-03	14	461733	6224310	22-Jul-13	21.2	4.2	4.6	20.0
	GN-04	14	463635	6222651	24-Jul-13	20.0	8.7	4.0	17.0
	GN-05	14	465252	6222034	24-Jul-13	21.4	12.0	11.2	18.0
	GN-06	14	464410	6221785	24-Jul-13	20.8	3.8	6.8	18.0
	GN-07	14	463699	6225917	22-Jul-13	21.3	3.0	2.3	19.0
	GN-08	14	465491	6224560	23-Jul-13	20.6	1.6	2.9	19.0
	GN-09	14	464624	6225070	23-Jul-13	21.4	1.6	5.2	19.0
	SN-01	14	457539	6224517	23-Jul-13	21.3	19.2	19.9	18.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
RAT	SN-03	14	461605	6224317	22-Jul-13	21.2	0.9	4.2	20.0
	SN-06	14	464331	6221908	24-Jul-13	20.8	3.4	3.8	18.0
	GN-01	14	457666	6224549	16-Jul-16	23.4	19.6	10.7	18.0
	GN-02	14	462557	6225330	17-Jul-16	22.5	14.3	7.8	17.0
	GN-03	14	461624	6224323	16-Jul-16	23.8	2.9	5.0	19.0
	GN-04	14	463697	6222538	16-Jul-16	24.1	10.9	12.9	18.0
	GN-05	14	465292	6221945	16-Jul-16	24.7	12.8	13.3	18.0
	GN-06	14	464403	6221789	17-Jul-16	22.6	6.9	6.5	16.0
	GN-07	14	463735	6225941	18-Jul-16	21.2	1.9	3.6	17.0
	GN-08	14	465459	6224589	17-Jul-16	22.3	4.0	4.4	16.0
	GN-09	14	464650	6225185	17-Jul-16	22.3	6.4	3.6	17.0
	SN-01	14	457657	6224561	16-Jul-16	23.4	19.6	19.6	18.0
	SN-03	14	461589	6224324	16-Jul-16	23.8	1.1	2.9	19.0
	SN-06	14	464396	6221769	17-Jul-16	22.6	6.2	6.9	16.0
	GN-01	14	457753	6224550	16-Jul-19	19.5	19.6	18.3	19.0
	GN-02	14	462459	6225392	16-Jul-19	20.0	14.1	5.9	18.0
	GN-03	14	461636	6224322	17-Jul-19	23.5	4.4	4.7	17.0
	GN-04	14	463687	6222543	18-Jul-19	18.9	10.1	12.2	18.0
	GN-05	14	465264	6221983	18-Jul-19	18.0	11.4	13.2	19.0
	GN-06	14	464388	6221787	18-Jul-19	19.3	7.3	6.6	20.0
	GN-07	14	463712	6225913	16-Jul-19	20.4	3.7	4.0	19.0
	GN-08	14	465466	6224535	17-Jul-19	23.6	4.5	3.4	18.5
	GN-09	14	464669	6225086	17-Jul-19	22.5	6.1	4.6	19.0
	SN-01	14	457639	6224525	16-Jul-19	19.5	19.6	19.6	19.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
RAT	SN-03	14	461627	6224316	17-Jul-19	23.5	3.0	4.4	17.0
	SN-06	14	464399	6221814	18-Jul-19	19.3	6.2	7.3	20.0
MYN	GN-01	14	488171	6223235	07-Aug-11	22.4	5.5	5.5	19.0
	GN-02	14	487866	6223075	07-Aug-11	22.9	5.4	1.3	19.0
	GN-03	14	487123	6221483	05-Aug-11	21.0	1.3	8.3	19.0
	GN-04	14	485862	6220825	07-Aug-11	23.5	9.7	9.8	19.0
	GN-05	14	485601	6221403	06-Aug-11	23.5	2.7	7.4	19.0
	GN-06	14	487191	6220302	06-Aug-11	23.1	11.2	7.2	19.0
	GN-07	14	488516	6219676	06-Aug-11	22.8	1.3	11.0	19.0
	GN-08	14	489400	6221224	05-Aug-11	20.8	15.4	13.9	19.0
	GN-09	14	490463	6220835	05-Aug-11	21.3	3.1	8.3	19.0
	SN-01	14	488171	6223235	07-Aug-11	22.4	5.5	5.5	19.0
	SN-07	14	488516	6219676	06-Aug-11	22.8	1.3	1.3	19.0
	SN-09	14	490463	6220835	05-Aug-11	21.3	3.1	3.1	19.0
	GN-01	14	488122	6223223	26-Jul-14	18.2	-	6.0	20.0
	GN-02	14	487767	6223102	26-Jul-14	18.6	5.5	2.9	20.0
	GN-03	14	487125	6221454	27-Jul-14	22.9	3.7	9.3	20.0
	GN-04	14	485851	6220828	28-Jul-14	22.6	9.9	10.3	20.0
	GN-05	14	485598	6221405	26-Jul-14	15.9	0.5	7.3	20.0
	GN-06	14	487189	6220297	28-Jul-14	22.2	10.4	8.3	20.0
	GN-07	14	488501	6219701	28-Jul-14	18.6	-	-	21.0
	GN-08	14	489442	6221268	27-Jul-14	21.2	15.2	15.3	20.0
	GN-09	14	490501	6220830	27-Jul-14	21.8	-	8.3	20.0
	SN-01	14	488162	6223207	26-Jul-14	18.2	5.2	-	20.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
MYN	SN-07	14	488515	6219676	28-Jul-14	18.6	-	-	21.0
	SN-09	14	490463	6220829	27-Jul-14	21.8	2.4	-	20.0
	GN-01	14	488190	6223273	01-Aug-17	20.1	5.4	5.4	20.0
	GN-02	14	487872	6223091	01-Aug-17	21.4	1.4	5.4	20.0
	GN-03	14	487110	6221467	30-Jul-17	22.1	2.7	8.6	22.0
	GN-04	14	485885	6220825	31-Jul-17	24.0	9.8	9.4	21.0
	GN-05	14	485617	6221399	01-Aug-17	22.6	3.5	7.6	20.0
	GN-06	14	487194	6220307	31-Jul-17	23.1	10.1	7.8	22.0
	GN-07	14	488498	6219701	31-Jul-17	21.8	10.0	11.2	22.0
	GN-08	14	489375	6221250	30-Jul-17	21.6	14.9	13.5	22.0
	GN-09	14	490498	6220869	30-Jul-17	21.4	6.3	8.6	22.0
	SN-01	14	488207	6223379	01-Aug-17	20.1	5.4	5.4	20.0
	SN-07	14	488512	6219678	31-Jul-17	21.8	3.0	10.0	22.0
	SN-09	14	490474	6220851	30-Jul-17	21.4	2.2	6.3	22.0
NOT	GN-06	14	477660	6199351	10-Aug-09	17.9	15.7	4.4	18.0
	GN-09	14	475259	6196757	10-Aug-09	17.7	5.5	11.7	18.0
	GN-14	14	473053	6198140	11-Aug-09	23.3	5.1	5.0	18.0
	GN-15	14	471340	6196839	11-Aug-09	23.8	4.6	2.8	19.0
	GN-16	14	474402	6193182	13-Aug-09	22.9	6.4	1.9	18.0
	GN-19	14	475507	6194289	12-Aug-09	23.1	3.4	3.8	19.0
	GN-21	14	478036	6193176	14-Aug-09	23.0	4.2	5.8	17.0
	GN-22	14	478529	6193107	14-Aug-09	22.6	23.0	24.0	17.0
	GN-23	14	476396	6192984	13-Aug-09	23.5	1.9	1.6	19.0
	GN-24	14	476058	6195573	12-Aug-09	22.8	20.2	22.3	17.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
NOT	SN-15	14	471340	6196839	11-Aug-09	23.8	4.6	2.8	19.0
	SN-23	14	476396	6192984	13-Aug-09	23.5	1.9	1.6	19.0
	SN-24	14	476058	6195573	12-Aug-09	22.8	20.2	22.3	17.0
	GN-06	14	477664	6199337	08-Aug-12	21.3	16.0	3.2	20.0
	GN-09	14	475255	6196769	08-Aug-12	21.6	5.0	13.0	20.0
	GN-14	14	473012	6198090	08-Aug-12	22.6	6.0	1.0	20.0
	GN-15	14	471247	6196739	09-Aug-12	22.6	3.0	4.9	20.0
	GN-16	14	474473	6193130	09-Aug-12	22.5	0.8	5.3	20.0
	GN-19	14	475519	6194282	09-Aug-12	22.7	3.3	4.8	20.0
	GN-21	14	478066	6193051	10-Aug-12	22.8	22.5	17.9	19.5
	GN-22	14	478531	6193130	10-Aug-12	22.6	3.8	13.3	19.5
	GN-23	14	476424	6193001	10-Aug-12	22.5	1.5	10.1	19.5
	GN-24	14	476058	6195593	08-Aug-12	21.7	20.3	21.4	20.0
	SN-15	14	471292	6196729	09-Aug-12	22.6	1.5	1.5	20.0
	SN-23	14	476428	6192986	10-Aug-12	22.5	0.9	0.9	19.5
	SN-24	14	476043	6195573	08-Aug-12	21.7	18.8	18.8	20.0
	GN-06	14	477574	6199412	11-Aug-15	20.9	2.0	16.1	20.5
	GN-09	14	475254	6196781	11-Aug-15	21.3	4.0	13.7	20.5
	GN-14	14	473032	6198082	12-Aug-15	25.4	6.7	1.0	20.5
	GN-15	14	471408	6196814	12-Aug-15	25.1	4.1	0.9	21.0
	GN-16	14	474354	6193655	12-Aug-15	25.7	7.0	2.2	20.5
	GN-19	14	475524	6194287	13-Aug-15	19.3	3.8	3.8	20.5
	GN-21	14	478068	6193303	14-Aug-15	22.1	17.7	18.1	19.5
	GN-22	14	478580	6193013	14-Aug-15	22.5	12.1	4.3	19.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
NOT	GN-23	14	476389	6192999	13-Aug-15	20.4	2.8	9.8	20.5
	GN-24	14	476057	6195611	11-Aug-15	21.4	21.0	20.2	20.5
	SN-15	14	471389	6196842	12-Aug-15	25.1	4.6	4.1	21.0
	SN-23	14	476409	6192975	13-Aug-15	20.4	1.0	2.8	20.5
	SN-24	14	476055	6195581	11-Aug-15	21.4	20.1	21.0	20.5
	GN-06	14	477680	6199342	15-Aug-18	22.6	16.0	21.0	17.5
	GN-09	14	475256	6196750	15-Aug-18	22.9	4.5	14.1	17.5
	GN-14	14	473050	6198143	16-Aug-18	22.3	4.5	7.1	18.0
	GN-15	14	471383	6196747	16-Aug-18	23.6	4.0	5.0	18.0
	GN-16	14	474401	6193144	17-Aug-18	21.9	5.8	3.6	17.5
	GN-19	14	475518	6194291	16-Aug-18	23.3	3.0	6.0	18.0
	GN-21	14	478046	6193180	17-Aug-18	22.6	18.2	18.0	17.5
	GN-22	14	478536	6193116	17-Aug-18	23.3	7.6	11.4	17.5
	GN-23	14	476384	6193016	17-Aug-18	22.4	-	8.7	17.5
	GN-24	14	476143	6195738	15-Aug-18	23.3	20.5	20.0	17.5
	SN-15	14	471362	6196727	16-Aug-18	23.6	2.5	4.0	18.0
	SN-23	14	476411	6192989	17-Aug-18	22.4	-	-	17.5
	SN-24	14	476163	6195716	15-Aug-18	23.3	21.0	20.5	17.5
GRV	GN-01	14	428146	6253537	11-Aug-08	16.3	13.4	10.0	20.0
	GN-03	14	421949	6248814	11-Aug-08	17.0	12.8	16.9	20.3
	GN-04	14	421669	6247998	11-Aug-08	19.8	30.0	6.7	20.3
	GN-05	14	413313	6243328	12-Aug-08	18.5	7.2	6.8	20.0
	GN-06	14	415673	6238861	12-Aug-08	20.2	8.4	8.4	19.8
	GN-07	14	411109	6238140	12-Aug-08	21.3	9.0	7.8	19.7

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-09	14	399730	6238925	13-Aug-08	20.1	8.3	5.3	21.6
	GN-10	14	401520	6234549	13-Aug-08	19.0	8.1	7.9	20.9
	GN-11	14	396551	6235043	13-Aug-08	23.5	12.7	13.1	20.8
	GN-12	14	394003	6238449	13-Aug-08	22.7	9.4	9.6	21.2
	GN-14	14	427296	6250747	14-Aug-08	17.9	7.6	10.1	22.4
	SN-09	14	399730	6238925	13-Aug-08	20.1	8.3	5.3	21.6
	GN-01	14	428161	6253597	22-Jul-09	18.3	15.1	5.5	-
	GN-02	14	427318	6250652	22-Jul-09	18.2	12.1	12.6	-
	GN-03	14	421946	6248762	22-Jul-09	19.9	17.0	21.1	-
	GN-05	14	413317	6243243	23-Jul-09	20.7	7.4	7.2	-
	GN-06	14	415624	6239177	23-Jul-09	21.7	10.9	2.6	-
	GN-07	14	411203	6238186	23-Jul-09	22.4	8.0	9.3	-
	GN-08	14	405280	6239071	24-Jul-09	21.8	13.0	12.7	-
	GN-09	14	399704	6239114	24-Jul-09	22.3	2.9	8.0	-
	GN-10	14	401517	6234673	24-Jul-09	24.1	8.0	8.3	-
	GN-11	14	396189	6235417	25-Jul-09	20.6	11.5	10.8	-
	GN-12	14	394540	6237871	25-Jul-09	20.9	3.8	11.8	-
	GN-01	14	428152	6253598	22-Jul-10	18.9	15.3	4.1	20.8
	GN-02	14	427209	6250881	22-Jul-10	19.6	10.4	8.9	21.7
	GN-03	14	421905	6248787	23-Jul-10	22.6	5.2	19.2	19.6
	GN-04	14	421021	6247986	23-Jul-10	23.3	20.2	2.9	19.9
	GN-05	14	413498	6243271	24-Jul-10	21.6	7.2	6.7	20.7
	GN-06	14	415572	6239186	24-Jul-10	22.2	8.5	3.8	20.8
	GN-07	14	411095	6238205	24-Jul-10	24.6	8.2	7.6	21.1

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-08	14	405280	6238958	03-Sep-10	18.9	12.3	13.2	15.8
	GN-09	14	399817	6239030	03-Sep-10	19.5	7.0	3.6	15.5
	GN-10	14	401588	6234567	03-Sep-10	20.5	-	-	-
	GN-11	14	396066	6235566	04-Sep-10	22.3	10.8	10.8	14.6
	GN-12	14	394404	6237833	04-Sep-10	23.1	-	-	-
	SN-06	14	415572	6239186	24-Jul-10	22.2	8.5	3.8	20.8
	SN-09	14	399817	6239030	03-Sep-10	19.5	7.0	3.6	15.5
	SN-12	14	394404	6237833	04-Sep-10	23.1	-	-	-
	GN-01	14	428279	6253608	22-Jul-11	22.7	2.3	13.1	18.2
	GN-02	14	427127	6250552	22-Jul-11	22.4	8.4	9.5	18.2
	GN-03	14	422067	6248691	23-Jul-11	20.1	3.1	16.8	19.3
	GN-04	14	421669	6247127	23-Jul-11	20.7	29.9	11.4	19.7
	GN-05	14	413454	6243459	24-Jul-11	22.1	6.3	6.6	19.8
	GN-06	14	415598	6239189	24-Jul-11	22.0	8.4	4.5	19.7
	GN-07	14	411223	6238213	24-Jul-11	23.3	8.6	8.1	19.7
	GN-08	14	404807	6238833	26-Jul-11	21.7	12.0	12.0	20.3
	GN-09	14	399818	6239020	26-Jul-11	22.1	6.9	4.4	20.4
	GN-10	14	402033	6234802	25-Jul-11	22.0	6.3	6.5	19.8
	GN-11	14	396886	6235434	25-Jul-11	22.6	7.9	8.0	19.7
	GN-12	14	394418	6237817	25-Jul-11	23.1	10.5	7.5	19.8
	SN-03	14	422067	6248691	23-Jul-11	20.1	3.1	16.8	19.3
	SN-06	14	415598	6239189	24-Jul-11	22.0	8.4	4.5	19.7
	SN-09	14	399818	6239020	26-Jul-11	22.1	6.9	4.4	20.4
	SN-12	14	394418	6237817	25-Jul-11	23.1	10.5	7.5	19.8

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-01	14	428270	6253591	19-Jul-12	20.7	16.4	4.0	20.3
	GN-02	14	427084	6250890	19-Jul-12	21.1	12.1	10.1	20.3
	GN-03	14	422029	6248756	20-Jul-12	22.1	15.7	20.6	20.3
	GN-04	14	421500	6248037	20-Jul-12	22.6	17.1	3.0	20.4
	GN-05	14	413379	6243222	21-Jul-12	23.7	7.2	7.2	19.9
	GN-06	14	415730	6239180	21-Jul-12	23.0	10.4	4.5	19.9
	GN-07	14	411222	6238207	22-Jul-12	20.5	9.6	8.1	20.5
	GN-08	14	405183	6238868	22-Jul-12	21.8	12.8	12.9	20.0
	GN-09	14	399731	6239110	23-Jul-12	22.3	7.8	4.0	21.0
	GN-10	14	401684	6234501	23-Jul-12	23.0	8.0	8.1	22.0
	GN-11	14	396197	6235561	24-Jul-12	22.8	8.9	9.1	22.5
	GN-12	14	394520	6237874	24-Jul-12	23.3	12.0	12.1	22.4
	SN-03	14	421905	6248787	20-Jul-12	22.1	9.5	20.6	20.3
	SN-06	14	415572	6239186	21-Jul-12	23.0	9.8	4.5	19.9
	SN-09	14	399817	6239030	23-Jul-12	22.3	7.8	4.0	21.0
	SN-12	14	394404	6237833	24-Jul-12	23.3	8.1	12.1	22.4
	GN-01	14	428143	6253543	31-Jul-13	18.1	12.7	4.9	18.5
	GN-02	14	427225	6250821	31-Jul-13	18.6	8.9	11.2	18.4
	GN-03	14	421951	6248776	01-Aug-13	21.7	15.4	20.5	18.5
	GN-04	14	421595	6247962	01-Aug-13	23.1	11.9	2.9	18.7
	GN-05	14	413493	6243258	02-Aug-13	23.6	6.8	6.7	17.8
	GN-06	14	415613	6239120	02-Aug-13	23.0	8.3	8.5	17.9
	GN-07	14	411108	6238198	03-Aug-13	21.1	8.8	7.8	18.6
	GN-08	14	405262	6238952	03-Aug-13	21.2	12.2	12.2	18.6

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-09	14	399862	6239100	03-Aug-13	21.8	7.1	4.7	19.6
	GN-10	14	401605	6234609	04-Aug-13	20.7	7.4	7.7	19.9
	GN-11	14	396077	6235561	04-Aug-13	21.2	10.0	10.2	20.2
	GN-12	14	394387	6237821	04-Aug-13	21.7	11.3	4.8	19.7
	SN-03	14	421919	6248791	01-Aug-13	21.7	4.5	20.5	18.5
	SN-06	14	415719	6239190	02-Aug-13	23.0	7.9	8.5	17.9
	SN-09	14	399895	6239097	03-Aug-13	21.8	7.2	4.7	19.6
	SN-12	14	394354	6237804	04-Aug-13	21.7	11.6	4.8	19.7
	GN-01	14	428152	6253598	28-Jul-14	21.4	-	-	-
	GN-02	14	427209	6250881	28-Jul-14	20.8	-	-	-
	GN-03	14	421905	6248787	29-Jul-14	24.5	-	-	-
	GN-04	14	421622	6247986	29-Jul-14	24.6	-	-	-
	GN-05	14	413498	6243271	30-Jul-14	24.1	7.2	7.6	-
	GN-06	14	415572	6239186	30-Jul-14	25.3	-	11.1	-
	GN-07	14	411080	6238171	31-Jul-14	22.3	10.2	8.5	20.5
	GN-08	14	405222	6238985	31-Jul-14	22.6	13.2	13.0	20.5
	GN-09	14	399821	6239061	12-Aug-14	20.3	7.5	2.1	20.1
	GN-10	14	401519	6234589	12-Aug-14	22.1	7.7	7.7	21.0
	GN-11	14	396063	6235597	12-Aug-14	22.6	10.9	10.9	20.0
	GN-12	14	394418	6237829	12-Aug-14	20.8	11.6	5.7	21.5
	SN-03	14	422029	6248756	29-Jul-14	24.5	-	-	-
	SN-06	14	415553	6239189	30-Jul-14	25.3	-	-	-
	SN-09	14	399844	6239039	12-Aug-14	20.3	7.5	2.1	20.1
	SN-12	14	394381	6237810	12-Aug-14	20.8	11.8	5.7	21.5

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-01	14	428159	6253572	22-Jul-15	20.2	12.9	5.6	17.7
	GN-02	14	427248	6250866	23-Jul-15	19.5	7.8	8.4	17.6
	GN-03	14	421945	6248746	24-Jul-15	23.3	17.1	19.9	18.1
	GN-04	14	421619	6248016	24-Jul-15	22.7	15.1	3.8	18.1
	GN-05	14	413500	6243280	23-Jul-15	22.4	5.9	6.1	17.6
	GN-06	14	415625	6239257	23-Jul-15	22.7	9.2	5.0	17.7
	GN-07	14	411108	6238231	23-Jul-15	25.4	8.2	7.6	17.8
	GN-08	14	405301	6239014	22-Jul-15	22.4	11.6	11.8	17.8
	GN-09	14	399803	6239034	22-Jul-15	21.7	6.8	2.9	18.2
	GN-10	14	401553	6234585	21-Jul-15	19.2	6.9	7.1	19.7
	GN-11	14	396069	6235570	21-Jul-15	18.1	9.5	9.6	19.3
	GN-12	14	394416	6237847	21-Jul-15	18.5	10.8	3.5	19.3
	SN-03	14	421912	6248770	24-Jul-15	23.3	10.5	19.9	18.1
	SN-06	14	415591	6239275	23-Jul-15	22.7	8.4	5.0	17.7
	SN-09	14	399836	6239012	22-Jul-15	21.7	7.0	2.9	18.2
	SN-12	14	394384	6237824	21-Jul-15	18.5	10.9	3.5	19.3
	GN-01	14	428141	6253589	19-Jul-16	18.7	15.0	4.2	-
	GN-02	14	427164	6250987	19-Jul-16	19.1	13.0	9.1	17.5
	GN-03	14	421966	6248763	19-Jul-16	17.8	16.9	19.9	17.5
	GN-04	14	421514	6248043	22-Jul-16	18.9	19.7	3.7	18.9
	GN-05	14	413510	6243274	21-Jul-16	24.3	6.2	6.3	18.9
	GN-06	14	415591	6239206	22-Jul-16	21.7	9.1	5.8	18.6
	GN-07	14	411099	6238191	20-Jul-16	20.5	8.5	7.2	19.5
	GN-08	14	405270	6238958	21-Jul-16	24.2	11.9	12.0	18.2

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-09	14	399823	6239030	20-Jul-16	21.7	7.1	3.7	19.3
	GN-10	14	401605	6234558	20-Jul-16	22.3	7.2	7.4	19.9
	GN-11	14	396057	6235576	20-Jul-16	23.4	10.6	9.7	19.2
	GN-12	14	394400	6237821	21-Jul-16	22.2	11.7	7.9	18.6
	SN-03	14	421938	6248768	19-Jul-16	17.8	14.8	19.9	17.5
	SN-06	14	415555	6239220	22-Jul-16	21.7	8.6	5.8	18.6
	SN-09	14	399847	6239004	20-Jul-16	21.7	7.3	3.7	19.3
	SN-12	14	394351	6237821	21-Jul-16	22.2	12.0	7.9	18.6
	GN-01	14	428254	6253601	25-Jul-17	18.0	8.1	15.8	18.4
	GN-02	14	427229	6250872	25-Jul-17	18.0	10.9	11.4	18.6
	GN-03	14	422023	6248720	25-Jul-17	18.0	10.6	21.8	18.8
	GN-04	14	421619	6247977	28-Jul-17	22.2	5.6	17.8	20.0
	GN-05	14	413462	6243262	28-Jul-17	21.5	8.4	8.3	21.2
	GN-06	14	415607	6239195	28-Jul-17	21.0	7.4	11.4	20.6
	GN-07	14	411106	6238182	27-Jul-17	23.3	3.1	10.5	20.0
	GN-08	14	405262	6238950	27-Jul-17	22.8	14.1	14.0	21.5
	GN-09	14	399824	6239062	27-Jul-17	22.5	5.6	9.0	21.2
	GN-10	14	401603	6234565	26-Jul-17	21.3	9.3	9.3	20.9
	GN-11	14	396070	6235594	26-Jul-17	22.6	11.1	11.9	20.7
	GN-12	14	394418	6237830	26-Jul-17	23.6	7.9	13.1	20.6
	SN-03	14	422051	6248709	25-Jul-17	18.0	21.8	22.2	18.8
	SN-06	14	415570	6239198	28-Jul-17	21.0	11.4	10.7	20.6
	SN-09	14	399860	6239063	27-Jul-17	22.5	9.0	9.1	21.2
	SN-12	14	394385	6237814	26-Jul-17	23.6	13.1	13.3	20.6

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-01	14	428154	6253598	07-Aug-18	19.8	1.5	14.9	18.7
	GN-02	14	427240	6250899	07-Aug-18	19.8	10.7	10.4	18.7
	GN-03	14	421928	6248767	07-Aug-18	20.4	18.0	21.3	19.0
	GN-04	14	421627	6247996	08-Aug-18	16.8	4.1	22.3	19.2
	GN-05	14	413514	6243236	08-Aug-18	19.3	7.9	7.8	19.6
	GN-06	14	415546	6239196	08-Aug-18	19.1	-	8.0	19.2
	GN-07	14	411133	6238366	10-Aug-18	15.0	10.0	9.0	20.6
	GN-08	14	405259	6238999	10-Aug-18	16.6	12.2	13.6	21.2
	GN-09	14	399874	6238991	10-Aug-18	16.8	8.8	6.0	21.4
	GN-10	14	401714	6234468	09-Aug-18	21.3	9.1	8.8	19.7
	GN-11	14	396081	6235579	09-Aug-18	21.4	11.5	10.6	19.2
	GN-12	14	394505	6237891	09-Aug-18	22.0	9.1	8.8	19.6
	SN-03	14	421904	6248795	07-Aug-18	20.4	18.0	1.8	19.0
	SN-06	14	415493	6239188	08-Aug-18	19.1	9.6	-	19.2
	SN-09	14	399867	6238986	10-Aug-18	16.8	8.8	-	21.4
	SN-12	14	394355	6237808	09-Aug-18	22.0	12.0	8.8	-
	GN-01	14	428016	6253634	09-Aug-19	15.7	15.6	11.3	17.9
	GN-02	14	427236	6250911	09-Aug-19	16.7	12.5	10.6	17.9
	GN-03	14	421965	6248823	09-Aug-19	17.8	13.1	16.2	17.9
	GN-04	14	422276	6248355	09-Aug-19	19.0	18.9	19.1	17.9
	GN-05	14	413565	6243281	09-Aug-19	20.1	7.0	6.9	17.9
	GN-06	14	415561	6239164	09-Aug-19	21.4	9.3	9.1	17.9
	GN-07	14	410977	6238293	10-Aug-19	18.8	8.7	8.9	17.0
	GN-08	14	405397	6238836	10-Aug-19	16.4	12.6	12.4	17.0

Table A5-1-1. continued.

Location	Site	UTM Coordinates			Set Date	Set Duration (h) [1]	Water Depth (m)		Set Water Temperature (°C)
		Zone	Easting	Northing			Start	End	
GRV	GN-09	14	399879	6238918	10-Aug-19	14.9	8.0	9.5	17.2
	GN-10	14	401483	6234642	10-Aug-19	15.8	8.0	8.2	17.5
	GN-11	14	395958	6235639	10-Aug-19	16.3	11.8	11.0	17.3
	GN-12	14	394394	6237878	10-Aug-19	17.0	12.8	11.6	17.2
	SN-03	14	422073	6248907	09-Aug-19	17.8	16.2	16.8	17.9
	SN-06	14	415594	6239173	09-Aug-19	21.4	10.0	9.3	17.9
	SN-09	14	399907	6238905	10-Aug-19	14.9	9.1	8.0	17.2
	SN-12	14	394336	6237873	10-Aug-19	17.0	13.4	12.8	17.2

Notes:

1. Gill nets that were set for >36 h (red font) were excluded from the data analysis for abundance and diversity metrics.

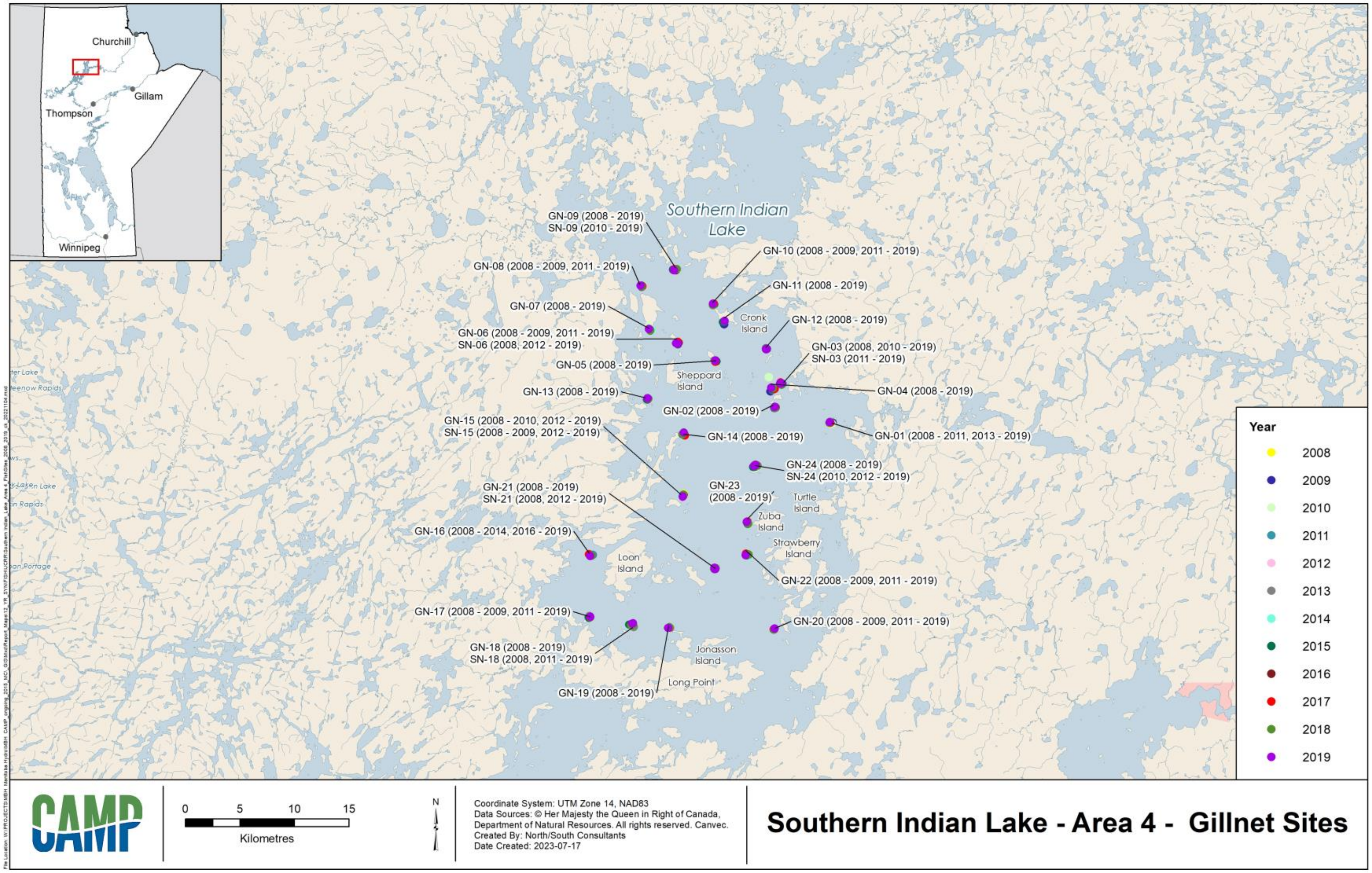


Figure A5-1-1. 2008-2019 Gillnetting sites in Southern Indian Lake - Area 4.

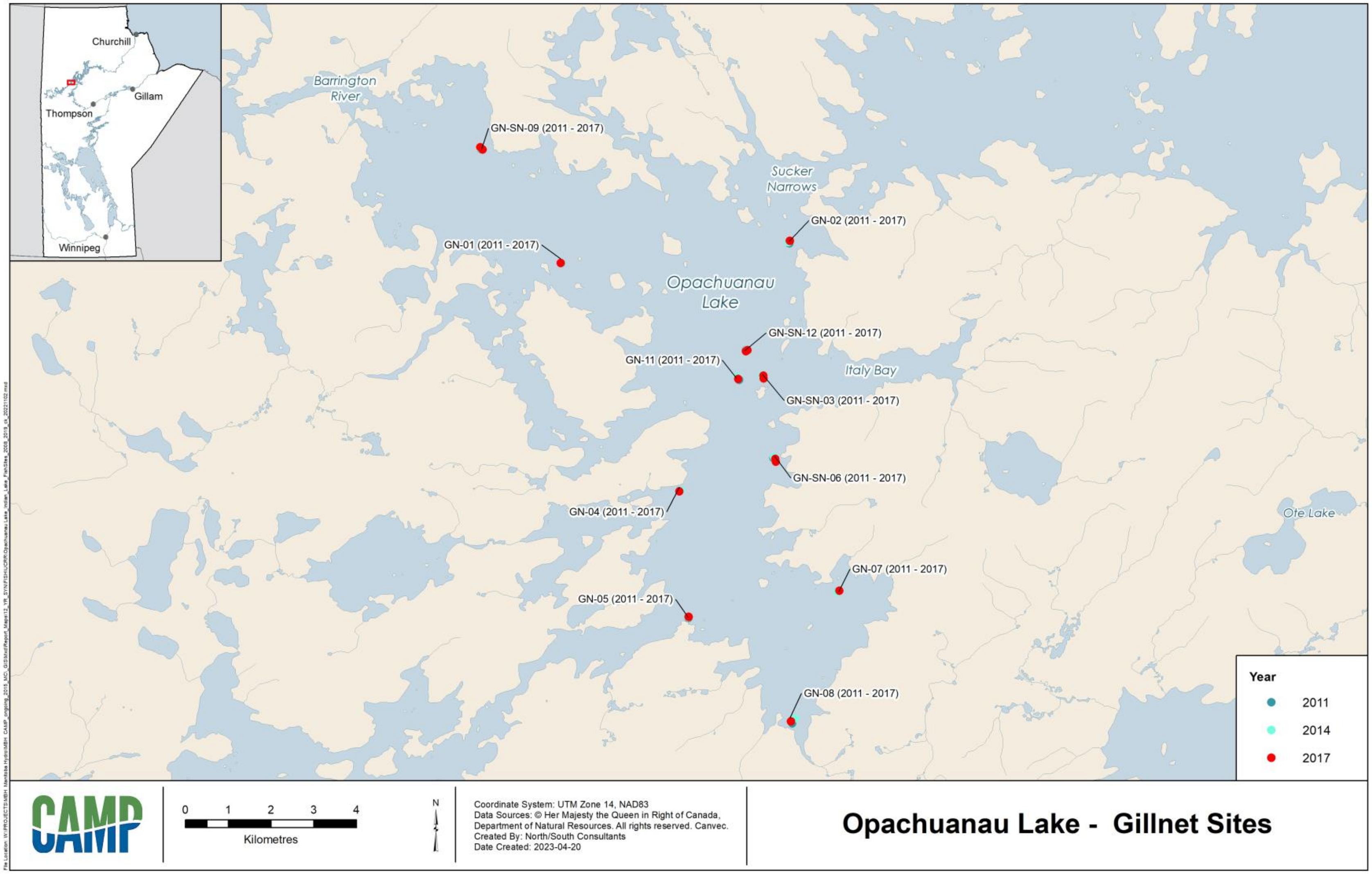


Figure A5-1-2. 2008-2019 Gillnetting sites in Opachuanau Lake.

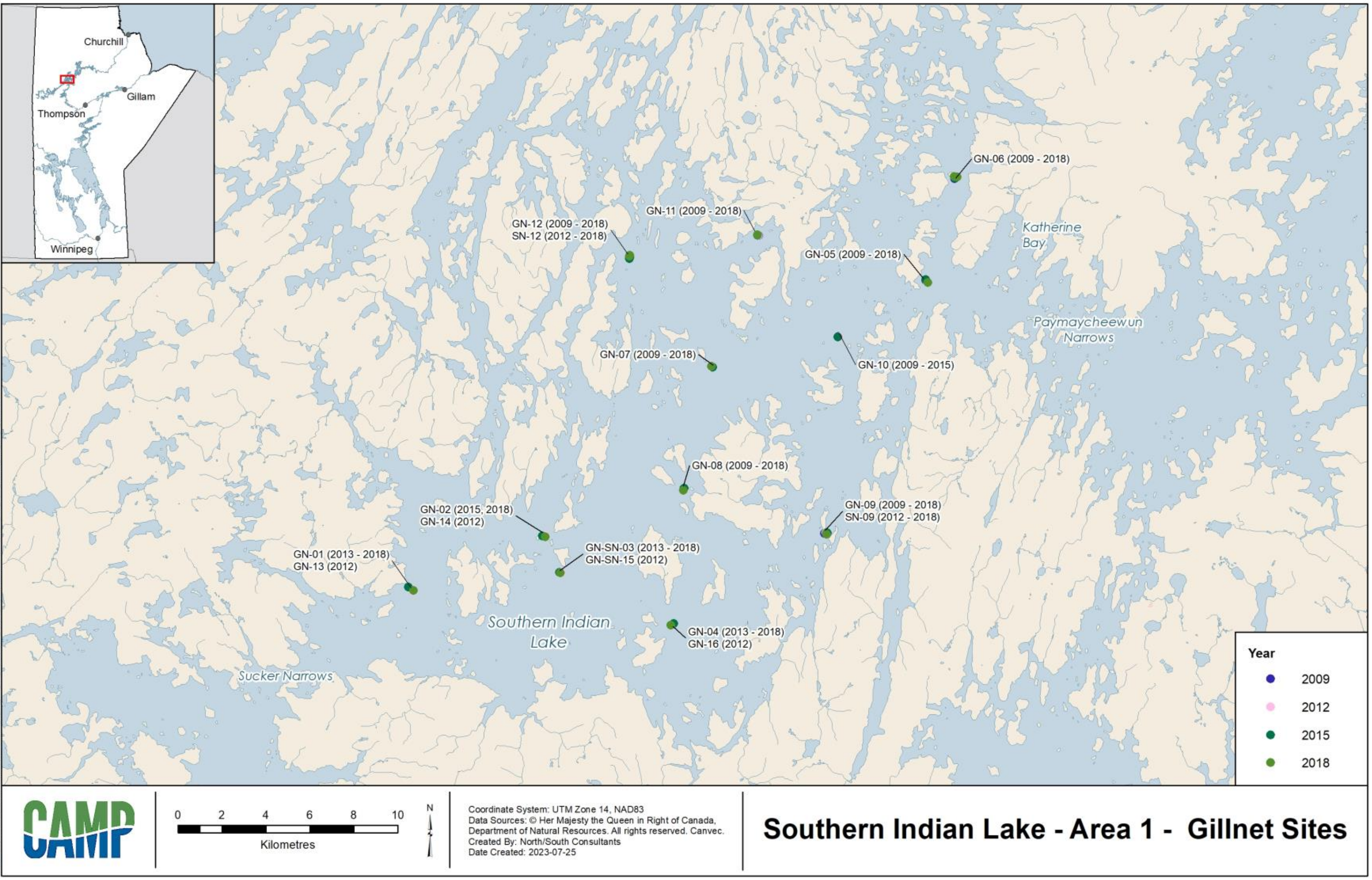


Figure A5-1-3. 2011-2017 Gillnetting sites in Southern Indian Lake - Area 1.

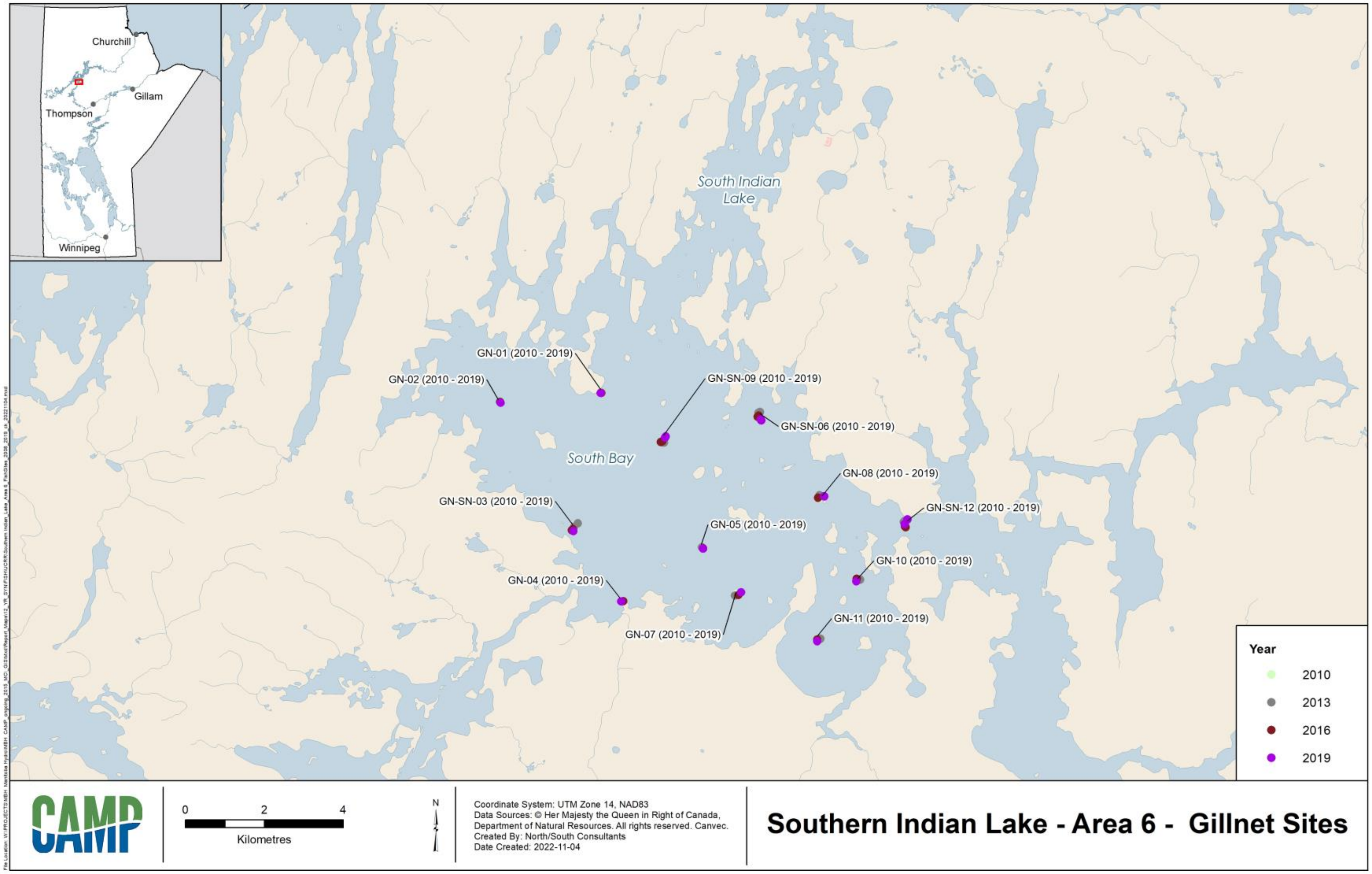


Figure A5-1-4. 2008-2019 Gillnetting sites in Southern Indian Lake - Area 6.

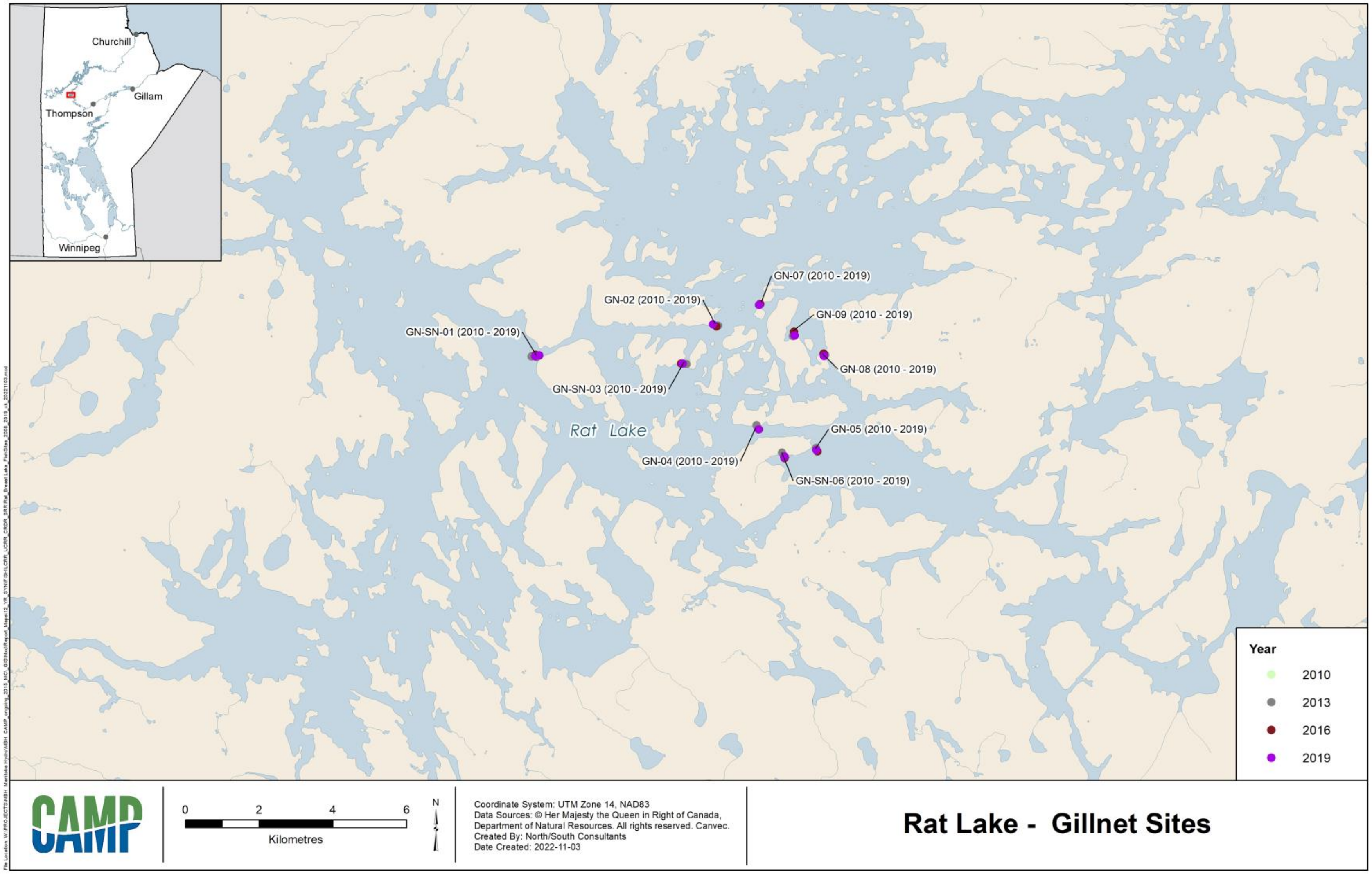


Figure A5-1-5. 2010-2019 Gillnetting sites in Rat Lake.

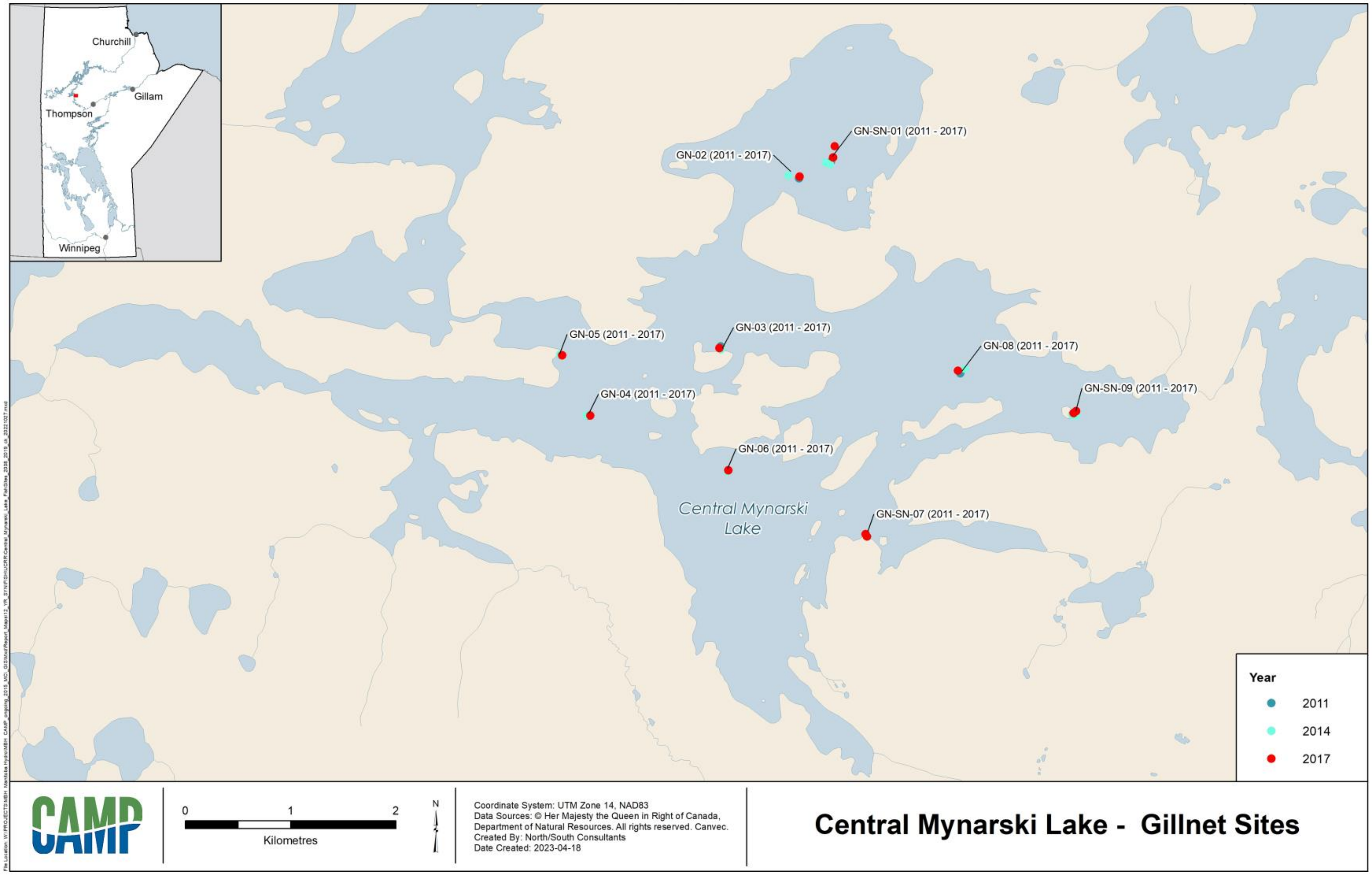


Figure A5-1-6. 2010-2019 Gillnetting sites in Central Mynarski Lake.

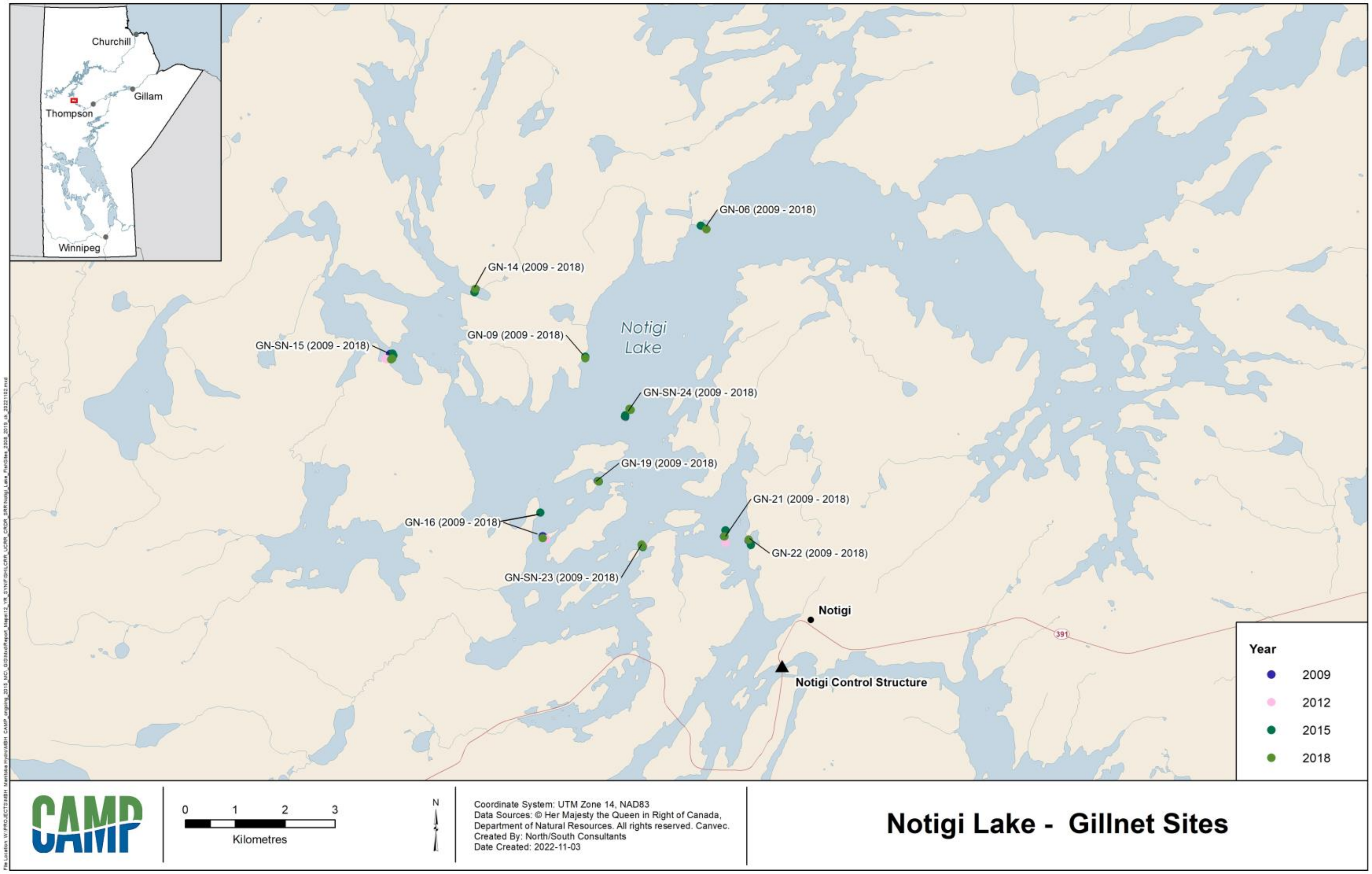


Figure A5-1-7. 2010-2019 Gillnetting sites in Notigi Lake.

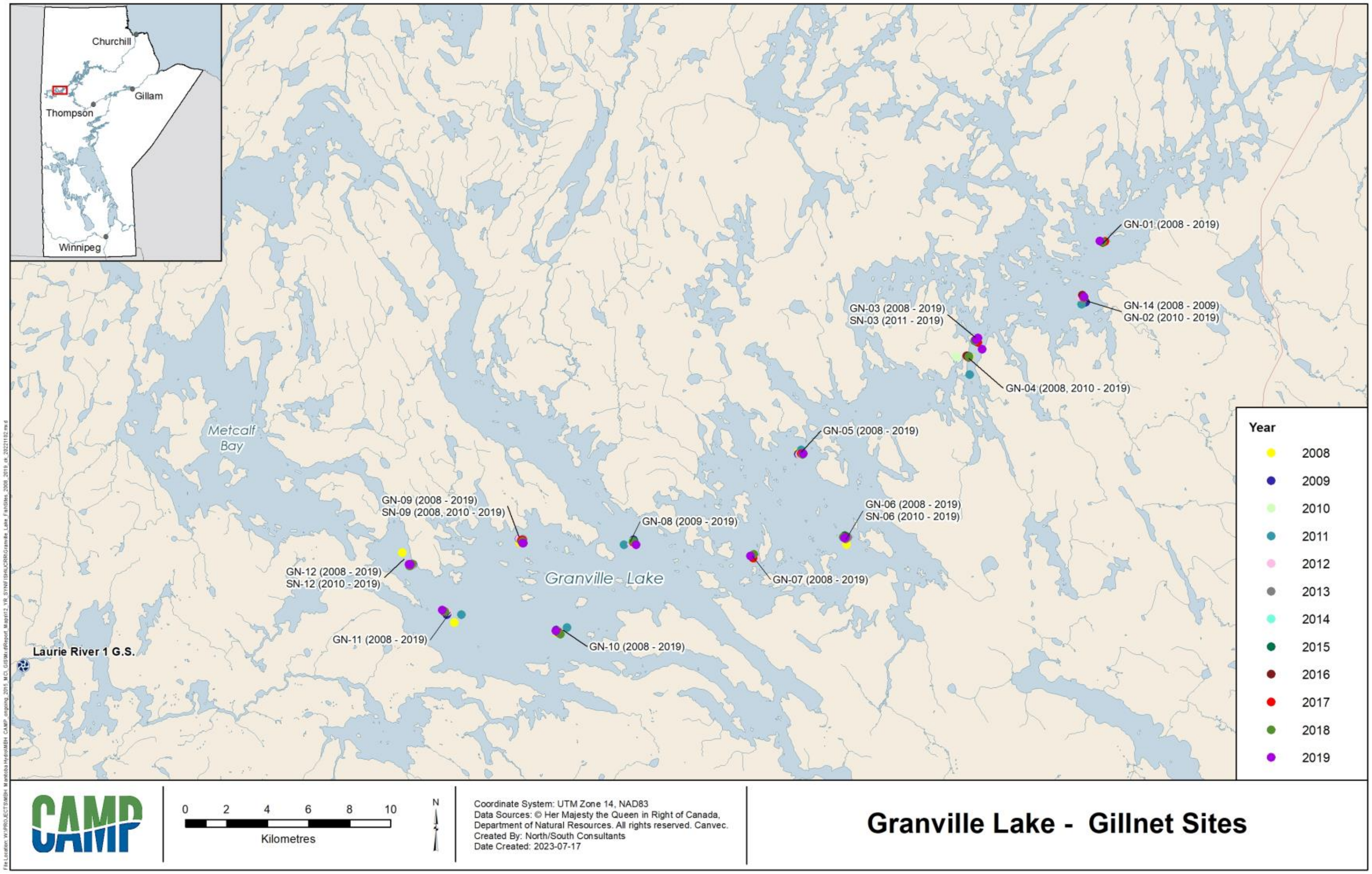


Figure A5-1-8. 2010-2019 Gillnetting sites in Granville Lake.

6.0 MERCURY IN FISH

6.1 INTRODUCTION

The following presents the results of fish mercury monitoring conducted from 2008-2019 in the Upper Churchill River Region. Fish mercury sampling was conducted on a three-year rotation beginning in 2010 at three on-system waterbodies, areas 4 and 6 of Southern Indian Lake and Rat Lake, and one off-system waterbody, Granville Lake (Table 6.1-1; Figure 6.1-1).

Mercury concentrations are measured in muscle tissue of commercially important fish species – Northern Pike, Walleye, and Lake Whitefish. Monitoring of mercury in 1-year-old Yellow Perch is also conducted as a potential early indicator of changes in mercury in the food web. Samples of fish muscle are collected during the conduct of fish community monitoring. Mercury is analysed in the trunk muscle of Northern Pike, Lake Whitefish, and Walleye selected over a range of fork lengths. Yearling Yellow Perch are analyzed for mercury as carcass with the head, pelvic and pectoral girdles, caudal fin, and digestive tract removed.

There were no departures from the planned field sampling schedule during the 12-year period.

Two metrics were selected for detailed reporting: arithmetic mean mercury concentrations; and length-standardized mean mercury concentrations (also referred to as “standard mean(s)”; Table 6.1-2). Standard lengths varied by species as follows: Lake Whitefish (350 mm); Northern Pike (550 mm); and Walleye (400 mm). As CAMP targets a specific age class of Yellow Perch, fish captured for this component are inherently of a limited size range; therefore, length-standardization for this species was not undertaken.

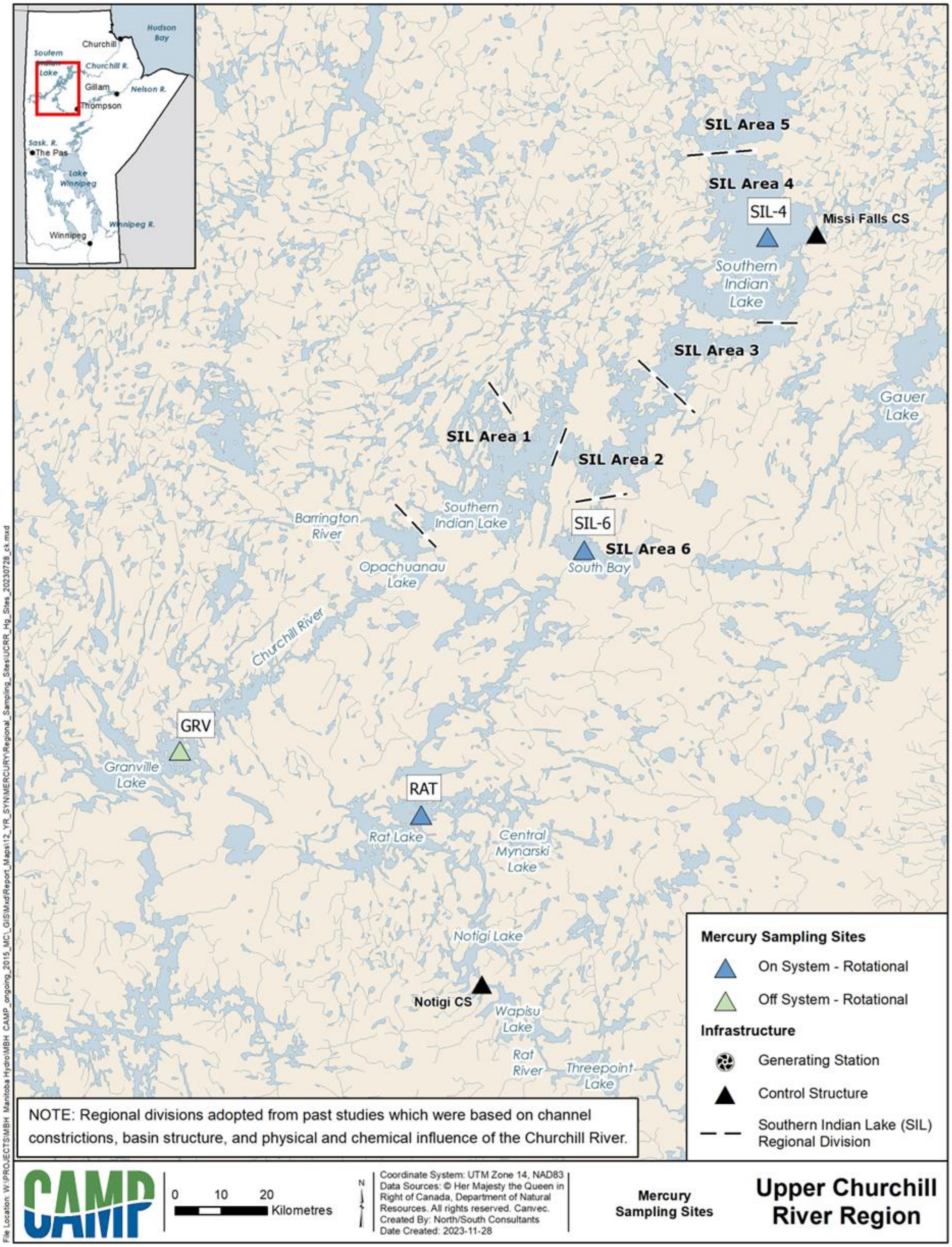
A detailed description of the program design and sampling methods is provided in Technical Document 1, Section 2.6.

Table 6.1-1. 2008-2019 Inventory of fish mercury sampling.

Waterbody/Area	**Sampling Year**											
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
SIL-4			●			●			●			●
SIL-6			●			●			●			●
RAT			●			●			●			●
GRV			●			●			●			●

Table 6.1-2. Mercury in fish indicators and metrics for CAMP reporting.

Key Indicator	**Key Metric**	**Units**
Mercury in Fish	• Arithmetic mean mercury concentration	Parts per million (ppm)
	• Length-standardized mean mercury concentration of large-bodied species	ppm



NOTE: Regional divisions adopted from past studies which were based on channel constrictions, basin structure, and physical and chemical influence of the Churchill River.

Coordinate System: UTM Zone 14, NAD83
Data Sources: © Her Majesty the Queen in Right of Canada, Department of Natural Resources. All rights reserved. Canvec.
Created By: North/South Consultants
Date Created: 2023-11-28

Figure 6.1-1. 2008-2019 Fish mercury sampling sites.

6.2 MERCURY IN FISH

6.2.1 ARITHMETIC MEAN MERCURY CONCENTRATION

6.2.1.1 ON-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Churchill River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

SIL-4

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.055 parts per million (ppm) in 2016 to a high of 0.074 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Lake Whitefish of the same length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.377 ppm in 2019 to a high of 0.477 ppm in 2013 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.193 ppm in 2016 to a high of 0.227 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

Over the three years of monitoring, the arithmetic mean mercury concentration of 1-year-old Yellow Perch was 0.017 ppm in 2013 (Table 6.2-2; Figure 6.2-4). No Yellow Perch were submitted for mercury analysis in 2016 or 2019 because none were caught.

SIL-6

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.026 ppm in 2010 to a high of 0.051 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Lake Whitefish of the same length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.475 ppm in 2013 to a high of 0.652 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.256 ppm in 2019 to a high of 0.479 ppm in 2013 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

Over the three years of monitoring, Yellow Perch were only submitted for mercury analysis in 2013, but none of these fish was 1-year-old (Table 6.2-2).

Rat Lake

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.053 ppm in 2016 to a high of 0.064 ppm in 2013 (Table 6.2-1). The mercury concentration typically increased with fork length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.287 ppm in 2013 to a high of 0.449 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.481 ppm in 2016 to a high of 0.548 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the three years of monitoring was below the laboratory detection limit in 2013 (<0.010 ppm) and was 0.019 ppm in 2019 (Figure 6.2-4). None of the Yellow Perch collected for mercury analysis in 2016 was 1-year-old.

6.2.1.2 OFF-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Churchill River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Granville Lake

Lake Whitefish

The arithmetic mean mercury concentration of Lake Whitefish over the four years of monitoring ranged from a low of 0.046 ppm in 2016 to a high of 0.070 ppm in 2019 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Lake Whitefish of the same length (Figure 6.2-1).

Northern Pike

The arithmetic mean mercury concentration of Northern Pike over the four years of monitoring ranged from a low of 0.336 ppm in 2016 to a high of 0.513 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Northern Pike of the same length (Figure 6.2-2).

Walleye

The arithmetic mean mercury concentration of Walleye over the four years of monitoring ranged from a low of 0.280 ppm in 2016 to a high of 0.416 ppm in 2010 (Table 6.2-1). The mercury concentration typically increased with fork length, although there was variation in the mercury concentration of Walleye of the same length (Figure 6.2-3).

Yellow Perch

The arithmetic mean mercury concentration of 1-year-old Yellow Perch over the three years of monitoring ranged was 0.011 ppm in 2013 and 0.015 ppm in 2016 (Figure 6.2-4). None of the Yellow Perch collected for mercury analysis in 2019 was 1-year-old.

Table 6.2-1. 2010-2019 Fork length, age, and mercury concentrations of Lake Whitefish, Northern Pike, and Walleye.

Species	Waterbody	Year	Fork Length (mm)					Age (years)					Mercury (ppm)						
			n[1]	Mean	Min[2]	Max[2]	SE[3]	n	Mean	Min	Max	SE	n	Mean	Min	Max	SE	Standard Mean[4]	95% CL[5]
LKWH	SIL-4	2010	37	325	196	414	10	37	11	5	19	0	37	0.070	0.041	0.130	0.004	0.072	0.066-0.79
		2013	36	330	200	416	10	35	12	3	19	1	36	0.068	0.026	0.152	0.006	0.070	0.062-0.079
		2016	36	339	200	466	11	36	14	4	22	1	36	0.055	0.019	0.089	0.003	0.055	0.051-0.060
		2019	28	338	218	452	13	28	13	5	22	1	28	0.074	0.037	0.254	0.008	0.072	0.062-0.082
	SIL-6	2010	29	324	206	446	12	28	4	2	9	0	29	0.026	0.012	0.067	0.002	0.028	0.025-0.030
		2013	35	309	212	462	10	35	4	2	8	0	35	0.028	0.01	0.069	0.002	0.032	0.028-0.036
		2016	36	325	192	522	13	36	5	2	20	0	36	0.032	0.016	0.14	0.003	0.032	0.028-0.037
		2019	36	335	126	534	17	35	6	1	21	1	36	0.051	0.018	0.154	0.005	0.048	0.043-0.055
	RAT	2010	3	339	225	541	13	1	3	-	-	-	3	0.063	0.017	0.137	0.037	not significant	
		2013	1	470	-	-	-	1	7	-	-	-	1	0.064	-	-	-	-	
		2016	18	407	248	497	17	18	6	3	14	1	18	0.053	0.034	0.091	0.003	0.046	0.042-0.051
		2019	4	433	400	461	14	4	9	6	11	1	4	0.061	0.050	0.069	0.005	0.036	0.028-0.047
	GRV	2010	36	308	172	504	16	29	6	2	18	1	36	0.047	0.020	0.090	0.003	0.052	0.048-0.056
		2013	22	342	208	500	20	21	7	2	16	1	22	0.047	0.022	0.124	0.005	0.046	0.040-0.052
		2016	35	369	120	502	14	35	7	1	16	1	35	0.046	0.018	0.102	0.004	0.041	0.036-0.047
		2019	17	353	180	488	26	17	7	2	13	1	17	0.070	0.034	0.088	0.004	0.070	0.063-0.077
NRPK	SIL-4	2010	36	562	371	774	15	36	8	3	14	0	36	0.408	0.131	0.762	0.026	0.371	0.330-0.417
		2013	36	577	390	784	14	36	9	3	16	0	36	0.477	0.127	0.771	0.028	0.415	0.363-0.473
		2016	36	582	390	800	17	35	9	3	15	1	36	0.402	0.111	0.820	0.031	0.322	0.290-0.358
		2019	36	591	440	820	13	36	8	3	15	1	36	0.377	0.160	0.921	0.028	0.297	0.265-0.334
	SIL-6	2010	28	518	324	666	16	28	7	2	13	1	28	0.500	0.149	1.13	0.053	0.522	0.445-0.612
		2013	36	538	258	804	19	36	7	1	12	0	36	0.475	0.079	1.62	0.053	0.433	0.380-0.493
		2016	36	562	310	772	14	36	7	2	14	0	36	0.529	0.124	1.38	0.048	0.446	0.394-0.506
		2019	7	607	502	802	39	7	8	6	11	1	7	0.652	0.311	1.07	0.113	not significant	
	RAT	2010	22	421	300	871	27	22	5	2	10	0	22	0.449	0.174	1.51	0.062	0.653	0.537-0.794
		2013	36	390	200	610	14	36	5	1	12	0	36	0.287	0.076	0.707	0.023	0.538	0.463-0.626
		2016	35	398	306	605	11	35	4	2	5	0	35	0.339	0.157	1.03	0.028	0.617	0.515-0.741
		2019	24	409	288	702	19	24	3	2	7	0	24	0.312	0.130	1.10	0.039	0.475	0.384-0.589
	GRV	2010	37	589	422	812	17	25	7	4	10	0	37	0.513	0.247	1.32	0.038	0.441	0.392-0.497
		2013	36	546	391	764	15	36	6	2	10	0	36	0.342	0.080	1.09	0.034	0.309	0.275-0.347
		2016	37	550	294	712	14	37	6	2	10	0	37	0.336	0.074	0.870	0.033	0.293	0.260-0.331
		2019	16	565	442	660	15	10	6	3	8	0	16	0.416	0.213	0.631	0.037	0.371	0.314-0.439

Table 6.2-1. continued.

Species	Waterbody	Year	Fork Length (mm)					Age (years)					Mercury (ppm)						
			n[1]	Mean	Min[2]	Max[2]	SE[3]	n	Mean	Min	Max	SE	n	Mean	Min	Max	SE	Standard Mean[4]	95% CL[5]
WALL	SIL-4	2010	12	343	241	435	18	12	6	4	8	0	12	0.217	0.158	0.257	0.011	not significant	
		2013	36	401	150	542	15	29	7	3	12	0	36	0.208	0.015	0.401	0.015	0.194	0.178-0.211
		2016	36	357	150	590	20	36	7	2	14	1	36	0.193	0.036	0.531	0.021	0.206	0.182-0.233
		2019	36	393	242	596	16	36	8	5	18	1	36	0.227	0.117	0.633	0.015	0.224	0.208-0.242
	SIL-6	2010	7	337	222	508	49	6	6	4	10	1	7	0.423	0.210	1.21	0.137	0.460	0.273-0.776
		2013	8	443	396	486	12	8	10	7	12	1	8	0.479	0.217	0.679	0.049	not significant	
		2016	35	336	116	492	20	35	7	2	20	1	35	0.303	0.051	1.21	0.045	0.329	0.277-0.392
		2019	4	271	154	410	68	4	5	2	8	1	4	0.256	0.070	0.582	0.115	not significant	
	RAT	2010	25	343	219	501	16	16	8	3	13	1	25	0.492	0.250	0.865	0.030	0.566	0.517-0.621
		2013	36	390	195	501	14	36	9	2	18	1	36	0.520	0.230	0.930	0.032	0.516	0.474-0.562
		2016	36	354	162	466	14	36	8	2	18	1	36	0.481	0.156	1.02	0.038	0.553	0.503-0.609
		2019	20	343	192	554	22	20	8	2	20	1	20	0.548	0.235	1.41	0.072	0.620	0.522-0.736
	GRV	2010	35	376	226	500	11	34	9	3	14	1	35	0.416	0.143	0.909	0.026	0.441	0.402-0.485
		2013	36	395	250	508	8	35	8	3	16	0	36	0.292	0.157	0.79	0.023	0.280	0.254-0.309
		2016	36	385	150	540	13	36	9	2	18	1	36	0.280	0.057	0.777	0.024	0.272	0.240-0.308
		2019	35	358	228	510	13	34	7	3	13	1	35	0.346	0.164	0.839	0.022	0.379	0.345-0.415

Notes:

1. n = sample size.
2. Min = minimum; Max = maximum.
3. SE = standard error.
4. For standard lengths of 350 mm for LKWH, 550 mm for NRPK, and 400 mm for WALL.
5. CL = confidence limits.

Table 6.2-2. 2013-2019 Fork length and mercury concentrations of 1-year-old Yellow Perch.

Species	Waterbody	Year	n[1]	Fork Length (mm)				Mercury (ppm)			
				Mean	Min[2]	Max[2]	SE[3]	Mean	Min	Max	SE
YLPR	SIL-4	2013	13	72	64	78	1	0.017	0.011	0.022	0.001
		2016	0	-	-	-	-	-	-	-	-
		2019	0	-	-	-	-	-	-	-	-
	SIL-6	2013	0	-	-	-	-	-	-	-	-
		2016	0	-	-	-	-	-	-	-	-
		2019	0	-	-	-	-	-	-	-	-
	RAT	2013	1	81	-	-	-	<0.010	-	-	-
		2016	0	-	-	-	-	-	-	-	-
		2019	2	93	92	94	1	0.019	0.0104	0.028	0.006
	GRV	2013	4	67	64	70	1	0.011	<0.010	0.028	0.005
		2016	1	70	-	-	-	0.015	-	-	-
		2019	0	-	-	-	-	-	-	-	-

Notes:

1. n = sample size.
2. Min = minimum; Max = maximum.
3. SE = standard error..

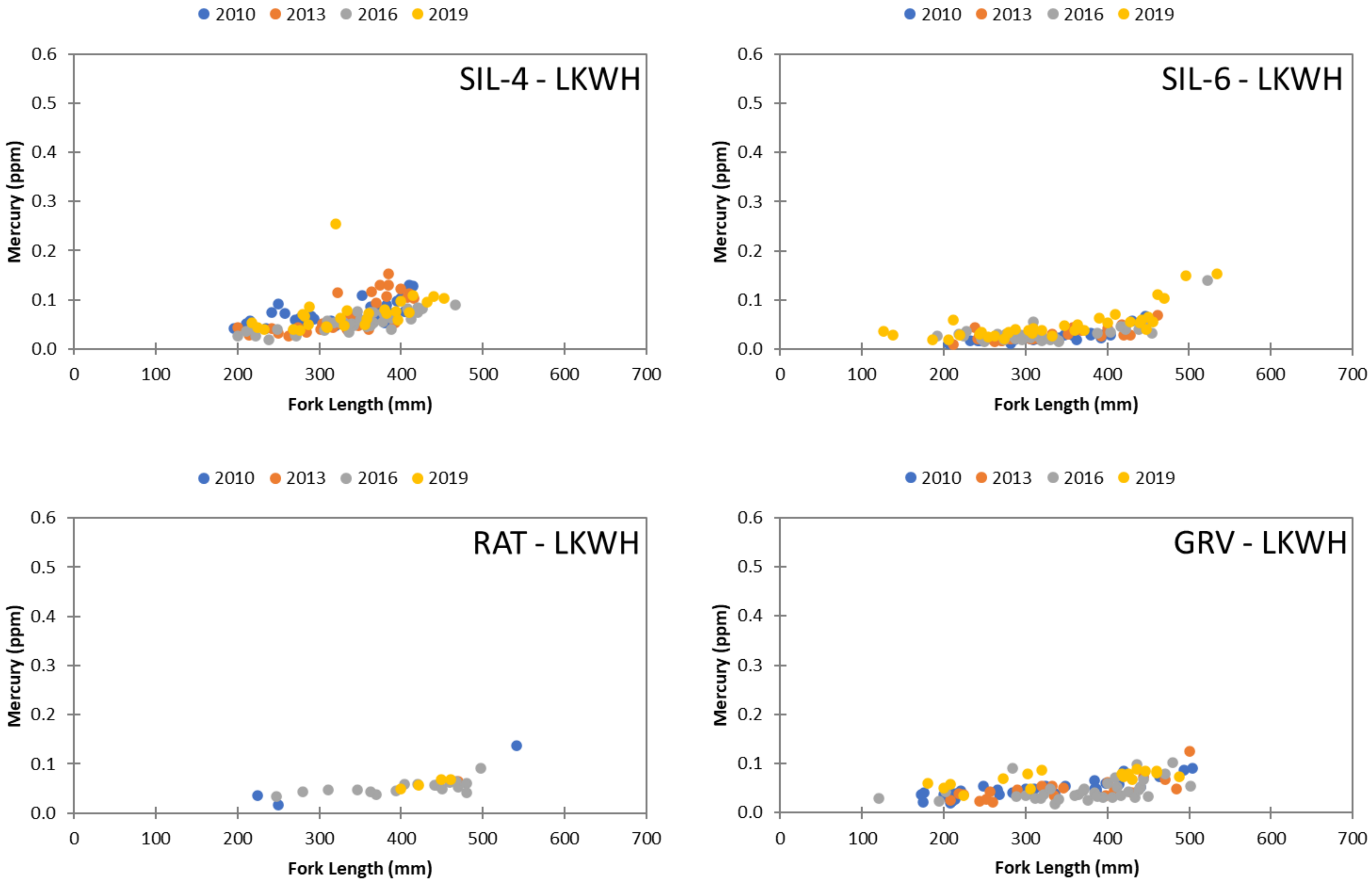


Figure 6.2-1. 2010-2019 Mercury concentration versus fork length of Lake Whitefish.

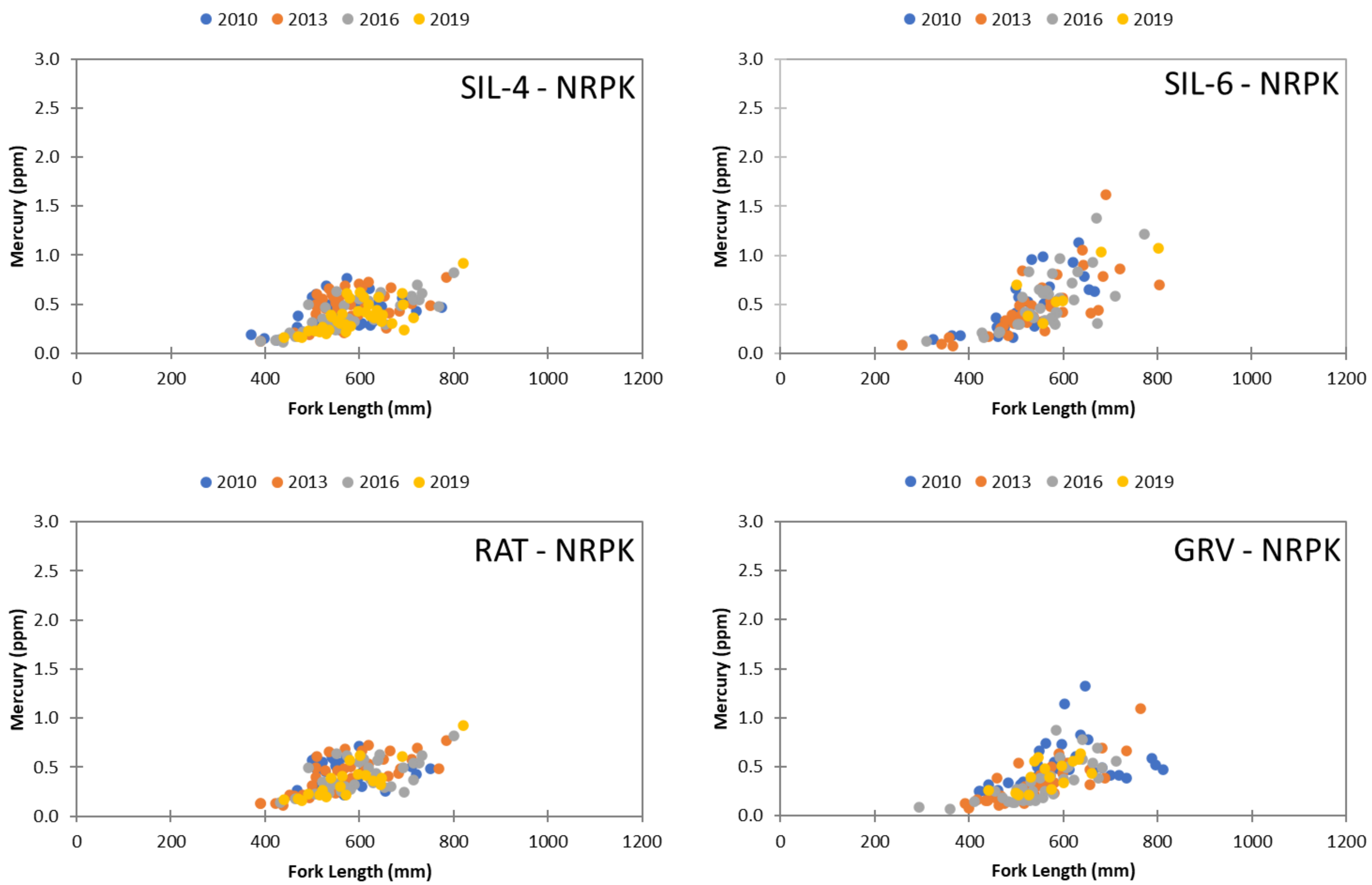


Figure 6.2-2. 2010-2019 Mercury concentration versus fork length of Northern Pike.

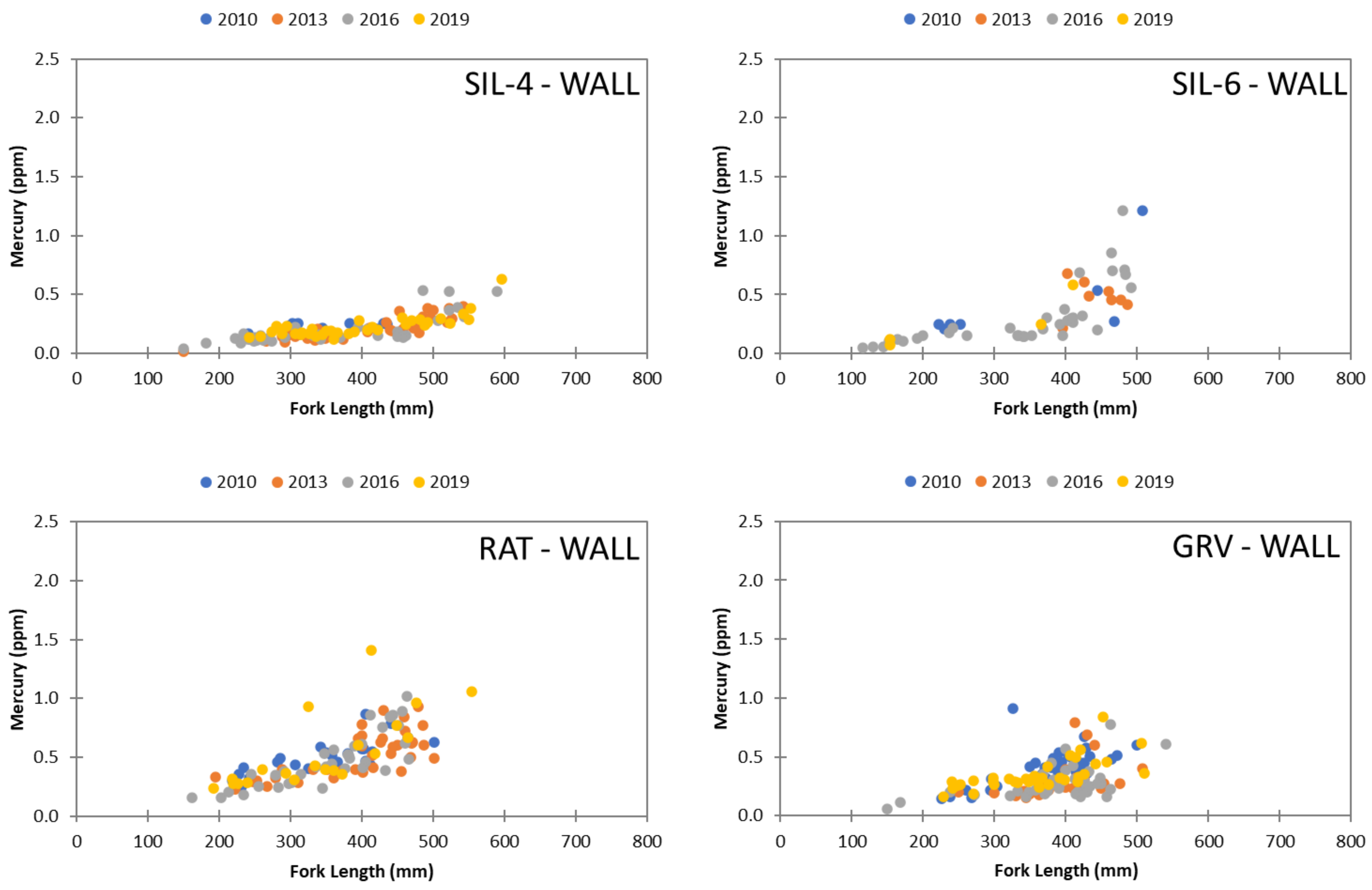


Figure 6.2-3. 2010-2019 Mercury concentration versus fork length of Walleye.

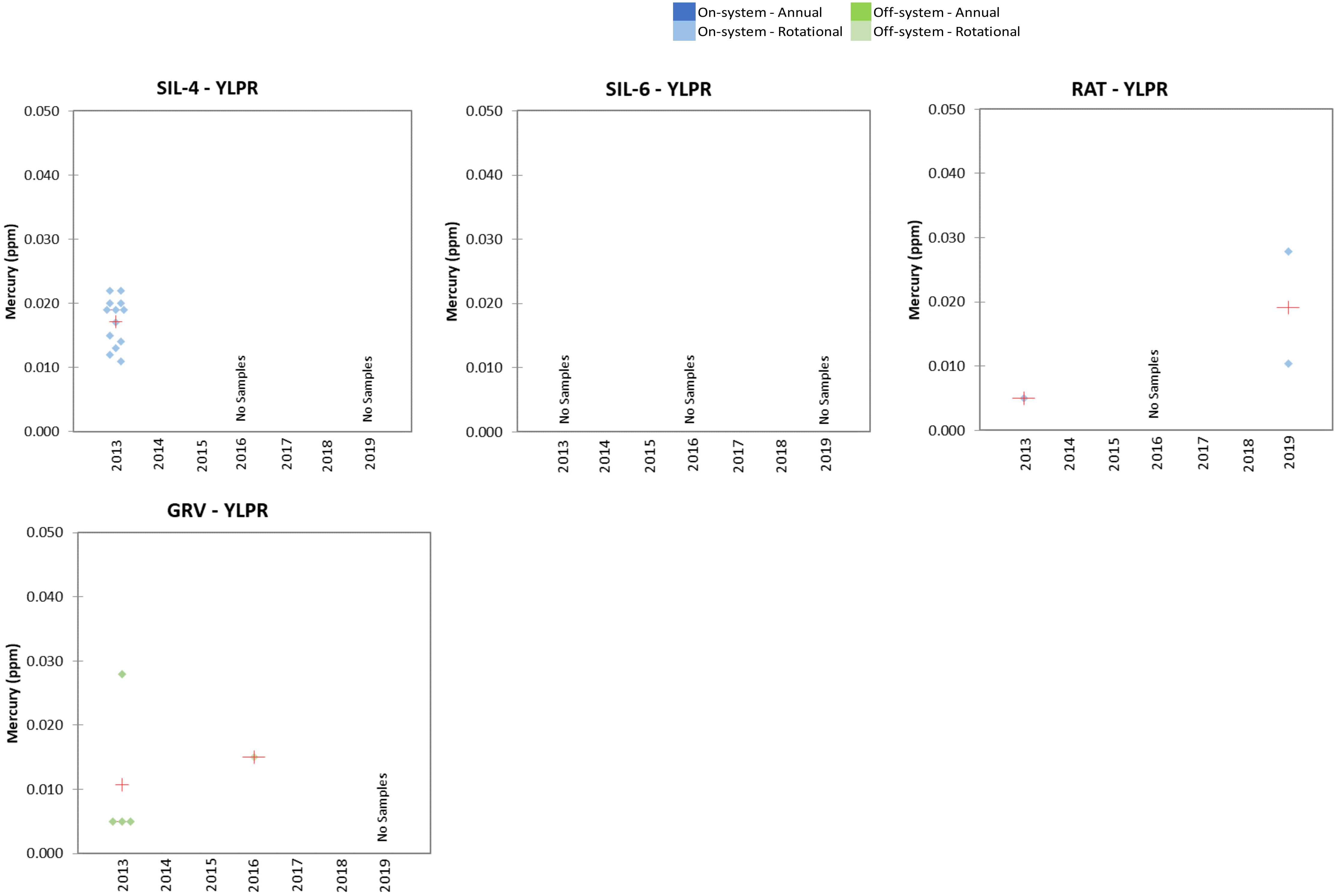


Figure 6.2-4. 2013-2019 Mercury concentrations of 1-year-old Yellow Perch.

6.2.2 LENGTH-STANDARDIZED MEAN CONCENTRATION

6.2.2.1 ON-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Churchill River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

SIL-4

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish over the four years of monitoring ranged from a low of 0.055 in 2016 to a high of 0.072 ppm in 2010 and 2019 (Table 6.2-1).

The overall mean concentration was 0.067 ppm, the median concentration was 0.071 ppm, and the IQR was 0.067–0.072 ppm (Figure 6.2-5). The annual mean mercury concentration fell within the IQR except in 2016 when it was below the IQR.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.297 ppm in 2019 to a high of 0.415 ppm in 2013 (Table 6.2-1).

The overall mean concentration was 0.351 ppm, the median concentration was 0.347 ppm, and the IQR was 0.316–0.382 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2019 when it was below the IQR and in 2013 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.194 ppm in 2013 to a high of 0.224 ppm in 2019 (Table 6.2-1). A standard mean could not be calculated for 2010 because there was not a significant relationship between mercury concentration and fork length.

The overall mean concentration was 0.208 ppm, the median concentration was 0.206 ppm, and the IQR was 0.200–0.215 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

SIL-6

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish over the four years of monitoring ranged from 0.028 in 2010 to a high of 0.048 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.035 ppm, the median concentration was 0.032 ppm, and the IQR was 0.031–0.036 ppm (Figure 6.2-5). The annual mean mercury concentration fell within the IQR except in 2010 when it was below the IQR and in 2019 when it was above the IQR.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.433 ppm in 2013 to a high of 0.522 ppm in 2010 (Table 6.2-1). A standard mean could not be calculated for 2019 because there was not a significant relationship between mercury concentration and fork length.

The overall mean concentration was 0.467 ppm, the median concentration was 0.446 ppm, and the IQR was 0.440–0.484 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2010 when it was above the IQR.

Walleye

Over the four years of monitoring, the length-standardized mean mercury concentration of a 400 mm Walleye was 0.460 ppm in 2010 and 0.329 ppm in 2016 (Table 6.2-1). A standard mean could not be calculated for 2013 or 2019 because there was not a significant relationship between mercury concentration and fork length.

Rat Lake

Lake Whitefish

Over the four years of monitoring, the length-standardized mean mercury concentration of a 350 mm Lake Whitefish was 0.046 ppm in 2016 and 0.036 ppm in 2019 (Table 6.2-1). A standard mean could not be calculated for 2010 because there was not a significant relationship between mercury concentration and fork length or in 2013 because only one Lake Whitefish was analyzed for mercury.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.475 ppm in 2019 to a high of 0.653 ppm in 2010 (Table 6.2-1).

The overall mean concentration was 0.571 ppm, the median concentration was 0.578 ppm, and the IQR was 0.522-0.626 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2019 when it was below the IQR and in 2010 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.516 ppm in 2013 to a high of 0.620 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.564 ppm, the median concentration was 0.560 ppm, and the IQR was 0.544-0.580 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2013 when it was below the IQR and in 2019 when it was above the IQR.

6.2.2.2 OFF-SYSTEM SITES

ANNUAL SITES

There are no waterbodies in the Upper Churchill River Region that are monitored for fish mercury annually.

ROTATIONAL SITES

Granville Lake

Lake Whitefish

The length-standardized mean mercury concentration of a 350 mm Lake Whitefish over the four years of monitoring ranged from a low of 0.041 ppm in 2016 to a high of 0.070 ppm in 2019 (Table 6.2-1).

The overall mean concentration was 0.052 ppm, the median concentration was 0.049 ppm, and the IQR was 0.045–0.056 ppm (Figure 6.2-5). The annual mean mercury concentration fell within the IQR except in 2016 when it was below the IQR and in 2019 when it was above the IQR.

Northern Pike

The length-standardized mean mercury concentration of a 550 mm Northern Pike over the four years of monitoring ranged from a low of 0.293 ppm in 2016 to a high of 0.441 ppm in 2010 (Table 6.2-1).

The overall mean concentration was 0.354 ppm, the median concentration was 0.340 ppm, and the IQR was 0.305–0.389 ppm (Figure 6.2-6). The annual mean mercury concentration fell within the IQR except in 2016 when it was below the IQR and in 2010 when it was above the IQR.

Walleye

The length-standardized mean mercury concentration of a 400 mm Walleye over the four years of monitoring ranged from a low of 0.272 ppm in 2016 to a high of 0.441 ppm in 2010 (Table 6.2-1).

The overall mean concentration was 0.343 ppm, the median concentration was 0.329 ppm, and the IQR was 0.278–0.394 ppm (Figure 6.2-7). The annual mean mercury concentration fell within the IQR except in 2016 when it was below the IQR and in 2010 when it was above the IQR.

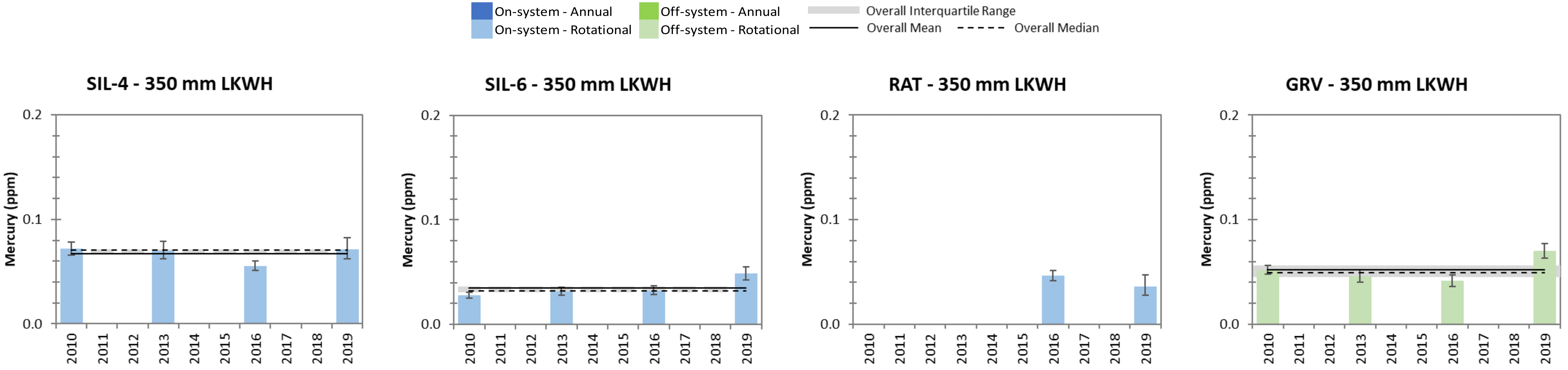


Figure 6.2-5. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Lake Whitefish.

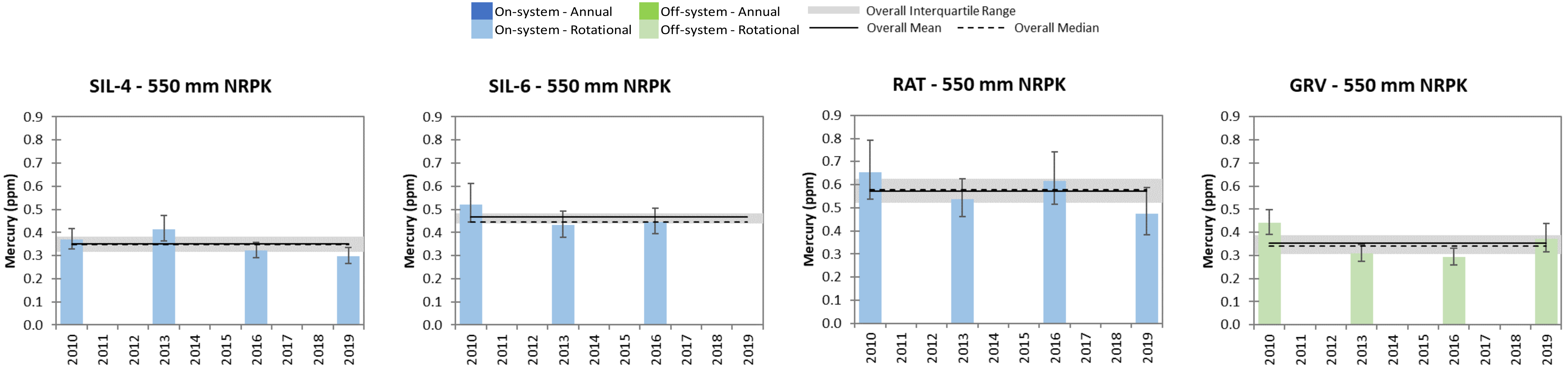


Figure 6.2-6. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Northern Pike.

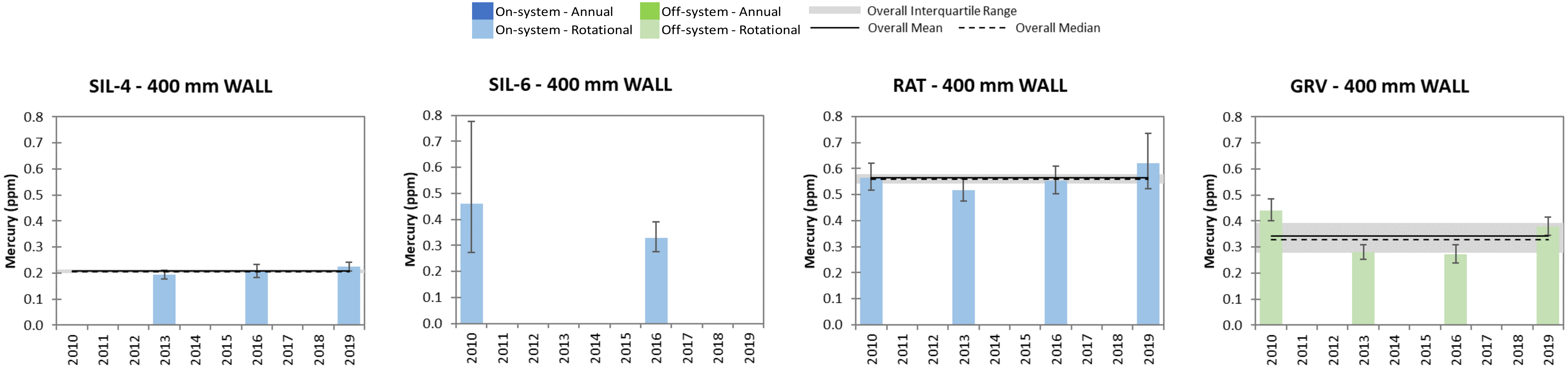


Figure 6.2-7. 2010-2019 Length-standardized mean mercury concentrations (±95% confidence intervals) of Walleye.

7.0 LITERATURE CITED

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