Keeyask Generation Project

Aquatic Effects Monitoring Plan

Fish Community Monitoring Report

AEMP-2022-07

KEEYASK

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KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2022-07

FISH COMMUNITY MONITORING IN THE NELSON RIVER FROM SPLIT LAKE TO STEPHENS LAKE, SUMMER 2021

Prepared for

Manitoba Hydro

By

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SUMMARY

Background

The Keeyask Hydropower Limited Partnership (KHLP) was required to prepare a plan to monitor the effects of construction and operation of the Keeyask Generating Station (GS) on the environment. Besides measuring the accuracy of the predictions made and actual effects of the GS on the environment, monitoring results will provide information on how construction and operation of the GS will affect the environment and if more needs to be done to reduce harmful effects.

Construction of the Keeyask GS began in mid-July 2014 and instream work was completed in 2020. The reservoir was impounded with water levels being raised to full supply level between August 31 and September 5, 2020. Commissioning of the powerhouse turbines was initiated in 2021, with five units commissioned by fall 2021. During commissioning, substantial flows continued through the spillway.

The monitoring of fish communities (in terms of species composition and abundance) is an important component of the overall plan to monitor the impacts of construction and operation of the Keeyask GS on fish. Fish communities upstream of the Keeyask GS, which include several species that are important sources of food to local people, may be affected by operation of the Keeyask GS through reservoir impoundment. Changes in water levels and flow will result in the alteration or loss of existing habitats and the creation of new habitats. Furthermore, these habitat changes will also result in changes to the production of aquatic plants, invertebrates, and forage fish. Results from fish community monitoring will be used to describe existing fish populations and to provide the basis for assessing potential changes that may be associated with the construction and operation of the Keeyask GS.

This report presents the results of fish community monitoring conducted in the reach of the Nelson River from Split Lake to the Kettle GS. Sites in Split Lake were sampled to record the fish community in an area not directly affected by creation of the Keeyask reservoir, to record how the fish community can vary from year to year. Sites in what is now the Keeyask reservoir from Clark Lake to the Keeyask GS were sampled as this environment has changed from a river and small lake environment to a large reservoir. Finally, the fish community in Stephens Lake could be affected by the loss of Gull Rapids, which was a spawning site for many of the fish species in Stephens Lake. Fish community data were previously collected in the Nelson River between Clark Lake and the Keeyask GS in 2001, 2002, 2009, 2015, 2018, and 2019. Since 2009, monitoring was conducted every year in Split Lake, and every third year in Stephens Lake, under the Coordinated Aquatic Monitoring Program (CAMP), a program conducted jointly by the province of Manitoba and Manitoba Hydro. However, different sites were sampled in each year. In this report, only years in which the same sites were sampled previously are used for comparison. These included 2009, 2015, 2019, and 2021 for Split Lake; 2001, 2002, 2009, 2015, 2019, and

2021 for the Keeyask reservoir; and 2009, 2015, 2018, and 2021 for Stephens Lake North and South.

Why is the study being done?

The monitoring of fish communities is being done to answer several questions:

Will the abundance (i.e., catch-per-unit-effort) and species composition of the fish communities in the Keeyask reservoir and Stephens Lake change as a result of construction and operation of the Project?

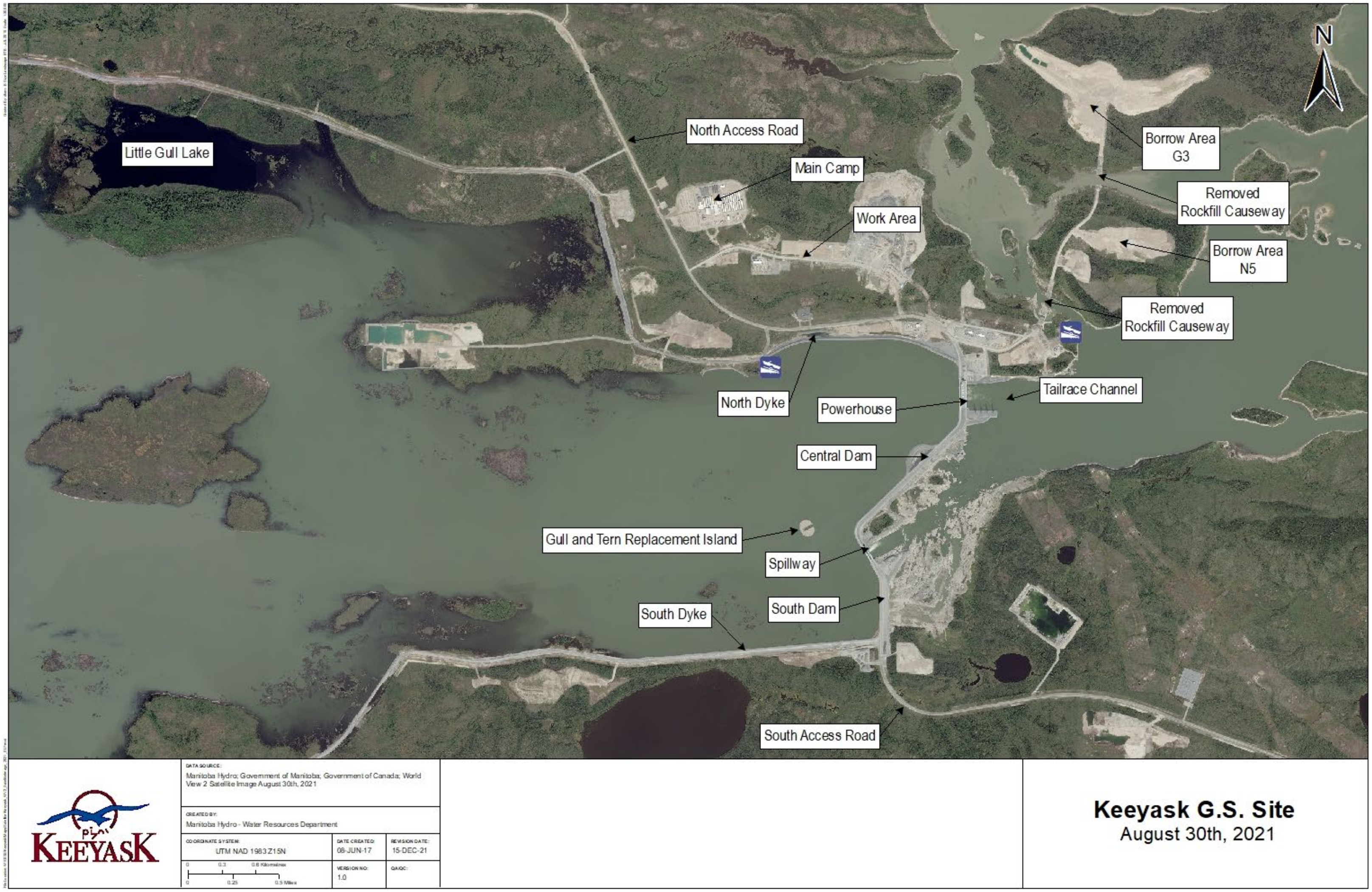
This question is important because habitat changes associated with the construction and operation of the Keeyask GS (for example, changes in water levels and flows) may result in changes in the abundance and species composition of resident fish communities. It is possible that certain fish species could move away from the newly created reservoir and be lost from the local populations, while other species could move into the reservoir and become more abundant.

For the three Valued Environmental Component (VEC) fish species (i.e., Lake Whitefish, Northern Pike, and Walleye), will a biologically meaningful change in condition factor or growth be observed in the Keeyask reservoir and/or Stephens Lake in comparison to pre-Project conditions?

This question is important because a change in body condition (if any of these species become fatter or skinnier than they used to be) might mean that something in their environment is changing.

Will the abundance of small-bodied fish captured in small mesh index (SMI) gill nets set in the Keeyask reservoir and Stephens Lake change following construction and during operation of the Project?

This question is important because the small-bodied fish community is the major food source for species such as Walleye (pickerel) and Northern Pike (jackfish).



Map illustrating instream structures at the Keeyask Generating Station site, August 2021.

What was done?

Sampling was conducted in Split Lake, the Keeyask reservoir, and Stephens Lake (split into North and South parts for data analysis) in the summer of 2021 (see study area map below). These sites have been sampled periodically since 2001 and are referred to as standard sites. Two types of gill nets were used: standard gang index (SGI) which catch large-bodied fish, and SMI which catch small-bodied fish (includes forage fish, like minnows, and the young of large fish). All fish captured in each waterbody were identified by species and counted. When a large-bodied fish was caught, it was measured and weighed. Ageing structures were taken from Lake Whitefish, Northern Pike, and Walleye. All Lake Sturgeon, Lake Whitefish, Northern Pike, Walleye, and White Sucker caught were checked for signs of any abnormal marks on the skin or growths. Data collected before Keeyask reservoir flooding (*i.e.,* 2019 and earlier; referred to as baseline data) were compared to those collected after flooding (*i.e.,* in 2021).

Additional sites were sampled in the Keeyask reservoir in seven newly flooded areas including four bays formed at flooded streams, one lake that became connected to the reservoir after flooding (Little Gull Lake), and two sites upstream of the GS. These new sites were not used for comparisons to past years but will be used in the future to see how fish use these newly flooded habitats.

Pulling gill nets (left) assessing debris (middle) and processing fish for the fish community sampling program.

What was found?

A total of 2,718 fish representing 20 different species were captured in SGI and SMI gill nets set at standard sites in 2021 (Split Lake, the Keeyask reservoir, and Stephens Lake North and South). This included 12 large-bodied species and eight forage species. Most species caught in 2021 were also caught in previous study years. The relative abundance of White Sucker increased between sampling periods in all areas. The most significant change in relative abundance observed between baseline (i.e., 2019 and earlier) and the first year after flooding (i.e., 2021) monitoring studies was in the number of Rainbow Smelt (a small, non-native forage fish that is food for larger fish) caught. Fewer Rainbow Smelt were captured in 2021 than during previous studies in all locations. This is a trend that is seen throughout northern Manitoba.

Catch-per-unit-effort (CPUE) is a measure of how many fish were caught over a certain time in a certain length of net and is used to tell how abundant fish are in an area. The CPUE for fish caught in SGI gill nets were similar in all areas except for Northern Pike. The mean total CPUE of Northern Pike has decreased yearly since 2002 in the Keeyask reservoir and was lower in 2021 than in any previous year. However, the decrease in 2021 may reflect where nets were set. Nets were set in the same places every year. Since flooding, these areas have become deeper and do not reflect habitat preferred by Northern Pike. Many Northern Pike were captured in the newly flooded areas.

The condition factor (a measure of how fat a fish is at a given size) and mean fork length for some fish was lower than seen in previous years and some were higher. These differences likely reflect a natural variation in size structure, as they were observed in both project-affected and reference sites. Further, any changes in condition and length due to reservoir impoundment would take more than one year to show.

CPUE in SMI gill nets was highly variable between study years and waterbodies, but fell within the ranges seen in other years in the Keeyask reservoir and in Stephens Lake South. Small mesh gillnetting resulted in the capture of both young-of-the-year Walleye and Northern Pike, indicating that recruitment occurred for both species in the first spring after impoundment.

All three VEC species were captured in the newly flooded areas in 2021. Northern Pike were the most commonly captured species at all sites and were captured in the largest numbers in the backbays and in Little Gull Lake.

What does it mean?

The number and type of fish caught was generally similar between baseline and 2021 monitoring studies. The number of Northern Pike captured was lower in all sampling locations after impoundment, but this may reflect the greater water depth at sites that were sampled both before and after impoundment. The number of Rainbow Smelt in each location has decreased since studies began, a pattern that has been observed throughout northern Manitoba. Ongoing monitoring will continue to record changes in the fish community as it evolves in the newly created Keeyask reservoir. Future monitoring in Stephens Lake as all of the units come into operation will show whether fish that used to spawn in the area of the former Gull Rapids or if they find other spawning habitat.

What will be done next?

Each year, sampling will be conducted using the same capture methods, so that results can be compared between different years and trends can be seen.

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station at Gull Rapids on the lower Nelson River in northern Manitoba. The Project is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, where Gull Lake flows into Stephens Lake, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam (Map 1). Construction of the Project began in July 2014.

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs, is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume* (AE SV). As part of the licensing process for the Project, an *Aquatic Effects Monitoring Plan* (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment. This includes targeting species that had been identified as being of particular concern during the environmental assessment (referred to as Valued Ecosystem Components, or VECs). These species include Lake Whitefish, Northern Pike, and Walleye.

Fish community studies in the Keeyask study area were initially conducted between 2001 and 2004. Surveyed waterbodies included Split Lake (Dunmall et al. 2004; Holm and Remnant 2004), Clark Lake (Dunmall et al. 2004; Holm and Remnant 2004; Holm 2005), Assean Lake (off-system waterbody that flows into Clark Lake) (Dunmall et al. 2003; Holm et al. 2003), the reach of the Nelson River between Clark Lake and Gull Rapids (site of the Keeyask Generating Station) (Remnant et al. 2004b; Johnson and Parks 2005; Bretecher et al. 2007; Johnson 2005, 2007) and Stephens Lake (Pisiak et al. 2004; Pisiak 2005a, b; MacDonald 2007). In these studies, fish species composition and abundance were described, fish movements and biological variables were assessed, and spawning areas were identified. Concurrent fish studies were also conducted in several tributaries of the Nelson River between Clark Lake and Gull Rapids from 2001 to 2003 to determine fish usage and to assess the importance of each tributary to fish spawning populations (Barth et al. 2003; Remnant et al. 2004a; Richardson and Holm 2005; Kroeker and Jansen 2006). A similar fish spawning study was conducted in several tributaries of Stephens Lake in 2005 and 2006 (Cassin and Remnant 2008). Also, in Stephens Lake, Walleye (*Sander vitreus*) condition was evaluated in 2003 (Cooley and Johnson 2008) and the habitat preferences of fish in flooded areas were described in 2006 (Cooley and Dolce 2008).

In 2009, fish community data were collected in the reach of the Nelson River between Clark Lake and Gull Rapids (Holm 2010). From 2009–2021 fish community monitoring took place in Split and Assean lakes (annually), and in Stephens Lake (every third year), as part of the Coordinated Aquatic Monitoring Program (CAMP), a program conducted jointly by the province of Manitoba and Manitoba Hydro (CAMP 2014, CAMP unpublished data).

Construction and operation of the Keeyask GS will affect fish populations within the reservoir due to alteration or loss of habitats (*e.g.*, tributaries, rapids, littoral) and the creation of new habitats. Effects to the fish community may also occur indirectly due to changes to the production of aquatic plants, invertebrates, and forage fish. Downstream, construction and operation of the generating station may also affect fish populations in Stephens Lake by changing fish habitat, primarily within the 3 km long reach of the Nelson River between the location of the powerhouse and Stephens Lake (KHLP 2012). In addition to changes in water levels, velocity, and sedimentation in this reach of river, spawning habitat in Gull Rapids will be lost.

The objective of the sampling conducted in 2021 was to collect information on species composition and abundance, as well as selected biological metrics, of the fish community in the Keeyask reservoir in the first year following impoundment. Sampling was also conducted in Stephens Lake, where the fish community may be experiencing effects due to changes in flow as water is diverted from the spillway discharging along the natural river channel to the powerhouse. Split Lake is upstream of the effects of the GS and is being sampled as a reference site to indicate natural interannual variation in the fish community. Data collected in 2021 will be compared to previous years' data to determine if the fish community has changed over time and since impoundment of the Keeyask GS reservoir in fall 2020.

Additional sites in newly flooded areas were sampled in the Keeyask reservoir in 2021. These locations represent areas of new habitat and will continue to be sampled during future studies. Data from these sites were not used in comparisons to data collected in previous years.

This report presents the results of fish community sampling conducted in the reach of the Nelson River between Clark Lake and Gull Rapids (i.e., the Keeyask reservoir) and data collected under the CAMP program for Split Lake and Stephens lakes in 2021.

2.0 STUDY SETTING

The study area encompasses an approximately 110 km long reach of the Nelson River from Clark Lake to the upstream end of the Limestone Reservoir (Map 1). This section of river offers a diversity of physical habitat conditions, including a variety of substrate types, and variable water depths (range 0–30 m) and velocities. Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of the Keeyask GS (formerly Gull Rapids) (Map 1). Current is restricted to the main section of the lake, with off-current bays outside the main channel. The Assean River is the only major tributary to Clark Lake and flows into the north side. Downstream from the outlet of Clark Lake, the Nelson River narrows and water velocity increases for a 3 km stretch, known as Long Rapids. For the next 7 km, the river widens, and water velocity decreases.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids (Maps 1 and 2) and marks the upstream end of major water level changes as a result of impoundment by the Keeyask GS. The drop in elevation from the upstream to downstream side of Birthday Rapids was approximately 2 m prior to impoundment but is now a nearly level, albeit fast-flowing section of river. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake was characterized as a large and somewhat uniform channel with medium to high water velocities and a few large bays. This area is now within the Keeyask reservoir, though flooding was limited to mainly shoreline areas.

Prior to impoundment, Gull Lake was a widening of the Nelson River, with moderate to low water velocity. Water levels on Gull Lake increased by several metres following impoundment and flooding along the shoreline and small tributaries entering this reach was extensive.

Just below Gull Rapids/the Keeyask GS, the Nelson River enters Stephens Lake (Map 3). Stephens Lake was formed in 1971 by construction of the Kettle GS. Between the Keeyask GS and Stephens Lake, there is an approximately 6 km long reach of the Nelson River that, although affected by water regulation at the Kettle GS, remains riverine habitat with moderate velocity. Construction has altered the flow distribution immediately downstream of Gull Rapids as all flow now passes via the south channel of Gull Rapids. In August 2018, flow was further constricted when the spillway was commissioned.

Construction of the Kettle GS flooded Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River, as well as the old channels of the Nelson River that now lie within the southern portion of the lake (Map 3). Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. Looking Back Creek is a second order stream that drains into the north arm of Stephens Lake (Map 1). Kettle GS is located approximately 40 km downstream of Gull Rapids.

2.1 FLOWS AND WATER LEVELS

From October 2020 to mid-June 2021 the calculated Split Lake outflow varied about the median flow of about 3,300 m^3/s, ranging between about 3,000 m^3/s and 3,900 m^3/s. From mid-June to mid-August, the flows steadily decreased from about 3,700 m^3/s to about 2,000 m^3/s, which is approximately the 5th percentile low flow. Low flow conditions persisted from summer into winter, with flows dropping to a low of about 1,800 m^3/s at the end of November 2021. These are the lowest flows that have occurred during Keeyask construction. It is not since 2005 that flows this low have occurred on the Nelson River.

Water levels on Gull Lake have been held steady between about 158.8-159 m since reservoir impoundment in September 2020. Upstream of Gull Lake at gauges below and above Birthday Rapids the levels were about 0.5 m and 2 m higher than on Gull Lake, a smaller difference than would have occurred prior to the project. Upstream levels increased about 3-4 m at these sites in winter due to ice effects as in previous years. Due to low flows in summer 2021 the water surface was relatively flat from Gull Lake to the gauge just upstream of Birthday Rapids, with a difference of only about 0.8-0.9 m between the two.

Keeyask is transitioning from a construction project to an operating station. In 2021, the work at site has been focused on bringing units into service. By the end of April 2021, prior to the start of aquatic monitoring, Unit 1 and Unit 2 were in service. Throughout the open water period more units were being tested and brought into service one at a time. As units came into service, the distribution of flow between the spillway and powerhouse has gradually shifted. By the end of October 2021 five units were fully in service.

Discharges from the spillway and powerhouse are not measured but have been estimated based on performance design curves. For reference it is noted that the design discharge capacity of the powerhouse is 4,000 m^3/s, giving each turbine unit a discharge capacity of approximately 570 m^3/s.

3.0 METHODS

Gillnetting was conducted at project-affected (the Nelson River between Clark Lake and the Keeyask GS and Stephens Lake; referred to herein as the Keeyask reservoir) and reference (Split Lake) waterbodies in 2021. Sampling was conducted in Split Lake from August 23 to 26, 2021 (Map 2), and in Stephens Lake North and South from August 31 to September 3, 2021 and September 3 to 6, 2021, respectively (Map 3). The Keeyask reservoir was sampled from August 3 to 14, 2021 (Map 4).

A total of 40 standard gang index (SGI) and 14 small mesh index (SMI) gill net sites were sampled in 2021. These included 12 SGI and four SMI sites on Split Lake, ten SGI and four SMI sites on the Keeyask reservoir, and nine SGI and three SMI sites on both Stephens Lake North and South. Sampling was conducted annually in Split Lake and every three years in Stephens Lake North and South since 2009 as well as in 2001 and 2002; however, different sites were sampled in each year. For this report, a subset of years was chosen in which the same sites were sampled to ensure comparability. These included 2009, 2015, 2019, and 2021 for Split Lake; 2001, 2002, 2009, 2015, 2019, and 2021 for the Keeyask reservoir; and 2009, 2015, 2018, and 2021 for Stephens Lake North and South. These data were compared between years to monitor potential changes occurring independent of GS operation.

An additional seven SGI and five SMI gill nets were set in newly-flooded areas in the Keeyask reservoir in 2021 including four backbays (Zone 7 [GN-10], Zone 12 [GN/SN-09], Zone 8 [GN/SN-11], and Zone 10 [GN/SN-15]), one previously isolated lake now connected to the Keeyask reservoir via flooded terrestrial habitat (Little Gull Lake, GN/SN-14), and two sites near the newly built GS (GN/SN-16 and GN-17) (Map 5). Areas near these sites were sampled for the first time in 2019 but were not fully accessible pre-impoundment (i.e., were not fully connected to the Nelson River, were not accessible by boat, or were situated too close to construction activities to sample) and are therefore the results are not directly comparable to 2021.

In this report, ten SGI and two SMI sites in the Keeyask reservoir (referred to herein as standard sites) that were fished in all study years were used for comparison. Data from the additional seven SGI and five SMI sites in the Keeyask reservoir not set in previous years (referred to herein as Keeyask reservoir additional sites) are presented separately (Section 4.2).

3.1 GILLNETTING

SGI gill nets were composed of six 22.9-m (25-yd) long by 2.4-m (2.7-yd) deep gillnet panels made of twisted nylon mesh. Individual panels were joined together in a stretched mesh-size sequence of 38, 51, 76, 95, 108, and 127 mm (or 1½, 2, 3, 3¾, 4¼, and 5 inches). All SGI gill nets were set on the bottom for approximately 24 hours. A hand-held global positioning system (GPS) unit was used to record the location of each gillnetting site. Water depth was measured (in metres) at each end of the net using a portable depth sounder, and water temperature was measured (±0.5°C) at least once daily using a hand-held thermometer.

SMI gill nets were attached to the 1½-inch end of four of the SGI gill nets at a subset of sites. SMI gill nets consisted of three 10-m (10.9-yd) long by 1.8-m (2.0-yd) deep gillnet panels made of twisted nylon mesh. Panels were tied together in a stretched mesh-size order of 16, 20, and 25 mm (or 0.63, 0.78, and 0.98 inches), with the 25-mm mesh size end attached to the 38-mm (1½ inch) end of the SGI gill net.

3.2 DEBRIS MONITORING IN GILL NETS

The type and quantity of debris in SGI and SMI gill nets were evaluated after each set by direct observation. Debris categories were based on the Manitoba Hydro Net Observation Program conducted in Playgreen Lake in 1984 (Horne 1994). Estimates of debris level and composition were based on the entire gill net gang. Each gang was assigned one of the following debris levels based on the area covered by debris:

- None (no debris in gang; nets were clean);
- Low (< 5% of gang area covered by debris);
- Moderate (5–15% of gang area covered by debris);
- High (16–25% of gang area covered by debris); and
- Very high (> 26% of gang area covered by debris).

Each type of debris observed in the gang was expressed as a percentage of the total debris present. Debris was categorized into the following types:

- terrestrial vegetation;
- terrestrial moss;
- sticks;
- algae;
- aquatic vegetation;
- aquatic moss; and
- silt/mud.

3.3 BIOLOGICAL SAMPLING

All fish captured in each waterbody surveyed were identified to species and enumerated. All fish captured in SGI gill nets and all large-bodied species captured in SMI gill nets were measured for fork length (FL; ± 1 mm) and round weight (± 25 g; mechanical pan scale). Burbot (*Lota lota*) were measured for total length and Lake Sturgeon (*Acipenser fulvescens*) were measured for both fork and total lengths. Forage fish species captured in SMI gill nets were bulk weighed.

Ageing structures were collected from a sub-sample of VEC species, across all sizes captured. Cleithra were collected from Northern Pike and otoliths were collected from both Lake Whitefish and Walleye. All structures were placed in individually labelled envelopes and air-dried prior to shipment to the North/South Consultants Inc. laboratory in Winnipeg.

For age determination, individual cleithra were first boiled to remove any tissue or oil residue that was left on the structure after removal from the fish. Cleithra were then typically read 'free-hand' (*i.e.*, without a microscope) against a dark background; however, a dissecting microscope (or a magnified ring light) was used when required. Dried otoliths were coated in epoxy and sectioned with a Struers Minitom™ low-speed sectioning saw. Sections were then fixed on glass slides with Cytoseal-60™ and examined under a microscope with transmitted light. Light intensity and magnification were adjusted throughout the viewing process.

Annuli from all ageing structures were counted by a single reader without knowledge of length or weight of the fish. Quality assurance and quality control (QA/QC) procedures were conducted, which included re-ageing a random sample of at least 10% of all structures by an ageing technician not involved in the initial age determination.

Prior to 2015, dorsal fin spines were taken as ageing structures from Walleye. Since that time, it has been shown that otoliths not only provide more accurate age estimates for young fish, but are easier to age, and are thus more accurate for determining ages of older fish than pelvic fin rays and dorsal spines (R. Remnant, pers comm.). Ages from Walleye collected in the Nelson River between Clark Lake and Gull Rapids prior to 2015 are presented herein but cannot be used for comparisons with more recent data (*e.g.*, comparison of age distribution prior to and after the onset of Keeyask GS construction). Cohort analysis was used to determine whether recruitment is occurring.

3.4 DEFORMITIES, EROSION, LESIONS, AND TUMOURS

All captured Lake Whitefish, Northern Pike, Walleye, White Sucker (*Catostomus commersonii*), Sauger and Lake Sturgeon were examined for external deformities, erosion, lesions, and tumours (collectively referred to as DELTs). Deformities consisted of a deformed fin or fin ray, head, spinal column or other body part, as well as scale disorientation, such as scale whorling or reversal. Erosion included erosion of fins, operculum, and tail, as well as fin rot. Lesions included open sores, exposed tissue, ulcerations, cysts, and eye abnormalities (*e.g.*, cataracts, exophthalmia). As per the US Environmental Protection Agency "fingernail test", solid growths were classified as tumours, whereas fluid-filled growths or nodules were considered lesions. Tumours may also include growths that are not true neoplaisia (*e.g.*, epidermal hyperplaisia, granulomatous growths), as histological confirmations were not performed. Physical injuries, such as injuries from predators or fishing gear, were not considered in the DELT classification. Where present, the frequency of DELTs was expressed as a percentage of the number of fish examined per species.

3.5 DATA ANALYSIS

Standard gang and small mesh index gill net catches were tabulated by species, sampling location, set type, and waterbody. For fish captured in SGI gill nets, catch-per-unit-effort (CPUE) was expressed as the number of fish captured in a 100-m net set for 24 hours. For fish captured in SMI index gill nets, CPUE was expressed as the number of fish captured in a 30-m net set for 24 hours. CPUE was calculated for the total catch and for each species by gear type and site. It was expressed as mean CPUE $\pm$ 1 standard deviation (StDev). Frequency of occurrence of a species was calculated as the percentage in relation to the total catch. Average CPUE of each VEC species captured in SGI nets was compared by year using a Kruskal-Wallis H test (significance level set at 0.05). If a significant difference was found, a Dunn's test was conducted to determine which sampling years differed. The test was only used if the sample size (*i.e.*, the number of fish captured) was greater than ten.

Mean length, weight, and condition factor (K) were calculated for all large-bodied VEC fish species captured in SGI and SMI gill nets. Condition factor was calculated (after Fulton 1911, in Ricker 1975) for individual fish using the following equation:

$$K = W \times 10^5 / L^3$$

where: W = round weight (g); and
L = fork length (mm).

Length-frequency distributions were plotted in 50 mm length class intervals (*e.g.*, 300–349 mm). Ages were used to determine the year in which a fish was spawned, with each year representing a different cohort. Cohort-frequency distributions were plotted for each species for each location. The frequency of DELTs was expressed as a percentage of the total number of fish caught of each species.

Fork length frequency distributions were compared between years. If the sample size (i.e., the number of fish captured) was greater than ten, a student's t-test was used to determine if mean fork lengths differed between sampling periods (significance level set at 0.05).

Analysis of co-variance (ANCOVA)/regression analysis was used to determine whether condition differed between years (for details see Schwarz 2015). This approach was taken as Fulton's condition factor is often positively correlated with fish length, making comparisons between years difficult when length distributions differ between years. To accomplish this, first a new variable was created called FL3, which was calculated by first rearranging the equation used to calculate Fulton's condition factor (K) and solving for weight as:

$$W = K \times FL3/100{,}000$$

where: W = weight (g);
K = Fulton's condition factor;
FL = fork length (mm); and
FL3 = FL3/100,000.

This rearranged equation is essentially a linear regression between W and FL3 without an intercept (i.e., α), while K equals the slope of the regression line (i.e., β).

An ANCOVA/regression with the intercept forced to zero was then fitted between W (weight), and FL3 and an interaction term (FL3 × YEAR) which represents the differential condition (K) between years (Schwarz 2015). An interaction term with a p-value < 0.05 indicates a difference in condition between years.

4.0 RESULTS

Gill net survey information for 2021 in the Keeyask study area is presented in Appendix 1. Water temperatures during sampling in August ranged from 14.4 to 20.0°C and remained between 15.0 and 16.5˚C in September. Water temperature ranged from 16.0 to 20.0°C during sampling in the reach of the Keeyask reservoir (August 3–14, 2021), 16.0 to 17.0°C in Stephens Lake South (August 31–September 3, 2021), and 15.0 to 16.0°C in Stephens Lake North (September 3–6, 2021).

A total of 20 fish species were captured during fish community monitoring in the Keeyask study area, including 12 large-bodied species and eight forage species (Table 1). Over half of the species (n = 12) were captured in all of the waterbodies surveyed. Two species were captured in only one waterbody: Logperch (*Percina caprodes*) in Split Lake and Silver Redhorse (*Moxostoma anisurum*) in the Keeyask reservoir.

4.1 2001–2021 STANDARD SITE COMPARISONS

4.1.1 SPECIES COMPOSITION

4.1.1.1 SPLIT LAKE

A total of 592 fish representing 14 species were captured in SGI gill nets set at 12 standard sites in Split Lake in 2021 (Table 2). White Sucker were the most common species captured (31.8%; n = 188), followed by Sauger (23.1%; n = 137), and Walleye (13.7%; n = 81). An additional 331 fish representing 12 species were captured in four SMI gill nets. Spottail Shiner were the most common species captured (42.6%; n = 141) followed by Emerald Shiner (28.4%; n = 94).

Large-bodied species composition of SGI gill nets were generally similar between baseline (i.e., 2009, 2015, and 2019) and 2021 monitoring (Table 2). The largest change in relative abundance was for Walleye which decreased from 27.0% of the catch to 13.7% in 2021. At the same time, the relative abundance of Sauger increased from 17.5% to 23.1%.

Spottail Shiner was the most commonly captured species in SMI gill nets set in both baseline and 2021, making up 41.4% and 42.6% of the catch in each study period, respectively. The largest change in relative abundance in SMI gill nets has been the decline of Rainbow Smelt, decreasing from 11.6% of the catch to 0.9%. Additionally, the relative abundance of Emerald Shiner increased from 18.9% to 28.4% of the catch between study periods.

4.1.1.2 KEEYASK RESERVOIR

In 2021, 183 fish representing 13 species were captured in SGI gill nets set at ten standard sites in the Keeyask reservoir. White Sucker was the most common species captured (21.9%; n = 40), followed by Walleye (21.3%; n = 39), and both Northern Pike and Sauger (15.8%; n = 29) (Table 3). An additional 130 fish representing nine species were captured in two standard SMI gill nets. Spottail Shiner was the most common species captured (63.8%; n = 83) (Table 3).

Large-bodied species composition of SGI gill nets were generally similar between baseline (i.e., 2001, 2002, 2009, 2015, and 2019) and post-impoundment (i.e., 2021) monitoring studies (Table 3). The largest change in relative abundance was for Northern Pike which decreased from 44.1% of the catch to 15.8% in 2021. At the same time, the relative abundance of White Sucker and Sauger increased from 8.5% and 1.3% to 21.9% and 15.8%, respectively.

Spottail Shiner was the most commonly captured species in SMI gill nets set in both baseline and 2021, increasing from 36.1% to 63.8% of the catch between study periods (Table 3). The relative abundance of Emerald Shiner decreased from 30.9% during baseline monitoring to just 3.8% of the catch in 2021.

4.1.1.3 STEPHENS LAKE NORTH

A total of 300 fish representing 11 species were captured in SGI gill nets set at nine standard sites in Stephens Lake North in 2021. Walleye were the most common species captured (47.0%; n = 141), followed by Northern Pike (14.3%; n = 43) and White Sucker (13.0%; n = 39) (Table 4). An additional 722 fish representing eight species were captured in three SMI gill nets. Spottail Shiner were the most common species captured (53.3%; n = 385) followed by Emerald Shiner (39.1%; n = 282).

Large-bodied species composition of SGI gill nets were generally similar between baseline (i.e., 2009, 2015, 2018) and 2021 monitoring (Table 4). Two species, Burbot and Common Carp, were not caught in 2021 despite being previously captured during baseline monitoring studies, although they only accounted for a small portion of the total catch (i.e., 0.1% each; Table 4). The largest change in relative abundance was for Northern Pike which decreased from 23.5% of the catch during baseline monitoring to 14.3% in 2021.

Spottail Shiner was the most commonly captured species in SMI gill nets set in both baseline and 2021, increasing from 47.1% to 53.3% of the catch between study periods (Table 4). The relative abundance of Emerald Shiner caught in SMI gill nets also increased slightly from 31.4% to 39.1% in baseline and 2021, respectively. The relative abundance of Rainbow Smelt in SMI gill nets decreased from 8.2% of the catch during baseline to 1.0% of the catch in 2021.

4.1.1.4 STEPHENS LAKE SOUTH

A total of 318 fish representing 11 species were captured in SGI gill nets set at nine standard sites in 2021 in Stephens Lake South. White Sucker were the most common species captured

(35.5%; n = 113) followed by Walleye (30.5%; n = 97), and Mooneye (11.0%; n = 35) (Table 5). An additional 142 fish representing nine species were captured in three standard SMI gill nets. Spottail Shiner were the most common species captured (47.2%; n = 67) followed by Troutperch (26.1%; n = 37).

Large-bodied species composition of SGI gill nets were generally similar between baseline (i.e., 2009, 2015, 2018) and 2021 (Table 5). Cisco were not caught in 2021, previously accounting for 0.4% of the total catch. At the same time, Freshwater Drum were captured for the first time in 2021, accounting for 0.6% of the total catch. The largest change in relative abundance was for White Sucker which increased from 16.8% of the catch to 35.5%. The relative abundance of Walleye and Northern Pike decreased from 44.2% and 20.5% to 30.5% and 8.5%, respectively.

Spottail Shiner was the most commonly captured species in SMI gill nets set in both baseline and 2021 accounting for 48.0% and 47.2% of the catch, respectively (Table 5). The relative abundance of Troutperch increased from 11.6% to 26.1%, while the relative abundance of Emerald Shiner decreased from 23.0% to 8.5% between baseline and 2021.

4.1.2 ABUNDANCE

4.1.2.1 SPLIT LAKE

Mean total CPUE for SGI gill nets set at 12 standard sites in Split Lake in 2021 was 35.3 fish/100 m of net/24 h (Table 6). In previous sampling years, mean total CPUE at the same sites ranged from 29.1 fish in 2019 to 32.6 fish in 2015. The mean total CPUE for all fish species captured in SGI gill nets did not differ significantly among years (Figure 1).

Average CPUE for Lake Whitefish, Northern Pike, and Walleye captured in 2021 was 1.5, 3.3, and 4.9 fish/100 m of net/24 h, respectively (Table 6; Figure 2). Average CPUE of Lake Whitefish ($H = 2.39$, $p = 0.49$), Northern Pike ($H = 0.28$; $p = 0.96$), and Walleye ($H = 1.79$, $p = 0.61$) did not differ significantly among sampling years.

Mean total CPUE for the SMI gillnet catch in 2021 was 114.0 fish/30 m of net/24 h (Table 7). In previous sampling years, mean total CPUE ranged from 90.2 fish in 2009 to 134.8 fish in 2019 (Table 7; Figure 3). Mean CPUE could not be compared statistically among years as too few sites were sampled.

4.1.2.2 KEEYASK RESERVOIR

Mean total CPUE for SGI gill nets set at ten standard sites in the Keeyask reservoir in 2021 was 13.5 fish/100 m of net/24 h (Table 8). In previous sampling years, mean total CPUE at the same sites ranged from 12.2 fish in 2019 to 30.0 fish in 2001 (Table 8). The mean total CPUE for all species captured in SGI gill nets was significantly lower in 2021 than in 2001, but did not differ significantly from any other study year (Figure 4).

Average CPUE for Lake Whitefish, Northern Pike, and Walleye captured in 2021 were 0.5, 2.1, and 2.9 fish/100 m of net/24 h, respectively (Table 8; Figure 5). Average CPUE of Lake Whitefish (H = 3.02, p = 0.70) and Walleye (H = 3.49, p = 0.63) did not differ significantly among sampling years (Figure 5). Average CPUE of Northern Pike was significantly lower in 2021 than in 2001, 2002, and 2009, but did not differ from 2015 or 2019 (Figure 5).

Mean total CPUE for the SMI gillnet catch in 2019 was 63.8 fish/30 m of net/24 h (Table 9). In previous sampling years, mean total CPUE ranged from 11.5 fish in 2002 to 316.3 fish in 2015 (Table 9; Figure 6). Because only two sites were sampled, mean CPUE could not be compared statistically among years.

4.1.2.3 STEPHENS LAKE NORTH

Mean total CPUE for SGI gill nets set at nine standard sites in 2021 was 29.5 fish/100 m of net/24 h (Table 10). In previous sampling years, mean total CPUE at the same sites ranged from 19.0 fish in 2009 to 34.6 fish in 2015. Mean total CPUE did not differ significantly among sampling years (Figure 7).

Average CPUE for Lake Whitefish, Northern Pike, and Walleye captured in 2021 was 1.4, 4.1, and 13.2 fish/100 m of net/24 h, respectively (Table 9). Average CPUE of Lake Whitefish, Northern Pike, and Walleye did not differ significantly among sampling years (Figure 8).

Mean total CPUE for the SMI gillnet catch in 2021 was 289.2 fish/30 m of net/24 h (Table 11). In previous sampling years, mean total CPUE was 66.7 fish in 2009, 196.5 fish in 2015, and 71.7 fish in 2018 (Table 11; Figure 9). Mean CPUE could not be compared statistically among years as too few sites were sampled each year.

4.1.2.4 STEPHENS LAKE SOUTH

Mean total CPUE for SGI gill nets set at nine standard sites in 2021 was 35.8 fish/100 m of net/24 h. In previous sampling years, mean total CPUE at the same sites ranged from 18.4 fish in 2015 to 33.9 fish in 2009 but did not differ significantly among sampling years (Table 12; Figure 10).

Average CPUE for Lake Whitefish, Northern Pike, and Walleye captured in 2021 were 0.5, 3.0, and 11.0 fish/100 m of net/24 h, respectively (Table 12). Average CPUE of Lake Whitefish (H = 0.64; p = 0.89), Northern Pike (H = 3.25; p = 0.35), and Walleye (H = 76; p = 0.86) did not differ significantly among sampling years (Figure 11).

Mean total CPUE for the SMI gillnet catch in 2021 was 56.5 fish/30 m of net/24 h (Table 13). In previous sampling years, mean total CPUE ranged from 43.6 fish in 2009 to 134.5 fish in 2015 (Table 13; Figure 12). Mean CPUE could not be compared statistically among years as too few sites were sampled each year.

4.1.3 SIZE

4.1.3.1 SPLIT LAKE

A total of 179 VEC fish captured in Split Lake were measured for FL in 2021 and 675 fish were measured during baseline studies (2009, 2015, 2019; Table 14). Length frequency distributions for VEC species during baseline and in 2021 are provided in Figure 13. Lake Whitefish in the 400–449 mm FL interval were the most frequently captured during both baseline (31.4%) and 2021 (36.0%) studies. Northern Pike measuring between 450 and 499 mm FL were captured most frequently during both baseline (21.0%) and 2021 (25.9%) studies. Walleye measuring between 350 and 399 mm FL were the most frequently captured (31.3%) during 2021, while fish between 400 and 449 mm FL were the most frequently captured (23.4%) during baseline studies.

Mean FL for Lake Whitefish (t = -0.88 *p* = 0.38) and Northern Pike (t = 0.56, *p* = 0.58) did not differ significantly between baseline and 2021. Mean FL for Walleye was significantly lower in 2021 than baseline studies (t = 2.04, *p* = 0.04).

4.1.3.2 KEEYASK RESERVOIR

A total of 81 VEC fish captured in the Keeyask reservoir were measured for FL in 2021 and 972 fish were measured during baseline studies (2001, 2002, 2009, 2015, 2019; Table 14). Length frequency distributions for VEC species during baseline and current year monitoring are provided in Figure 14. Lake Whitefish in the 150–199 mm and 200–249 mm FL intervals were the most frequently captured in 2021 (each representing 25% of the catch), but only represented 3.2% and 4.3% of the catch during baseline studies, respectively. More small Northern Pike were also captured in 2021 with fish in the 200–249 mm FL interval making up 22.6% of the catch in 2021 and only 2.3% during baseline studies. Walleye measuring between 400 and 499 mm FL were captured most frequently during both baseline (35.8%) and 2021 (38.1%).

Too few Lake Whitefish were measured to statistically compare mean FL between sampling periods. Mean FL of Northern Pike (t = 2.98, *p* = 0.003) and Walleye (t = 4.7, *p* = <0.0001) was significantly lower during 2021 compared to baseline.

4.1.3.3 STEPHENS LAKE NORTH

A total of 213 VEC fish captured in Stephens Lake North were measured for FL in 2021 and 683 fish were measured during baseline studies (2009, 2015, 2018; Table 14). Length frequency distributions for VEC species during baseline and in 2021 are provided in Figure 15. Lake Whitefish in the 400-449 mm FL range, were more commonly captured in 2021 accounting for 35.7% of the catch, compared to 11.5% during baseline studies. Length frequency distributions were similar between baseline and 2021 studies for Northern Pike and Walleye. Northern Pike measuring between 400 and 549 mm FL were the most frequently captured during both baseline

(49.5%) and 2021 (52.2%) studies. Walleye measuring between 300 and 449 mm FL were the most frequently captured during both baseline (58.4%) and 2021 (71.9%) studies.

Mean FL was significantly lower during 2021 than baseline for Walleye (t = 4.03, *p* = <0.0001). Mean FL for Lake Whitefish (t = 0.24, *p* = 0.81) and Northern Pike (t = 1.38, *p* = 0.12) did not differ significantly between baseline and 2021.

4.1.3.4 STEPHENS LAKE SOUTH

A total of 138 VEC fish captured in Stephens Lake South were measured for FL during 2021 and 558 fish were measured during baseline studies (2009, 2015, 2018; Table 14). Length frequency distributions for VEC species during baseline and in 2021 are provided in Figure 15. Too few Lake Whitefish were captured and measured during both baseline and 2021 to show definite modes in length frequency. Northern Pike measuring between both 400 and 499 mm FL made up the majority of captured fish during both baseline (31.8%) and 2021 (37.0%). More small Walleye were captured in 2021. Fish measuring less than 349 mm FL made up 52.3% of the catch in 2021 and only 16.4% during baseline.

Too few Lake Whitefish were measured to statistically compare mean FL between sampling periods. Mean FL for Northern Pike did not differ significantly between baseline and 2021 (t = 0.70, *p* = 0.81). Mean FL for Walleye was significantly lower during 2021 than baseline studies (t = 7.44, *p* = <0.0001).

4.1.4 CONDITION

4.1.4.1 SPLIT LAKE

Mean condition factor of VEC fish captured in Split Lake during 2021 was 1.61 for Lake Whitefish (n = 25), 0.73 for Northern Pike (n = 58), and 1.10 for Walleye (n = 96; Table 14). The condition factor of Lake Whitefish and Walleye was significantly higher during baseline (i.e., 2009, 2015, and 2019) than 2021 (ANCOVA, *p* = <0.0001, and <0.001, respectively). In contrast, the condition factor of Northern Pike was significantly lower during baseline than 2021 (ANCOVA, *p* = <0.0001) (Figure 17).

4.1.4.2 KEEYASK RESERVOIR

Mean condition factor of VEC fish captured in the Keeyask reservoir in 2021 was 1.39 for Lake Whitefish (n = 8), 0.71 for Northern Pike (n = 31), and 1.07 for Walleye (n = 42; Table 14). Due to the small sample size, condition of Lake Whitefish could not be compared statistically between baseline and 2021 studies. The condition factor of Northern Pike (ANCOVA, *p* = 0.17) did not differ between study periods. The condition factor for Walleye was significantly higher (ANVOCA, *p* = <0.0001) during baseline monitoring (*i.e.*, 2001, 2002, 2009, 2015, and 2019) than in 2021

(Figure 18). However, mean condition was within the range of condition factors reported during baseline sampling.

4.1.4.3 STEPHENS LAKE NORTH

Mean condition factor of VEC fish captured in Stephens Lake North in 2021 was 1.51 for Lake Whitefish (n = 14), 1.04 for Northern Pike (n = 46), and 1.14 for Walleye (n = 153; Table 14). The condition factor of Lake Whitefish (ANCOVA, *p* = <0.0001) and Walleye (ANCOVA, *p* = <0.001) was significantly higher during baseline monitoring (*i.e.*, 2009, 2015, and 2018) than in 2021. The condition factor of Northern Pike (ANCOVA, *p* = 0.59) did not differ significantly between the two time periods (Figure 19).

4.1.4.4 STEPHENS LAKE SOUTH

Mean condition factor of VEC fish captured in Stephens Lake South in 2021 was 1.80 for Lake Whitefish (n = 4), 0.69 for Northern Pike (n = 27), and 1.15 for Walleye (n = 107; Table 14). Due to the small sample size, condition of Lake Whitefish could not be compared statistically between baseline and 2021. The condition factor of Northern Pike was significantly lower during baseline monitoring (*i.e.*, 2009, 2015, and 2018) than during 2021 (*p* = 0.01). The condition factor of Walleye was significantly higher during baseline monitoring than 2021 (*p* = <0.001; Figure 20).

4.1.5 AGE

4.1.5.1 SPLIT LAKE

Ageing structures were collected from 175 VEC fish captured in Split Lake in 2021. Aged Lake Whitefish (n = 25) ranged from 6–18 years and aged Northern Pike (n = 58) ranged from 1–10 years, with 4-year-old fish (*i.e.*, 2017 cohort) captured most frequently (29.3% of aged fish). Aged Walleye (n = 92) ranged from 1–22 years.

Cohort frequency distributions for VEC species (n = 799) captured in 2009, 2015, 2019, and 2021 are provided in Figure 21. Lake Whitefish from the 2007–2010 cohorts were most commonly captured. Few young (*i.e.*, 2014–2021 cohorts) Lake Whitefish were captured. Northern Pike from every cohort between 1997 and 2020 were captured, with fish from the 2015 cohort accounting for 10.7% (n = 24) of the catch. For Walleye, all cohorts between 1999 and 2020 were represented in the catch, with large numbers of the 2002 and 2012 cohorts captured.

4.1.5.2 KEEYASK RESERVOIR

Ageing structures were collected from 111 VEC fish captured in the Keeyask reservoir in 2021. Aged Lake Whitefish (n = 16) ranged from 2–22 years and aged Walleye (n = 54) ranged from 1–

12 years. Northern Pike (n = 43) ranged from 1–12 years, with 3-year-old fish (*i.e.*, 2018 cohort) the most numerous (27.9% of aged fish).

Cohort frequency distributions for VEC species (n = 537) captured in SGI and SMI gill nets sampled in 2001, 2002, 2015, 2019, and 2021 are provided in Figure 22 (fish sampled in 2009 were not aged). Lake Whitefish from nearly every cohort between 1980 and 2020 were captured, with fish from the 1998 cohort accounting for 11.5% (n = 9). Northern Pike from every cohort between 1987 and 2021 (except 2019) were captured, with fish from the 2010 cohort accounting for 9.2% (n = 26) of the catch Walleye from nearly every cohort between 1983 and 2021 were captured, however, no definitive modes in cohort strength were obvious.

4.1.5.3 STEPHENS LAKE NORTH

Ageing structures were collected from 105 VEC fish captured in Stephens Lake North in 2021. Aged Lake Whitefish (n = 14) ranged from 2–20 years, aged Northern Pike (n = 46) ranged from 1–10 years, and aged Walleye (n = 54) ranged from 1–14 years.

Cohort frequency distributions for VEC species (n = 739) captured in SGI and SMI gill nets sampled in 2009, 2015, 2018, and 2021 are provided in Figure 23. Lake Whitefish from every cohort between 2009 and 2019 were captured, as well as small numbers of cohorts dating back to 1984. Northern Pike from every cohort between 1997 and 2020 were captured, with individuals from the 2005 and 2011 cohorts captured most frequently. Walleye from every cohort between 1993 and 2020 were captured, with the 2010 cohort accounting for 17.6% (n = 81) of the total catch.

4.1.5.4 STEPHENS LAKE SOUTH

Ageing structures were collected from 124 VEC fish captured in Stephens Lake South in 2021. Aged Lake Whitefish (n = 4) ranged from 5–18 years and aged Walleye (n = 101) ranged from 1–23 years. Northern Pike (n = 27) ranged from 2–10 years, with 5-year-old fish (*i.e.*, 2016 cohort) the most numerous (29.6% of aged fish).

Cohort frequency distributions for VEC species (n = 632) captured in SGI and SMI gill nets sampled in 2009, 2015, 2018, and 2021 are provided in Figure 24. Lake Whitefish from the 1990 to 2015 cohorts were present in the catch, however, too few fish were captured to identify definitive modes in cohort strength. Northern Pike from every cohort between 1997 and 2016 were captured, with the 2004 and 2011 cohorts being the most common. Walleye from every cohort between 1981 and 2021 were captured, with fish from the 2002 cohort the most prevalent of the catch.

4.1.6 DEFORMITIES, EROSION, LESIONS AND TUMOURS (DELTS)

4.1.6.1 SPLIT LAKE

Of the 520 fish examined during 2021, one fish (0.2%) displayed DELTs, one Sauger (Table 15). In previous studies, DELTs have represented between 0.2% (n = 1; 2015) and 2.6% (n = 9; 2009) of the total catch.

4.1.6.2 KEEYASK RESERVOIR

Of the 287 fish examined during 2021, seven fish (2.4%) displayed DELTs, three White Sucker one Northern Pike, and three Sauger (Table 15). In previous studies, DELTs have represented between 0% (2001) and 8.2% (n = 15; 2015) of the total catch.

4.1.6.3 STEPHENS LAKE NORTH

No DELTs were recorded from the 266 fish examined in 2021 (Table 15). In previous studies, DELTs have represented between 0.7% (n = 2; 2015) and 2.6% (n = 6; 2009) of the total catch.

4.1.6.4 STEPHENS LAKE SOUTH

No DELTs were recorded from the 281 fish examined in 2021 (Table 15). In previous studies, DELTs have represented between 0.0% (n = 0; 2018) and 3.6% (n = 11; 2009) of the total catch.

4.1.7 DEBRIS MONITORING

Debris levels were primarily low (*i.e.*, covered <5% of the net) in both SGI and SMI gill nets set in Split Lake in 2021. Two nets (GN-15, GN-28) had moderate (i.e., 5-15%) and very high (i.e., >26%) debris, respectively. Debris consisted predominately of aquatic vegetation, sticks, and algae (Appendix A2-1). In previous study years, debris levels ranged from none/low to very high, consisting primarily of algae and sticks.

Debris was present in 94% of SGI gill nets and 100% of SMI gill nets set in the reach of the Keeyask reservoir in 2021. When present, debris levels were mostly moderate (*i.e.*, 5–15%) to very high (*i.e.*, >26%) and consisted of aquatic vegetation, algae and/or sticks (Appendix A2-2). In previous study years, debris levels mostly ranged from low to very high with a combination of algae, aquatic vegetation, and sticks accounting for the majority of debris.

The amount of debris present in both SGI and SMI gill nets set in Stephens Lake North in 2021 ranged from none (at one site), to low (*i.e.*, <5%) at eight sites, to moderate (*i.e.*, 5–15%) at three sites. The amount of debris present in gill nets set in Stephens Lake South was generally low (*i.e.*, <5%). In both areas, all debris was composed of sticks (Appendix A2-3). In previous study years, debris levels ranged from none/low to high composed of a combination of algae, aquatic vegetation, and sticks.

4.2 KEEYASK RESERVOIR ADDITIONAL SITES

Eleven species (n = 143 fish) were captured in seven SGI gill nets set within newly flooded areas of the Keeyask reservoir during summer 2021 (Table 16). Northern Pike were the most abundant species captured accounting for 46.2% (n = 66) of the catch. White Sucker (16.1%; n = 23) and Shorthead Redhorse (9.8%; n = 14) were also frequently caught. A further 268 fish representing ten species were caught at four new SMI gill net sites with one additional site not catching any fish. Spottail Shiner were the most abundant accounting for 52.6% (n = 141) of the SMI gill net catch.

Mean total CPUE for the SGI gillnet catch was 16.4 fish/100 m of net/24 h (Table 17). Average CPUE for Lake Whitefish, Northern Pike, and Walleye were 0.7, 6.8, and 1.2 fish/100 m of net/24 h (Table 18). CPUE for Northern Pike ranged from 0.0 to 16.6 fish/100 m of net/24 h by site. Walleye were the second most abundant VEC species, ranging from 0.0 to 4.1 fish/100 m of net/24 h by site. Lake Whitefish were absent from six of the seven sites sampled, with CPUE ranging from 0.0 to 0.7 fish/100 m of net/24 h by site. Mean total CPUE was 54.4 fish/30 m of net/24 h in the four SMI gill nets (Table 17).

The Lake Whitefish (n = 1) caught in SGI and SMI gill nets measured 415 mm FL with a condition factor of 1.47 (Table 19). This Lake Whitefish was aged at 5 years old representing the 2016 cohort (Table 20). Northern Pike (n = 66) had a mean FL of 386 mm (StDev = 143; range 103–904 mm) and a mean condition factor of 0.75 (StDev = 0.13; range 0.01–0.97). Aged Northern Pike (n = 27) ranged from 0–11 years old with 2-year-old fish (n = 9; 33.3%) the most numerous (Table 20). Walleye (n = 9) had a mean FL of 390 mm (StDev = 89; range 260–480 mm) and a mean condition factor of 1.10 (StDev = 0.08; range 1.00–1.23) (Table 19). The 50–99 mm FL interval was the most frequently captured, accounting for 33.3% of the catch (n = 6; Figure 25). Aged Walleye (n = 12) ranged from 1–12 years old (Table 20). Too few fish were aged to determine definitive modes in cohort strength.

5.0 DISCUSSION

The primary objective of the fish community monitoring program is to assess whether the Project has caused a change in selected fish community metrics compared to baseline and, if so, the magnitude, direction, and duration of these changes. Sampling in 2021 represents the first year of sampling following reservoir impoundment. All years prior are considered baseline sampling. Due to the prolonged period of construction, additional sampling was conducted in 2015 and 2019, after the start of construction, but water levels in the future reservoir at that time were not above the historic high water level for the open water season. The fish community in Stephens Lake has been affected by progressive changes at Gull Rapids and downstream following the start of construction in 2014. However, the major change will be the loss of spawning habitat associated with the flow over the natural river channel, which will occur after commissioning of all units in the powerhouse is completed by spring 2022. Therefore, monitoring in 2021 represents the completion of a transitional period, which began at the start of construction in 2014.

The metrics presented in this report represent fish capture rates and species composition, as well as parameters related to the growth, condition, and health of VEC species. Evaluation of these metrics will allow evaluation of predictions made in the EIS.

Effects to the fish community were predicted to occur primarily as a result of changes in the quality and quantity of aquatic habitat, changes in water quality, and changes in the availability of lower trophic levels as forage. It was predicted that newly flooded habitat in the reservoir would initially be of low quality due to due to low DO conditions, shoreline instability, and the absence of aquatic plants. In the long-term, the EIS predicted that there will be an increase in fish abundance in the reservoir in response to an increase in aquatic habit; however, there will also be a shift in the fish community towards species that prefer lacustrine (e.g., Walleye) rather than riverine (e.g., Longnose Sucker) conditions.

The EIS predicted that the fish community would not change immediately after full supply level was reached as short-term monitoring (i.e., less than 4 years) has been demonstrated to not detect changes in fish communities immediately after impoundment. Rather, a lag response is expected, whereby changes in the fish populations and communities are expected to occur gradually after Project completion and may not be detectable for a considerable period of time. Sampling conducted in 2021 likely occurred too soon after impoundment to detect changes in fish abundance, given that most species are not fully recruited to the gear until 4 years of age. Further, changes in populations as a result of increased feeding and spawning habitat would take time to become apparent. However, changes due to factors such as an absence of recruitment and large-scale adult emigration, are possible to detect.

Standard gang and small mesh index gillnetting was conducted in both upstream reference (Split Lake) and Project-affected (the Keeyask reservoir and Stephens Lake) sites between 2001 and 2021. However, because not all sites were sampled in all years, a subset of years was chosen in which the same sites were sampled to ensure comparability. These included 2009, 2015, 2019, and 2021 for Split Lake; 2001, 2002, 2009, 2015, 2019, and 2021 for the Keeyask reservoir; and

2009, 2015, 2018, and 2021 for Stephens Lake North and South. Data collected during baseline studies (i.e., pre-2021) were compared to those collected in 2021, nearly a full year following Keeyask reservoir impoundment. These sites are referred to as standard sites. Additional, newly flooded sites were sampled within the reservoir in 2021. These sites were not included in standard site comparisons and are discussed separately below (Section 5.2).

5.1 COMPARISON OF BASELINE AND 2021 DATA

The AEMP identified three key questions for fish community monitoring in the Keeyask area.

Will the abundance (CPUE) and species composition of the fish communities in the Keeyask reservoir and Stephens Lake change as a result of construction and operation of the Project?

The overall mean CPUE of all fish species captured in standard gang and small mesh gill nets did not differ significantly between baseline and 2021 in the Keeyask reservoir or Stephens Lake. Average CPUE of VEC species captured in standard gang index gill nets were also compared between years. The largest change in CPUE was observed for Northern Pike, which has decreased yearly since 2002 in the reservoir. Although the CPUE of Northern Pike was lower in 2021 than in any other year, it did not differ significantly from 2015 or 2019, prior to reservoir impoundment. Therefore, the observed decrease may be the result of natural variation. It is possible that the observed decrease in 2021 may also be the result of post-impoundment sampling locations. Prior to reservoir flooding, sampling sites included shallow nearshore areas typically preferred by Northern Pike. Flooding changed many of these areas to deeper offshore habitats, which is not preferred pike habitat. Northern Pike were the most commonly captured species in the newly flooded areas sampled in the reservoir post-impoundment sites, suggesting that pike may have shifted to these areas. Therefore, the decrease in Northern Pike CPUE is likely an artefact of sampling and does not reflect a decrease in abundance within the reservoir as a whole.

Species composition in the reach of the Keeyask reservoir and in Stephens Lake was comparable to that of previous years, with only one uncommon species captured in 2021 (Silver Redhorse; n = 1) that was not captured in previous years. The relative abundance of Walleye has decreased between baseline and 2021 in both Split Lake and Stephens Lake South. At the same time, the relative abundance of White Sucker has increased in all waterbodies. Given that only one year of data are available, this difference could reflect interannual variation.

For the three VEC fish species, will a biologically relevant (and statistically significant) change in condition factor or growth be observed in the Keeyask reservoir and Stephens Lake in comparison to pre-Project conditions?

Fish size and condition were compared between baseline and 2021. Walleye showed the largest differences: both mean fork length and condition factor was significantly lower during 2021 than baseline in all four sampling areas. Average condition of Lake Whitefish was also significantly lower during 2021 in both Split Lake and Stephens Lake North, while Northern Pike showed a higher condition in both Split Lake and Stephens Lake South. These differences may reflect natural variation, as they were observed in both project-affected and reference sites and values in 2021 fell within the range seen during baseline sampling. Further, the first open water season after reservoir impoundment is too early to detect all but the most extreme operation-related changes in fish size and condition. Similar to CPUE, changes in the aquatic environment are expected to translate into gradual changes in fish condition.

Will the abundance of small-bodied fish captured in SMI gill nets set in the Keeyask reservoir and Stephens Lake change following construction of the Project?

CPUE in SMI gill nets was highly variable between study years and waterbodies, and could not be compared statistically because too few sites were sampled. The CPUE for all fish captured within SMI gill nets during the first year post-impoundment fell within ranges observed during baseline in the reservoir (2021: 64 fish/30 m of net/24 h; baseline: 12–316 fish) and Stephens Lake South (2021: 57 fish/30 m of net/24 h; baseline: 44–135 fish). The abundance of Rainbow Smelt has decreased in all four waterbodies since 2009, a pattern that has been observed throughout Northern Manitoba.

It was predicted in the EIS that impoundment of the Keeyask reservoir would result in a loss of Walleye and Lake Whitefish spawning habitat due to increased water depth over existing spawning sites. At the same time, the inundation of terrestrial vegetation near the mouths of several tributaries resulting from higher water levels could result in a short-term increase in spawning habitat for Northern Pike. Small mesh gillnetting resulted in the capture of both young-of-the-year (YOY) Walleye and Northern Pike, indicating that recruitment has continued to occur for both species in the first year post-impoundment. Although no YOY Lake Whitefish were captured, larval fish were captured in spring 2021 during spawning studies, indicating successful larval incubation occurred (Hrenchuk and Loeppky 2022). Future studies will indicate if these Lake Whitefish are recruited into the population.

5.2 NEWLY FLOODED AREAS

As discussed previously, the EIS predicted that fish habitat in the Keeyask reservoir would decrease in both quality and quantity due to low DO conditions, shoreline instability, and the absence of aquatic plants for the first five to ten years following impoundment. These changes would be most pronounced in newly flooded areas and backbays of the reservoir where water is poorly mixed and has long residency times. Here, the creation of new littoral habitats in unstable environments (i.e., eroding shorelines, fluctuating water levels) could reduce the amount of rearing habitat available to many species of fish in the short-term.

Sampling was conducted within seven newly flooded areas in 2021 including four backbays (Zones 7, 8, 10, and 12), one previously isolated lake now connected to the Keeyask reservoir via flooded terrestrial habitat (Little Gull Lake), and two sites near the newly built GS (Map 4). Areas near these sites were sampled for the first time in 2019 but were not fully accessible pre-impoundment (i.e., were not fully connected to the Nelson River, were not accessible by boat, or were situated too close to construction activities to sample). Gill nets will continue to be set in the same locations in future sampling years and post-impoundment sampling years will be compared to monitor potential changes to flooded areas over time.

All three VEC species were captured in the newly flooded areas in 2021, and CPUEs were similar to the closest sampled sites in 2019. Northern Pike were the most commonly captured species in all sites and were captured in the largest numbers in the backbays and in Little Gull Lake. Dissolved oxygen remained high within each of the backbays between June and October, providing suitable levels for fish (*NTD: Data obtained from MBH; will be included in the 2021 AEMP report when PEMP is published*).

6.0 SUMMARY AND CONCLUSIONS

- Fish community sampling in 2021 was conducted using standard gang and small mesh index gill nets in the Keeyask reservoir, Split Lake, Stephens Lake North, and Stephens Lake South. Sampling in Split and Stephens lakes was conducted as part of the Coordinated Aquatic Monitoring Program (CAMP). Data collected in the reach of the Keeyask reservoir was collected as per the Keeyask Generation Project Aquatic Effects Monitoring Plan (AEMP).
- A total of 40 standard gang index (SGI) and 12 small mesh index (SMI) gill net sites were sampled in 2021, which represented the first year of monitoring since impoundment of the Keeyask reservoir in fall 2020. This included 12 SGI and four SMI sites on Split Lake, ten SGI and two SMI sites on the Keeyask reservoir, and nine SGI and three SMI sites on both Stephens Lake North and South. Sampling was conducted in 2009, 2015, 2019, and 2021 for Split Lake; in 2001, 2002, 2009, 2015, 2019, and 2021 for the Keeyask reservoir; and in 2009, 2015, 2018, and 2021 for Stephens Lake North and South. The same sites were sampled in all years and were thus used for between year and baseline and post-impoundment monitoring comparisons.
- An additional seven SGI and five SMI gill nets were set in the Keeyask reservoir in 2021 at sites outlined in the AEMP as newly flooded habitat post-impoundment. These sites were defined in the AEMP and were accessible for the first time since impoundment and were not used for between-year comparisons.
- Sampling conducted in 2021 likely occurred too soon after impoundment to detect long-term changes in fish abundance, given that most species are not fully recruited to the gear until 4 years of age. Further, changes in populations as a result of increased feeding and spawning habitat would take time to become apparent. However, changes due to factors such as mass mortality due to impoundment, an absence of recruitment and large-scale adult emigration, are possible to detect.
- Key questions in the AEMP related to fish community monitoring in the Keeyask area are listed below:
    - *Will the abundance (CPUE) and species composition of the fish communities in the Keeyask reservoir and Stephens Lake change as a result of construction and operation of the Project?*

      The overall mean CPUE of all fish species captured in standard gang and small mesh gill nets did not differ significantly between baseline and 2021 studies in the Keeyask reservoir or Stephens Lake. The mean total CPUE of Northern Pike has decreased yearly since 2002 in the reservoir, and was lower in 2021 than in any previous year. It may be a sampling artefact in that sites that provided preferred habitat prior to impoundment were flooded and Northern Pike moved to shallower areas. Northern Pike were the most commonly captured species in the newly flooded areas sampled in the reservoir post-impoundment.

Species composition in the reach of the Keeyask reservoir and in Stephens Lake was comparable to that of previous years, with only one uncommon species captured in 2021 (Silver Redhorse; n = 1) that was not captured in previous years. The relative abundance of Walleye has decreased between baseline and 2021 in both Split Lake and Stephens Lake South. At the same time, the relative abundance of White Sucker has increased in all waterbodies.

- *For the three VEC fish species, will a biologically relevant (and statistically significant) change in condition factor or growth be observed in the Keeyask reservoir and Stephens Lake in comparison to pre-Project conditions?*

  Both mean fork length and condition factor were significantly lower for Walleye during 2021 than baseline in all four sampling areas. Average condition of Lake Whitefish was also significantly lower in both Split Lake and Stephens Lake North, while Northern Pike showed a higher condition in both Split Lake and Stephens Lake South. These differences likely reflect natural variation in size structure, as they were observed in both project-affected and reference sites and were within the range observed in previous years.

- *Will the abundance of small-bodied fish captured in SMI gill nets set in the Keeyask reservoir and Stephens Lake change following construction of the Project?*

  CPUE in SMI gill nets was highly variable between study years and waterbodies, and could not be compared statistically because of few sites sampled. The CPUE for all fish captured within SMI gill nets during the first year post-impoundment fell within ranges observed during baseline in reservoir (2021: 64 fish/30 m of net/24 h; baseline: 12–316 fish) and Stephens Lake South (2021: 57 fish/30 m of net/24 h; baseline: 44–135 fish). The abundance of Rainbow Smelt has decreased in all four waterbodies since 2009, a pattern that has been observed throughout Northern Manitoba. Small mesh gillnetting resulted in the capture of both young-of-the-year Walleye and Northern Pike, indicating that recruitment occurred for both species in the first year post-impoundment.

- Sampling was conducted within seven newly flooded areas in 2021 including four backbays, one previously isolated lake now connected to the Keeyask reservoir via flooded terrestrial habitat (Little Gull Lake), and two sites near the newly built GS. All three VEC species were captured in the newly flooded areas in 2021, and CPUE's were similar to the closest sampled sites in 2019. Northern Pike were the most commonly captured species at all new sites and were captured in the largest numbers in the backbays and in Little Gull Lake.

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TABLES

Table 1: Fish species captured during standard gang and small mesh index gillnetting surveys conducted in the Keeyask study area during summer 2021.

Common name	Scientific name	Abbreviation	Split Lake	Keeyask reservoir	Stephens Lake	
					North	South
Burbot	*Lota lota*	BURB	X	X		X
Cisco	*Coregonus artedi*	CISC	X	X	X	
Emerald Shiner	*Notropis atherinoides*	EMSH	X	X		
Freshwater Drum	*Aplodinotus grunniens*	FRDR	X			X
Lake Chub	*Couesius plumbeus*	LKCH	X	X		
Lake Sturgeon	*Acipenser fluvescencs*	LKST	X	X		X
Lake Whitefish	*Coregonus clupeaformis*	LKWH	X	X	X	X
Logperch	*Percina caprodes*	LGPR	X			
Longnose Sucker	*Catostomus catostomus*	LNSC	X	X	X	X
Mooneye	*Hiodon tergisus*	MOON	X	X	X	X
Northern Pike	*Esox lucius*	NRPK	X		X	X
Rainbow Smelt	*Osmerus mordax*	RNSM	X	X	X	
Sauger	*Sander canadensis*	SAUG	X	X	X	X
Shorthead Redhorse	*Moxostoma macrolepidotum*	SHRD	X	X	X	X
Silver Redhorse	*Moxostoma anisurum*	SLRD		X		
Spottail Shiner	*Notropis hudsonius*	SPSH	X	X		
Troutperch	*Percopsis omiscomaycus*	TRPR	X	X		
Walleye	*Sander vitreus*	WALL	X	X	X	X
White Sucker	*Catostomus commersonii*	WHSC	X	X	X	X
Yellow Perch	*Perca flavescens*	YLPR	X	X	X	

Table 2: Total number (n) and relative abundance (%) of fish, by species, captured in standard gang (SGI) and small mesh index (SMI) gill nets set in Split Lake during baseline (2009, 2015, 2019) and 2021 monitoring studies.

Common Name	Baseline				2021			
	SGI		SMI		SGI		SMI	
	n[1]	%	n	%	n	%	n	%
Burbot	14	0.9	-	-	4	0.7	-	-
Cisco	19	1.2	30	2.9	5	0.8	18	5.4
Emerald Shiner	-	-	196	18.9	-	-	94	28.4
Freshwater Drum	3	0.2	-	-	1	0.2	-	-
Lake Chub	13	0.8	73	7.0	8	1.4	14	4.2
Lake Sturgeon	8	0.5	-	-	2	0.3	-	-
Lake Whitefish	52	3.3	-	-	25	4.2	-	-
Logperch	-	-	1	0.1	-	-	2	0.6
Longnose Sucker	31	1.9	-	-	28	4.7	-	-
Mooneye	31	1.9	-	-	24	4.1	4	1.2
Northern Pike	167	10.5	15	1.4	55	9.3	3	0.9
Rainbow Smelt	28	1.8	121	11.6	-	-	3	0.9
Sauger	278	17.5	11	1.1	137	23.1	14	4.2
Shorthead Redhorse	47	3.0	-	-	22	3.7	-	-
Silver Redhorse	1	0.1	-	-	-	-	-	-
Slimy Sculpin	-	-	7	0.7	-	-	-	-
Spottail Shiner	-	-	430	41.4	-	-	141	42.6
Troutperch	2	0.1	119	11.5	-	-	21	6.3
Walleye	430	27.0	21	2.0	81	13.7	15	4.5
White Sucker	443	27.9	5	0.5	188	31.8	-	-
Yellow Perch	23	1.4	10	1.0	12	2.0	2	0.6
Total	**1590**	**-**	**1039**	**-**	**592**	**-**	**331**	**-**

1 – Number of fish

Table 3: Total number (n) and relative abundance (%) of fish, by species, captured in all standard gang (SGI) and small mesh index (SMI) gill nets set in the Keeyask reservoir during baseline (2001, 2002, 2009, 2015, 2019) and 2021 monitoring studies.

Common Name	Baseline				2021			
	SGI		SMI		SGI		SMI	
	n[1]	%	n	%	n	%	n	%
Burbot	2	0.1	-	-	1	0.5	-	-
Cisco	7	0.5	40	3.0	3	1.6	3	2.3
Emerald Shiner	-	-	416	30.9	-	-	5	3.8
Logperch	-	-	1	0.1	-	-	-	-
Lake Chub	2	0.1	-	-	1	0.5	-	-
Lake Sturgeon	3	0.2	-	-	-	-	-	-
Lake Whitefish	94	6.9	2	0.1	7	3.8	1	0.8
Longnose Sucker	8	0.6	3	0.2	7	3.8	-	-
Mooneye	51	3.7	-	-	-	-	-	-
Northern Pike	601	44.1	22	1.6	29	15.8	2	1.5
Rainbow Smelt	35	2.6	121	9.0	4	2.2	-	-
Sauger	18	1.3	-	-	29	15.8	2	1.5
Shorthead Redhorse	51	3.7	-	-	18	9.8	-	-
Silver Redhorse	-	-	-	-	1	0.5	-	-
Spottail Shiner	-	-	486	36.1	-	-	83	63.8
Troutperch	1	0.1	78	5.8	-	-	10	7.7
Walleye	255	18.7	2	0.1	39	21.3	3	2.3
White Sucker	116	8.5	10	0.7	40	21.9	-	-
Yellow Perch	120	8.8	164	12.2	4	2.2	21	16.2
Total	**1364**	**-**	**1345**	**-**	**183**	**-**	**130**	**-**

1 – Number of fish

Table 4: Total number (n) and relative abundance (%) for fish, by species, captured in all standard gang (SGI) and small mesh index (SMI) gill nets set in Stephens Lake North during baseline (2009, 2015, 2018) and 2021 monitoring studies.

Common Name	Baseline				2021			
	SGI		SMI		SGI		SMI	
	n[1]	%	n	%	n	%	n	%
Burbot	1	0.1	-	-	-	-	-	-
Cisco	23	2.9	8	0.9	30	10.0	9	1.2
Common Carp	1	0.1	-	-	-	-	-	-
Emerald Shiner	-	-	277	31.4	-	-	282	39.1
Lake Chub	-	-	-	-	-	-	-	-
Lake Sturgeon	-	-	-	-	-	-	-	-
Lake Whitefish	49	6.1	3	0.3	14	4.7	-	-
Longnose Sucker	2	0.3	-	-	1	0.3	-	-
Mooneye	42	5.3	-	-	7	2.3	-	-
Northern Pike	188	23.5	19	2.2	43	14.3	3	0.4
Rainbow Smelt	22	2.8	72	8.2	2	0.7	7	1.0
Sauger	23	2.9	3	0.3	14	4.7	-	-
Shorthead Redhorse	3	0.4	-	-	7	2.3	-	-
Spottail Shiner	-	-	416	47.1	-	-	385	53.3
Troutperch	-	-	43	4.9	-	-	9	1.2
Walleye	391	48.9	36	4.1	141	47.0	12	1.7
White Sucker	53	6.6	-	-	39	13.0	-	-
Yellow Perch	2	0.3	6	0.7	2	0.7	15	2.1
Total	**800**	**-**	**883**	**-**	**300**	**-**	**722**	**-**

1 – Number of fish

Table 5: Total number (n) and relative abundance (%) for fish, by species, captured in all standard gang (SGI) and small mesh index (SMI) gill nets set in Stephens Lake South during baseline (2009, 2015, 2018) and 2021 monitoring studies.

Common Name	Baseline				2021			
	SGI		SMI		SGI		SMI	
	n[1]	%	n	%	n	%	n	%
Burbot	2	0.2	-	-	2	0.6	-	-
Cisco	3	0.4	-	-	-	-	-	-
Emerald Shiner	-	-	188	23.0	-	-	12	8.5
Freshwater Drum	-	-	-	-	2	0.6	-	-
Lake Chub	-	-	1	0.1	-	-	-	-
Lake Sturgeon	1	0.1	-	-	1	0.3	-	-
Lake Whitefish	16	2.0	19	2.3	4	1.3	-	-
Longnose Sucker	7	0.9	5	0.6	11	3.5	1	0.7
Mooneye	31	3.9	3	0.4	35	11.0	-	-
Northern Pike	165	20.5	5	0.6	27	8.5	-	-
Rainbow Smelt	28	3.5	54	6.6	-	-	1	0.7
Sauger	43	5.3	12	1.5	20	6.3	8	5.6
Shorthead Redhorse	7	0.9	-	-	6	1.9	-	-
Spottail Shiner	-	-	393	48.0	-	-	67	47.2
Troutperch	2	0.2	95	11.6	-	-	37	26.1
Walleye	356	44.2	22	2.7	97	30.5	10	7.0
White Sucker	135	16.8	7	0.9	113	35.5	1	0.7
Yellow Perch	9	1.1	15	1.8	-	-	5	3.5
Total	**805**	**-**	**819**	**-**	**318**	**-**	**142**	**-**

1 – Number of fish

Table 6: Mean catch-per-unit-effort (CPUE; fish/100 m of net/24 h) by species and study year for fish captured in standard gang index gill nets set in Split Lake, summer 2009, 2015, 2019, and 2021.

Common Name	2009			2015			2019			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Burbot	10	0.5	1.1	-	-	-	4	0.3	0.5	4	0.3	0.8
Cisco	2	0.1	0.3	4	0.2	0.7	13	0.9	1.7	5	0.3	0.6
Freshwater Drum	-	-	-	3	0.1	0.4	-	-	-	1	0.1	0.2
Lake Chub	3	0.2	0.3	5	0.3	0.5	5	0.3	0.6	8	0.5	0.9
Lake Sturgeon	-	-	-	8	0.4	1.1	-	-	-	2	0.1	0.3
Lake Whitefish	10	0.5	0.7	22	1.2	1.4	20	1.3	2.4	25	1.5	1.8
Longnose Sucker	10	0.5	0.9	9	0.5	0.9	12	0.8	1.4	28	1.7	3.1
Mooneye	9	0.5	1.2	13	0.6	1.5	9	0.5	1.1	24	1.4	2.6
Northern Pike	64	3.5	3.7	60	3.5	4.4	43	2.7	2.4	55	3.3	3.5
Rainbow Smelt	27	1.5	1.9	1	0.0	0.2	-	-	-	-	-	-
Sauger	74	4.3	6.0	112	6.2	3.7	92	5.7	6.0	137	8.2	7.4
Shorthead Redhorse	3	0.2	0.4	18	1.0	2.7	26	1.5	3.1	22	1.3	1.4
Silver Redhorse	-	-	-	-	-	-	1	0.1	0.2	-	-	-
Troutperch	2	0.1	0.3	-	-	-	-	-	-	-	-	-
Walleye	220	12.5	19.4	138	7.9	6.3	72	4.2	3.4	81	4.9	3.7
White Sucker	100	5.8	4.4	178	10.2	9.0	165	10.3	5.0	188	11.1	5.1
Yellow Perch	4	0.2	0.4	9	0.5	0.8	10	0.6	0.8	12	0.7	0.9
Total	**538**	**30.5**	**41.0**	**580**	**32.6**	**33.6**	**472**	**29.1**	**28.5**	**592**	**35.3**	**32.4**

1 – Number of fish

2 – Standard deviation

Table 7: Mean catch-per-unit-effort (CPUE; fish/30 m of net/24 h) by species and study year for fish captured in small mesh index gill nets set in Split Lake, summer 2009, 2015, 2019, and 2021.

Common Name	2009			2015			2019			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Cisco	-	-	-	1	0.3	0.6	29	10.1	12.3	18	6.1	6.0
Emerald Shiner	29	8.3	14.4	45	15.2	14.9	122	43.4	37.6	94	30.8	33.9
Lake Chub	14	4.3	7.5	35	11.9	16.4	24	8.3	14.3	14	3.9	3.9
Logperch	-	-	-	-	-	-	1	0.3	0.6	2	0.7	1.3
Mooneye	-	-	-	-	-	-	-	-	-	4	1.4	1.2
Northern Pike	6	1.8	1.8	6	2.0	2.7	3	1.1	1.0	3	1.0	1.7
Rainbow Smelt	105	31.3	6.6	9	3.0	2.7	7	2.6	4.5	3	1.0	0.1
Sauger	1	0.3	0.5	5	1.3	1.1	5	1.7	2.1	14	2.6	3.6
Slimy Sculpin	7	2.3	3.1	-	-	-	-	-	-	-	-	-
Spottail Shiner	86	26.3	36.1	172	58.3	59.9	172	60.2	67.5	141	46.3	38.5
Troutperch	42	12.9	7.5	65	19.8	16.6	12	3.5	0.5	21	7.2	8.4
Walleye	5	1.6	1.5	7	2.4	2.1	9	3.2	2.9	15	5.1	1.5
White Sucker	2	0.6	1.1	3	1.0	1.0	-	-	-	-	-	-
Yellow Perch	2	0.6	1.1	7	2.0	3.5	1	0.3	0.6	2	0.7	0.6
Total	**299**	**90.2**	**81.1**	**355**	**117.3**	**121.5**	**385**	**134.8**	**143.9**	**331**	**114.0**	**75.9**

1 – Number of fish

2 – Standard deviation

Table 8: Mean catch-per-unit-effort (CPUE; fish/100 m of net/24 h) by species and study year for fish captured in standard gang index gill nets set in the Keeyask reservoir, summer 2001, 2002, 2009, 2015, 2019, and 2021.

Common Name	2001			2002			2009			2015			2019			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Burbot	-	-	-	1	0.1	0.3	-	-	-	-	-	-	1	0.1	0.2	1	0.1	0.2
Cisco	4	0.4	0.9	1	0.1	0.3	-	-	-	1	0.1	0.3	1	0.1	0.2	3	0.2	0.4
Lake chub	-	-	-	1	0.1	0.3	-	-	-	-	-	-	1	0.1	0.3	1	0.1	0.2
Lake Sturgeon	-	-	-	-	-	-	1	0.1	0.2	1	0.1	0.2	1	0.1	0.2	-	-	-
Lake Whitefish	30	2.6	3.2	15	1.2	1.7	27	1.8	4.2	14	0.9	2.1	8	0.6	1.3	7	0.5	1.2
Longnose Sucker	3	0.3	0.6	-	-	-	1	0.1	0.2	1	0.1	0.2	3	0.2	0.5	7	0.5	0.6
Mooneye	31	2.8	6.3	12	1.0	2.9	6	0.4	1.1	1	0.1	0.2	1	0.1	0.2	-	-	-
Northern Pike	122	10.1	6.5	190	15.7	5.9	144	9.5	5.4	84	6.0	4.1	61	4.2	4.2	29	2.1	1.9
Rainbow Smelt	6	0.5	0.8	12	1.0	1.9	13	0.9	1.0	-	-	-	4	0.3	0.7	4	0.3	0.4
Sauger	1	0.1	0.2	-	-	-	-	-	-	2	0.1	0.3	15	1.1	1.4	29	2.2	2.0
Shorthead Redhorse	2	0.2	0.3	2	0.2	0.6	32	2.1	3.8	5	0.3	0.7	10	0.7	1.6	18	1.3	0.9
Silver Redhorse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1	0.3
Troutperch	-	-	-	-	-	-	1	0.1	0.2	-	-	-	-	-	-	-	-	-
Walleye	66	5.5	6.4	41	3.4	4.4	57	3.7	4.1	61	4.3	3.1	30	2.1	1.9	39	2.9	2.2
White Sucker	28	2.3	2.4	17	1.5	2.2	15	1.0	0.9	22	1.5	1.7	34	2.4	3.4	40	2.9	2.1
Yellow Perch	62	5.4	10.7	17	1.4	2.9	15	1.0	1.6	21	1.4	1.7	5	0.3	0.7	4	0.3	0.5
Total	**355**	**30.0**	**27.7**	**309**	**25.6**	**9.7**	**312**	**20.6**	**7.4**	**213**	**15.0**	**5.5**	**175**	**12.2**	**5.0**	**183**	**13.5**	**5.6**

1 – Number of fish

2 – Standard deviation

Table 9: Mean catch-per-unit-effort (CPUE; fish/30 m of net/24 h) by species and study year for fish captured in small mesh index gill nets set in the Keeyask reservoir, summer 2001, 2002, 2009, 2015, 2019, and 2021.

Common Name	2001			2002			2009			2015			2019			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Cisco	-	-	-	-	-	-	1	0.4	0.6	17	8.1	11.4	22	10.8	15.3	3	1.5	2.1
Emerald Shiner	-	-	-	1	0.6	0.8	-	-	-	413	195.9	260.3	2	1.0	1.4	5	2.5	3.5
Lake Whitefish	2	1.2	1.7	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	0.7
Logperch	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	0.7	-	-	-
Longnose Sucker	-	-	-	1	0.6	0.8	-	-	-	-	-	-	2	1.0	1.4	-	-	-
Northern Pike	2	1.2	1.7	2	1.1	1.6	6	2.7	3.8	5	2.4	3.3	7	3.4	4.9	2	1.0	1.4
Rainbow Smelt	98	58.4	82.7	-	-	-	21	9.3	9.6	2	0.9	1.3	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.0	0.1
Spottail Shiner	146	87.1	123.1	2	1.1	1.6	33	14.7	20.8	214	101.4	142.0	91	44.7	63.2	83	41.1	58.1
Troutperch	18	10.6	12.0	7	4.2	5.9	39	16.9	1.3	9	4.3	1.9	5	2.5	2.1	10	4.7	2.4
Walleye	2	1.2	1.7	-	-	-	-	-	-	-	-	-	-	-	-	3	1.5	2.1
White Sucker	3	1.7	1.0	-	-	-	1	0.4	0.6	4	1.9	2.7	2	1.0	1.4	-	-	-
Yellow Perch	30	17.9	25.3	7	3.9	5.5	123	54.8	77.5	3	1.4	2.0	1	0.5	0.7	21	10.1	5.3
Total	**301**	**179.3**	**249.2**	**20**	**11.5**	**1.1**	**224**	**99.3**	**114.3**	**667**	**316.3**	**425.0**	**133**	**65.4**	**87.9**	**130**	**63.8**	**70.8**

1 – Number of fish

2 – Standard deviation

Table 10: Mean catch-per-unit-effort (CPUE; fish/100 m of net/24 h) by species and study year for fish captured in standard gang index gill nets set in Stephens Lake North, summer 2009, 2015, 2018, and 2021.

Common Name	2009			2015			2018			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Burbot	-	-	-	1	0.1	0.3	-	-	-	-	-	-
Cisco	7	0.5	1.4	7	1.0	2.2	9	0.9	1.1	30	2.7	4.6
Common Carp	1	0.1	0.2	-	-	-	-	-	-	-	-	-
Lake Whitefish	13	1.1	1.5	21	2.2	2.4	15	1.4	2.2	14	1.4	0.9
Longnose Sucker	-	-	-	2	0.2	0.4	-	-	-	1	0.1	0.3
Mooneye	-	-	-	42	2.8	8.4	-	-	-	7	0.8	1.4
Northern Pike	85	6.7	3.2	74	7.3	4.9	29	2.9	3.0	43	4.1	3.1
Rainbow Smelt	16	1.3	1.0	6	0.8	1.7	-	-	-	2	0.2	0.4
Sauger	-	-	-	-	-	-	23	2.3	3.9	14	1.6	2.9
Shorthead Redhorse	-	-	-	-	-	-	3	0.3	0.9	7	0.8	1.4
Walleye	107	8.8	9.6	168	18.8	24.1	116	11.1	7.4	141	13.2	14.9
White Sucker	6	0.5	0.6	15	1.2	1.4	32	3.1	3.1	39	4.3	3.9
Yellow Perch	-	-	-	2	0.3	0.5	-	-	-	2	0.2	0.4
Total	**235**	**19.0**	**10.1**	**338**	**34.6**	**31.9**	**227**	**21.9**	**11.3**	**300**	**29.5**	**34.1**

1 – Number of fish

2 – Standard deviation

Table 11: Mean catch-per-unit-effort (CPUE; fish/30 m of net/24 h) by species and study year for fish captured in small mesh index gill nets set in Stephens Lake North, summer 2009, 2015, 2018, and 2021.

Common Name	2009			2015			2018			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Cisco	-	-	-	-	-	-	8	3.3	3.4	9	3.3	5.7
Common Carp	34	11.6	20.0	180	84.6	114.4	63	26.7	34.7	282	118.2	87.4
Emerald Shiner	1	0.3	0.5	-	-	-	2	0.9	1.6	-	-	-
Mooneye	3	1.0	0.1	13	6.2	8.7	3	1.1	1.0	3	1.2	2.1
Northern Pike	66	21.3	14.4	5	1.3	2.2	1	0.3	0.6	7	2.8	4.8
Rainbow Smelt	-	-	-	-	-	-	3	1.3	1.3	-	-	-
Shorthead Redhorse	87	27.6	19.7	283	98.4	38.7	46	18.6	13.6	385	149.6	162.2
Spottail Shiner	1	0.3	0.6	10	2.7	2.9	32	11.6	11.1	9	3.7	0.6
Troutperch	12	4.0	3.8	8	2.9	1.7	16	6.5	2.5	12	4.7	2.9
White Sucker	2	0.6	1.1	1	0.5	0.9	3	1.3	1.3	15	5.7	4.9
Total	**206**	**66.7**	**44.3**	**500**	**196.5**	**159.5**	**177**	**71.7**	**50.0**	**722**	**289.2**	**95.2**

1 – Number of fish

2 – Standard deviation

Table 12: Mean catch-per-unit-effort (CPUE; fish/100 m of net/24 h) by species and study year for fish captured in standard gang index gill nets set in Stephens Lake South, summer 2009, 2015, 2018, and 2021.

Common Name	2009			2015			2018			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Burbot	-	-	-	-	-	-	2	0.2	0.5	2	0.2	0.5
Cisco	1	0.1	0.2	2	0.1	0.4	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	2	0.2	0.5
Lake Sturgeon	-	-	-	1	0.1	0.3	-	-	-	1	0.1	0.3
Lake Whitefish	6	0.5	0.7	6	0.5	0.5	4	0.3	0.5	4	0.5	0.6
Longnose Sucker	-	-	-	4	0.4	1.3	3	0.4	0.7	11	1.2	2.7
Mooneye	12	1.0	3.0	-	-	-	19	1.6	2.8	35	3.2	9.2
Northern Pike	88	8.9	11.7	45	3.6	3.8	32	3.1	2.4	27	3.0	2.8
Rainbow Smelt	28	2.5	2.8	-	-	-	-	-	-	-	-	-
Sauger	33	2.8	7.3	5	0.3	0.4	5	0.6	0.7	20	2.2	3.8
Shorthead Redhorse	-	-	-	-	-	-	7	0.7	1.6	6	0.7	1.4
Troutperch	1	0.1	0.3	-	-	-	1	0.1	0.4	-	-	-
Walleye	183	16.6	21.4	101	8.4	5.6	72	6.7	6.7	97	11.0	7.8
White Sucker	15	1.3	1.7	57	4.5	2.7	63	5.8	6.8	113	13.4	14.7
Yellow Perch	1	0.1	0.4	5	0.4	0.7	3	0.2	0.5	-	-	-
Total	**368**	**33.9**	**29.4**	**226**	**18.4**	**8.7**	**211**	**19.8**	**16.5**	**318**	**35.8**	**21.1**

1 – Number of fish

2 – Standard deviation

Table 13: Mean catch-per-unit-effort (CPUE; fish/30 m of net/24 h) by species and study year for fish captured in small mesh index gill nets set in Stephens Lake South, summer 2009, 2015, 2018, and 2021.

Common Name	2009			2015			2018			2021		
	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std	n	CPUE	Std
Emerald Shiner	-	-	-	53	17.3	17.1	135	48.0	41.6	12	4.7	5.9
Freshwater Drum	-	-	-	6	2.2	3.1	13	4.0	6.9	-	-	-
Lake chub	-	-	-	5	1.3	2.3	-	-	-	1	0.3	0.5
Lake Sturgeon	-	-	-	-	-	-	3	0.9	1.6	-	-	-
Lake Whitefish	-	-	-	5	2.1	1.8	-	-	-	-	-	-
Longnose Sucker	45	15.4	13.4	9	2.5	3.3	-	-	-	1	0.4	0.7
Mooneye	5	1.6	2.8	2	0.9	1.6	5	2.5	2.5	8	3.8	3.3
Rainbow Smelt	31	10.3	10.0	277	92.9	95.0	85	29.5	26.1	67	25.7	29.3
Sauger	41	13.6	12.7	31	12.5	10.0	23	10.9	9.6	37	15.4	6.6
Shorthead Redhorse	1	0.4	0.6	3	0.9	0.8	18	6.5	5.8	10	3.6	3.2
Spottail Shiner	4	1.3	2.2	1	0.3	0.5	2	0.6	1.1	1	0.6	1.0
Troutperch	3	1.1	1.1	5	1.3	2.3	7	2.3	2.9	5	2.0	2.7
Walleye	-	-	-	1	0.4	0.7	-	-	-	-	-	-
Total	**130**	**43.6**	**38.2**	**398**	**134.5**	**108.3**	**291**	**105.3**	**68.6**	**142**	**56.5**	**35.5**

1 – Number of fish

2 – Standard deviation

Table 14: Mean Fork length (FL), weight and condition factor (K) for Lake Whitefish, Northern Pike and Walleye captured in the Keeyask Area during baseline (i.e., 2001–2019) and 2021 studies.

Location	Year	Lake Whitefish				Northern Pike				Walleye			
		n[1]	FL (mm)	Weight (g)	K	n	FL (mm)	Weight (g)	K	n	FL (mm)	Weight (g)	K
Split Lake	2009	10	498	2435	1.93	64	513	1294	0.77	222	369	741	1.29
	2015	22	404	1159	1.65	66	495	1032	0.68	145	342	530	1.09
	2019	19	434	1453	1.75	46	487	833	0.66	81	292	363	1.07
	Baseline[2]	51	433	1,518	1.74	176	499	1,078	0.71	448	346	605	1.19
	2021	25	446	1,489	1.61	58	488	1,121	0.73	96	326	452	1.10
Keeyask reservoir[3]	2001	31	416	1674	1.73	124	483	1201	0.77	68	420	1206	1.30
	2002	15	406	1659	1.69	190	561	1669	0.77	41	470	1643	1.37
	2009	27	455	1894	1.76	150	539	1487	0.76	57	433	1268	1.30
	2015	13	419	1357	1.60	89	564	1503	0.68	61	402	942	1.13
	2019	8	463	1960	1.88	68	534	1524	0.71	30	379	706	1.10
	Baseline[2]	94	430	1715	1.73	621	538	1492	0.75	257	422	1168	1.25
	2021	8	287	842	1.39	31	446	1314	0.71	42	333	530	1.07
Stephens Lake North	2009	14	388	1581	1.91	88	547	1416	0.74	119	428	1284	1.40
	2015	21	361	1044	1.45	87	571	1533	0.66	176	382	771	1.15
	2018	17	383	991	1.52	31	498	958	0.72	130	387	692	1.13
	Baseline[2]	52	375	1171	1.59	206	550	1395	0.71	425	396	890	1.22
	2021	14	366	976	1.51	46	517	1322	1.04	153	362	625	1.14
Stephens Lake South	2009	6	486	2528	2.04	88	529	1449	0.75	184	442	1345	1.40
	2015	12	284	1043	1.42	50	520	1268	0.69	104	413	984	1.15
	2018	4	500	1952	1.92	32	517	1173	0.71	78	409	823	1.09
	Baseline[2]	22	378	1628	1.68	170	524	1344	0.73	366	427	1130	1.26
	2021	4	411	1223	1.80	27	501	1325	0.69	107	347	573	1.15

1 – Number of fish.

2 – All baseline (i.e., pre-2021) sampling years combined.

3 – Area of the Nelson River between Clark Lake and Gull Rapids/the Keeyask GS.

Table 15: Number (n) and percentage of catch (%) of deformities, erosion, lesions, and tumours (DELTs) recorded on fish captured in standard gang (SGI) and small mesh (SMI) index gill nets set in Split Lake, the Keeyask reservoir, Stephens Lake North, and Stephens Lake South during the 2001, 2002, 2009, 2015, 2018, 2019, and 2021 study years.

	Study Year																				
	2001			2002			2009			2015			2018			2019			2021		
	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%
Split Lake																					
Lake Sturgeon	-	-	-	-	-	-	0	0	0	8	0	0	-	-	-	0	0	0	2	0	0
Lake Whitefish	-	-	-	-	-	-	10	1	10	22	0	0	-	-	-	20	1	5	25	0	0
Northern Pike	-	-	-	-	-	-	64	0	0	66	0	0	-	-	-	46	0	0	58	0	0
Sauger	-	-	-	-	-	-	29	2	6.9	0	0	0	-	-	-	96	1	1	151	1	0.7
Walleye	-	-	-	-	-	-	223	5	2.2	145	0	0	-	-	-	81	0	0	96	0	0
White Sucker	-	-	-	-	-	-	18	1	5.6	181	1	0.6	-	-	-	165	0	0	188	0	0
	-	**-**	**-**	**-**	**-**	**-**	**344**	**9**	**2.6**	**422**	**1**	**0.2**	**-**	**-**	**-**	**408**	**2**	**0.5**	**520**	**1**	**0.2**
Keeyask reservoir																					
Lake Sturgeon	0	0	0	0	0	0	1	0	0	1	0	0	-	-	-	1	0	0	0	0	0
Lake Whitefish	30	0	0	15	1	6.7	27	3	11.1	13	0	0	-	-	-	8	0	0	9	0	0
Northern Pike	122	0	0	190	1	0.5	150	3	2	89	8	9	-	-	-	61	0	0	113	1	0.9
Sauger	1	0	0	0	0	0	0	0	0	0	0	0	-	-	-	0	0	0	40	3	7.5
Walleye	66	0	0	41	0	0	57	1	1.8	61	7	11.5	-	-	-	30	1	3.3	60	0	0
White Sucker	28	0	0	17	1	5.9	16	0	0	19	0	0	-	-	-	34	1	2.9	65	3	4.6
	247	**0**	**0**	**263**	**3**	**1.1**	**251**	**7**	**2.8**	**183**	**15**	**8.2**	**-**	**-**	**-**	**134**	**2**	**1.5**	**287**	**7**	**2.4**
Stephens Lake North																					
Lake Sturgeon	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	-	-	-	0	0	0
Lake Whitefish	-	-	-	-	-	-	14	0	0	21	0	0	17	0	0	-	-	-	14	0	0
Northern Pike	-	-	-	-	-	-	88	2	2.3	87	1	1.1	32	0	0	-	-	-	46	0	0
Sauger	-	-	-	-	-	-	0	0	0	0	0	0	26	1	3.8	-	-	-	14	0	0
Walleye	-	-	-	-	-	-	119	4	3.4	176	1	0.6	130	1	0.8	-	-	-	153	0	0
White Sucker	-	-	-	-	-	-	6	0	0	15	0	0	32	0	0	-	-	-	39	0	0
	-	**-**	**-**	**-**	**-**	**-**	**227**	**6**	**2.6**	**299**	**2**	**0.7**	**237**	**2**	**0.8**	**-**	**-**	**-**	**266**	**0**	**0**

Table 15: Number (n) and percentage of catch (%) of deformities, erosion, lesions and tumours (DELTs) recorded on fish captured in standard gang (SGI) and small mesh index (SMI) gill nets set in Split Lake, the Keeyask reservoir, Stephens Lake North and Stephens Lake South during the 2001, 2002, 2009, 2015, 2018, 2019, and 2021 study years (continued).

	Study Year																				
	2001			2002			2009			2015			2018			2019			2021		
	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%	n	DELTs	%
Stephens Lake South																					
Lake Sturgeon	-	-	-	-	-	-	0	0	0	1	0	0	0	0	0	-	-	-	1	0	0
Lake Whitefish	-	-	-	-	-	-	6	0	0	12	0	0	4	0	0	-	-	-	4	0	0
Northern Pike	-	-	-	-	-	-	88	4	4.5	50	0	0	32	0	0	-	-	-	27	0	0
Sauger	-	-	-	-	-	-	14	2	14.3	0	0	0	8	0	0	-	-	-	28	0	0
Walleye	-	-	-	-	-	-	184	3	1.6	104	3	2.9	78	0	0	-	-	-	107	0	0
White Sucker	-	-	-	-	-	-	11	2	18.2	58	0	0	63	0	0	-	-	-	114	0	0
	-	**-**	**-**	**-**	**-**	**-**	**303**	**11**	**3.6**	**225**	**3**	**1.3**	**185**	**0**	**0**	**-**	**-**	**-**	**281**	**0**	**0**

Table 16. Total number (n) and relative abundance (%) of fish, by species, captured in all standard gang and small mesh index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2019 and 2021. Because sites were not fully accessible prior to reservoir impoundment, 2019 sites were set as close as possible to sites prescribed in the AEMP and set in 2021, however, the two years are not directly comparable.

Common Name	Standard Index				Small Mesh			
	2019		2021		2019		2021	
	n	%	n	%	n	%	n	%
Burbot	-		1	0.7	-	-	-	-
Cisco	-		1	0.7	1	0.7	12	4.5
Emerald Shiner	-		-	-	10	6.8	11	4.1
Lake chub	-		-	-	-	-	-	-
Lake Whitefish	2	2.0	1	0.7	-	-	-	-
Logperch	-	-	-	-	1	0.7	-	-
Longnose Sucker	-		7	4.9	-	-	1	0.4
Mooneye	6	6.1	-	-	2	1.4		
Northern Pike	59	59.6	66	46.2	8	5.4	16	6.0
Rainbow Smelt	-	-	2	1.4	-	-	2	0.7
Sauger	4	4.0	9	6.3	-	-	-	-
Shorthead Redhorse	4	4.0	14	9.8	-	-	-	-
Silver Redhorse	-	-	-	-	-	-	-	-
Spottail Shiner	-	-	-	-	97	65.5	141	52.6
Troutperch	-	-	-	-	22	14.9	35	13.1
Walleye	9	9.1	9	6.3	2	1.4	9	3.4
White Sucker	12	12.1	23	16.1	3	2.0	2	0.7
Yellow Perch	3	3.0	10	7.0	2	1.4	39	14.6
Total	**99**	**-**	**143**	**-**	**148**		**268**	**-**

Table 17: Mean catch-per-unit-effort (CPUE) by species of fish captured in standard gang (# fish/100 m of net/24 h) and small mesh (# fish/30 m of net/24 h) index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2019 and 2021. Because sites were not fully accessible prior to reservoir impoundment, 2019 sites were set as close as possible to sites prescribed in the AEMP and set in 2021, however, the two years are not directly comparable.

Common Name	Standard Index						Small Mesh					
	2019			2021			2019			2021		
	n[1]	CPUE	Std[2]	n[1]	CPUE	Std[2]	n	CPUE	Std	n	CPUE	Std
Burbot	-	-	-	1	0.1	0.4	-	-	-	-	-	-
Cisco	-	-	-	1	0.1	0.3	1	0.3	0.5	12	3.0	3.6
Emerald Shiner	-	-	-	-	-	-	10	2.5	1.9	11	2.9	5.7
Lake chub	-	-	-	-	-	-	-	-	-	-	-	-
Lake Sturgeon	-	-	-				-	-	-			
Lake Whitefish	2	0.2	0.4	1	0.1	0.3	-	-	-	-	-	-
Logperch	-	-	-				1	0.3	0.5			
Longnose Sucker	-	-	-	7	1.0	1.8	-	-	-	1	0.4	0.7
Mooneye	6	0.8	1.3				2	0.5	0.6			
Northern Pike	59	7.0	5.2	66	6.8	6.6	8	2.0	2.6	16	4.0	4.4
Rainbow Smelt	-	-	-	2	0.2	0.4	-	-	-	2	0.5	1.0
Sauger	4	0.5	0.6	9	1.1	2.0	-	-	-	-	-	-
Shorthead Redhorse	4	0.5	0.6	14	1.9	2.6	-	-	-	-	-	-
Silver Redhorse				-	-	-				-	-	-
Spottail Shiner	-	-	-	-	-	-	97	25.7	31.0	141	35.5	47.5
Troutperch	-	-	-	-	-	-	22	5.9	7.8	35	8.2	15.5
Walleye	9	1.1	1.2	9	1.2	1.5	2	0.5	1.1	9	2.3	3.4
White Sucker	12	1.5	2.1	23	2.9	3.3	3	0.8	1.6	2	0.5	0.6
Yellow Perch	3	0.4	0.6	10	1.0	0.9	2	0.5	1.1	39	10.0	15.8
Total	**99**	12.0	3.9	**143**	**16.4**	**6.8**	**148**	39.0	**39.8**	**218**	**54.4**	**61.8**

1 – Number of fish

2 – Standard deviation

Table 18: Mean catch-per-unit-effort (CPUE) by species and site of VEC fish captured in standard gang index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2021.

Area	Site	Species					
		LKWH		NRPK		WALL	
		n	CPUE	n	CPUE	n	CPUE
Backbays	GN-09	0	0.0	14	11.1	0	0.0
	GN-10	0	0.0	18	13.1	0	0.0
	GN-11	0	0.0	4	2.7	1	0.7
	GN-15	1	0.7	3	2.0	2	1.4
Little Gull Lake	GN-14	0	0.0	25	16.6	0	0.0
Upstream Keeyask GS	GN-16	0	0.0	0	0.0	2	2.0
	GN-17	0	0.0	2	2.0	4	4.1
Total		**1**	**0.7**	**66**	**6.8**	**9**	**1.2**

Table 19: Mean fork length, weight, and condition factor (K) of fish, by species, captured in standard gang index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2021.

Species	Length (mm)					Weight (g)					k				
	n[1]	Mean	Std[2]	Min	Max	n	Mean	Std	Min	Max	n	Mean	Std	Min	Max
Burbot	-	-	-	-	-	1	925	-	-	-	-	-	-	-	-
Cisco	-	-	-	-	-	1	32	-	-	-	-	-	-	-	-
Lake Whitefish	1	415	-	-	-	1	1,050	-	-	-	1	1.47	-	1.47	1.47
Longnose Sucker	7	340	81	172	411	7	561	249	55	750	7	1.26	0.14	1.08	1.41
Northern Pike	66	386	143	103	904	66	572	686	9	4,500	66	0.75	0.13	0.01	0.97
Rainbow Smelt	-	-	-	-	-	2	2	0	2	3	-	-	-	-	-
Sauger	9	290	67	206	390	9	258	159	80	500	9	0.94	0.09	0.80	1.07
Shorthead Redhorse	-	-	-	-	-	9	1,306	691	750	2,700	-	-	-	-	-
Walleye	9	390	89	260	480	9	731	412	200	1,250	9	1.10	0.08	1.00	1.23
White Sucker	23	375	93	162	478	23	991	513	52	1,950	23	1.58	0.20	1.12	1.89
Yellow Perch	-	-	-	-	-	7	82	82	13	200	-	-	-	-	-
Total	**115**	**-**	**-**	**-**	**-**	**135**	**-**	**-**	**-**	**-**	**115**	**-**	**-**	**-**	**-**

1 – Number of fish measured

2 – Standard deviation

Table 20: Age and cohort for Lake Whitefish, Northern Pike, and Walleye caught in standard gang and small mesh index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2021.

Age	Cohort	Species		
		Lake Whitefish	Northern Pike	Walleye
0	2021	-	1	-
1	2020	-	7	1
2	2019	-	9	-
3	2018	-	6	1
4	2017	-	-	2
5	2016	1	1	-
6	2015	-	1	-
7	2014	-	1	1
8	2013	-	-	1
9	2012	-	-	-
10	2011	-	-	1
11	2010	-	1	3
12	2009	-	-	2

FIGURES

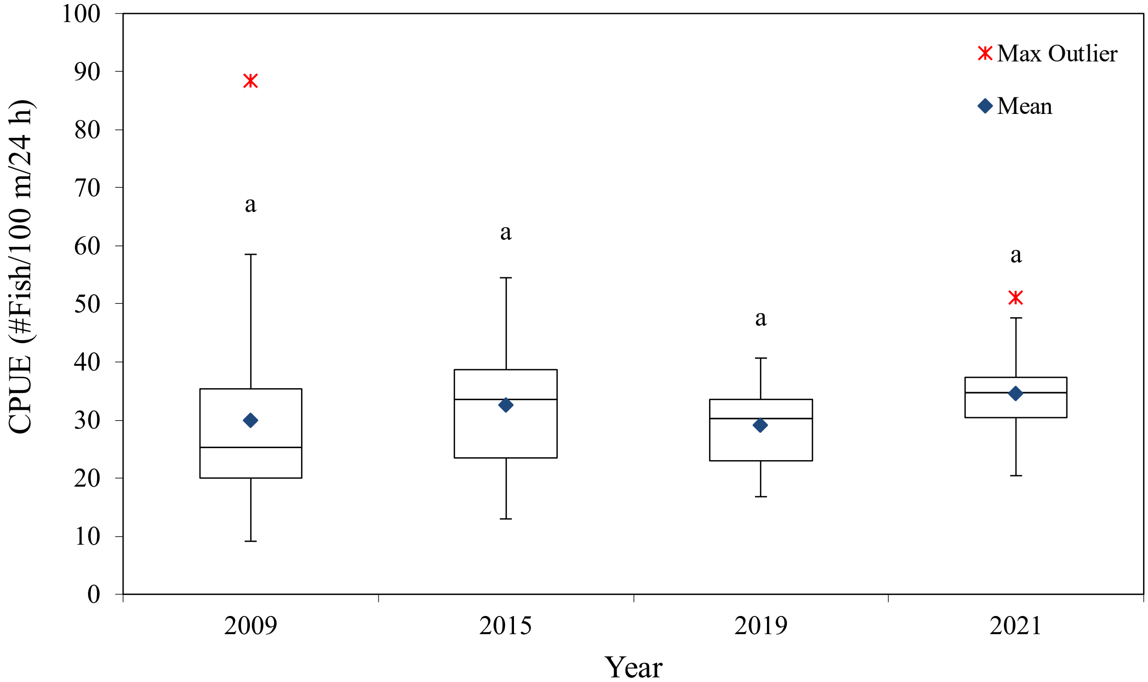


Figure 1: Mean total CPUE for all fish species captured in standard gang index gill nets set in Split Lake in 2009, 2015, 2019, and 2021. Letters denote significant differences in CPUE between study years.

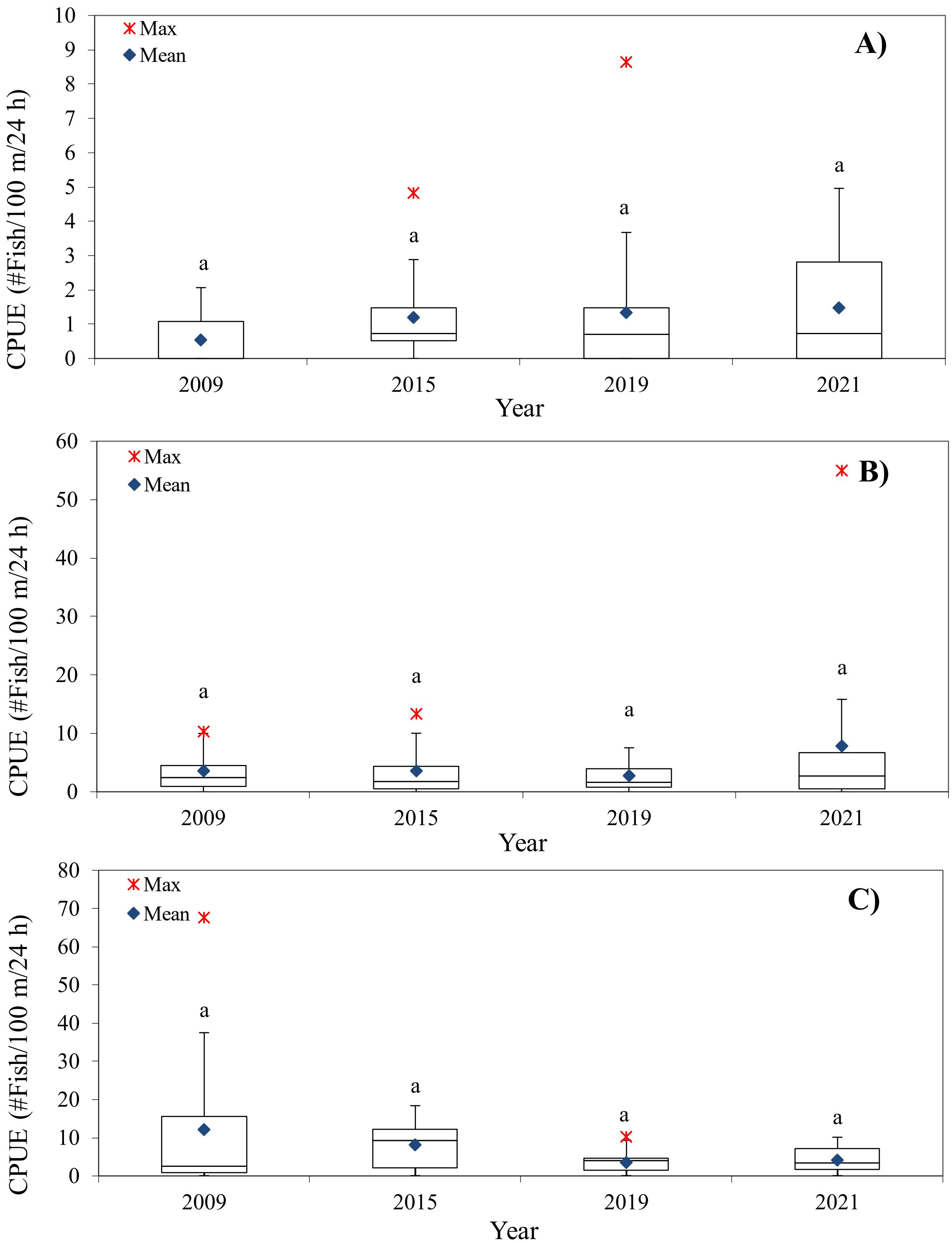


Figure 2: **Mean total CPUE for A) Lake Whitefish, B) Northern Pike and C) Walleye captured in standard gang index gill nets set in Split Lake in 2009, 2015, 2019, and 2021. Letters denote significant differences in CPUE between study years.**

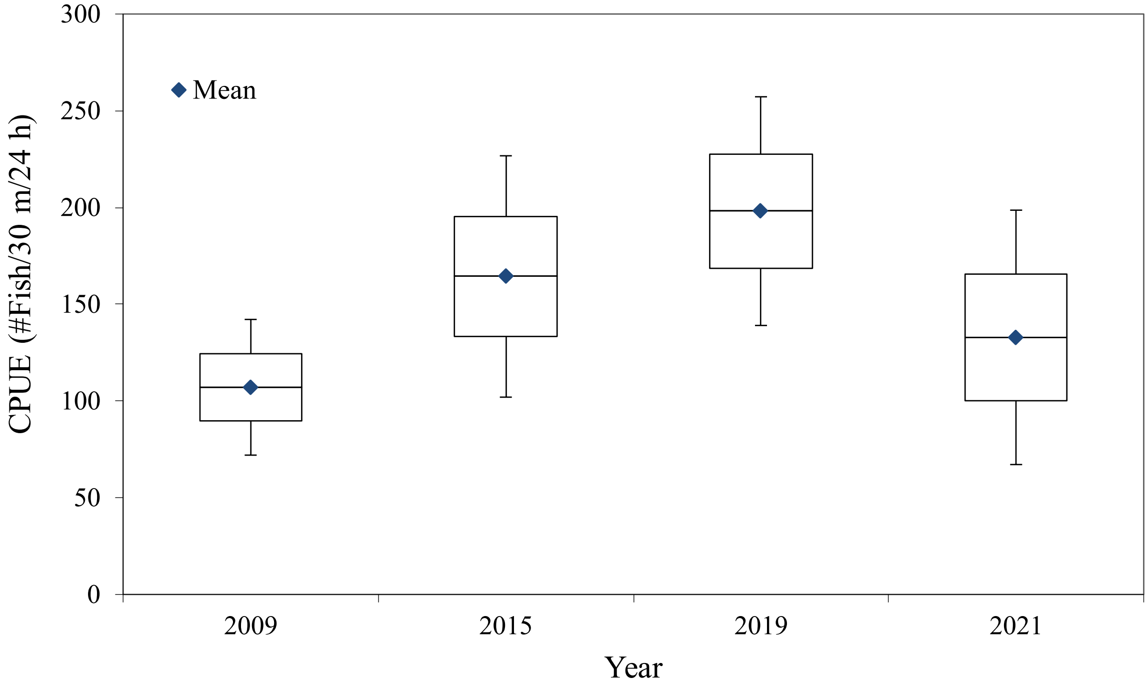


Figure 3: Mean total CPUE for all fish species captured in small mesh index gill nets set in Split Lake in 2009, 2015, 2019, and 2021.

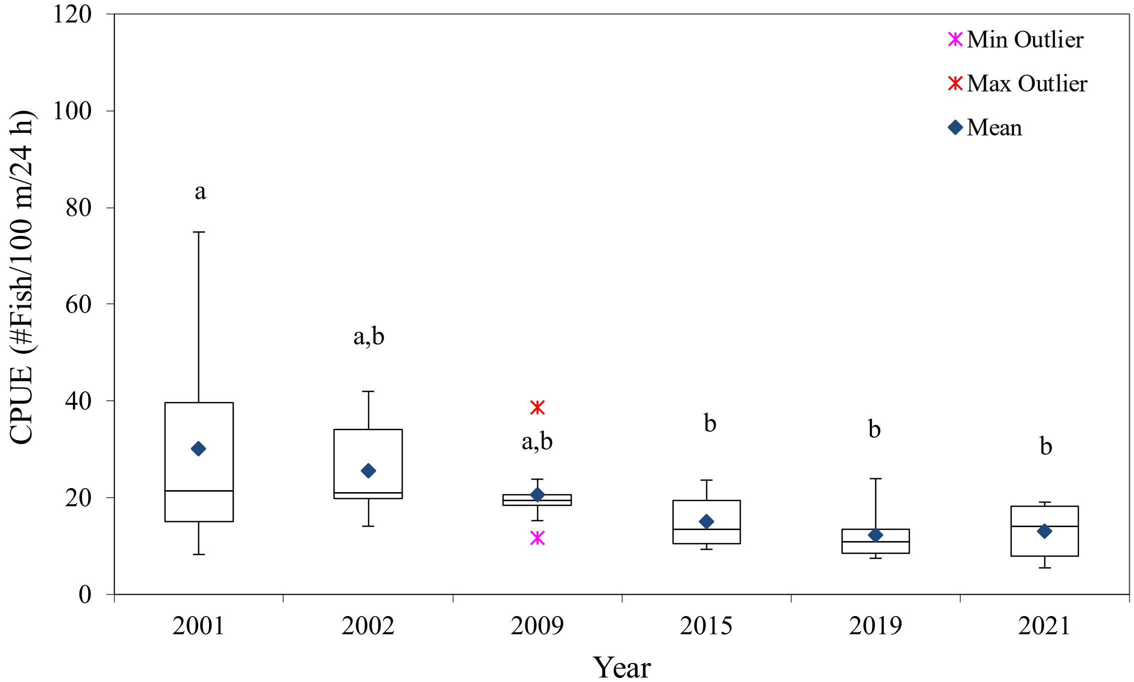


Figure 4: Mean total CPUE for all fish species captured in standard gang index gill nets set in the Keeyask reservoir in 2001, 2002, 2009, 2015, 2019, and 2021. Letters denote significant differences in CPUE between study years.

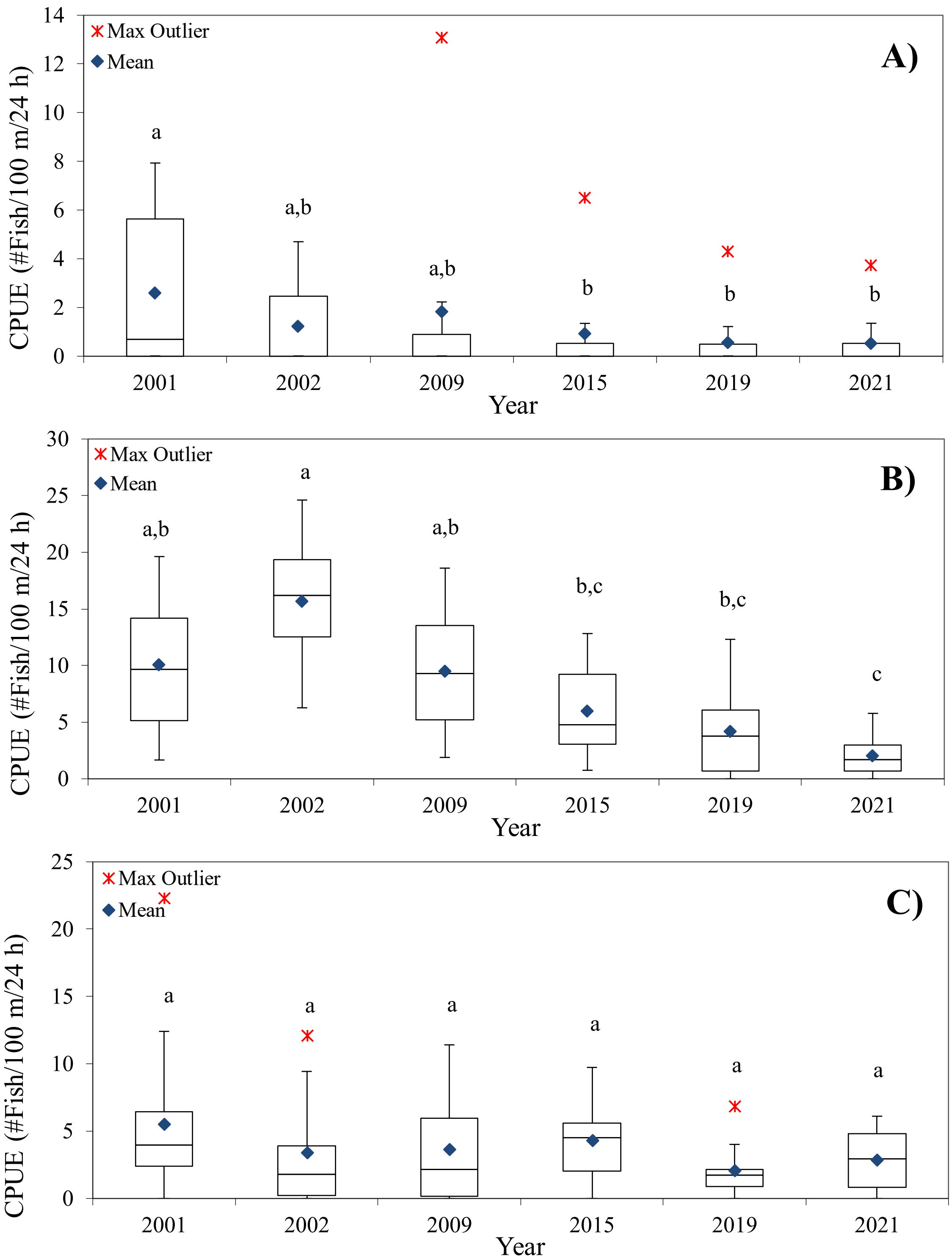


Figure 5: Mean total CPUE for A) Lake Whitefish, B) Northern Pike and C) Walleye captured in standard gang index gill nets set in the Keeyask reservoir in 2001, 2002, 2009, 2015, 2019, and 2021. Letters denote significant differences in CPUE between study years.

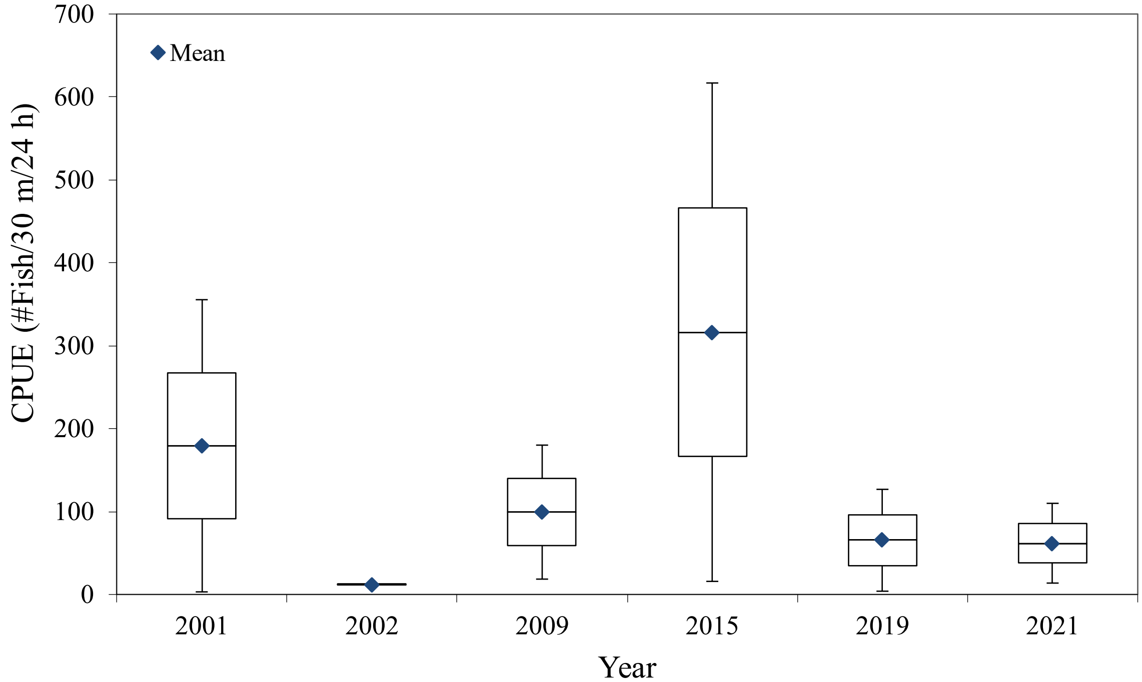


Figure 6: Mean total CPUE for all fish species captured in small mesh index gill nets set in the Keeyask reservoir in 2001, 2002, 2009, 2015, 2019, and 2021.

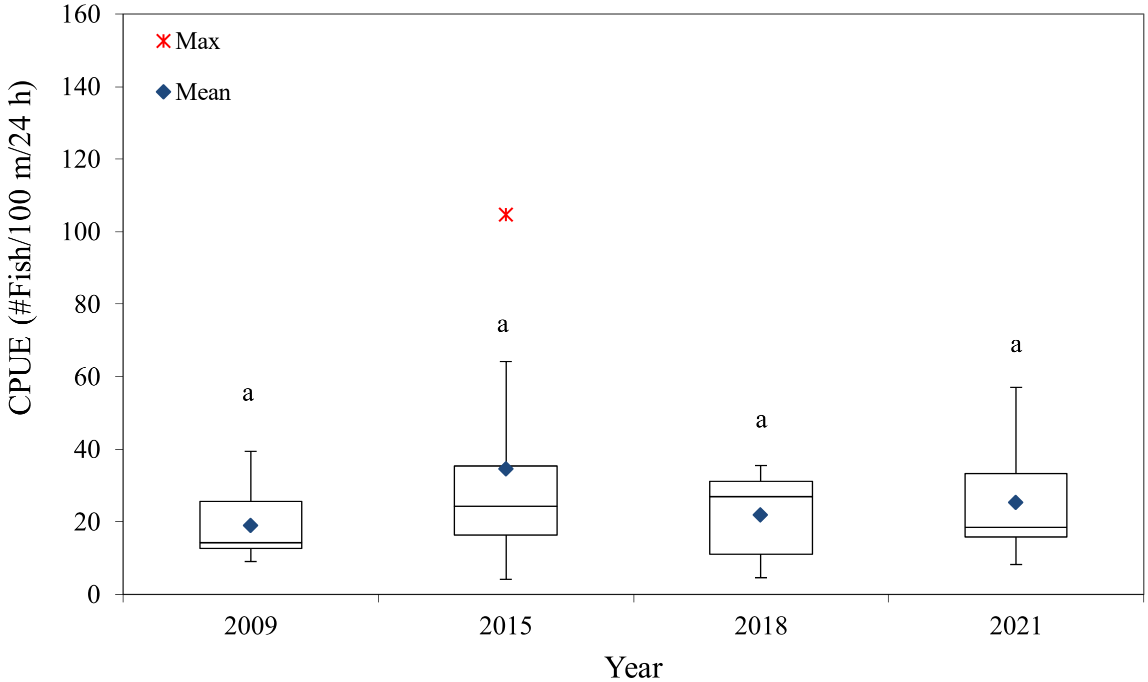


Figure 7: Mean total CPUE for all fish species captured in standard gang index gill nets set in Stephens Lake North in 2009, 2015, 2018, and 2021. Letters denote significant differences in CPUE between study years.

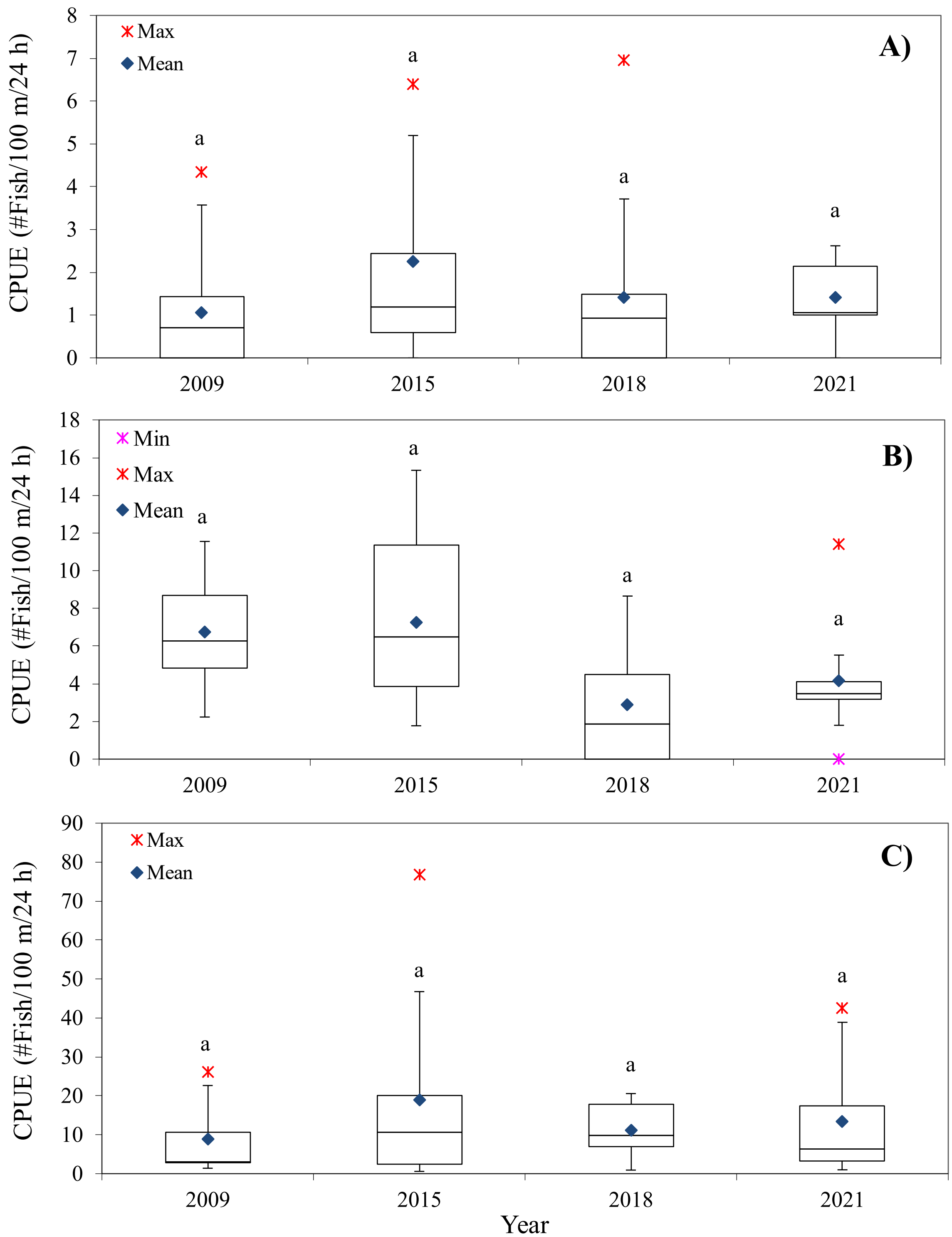


Figure 8: **Mean total CPUE for A) Lake Whitefish, B) Northern Pike and C) Walleye captured in standard gang index gill nets set in Stephens Lake North in 2009, 2015, 2018, and 2021. Letters denote significant differences in CPUE between study years.**

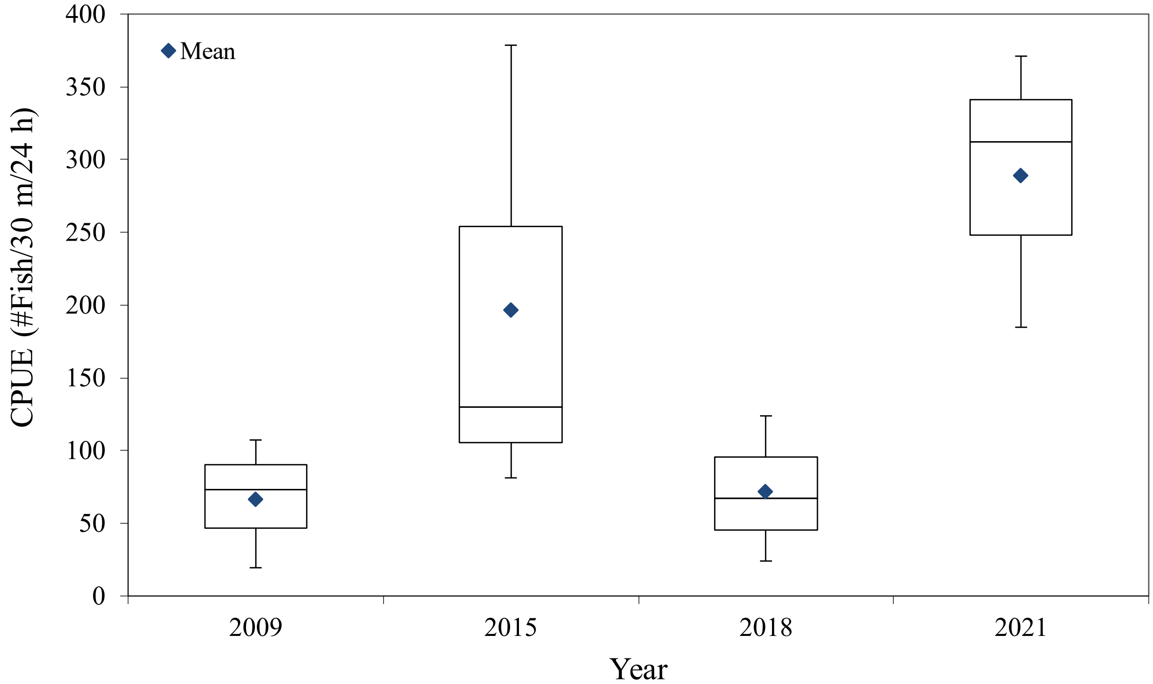


Figure 9: Mean total CPUE for all fish species captured in small mesh index gill nets set in Stephens Lake North in 2009, 2015, 2018, and 2021.

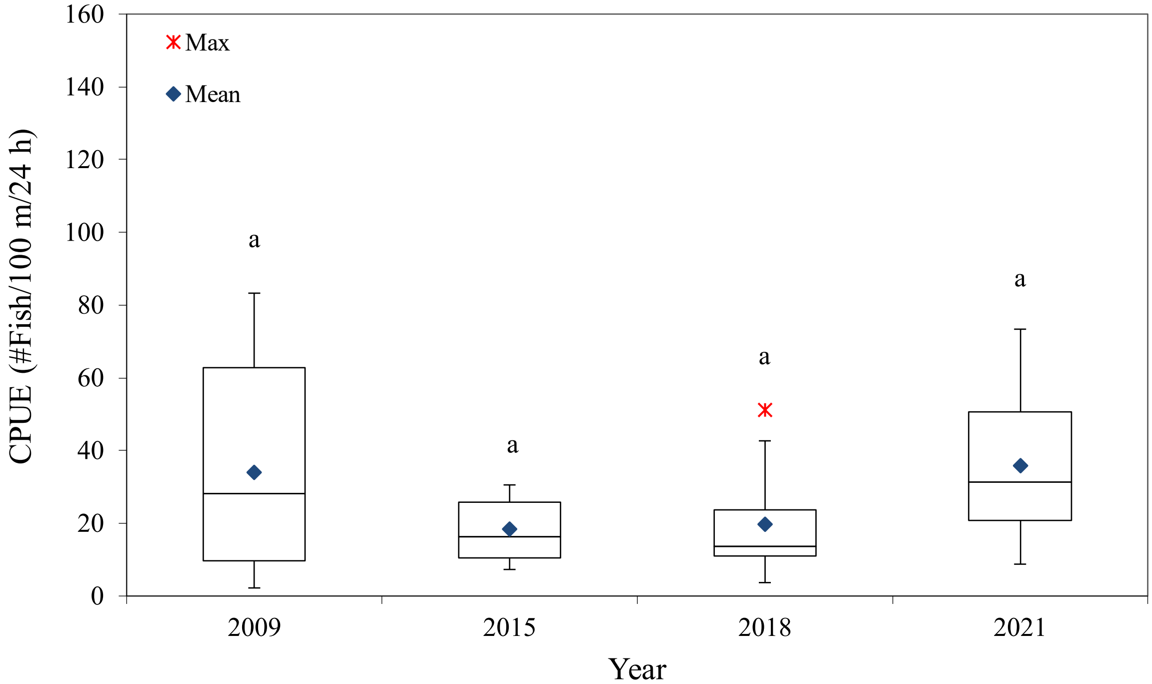


Figure 10: Mean total CPUE for all fish species captured in standard gang index gill nets set in Stephens Lake South in 2009, 2015, 2018, and 2021. Letters denote significant differences in CPUE between study years.

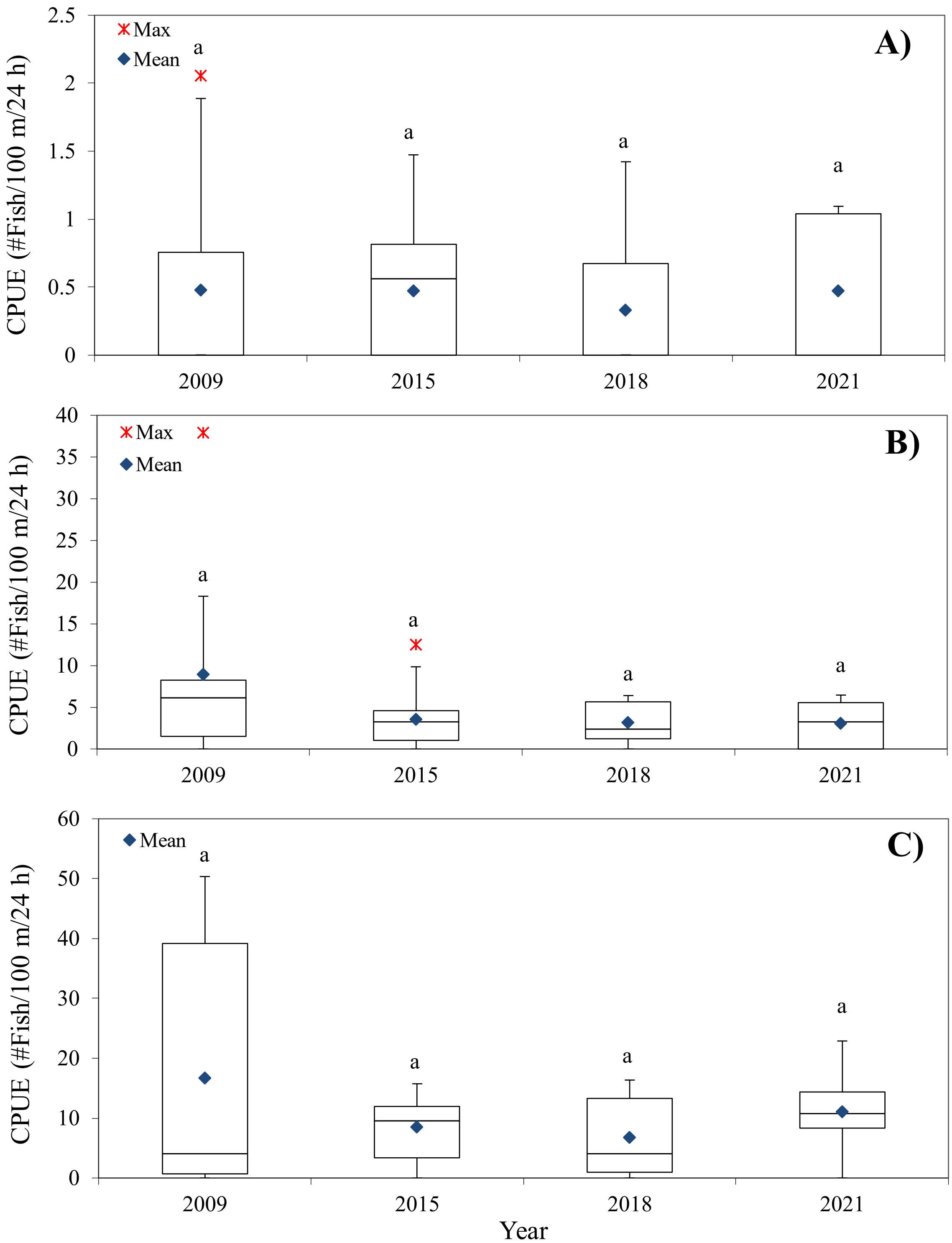


Figure 11: Mean total CPUE for A) Lake Whitefish, B) Northern Pike and C) Walleye captured in standard gang index gill nets set in Stephens Lake South in 2009, 2015, 2018, and 2021. Letters denote significant differences in CPUE between study years.

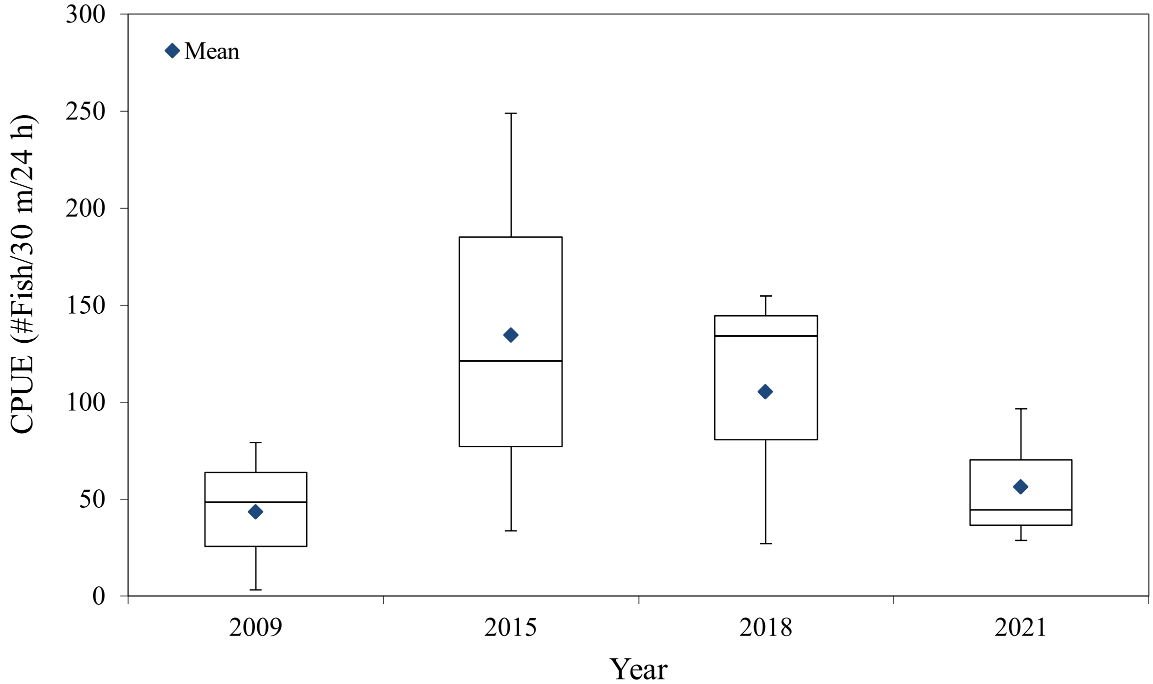


Figure 12: Mean total CPUE for all fish species captured in small mesh index gill nets set in Stephens Lake South in 2009, 2015, 2018, and 2021.

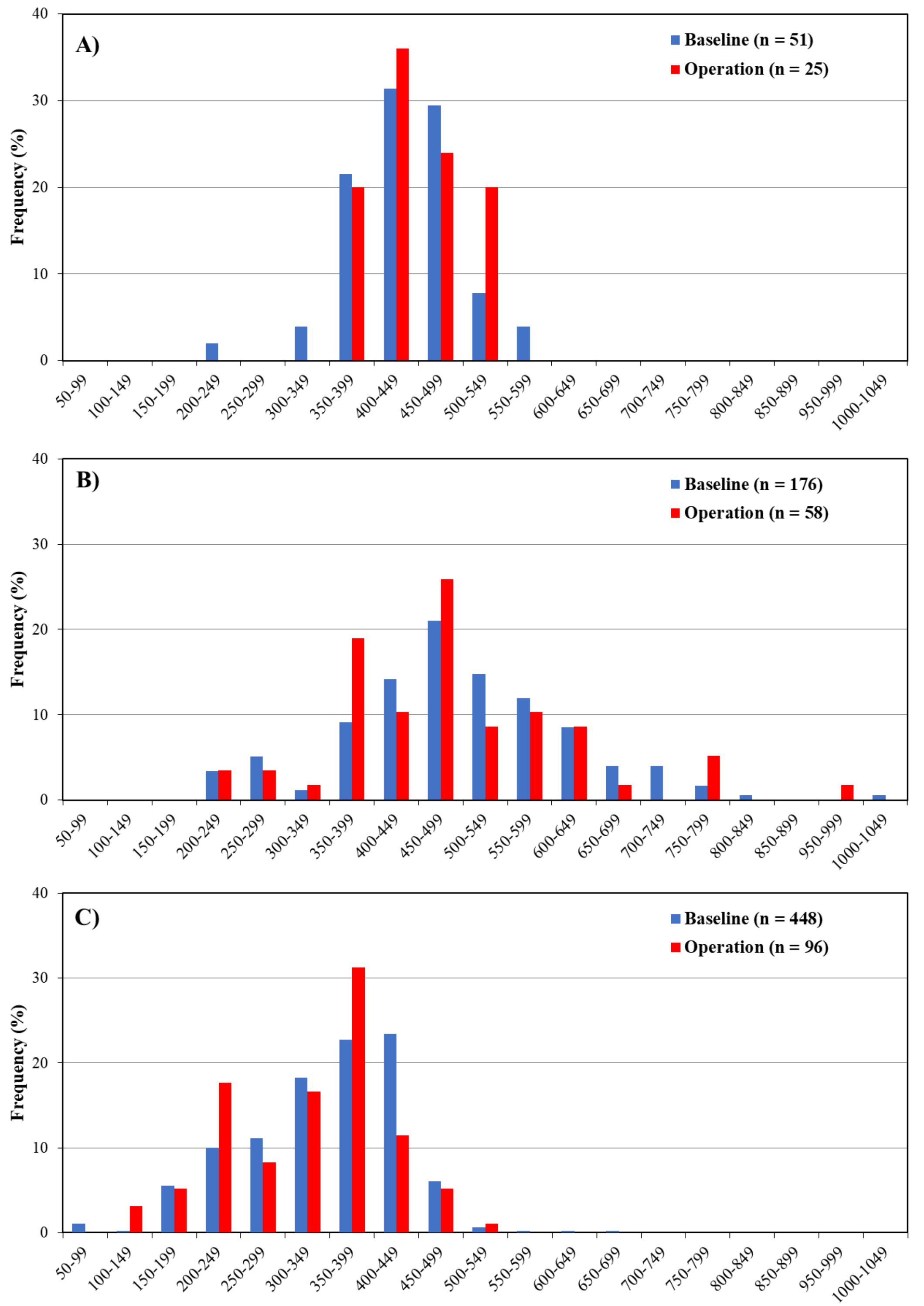


Figure 13: Fork length frequency distribution of A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang index gill nets in Split Lake, during baseline (2009, 2015, 2019) and 2021 monitoring.

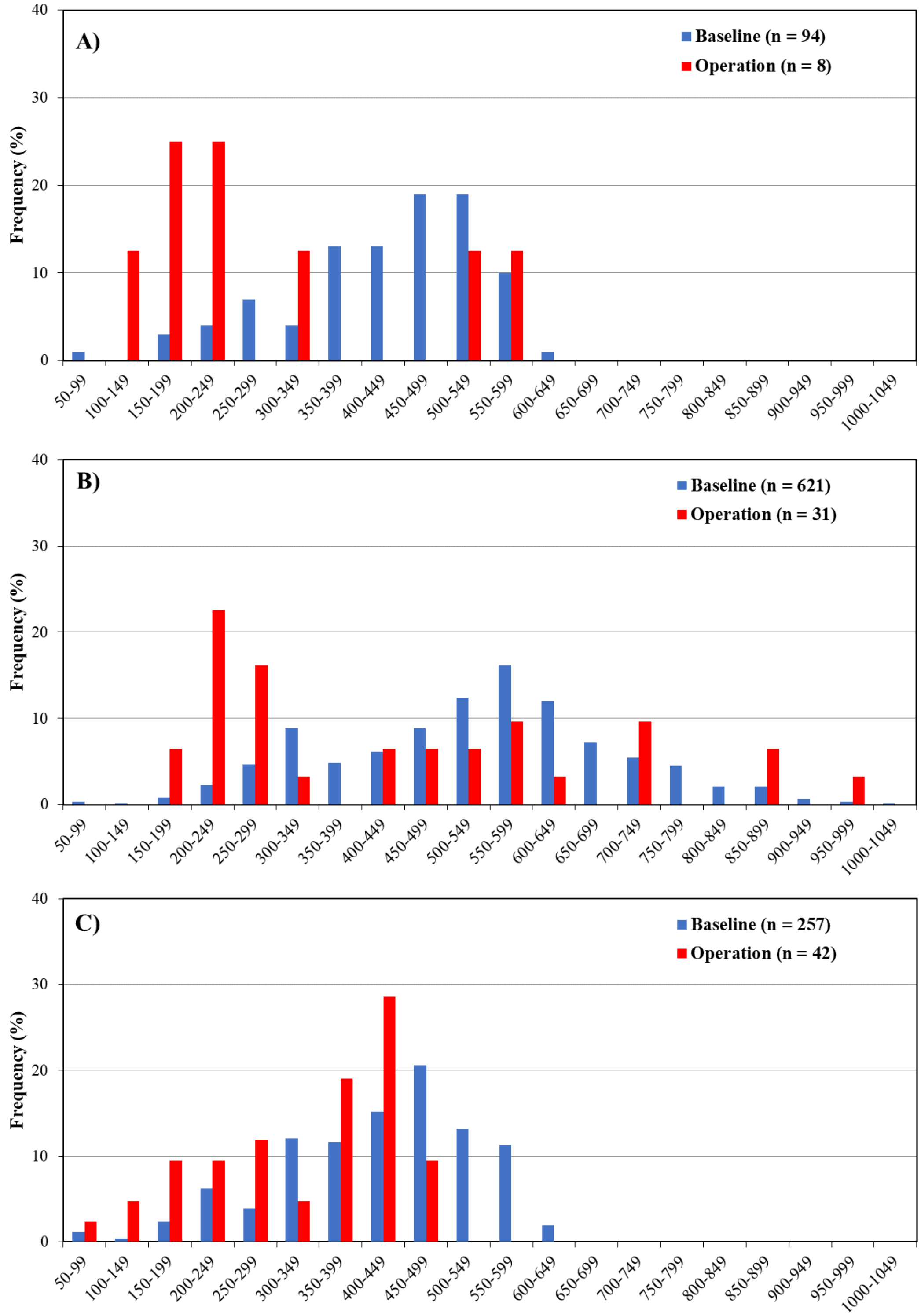


Figure 14: Fork length frequency distribution of A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang index gill nets in the Keeyask reservoir, during baseline (2001, 2002, 2009, 2015, 2019) and 2021 monitoring.

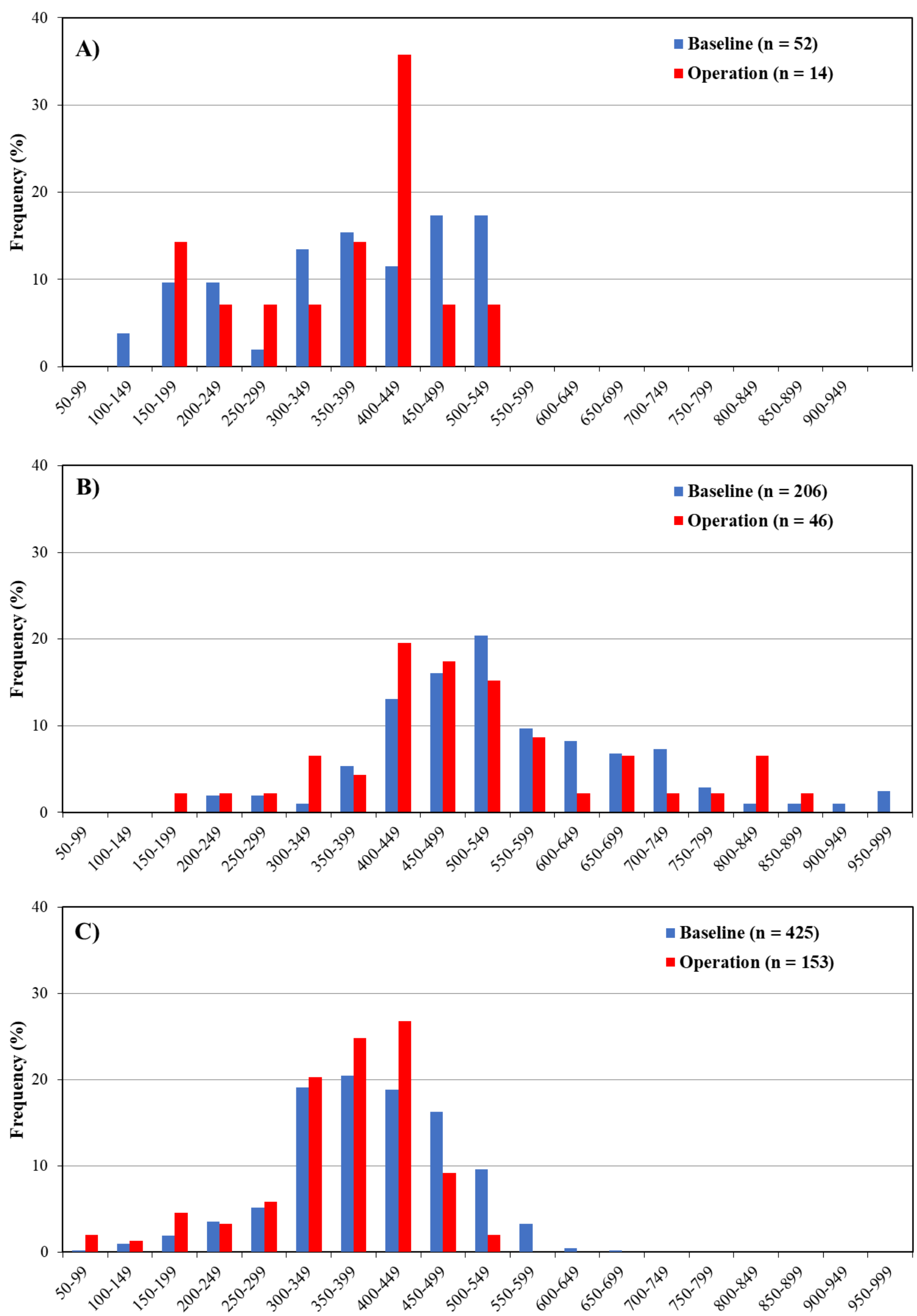


Figure 15: Fork length frequency distribution of A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang index gill nets in Stephens Lake North, during baseline (2009, 2015, 2018) and 2021 monitoring.

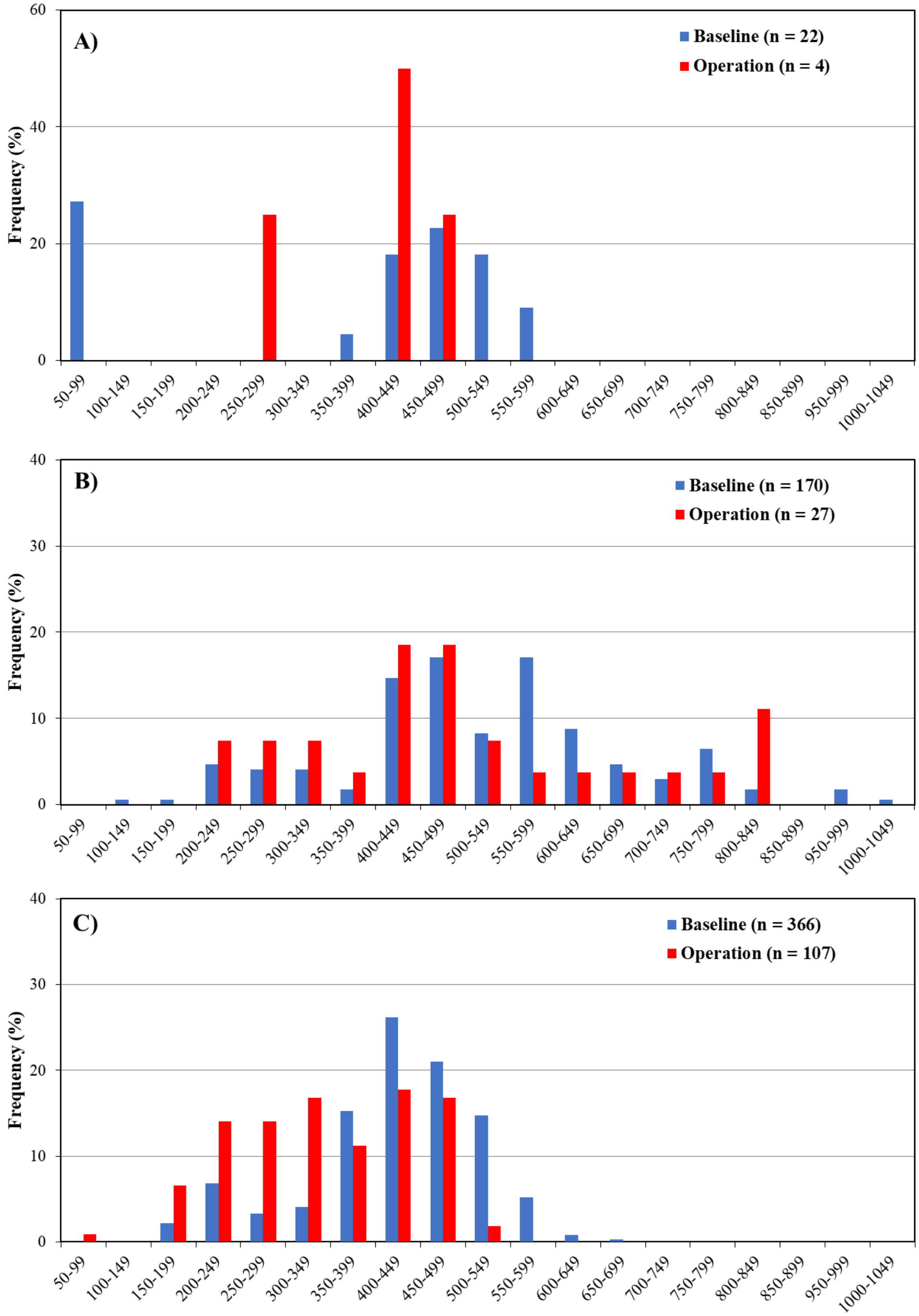


Figure 16: Fork length frequency distribution of A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang index gill nets in Stephens Lake South, during baseline (2009, 2015, 2018) and 2021 studies.

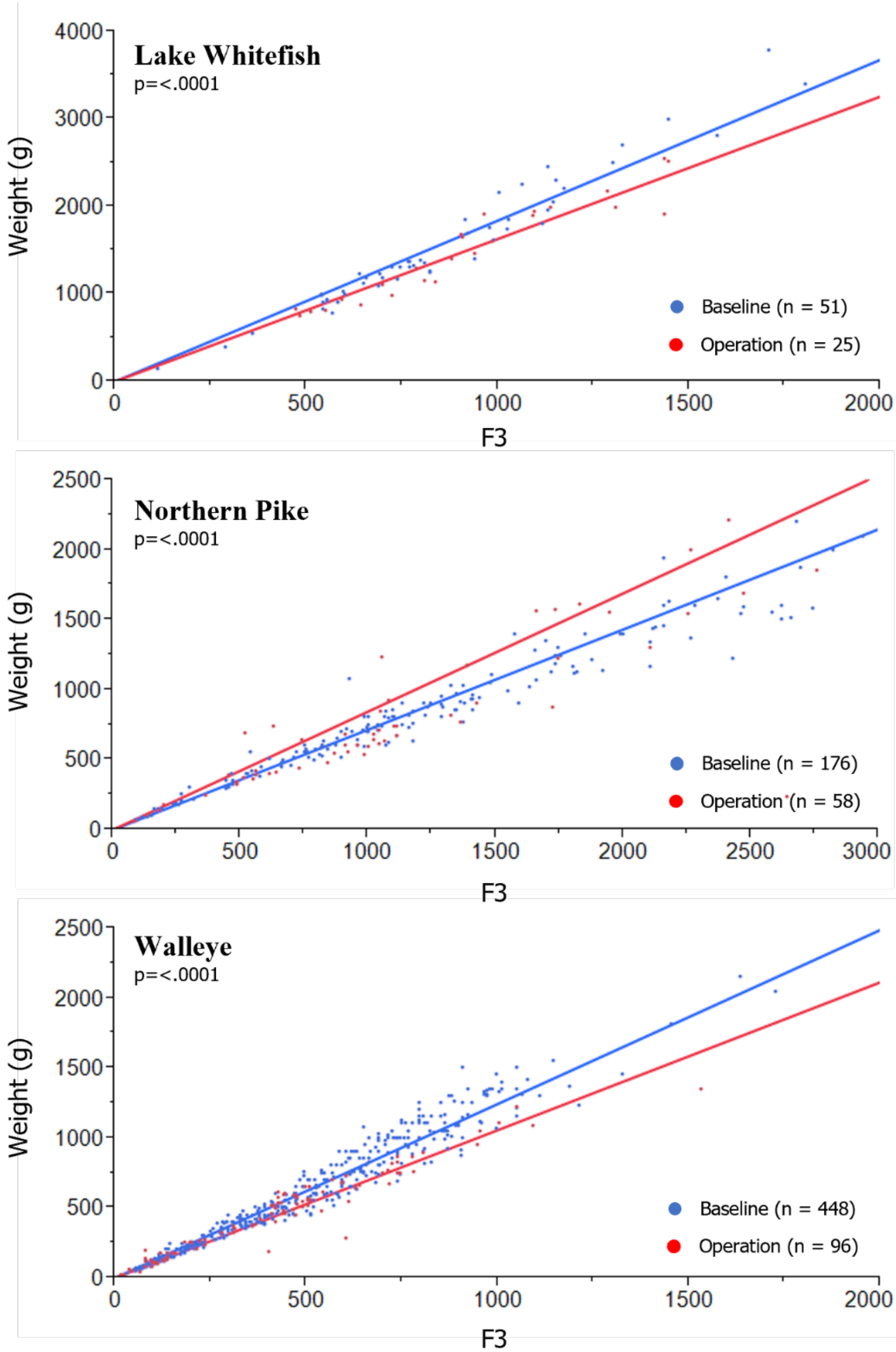


Figure 17: Bivariate plots of weight (Wt; g) versus FL3 (fork length [mm]^3/100,000) for VEC species captured in standard gang and small mesh index gill nets set in Split Lake during baseline (2009, 2015, 2019) and 2021 studies. Note that the slope of the lines is equivalent to the estimate of condition, and the x- and y-axes differ between plots.

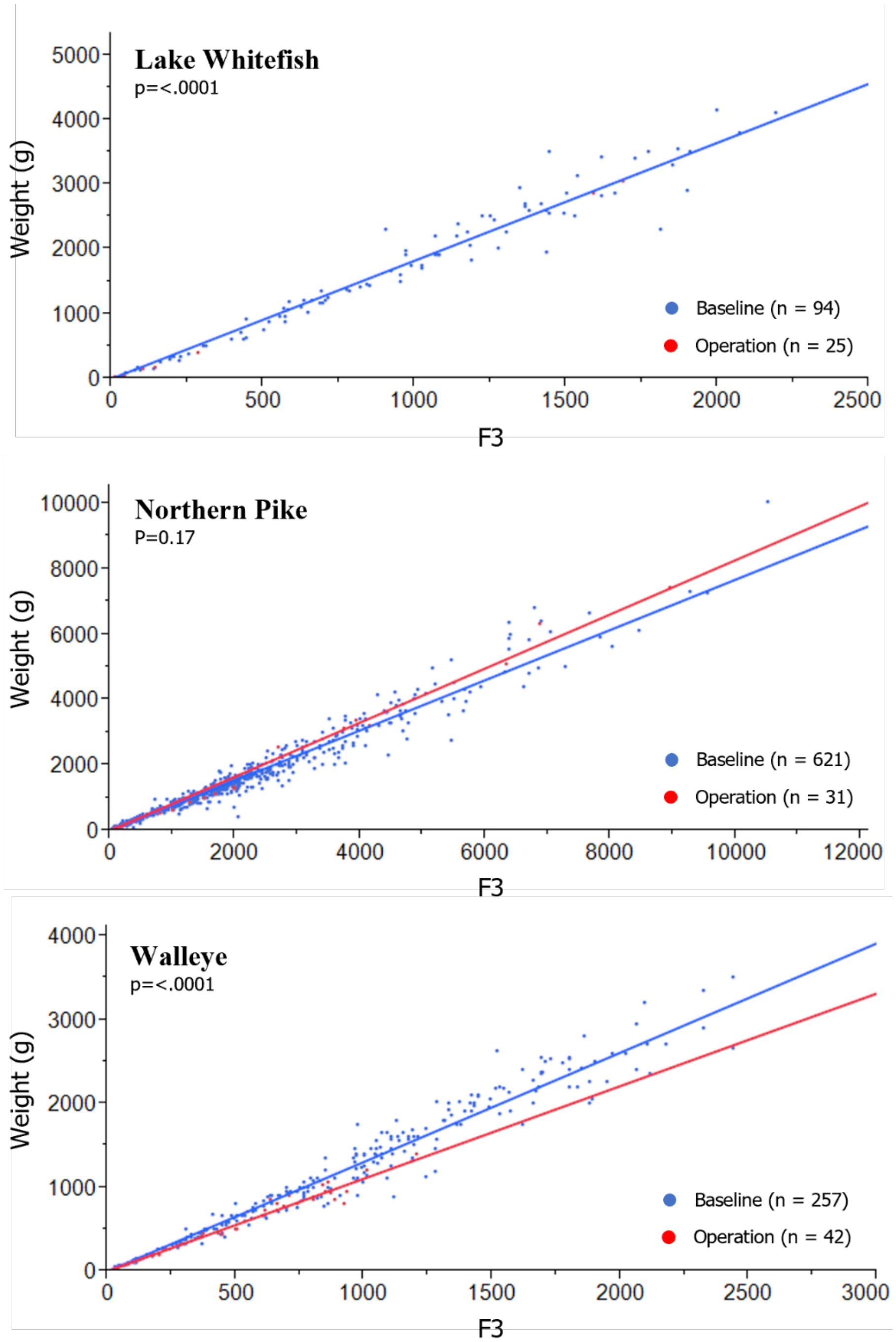


Figure 18: Bivariate plots of weight (Wt; g) versus FL3 (fork length [mm]^3/100,000) for VEC species captured in standard gang and small mesh index gill nets set in the Keeyask reservoir during baseline (2001, 2002, 2009, 2015, 2019) and 2021 studies. Note that the slope of the lines is equivalent to the estimate of condition, and the x- and y-axes differ between plots.

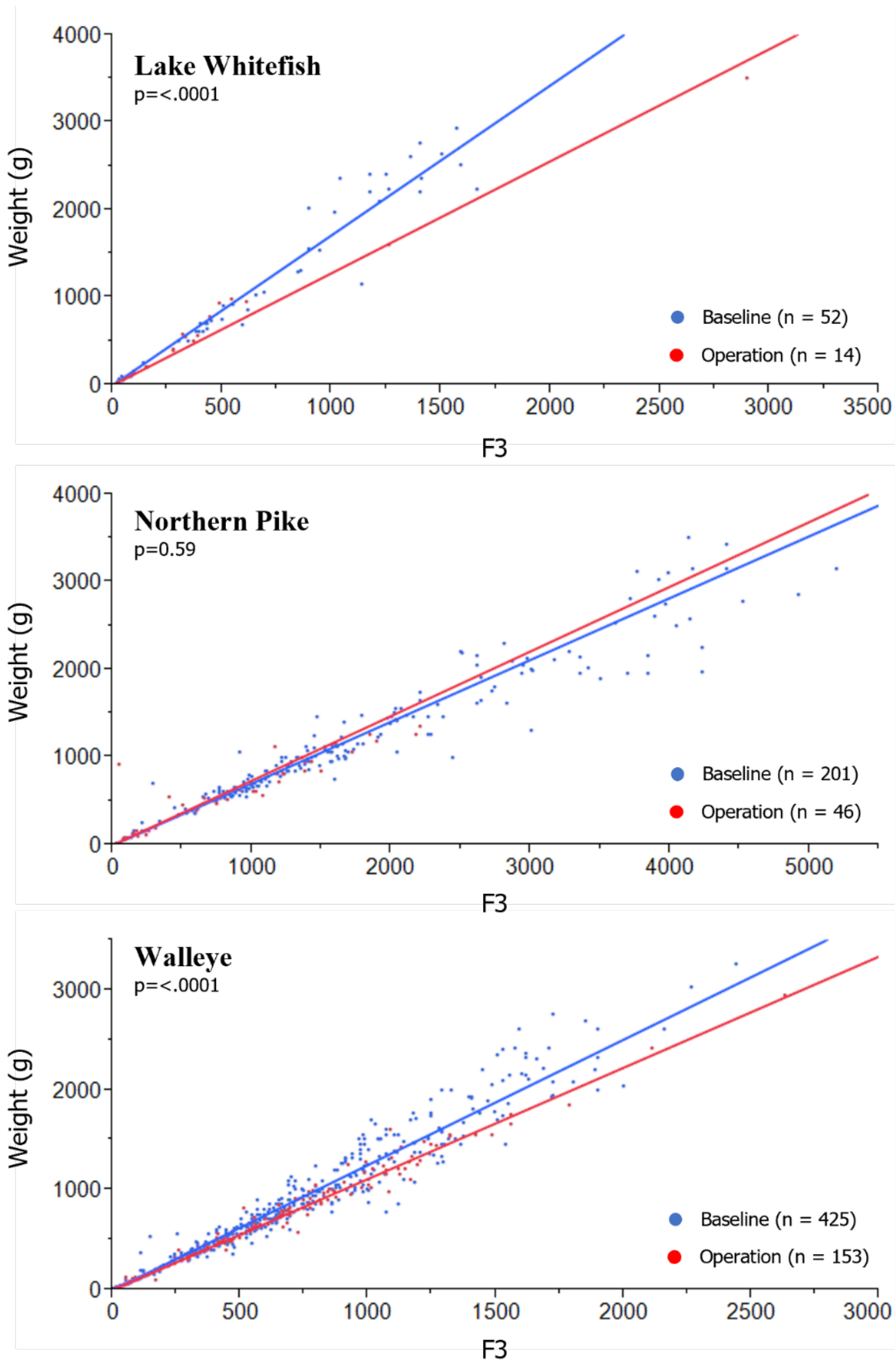


Figure 19: Bivariate plots of weight (Wt; g) versus FL3 (fork length [mm]^3/100,000) for VEC species captured in standard gang and small mesh index gill nets set in Stephens Lake North during baseline (2009, 2015, 2018) and 2021 studies. Note that the slope of the lines is equivalent to the estimate of condition, and the x- and y-axes differ between plots.

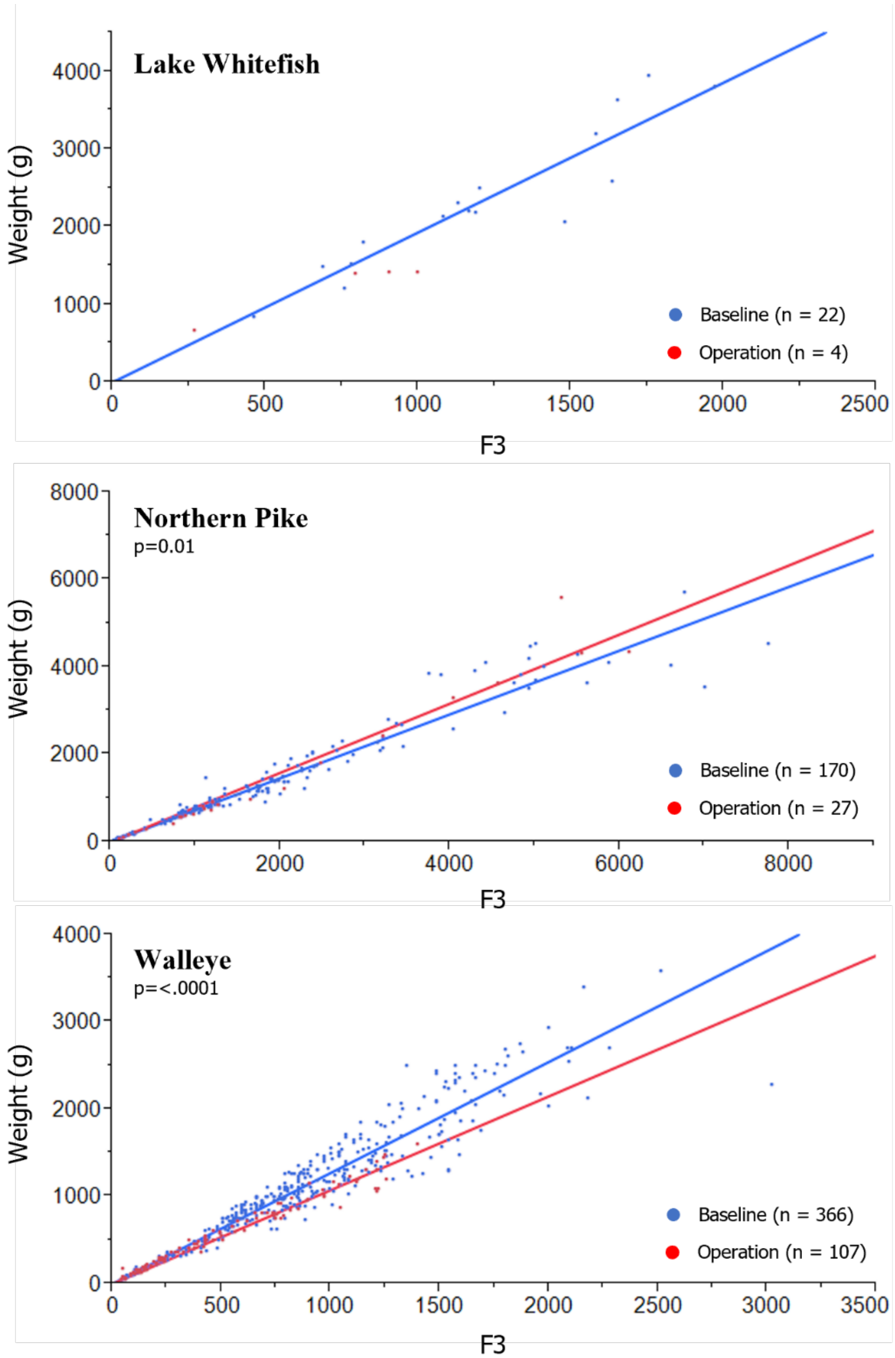


Figure 20: Bivariate plots of weight (Wt; g) versus FL3 (fork length [mm]^3/100,000) for VEC species captured in standard gang and small mesh index gill nets set in Stephens Lake South during baseline (2009, 2015, 2018) and 2021 studies. Note that the slope of the lines is equivalent to the estimate of condition, and the x- and y-axes differ between plots.

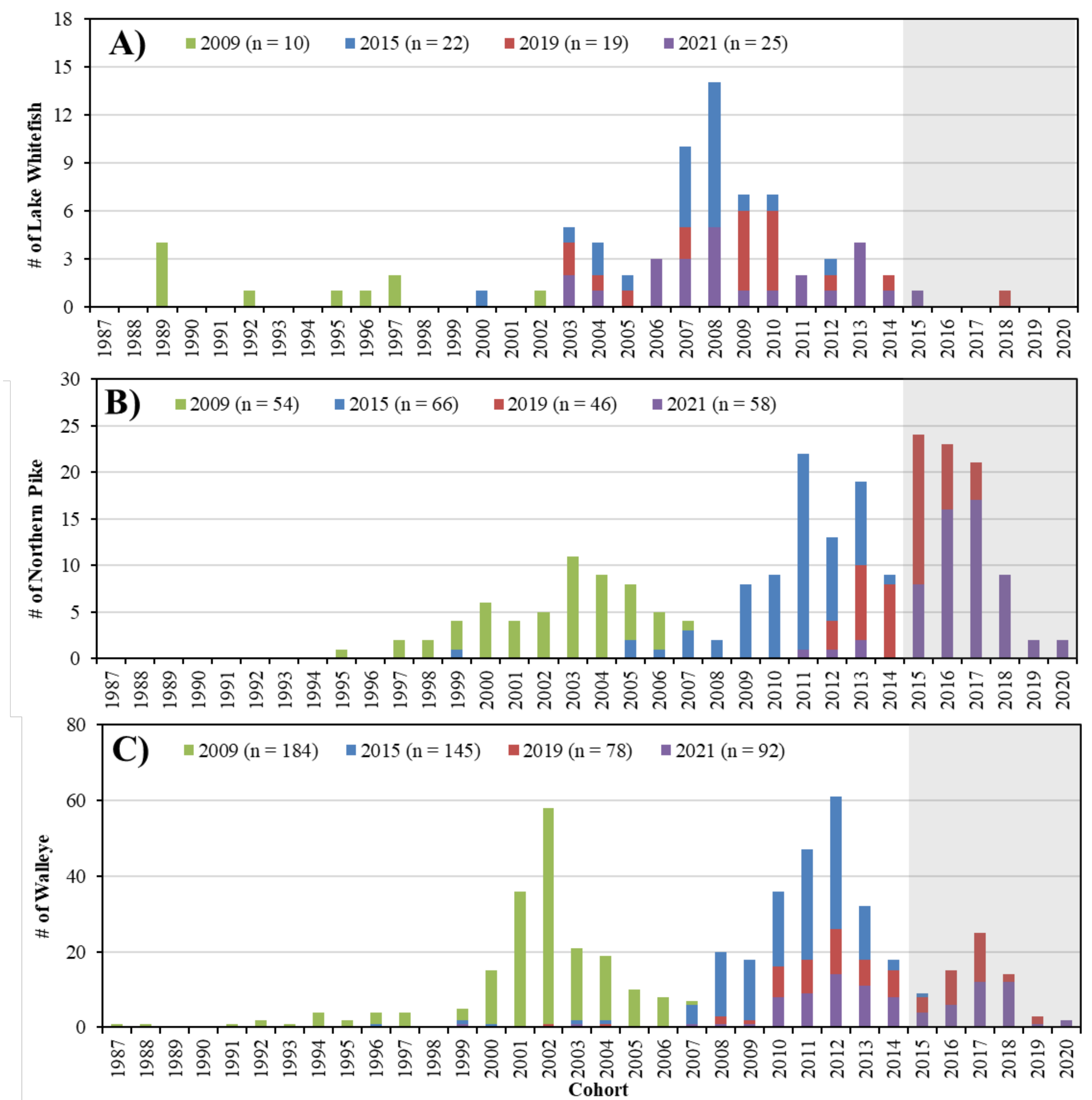


Figure 21: Cohort frequency distributions for A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang and small mesh index gill nets set in Split Lake in 2009, 2015, 2019, and 2021. Grey shading indicates fish spawned during Keeyask GS construction.

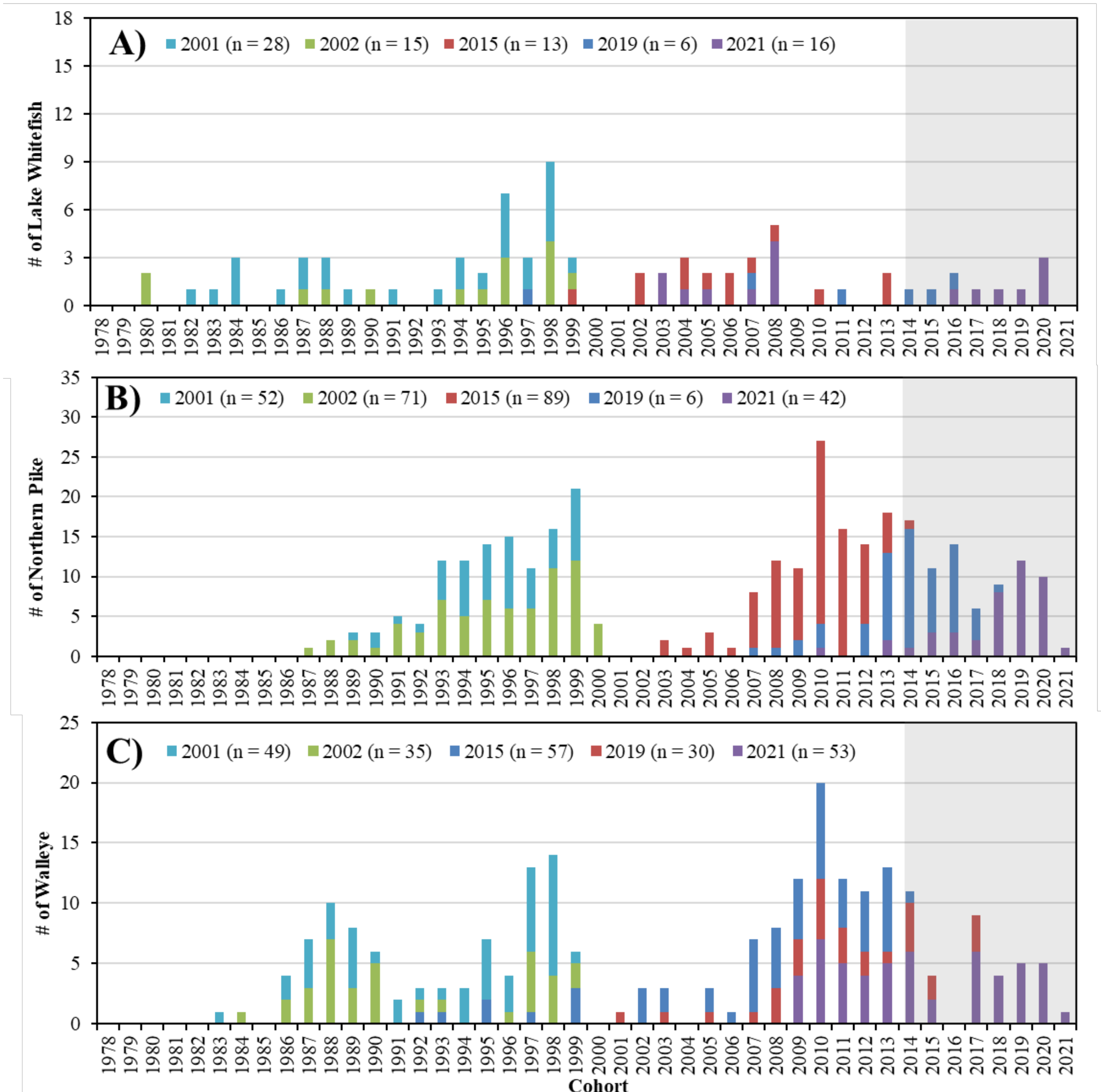


Figure 22: Cohort breakdown of A) Lake Whitefish B) Northern Pike and C) Walleye caught in standard gang and small mesh index gill nets set in the Keeyask reservoir in 2001, 2002, 2015, 2019, and 2021. Grey shading indicates fish spawned during Keeyask GS construction.

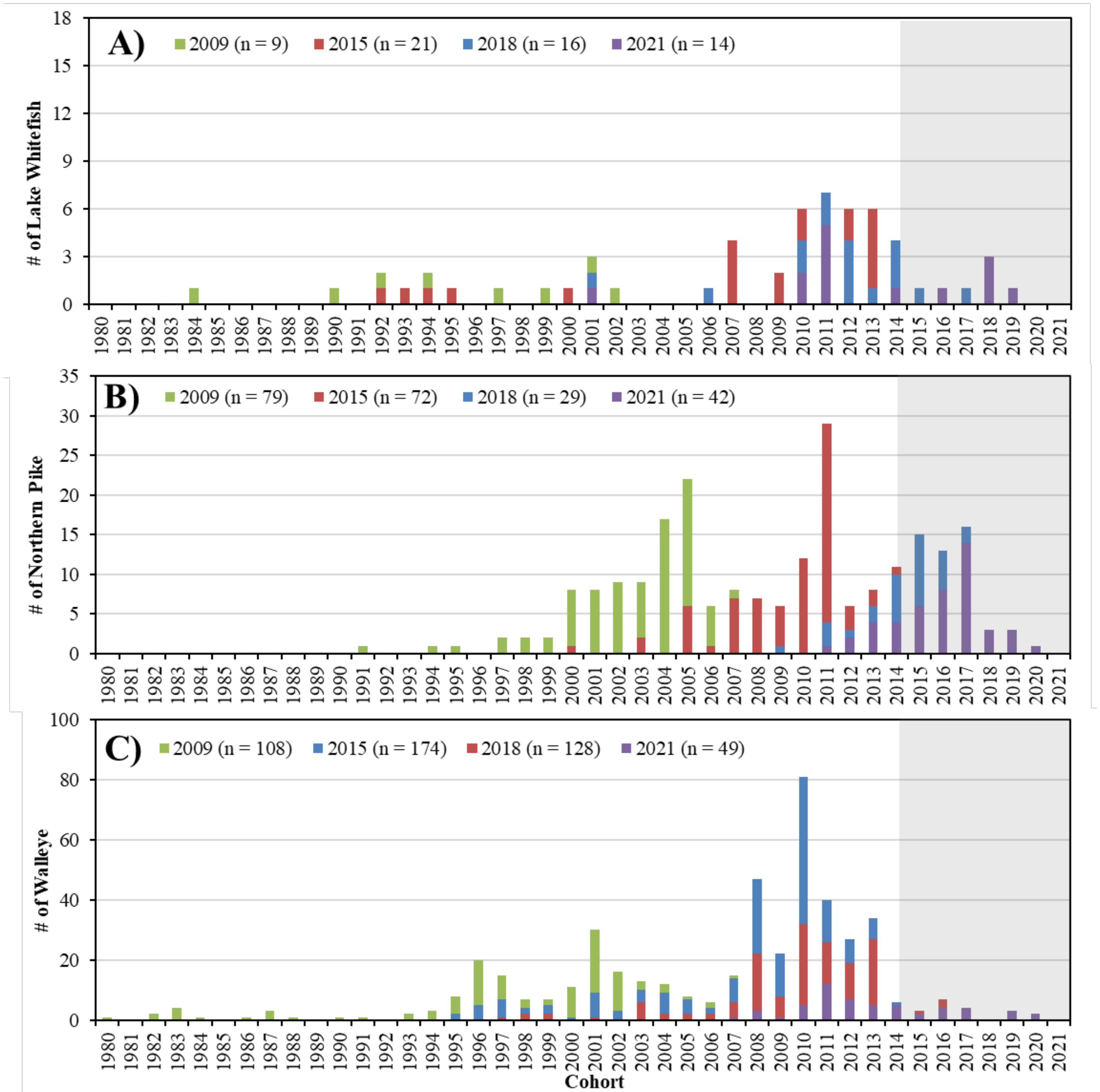


Figure 23: Cohort breakdown of A) Lake Whitefish B) Northern Pike and C) Walleye caught in standard gang and small mesh index gill nets set in Stephens Lake North in 2009, 2015, 2018, and 2021. Grey shading indicates fish spawned during Keeyask GS construction.

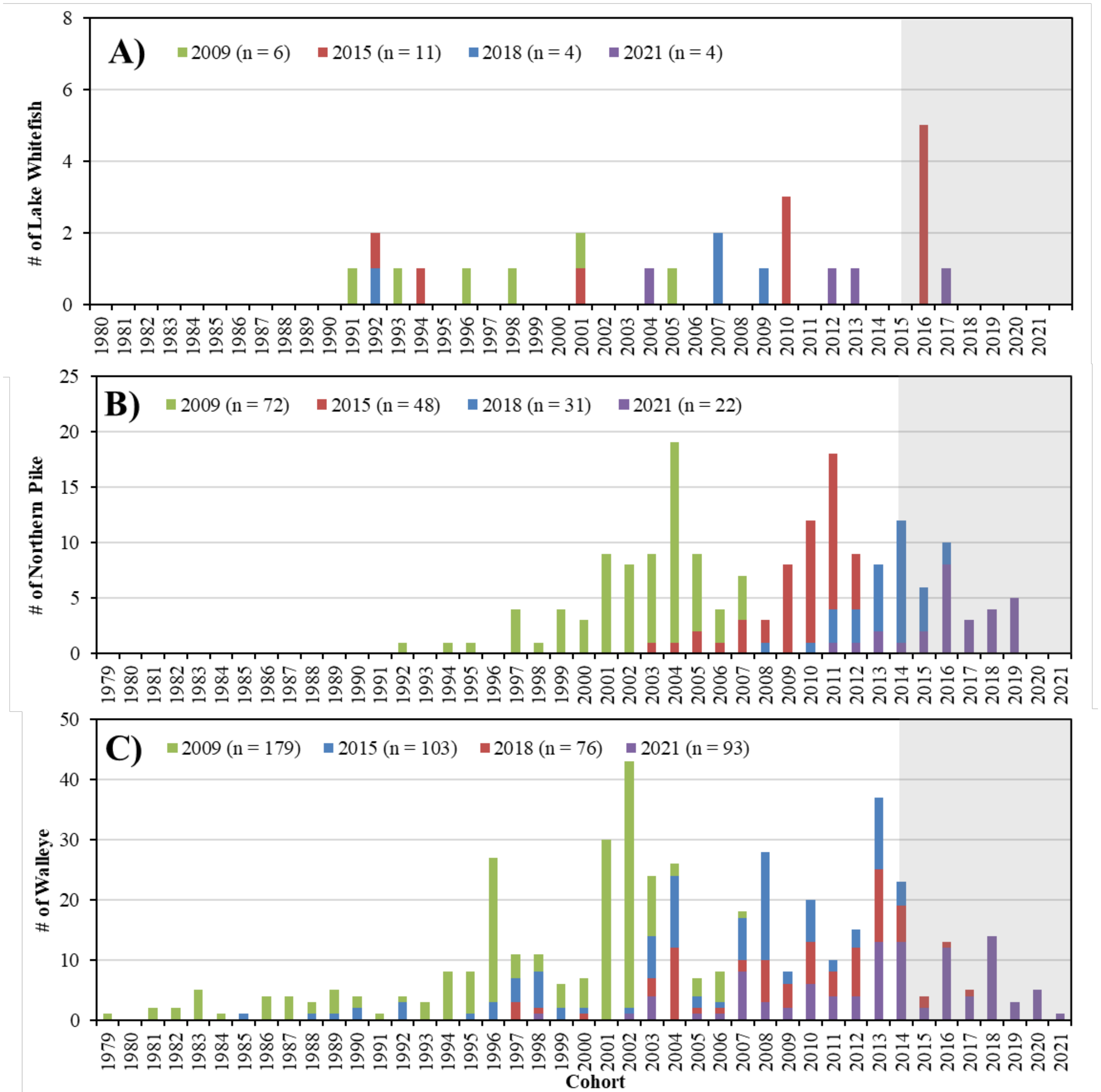


Figure 24: Cohort breakdown of A) Lake Whitefish B) Northern Pike and C) Walleye caught in standard gang and small mesh index gill nets set in Stephens Lake South in 2009, 2015, 2018, and 2021. Grey shading indicates fish spawned during Keeyask GS construction.

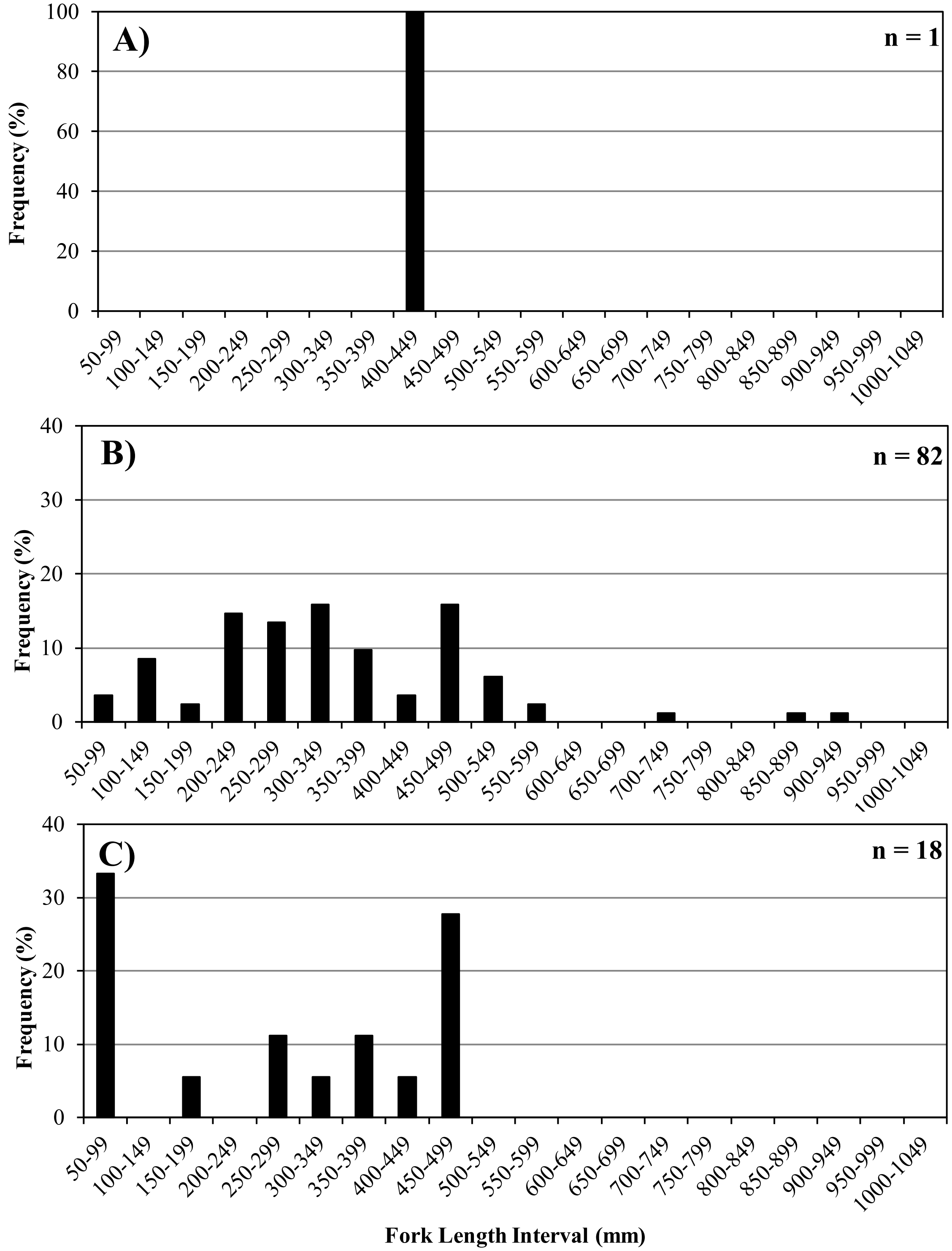
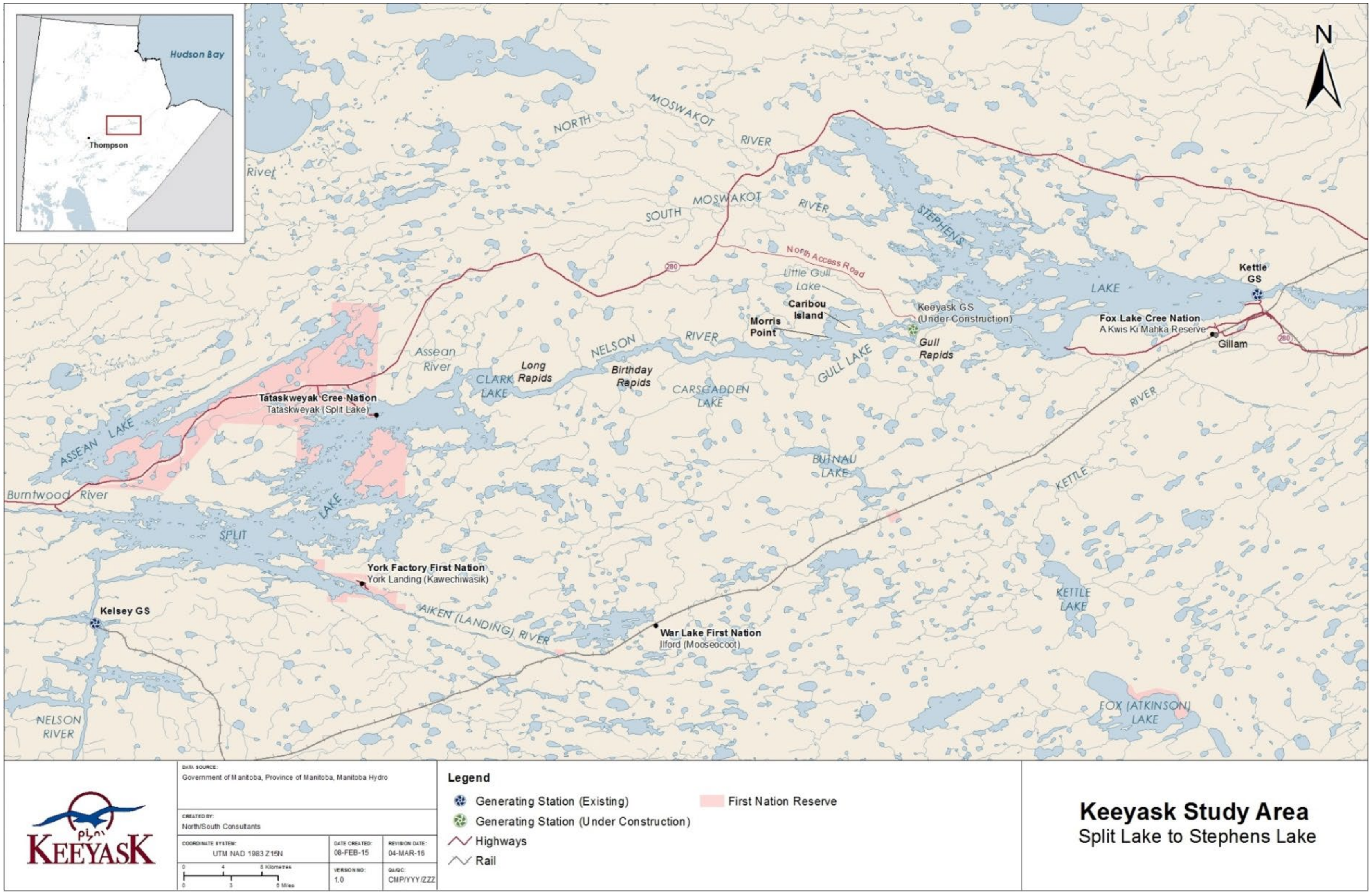
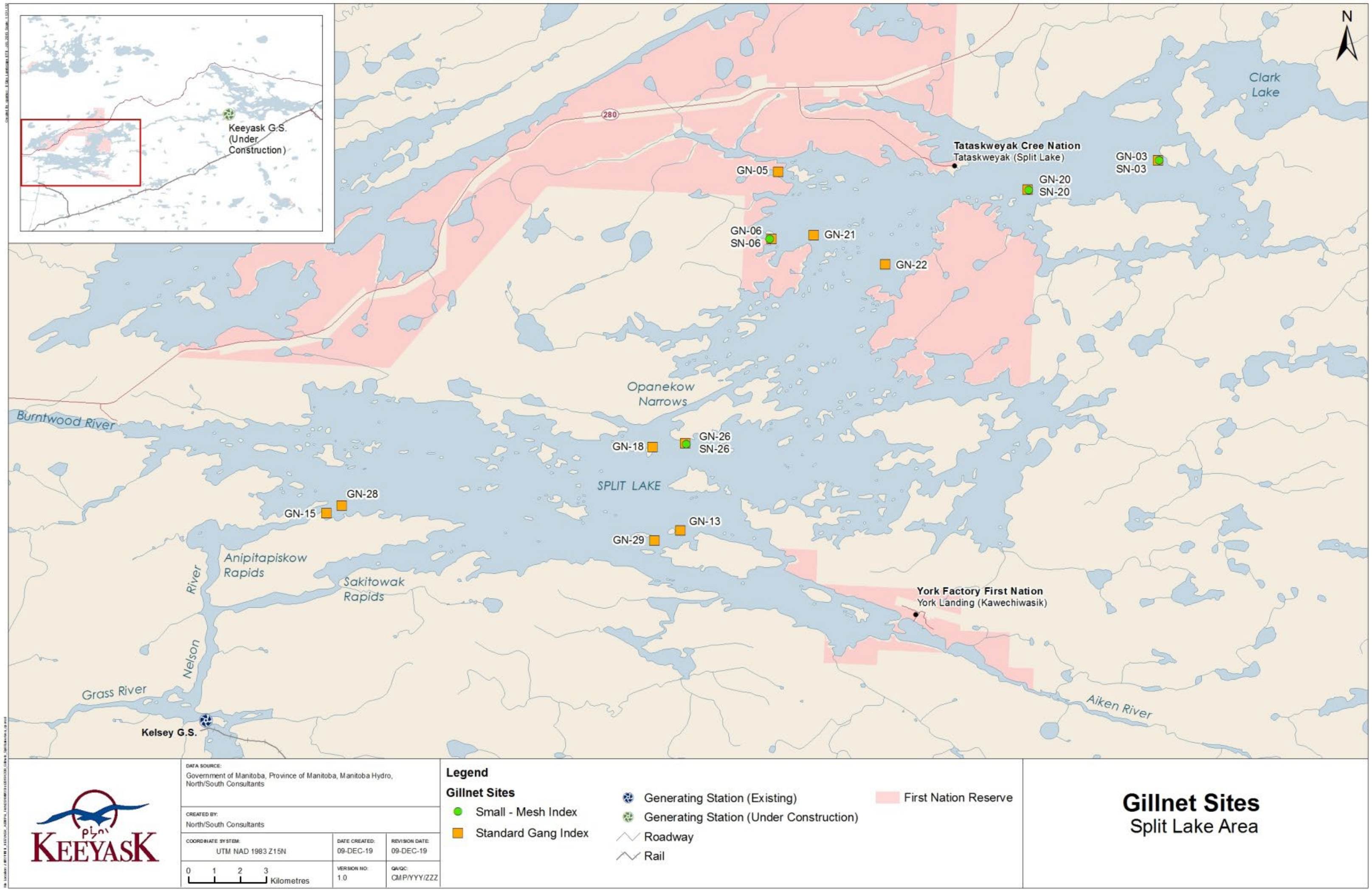


Figure 25: Fork length-frequency distribution of A) Lake Whitefish B) Northern Pike and C) Walleye captured in standard gang and small mesh index gill nets set at newly flooded sites in the Keeyask reservoir, summer 2021.

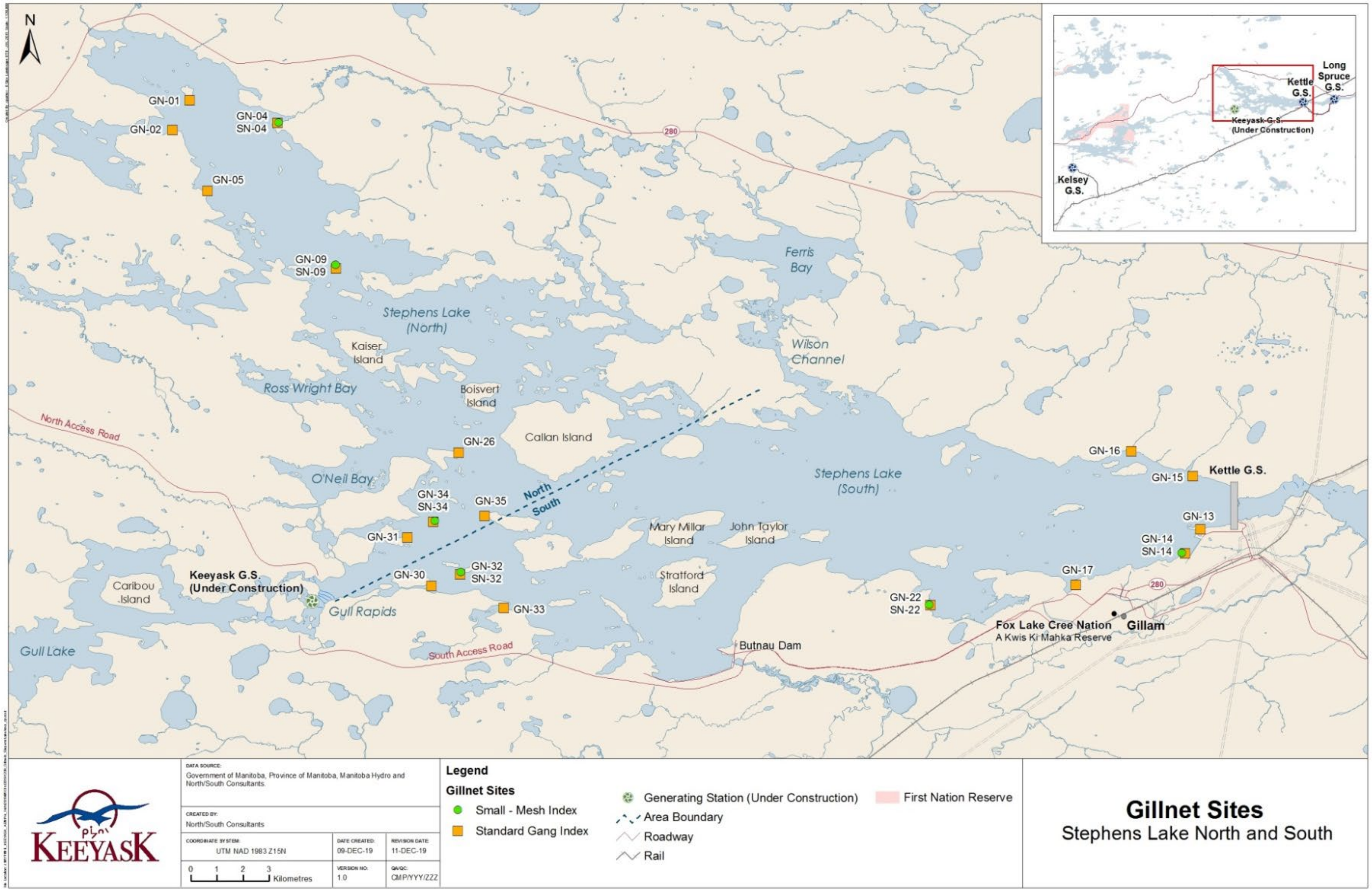
MAPS



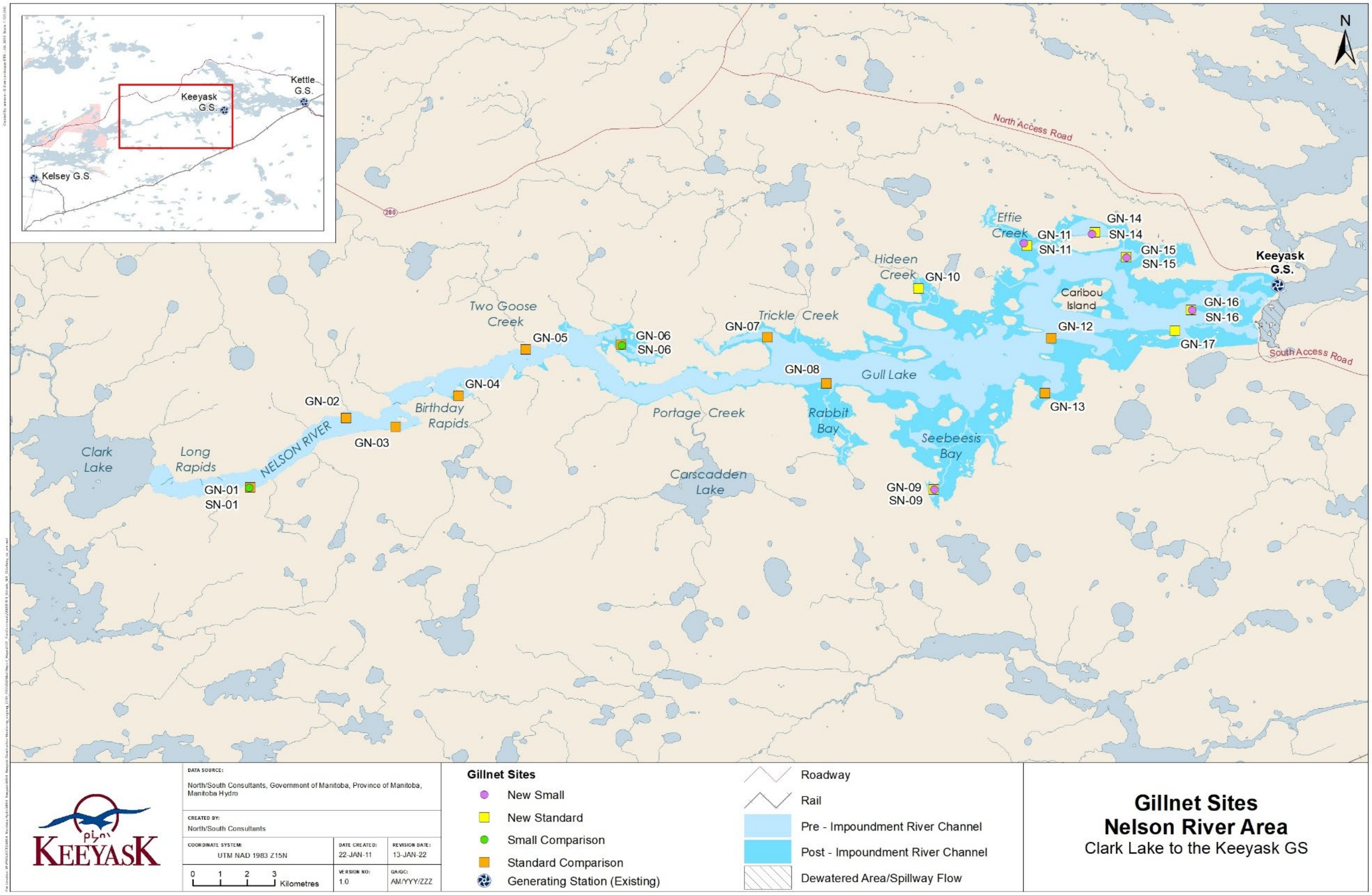
Map 1: Map of Nelson River showing the site of Keeyask Generating Station and the fish community study setting.



Map 2: Standard gang and small mesh index gillnetting sites in Split Lake, summer 2021.



Map 3: **Standard gang and small-mess index gillnetting sites set in Stephens Lake North and South, summer 2021.**



Map 4: Standard gang and small mesh index gillnetting sites set in the Keeyask reservoir, summer 2021.

APPENDICES

APPENDIX 1: GILLNET SURVEY INFORMATION FOR SPLIT LAKE, KEEYASK RESERVOIR, STEPHENS LAKE NORTH, AND STEPHENS LAKE SOUTH, SUMMER 2021

No table of figures entries found.

Table A1-1: Standard gang and small mesh index gillnet survey information, Split Lake, summer 2021.

Site	Date Set	UTM coordinates			Duration (dec. hours)	Depth (m)		velocity	substrate	Vegetation	Water Temp
		Zone	Easting	Northing		1.5"	5"				
GN-03	26-Aug-21	14V	657562	6221750	25.43	5.7	8.0	Low	Soft	-	15.8
GN-05	26-Aug-21	14V	669595	6225259	24.10	6.2	7.2	Low	Soft	None	15.8
GN-06	25-Aug-21	14V	657868	6221835	25.05	7.3	6.9	Low	Soft	-	16.3
GN-13	24-Aug-21	14V	669789	6221720	24.67	8.0	9.7	Low	Soft	None	15.8
GN-15	23-Aug-21	14V	670857	6225554	24.50	1.2	1.2	Low	Soft	None	15.7
GN-18	23-Aug-21	14V	670892	6222080	24.13	6.9	6.7	Low	Soft	None	16.3
GN-20	26-Aug-21	14V	673490	6233813	24.67	3.2	1.5	None	Soft	None	17.2
GN-21	25-Aug-21	14V	675327	6234107	26.08	2.2	3.2	None	Soft	None	15.0
GN-22	25-Aug-21	14V	677980	6233152	23.25	2.2	2.2	Low	Soft	None	15.0
GN-26	24-Aug-21	15V	316405	6237848	24.18	1.6	1.2	Low	Soft	None	15.7
GN-28	23-Aug-21	14V	673671	6236201	25.13	12.6	13.6	Low	Soft	None	15.7
GN-29	24-Aug-21	14V	683009	6236568	21.42	3.5	3.1	Low	Soft	None	15.8
		Small Mesh Sites				**16 mm**	**25 mm**				
SN-26	26-Aug-21	14V	670826	6225569	24.50	5.8	5.4	Low	Soft	None	14.6
SN-06	25-Aug-21	14V	673464	6233837	24.67	2.0	-	None	Soft	None	14.4
SN-03	26-Aug-21	15V	316433	6237834	24.18	8.5	10.4	Low	Soft	None	16.4
SN-20	24-Aug-21	14V	683152	6236556	21.42	1.1	2.0	Low	Soft	None	14.4

Table A1-2: Standard gang and small mesh index gillnet survey information, Keeyask reservoir, summer 2021.

Site	Date Set	UTM coordinates			Duration	Depth (m)		Velocity	Substrate	Vegetation	Water
		Zone	Easting	Northing	(dec.hours)	1.5"	5"				Temp
GN-01	9-Aug-21	15V	326063	6239774	26.23	1.5	2.3	High	-	None	19.5
GN-02	9-Aug-21	15V	329600	6242322	25.47	4.8	2.5	Low	Hard	None	19.5
GN-03	9-Aug-21	15V	331420	6241999	25.45	2.1	2.5	Low	Hard	None	19.5
GN-04	9-Aug-21	15V	333734	6243150	25.08	3.1	4.4	Medium	Hard	None	19.5
GN-05	13-Aug-21	15V	336216	6244849	23.73	3.3	7.3	Low	Soft	None	16.0
GN-06	13-Aug-21	15V	339727	6245029	24.23	4.2	4.8	None	-	None	16.4
GN-07	8-Aug-21	15V	345119	6245297	22.92	6.1	5.2	Low	Soft	None	19.5
GN-08	8-Aug-21	15V	347277	6243605	21.83	6.1	8.1	Low	Soft	None	19.3
GN-09	10-Aug-21	15V	351234	6239698	22.75	2.5	2.9	None	-	None	19.4
GN-10	8-Aug-21	15V	350668	6247099	23.97	1.6	2.0	None	Soft	Medium	19.4
GN-11	10-Aug-21	15V	354672	6248681	22.97	2.9	5.6	None	Soft	None	19.3
GN-12	7-Aug-21	15V	355564	6245264	22.88	7.8	7.0	Low	Soft	None	20.0
GN-13	7-Aug-21	15V	355339	6243246	23.5	5.5	6.0	None	Soft	None	20.0
GN-14	8-Aug-21	15V	357173	6249180	26.3	2.4	2.3	None	Soft	None	19.7
GN-15	7-Aug-21	15V	358329	6248265	25.92	6.3	6.5	None	-	None	19.9
GN-16	3-Aug-21	15V	360715	6246302	17.37	9.5	9.3	Low	-	None	18.0
GN-17	3-Aug-21	15V	360116	6245552	17.12	7.2	7.1	Low	Soft	None	18.0
		Small Mesh				**16 mm**	**25 mm**				
SN-01	9-Aug-21	15V	326030	6239765	26.23	1.5	1.5	High	Hard	None	19.5
SN-06	13-Aug-21	15V	339752	6245012	24.23	4.1	4.1	None	Soft	None	16.4
SN-09	10-Aug-21	15V	351258	6239699	22.75	2.0	2.0	None	Soft	Low	19.4
SN-11	10-Aug-21	15V	354564	6248763	22.97	2.9	2.9	None	-	None	19.3
SN-14	8-Aug-21	15V	357070	6249119	26.3	2.2	2.4	None	-	Low	19.7
SN-15	7-Aug-21	15V	358336	6248240	25.92	6.1	6.3	None	Soft	None	19.9
SN-16	3-Aug-21	15V	360748	6246316	17.37	9.0	9.5	Low	Hard	None	18.0

Table A1-3: Standard gang and small mesh index gillnet survey information, Stephens Lake North, summer 2021.

Site	Date Set	UTM Coordinates			Duration (dec. hours)	Depth (m)		Velocity	Substrate	Vegetation	Water Temp
		Zone	Easting	Northing		1.5"	5"				
GN-01	05-Sep-21	15V	359072	6265734	21.73	3.7	9.0	None	Soft	None	15
GN-02	05-Sep-21	15V	358259	6264462	21.45	8.1	1.8	None	Soft	None	15
GN-04	05-Sep-21	15V	362494	6264800	21.93	2.2	5.5	None	Soft	None	15
GN-05	05-Sep-21	15V	359688	6262218	21.22	1.5	3.1	None	Soft	None	15
GN-09	05-Sep-21	15V	364637	6259322	20.05	6.0	7.0	Low	Soft	None	15
GN-26	03-Sep-21	15V	369336	6252012	17.58	3.1	6.6	None	Soft	None	15
GN-31	03-Sep-21	15V	367228	6249001	17.00	1.0	3.3	None	Soft	None	15.5
GN-34	03-Sep-21	15V	368391	6249451	16.50	2.4	2.0	Low	Soft	None	15.5
GN-35	03-Sep-21	15V	370241	6249703	16.32	1.7	1.8	Low	Soft	None	15.5
Small Mesh						**16 mm**	**25 mm**				
SN-04	05-Sep-21	15V	362516	6264778	21.93	1.3	2.2	None	Soft	None	15
SN-09	05-Sep-21	15V	364603	6259345	20.05	1.6	6.0	Low	Soft	None	15
SN-34	03-Sep-21	15V	368369	6249477	16.50	0.9	2.4	Low	Soft	None	15.5

Table A1-4: Standard gang and small mesh index gillnet survey information, Stephens Lake South, summer 2021.

Site	Date Set	UTM Coordinates			Duration (dec. hours)	Depth (m)		Velocity	Substrate	Vegetation	Water Temp
		Zone	Easting	Northing		1.5"	5"				
GN-13	01-Sep-21	15V	359072	6265734	17.97	5.8	5.2	Low	-	Low	12.5
GN-14	02-Sep-21	15V	358259	6264462	22.97	2.7	11.3	-	-	Low	12.5
GN-15	02-Sep-21	15V	362494	6264800	22.07	6.2	17.7	None	-	None	12.5
GN-16	02-Sep-21	15V	359688	6262218	21.42	1.8	5.2	None	-	-	12.0
GN-17	01-Sep-21	15V	364637	6259322	17.08	1.6	3.5	None	-	-	15.0
GN-22	01-Sep-21	15V	369336	6252012	16.82	2.0	2.0	None	-	-	14.5
GN-30	31-Aug-21	15V	367228	6249001	15.82	9.0	2.4	Low	-	None	12.5
GN-32	31-Aug-21	15V	368391	6249451	15.98	14.1	14.8	Low	-	-	13.5
GN-33	31-Aug-21	15V	370241	6249703	16.25	2.1	0.9	None	-	-	13.5
Small Mesh						**16 mm**	**25 mm**				
SN-14	02-Sep-21	15V	362516	6264778	22.97	2.0	2.7	-	-	None	12.5
SN-22	01-Sep-21	15V	364603	6259345	16.82	1.5	2.0	None	-	Low	14.5
SN-32	31-Aug-21	15V	368369	6249477	15.98	10.7	14.1	Low	Soft	None	13.5

APPENDIX 2:
OCCURENCE OF DEBRIS IN STANDARD GANG AND SMALL MESH INDEX GILL NETS SET THROUGHOUT THE KEEYASK STUDY AREA, SUMMER 2021

No table of figures entries found.

Table A2-1: Occurrence of debris in standard gang and small mesh index gill nets set in Split Lake, summer 2021.

Gillnet Type	Site	Quantity of Debris	Type of Debris (%)						
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Algae	Aquatic Vegetation	Aquatic Moss	Silt/Mud
Standard Gang	GN-03	None	-	-	-	-	-	-	-
	GN-20	Low (< 5%)	-	-	-	-	100	-	-
	GN-05	Low (< 5%)	-	-	-	-	100	-	-
	GN-06	Low (< 5%)	-	-	10	-	90	-	-
	GN-26	Low (< 5%)	-	-	-	-	100	-	-
	GN-29	None	-	-	-	-	-	-	-
	GN-15	Moderate (5-15%)	-	-	10	90	-	-	-
	GN-28	Very High (> 26%)	-	-	95	-	5	-	-
	GN-18	None	-	-	-	-	-	-	-
	GN-13	Low (< 5%)	-	-	50	-	50	-	-
	GN-21	Low (< 5%)	-	-	100	-	-	-	-
	GN-22	None	-	-	-	-	-	-	-
Small Mesh	SN-03	None	-	-	-	-	-	-	-
	SN-06	Low (< 5%)	-	-	10	-	90	-	-
	SN-20	Low (< 5%)	-	-	-	-	100	-	-
	SN-26	Low (< 5%)	-	-	100	-	-	-	-

Table A2-2: Occurrence of debris in standard gang and small mesh index gill nets set in the Keeyask reservoir, summer 2021.

Gillnet Type	Site	Quantity of Debris	Type of Debris (%)						
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Algae	Aquatic Vegetation	Aquatic Moss	Silt/Mud
Standard Gang	GN-15	Low (< 5%)	-	-	-	-	100	-	-
	GN-12	Low (< 5%)	-	-	-	-	100	-	-
	GN-17	Moderate (5-15%)	-	-	100	-	-	-	-
	GN-16	Moderate (5-15%)	-	-	-	100	-	-	-
	GN-11	Moderate (5-15%)	-	-	90	-	10	-	-
	GN-10	Very High (> 26%)	-	-	-	-	100	-	-
	GN-13	Very High (> 26%)	-	-	-	-	100	-	-
	GN-07	Very High (> 26%)	-	-	-	-	100	-	-
	GN-06	Moderate (5-15%)	-	-	-	-	100	-	-
	GN-05	None	-	-	-	-	-	-	-
	GN-08	Low (< 5%)	-	-	100	-	-	-	-
	GN-04	Moderate (5-15%)	-	-	-	90	10	-	-
	GN-03	Moderate (5-15%)	-	-	5	95	-	-	-
	GN-02	Low (< 5%)	-	-	100	-	-	-	-
	GN-01	Very High (> 26%)	-	-	-	100	-	-	-
	GN-09	High (16-25%)	-	-	-	50	50	-	-
Small Mesh	SN-15	Low (< 5%)	-	-	-	-	100	-	-
	SN-16	Moderate (5-15%)	-	-	-	100	-	-	-
	SN-11	Moderate (5-15%)	-	-	90	-	10	-	-
	SN-06	Moderate (5-15%)	-	-	-	-	100	-	-
	SN-01	Very High (> 26%)	-	-	-	100	-	-	-
	SN-09	High (16-25%)	-	-	-	50	50	-	-

Table A2-3: Occurrence of debris in standard gang and small mesh index gill nets set in Stephens Lake North, summer 2021.

Gillnet Type	Site	Quantity of Debris	Type of Debris (%)						
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Algae	Aquatic Vegetation	Aquatic Moss	Silt/Mud
Standard Gang	GN-01	Low (< 5%)	-	-	100	-	-	-	-
	GN-02	Moderate (5-15%)	-	-	100	-	-	-	-
	GN-04	Moderate (5-15%)	-	-	100	-	-	-	-
	GN-05	Low (< 5%)	-	-	100	-	-	-	-
	GN-09	Low (< 5%)	-	-	100	-	-	-	-
	GN-26	Low (< 5%)	-	-	100	-	-	-	-
	GN-31	None	-	-	-	-	-	-	-
	GN-34	Low (< 5%)	-	-	100	-	-	-	-
	GN-35	Low (< 5%)	-	-	100	-	-	-	-
Small Mesh	SN-04	Moderate (5-15%)	-	-	100	-	-	-	-
	SN-09	Low (< 5%)	-	-	100	-	-	-	-
	SN-34	Low (< 5%)	-	-	100	-	-	-	-

Table A2-4: Occurrence of debris in standard gang and small mesh index gill nets set in Stephens Lake South, summer 2021.

Gillnet Type	Site	Quantity of Debris	Type of Debris (%)						
			Terrestrial Vegetation	Terrestrial Moss	Sticks	Algae	Aquatic Vegetation	Aquatic Moss	Silt/Mud
Standard Gang	GN-13	Low (< 5%)	-	-	100	-	-	-	-
	GN-14	Low (< 5%)	-	-	100	-	-	-	-
	GN-15	None	-	-	-	-	-	-	-
	GN-16	Moderate (5-15%)	-	-	100	-	-	-	-
	GN-17	Very High (> 26%)	-	-	100	-	-	-	-
	GN-22	Low (< 5%)	-	-	100	-	-	-	-
	GN-30	Low (< 5%)	-	-	100	-	-	-	-
	GN-32	Low (< 5%)	-	-	100	-	-	-	-
	GN-33	Moderate (5-15%)	-	-	100	-	-	-	-
Small Mesh	SN-14	Low (< 5%)	-	-	100	-	-	-	-
	SN-22	Low (< 5%)	-	-	100	-	-	-	-
	SN-32	Low (< 5%)	-	-	100	-	-	-	-