Keeyask Generation Project

Aquatic Effects Monitoring Plan

Adult Lake Sturgeon Population Monitoring Report

AEMP-2024-04

KEEYASK

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KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2024-04

ADULT LAKE STURGEON POPULATION MONITORING IN THE KEEYASK RESERVOIR AND STEPHENS LAKE, 2023

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. Monitoring results provide information to assess the accuracy of predictions, information to determine the actual effects of construction and operation of the GS on the environment, and whether 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, and water levels were raised to full supply level between August 31 and September 5, 2020. Commissioning of the powerhouse turbines was initiated after impoundment. They were brought into service one at a time with the final of seven turbines completed on March 9, 2022.

Lake Sturgeon (sturgeon) are one of the key species for monitoring because they are culturally important to local people, the local sturgeon populations have been previously impacted, and construction and operation of the GS will change or negatively impact important habitat. The plan to monitor the impacts of GS construction and operation on sturgeon includes several types of studies:

- Estimating the number of adults;
- Estimating the number and growth of juveniles (less than 800 millimetres [mm] in length);
- Identifying spawning locations and numbers of spawning fish; and
- Recording seasonal habitat use and long-distance movements (*i.e.*, past GSs or rapids) through movement studies.

Sampling for adult sturgeon is scheduled to alternate between the Upper Split Lake Area (the Burntwood River and the Nelson River downstream of the Kelsey GS) and the Keeyask Area (the Keeyask reservoir and Stephens Lake) with each area being sampled every second year. Sampling in the Keeyask Area was conducted as scheduled in spring 2021 and again in spring 2022 due to the large number of adult sturgeon that moved downstream through the Keeyask GS during this period. Sampling in 2023 was the third consecutive year that monitoring was conducted in the Keeyask Area, representing the first three years since reservoir impoundment in 2020 and the first two years since the GS became fully operational (2022 and 2023).

This report presents results of adult sturgeon population monitoring conducted in the Keeyask reservoir (*i.e.*, the Nelson River between Clark Lake and the Keeyask GS) and Stephens Lake (see study area map below) during spring, 2023.

Why is the study being done?

Monitoring of the adult sturgeon population in the Keeyask reservoir and Stephens Lake is being done to answer several questions:

Is there a change in how many sturgeon are in Keeyask reservoir and Stephens Lake?

Population estimates will allow us to determine if and how the number of adults is changing as we try to increase the number of sturgeon by stocking young fish. Sturgeon are different from other fish in Manitoba because they do not begin to reproduce until they are at least 15 years old, and they can live a very long time (more than 60 years and even up to 100 years). If the adult fish disappear, then recovery of the population will depend on young fish eventually growing to adult size and reproducing. Stocking of fish while there is no natural reproduction would be important for population recovery.

Is there a change in the mortality rate of sturgeon in the Keeyask reservoir and Stephens Lake?

If the mortality rate increases, steps would need to be taken to determine the cause and to develop a plan to stop further decreases in the population.

Is there a change in the number of sturgeon captured in Stephens Lake each year the monitoring occurs?

This question is important because spawning sites in Stephens Lake changed based on operation of the GS (*i.e.*, sturgeon may use both the spillway and tailrace when water levels are high and the spillway is open, but only the tailrace when water levels are low and the spillway is closed). Changes in the number of fish captured and where they are captured will tell us if the population is increasing or decreasing and where they are spawning.

Is there a significant change in the condition (how fat they are) of sturgeon in the Keeyask reservoir and in Stephens Lake?

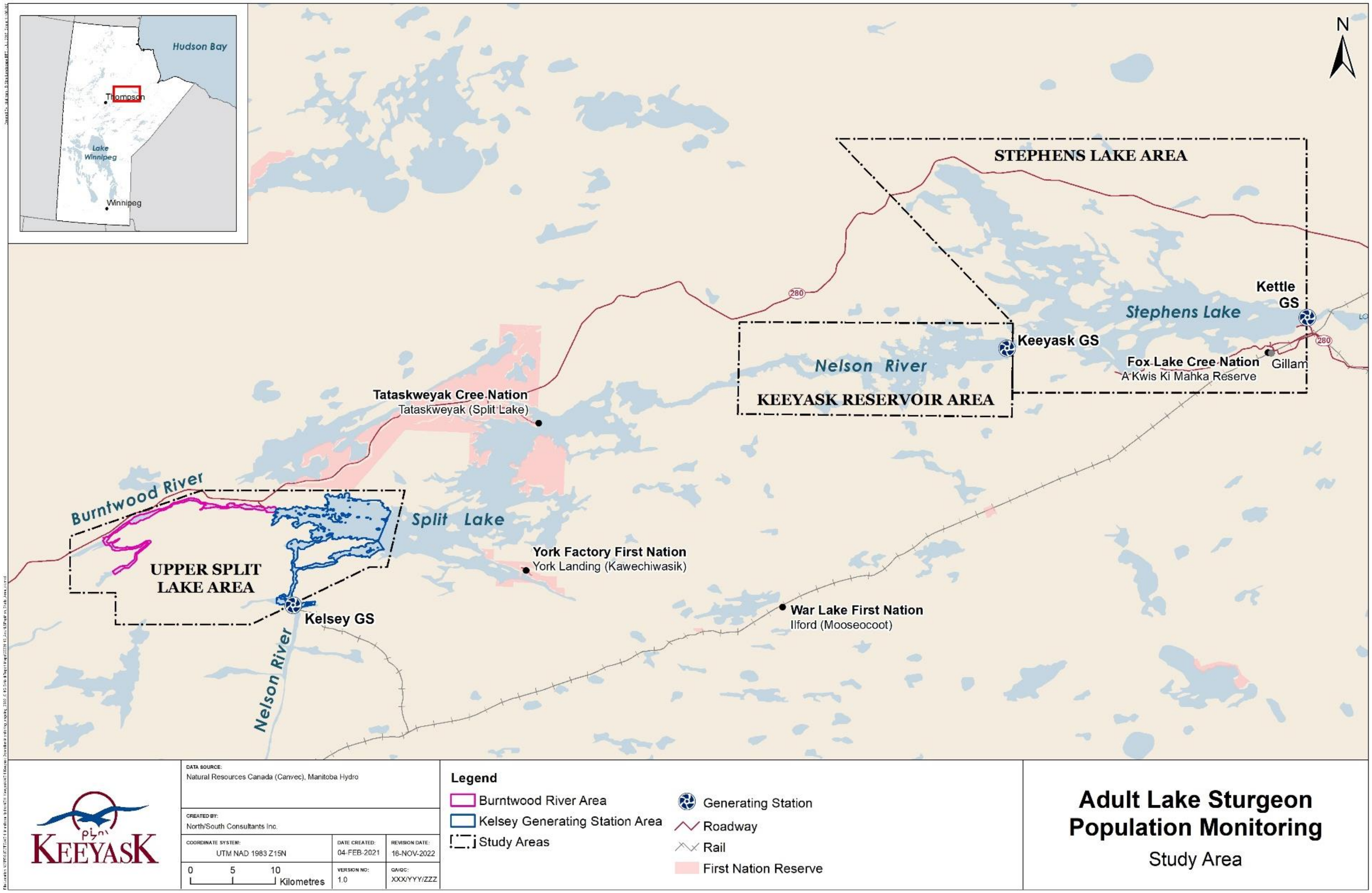
This question is important because if sturgeon become fatter or skinnier than they used to be, something is changing in their environment. It might also mean that stocking has increased population levels to the point that there is not enough food for all the fish, and stocking should be reduced or stopped.

Are spawning adults present in the Keeyask reservoir and Stephens Lake?

This question is important because if there are no spawning fish, recruitment will not happen, and the populations will decrease. If this happens, efforts would be needed to find the cause (for example, if there is no suitable habitat for spawning).

Where (on a coarse-scale) do sturgeon spawn after the Keeyask GS was built?

This question is important to make sure that there is suitable habitat for sturgeon spawning.



Map of the lower Nelson River showing the site of the Keeyask Generating Station and the sturgeon study setting.

What was done?

Sampling in 2023 was conducted from May 24–July 1 in both the Keeyask reservoir and Stephens Lake. Gill nets were set to target adult sturgeon. For this study, sturgeon that were 800 mm or longer were considered adults. The exact size when sturgeon become mature and ready to spawn can vary, but previous information from the area tells us that 800 mm is a good standard size to determine if fish are mature.

Scanning adult sturgeon for a PIT tag (left), weighing adult sturgeon (middle), and releasing adult sturgeon after it was captured and sampled (right).

Gill nets were set in places where adults are known to occur, including at spawning sites, because sturgeon gather there to spawn in spring and are easy to catch. When a fish was caught it was measured, weighed, and examined for signs of spawning. If the fish was not already tagged, then two different tags were applied: an external Floy tag and a small internal PIT tag. If the captured fish had already been tagged, then the tag numbers were recorded before the fish was released. Tagging and recapturing fish makes it possible to estimate how many sturgeon are in a population. Populations are estimated using a model. Each year, as more data are collected and added to the model, the population estimates are adjusted. Therefore, these estimates are recalculated each sampling year and might differ between reports. A catch-per-unit-effort (CPUE) is also calculated which is the total catch divided by the total amount of effort (time and net size) used to capture the fish. This number can also tell us about abundance as the CPUE goes up or down over time.

What was found?

A total of 50 sturgeon were captured in the Keeyask reservoir in 2023. Approximately half (23 fish) were classified as adults. Twenty of these adults were recaptures from previous gillnetting studies, four were hatchery-reared fish captured for the first time since stocking (these fish are still juvenile size), one was previously tagged during a TCN traditional knowledge study, and 25 were untagged fish. Four of the 20 recaptured fish and all four hatchery-reared fish were juvenile sized, measuring <800 mm in length, while the rest were adult sized. A total of seven spawning fish were caught, all of which were males captured near Birthday Rapids. Too few fish were caught in 2023 to compare condition factor to previous years, but average condition was within the range seen in other years. In 2023, the population was estimated at 123 individuals (which is much lower than in previous years) with a 92% survival rate (which is similar to previous years). The CPUE (0.13 sturgeon/91.4 m net/24 h) was lower than any recent study year (*i.e.*, since 2011).

Sturgeon caught in the Keeyask reservoir (left and middle) and Stephens Lake (right) in spring 2023.

A total of 159 sturgeon were captured in Stephens Lake in 2023. Most (124 fish) were classified as adults. Of the total captured, 82 were recaptures from previous gillnetting studies, two were hatchery-reared fish captured for the first time since stocking, and 75 had not been tagged before. A large number (45 fish or 55%) of recaptured fish in Stephens Lake were last captured in the Keeyask reservoir. The majority of these fish (39 fish or 87%) were adults, measuring ≥800 mm in length. One spawning male was caught downstream of the Keeyask GS near the powerhouse tailrace and two spawning males were caught approximately 3.5 and 5.0 km downstream of the powerhouse, closer to the center of the river. It is not unusual to catch few spawners because the area where fish spawn has very fast water and it is not possible to set nets. Condition factor was significantly higher for fish between 850–899 and 950–999 mm long during construction compared to operation but was similar for all other sizes of fish during baseline, construction, and operation. Because a large number of sturgeon from the Keeyask reservoir moved downstream into Stephens Lake during operation, any differences in average condition factor in fish from the two areas may influence these results (*i.e.*, mean condition factor in Stephens Lake may be lower during operation because of an influx of fish from the Keeyask reservoir with a lower condition). However, the same result was observed when all fish originally tagged in the Keeyask reservoir and recaptured in Stephens Lake were removed from analyses. In 2023, the population was estimated at 1,291 individuals with 99% survival, which is high. The estimate shows that the number of adult fish in Stephens Lake is increasing. The CPUE (0.42 sturgeon/91.4 m net/24 h) was slightly lower than 2021 and 2022, but still among the highest since sampling began in 2001.

What does it mean?

The EIS predicted that the number of adult sturgeon in the Keeyask reservoir would initially decrease after impoundment because fish would move out of the area, both upstream and downstream. Fewer adult sturgeon were captured in the Keeyask reservoir in 2023 than in any recent study year. The population estimate shows that the adult population is decreasing. This is likely because a large number of adult sturgeon moved out of the Keeyask reservoir between 2021 and spring 2023, which can be seen in the large number of sturgeon from this area that were recaptured in Stephens Lake and through results of the adult sturgeon movement study which shows between 8 and 32% of acoustically tagged fish have moved downstream through the Keeyask GS each year since the reservoir was impoundment. Increased water levels in the Keeyask reservoir may also make it harder to catch sturgeon. Despite this, spawning fish were captured in the Keeyask reservoir and young-of-the-year fish were captured during studies in fall 2023, both indicating successful spawning. All seven males in spawning condition that were captured in the Keeyask reservoir were caught near spawning habitat at Birthday Rapids. Condition factor fell within the range seen in previous years suggesting that enough feeding habitat is present in the reservoir.

Unlike the Keeyask reservoir, the number of adult sturgeon in Stephens Lake is increasing. The 2023 population estimate was only slightly different from 2022 and was significantly larger than the 2021 estimate. This is likely due partly to the large number of fish that have moved downstream from the Keeyask reservoir. The population estimate also shows a significant increasing trend since 2003, showing that the population is growing in the long-term.

What will be done next?

Monitoring will continue in the Keeyask reservoir and Stephens Lake every two years until 2044, next occurring in 2025. Sampling in the Upper Split Lake area (the Burntwood River between First Rapids and Split Lake and the Nelson River between the Kelsey GS and Split Lake) will take place in the spring of 2024. Sampling will be conducted during the spawning period in Stephens Lake in 2024 to capture spawning adult fish for broodstock collection.

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 STUDY SETTING 3
3.0 METHODS 5
3.1 GILLNETTING 5
3.2 DATA ANALYSIS 6
3.3 POPULATION ESTIMATION 7
4.0 RESULTS 9
4.1 KEEYASK RESERVOIR 9
4.1.1 Relative Abundance/CPUE 9
4.1.2 Biological Metrics 13
4.1.3 Movements 18
4.1.4 Population Estimation 21
4.2 STEPHENS LAKE 26
4.2.1 Relative Abundance/CPUE 26
4.2.2 Biological Metrics 30
4.2.3 Movements 35
4.2.4 Population Estimation 38
5.0 DISCUSSION 43
5.1 MOVEMENT 43
5.2 ADULT LAKE STURGEON ABUNDANCE 43
5.3 SPAWNING 44
5.4 KEY QUESTIONS 45
6.0 SUMMARY AND CONCLUSIONS 48
7.0 LITERATURE CITED 51

LIST OF TABLES

Table 1. Number of fish, by species, captured during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2023. 9
Table 2. Lake Sturgeon catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values observed during mark/recapture studies in the Keeyask reservoir, spring 2001–2023. 12
Table 3. Number and catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values, by zone, observed during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2023. 12
Table 4. Mean fork length (mm), weight (g), and relative condition factor (K) of Lake Sturgeon captured during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2001–2023. 14
Table 5. Sex and maturity data for Lake Sturgeon captured in the Keeyask reservoir (Birthday Rapids to the Keeyask GS), spring, 2001–2023. 18
Table 6. Recapture data for Lake Sturgeon captured in the Keeyask reservoir during adult population monitoring, spring 2002–2023. 20
Table 7. Number of fish, by species, captured during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2023. 26
Table 8. Lake Sturgeon catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values observed during mark/recapture studies in Stephens Lake, spring 2001–2023. 29
Table 9. Number and catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values, by zone, observed during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2023. 29
Table 10. Mean fork length (mm), weight (g), and relative condition factor (K) of Lake Sturgeon captured during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2001–2023. 31
Table 11. Sex and maturity data for Lake Sturgeon captured in Stephens Lake, spring 2001–2023. 35
Table 12. Recapture data for Lake Sturgeon captured in Stephens Lake during adult population monitoring, spring 2002–2023. 37

LIST OF FIGURES

Figure 1. Mean daily water temperature of the Nelson River in the Keeyask reservoir May 24 to July 1, 2023. 11
Figure 2. Length-frequency distribution of Lake Sturgeon captured in large mesh gill nets set in the Keeyask reservoir, spring 2023. 15
Figure 3. Mean condition factor by 50 mm length intervals for adult (≥ 800 mm) Lake Sturgeon captured in the Keeyask reservoir during baseline studies (red bars), construction monitoring (blue bars), and operation monitoring (green bars). 16
Figure 4. Length-weight regression for Lake Sturgeon captured in large mesh gill nets set in the Keeyask reservoir, spring 2023. 17
Figure 5. Adult Lake Sturgeon abundance estimates based on POPAN best model for the Keeyask reservoir (2002–2023). 22
Figure 6. Annual percent change in adult Lake Sturgeon population growth estimates (lambda) based on the POPAN annual estimates in the Keeyask reservoir. 23
Figure 7. Analysis of change in mean population abundance estimates for the Keeyask reservoir between one sample period (2022 to 2023) and two sampling periods (2021 to 2023). 24
Figure 8. Abundance estimates for adult Lake Sturgeon in the Keeyask reservoir by sampling year (2002–2023) showing no significant trend in the long-term. 25
Figure 9. Mean daily water temperature of the Nelson River in Stephens Lake, May 24 to July 1, 2023. 28
Figure 10. Length-frequency distribution for Lake Sturgeon captured in large mesh gill nets set in Stephens Lake, spring 2023. 32
Figure 11. Mean condition factor by 50 mm length intervals for adult (≥ 800 mm) Lake Sturgeon captured in Stephens Lake baseline (red bars), construction (blue bars), and operation (green bars) periods including (A) and excluding (B) immigrants from the Keeyask reservoir. 33
Figure 12. Length-weight regression for Lake Sturgeon captured in large mesh gill nets set in Stephens Lake, spring 2023. 34
Figure 13. Adult Lake Sturgeon abundance estimates based on POPAN best model for Stephens Lake (2003–2023). 39
Figure 14. Annual percent change in adult Lake Sturgeon population growth estimates (lambda) based on the POPAN annual estimates in Stephens Lake. 40
Figure 15. Analysis of change in mean population abundance estimates for Stephens Lake between one sample period (2022 to 2023) and two sampling periods (2021 to 2023). 41
Figure 16. Abundance estimates for adult Lake Sturgeon in Stephens Lake by sampling year (2003–2023) showing a significant positive trend. 42

LIST OF MAPS

Map 1. Map of the lower Nelson River showing the site of the Keeyask Generating Station and the Lake Sturgeon study setting. 4
Map 2. Sites fished with large mesh gill net gangs in the Keeyask reservoir, spring 2023...10
Map 3. Sites fished with large mesh gill net gangs in Stephens Lake, spring 2023. 27

LIST OF APPENDICES

Appendix 1: Tagging and biological information for Lake Sturgeon captured in the Keeyask reservoir and Stephens Lake, spring 2023 55

Appendix 2: Tagging and biological information for Lake Sturgeon recaptured in the Keeyask reservoir and Stephens Lake, spring 2023 60

Appendix 3: Population estimate information 73

1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station (GS) on the lower Nelson River in northern Manitoba. The GS is approximately 725 kilometres (km) northeast of Winnipeg, 35 km upstream of the existing Kettle Generating Station, 60 km east of the community of Split Lake, 180 km east-northeast of Thompson and 30 km west of Gillam. Construction of the GS began in July 2014 and the seven generating units were all in-service as of March 2022.

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 (AESV)*. 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, including the focus of this report, adult Lake Sturgeon populations, for the construction and operation phases of the Project.

Adult population monitoring studies were initiated in 2001. Two areas were considered: the area that would be directly affected by the Project (including the reach of the Nelson River from Clark Lake to Gull Rapids) and Stephens Lake; and rivers flowing into the upstream portion of Split Lake (referred to as the Upper Split Lake Area). When studies were initiated in 2001, it was known that Lake Sturgeon habitat in the Upper Split Lake Area would not be affected by the Project, but the degree of interaction between Lake Sturgeon in the Upper Split Lake Area and Gull and Stephens lakes was not known. Genetic studies completed since that time have demonstrated that sturgeon in the Keeyask reservoir and Stephens Lake are separate populations from sturgeon in the Upper Split Lake Area and that, within this area, the Kelsey GS and Burntwood River populations differ (Gosselin *et al*. 2015). However, movement of adult Lake Sturgeon between the Keeyask reservoir and the Nelson River downstream of the Kelsey GS has been recorded. Studies have continued in the Upper Split Lake Area because this area was selected as a location where the KHLP could support the recovery of a Lake Sturgeon population outside the direct influence of the Project as an offsetting measure[1].

Since 2001, Lake Sturgeon data have been collected in multiple years from the Upper Split Lake, the Keeyask reservoir, and Stephens Lake areas (Barth and Mochnacz 2004; Barth 2005; Barth and Murray 2005; Barth and Ambrose 2006; Barth and MacDonald 2008; MacDonald 2008a, b; Michaluk and MacDonald 2010; MacDonald and Barth 2011; Hrenchuk and McDougall 2012; Hrenchuk 2013; Groening *et al*. 2014; Henderson *et al.* 2016; Legge *et al.* 2017; Lacho *et al.* 2018; Holm and Hrenchuk 2019; Ambrose *et al.* 2020; Loeppky and Hrenchuk 2022; Ambrose *et*

1 See the Fisheries Offsetting and Mitigation Plan for more information on the selection of stocking locations and the stocking plan.

al. 2023). Studies focused on adults were conducted during alternate years among locations, *i.e.*, alternating between the Upper Split Lake Area and the Keeyask reservoir and Stephens Lake. These studies were conducted during spring and identified sturgeon spawning areas, determined the relative importance of spawning sites, and contributed to the understanding of sturgeon movements. Mark-recapture data have also been used to develop adult abundance estimates for populations in all three areas.

Following sampling in 2021, a large number of adult Lake Sturgeon were observed moving downstream through the Keeyask GS during acoustic telemetry studies (Hrenchuk and Small 2022). Monitoring in the Keeyask Area was repeated in 2022 to determine if the downstream movements observed in 2021 were enough to change the population estimate. As such, 2023 was the third consecutive year that sampling was conducted in the Keeyask reservoir and Stephens Lake.

This report presents results of adult Lake Sturgeon population monitoring conducted in the Keeyask reservoir (*i.e.*, the Nelson River between Clark Lake and the Keeyask GS) and in Stephens Lake in the spring of 2023 and compares these results to previous years. Sampling in 2023 represents the third year of sampling in the Keeyask reservoir following reservoir impoundment, and the second year of sampling during operation in both the Keeyask reservoir and Stephens Lake. The key questions set out in the AEMP for adult population monitoring during GS operation were:

- Is there a biologically relevant (and statistically significant) change in the rate of population growth for the Keeyask reservoir and Stephens Lake populations?
- Is there a biologically relevant (and statistically significant) change in survival for the Keeyask reservoir and Stephens Lake populations?
- Is there a biologically relevant (and statistically significant) change in the condition factor of Lake Sturgeon?
- Is the population of adult Lake Sturgeon in Stephens Lake changing?
- Are spawning adults present in the Keeyask reservoir and Stephens Lake?
- Where (on a coarse-scale) do Lake Sturgeon spawn in the post-Project environment?
- Over the long-term, is there a measurable effect on population growth due to stocking?
- Over the long-term, is the Lake Sturgeon population considered sustainable based on the size of the adult population and the population viability analysis?

The last two questions in this list relate to long-term changes and are not addressed in this report.

2.0 STUDY SETTING

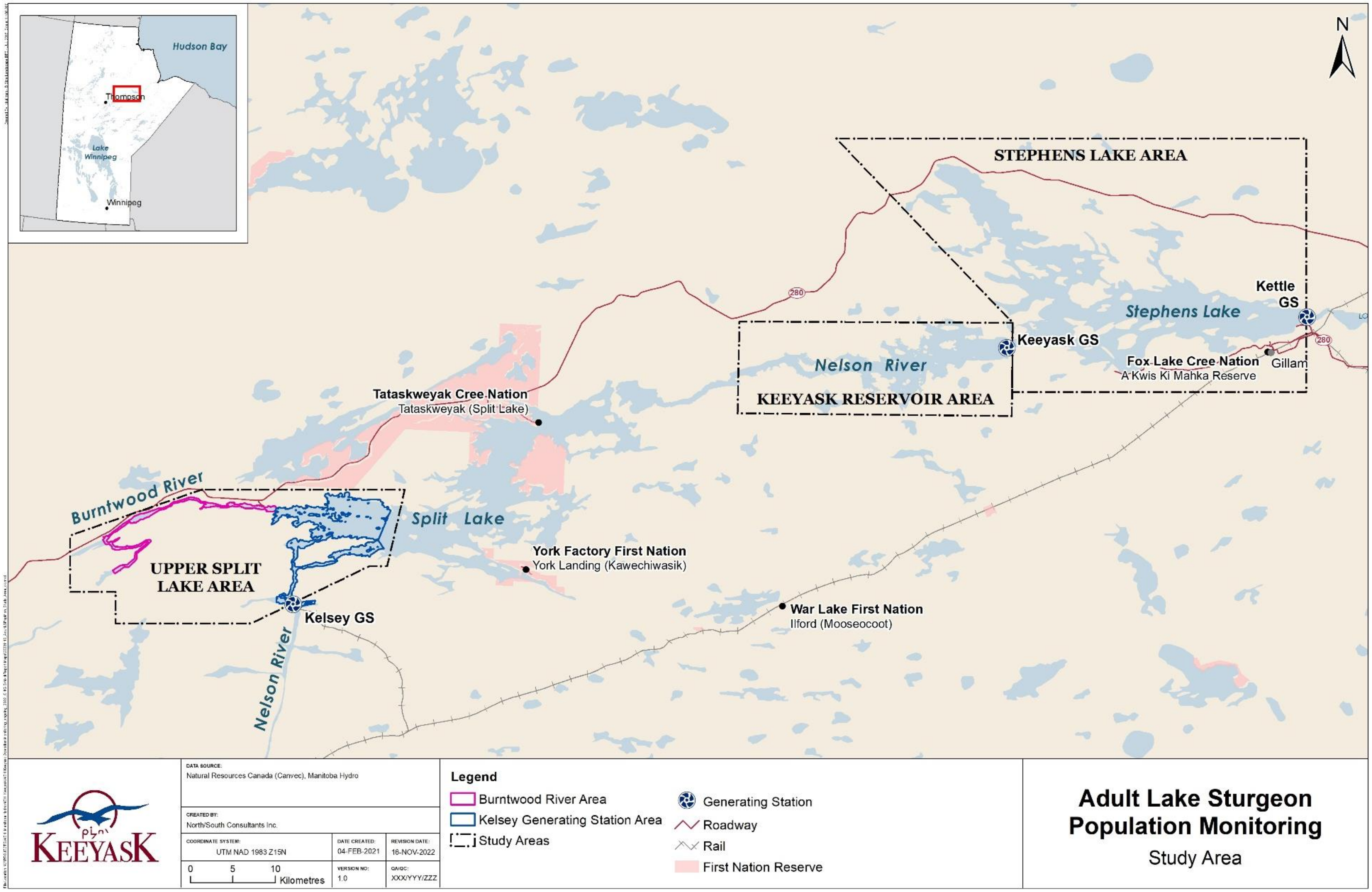
The study area encompasses an approximately 110 km long reach of the Nelson River from Clark Lake to the Kettle GS (Map 1). This section of river offers a diverse range of physical habitat conditions, including a variety of substrate types, and variable water depths (range: 0–30 m) and velocities. Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of the Keeyask GS. 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. The area between Clark Lake and Birthday Rapids is referred to herein as the upper Keeyask reservoir.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of the Keeyask GS and marks the upstream end of major water level changes because 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 nearly level, albeit a 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, and is referred to herein as the middle Keeyask reservoir.

Prior to impoundment, Gull Lake was a widening of the Nelson River, with moderate to low water velocity beginning approximately 20 km upstream the Keeyask GS. Water levels on Gull Lake increased by several metres following impoundment and flooding along the shoreline and small tributaries entering this reach was extensive. Although this area is larger than prior to impoundment, the portion of the Keeyask reservoir is referred to herein as Gull Lake.

Just below the Keeyask GS, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Construction of the Keeyask GS has altered the flow distribution immediately downstream of the station.

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. 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. Kettle GS is located approximately 40 km downstream of the Keeyask GS.



Map 1. **Map of the lower Nelson River showing the site of the Keeyask Generating Station and the Lake Sturgeon study setting.**

3.0 METHODS

3.1 GILLNETTING

Large mesh gill nets were used to capture adult Lake Sturgeon (≥800 mm fork length) in the Keeyask reservoir and Stephens Lake. Gillnetting occurred from May 24 to July 1, 2023 in both locations.

Gill net gangs consisted of four 25 yd (22.9 m) long, 2.7 yd (2.5 m) deep panels of 8, 9, 10, and 12” (203, 229, 254, and 305 mm) twisted nylon stretched mesh. Gill nets were checked approximately every 24 hours, weather permitting. At each gillnetting site, water depth was measured using a HawkEye DepthTrax 1H handheld depth finder, and UTM coordinates were taken using a handheld GPS unit (Garmin Limited, Olathe, Kansas).

HOBO Temperature Pro data loggers (± 0.2°C), set approximately 1 m off the substrate, were used to log water temperature at 6-hour intervals.

Captured Lake Sturgeon were measured for fork length (FL) and total length (TL; ± 1 cm), weighed (with a digital handheld hanging scale, handheld conventional scale, or pan scale ± 25 g), and externally marked with an individually numbered plastic Floy-FD-94 T-bar anchor tag (Floy tag). Floy tags were inserted between the basal pterygiophores of the dorsal fin using a Dennison Mark II tagging gun. In addition to the external tag, each sturgeon had an individually numbered 12 mm Passive Integrated Transponder (PIT) tag (Oregon RFID Ltd., Portland, Oregon) injected under the third dorsal scute using Oregon RFID tag injector needles, dipped in Polysporin to minimize the risk of infection. Tags were injected into dorsal muscle tissue parallel to the horizontal axis of the fish. Following implantation, the fish was scanned using a Biomark HPR Lite Handheld PIT tag reader (Biomark, Boise, Idaho).

Sex and maturity were determined for individual adult Lake Sturgeon by applying pressure to the ventral surface of the fish to express gametes. If no gametes were expressed, sex and maturity codes were not assigned. The following sexual maturity codes were used:

Female (F)	Male (M)
2 – maturing to spawn (pre-spawn)	7 – maturing to spawn (pre-spawn)
3 – ripe	8 – ripe
4 – spent (post-spawn)	9 – spent (post-spawn)

Species other than Lake Sturgeon captured in the gill nets were measured for FL, weighed, and released.

3.2 DATA ANALYSIS

As was done in previous years, data analysis included all sizes of Lake Sturgeon captured (as opposed to only those with FL measuring 800 mm or greater). Mesh sizes are used to target large Lake Sturgeon, but smaller fish are also captured. Inclusion of all fish in the summary statistics ensures comparability among years.

Mean FL (mm), weight (g), and condition factor (K) were calculated for all first-time captures and recaptured Lake Sturgeon tagged in a previous year. Condition factor was calculated for individual fish based on the following equation (after Fulton 1911, in Ricker 1975):

$$K = W / (FL^3/10^5)$$

Where:

W = round weight (g); and

FL = fork length (mm)

Mean condition factor was calculated by 50 mm FL intervals for adult Lake Sturgeon. Mean condition factor by FL interval was compared between pre-Project (*i.e.*, 2001–2014), construction (*i.e.*, 2015–2021), and operation (*i.e.*, 2022) 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 period differed. The test was only used if the sample size (*i.e.*, the number of fish captured) was greater than ten.

A length-frequency distribution for Lake Sturgeon was plotted in 50 mm FL intervals (*e.g.*, 1,000–1,049 mm).

A length-weight relationship was calculated using least squares regression analysis on logarithmic transformations of FL and weight according to the following relationship:

$$Log_{10}(W) = Log_{10}(a) + b*Log_{10}(FL)$$

Where:

W = round weight (g);

FL = fork length (mm);

a = Y-intercept; and

b = slope of the regression line

Catch-per-unit-effort (CPUE) was calculated and expressed as the number of Lake Sturgeon captured in 91.4 m (100 yd; the standard length of adult Lake Sturgeon nets) of net per 24-hour period using the following formula:

$$CPUE = \Sigma \text{ \# Lake Sturgeon} / \Sigma \text{ gillnetting hours} \times 24 \text{ h} / \text{length of gill net used} \times 91.4 \text{ m}$$

Where:

Σ = sum of the number of fish or gillnetting hours at all sites.

Lake Sturgeon that were tagged in a previous year and recaptured in 2023 were included in all analyses; however, current-year recaptures (*i.e.*, those captured multiple times within the same sampling year) were only included for the first capture.

3.3 POPULATION ESTIMATION

Mark-recapture population estimates have been calculated for the Keeyask reservoir (1995, 2001–2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, and 2021–2023) based on data collected during spring from 15 different years. For Stephens Lake, 2023 was the fourth year during which enough fish were re-captured that mark-recapture population estimates could be calculated. Given that encounter histories were developed for these fish, estimates were calculated for the spring in all the years that sturgeon gillnetting studies were conducted in Stephens Lake (2001–2006, 2008, 2010–2012, 2014, 2016, 2018, 2021, 2022, and 2023). However, estimates from years prior to 2018 are associated with a higher degree of uncertainty due to the small numbers of fish captured. Sampling methods and protocols differed between time periods. Lake Sturgeon were tagged in 1995 in Gull Lake by Manitoba Fisheries Branch and the Split Lake Resource Management Board. All data for the period 2001–2012 were collected annually as part of environmental studies related to the pre-Project environment, while data from 2014 until 2044 are collected biennially as part of monitoring studies related to the Keeyask GS Project.

Starting in summer 2021, a large number of adult Lake Sturgeon moved downstream out of the Keeyask reservoir (Hrenchuk and Small 2022; Hrenchuk 2023, 2024). This impacted the population model for the Keeyask reservoir in both 2022 and 2023. The population model interprets fish that move from the Keeyask reservoir to Stephens Lake as mortalities as they are not able to return and are lost from the upstream population. Although these fish moved downstream after sampling in 2021, the model assumes the event happened over time, impacting survival rates prior to this date. This leads to falsely low estimates in years before the movements began (*i.e.*, 2021 and earlier). To account for this, abundance estimates generated for the Keeyask reservoir in 2021 were used for the years between 1995–2021 (*i.e.*, these population estimates no longer change when new data are added to the model) and only the 2022 and 2023 estimates were generated for the current study year.

The Jolly-Seber model (POPAN formulation; Arnason and Schwarz 2002), as implemented within MARK, was used to estimate the annual abundance of adult Lake Sturgeon in the Keeyask reservoir and Stephens Lake. Survival estimates were calculated based on model recommendations. These differed based on location as follows:

- Keeyask reservoir: 1995–2001, 2001–2004, 2004–2021, and 2021–2023; and
- Stephens Lake: 2001–2014 and 2016–2023.

In order to track short-term trends in population size, current-year estimates were compared to those from the previous one and two sampling periods. The Keeyask reservoir and Stephens Lake were both compared to 2021 and 2022. A statistically significant change was determined as an increase beyond the 95th percentile or a decrease below the 5th percentile (*e.g.,* if the 2023 estimate was greater than the 95th percentile from the 2022 estimate, the increase in population size was significant).

Long-term population trajectory was analysed using a standard linear regression. Slopes that were significantly different than zero (F-tests, $p < 0.05$) indicated an increasing or decreasing trend. The slope of the regression through time indicated the approximate number of individuals added to or removed from the population each year.

Fish that moved downstream from the Keeyask reservoir to Stephens Lake prior to the spring sampling period were removed from upstream analysis and added to Stephens Lake.

Detailed population estimation methods are described in Appendix 3.

4.0 RESULTS

Tag and biological data for all first-time Lake Sturgeon captures are presented in Appendix 1 and data from recaptured Lake Sturgeon are presented in Appendix 2.

4.1 KEEYASK RESERVOIR

4.1.1 RELATIVE ABUNDANCE/CPUE

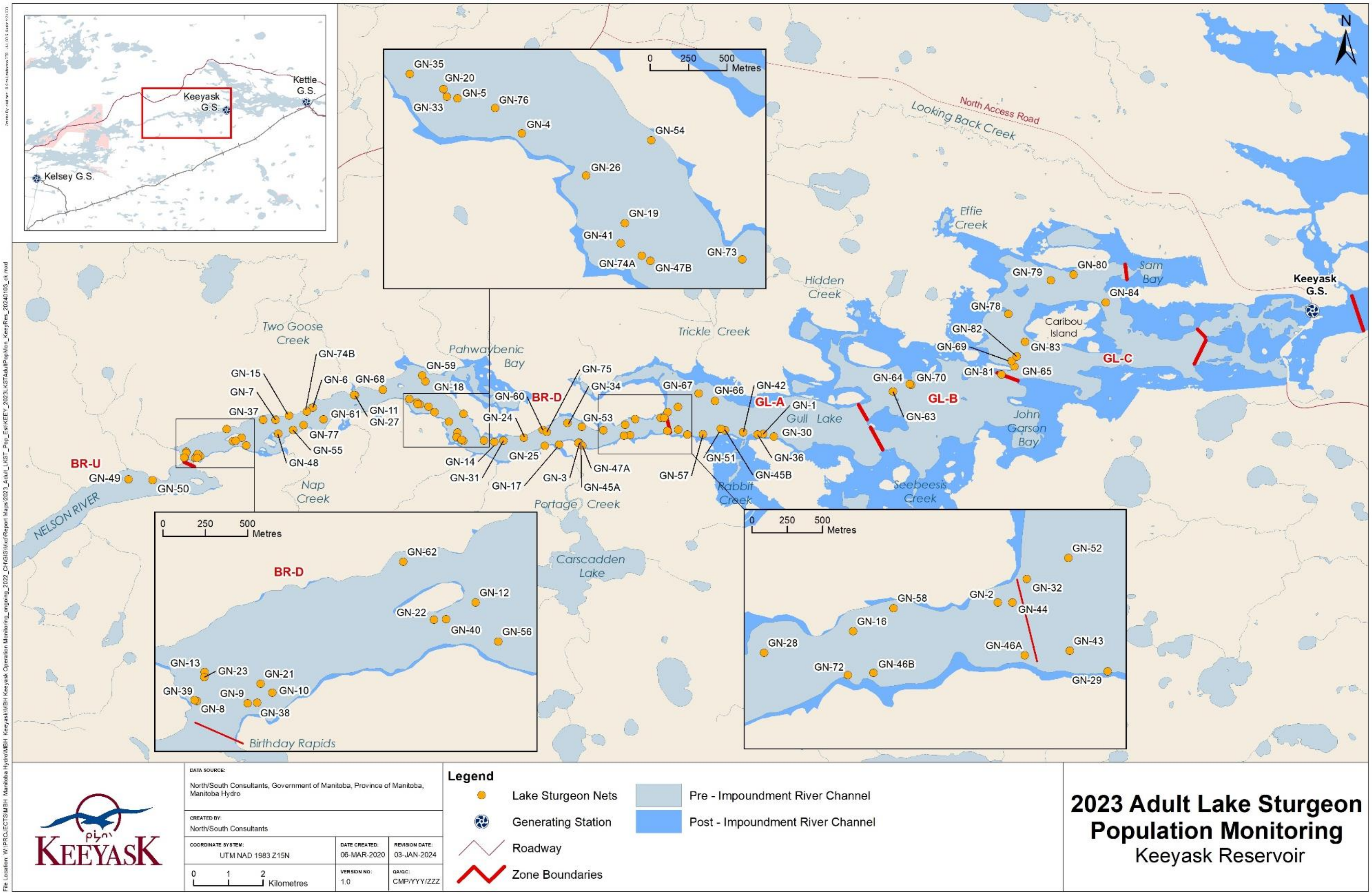
Gill nets were set at 87 sites between Clark Lake and the Keeyask GS between May 24 and July 1, 2023 (Map 2). Water temperature ranged from 8.4 to 20.4°C during the study (Figure 1). A total of 67 fish were captured, the majority of which (n = 50; 75%) were Lake Sturgeon (Table 1). No Lake Sturgeon mortalities occurred during sampling.

Table 1. Number of fish, by species, captured during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2023.

Common Name	Scientific Name	Abbreviation	Keeyask reservoir[1,2]	% of Catch
Lake Sturgeon	***Acipenser fulvescens***	***LKST***	***50***	***74.6***
Lake Whitefish	*Coregonus clupeaformis*	LKWH	1	1.5
Northern Pike	*Esox lucius*	NRPK	11	16.4
Walleye	*Sander vitreus*	WALL	5	7.5
Total			**67**	**100**

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.
2. Includes catch and effort from gillnetting in the reach upstream of Birthday Rapids (Zone BR-U).

In total, 50 Lake Sturgeon were captured in 8,915 gill net hours, resulting in an overall CPUE of 0.13 LKST/91.4 m net/24 h (Table 2). Site-specific CPUE ranged from 0.0–0.68 LKST/91.4 m net/24 h. Gillnetting effort was highest in Zone BR-D (immediately downstream of Birthday Rapids; 6,735 gill net hours) and CPUE was highest in Zone GL-C (lower Gull Lake; 0.20 LKST/91.4 m net/24 h) (Map 2; Table 3).



Map 2. Sites fished with large mesh gill net gangs in the Keeyask reservoir, spring 2023.

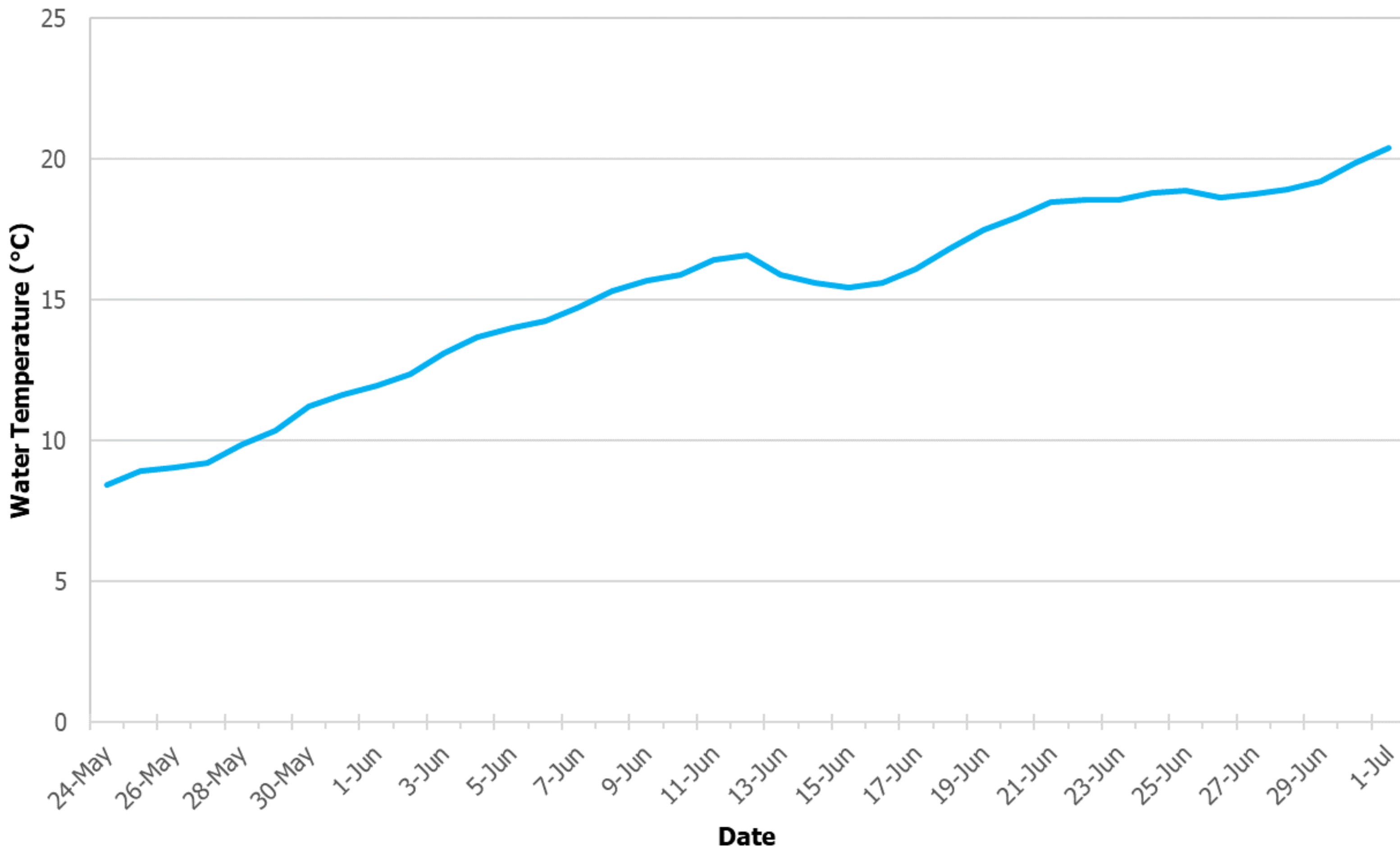


Figure 1. Mean daily water temperature of the Nelson River in the Keeyask reservoir May 24 to July 1, 2023.

Table 2. Lake Sturgeon catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values observed during mark/recapture studies in the Keeyask reservoir, spring 2001–2023.

Year	# Sites	Total Lake Sturgeon[1]	Total Gill Net Hours[2]	Total CPUE
2001	37	60	4,538	0.32
2002	19	59	4,918	0.29
2003	30	85	7,565	0.27
2004	17	51	6,907	0.18
2006	22	150	12,587	0.29
2008	16	52	9,960	0.13
2010	18	65	9,128	0.17
2011[3]	34	33	6,734	0.12
2012[3]	32	114	10,018	0.27
2014	62	239	17,897	0.32
2016[3]	55	189	15,503	0.29
2018[3]	49	232	16,763	0.33
2021[3]	61	178	7,911	0.54
2022[3]	79	63	11,057	0.14
2023[3]	**87**	**50**	**8,915**	**0.13**

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.
2. The effort has been corrected to account for net length set at each site. For example, the duration of a gill net gang consisting of two panels (*i.e.*, 45.7 m long) was halved (*i.e.*, equivalent of half a four-panel set).
3. Includes catch and effort from gillnetting in the reach upstream of Birthday Rapids (Zone BR-U).

Table 3. Number and catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values, by zone, observed during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2023.

Zone	# Sites	Total Lake Sturgeon[1]	Total Gill Net Hours[2]	Total CPUE
BR-U	2	0	241	0.00
BR-D	60	39	6,735	0.15
GL-A	13	4	1,035	0.09
GL-B	4	3	416	0.17
GL-C	8	4	489	0.20

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.
2. The effort has been corrected to account for net length set at each site. For example, the duration of a gill net gang consisting of two panels (*i.e.*, 45.7 m long) was halved (*i.e.*, equivalent of half a four-panel set).

4.1.2 BIOLOGICAL METRICS

Lake Sturgeon had a mean fork length of 773 mm (range: 140–1,480 mm), a mean weight of 4,579 g (range: 12–23,678 g), and a mean condition factor of 0.81 (range: 0.44–1.27) (Table 4). One weight was removed as an outlier and was excluded from mean calculations for weight and condition factor. Of the 50 Lake Sturgeon measured, 23 were considered adults (FL ≥ 800 mm) and 27 were considered juveniles (FL < 800 mm). Lake Sturgeon measuring 550–599 mm, 750–799 mm, and 850–899 mm FL were captured most frequently (n = 6), each accounting for 12% of the total catch (Figure 2).

Too few Lake Sturgeon were captured in 2023 to compare mean condition factor between sampling periods. Mean condition factor ranged from 0.77–1.23 during baseline (2001–2014), 0.80–1.02 during construction (2016, 2018, and 2021), and 0.73–1.27 during operation (2022 and 2023) (Figure 3). The length-weight relationship is presented in Figure 4.

Sex and maturity were confirmed for seven sturgeon including six pre-spawn males and one post-spawn male (Table 5). These fish were captured between May 28 and June 6 when water temperatures ranged from 9.8 to 14.3°C.

Table 4. Mean fork length (mm), weight (g), and relative condition factor (K) of Lake Sturgeon captured during adult Lake Sturgeon population monitoring in the Keeyask reservoir, spring 2001–2023.

Year[1]	Fork Length (mm)				Weight (g)				K		
	n[2]	Mean	Std[3]	Range	n	Mean	Std	Range	n	Mean	Range
2001	79	1,022	148	739-1,355	78	9,984	5,059	3,500-24,000	78	0.88	0.64-1.26
2002	67	1,055	149	680-1,415	66	12,198	6,367	2,722-34,020	66	0.97	0.73-1.44
2003	52	1,067	148	700-1,540	87	11,949	6,681	3,000-54,431	87	0.94	0.67-1.49
2004	51	1,149	152	870-1,468	51	14,115	6,747	5,443-31,298	51	0.87	0.67-1.10
2006	150	1,003	217	300-1,550	146	10,343	7,071	1,134-43,091	146	0.86	0.61-1.44
2008	52	1,057	223	648-1,551	50	12,186	8,207	2,268-40,823	50	0.87	0.66-1.09
2010	65	901	267	443-1,390	65	8,056	6,977	500-29,937	65	0.83	0.57-1.11
2011*	34	1,090	219	664-1,610	34	13,209	9,052	2,268-43,092	34	0.89	0.61-1.19
2012*	116	844	284	330-1,620	116	7,536	8,214	200-37,648	116	0.85	0.51-1.23
2014	239	838	229	449-1,640	238	6,111	5,873	650-29,710	238	0.82	0.38-1.39
2016*	189	872	229	301-1,439	184	7,569	6,531	227-33,566	184	0.90	0.49-1.46
2018*	235	850	189	436-1,550	235	5,960	4,960	318-30,844	235	0.81	0.28-1.43
2021	178	908	189	401-1,435	178	6,892	4,760	450-27,216	178	0.82	0.61-1.54
2022	63	843	234	400-1,495	63	6,020	7,193	475-40,000	63	0.76	0.41-1.27
2023	**50**	**773**	**250**	**140-1,480**	**49**	**4,579**	**4,108**	**12-23,678**	**49**	**0.81**	**0.44-1.27**

1. An * indicates that a few individuals from the Nelson River between Clark Lake to Birthday Rapids are included in the analysis.
2. Number of fish measured.
3. Standard deviation.

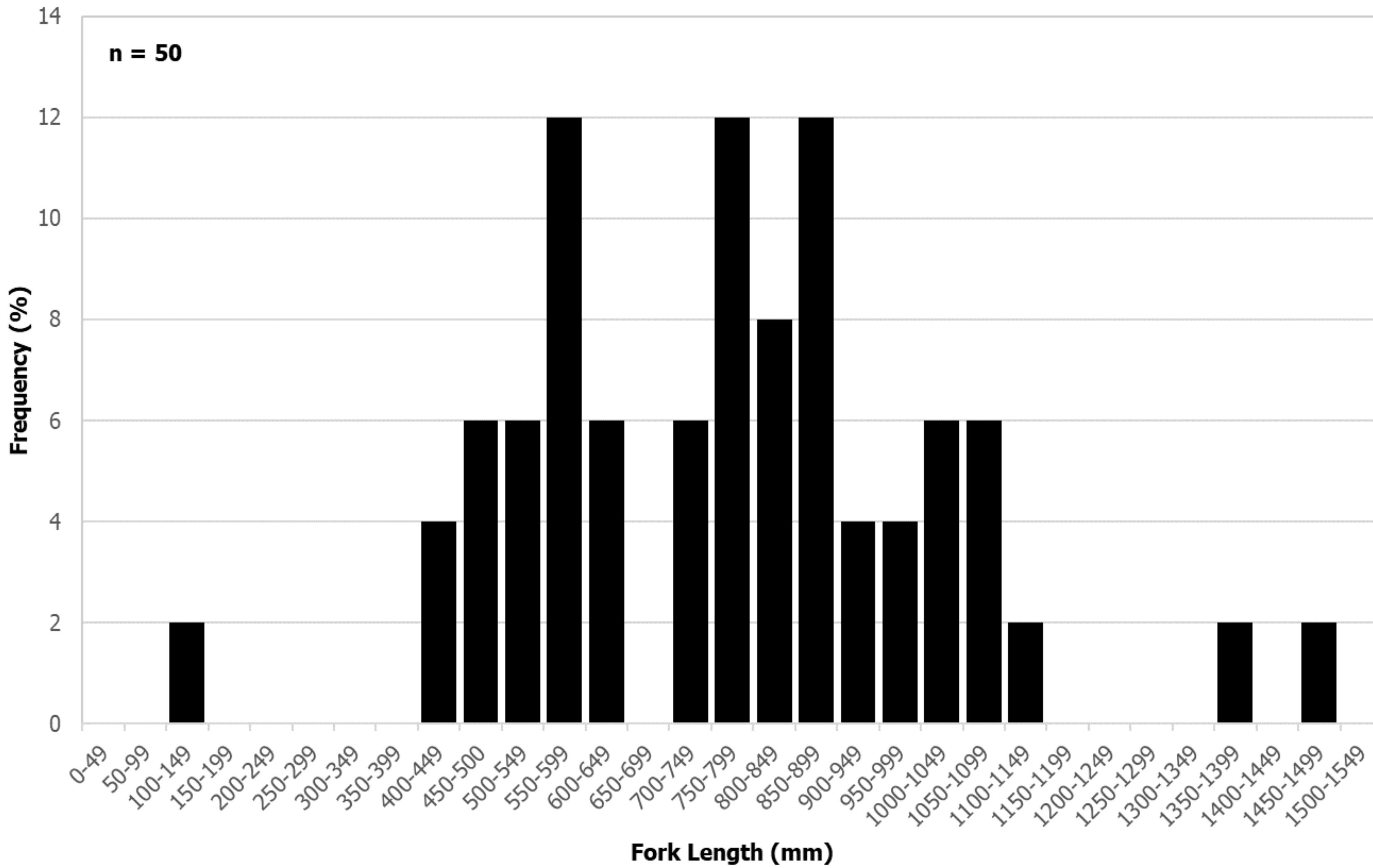


Figure 2. Length-frequency distribution of Lake Sturgeon captured in large mesh gill nets set in the Keeyask reservoir, spring 2023.

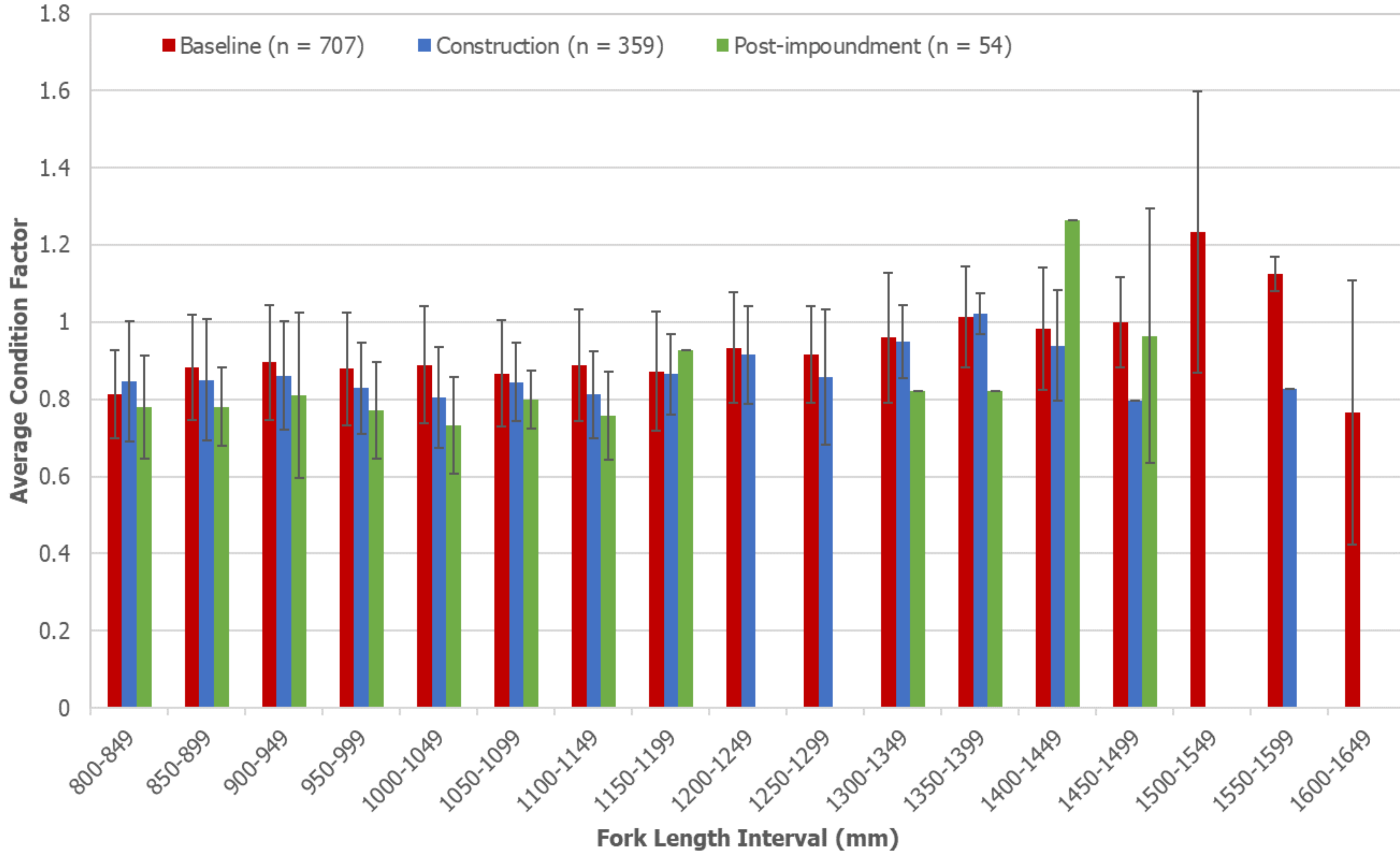


Figure 3. Mean condition factor by 50 mm length intervals for adult (≥800 mm) Lake Sturgeon captured in the Keeyask reservoir during baseline studies (red bars), construction monitoring (blue bars), and operation monitoring (green bars). Too few fish were captured post-impoundment to statistically compare any Fork Length interval. Error bars represent standard deviations.

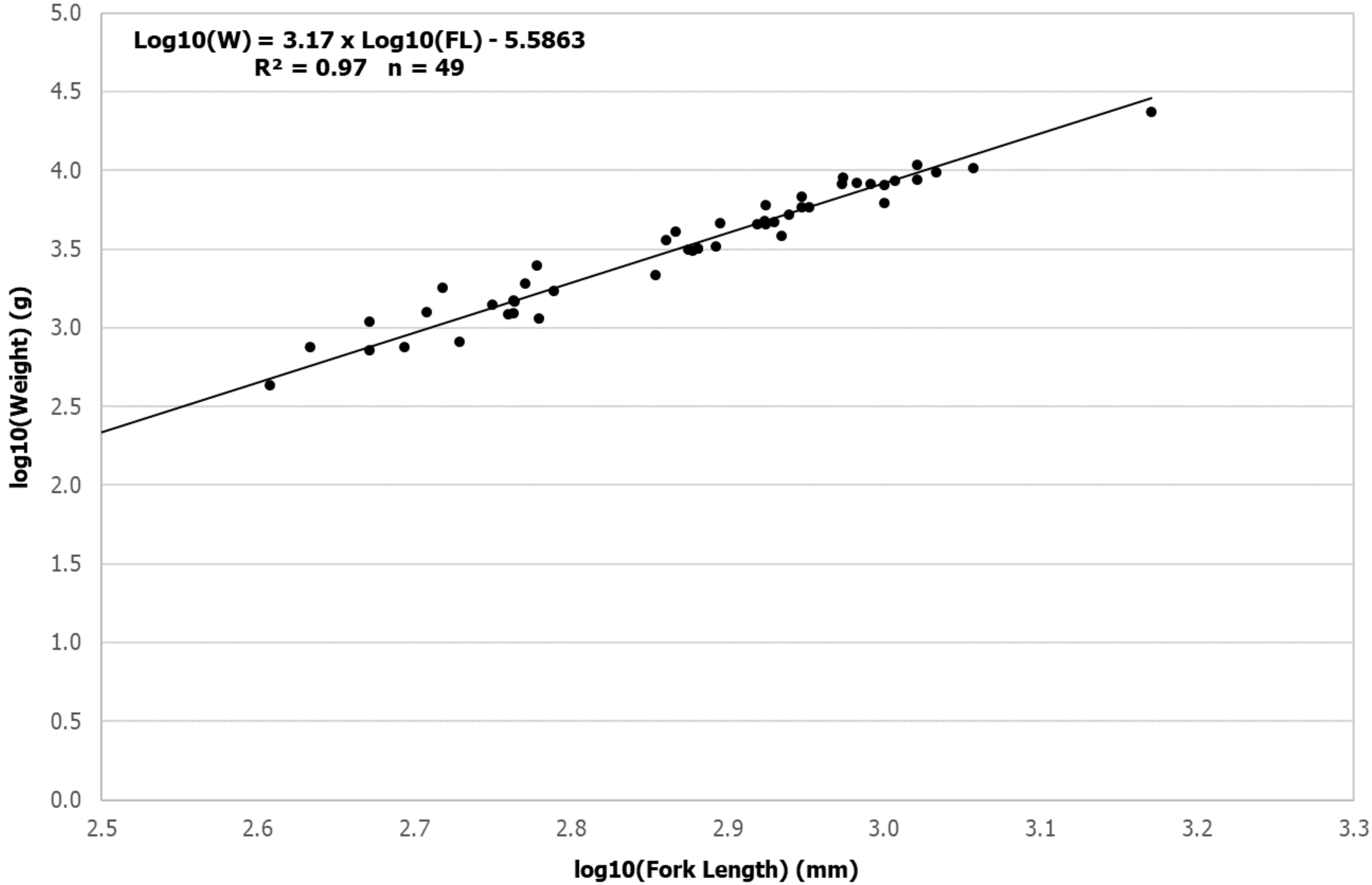


Figure 4. Length-weight regression for Lake Sturgeon captured in large mesh gill nets set in the Keeyask reservoir, spring 2023.

Table 5. Sex and maturity data for Lake Sturgeon captured in the Keeyask reservoir (Birthday Rapids to the Keeyask GS), spring, 2001–2023.

Year[1]	Sex and Maturity[2]						# of Spawners[3]	Unknown maturity	Total
	Male			Female					
	7	8	9	2	3	4			
2001	5	10	1	3	-	-	19	41	60
2002	8	1	5	-	-	-	14	46	60
2003	3	-	-	1	-	-	4	89	93
2004	3	2	-	-	-	-	5	46	51
2006	13	3	-	-	-	-	16	134	150
2008	1	1	1	-	-	-	3	49	52
2010	5	3	-	-	-	-	8	57	65
2011*	6	4	1	1	1	2	15	19	34
2012*	1	4	2	-	-	-	7	109	116
2014	8	7	2	4	-	3	21	227	248
2016*	16	2	-	2	2	-	22	168	190
2018*	13	4	-	1	-	-	18	217	235
2021	14	5	-	-	1	-	20	158	178
2022	1	1	-	1	-	-	3	60	63
2023	**6**	**-**	**1**	**-**	**-**	**-**	**7**	**43**	**50**

1. An * indicates that a few individuals from the Nelson River between Clark Lake to Birthday Rapids are included in the analysis.
2. Refer to Section 3.1 for maturity codes.
3. Maturity status columns include recaptures of fish whose maturity status progressed between captures (*e.g.*, would include recaptures of fish initially captured in maturing condition and recaptured in ripe or spent condition), but the columns may not add up to the "# of Spawners" column since this only includes individual fish captured (*i.e.*, CYTR that were captured in different maturity classifications were only counted once).

4.1.3 MOVEMENTS

Of the 50 Lake Sturgeon captured in the Keeyask reservoir, 20 were recaptures from previous gillnetting studies, four were hatchery-reared fish captured for the first time since stocking, one was previously tagged during TCN traditional knowledge studies, and 25 were untagged fish. Four of the 20 recaptured fish and all four hatchery-reared fish were juvenile size, measuring <800 mm FL. Floy and PIT tags were applied to all 25 newly captured fish (Table A1-1). Acoustic transmitters were applied to 14 adult fish to continue ongoing acoustic telemetry studies (described in Hrenchuk 2024).

Of the four hatchery-reared fish that were captured for the first time in 2023, two were released in the Burntwood River (Zone BWR-B) in 2014 (one in May and one in October). The other two hatchery-reared fish were released in Gull Lake in June 2019, one in GL-B and one in GL-C.

Excluding the four hatchery-reared fish, 43% (20 of 46) of Lake Sturgeon were recaptures from previous gillnetting studies (Table 6). Two of the recaptured Lake Sturgeon (10%) lost their Floy tag since initial tagging or last recapture but retained their PIT tag. Biological and previous year capture information are provided in Table A2-1.

Of the 20 Lake Sturgeon that were recaptured from previous studies, 19 (95%) were last captured in the Keeyask reservoir.

- Seventeen were originally tagged in the reach of the Nelson River between Birthday Rapids and the Keeyask GS.
    - Four of these fish have been captured multiple times within this area since initial tagging.
- Two were originally tagged in Split Lake but were since captured in Gull Lake during previous studies.
    - Floy #116621 was tagged in 2019 and was captured downstream of Birthday Rapids (BR-D) in 2022 and 2023.
    - Floy #74302 was tagged in 2005. It was captured in Gull Lake in 2014 and 2023.

One fish (Floy #128076, previously Floy #98642) was initially tagged in the Grass River in 2015 and was recaptured immediately downstream of Birthday Rapids (BR-D) in 2023 (Map 2).

Table 6. Recapture data for Lake Sturgeon captured in the Keeyask reservoir during adult population monitoring, spring 2002–2023.

Recapture Location	Year	Original Tagging / Last Capture Location[3]							Total Recaptures[2]	Total LKST Captured	% Recaptures
		Kelsey GS Area	Split Lake	Upstream Birthday Rapids	Downstream Birthday Rapids	Gull Lake	Stephens Lake	Unknown			
Keeyask reservoir[1]	2002	0	0	0	6	9	0	0	15	59	25.4
	2003	0	0	0	10	5	1	0	16	85	18.8
	2004	0	0	0	11	4	0	0	15	51	29.4
	2006	0	0	0	23	2	0	0	25	150	16.7
	2008	1	0	0	16	7	0	0	24	52	46.2
	2010	0	0	0	11	9	1	0	21	65	32.3
	2011*	0	0	0	10	4	0	1	15	34	44.1
	2012*	0	0	0	6	27	0	0	33	116	28.4
	2014	1	1	0	16	50	1	1	70	239	29.3
	2016*	1	0	0	20	51	2	2	76	190	40.0
	2018*	0	0	0	16	57	0	1	74	235	31.5
	2021	0	0	1	29	40	1	0	71	178	39.9
	2022	0	1	0	19	6	0	0	26	63	41.3
	2023	**1**	**0**	**0**	**7**	**12**	**0**	**0**	**20**	**50**	**40.0**

1. An * indicates that a few individuals from the Nelson River between Clark Lake to Birthday Rapids are included in the analysis.
2. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged, nor does it include hatchery fish that were captured in gill nets for the first time.
3. Initial tagging location of fish recaptured for the very first time since tagging or last known location of fish caught multiple times over multiple years.

4.1.4 POPULATION ESTIMATION

The population estimate for adult Lake Sturgeon (measuring ≥800 mm FL) in the Keeyask reservoir in 2023 was 123 individuals (95% CI: 32–464), which is much lower than in previous years (Figure 5; Table A3-1). The estimated annual survival (2021–2023) was 40%. The low survival was driven by the large number of fish that moved downstream out of the Keeyask reservoir beginning in summer 2021, which the model interprets as mortalities as they are lost from the population. When emigration (52% based on mark-recapture data) is considered, the actual survival is 92%.

The annual population growth rate (lambda) decreased by 64% between 2021 and 2022 and by 62% between 2022 and 2023 (Figure 6). The mean population abundance in 2023 decreased significantly from both 2021 and 2022 (Figure 7). Although the population has significantly decreased since 2021, abundance estimates calculated between 2002 and 2023 do not show a significant increasing or decreasing trend (r^2 = 0.002, F = 0.02, p = 0.90; Figure 8).

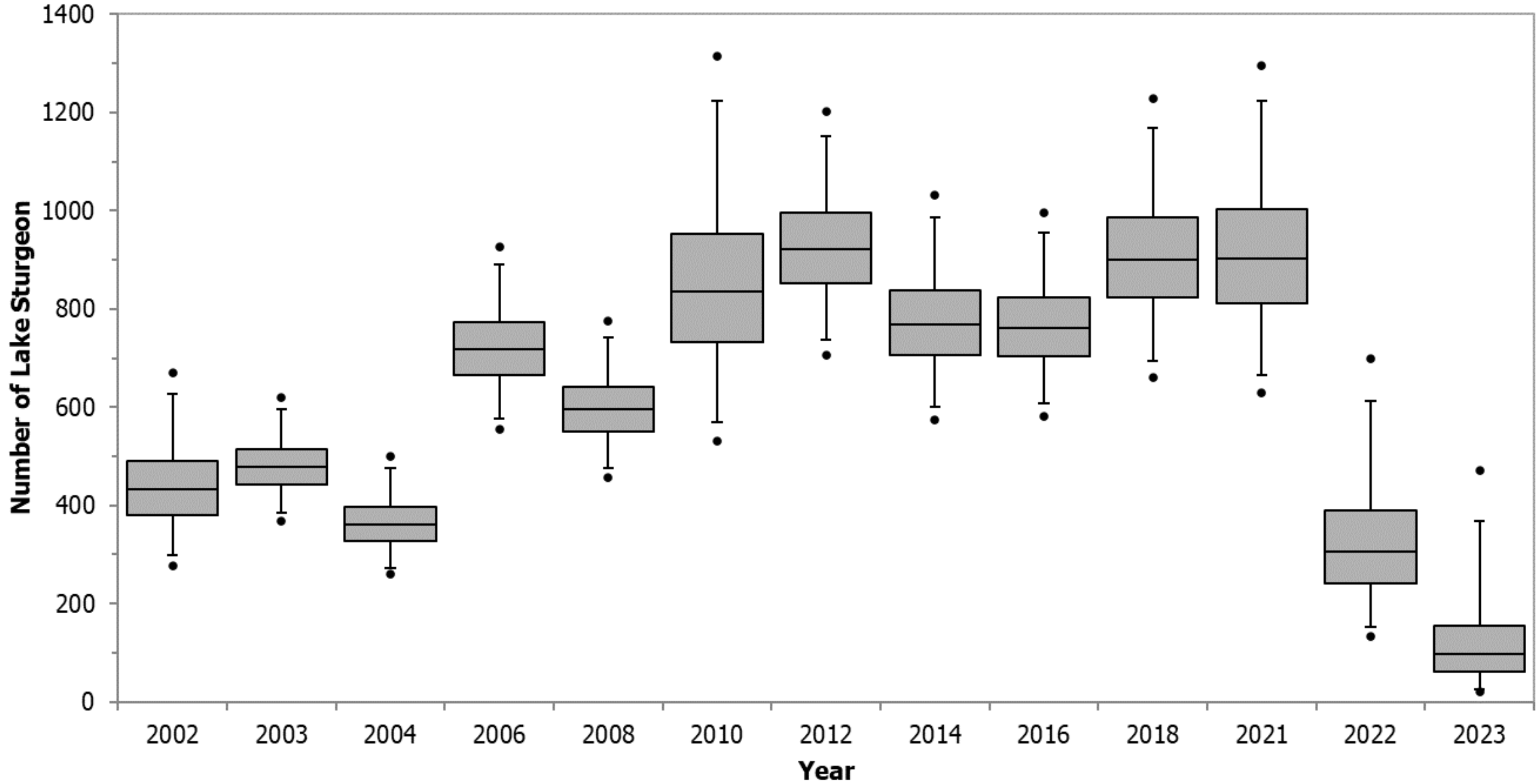


Figure 5. **Adult Lake Sturgeon abundance estimates based on POPAN best model for the Keeyask reservoir (2002–2023). Horizontal line inside the box represents the estimated abundance (*i.e.*, the number of adult Lake Sturgeon in the area during the time of capture), the black dots represent the minimum and maximum estimates, and the vertical bar lines represent the upper and lower 95% confidence intervals.**

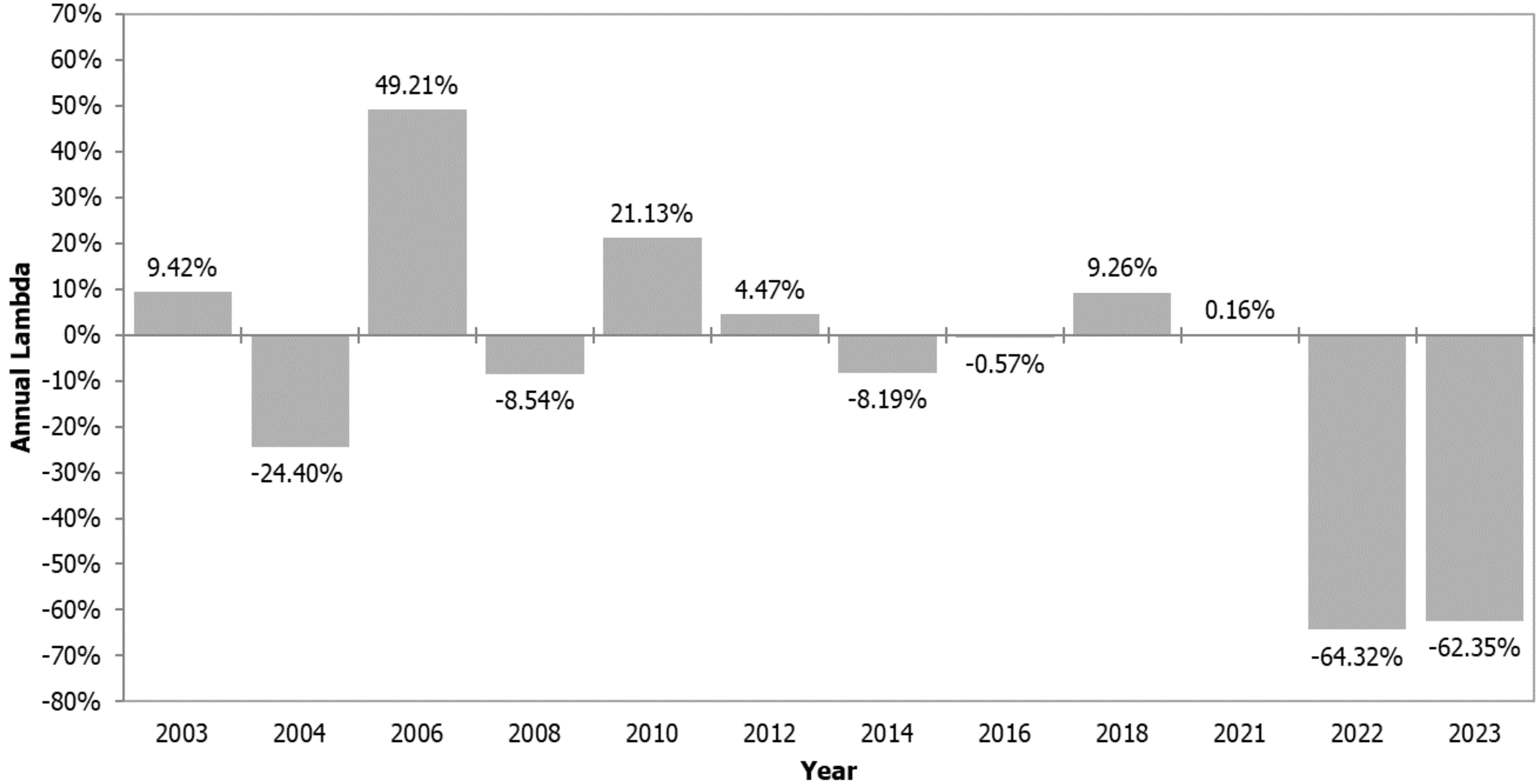


Figure 6. Annual percent change in adult Lake Sturgeon population growth estimates (lambda) based on the POPAN annual estimates in the Keeyask reservoir. Percentages indicate change in population abundance between years.

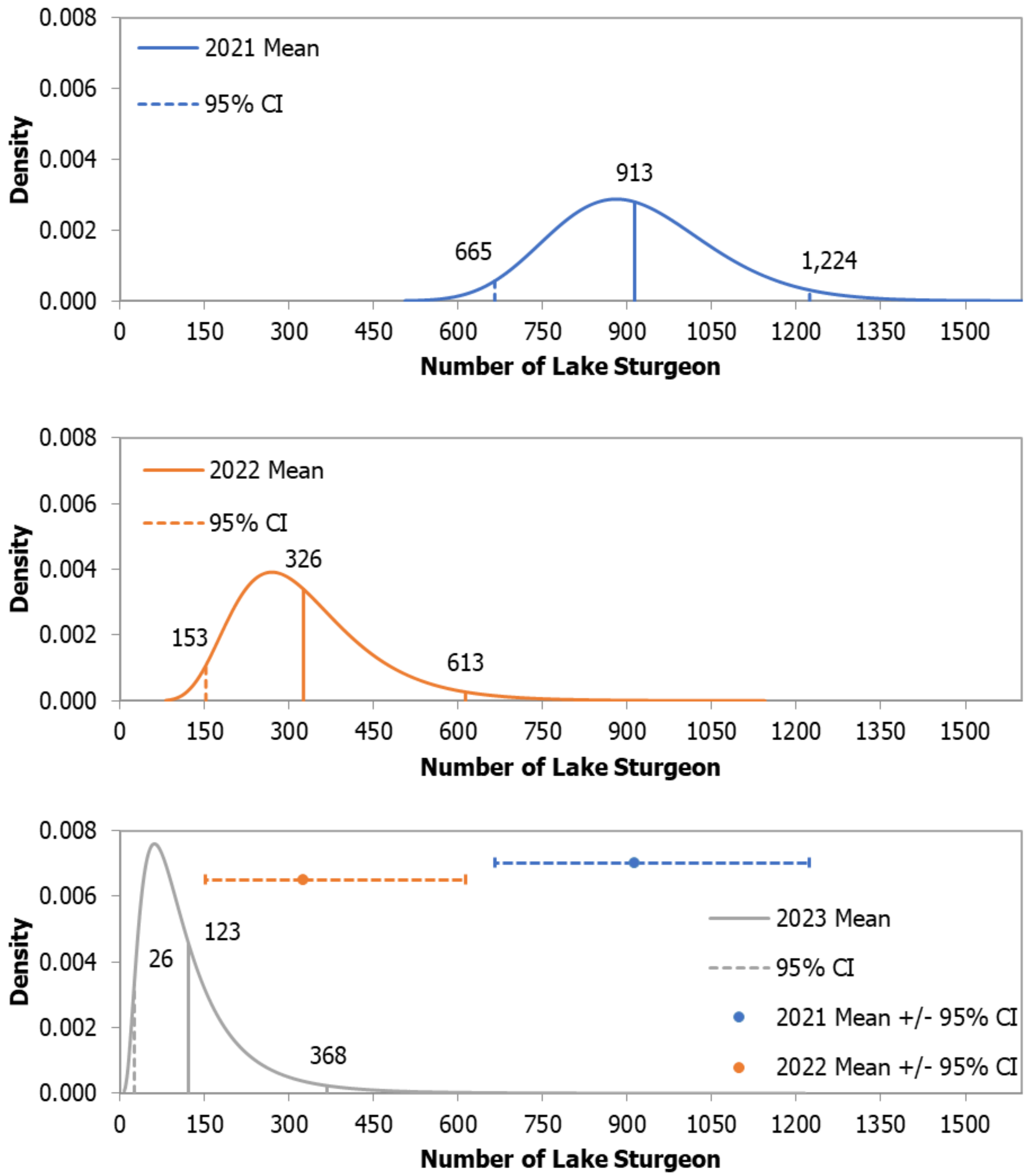


Figure 7. Analysis of change in mean population abundance estimates for the Keeyask reservoir between one sample period (2022 to 2023) and two sampling periods (2021 to 2023). A significant change from the 2021 estimate would be a 23% decrease or a 28% increase. A significant change from the 2022 estimate would be a 48% decrease or a 68% increase. The mean population estimate in 2023 showed a significant decrease both from the 2021 (87%) and 2022 (62%) estimates.

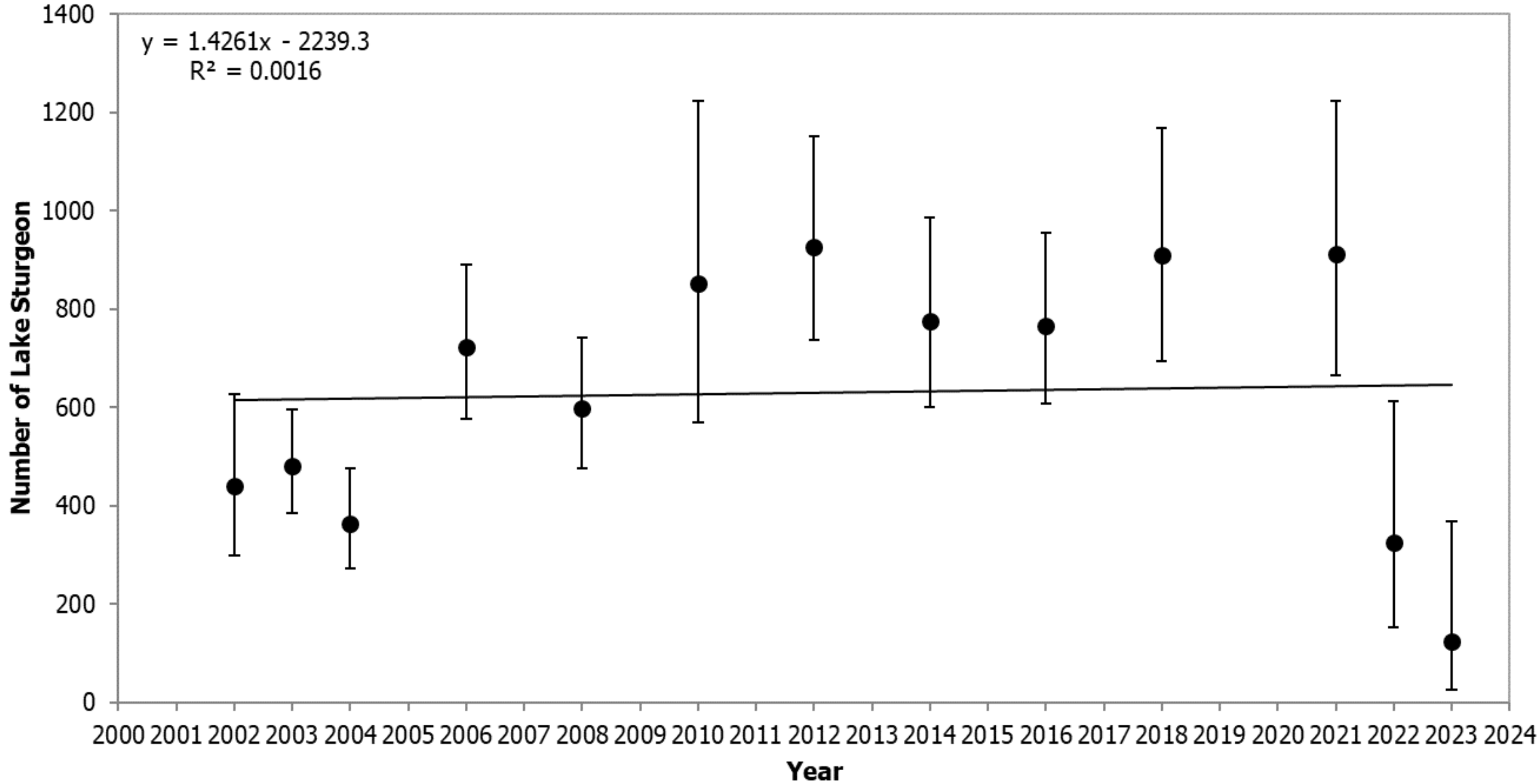


Figure 8. Abundance estimates for adult Lake Sturgeon in the Keeyask reservoir by sampling year (2002–2023) showing no significant trend in the long-term. A significant decrease in abundance was observed following 2021.

4.2 STEPHENS LAKE

4.2.1 RELATIVE ABUNDANCE/CPUE

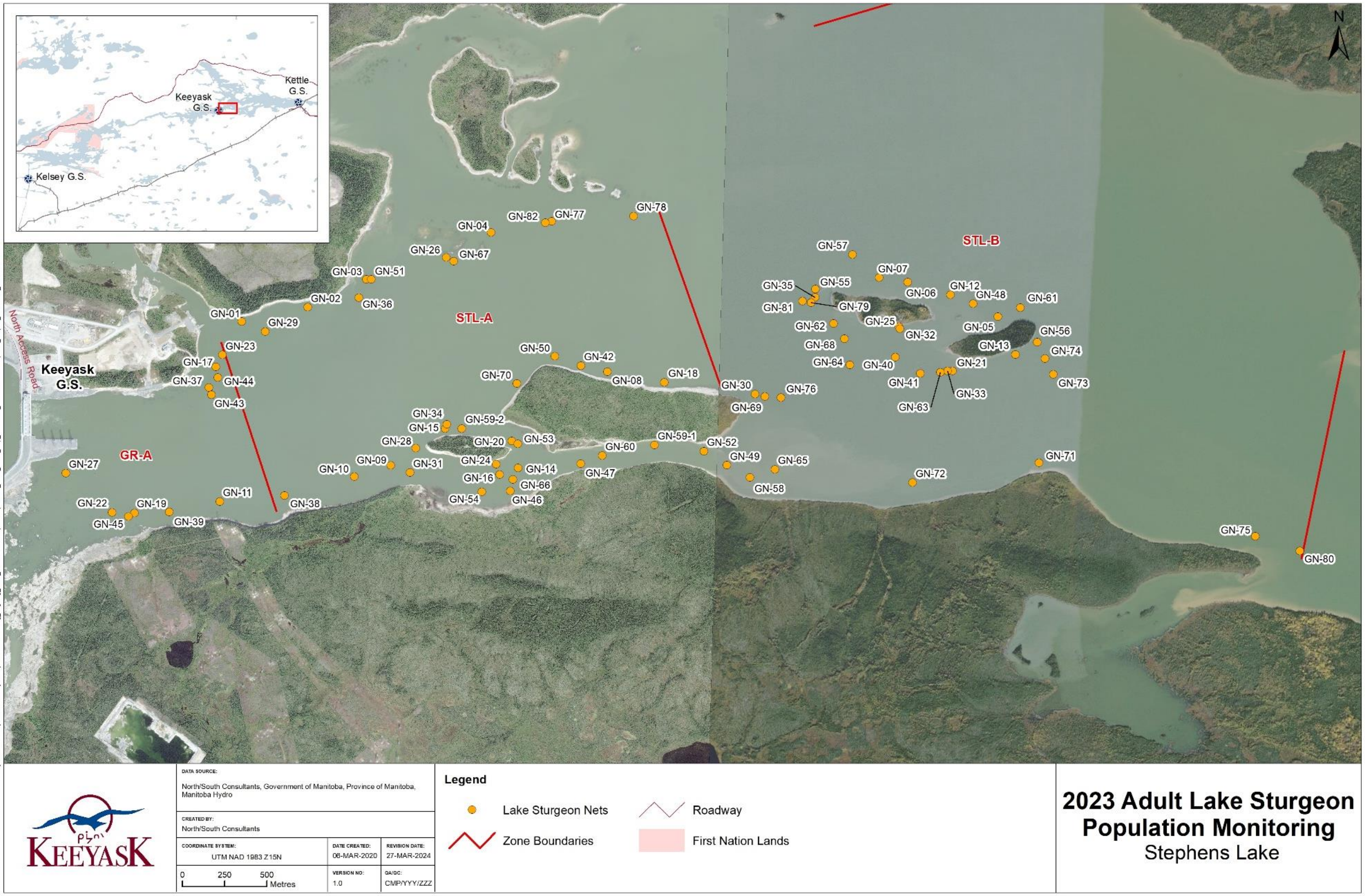
Large mesh gill nets were set at 83 sites in Stephens Lake between May 24 and July 1, 2023 (Map 3). Water temperature ranged from 7.4 to 19.7°C during this time (Figure 9). A total of 200 fish, comprised of seven species, were captured, the majority of which (n = 159; 80%) were Lake Sturgeon (Table 7). No Lake Sturgeon mortalities occurred during sampling.

Table 7. Number of fish, by species, captured during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2023.

Common Name	Scientific Name	Abbreviation	Stephens Lake[1]	% of Catch
Carp	*Cyprinus carpio*	CARP	4	2.0
Freshwater Drum	*Aplodinotus grunniens*	FRDR	9	4.5
Lake Sturgeon	***Acipenser fulvescens***	***LKST***	***159***	***79.5***
Northern Pike	*Esox lucius*	NRPK	13	6.5
Sauger	*Sander canadensis*	SAUG	4	2.0
Walleye	*Sander vitreus*	WALL	10	5
White Sucker	*Catostomus commersonii*	WHSC	1	0.5
Total			**200**	**100**

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.

In total, 159 Lake Sturgeon were captured in 9,032 gill net hours, resulting in an overall CPUE of 0.42 LKST/91.4 m net/24 h (Table 8). Site-specific CPUE ranged from 0.0–3.02 LKST/91.4 m net/24 h. Gillnetting effort was highest in Zone STL-A (3,799 gill net hours) and CPUE was highest in Zone GR-A, the area immediately downstream of the Keeyask GS (0.47 LKST/91.4 m net/24 h) (Map 3; Table 9).



Map 3. **Sites fished with large mesh gill net gangs in Stephens Lake, spring 2023.**

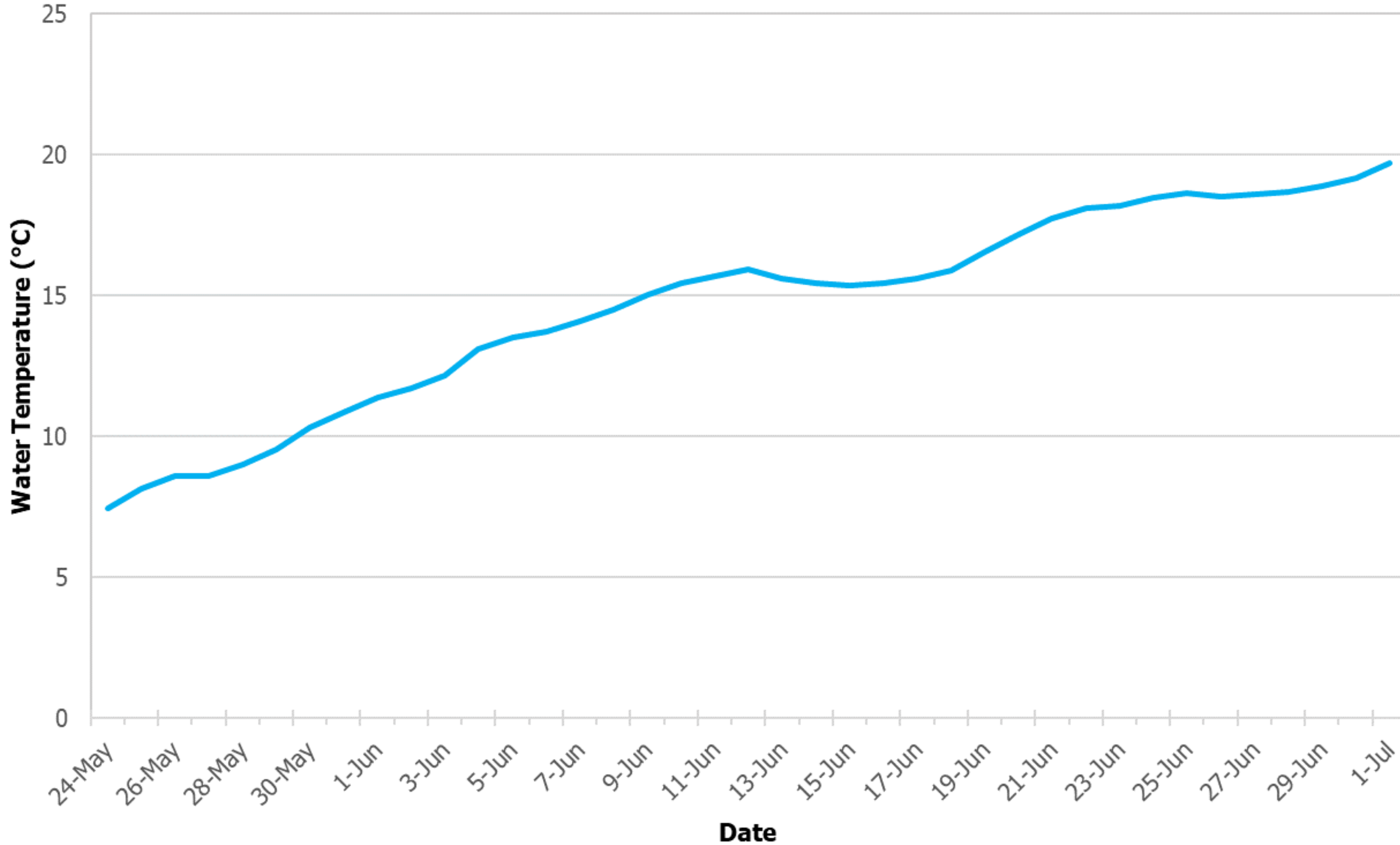


Figure 9. Mean daily water temperature of the Nelson River in Stephens Lake, May 24 to July 1, 2023.

Table 8. Lake Sturgeon catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values observed during mark/recapture studies in Stephens Lake, spring 2001–2023.

Year	# Sites	Total Lake Sturgeon[1]	Total Gill Net Hours[2,3]	Total CPUE
2001	18	24	6,254	0.09
2002	15	4	3,250	0.03
2003	29	24	9,638	0.06
2004	8	5	4,638	0.03
2005	35	6	7,933	0.02
2006	21	13	6,084	0.05
2010	37	17	4,898	0.08
2011	49	18	6,663	0.06
2012[4]	23	15	3,555	0.10
2014[4]	5	9	473	0.46
2016	90	71	17,037	0.10
2018	62	241	15,863	0.36
2021	72	170	6,382	0.64
2022	64	176	8,759	0.48
2023	**83**	**159**	**9,032**	**0.42**

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.
2. The effort has been corrected to account for net length set at each site. For example, the duration of a gill net gang consisting of two panels (*i.e.*, 45.7 m long) was halved (*i.e.*, equivalent of half a four-panel set).
3. The catch and effort from gillnetting conducted in other areas of Stephens Lake other than the reach downstream of the Keeyask GS (*i.e.*, zones GR-A, STL-A, and STL-B) have been excluded from this table in the years it was conducted.
4. CPUE value reflects study objective (*i.e.*, fish were captured for acoustic tagging) and may not be comparable to studies conducted in other years.

Table 9. Number and catch-per-unit-effort (CPUE; # LKST/91.4 m net/24 h) values, by zone, observed during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2023.

Zone	# Sites	Total Lake Sturgeon[1]	Total Gill Net Hours[2]	Total CPUE
GR-A	11	29	1,488	0.47
STL-A	39	64	3,799	0.40
STL-B	33	66	3,746	0.42

1. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged.
2. The effort has been corrected to account for net length set at each site. For example, the duration of a gill net gang consisting of two panels (*i.e.*, 45.7 m long) was halved (*i.e.*, equivalent of half a four-panel set).

4.2.2 BIOLOGICAL METRICS

Lake Sturgeon captured in Stephens Lake had a mean FL of 916 mm (range: 555–1,455 mm), a mean weight of 6,877 g (range: 1,980–21,400 g), and a mean condition factor of 0.86 (range: 0.49–1.61) (Table 10). Of the 159 Lake Sturgeon measured, 124 were classified as adults (FL ≥800 mm) and 35 were classified as juveniles (FL <800 mm). Lake Sturgeon measuring 800–849 mm FL were captured most frequently (n = 26), accounting for 16% of the total and 21% of the adult Lake Sturgeon catch (Figure 10). Most (46%; n = 16) of the 35 juvenile fish (FL <800 mm) captured were in the 750–799 mm interval.

Mean condition factor of all adult Lake Sturgeon captured in Stephens Lake was significantly higher during construction (2016, 2018, and 2021) compared to operation (2022 and 2023) for two of five FL intervals (850–899 and 950–999 mm) for which statistical comparisons were possible (Figure 11). There was no significant difference for mean condition factor between baseline (2001–2014) and construction or operation. A significant difference was not found for the other three FL intervals (800–849, 900–949, and 1,000–1,049 mm) for which comparisons were possible. The same result was observed when all fish originally tagged in the Keeyask reservoir were removed from analyses.

The length-weight relationship is presented in Figure 12.

Sex and maturity was confirmed for three pre-spawn males, all of which were captured on May 25 at a water temperature of 8.1°C (Table 11).

Table 10. Mean fork length (mm), weight (g), and relative condition factor (K) of Lake Sturgeon captured during adult Lake Sturgeon population monitoring in Stephens Lake, spring 2001–2023.

Year[1]	Fork Length (mm)				Weight (g)				K		
	n[2]	Mean	Std[3]	Range	n	Mean	Std	Range	n	Mean	Range
2001	24	1,077	181	792-1,447	24	13,148	9,499	4,400-40,000	24	0.94	0.71-1.56
2002	4	1,045	51	1,001-1,100	4	10,888	2,995	8,050-15,000	4	0.94	0.80-1.13
2003	24	1,018	206	555-1,340	23	11,212	7,205	1,700-26,000	23	0.90	0.61-1.20
2004	5	1,180	112	1,025-1,324	4	15,347	4,577	9,450-20,412	4	0.97	0.72-1.32
2005*	7	922	130	763-1,100	7	8,701	4,989	3,636-15,455	7	1.00	0.82-1.44
2006*	14	1,144	162	902-1,421	13	13,224	6,071	5,897-24,948	13	0.86	0.73-1.03
2010	17	1,028	162	730-1,349	16	9,993	5,272	3,200-24,040	16	0.83	0.65-0.98
2011	18	890	255	362-1,208	12	9,053	3,984	1,082-16,556	12	0.87	0.76-0.99
2012	15	896	144	645-1,176	11	7,468	3,113	3,901-14,969	11	0.92	0.74-1.07
2014	9	941	115	810-1,150	9	6,854	3,374	4,082-13,608	9	0.77	0.66-1.01
2016	71	902	152	343-1,425	69	6,740	3,540	253-22,680	69	0.85	0.63-1.20
2018	240	901	159	361-1,411	240	6,692	3,951	250-27,125	239	0.83	0.43-1.53
2021	170	837	215	335-1,480	170	6,717	4,538	250-29,000	170	0.97	0.64-1.77
2022	170	918	190	410-1,475	167	6,807	4,727	450-24,040	167	0.76	0.48-1.30
2023	**159**	**916**	**174**	**555-1,455**	**159**	**6,877**	**3,711**	**1,980-21,400**	**159**	**0.86**	**0.49-1.61**

1. An * indicates a few individuals from farther downstream in Stephens Lake are included in the analysis.
2. Number of fish measured.
3. Standard deviation.

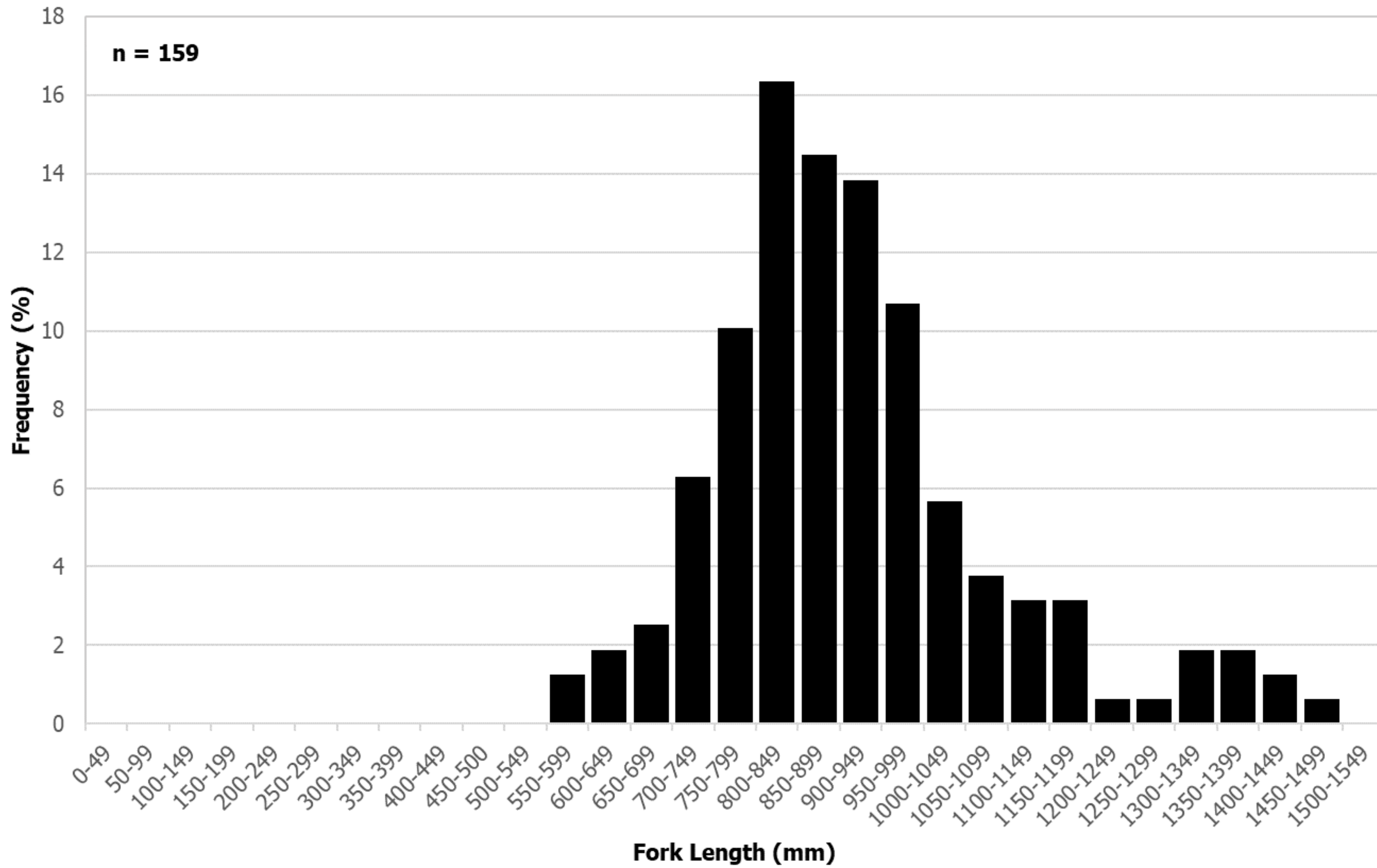


Figure 10. Length-frequency distribution for Lake Sturgeon captured in large mesh gill nets set in Stephens Lake, spring 2023.

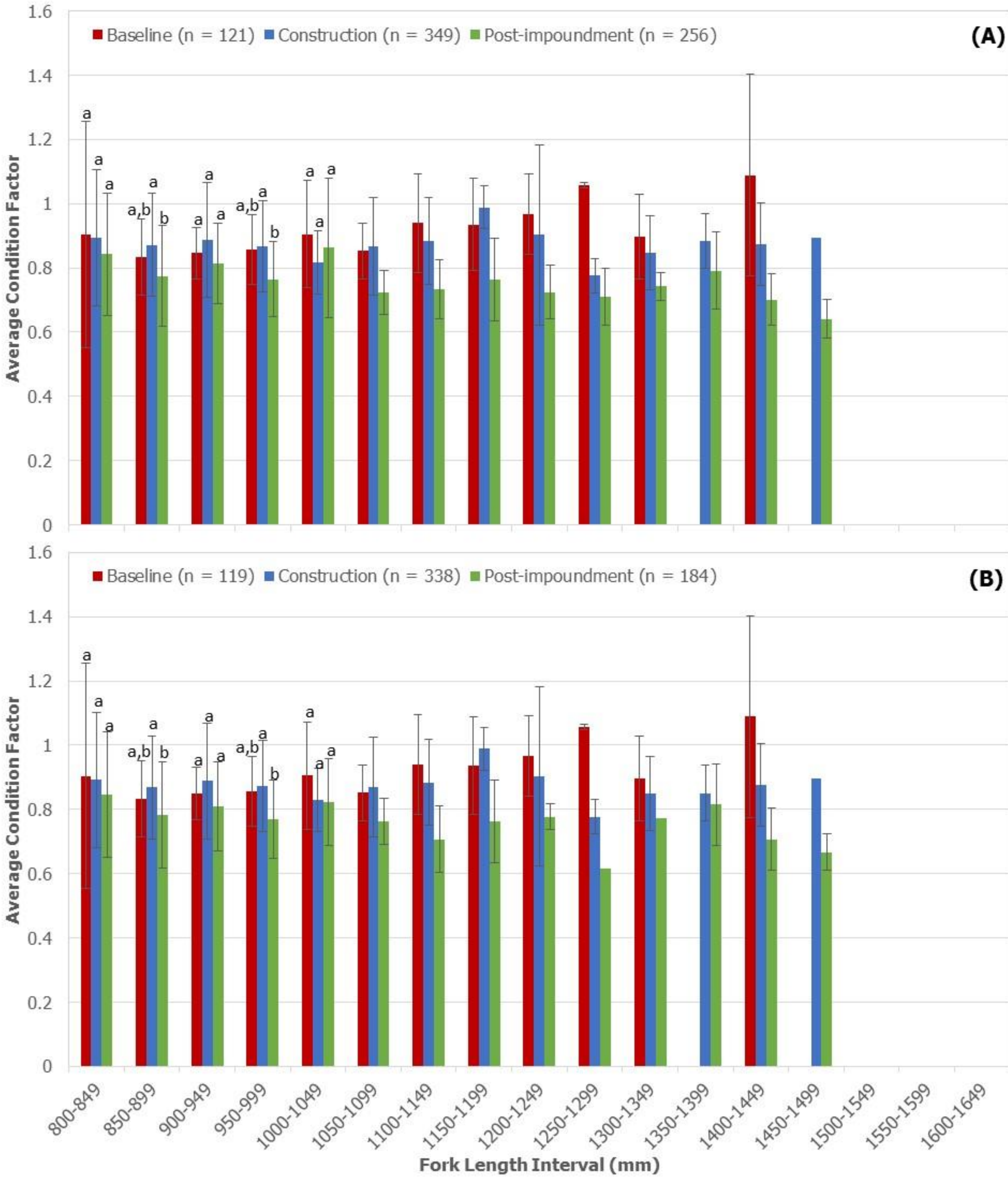


Figure 11. Mean condition factor by 50 mm length intervals for adult (≥800 mm) Lake Sturgeon captured in Stephens Lake baseline (red bars), construction (blue bars), and operation (green bars) periods including (A) and excluding (B) immigrants from the Keeyask reservoir. A significant difference was found for two of five Fork Length intervals (850–899 and 950–999 mm) that could be compared (Mann Whitney U test, $p > 0.05$). Error bars represent standard deviations.

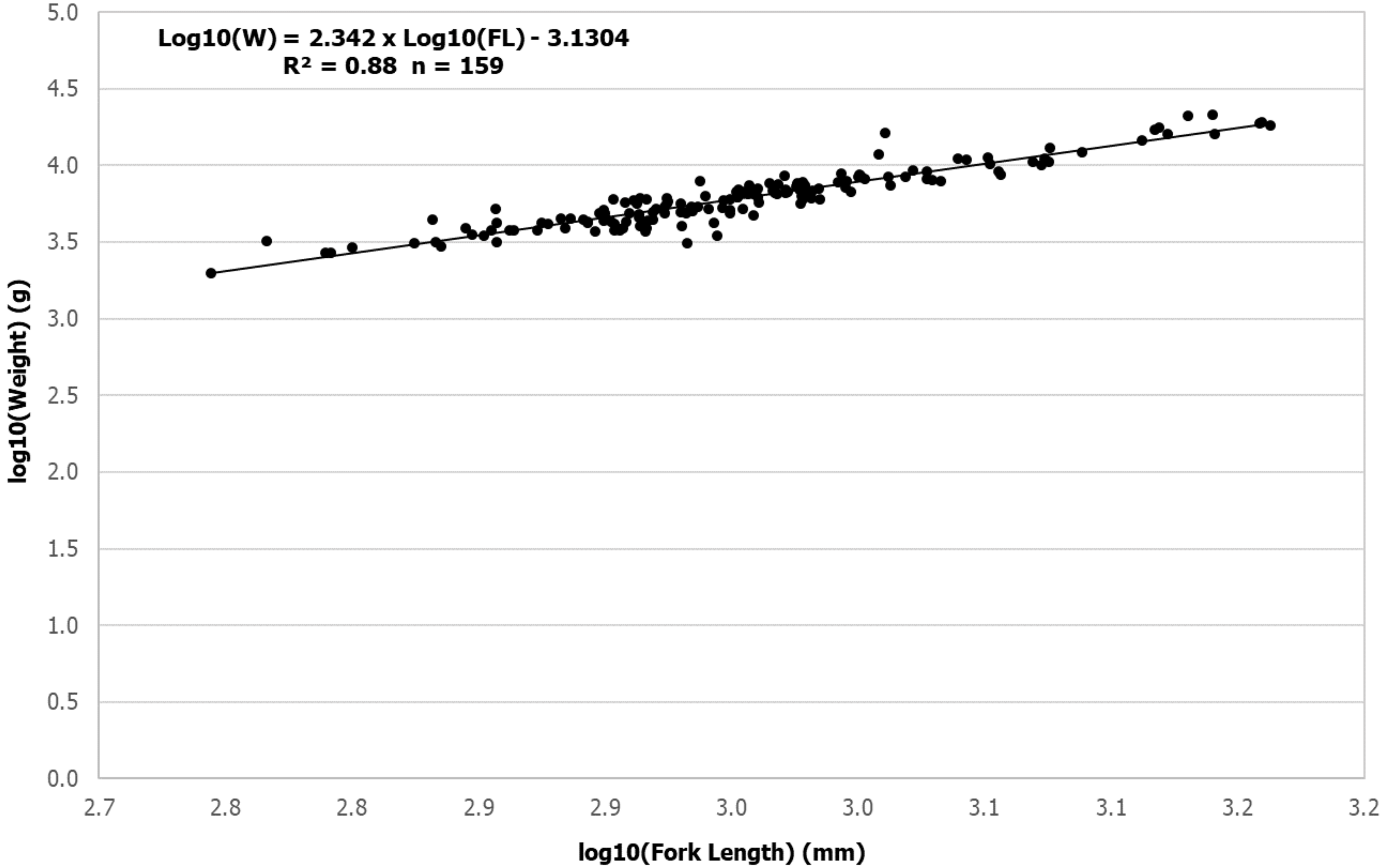


Figure 12. **Length-weight regression for Lake Sturgeon captured in large mesh gill nets set in Stephens Lake, spring 2023.**

Table 11. Sex and maturity data for Lake Sturgeon captured in Stephens Lake, spring 2001–2023.

Year[1]	Sex and Maturity[2]						# of Spawners[3]	Unknown maturity	Total
	Male			Female					
	7	8	9	2	3	4			
2001	5	-	-	3	-	-	8	16	24
2002	3	-	-	-	-	-	3	1	4
2003	2	-	-	1	-	-	3	21	24
2004	-	-	-	-	-	-	-	5	5
2005*	-	-	-	-	-	-	-	7	7
2006*	-	1	-	-	-	-	1	15	16
2010	-	-	-	-	-	-	-	17	17
2011	1	-	-	-	-	-	1	29	30
2012	3	1	-	-	-	-	4	11	15
2014	-	2	-	-	-	-	2	7	9
2016	4	4	-	-	-	-	8	63	71
2018	11	15	6	-	-	-	30	211	241
2021	5	-	-	-	-	-	5	165	170
2022	2	-	-	-	-	-	2	174	176
2023	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**156**	**159**

1. An * indicates a few individuals from farther downstream in Stephens Lake are included in the analysis.
2. Refer to Section 3.1 for maturity codes.
3. Maturity status columns include recaptures of fish whose maturity status progressed between captures (*e.g.*, would include recaptures of fish initially captured in maturing condition and recaptured in ripe or spent condition), but the columns may not add up to the "# of Spawners" column since this only includes individual fish captured (*i.e.*, CYTR that were captured in different maturity classifications were only counted once).

4.2.3 MOVEMENTS

Of the 159 Lake Sturgeon captured in Stephens Lake, 82 were recaptures from previous gillnetting studies, two were hatchery fish that were captured for the first time since stocking, and 75 were newly captured fish (all which received a Floy and a PIT tag; Table A1-2).

Both hatchery-reared fish that were captured for the first time in 2023 were initially released in Stephens Lake in 2015, one in June and one in September.

In total, 52% (82 of 157) of Lake Sturgeon were recaptures from previous gillnetting studies (Table 12). Five of the 82 recaptured Lake Sturgeon (6%) lost their Floy tag but retained their PIT tag. Biological and previous year capture information are provided in Table A2-2 and movements are summarized below:

Of the 82 Lake Sturgeon that were recaptured from previous studies, 37 (45%) were last captured in Stephens Lake.

- Thirty-five were originally tagged in Stephens Lake between 2003 and 2022. These fish were captured between one and three times.
- Two were originally tagged in Gull Lake but were last captured in Stephens Lake during previous studies.
    - Floy #75316 was tagged in Gull Lake in September 2008 and captured in Stephens Lake in June 2022.
    - Floy #75277 was tagged in Gull Lake in June 2008 and captured in Stephens Lake in June 2022.

Forty-five (55%) previously captured Lake Sturgeon were last captured in the Keeyask reservoir between 2003 and 2022. The majority of these fish (n = 39; 87%) were adults, measuring ≥800 mm FL.

- Thirty-five were last captured in Gull Lake prior to impoundment of the Keeyask reservoir in September 2020.
- Ten were last captured in the reservoir after September 2020 and definitively moved downstream after impoundment. All ten fish were adult sized.
    - One (Floy #118313) was last captured in the Keeyask reservoir in late September 2020.
    - Five were last captured in the Keeyask reservoir in spring (Floy #117037 and 121160) and fall (Floy #76320, 87856, and 117053) 2021.
    - Four were last captured in the Keeyask reservoir in spring 2022 (Floy #119116, 119129, 114643, and 120437)

Table 12. Recapture data for Lake Sturgeon captured in Stephens Lake during adult population monitoring, spring 2002–2023.

Recapture Location	Year	Original Tagging / Last Capture Location[3]							Total Recaptures[2]	Total LKST Captured	% Recaptures
		Kelsey GS Area	Split Lake	Upstream Birthday Rapids	Downstream Birthday Rapids	Gull Lake	Stephens Lake	Unknown			
Stephens Lake[1]	2002	0	0	0	0	0	0	0	0	4	0.0
	2003	0	0	0	0	1	3	0	4	24	16.7
	2004	0	0	0	0	0	3	0	3	5	60.0
	2005*	0	0	0	0	0	2	0	2	7	28.6
	2006*	0	0	0	0	2	7	0	9	14	64.3
	2010	0	0	0	2	0	8	0	10	17	58.8
	2011	0	0	0	0	0	6	0	6	18	33.3
	2012	0	0	0	1	0	5	0	6	15	40.0
	2014	0	0	0	0	1	3	0	4	9	44.4
	2016	0	0	0	0	1	15	0	16	71	22.5
	2018	0	0	1	2	3	81	0	87	241	36.1
	2021	0	0	0	0	6	82	1	89	170	52.3
	2022	0	0	0	16	31	60	1	110	176	62.5
	2023	**0**	**0**	**0**	**15**	**30**	**37**	**0**	**82**	**159**	**51.6**

1. An * indicates a few individuals from farther downstream in Stephens Lake are included in the analysis.
2. Does not include fish recaptured in the same waterbody in the season/year in which they were tagged, nor does it include hatchery fish that were captured in gill nets for the first time.
3. Initial tagging location of fish recaptured for the very first time since tagging or last known location of fish caught multiple times over multiple years.

4.2.4 POPULATION ESTIMATION

The 2023 population estimate for adult Lake Sturgeon (measuring ≥800 mm FL) in Stephens Lake was 1,291 individuals (CI 95%: 1,196–1,393; Figure 13; Table A3-2). The annual survival estimate (2016–2023) was 99%. The annual population growth rate (lambda) increased 64% between 2021 and 2022, and slightly decreased by 1.4% between 2022 and 2023 (Figure 14).

There was a significant increase in the estimated mean abundance of Lake Sturgeon in Stephens Lake between 2021 and 2023, however, the mean abundance did not change significantly between 2022 and 2023 (Figure 15). The 2023 population estimate showed an increase of 62% from 2021 and a 1% decrease from 2022. Abundance estimates between 2003 and 2023 show a significant increasing trend ($r^2 = 0.79$, $F = 41.90$, $p = 0.00005$; Figure 16).

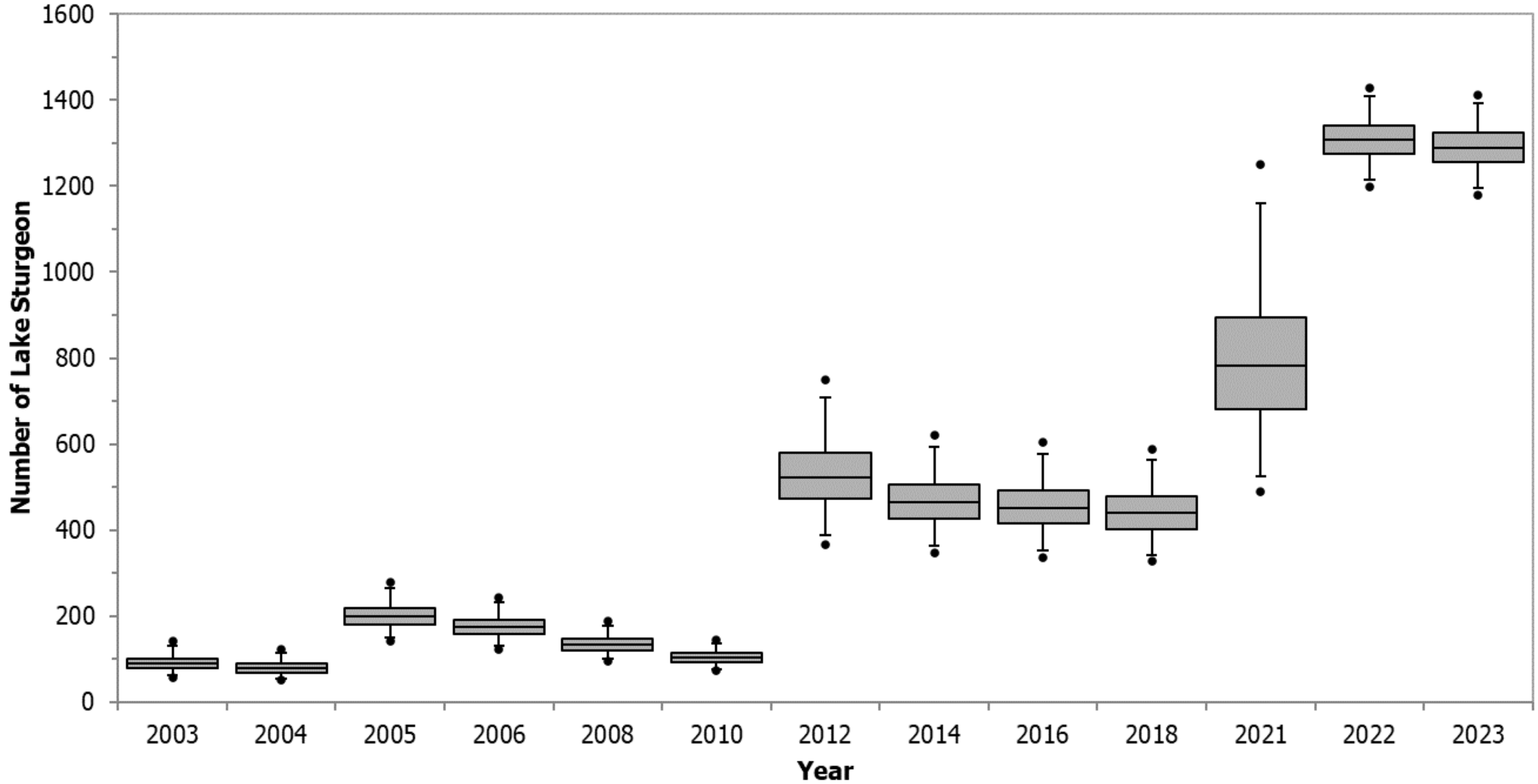


Figure 13. **Adult Lake Sturgeon abundance estimates based on POPAN best model for Stephens Lake (2003–2023). Horizontal line inside the box represents the estimated abundance (*i.e.*, the number of adult Lake Sturgeon in the area during the time of capture), the black dots represent the minimum and maximum estimates, and the vertical bar lines represent the upper and lower 95% confidence intervals.**

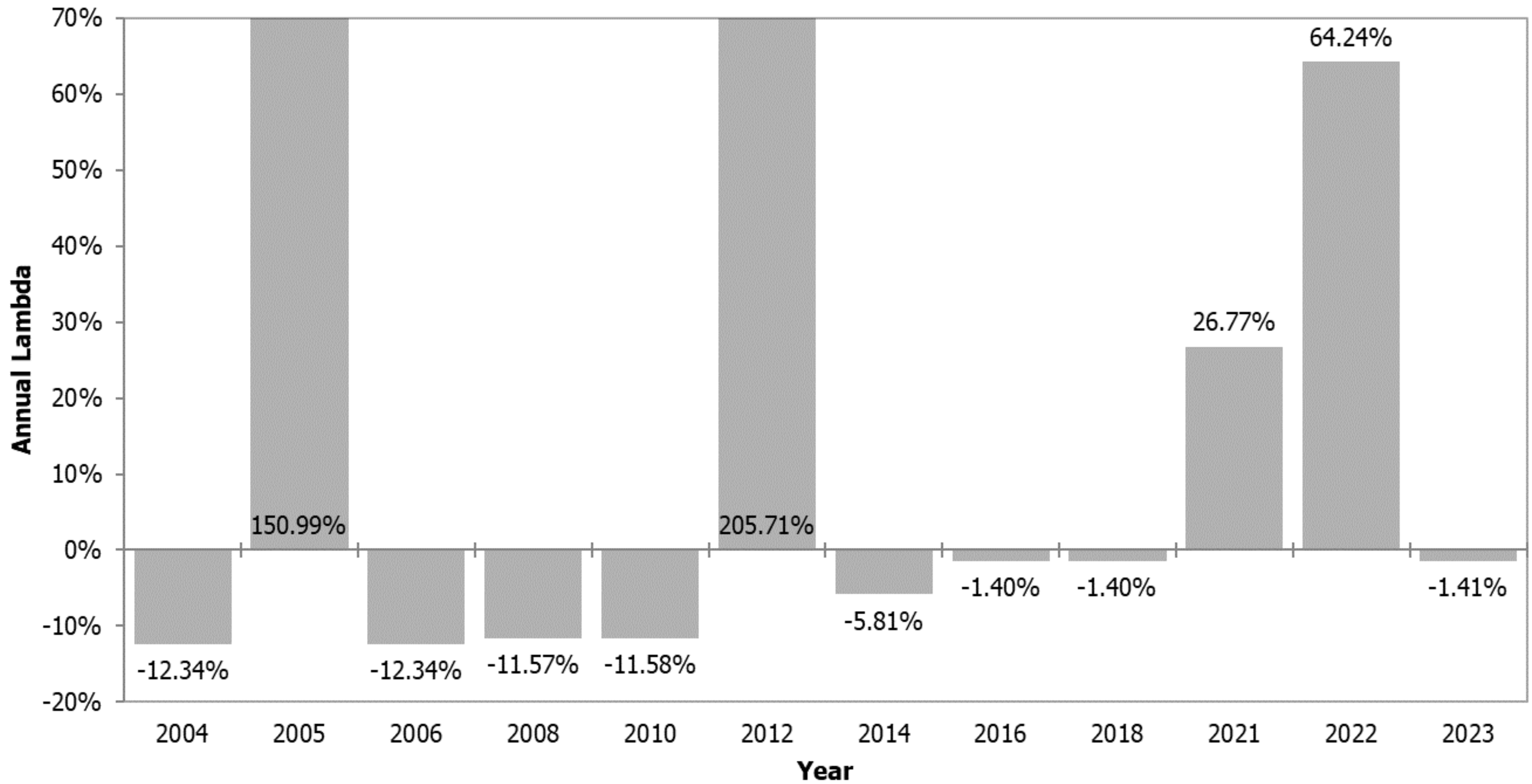


Figure 14. Annual percent change in adult Lake Sturgeon population growth estimates (lambda) based on the POPAN annual estimates in Stephens Lake. Percentages indicate change in population abundance between years.

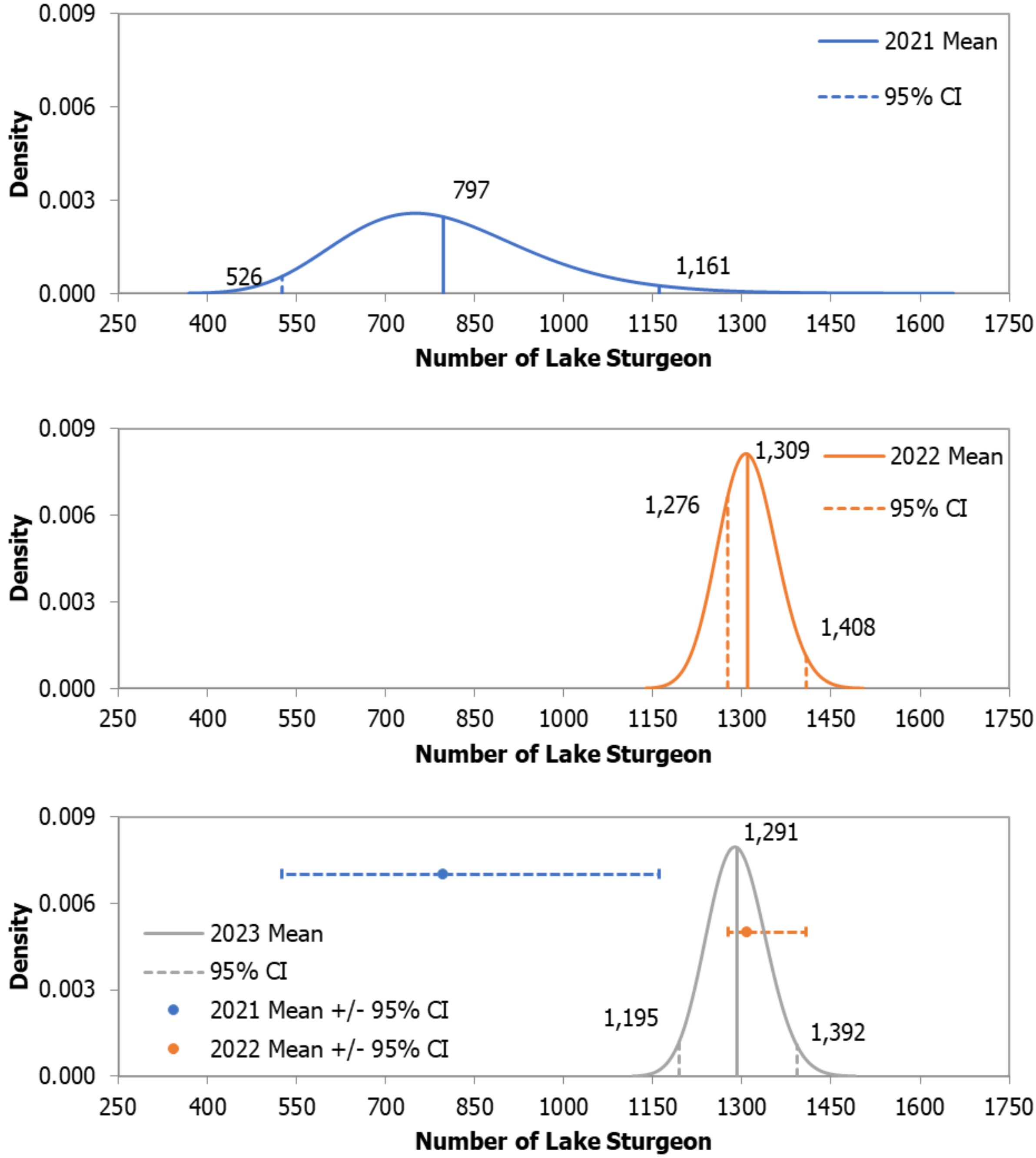


Figure 15. Analysis of change in mean population abundance estimates for Stephens Lake between one sample period (2022 to 2023) and two sampling periods (2021 to 2023). A significant change from the 2021 estimate would be a 30% decrease or a 37% increase. A significant change from the 2022 estimate would be a 6% decrease or a 6% increase. The mean population estimate in 2023 showed a significant increase from the 2021 estimate (62%) but did not differ significantly from the 2022 estimate (decreased by 1.4%).

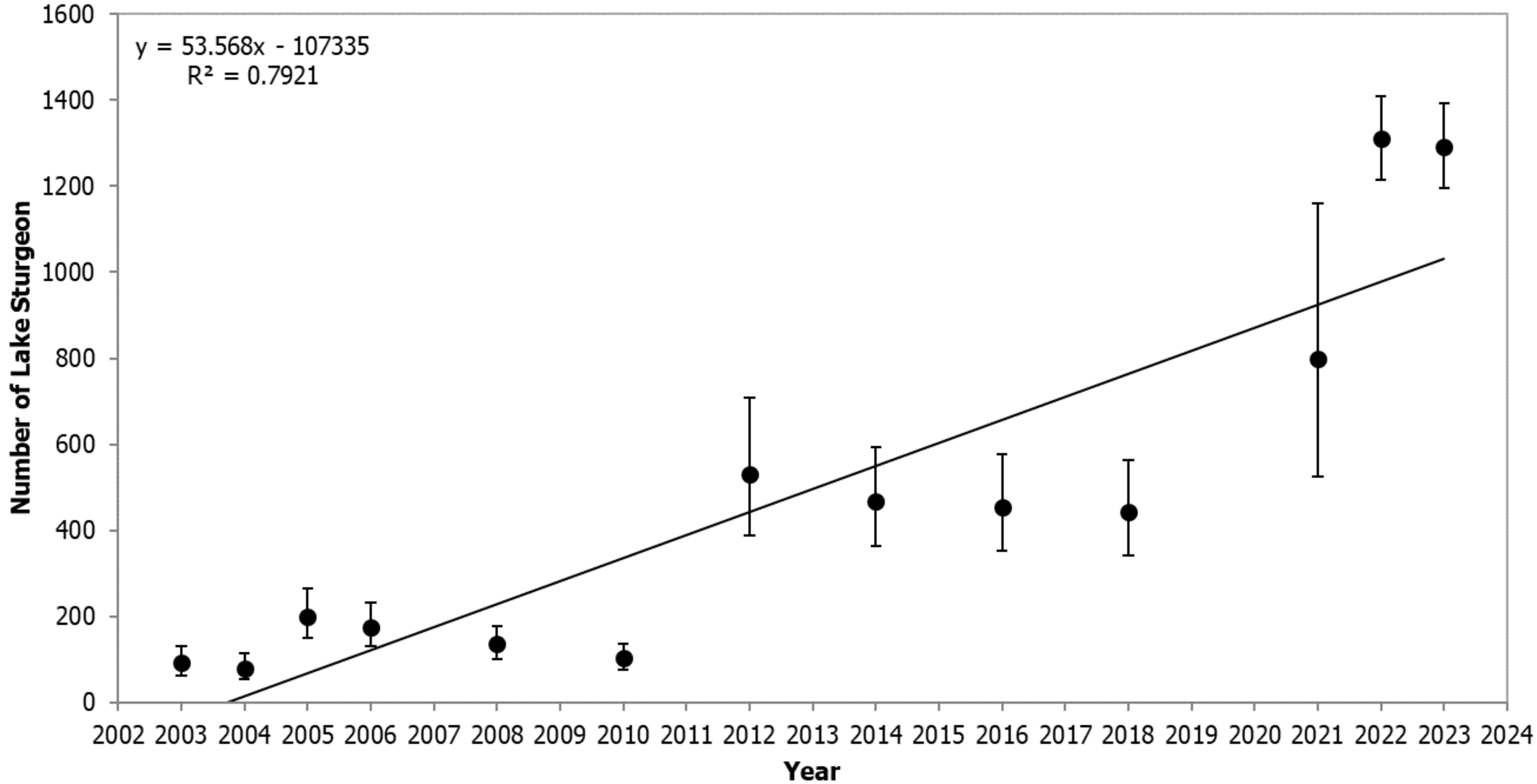


Figure 16. **Abundance estimates for adult Lake Sturgeon in Stephens Lake by sampling year (2003–2023) showing a significant positive trend.**

5.0 DISCUSSION

Although adult Lake Sturgeon population monitoring data are to be collected in the Keeyask reservoir and Stephens Lake every two years until 2044, following a large influx of adult Lake Sturgeon downstream into Stephens Lake after monitoring in 2021 (Hrenchuk and Small 2022), sampling was also conducted in 2022 to determine if these movements were substantial enough to impact the population size. As such, population monitoring data have been collected for three consecutive years (2021, 2022, and 2023), which represent the first three years following reservoir impoundment.

5.1 MOVEMENT

Since initial population monitoring was conducted in 2001, a total of 501 and 428 Lake Sturgeon have been recaptured in the Keeyask reservoir and Stephens Lake, respectively. Increased emigration from the Keeyask reservoir into Stephens Lake was identified as a potential impact of construction of the Keeyask GS in the EIS. Prior to impoundment in September 2020, between 0 and 14% of fish captured in Stephens Lake each sampling year were originally tagged in Gull Lake, representing only a small proportion of the overall catch. In 2021, 4% of the overall catch in Stephens Lake consisted of fish originally tagged in Gull Lake and by 2022, this number increased to 27%. In 2023, 45 fish captured in Stephens Lake were originally tagged in the Keeyask reservoir (28% of all captures and 55% of recaptured fish). Due to the length of time between last capture and recapture, it is impossible to determine when most of these fish moved downstream, or whether they moved through the powerhouse or the spillway. However, it is likely that adult-sized fish are too large to fit through the powerhouse trashracks and all downstream movements happen past the spillway. Ten fish captured in 2023 definitively moved downstream after impoundment, as one fish was last captured in the Keeyask reservoir in late September 2020, five in 2021, and four in spring 2023.

Acoustic telemetry studies have also identified an increase in downstream movements of adult Lake Sturgeon past the Keeyask GS following reservoir impoundment. Prior to 2021 (*i.e.*, from 2011–2020), only six fish tagged with acoustic transmitters had been observed moving downstream. Since that time, 28 adult Lake Sturgeon tagged with acoustic transmitters have moved from the Keeyask reservoir into Stephens Lake. A detailed discussion of all adult Lake Sturgeon movements through the Keeyask GS using both acoustic telemetry and mark-recapture methods can be found in Hrenchuk (2024).

5.2 ADULT LAKE STURGEON ABUNDANCE

A decline in Lake Sturgeon abundance in the Keeyask reservoir was predicted in the EIS due to upstream and downstream emigration resulting from environmental disturbances associated with impoundment and initial operations. However, the extent of emigration from the Keeyask reservoir has been larger than expected. Large-scale emigration from the Keeyask reservoir was observed following sampling in spring 2021. As a result, the abundance of adult Lake Sturgeon has also decreased. Sampling efforts in 2022 yielded the lowest CPUE (0.14 Lake Sturgeon/91.4 m net/24 h) since 2011 (0.12 Lake Sturgeon/91.4 m net/24 h). This decreased further in 2023 to 0.13 Lake Sturgeon/91.4 m net/24 h. As a result, the population estimate for 2023 was significantly lower than the two most recent study years and produced the lowest number since estimates have been recorded. Conversely, population estimates for Stephens Lake have shown a significant increasing trend between 2011 and 2023. In the short-term, Lake Sturgeon abundance in Stephens Lake in 2023 increased significantly from 2021 (69%) but did not differ significantly from 2022 (11%). Although the decrease in population abundance in the Keeyask reservoir and the increase in Stephens Lake is mainly driven by an increase in the number of fish moving downstream through the Keeyask GS between summer 2021 and spring 2023, it should be noted that the reduction in the Keeyask reservoir may partially be due to the increase in the volume of the reservoir and lower capture efficiency.

5.3 SPAWNING

A total of seven Lake Sturgeon captured in the Keeyask reservoir in 2023 were in spawning condition: this included six pre-spawn males and one post-spawn male. All seven fish were captured near Birthday Rapids (Map 2), which is similar to capture locations during previous studies (Hrenchuk *et al.* 2015; Legge *et al.* 2017; Holm and Hrenchuk 2019; Loeppky and Hrenchuk 2022; Ambrose *et al.* 2023). Spawning condition fish are often underrepresented in the catch and their presence is not always indicative of spawning success. For example, despite not capturing a spawning female in spring 2023, a wild young-of-the-year Lake Sturgeon was captured during fall juvenile Lake Sturgeon surveys (Dowd and Hrenchuk 2024), suggesting that spawning in the Keeyask reservoir did occur, although it is possible that this fish was spawned farther upstream (such as in the Burntwood River). In 2022, three fish in spawning condition were captured at Birthday Rapids, including one female. It was predicted in the EIS that the inundation of Birthday Rapids may change spawning habitat and potentially limit spawning potential, however, capture data suggest that Lake Sturgeon have continued to use this area to spawn. Gillnetting was conducted upstream of Birthday rapids during spawn in both 2022 and 2023 and no fish were captured.

Ongoing acoustic telemetry studies also suggest that post-impoundment, Lake Sturgeon continued to use spawning areas in the vicinity of Birthday Rapids. Ten fish (34% of all tracked) were detected downstream of Birthday Rapids during the spawning period in 2022 (Hrenchuk 2023) while six fish (33%) were detected here in 2023 (Hrenchuk 2024). One of the six fish detected in 2023 was also captured during population monitoring studies. This, along with evidence of spawning individuals at Birthday Rapids, suggests Lake Sturgeon continue to use this habitat post-impoundment.

In Stephens Lake, spawning Lake Sturgeon have been observed in nearly all study years since 2011, representing between 3% and 75% of the total number of fish captured. During 2023 sampling, the Keeyask spillway gates were closed between May 24 and June 12 due to low water levels, but reopened on June 12–13 and again on June 15 for the remainder of the program to facilitate maintenance work on the powerhouse (Manitoba Hydro 2024). Lake Sturgeon generally spawn when water temperatures range from 8–13°C. In 2023, Stephens Lake reached these temperatures from May 25–June 6, suggesting that the entire spawning period occurred when the spillway was closed. Three pre-spawn males, representing only 2% of the total catch, were captured in Stephens Lake on May 25. One was captured on the north shore, approximately 1.7 km downstream of the powerhouse and two were captured farther downstream, approximately 3.5 and 5.0 km downstream of the GS, closer to the middle of the river channel. Sampling in 2022 marked the first year in which the Keeyask GS was fully operational during the spawning period. High water levels necessitated the use of Keeyask spillway in this year and it was unclear if spawning occurred downstream of the spillway, powerhouse, or both (Ambrose *et al.* 2023). The closure of the spillway during the 2023 spawn and the capture of wild young-of-the-year Lake Sturgeon during fall 2023 juvenile Lake Sturgeon monitoring suggests that successful spawning occurred downstream of the Keeyask GS powerhouse in 2023 (Dowd and Hrenchuk 2024).

5.4 KEY QUESTIONS

Key questions identified in the AEMP for the operation period are addressed below.

Is there a biologically relevant (and statistically significant) change in the rate of population growth for the Keeyask reservoir and Stephens Lake populations?

The population estimate for adult Lake Sturgeon (measuring ≥800 mm FL) in 2023 was 123 individuals (95% CI: 32–464) in the Keeyask reservoir and 1,291 individuals (CI 95%: 1,196–1,393) in Stephens Lake. The population estimate for the Keeyask reservoir in 2023 was significantly lower than both the 2021 and 2022 estimates. The 2023 population estimate for Stephens Lake was significantly higher than the 2021 estimate but did not differ significantly from the 2022 estimate. The overall abundance estimates calculated between 2003 and 2023 show a significant increasing trend in Stephens Lake over time.

Is there a biologically relevant (and statistically significant) change in survival for the Keeyask reservoir and Stephens Lake populations?

The best-fit model indicated a marked decrease in adult Lake Sturgeon survival in the Keeyask reservoir, decreasing from 91% in 2004–2021 to only 40% from 2021–2023. However, this is the result of the large number of Lake Sturgeon that were observed moving out of the reservoir after impoundment in 2021 and 2022. Since these fish are unable to return and are lost from the upstream population, the model interprets them as mortalities, leading to an observed decrease in survival. When emigration (52% based on mark-recapture) is considered, the survival estimate becomes 92%, which is comparable to previous years.

The survival estimate for Stephens Lake was 99%, which is very high. In reality, survival is likely slightly lower, however, because survival is high and stable, the model interprets it as 99%.

Is there a biologically relevant (and statistically observable) change in the condition factor of Lake Sturgeon?

Too few adult Lake Sturgeon were captured in the Keeyask reservoir to compare condition at FL interval between baseline, construction, and post-impoundment. However, annual mean condition during operation (2022 and 2023; 0.74–1.27) was similar to the ranges observed during baseline (2001–2014; 0.77–1.23) and construction (2016, 2018, and 2021; 0.80–1.02). In Stephens Lake, comparisons of condition factor could be made for five size classes (800–849 mm, 850–899 mm, 900–949 mm, 950–999 mm, and 1,000–1,049 mm FL). Of these, a significant difference was only observed when comparing the mean condition factor of Lake Sturgeon post-impoundment to construction for 850–899 mm FL and 950-999 mm FL (fish of these size classes had significantly higher condition during construction than post-impoundment). Because a large number of Lake Sturgeon from the Keeyask reservoir moved downstream into Stephens Lake during operation, any differences in average condition factor in fish from the two areas may influence these results (*i.e.*, mean condition factor in Stephens Lake may be lower during operation because of an influx of fish from the Keeyask reservoir with a lower condition). However, the same result was observed when all fish originally tagged in the Keeyask reservoir were removed from analyses. No differences from baseline (*i.e.*, pre-construction) were observed.

Is the relative abundance/CPUE of adult Lake Sturgeon in Stephens Lake changing?

The CPUE of Lake Sturgeon in 2023 in Stephens Lake (0.42 LKST/91.4 m net/24 h) was lower than the two previous sampling years, but higher than any sampling year prior to 2021. Together, CPUE data and population estimates indicate that, although there is some year-to-year variation, the abundance of Lake Sturgeon in Stephens Lake is increasing over the long-term.

Are spawning adults present in the Keeyask reservoir and Stephens Lake?

Spawning males were captured in the Keeyask reservoir (n = 7) and in Stephens Lake (n = 3) during spring 2023. No spawning females were captured in either location, however, a lack of female fish is not indicative of spawning success. Lake Sturgeon are only identified as females based on the presence of eggs, which they generally release for a short period of time. Only 22 female Lake Sturgeon have been captured in the Keeyask reservoir since 2001, while 163 males have been caught over the same period. In Stephens Lake, four female and 67 male fish have been captured since 2001. The capture of young-of-the-year Lake Sturgeon in both the Keeyask reservoir (n = 1) and Stephens Lake (n = 2) in fall 2023 suggests that spawning did occur (Dowd and Hrenchuk 2024).

Where (on a coarse-scale) do Lake Sturgeon spawn in the post-Project environment?

All spawning adult Lake Sturgeon were captured in the Keeyask reservoir in the vicinity of Birthday Rapids. In Stephens Lake, one spawning fish was captured on the north shore downstream of the Keeyask GS powerhouse, while two fish were captured in the middle of the channel farther downstream (between 3.5 and 5.0 km from the powerhouse). All spillway gates were closed during the 2023 spawning period; therefore, it is unlikely that the area downstream of the spillway would provide sufficient attractant flow for spawning fish. Despite this, successful recruitment occurred in 2023 (Dowd and Hrenchuk 2024), indicating that adult Lake Sturgeon spawned downstream of the Keeyask GS powerhouse.

6.0 SUMMARY AND CONCLUSIONS

- Population monitoring was conducted in spring 2023 to derive an adult Lake Sturgeon abundance estimate and examine size and condition of the sturgeon populations in the Keeyask reservoir and Stephens Lake.
  - Although adult Lake Sturgeon population monitoring data are to be collected in the Keeyask reservoir and Stephens Lake every two years until 2044, following a large influx of adult Lake Sturgeon downstream into Stephens Lake after 2021 monitoring (Hrenchuk and Small 2022), sampling was also conducted in 2022 to determine if these movements were substantial enough to impact the population size. As such, population monitoring data have been collected for three consecutive years, which represent the first three years following reservoir impoundment.
- A total of 209 individual Lake Sturgeon were captured in the two different areas sampled in 2023. Of these, 50 were caught in the Keeyask reservoir (23 adults [≥ 800 mm FL] and 27 juveniles) and 159 were caught in Stephens Lake (124 adults and 35 juveniles).
- Overall CPUE in the Keeyask reservoir in 2023 (0.13 Lake Sturgeon/91.4 m net/24 h) was the second lowest since studies began in 2001 (0.12–0.54 Lake Sturgeon), and the lowest since 2011. Conversely, CPUE in Stephens Lake (0.42 Lake Sturgeon/91.4 m net/24 h) was among the highest recorded since 2001 (0.02–0.64 Lake Sturgeon), albeit lower than the CPUE observed in both 2021 and 2022.
- Sex and maturity were confirmed for seven individuals in the Keeyask reservoir, all of which were male (six pre-spawn and one post-spawn). Three male fish in pre-spawn condition were captured in Stephens Lake.
- The population estimates for adult Lake Sturgeon (measuring ≥800 mm FL) in the Keeyask reservoir and Stephens Lake in 2023 were 123 individuals (95% CI: 32–464) and 1,291 individuals (95% CI: 1,196–1,393), respectively.
- Key questions in the AEMP related to Lake Sturgeon monitoring in the Keeyask Area are addressed below:
  - *Is there a biologically relevant (and statistically significant) change in the rate of population growth for the Keeyask reservoir and Stephens Lake populations?*

    The population estimate for the Keeyask reservoir in 2023 was significantly lower than both the 2021 and 2022 estimates. The 2023 population estimate for Stephens Lake was significantly higher than the 2021 estimate, but not the 2022 estimate. The overall abundance estimates calculated between 2003 and 2023 show a significant increasing trend in Stephens Lake over time. The change in adult Lake Sturgeon abundance in both the Keeyask reservoir and Stephens Lake is largely driven by movements out of the reservoir since 2021.

- *Is there a biologically relevant (and statistically significant) change in survival for the Keeyask reservoir and Stephens Lake populations?*

  The best-fit model indicated a marked decrease in adult Lake Sturgeon survival in the Keeyask reservoir, decreasing from 91% in 2004–2021 to only 40% from 2021–2023. However, this is the result of the large number of Lake Sturgeon that were observed moving out of the reservoir in 2021 and 2022. Since these fish are unable to return and are lost from the upstream population, the model interprets them as mortalities, leading to an observed decrease in survival. When emigration (52% based on mark-recapture) is considered, the survival estimate becomes 92%, which is comparable to previous years.

  The survival estimate for Stephens Lake was 99%.

- *Is there a biologically relevant (and statistically observable) change in the condition factor of Lake Sturgeon?*

  Too few Lake Sturgeon were captured in the Keeyask reservoir to compare between baseline, construction, and post-impoundment periods; however, condition factor was within the range observed pre-construction and during construction. In Stephens Lake, a significant difference was observed between construction and post-impoundment periods for two of five size classes for which statistical comparisons could be made. Mean condition factor in Stephens Lake may be lower during operation because of an influx of fish from the Keeyask reservoir with a lower condition. However, the same result was observed when all fish originally tagged in the Keeyask reservoir were removed from analyses. No differences were observed from pre-construction.

- *Is the relative abundance/CPUE of adult Lake Sturgeon in Stephens Lake changing?*

  The CPUE of Lake Sturgeon in 2023 in Stephens Lake (0.42 LKST/91.4 m net/24 h) was lower than the two previous sampling years, but higher than any sampling year prior to 2021. Together, CPUE data and population estimates indicate that, although there is some year-to-year variation, the abundance of Lake Sturgeon in Stephens Lake is increasing over the long-term.

- *Are spawning adults present in the Keeyask reservoir and Stephens Lake?*

  Spawning males were captured in both the Keeyask reservoir (n = 7) and in Stephens Lake (n = 3) during spring 2023. No spawning females were captured in either location. The capture of young-of-the-year Lake Sturgeon in both the Keeyask reservoir (n = 1) and Stephens Lake (n = 2) in fall 2023 suggests that spawning did occur (Dowd and Hrenchuk 2024).

- *Where (on a coarse-scale) do Lake Sturgeon spawn in the post-Project environment?*

All spawning adult Lake Sturgeon were captured in the Keeyask reservoir in the vicinity of Birthday Rapids. Ongoing acoustic telemetry studies also suggest that post-impoundment, Lake Sturgeon continued to use spawning areas in the vicinity of Birthday Rapids (Hrenchuk and Small 2022; Hrenchuk 2023, 2024).

In Stephens Lake, one spawning fish was captured on the north shore downstream of the Keeyask GS powerhouse, while two fish were captured in the middle of the channel farther downstream (between 3.5 and 5.0 km from the powerhouse). All spillway gates were closed during the 2023 spawning period; therefore, it is unlikely that the area downstream of the spillway would provide sufficient attractant flow for spawning fish, therefore, adult Lake Sturgeon likely spawned downstream of the Keeyask GS powerhouse.

- During the initial years of Project operation, the EIS predicted that increased numbers of Lake Sturgeon would leave the Keeyask reservoir leading to a decrease in population abundance. However, the extent of emigration from the Keeyask reservoir has been larger than expected. Floy-tag recaptures in both 2022 and 2023 suggest that downstream emigration has occurred at higher rates than pre-impoundment. Between 2003 and 2021, a combined total of 14 fish tagged in Gull Lake were captured in Stephens Lake. Between 2022 and 2023, 92 fish originally tagged in Gull Lake were captured in Stephens Lake. Acoustic telemetry studies have also identified an increase in downstream movements of adult Lake Sturgeon past the Keeyask GS following reservoir impoundment. Prior to 2021 (*i.e.*, from 2011–2020), only six fish tagged with acoustic transmitters were observed moving downstream. Since that time, 28 adult Lake Sturgeon tagged with acoustic transmitters have moved from the Keeyask reservoir into Stephens Lake. Further, this was reflected both in the decreases in overall CPUE and the population estimate in the Keeyask reservoir. The total CPUE in 2023 (0.13 Lake Sturgeon/91.4 m net/24 h) was the lowest since 2011 (0.12 Lake Sturgeon/91.4 m net/24 h). The population abundance, estimated at 123 individuals (95% CI: 32–464), was significantly lower than 2021 (913 individuals; 95% CI 673–1,239) and 2022 (326 individuals; 95% CI: 163–653). It should be noted that this reduction may also be in part due to the increase in volume of the reservoir and lower capture efficiency. The EIS also predicted that habitat alterations at Birthday Rapids would decrease its attraction and use as spawning habitat. Although there has been a reduction in the amount of white-water present, water velocities have remained high and spawning Lake Sturgeon were captured downstream of Birthday Rapids in all three study years following reservoir impoundment. Wild Lake Sturgeon recruitment has been observed in each year post-impoundment, also suggesting that spawning habitat remains in the Keeyask reservoir.

7.0 LITERATURE CITED

Ambrose, K.M., Hrenchuk, C.L., and Nelson, P.A. 2020. Adult Lake Sturgeon population monitoring in the Upper Split Lake Area, 2019. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2020-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2020. xv + 93 pp.

Ambrose, K.M., Hrenchuk, C.L., and Burnett, D.C. 2023. Adult Lake Sturgeon population monitoring in the Upper Split Lake and Keeyask Areas, 2022. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2023-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2023. xviii + 152 pp.

Arnason, A.N. and Schwarz, C.J. 2002. POPAN-6: Exploring convergence and estimate properties with SIMULATE. Journal of Applied Statistics 29: 649-668.

Barth, C.C. 2005. Lake Sturgeon investigations in the Gull (Keeyask) Study Area, 2002. A report prepared for Manitoba Hydro by North/South Consultants Inc. xii + 114 pp.

Barth, C.C. and Ambrose, K. 2006. Lake Sturgeon investigations in the Keeyask Study Area, 2004. A report prepared for Manitoba Hydro by North/South Consultants Inc. x + 91 pp.

Barth, C.C. and MacDonald, J.E. 2008. Lake Sturgeon investigations in the Keeyask Study Area, 2005. A report prepared for Manitoba Hydro by North/South Consultants Inc. xiii + 50 pp.

Barth, C.C. and Mochnacz, N.J. 2004. Lake Sturgeon investigations in the Gull (Keeyask) Study Area, 2001. A report prepared for Manitoba Hydro by North/South Consultants Inc. xvi + 130 pp.

Barth, C.C. and Murray, L. 2005. Lake Sturgeon investigations in the Keeyask Study Area, 2003. A report prepared for Manitoba Hydro by North/South Consultants Inc. xiv + 101 pp.

Burnett, D.C. and Hrenchuk, C.L. 2022. Juvenile Lake Sturgeon population monitoring, fall 2021: Year 8 Construction. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2022-02. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2022. xvii + 119 pp.

Dowd, M.B. and Hrenchuk, C.L. 2024. Juvenile Lake Sturgeon population monitoring, fall 2023: Year 2 Operation. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2024-06. A report prepared for Manitoba Hydro by North/South Consultants Inc., January 2024. xvi + 121 pp.

Gosselin, T., Nelson, P.A., McDougall, C.A. and Bernatchez, L. 2015. Population genomics of Lake Sturgeon (*Acipenser fulvescens*) in the Churchill, Hayes, and Nelson Rivers. A report prepared for Manitoba Hydro by Université Laval and North/South Consultants Inc. 68 pp.

Groening, L., Henderson, L.M., and Hrenchuk, C.L. 2014. Results of adult Lake Sturgeon gillnetting in the Upper Split Lake Area, 2013. A report prepared for Manitoba Hydro by North/South Consultants Inc. ix + 64 pp.

Henderson, L.M., Hrenchuk, C.L., Nelson, P.A., Lacho, C.D., and Barth, C.C. 2016. Adult Lake Sturgeon population monitoring in the Upper Split Lake Area, 2015. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2016-01. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2016. xii + 72 pp.

Holm, J. and Hrenchuk. C.L. 2019. Adult Lake Sturgeon population monitoring in the future Keeyask reservoir and Stephens Lake, 2018. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2019-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2019. xv + 99 pp.

Hrenchuk, C.L. 2013. Adult Lake Sturgeon investigations in the Keeyask Study Area, 2012. A report prepared for Manitoba Hydro by North/South Consultants Inc. x + 62 pp.

Hrenchuk, C.L. 2023. Adult Lake Sturgeon acoustic tracking in the Nelson River between Clark Lake and the Limestone Generating Station, September 2021 to October 2022: Year 1 Operation. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2023-01. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2023. xix + 253 pp.

Hrenchuk, C.L. 2024. Adult Lake Sturgeon acoustic tracking in the Nelson River between Clark Lake and the Limestone Generating Station, October 2022 to August 2023: Year 2 Operation. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2024-01. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2024. xx + 279 pp.

Hrenchuk, C.L. and Lacho, C.D. 2019. Adult Lake Sturgeon movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2017 to October 2018: Year 5 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2019-01. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2019. xvii + 149 pp.

Hrenchuk, C.L. and McDougall, C.A. 2012. Lake Sturgeon investigations in the Keeyask Study Area, 2011. A report prepared for Manitoba Hydro by North/South Consultants Inc. xii + 169 pp.

Hrenchuk, C.L. and Small, K. 2022. Adult Lake Sturgeon movement monitoring in the Nelson River between Clark Lake and the Limestone Generating Station, October 2020 to 2021: Year 8 Construction. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2022-01. A report prepared for Manitoba Hydro by North/South Consultants Inc. xix + 342 pp.

Hrenchuk, C.L., Barth, C.C., and Nelson, P.A. 2015. Adult Lake Sturgeon population and spawn monitoring in the Keeyask area and Stephens Lake, 2014. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2015-06. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2015. x + 52 pp.

Klassen, C, Michaluk, Y., Kirchmann, S. and Groening, L. 2019. Lake Sturgeon production and stocking summary for Birthday Rapids and Burntwood River populations, November 2017 to October 2018: Year 5 Construction. Keeyask Generation Project Fisheries Off-setting and Mitigation Report. A report prepared by Manitoba Hydro.

Lacho, C.D., Hrenchuk, C.L., Nelson, P.A. and Barth, C.C. 2018. Adult Lake Sturgeon population monitoring in the Upper Split Lake Area, 2017. Keeyask Generation Project Aquatic Effects Monitoring Report #AEMP-2018-01. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2018. xvi + 94 pp.

Legge, M.M., Hrenchuk, C.L., Nelson, P.A., Burnett, D.C., and Barth, C.C. 2017. Adult Lake Sturgeon population monitoring in the Keeyask reservoir and Stephens Lake, 2016. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2017-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2017. xii + 67 pp.

Loeppky, A. and Hrenchuk, C.L. 2022. Adult Lake Sturgeon population monitoring in the Keeyask reservoir and Stephens Lake, 2021. Keeyask Generation Project Aquatic Effects Monitoring Plan Report #AEMP-2022-05. A report prepared for Manitoba Hydro by North/South Consultants Inc., June 2022. xv + 89 pp.

MacDonald, J.E. 2008a. Lake Sturgeon investigations in the Keeyask Study Area, 2005. A report prepared for Manitoba Hydro by North/South Consultants Inc. xiv + 100 pp.

MacDonald, J.E. 2008b. Lake Sturgeon investigations in the Keeyask Study Area, 2006. A report prepared for Manitoba Hydro by North/South Consultants Inc. xv + 95 pp.

MacDonald, J.E. and Barth, C.C. 2011. Lake Sturgeon investigations in the Keeyask Study Area, 2010. A report prepared for Manitoba Hydro by North/South Consultants Inc. xii + 64 pp.

Manitoba Hydro. 2024. 2023-2024 Physical Environment Monitoring Report: Year 2 Operation. Keeyask Generation Project Physical Environment Monitoring Plan Report #PEMP-2024-01. June 2024.

Michaluk, Y. and MacDonald, J.E. 2010. Lake Sturgeon investigations in the Keeyask Study Area, 2009. A report prepared for Manitoba Hydro by North/South Consultants Inc. xiii + 68 pp.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191. xvii + 382 pp.

APPENDICES

APPENDIX 1:
TAGGING AND BIOLOGICAL INFORMATION FOR LAKE STURGEON CAPTURED IN THE KEEYASK RESERVOIR AND STEPHENS LAKE, SPRING 2023

Table A1-1. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in the Keeyask reservoir, spring 2023....................................56
Table A1-2. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in Stephens Lake, spring 2023. 57

Table A1-1. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in the Keeyask reservoir, spring 2023.

Location	Zone	Date	Prefix	Floy tag	PIT tag	Acoustic Serial No.	Acoustic Tag Code	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Keeyask Reservoir	BR-D	25-May-23	NSC	128051	900 226001225389	57503	1520543	885	1000	6850	-	-
Keeyask Reservoir	GL-A	28-May-23	NSC	128052	900 226001225845	-	-	602	651	1150	-	-
Keeyask Reservoir	BR-D	28-May-23	NSC	128053	900 226001225350	-	-	760	845	3190	-	-
Keeyask Reservoir	BR-D	28-May-23	NSC	128054	900 226001225383	-	-	1050	1140	8760	M	7
Keeyask Reservoir	BR-D	29-May-23	-	-	-	-	-	140	160	12	-	-
Keeyask Reservoir	BR-D	30-May-23	NSC	128057	900 226001225892	57500	1520540	885	971	5830	-	-
Keeyask Reservoir	BR-D	30-May-23	NSC	128058	900 226001225810	51953	1563899	960	1090	8320	M	7
Keeyask Reservoir	BR-D	1-Jun-23	NSC	128059	900 226001225833	-	-	725	815	3620	-	-
Keeyask Reservoir	BR-D	2-Jun-23	NSC	128060	989 001038119800	57501	1520541	895	995	5850	-	-
Keeyask Reservoir	BR-D	2-Jun-23	NSC	128061	900 226001225806	51942	1563888	1000	1109	8140	M	7
Keeyask Reservoir	BR-D	2-Jun-23	NSC	128062	900 226001225394	-	-	760	855	3210	-	-
Keeyask Reservoir	BR-D	3-Jun-23	NSC	128063	900 226001055718	-	-	754	800	3100	-	-
Keeyask Reservoir	BR-D	4-Jun-23	NSC	128065	900 226001225800	-	-	600	700	2500	-	-
Keeyask Reservoir	BR-D	6-Jun-23	NSC	114766	-	-	-	838	952	4762	-	-
Keeyask Reservoir	BR-D	6-Jun-23	NSC	114765	-	7022	1320113	1016	1130	8618	M	9
Keeyask Reservoir	BR-D	9-Jun-23	NSC	128066	900 226001225865	-	-	714	810	2150	-	-
Keeyask Reservoir	BR-D	10-Jun-23	NSC	128070	900 226001225817	-	-	510	594	1250	-	-
Keeyask Reservoir	BR-D	10-Jun-23	NSC	128068	900 226001225834	-	-	562	643	1400	-	-
Keeyask Reservoir	BR-D	10-Jun-23	NSC	128069	900 226001225807	-	-	469	529	1100	-	-
Keeyask Reservoir	BR-D	14-Jun-23	NSC	128071	900 226001225872	-	-	581	673	1480	-	-
Keeyask Reservoir	GL-A	18-Jun-23	NSC	128072	900 226001225855	-	-	494	559	760	-	-
Keeyask Reservoir	BR-D	18-Jun-23	NSC	128073	900 226001225869	-	-	869	965	5240	-	-
Keeyask Reservoir	GL-B	26-Jun-23	NSC	128074	900 226001225885	-	-	860	936	3856	-	-
Keeyask Reservoir	GL-B	27-Jun-23	NSC	128100	900 226001225859	-	-	780	885	3289	-	-
Keeyask Reservoir	BR-D	28-Jun-23	NSC	128099	900 226001225876	-	-	840	892	6010	-	-
Keeyask Reservoir	GL-C	30-Jun-23	NSC	128095	900 226001225880	-	-	580	660	1247	-	-

Table A1-2. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in Stephens Lake, spring 2023.

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-A	25-May-23	NSC	130800	-	900 226001225327	856	954	3100	-	-
Stephens Lake	STL-A	25-May-23	NSC	130799	-	900 226001224186	668	760	3100	-	-
Stephens Lake	STL-A	25-May-23	NSC	130798	-	900 226001225421	1002	1115	8600	-	-
Stephens Lake	STL-B	25-May-23	NSC	130997	-	900 226001227539	779	875	4400	-	-
Stephens Lake	STL-B	25-May-23	NSC	130795	-	900 226000327327	873	960	5240	-	-
Stephens Lake	STL-A	25-May-23	NSC	130780	-	900 226001225488	799	911	4320	M	7
Stephens Lake	STL-A	27-May-23	NSC	130790	-	900 226001658283	936	1044	6960	-	-
Stephens Lake	STL-A	27-May-23	NSC	130788	-	900 226000768092	982	1105	7800	-	-
Stephens Lake	STL-A	27-May-23	NSC	130987	-	900 226001031903	787	886	3720	-	-
Stephens Lake	STL-A	27-May-23	NSC	130786	-	900 226001230453	1006	1125	8140	-	-
Stephens Lake	STL-B	27-May-23	NSC	130783	-	900 226001230595	864	964	5380	-	-
Stephens Lake	STL-B	27-May-23	NSC	130782	-	900 226001230521	951	1068	6000	-	-
Stephens Lake	GR-A	27-May-23	NSC	130781	-	900 226000548946	938	1061	6740	-	-
Stephens Lake	STL-A	28-May-23	NSC	130776	-	900 226001230548	890	994	5120	-	-
Stephens Lake	STL-A	28-May-23	NSC	130796	-	900 226001230582	826	904	4340	-	-
Stephens Lake	STL-B	28-May-23	NSC	130785	-	900 226001230421	794	896	4860	-	-
Stephens Lake	STL-B	28-May-23	NSC	130784	-	900 226000768444	782	909	4300	-	-
Stephens Lake	STL-A	28-May-23	NSC	130779	-	900 226001230498	766	863	3900	-	-
Stephens Lake	GR-A	28-May-23	NSC	130775	-	900 226001230513	839	918	5420	-	-
Stephens Lake	STL-A	29-May-23	NSC	130774	-	900 226001658884	681	779	3160	-	-
Stephens Lake	STL-A	29-May-23	NSC	130773	-	900 226001230519	860	961	5080	-	-
Stephens Lake	STL-A	29-May-23	NSC	130772	-	900 226001230487	720	812	3180	-	-
Stephens Lake	GR-A	29-May-23	NSC	130771	-	900 226001230534	905	1003	6520	-	-
Stephens Lake	GR-A	29-May-23	NSC	130770	-	900 226001230571	830	915	4960	-	-
Stephens Lake	GR-A	29-May-23	NSC	130769	-	900 226001230583	700	800	3880	-	-
Stephens Lake	GR-A	29-May-23	NSC	130768	-	900 226001225145	801	892	3780	-	-
Stephens Lake	GR-A	29-May-23	NSC	130767	-	900 226001225211	951	1061	6480	-	-
Stephens Lake	STL-A	30-May-23	NSC	130766	-	900 226001224637	948	1050	6980	-	-
Stephens Lake	STL-B	30-May-23	NSC	130765	-	900 226001225462	684	769	2980	-	-
Stephens Lake	STL-B	30-May-23	NSC	130751	-	900 226001225116	770	859	4480	-	-
Stephens Lake	STL-B	30-May-23	NSC	130752	-	900 226001230128	832	938	5240	-	-

Table A1-2. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in Stephens Lake, spring 2023 (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-A	30-May-23	NSC	130753	-	900 226001230465	805	894	3800	-	-
Stephens Lake	STL-A	30-May-23	NSC	130754	-	900 226001230489	704	801	3560	-	-
Stephens Lake	STL-A	30-May-23	NSC	130755	-	900 226001230491	896	981	6260	-	-
Stephens Lake	STL-A	01-Jun-23	NSC	130756	-	900 226001230578	851	958	4970	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130758	-	900 226001225547	855	956	5000	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130759	-	900 226001225523	914	1010	5700	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130760	-	900 226001230475	923	1012	7700	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130761	-	900 043000103813	679	755	4450	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130762	-	900 226001230588	815	1040	5950	-	-
Stephens Lake	STL-A	02-Jun-23	NSC	130763	-	900 226001230551	584	658	3200	-	-
Stephens Lake	GR-A	05-Jun-23	NSC	130793	-	900 226001230481	819	915	4800	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130785	-	900 226001230445	820	919	4000	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130724	-	900 226001230461	852	944	4000	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130723	-	900 226001230490	877	944	4200	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130721	-	900 226001230454	750	854	4200	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130720	-	900 226000327531	731	833	3800	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130719	-	900 226001230493	809	903	5700	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130718	-	900 226001230130	953	1051	7400	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	130717	-	900 226001230530	866	956	7900	-	-
Stephens Lake	STL-A	06-Jun-23	NSC	130715	-	900 226001230525	795	890	4450	-	-
Stephens Lake	STL-A	07-Jun-23	NSC	130714	-	900 226001230478	949	1080	5600	-	-
Stephens Lake	STL-A	07-Jun-23	NSC	130713	-	900 226001230538	897	985	6900	-	-
Stephens Lake	STL-B	09-Jun-23	NSC	130710	-	900 226001230402	820	918	6100	-	-
Stephens Lake	STL-B	09-Jun-23	NSC	130709	-	900 226001230449	855	975	4900	-	-
Stephens Lake	STL-B	09-Jun-23	NSC	130708	-	900 226001230423	1001	1112	8700	-	-
Stephens Lake	GR-A	09-Jun-23	NSC	130707	-	900 226001230567	1444	1554	19200	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	130705	-	900 226001230597	880	1014	3500	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	130704	-	900 226001230400	1139	1273	8700	-	-
Stephens Lake	STL-B	14-Jun-23	NSC	130703	-	900 226001230505	906	995	7420	-	-
Stephens Lake	STL-B	14-Jun-23	NSC	130702	-	900 226001230537	1000	1121	8490	-	-
Stephens Lake	STL-B	16-Jun-23	NSC	130676	-	900 226001230554	965	1040	7100	-	-
Stephens Lake	STL-B	16-Jun-23	NSC	130677	-	900 226001227445	909	1013	6520	-	-

Table A1-2. Tagging and biological information for Lake Sturgeon marked with Floy tags and PIT tags in Stephens Lake, spring 2023 (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-A	16-Jun-23	NSC	130678	-	900 226001230580	720	809	4200	-	-
Stephens Lake	GR-A	17-Jun-23	NSC	130681	-	900 226001230485	1315	1459	17600	-	-
Stephens Lake	STL-B	18-Jun-23	NSC	130680	-	900 067000055308	711	811	3500	-	-
Stephens Lake	STL-A	18-Jun-23	NSC	130682	-	900 226001230496	782	878	4200	-	-
Stephens Lake	STL-A	18-Jun-23	NSC	130683	-	900 226001230403	1104	1209	10900	-	-
Stephens Lake	STL-B	21-Jun-23	NSC	130684	-	900 226001230545	896	1015	6220	-	-
Stephens Lake	GR-A	21-Jun-23	NSC	130685	-	900 226001230455	795	911	4500	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	130686	-	900 226001055370	927	1048	6600	-	-
Stephens Lake	STL-A	26-Jun-23	NSC	130687	-	900 226001225564	966	1079	6000	-	-
Stephens Lake	STL-A	30-Jun-23	NSC	130688	-	900 226001230415	810	919	4280	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	130689	-	900 067000055499	616	709	2700	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	130690	-	900 226001230584	950	1085	7700	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	130691	-	900 226001230412	754	855	4180	-	-
Stephens Lake	STL-A	01-Jul-23	NSC	130694	-	900 226000153897	1181	1307	10100	-	-

APPENDIX 2: TAGGING AND BIOLOGICAL INFORMATION FOR LAKE STURGEON RECAPTURED IN THE KEEYASK RESERVOIR AND STEPHENS LAKE, SPRING 2023

Table A2-1. Tagging and biological information for Lake Sturgeon recaptured in the Keeyask reservoir, spring 2023. 61
Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. 63

Table A2-1. Tagging and biological information for Lake Sturgeon recaptured in the Keeyask reservoir, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font.

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	Acoustic Serial No.	Acoustic Tag Code	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-C	07-Jun-12	NSC	100416		-	-	-	728	824	3050	-	-
Keeyask Reservoir	GL-A	27-May-23	NSC	100416		1520537	57497	900 226001225893	940	1092	8180	-	-
Keeyask Reservoir	BR-D	19-Jun-21	NSC	120829		-	-	900 043000182251	1010	1033	7800	-	-
Keeyask Reservoir	BR-D	28-May-23	NSC	120829		-	-	900 043000182251	1080	1140	9720	M	7
Gull Lake	BR-D	12-Aug-19	NSC	107963		-	-	-	512	602	1089	-	-
Keeyask Reservoir	BR-D	28-May-23	NSC	107963		-	-	900 226001225821	590	675	1900	-	-
Keeyask Reservoir	BR-D	03-Jun-21	NSC	117030		-	-	900 226001225589	1024	1142	8300	-	-
Keeyask Reservoir	BR-D	30-May-23	NSC	117030		1563887	51941	900 226001225867	1050	1121	10780	M	7
Keeyask Reservoir	BR-D	09-Jun-23	NSC	117030		-	-	900 226001225867	-	-	-	-	-
Gull Lake	BR-D	29-Jun-02	NSC	48803		-	-	-	925	1004	8618	-	-
Gull Lake	BR-D	31-May-06	NSC	48803		-	-	-	1000	1100	8150	-	-
Gull Lake	BR-D	19-May-10	NSC	48803		-	-	-	1040	1145	9525	M	7
Keeyask Reservoir	BR-D	30-May-23	NSC	48803		1520538	57498	900 226001225825	1140	1265	10380	-	-
Gull Lake	GL-A	23-Sep-16	NSC	111022		-	-	900 226000893629	664	747	2380	-	-
Keeyask Reservoir	BR-D	30-May-23	NSC	111022		-	-	900 226000893629	750	840	3120	-	-
Gull Lake	BR-D	01-Jun-16	NSC	107230		-	-	900 226000768503	930	1009	7257	M	8
Keeyask Reservoir	BR-D	01-Jun-23	NSC	107230		1563885	51939	900 226000768503	980	1050	8170	M	7
Gull Lake	BR-D	11-Jun-18	NSC	111990		-	-	900 226000767047	795	890	4037	-	-
Keeyask Reservoir	BR-D	01-Jun-23	NSC	111990		-	-	900 226000767047	840	945	4580	-	-
Keeyask Reservoir	BR-D	10-Jun-23	NSC	111990		1563898	51952	900 226000767047	-	-	-	-	-
Keeyask Reservoir	BR-D	02-Jun-23	NSC	128060	AAE 202	1520541	57501	989 001038119800	895	995	5850	-	-
Keeyask Reservoir	BR-D	17-Jun-23	NSC	128060		-	-	989 001038119800	-	-	-	-	-
Gull Lake	GL-B	21-Jun-10	NSC	94108		-	-	-	625	710	2100	-	-
Gull Lake	GL-B	25-Jun-14	NSC	94108		-	-	900 226000629159	744	849	2722	-	-
Keeyask Reservoir	BR-D	08-Jun-23	NSC	94108		1563886	51940	900 226000629159	941	1013	9020	-	-
Keeyask Reservoir	GL-B	16-Sep-22	NSC	125217		-	-	900 067000055401	580	664	1175	-	-
Keeyask Reservoir	GL-A	10-Jun-23	NSC	125217		-	-	900 067000055401	580	660	1500	-	-
Split Lake	SPL-A	16-Sep-19	NSC	116621		-	-	900 067000121183	788	881	3410	-	-
Keeyask Reservoir	BR-D	28-Jun-22	NSC	116621		1520545	57505	900 067000121183	841	933	4350	-	-
Keeyask Reservoir	BR-D	15-Jun-23	NSC	116621		-	-	900 067000121183	851	946	4720	-	-
Keeyask Reservoir	BR-D	17-Jun-23	NSC	116621		-	-	900 067000121183	-	-	-	-	-

Table A2-1. Tagging and biological information for Lake Sturgeon recaptured in the Keeyask reservoir, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	Acoustic Serial No.	Acoustic Tag Code	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-B	24-Sep-20	NSC	118339		-	-	900 067000113266	348	401	200	-	-
Keeyask Reservoir	BR-D	15-Jun-23	NSC	118339		-	-	900 067000113266	430	489	760	-	-
Gull Lake	GL-A	20-Jun-11	NSC	77507		-	-	-	1310	1405	25855	F	4
Gull Lake	BR-D	11-Jun-14	NSC	77507		-	-	900 226000629028	1330	1410	29710	F	2
Gull Lake	GL-B	06-Jul-24	NSC	77507		-	-	900 226000629028	-	-	-	-	-
Gull Lake	GL-C	01-Jun-16	NSC	77507		-	-	900 226000629028	1360	1414	25855	F	3
Keeyask Reservoir	BR-D	17-Jun-23	NSC	77507		-	-	900 226000629028	1387	1479	-	-	-
Gull Lake	GL-B	16-Sep-15	NSC	97336		-	-	900 226000703492	553	628	1340	-	-
Keeyask Reservoir	BR-D	17-Jun-23	NSC	97336		-	-	900 226000703492	736	841	4120	-	-
Gull Lake	GL-B	19-Sep-19	NSC	117131		-	-	900 226001031105	448	518	500	-	-
Keeyask Reservoir	BR-D	17-Jun-23	NSC	117131		-	-	900 226001031105	535	621	820	-	-
Gull Lake	GL-B	20-Sep-11	NSC	93863		-	-	-	443	506	600	-	-
Keeyask Reservoir	BR-D	18-Jun-23	NSC	93863		-	-	900 226001225847	830	939	4540	-	-
Grass River	KGS-A	15-Jun-15	NSC	**98642**		-	-	900 226000548653	947	1053	6577	-	-
Keeyask Reservoir	BR-D	26-Jun-23	NSC	128076		-	-	900 226000548653	1000	1111	6169	-	-
Gull Lake	GL-B	23-Jun-18	NSC	112282		-	-	900 067000055015	466	585	544	-	-
Keeyask Reservoir	GL-C	29-Jun-23	NSC	112282		-	-	900 067000055015	575	660	1225	-	-
Split Lake	SPL-F	15-Jun-05	NSC	74302		-	-	-	1241	1329	17010	-	-
Split Lake	SPL-F	16-Jun-05	NSC	74302		-	-	-	-	-	-	-	-
Gull Lake	GL-B	27-Jun-14	NSC	**74302**		-	-	900 226000629184	-	-	-	-	-
Keeyask Reservoir	GL-C	30-Jun-23	NSC	128094		-	-	900 226000629184	1480	1535	23678	-	-
Gull Lake	GL-C	16-Sep-14	NSC	90273		-	-	900 226000629340	542	625	1275	-	-
Gull Lake	GL-C	21-Sep-17	NSC	90273		-	-	900 226000629340	671	757	2600	-	-
Keeyask Reservoir	GL-B	01-Jul-23	NSC	90273		-	-	900 226000629340	786	886	4604	-	-
Keeyask Reservoir	BR-D	25-May-23	NSC	128051		1520543	57503	900 226001225389	885	1000	6850	-	-
Keeyask Reservoir	BR-D	02-Jun-23	NSC	128051		-	-	900 226001225389	-	-	-	-	-
Keeyask Reservoir	BR-D	30-May-23	NSC	128058		1563899	51953	900 226001225810	960	1090	8320	M	7
Keeyask Reservoir	BR-D	08-Jun-23	NSC	128058		-	-	900 226001225810	-	-	-	M	7
Keeyask Reservoir	BR-D	14-Jun-23	NSC	128071		-	-	900 226001225872	581	673	1480	-	-
Keeyask Reservoir	BR-D	17-Jun-23	NSC	128071		-	-	900 226001225872	-	-	-	-	-

Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font. Lengths that decrease over time are considered suspect and are indicated by italicized font.

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-C	23-Jun-16	NSC	107709	-	900 226000153802	1181	1344	15876	-	-
Stephens Lake	STL-A	25-May-23	NSC	107709	-	900 226000153802	1226	1390	12200	M	7
Stephens Lake	GR-A	23-Jun-22	NSC	122953	-	900 226001226091	867	976	7257	-	-
Stephens Lake	STL-A	24-Jun-22	NSC	122953	-	900 226001226091	-	-	-	-	-
Stephens Lake	STL-A	25-May-23	NSC	122953	-	900 226001226091	870	963	6300	-	-
Gull Lake	BR-D	26-May-16	NSC	107248	-	900 226000768401	976	1074	7257	-	-
Stephens Lake	STL-B	25-May-23	NSC	107248	-	900 226000768401	1065	1174	8140	M	7
Keeyask Reservoir	BR-D	25-Jun-21	NSC	119116	-	900 226001055388	892	995	6300	-	-
Keeyask Reservoir	BR-D	24-Jun-22	NSC	119116	-	900 226001055388	*900*	*1000*	4100	-	-
Stephens Lake	STL-A	25-May-23	NSC	119116	226	989 001038119823	*884*	*985*	5300	-	-
Gull Lake	BR-D	27-Jun-06	NSC	76340	76339	-	1040	1164	8845	-	-
Stephens Lake	STL-A	27-May-23	NSC	76340	76339	900 226001030862	1310	1445	17120	-	-
Gull Lake	GL-B	20-Jun-12	NSC	100486	-	-	620	705	1650	-	-
Stephens Lake	STL-A	27-May-23	NSC	100486	-	900 226001055764	890	1005	4920	-	-
Stephens Lake	STL-B	21-Jun-23	NSC	100486	-	900 226001055764	-	-	-	-	-
Gull Lake	GL-C	12-Sep-17	NSC	106474	-	900 226000893837	919	1000	5950	-	-
Stephens Lake	STL-B	27-May-23	NSC	106474	-	900 226000893837	950	1046	6300	-	-
Stephens Lake	STL-A	25-Sep-14	NSC	94235	-	-	341	387	260	-	-
Stephens Lake	STL-A	25-Sep-15	NSC	94235	-	900 226000703457	664	725	2350	-	-
Stephens Lake	STL-B	27-May-23	NSC	94235	-	900 226000703457	859	960	5420	-	-
Gull Lake	GL-B	17-Sep-18	NSC	113834	-	900 226000767217	453	512	500	-	-
Stephens Lake	STL-B	27-May-23	NSC	113834	-	900 226000767217	555	629	1980	-	-
Gull Lake	GL-C	25-Sep-10	NSC	87866	-	-	328	372	200	-	-
Stephens Lake	STL-B	27-May-23	NSC	87866	-	900 226001230555	819	890	4560	-	-
Gull Lake	BR-D	12-Jun-11	NSC	77511	-	-	958	1058	7484	-	-
Gull Lake	BR-D	20-Jun-12	NSC	77511	-	-	985	1100	7711	-	-
Stephens Lake	STL-A	27-May-23	NSC	77511	-	900 226001230418	1078	1121	7960	-	-
Stephens Lake	STL-A	25-Jun-22	NSC	122958	-	900 226001226851	990	1135	9525	-	-
Stephens Lake	STL-A	27-May-23	NSC	122958	-	900 226001226851	993	1129	6740	-	-

Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font. Lenths that decrease over time are considered suspect and are indicated by italicized font (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Keeyask Reservoir	BR-D	20-Jun-21	NSC	120437	-	900 226000767045	955	1060	8350	-	-
Keeyask Reservoir	BR-D	29-May-22	NSC	120437	-	900 226000767045	*962*	*1062*	6400	-	-
Stephens Lake	GR-A	27-May-23	NSC	120437	-	900 226000767045	*958*	*1064*	6100	-	-
Stephens Lake	STL-A	10-Jun-16	NSC	110986	-	900 226000548912	886	998	6350	-	-
Stephens Lake	STL-A	29-May-18	NSC	110986	-	900 226000548912	942	1061	7620	-	-
Stephens Lake	STL-A	16-Jun-18	NSC	110986	-	900 226000548912	-	-	-	-	-
Stephens Lake	STL-A	12-Jun-22	NSC	110986	-	900 226000548912	985	1105	9525	-	-
Stephens Lake	STL-A	28-May-23	NSC	110986	-	900 226000548912	990	1105	7950	-	-
Stephens Lake	STL-A	07-Jun-23	NSC	110986	-	900 226000548912	-	-	-	-	-
Stephens Lake	STL-A	12-Sep-17	NSC	111060	-	900 226000154296	838	941	4775	-	-
Stephens Lake	STL-B	28-May-23	NSC	111060	-	900 226000154296	913	1010	6200	-	-
Stephens Lake	STL-A	07-Jun-23	NSC	111060	-	900 226000154296	-	-	-	-	-
Gull Lake	GL-B	03-Jul-14	NSC	105104	-	900 043000103894	580	624	1350	-	-
Gull Lake	GL-B	17-Sep-15	NSC	105104	-	900 043000103894	660	731	1800	-	-
Stephens Lake	STL-B	28-May-23	NSC	105104	-	900 043000103894	830	915	4460	-	-
Stephens Lake	STL-B	29-May-23	NSC	105104	-	900 043000103894	-	-	-	-	-
Stephens Lake	STL-A	01-Jul-23	NSC	105104	-	900 043000103894	-	-	-	-	-
Stephens Lake	STL-B	31-May-22	NSC	122935	-	900 226001226098	834	938	3629	-	-
Stephens Lake	STL-A	28-May-23	NSC	122935	-	900 226001226098	839	940	4880	-	-
Stephens Lake	GR-A	06-Jun-23	NSC	122935	-	900 226001226098	-	-	-	-	-
Stephens Lake	STL-A	12-Jun-18	NSC	115843	-	900 226000768940	867	993	5050	-	-
Stephens Lake	STL-A	03-Jun-19	NSC	115843	-	900 226000768940	893	1021	5443	-	-
Stephens Lake	STL-B	09-Sep-20	NSC	115843	-	900 226000768940	928	1064	5750	-	-
Stephens Lake	STL-A	28-May-23	NSC	115843	-	900 226000768940	951	1082	6440	-	-
Stephens Lake	STL-A	24-Jun-23	NSC	115843	-	900 226000768940	-	-	-	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	115843	-	900 226000768940	-	-	-	-	-
Gull Lake	GL-B	22-Sep-20	NSC	118313	-	900 226001658906	789	902	3350	-	-
Stephens Lake	STL-B	29-May-23	NSC	118313	-	900 226001658906	801	910	4160	-	-

Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font. Lenths that decrease over time are considered suspect and are indicated by italicized font (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-A	15-Sep-16	NSC	110950	-	900 226000767128	665	760	2420	-	-
Stephens Lake	STL-A	19-Jun-18	NSC	110950	-	900 226000767128	727	828	3158	-	-
Stephens Lake	STL-A	02-Jun-21	NSC	110950	-	900 226000767128	805	915	9000	-	-
Stephens Lake	STL-B	29-May-23	NSC	110950	-	900 226000767128	840	946	5600	-	-
Stephens Lake	STL-A	31-May-22	NSC	122937	-	900 226001226048	*1202*	*1303*	12701	-	-
Stephens Lake	GR-A	29-May-23	NSC	122937	-	900 226001226048	*1185*	*1296*	11140	-	-
Stephens Lake	GR-A	09-Jun-11	NSC	74411	-	-	*1006*	*1105*	8391	M	7
Stephens Lake	GR-A	13-Jun-14	NSC	74411	-	-	*995*	*1094*	9979	M	8
Stephens Lake	GR-A	29-May-23	NSC	74411	-	900 226001225624	1190	1285	10520	-	-
Gull Lake	GL-C	09-Jun-03	NSC	50853	-	-	1088	1210	17250	-	-
Gull Lake	GL-C	11-Jun-08	NSC	50853	-	-	1170	1252	17236	-	-
Gull Lake	GL-C	18-Jun-14	NSC	50853	-	-	1236	1370	22226	-	-
Stephens Lake	GR-A	29-May-23	NSC	50853	-	900 226001230448	1325	1439	16120	-	-
Stephens Lake	GR-A	31-May-23	NSC	50853	-	900 226001230448	-	-	-	-	-
Gull Lake	GL-B	15-Jun-12	NSC	100446	-	-	705	795	3175	-	-
Gull Lake	GL-C	07-Jun-16	NSC	100446	-	900 226000768468	828	925	6350	-	-
Stephens Lake	GR-A	30-May-23	NSC	100446	-	900 226000768468	936	1040	6580	-	-
Gull Lake	N/A	29-Aug-13	NSC	103122	-	-	851	962	-	-	-
Stephens Lake	GR-A	30-May-23	NSC	103122	-	900 226001230572	925	1024	6880	-	-
Gull Lake	GL-B	24-Sep-10	NSC	87856	-	-	350	399	300	-	-
Keeyask Reservoir	GL-A	02-Jul-21	NSC	87856	-	900 226001055311	726	820	3150	-	-
Stephens Lake	STL-B	30-May-23	NSC	87856	-	900 226001055311	728	835	3760	-	-
Gull Lake	GL-A	29-May-19	NSC	114643	-	900 226000629150	*1016*	*1128*	7938	-	-
Keeyask Reservoir	BR-D	10-Jun-22	NSC	114643	-	900 226000629150	*1004*	*1105*	6350	-	-
Stephens Lake	GR-A	01-Jun-23	NSC	114643	-	900 226000629150	*989*	*1103*	7200	-	-
Gull Lake	BR-D	9-Jun-19	NSC	114768	-	900 226000327769	*1135*	*1259*	9525	M	7
Stephens Lake	GR-A	01-Jun-23	NSC	114768	-	900 226000327769	*1128*	*1247*	10200	-	-

Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font. Lengths that decrease over time are considered suspect and are indicated by italicized font (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-B	12-Sep-14	NSC	82832	-	900 226000629259	645	745	2150	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	82832	-	900 226000629259	747	859	3800	-	-
Stephens Lake	STL-B	10-Jun-23	NSC	82832	-	900 226000629259	-	-	-	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	82832	-	900 226000629259	-	-	-	-	-
Stephens Lake	STL-A	30-May-18	NSC	**115744**	-	900 226000893399	735	817	3000	-	-
Stephens Lake	STL-A	22-Jun-21	NSC	120053	-	900 226000893399	800	892	4200	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	120053	-	900 226000893399	841	928	5800	-	-
Gull Lake	GL-A	07-Sep-12	NSC	103543	-	-	428	486	560	-	-
Gull Lake	GL-A	09-Sep-12	NSC	103543	-	-	-	-	-	-	-
Gull Lake	GL-A	19-Jun-18	NSC	103543	-	900 226000893251	658	753	1950	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	103543	-	900 226000893251	719	818	5200	-	-
Stephens Lake	STL-B	14-Jun-23	NSC	103543	-	900 226000893251	-	-	-	-	-
Keeyask Reservoir	BR-D	20-Jun-21	NSC	119129	-	900 226001225546	1020	1126	6900	-	-
Keeyask Reservoir	BR-D	09-Jun-22	NSC	119129	-	900 226001225546	1030	1136	7050	-	-
Stephens Lake	GR-A	02-Jun-23	NSC	119129	-	900 226001225546	1030	1139	7450	-	-
Gull Lake	GL-B	16-Sep-15	NSC	90312	-	900 226000628161	596	665	1540	-	-
Stephens Lake	STL-B	03-Jun-23	NSC	90312	-	900 226000628161	790	874	4900	-	-
Stephens Lake	STL-A	07-Jun-21	NSC	119411	-	900 226001225285	943	1055	7000	-	-
Stephens Lake	STL-B	06-Jun-23	NSC	119411	-	900 226001225285	953	1061	6700	-	-
Gull Lake	GL-B	05-Jun-16	NSC	**107221**	-	900 226000153886	660	751	2268	-	-
Stephens Lake	STL-A	06-Jun-23	NSC	130722	-	900 226000153886	807	919	3900	-	-
Stephens Lake	STL-A	22-Sep-13	NSC	103250	-	-	450	510	600	-	-
Stephens Lake	STL-B	14-Jun-22	NSC	103250	-	900 226001226049	825	922	4082	-	-
Stephens Lake	STL-A	06-Jun-23	NSC	103250	-	900 226001226049	840	944	6100	-	-
Stephens Lake	GR-A	20-Jun-22	NSC	121778	-	900 226001226052	*863*	*971*	4990	-	-
Stephens Lake	STL-A	06-Jun-23	NSC	121778	-	900 226001226052	*851*	*970*	5600	-	-
Gull Lake	GL-C	20-Aug-06	NSC	82613	-	-	502	576	590	-	-
Stephens Lake	GR-A	06-Jun-23	NSC	82613	82164	900 226001230471	951	1061	7800	-	-
Stephens Lake	STL-B	26-Jun-23	NSC	82613	82164	900 226001230471	-	-	-	-	-

Table A2-2. Tagging and biological information for Lake Sturgeon recaptured in Stephens Lake, spring 2023. A Floy tag that was lost and fish was retagged in 2023 is indicated by bold font. Lengths that decrease over time are considered suspect and are indicated by italicized font (continued).

Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	BR-D	24-Jun-06	NSC	76326	76327	-	1030	1122	9299	-	-
Gull Lake	GL-B	21-Jun-14	NSC	76326	76327	900 226000629003	*1175*	*1309*	16783	-	-
Stephens Lake	GR-A	7-Jun-23	NSC	76326	76327	900 226000629003	*1025*	*1139*	16200	-	-
Gull Lake	BR-D	24-Jun-06	NSC	76448	-	-	965	1066	8165	-	-
Gull Lake	GL-A	14-Jun-16	NSC	76448	76447	900 226000153836	-	-	-	-	-
Stephens Lake	STL-B	09-Jun-23	NSC	76448	-	900 226000153836	1019	1135	11900	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	76448	-	900 226000153836	-	-	-	-	-
Gull Lake	GL-B	21-Jun-10	NSC	94109	-	-	650	730	2200	-	-
Gull Lake	GL-B	08-Jul-14	NSC	94109	-	900 226000629103	814	893	4536	-	-
Stephens Lake	STL-A	9-Jun-23	NSC	94109	-	900 226000629103	985	1192	8900	-	-
Gull Lake	BR-D	23-May-16	NSC	110546	-	-	1380	1535	-	-	-
Stephens Lake	STL-A	10-Jun-23	NSC	110546	-	900 226001230470	1383	1515	16100	-	-
Stephens Lake	STL-A	22-Jun-22	NSC	122952	-	900 226001226096	*1360*	*1505*	24040	-	-
Stephens Lake	GR-A	10-Jun-23	NSC	122952	-	900 226001226096	*1350*	*1445*	21200	-	-
Gull Lake	GL-B	14-Jun-12	NSC	100431	-	-	905	1020	6350	-	-
Stephens Lake	GR-A	10-Jun-23	NSC	100431	-	900 226001230556	1125	1250	11300	-	-
Gull Lake	GL-C	26-Jun-18	NSC	112295	-	900 226000893367	662	742	1950	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	112295	-	900 226000893367	716	803	3800	-	-
Stephens Lake	GR-A	25-Jun-03	NSC	56205	-	-	771	877	4000	-	-
Stephens Lake	GR-A	26-Jun-03	NSC	56205	-	-	-	-	-	-	-
Stephens Lake	GR-A	29-May-16	NSC	56205	-	900 226000548766	1115	1246	12701	-	-
Stephens Lake	STL-A	30-May-18	NSC	56205	-	900 226000893315	1150	1282	14606	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	56205	-	900 226000893315	1172	1304	10600	-	-
Gull Lake	BR-D	11-Jun-14	NSC	105418	-	900 226000629121	1440	1520	23360	F	4
Stephens Lake	GR-A	11-Jun-23	NSC	105418	-	900 226000629121	1455	1580	18200	-	-
Stephens Lake	STL-A	15-Jun-23	NSC	105418	-	900 226000629121	-	-	-	-	-
Stephens Lake	STL-A	22-Sep-13	NSC	103349	-	-	530	596	900	-	-
Stephens Lake	STL-A	01-Jun-18	NSC	103349	-	900 226000893488	715	796	2475	-	-
Stephens Lake	STL-A	11-Jun-23	NSC	103349	-	900 226000893488	825	920	3900	-	-

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Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-A	21-Jun-14	NSC	101396	-	900 226000629134	1348	1455	27216	-	-
Stephens Lake	STL-A	11-Jun-23	NSC	101396	-	900 226000629134	1381	1490	21400	-	-
Stephens Lake	STL-A	22-Sep-12	NSC	100151	-	-	740	833	3325	-	-
Stephens Lake	STL-B	31-May-19	NSC	100151	-	900 226000327771	890	996	5897	-	-
Stephens Lake	STL-A	02-Jun-21	NSC	100151	-	900 226000327771	*910*	*1005*	11500	-	-
Stephens Lake	STL-A	24-Jun-21	NSC	100151	-	900 226000327771	-	-	-	-	-
Stephens Lake	STL-A	11-Jun-23	NSC	100151	-	900 226000327771	*909*	*1014*	4700	-	-
Gull Lake	GL-C	17-Jun-14	NSC	**105404**	-	900 226000629089	755	840	2722	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	130706	-	900 226000629089	900	1000	5200	-	-
Stephens Lake	GR-A	09-Jun-18	NSC	115809	-	900 226000152923	1005	1111	8981	-	-
Stephens Lake	STL-A	14-Jun-18	NSC	115809	-	900 226000152923	-	-	-	-	-
Stephens Lake	GR-A	12-Jun-23	NSC	115809	-	900 226000152923	1044	1150	8450	-	-
Stephens Lake	STL-A	22-Jun-18	NSC	110709	-	900 226000768613	823	891	4700	-	-
Stephens Lake	STL-B	14-Jun-23	NSC	110709	-	900 226000768613	930	999	7580	-	-
Gull Lake	GL-C	20-Sep-08	NSC	75316	-	-	575	663	-	-	-
Gull Lake	BR-D	28-May-18	NSC	75316	-	900 226000767023	937	1052	8845	-	-
Gull Lake	BR-D	01-Jun-18	NSC	75316	-	900 226000767023	-	-	-	M	7
Stephens Lake	GR-A	17-Jun-22	NSC	75316	-	900 226000767023	*977*	*1092*	7257	-	-
Stephens Lake	STL-A	30-Jun-22	NSC	75316	-	900 226000767023	-	-	-	-	-
Stephens Lake	STL-A	02-Jul-22	NSC	75316	-	900 226000767023	-	-	-	-	-
Stephens Lake	GR-A	14-Jun-23	NSC	75316	-	900 226000767023	*946*	*1067*	7700	-	-
Stephens Lake	STL-A	10-Jun-18	NSC	115819	-	900 226000152908	762	840	3800	-	-
Stephens Lake	STL-A	14-Jun-23	NSC	115819	-	900 226000152908	800	881	6000	-	-
Keeyask Reservoir	BR-D	3-Jun-21	NSC	117037	-	900 226001225551	*982*	*1032*	7320	M	7
Stephens Lake	GR-A	14-Jun-23	NSC	117037	-	900 226001225551	*959*	*1009*	6870	-	-
Stephens Lake	STL-B	29-Sep-10	NSC	94242	-	-	307	345	220	-	-
Stephens Lake	STL-A	17-Sep-12	NSC	94242	-	-	423	481	-	-	-
Stephens Lake	STL-A	14-Sep-16	NSC	94242	-	900 226000767108	640	721	2120	-	-
Stephens Lake	STL-B	15-Jun-23	NSC	94242	-	900 226000767108	763	864	4500	-	-

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Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-B	25-Jun-18	NSC	**110705**	-	900 226000768920	*890*	*977*	4750	-	-
Stephens Lake	STL-B	15-Jun-23	NSC	130701	-	900 226000768920	*885*	*974*	5900	-	-
Stephens Lake	STL-A	27-Jun-22	NSC	84897	-	900 226001225607	*905*	*1130*	8618	-	-
Stephens Lake	STL-A	16-Jun-23	NSC	84897	-	900 226001225607	*895*	*1017*	6700	-	-
Gull Lake	GL-C	12-Sep-17	NSC	109555	-	900 226000154241	761	852	3150	-	-
Stephens Lake	STL-A	16-Jun-23	NSC	109555	-	900 226000154241	824	915	3729	-	-
Stephens Lake	STL-A	14-Jun-18	NSC	115850	-	900 226000153905	975	1110	8150	-	-
Stephens Lake	STL-B	21-Sep-20	NSC	**115850**	-	900 226000153905	1050	1190	9000	-	-
Stephens Lake	STL-A	16-Jun-23	NSC	130679	-	900 226000153905	1065	1201	9200	-	-
Gull Lake	GL-C	14-Sep-14	NSC	90257	-	900 226000629486	594	668	1575	-	-
Stephens Lake	STL-A	19-Jun-23	NSC	90257	-	900 226000629486	812	907	4920	-	-
Gull Lake	GL-C	20-Jun-03	NSC	50971	-	-	1255	1370	17690	-	-
Gull Lake	BR-D	05-Jun-12	NSC	50971	-	-	1380	1492	24040	-	-
Stephens Lake	STL-A	19-Jun-23	NSC	50971	-	900 226001230164	1441	1552	18700	-	-
Stephens Lake	STL-A	25-Sep-14	NSC	88481	-	900 226000629398	662	761	2025	-	-
Stephens Lake	GR-A	07-Jun-23	NSC	88481	-	900 226000629398	935	1050	8600	-	-
Stephens Lake	STL-A	20-Jun-23	NSC	88481	-	900 226000629398	-	-	-	-	-
Gull Lake	GL-C	23-Jun-08	NSC	75277	-	-	732	832	2948	-	-
Gull Lake	GL-C	15-Sep-08	NSC	75277	-	-	-	-	-	-	-
Gull Lake	GL-C	16-Sep-08	NSC	75277	-	-	-	-	-	-	-
Gull Lake	GL-C	05-Jul-14	NSC	75277	-	900 226000629145	977	1086	7711	-	-
Gull Lake	GL-C	12-Jun-18	NSC	75277	-	900 226000629145	1052	1180	7983	-	-
Stephens Lake	STL-A	17-Jun-22	NSC	75277	-	900 226000629145	*1075*	*1201*	9072	-	-
Stephens Lake	STL-A	20-Jun-23	NSC	75277	-	900 226000629145	*1070*	*1201*	8000	-	-
Gull Lake	GL-B	21-Jun-11	NSC	77504	-	-	805	901	3175	-	-
Gull Lake	GL-A	22-May-16	NSC	77504	-	900 226000768411	884	980	6123	-	-
Gull Lake	BR-D	30-May-18	NSC	77504	-	900 226000768411	915	1011	7802	-	-
Gull Lake	GL-C	05-Jun-19	NSC	77504	-	-	*968*	*1090*	6577	-	-
Stephens Lake	STL-A	21-Jun-23	NSC	77504	-	900 226000768411	*945*	*1047*	7300	-	-

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Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-B	19-Sep-22	NSC	125421	-	900 067000055345	*630*	*720*	1600	-	-
Stephens Lake	STL-B	23-Jun-23	NSC	125421	-	900 067000055345	*619*	*712*	2700	-	-
Stephens Lake	STL-B	21-Sep-17	NSC	112946	-	900 226000628311	371	424	325	-	-
Stephens Lake	STL-B	16-Sep-19	NSC	112946	-	900 226000628311	476	546	750	-	-
Stephens Lake	STL-B	23-Jun-23	NSC	112946	-	900 226000628311	631	725	2900	-	-
Stephens Lake	STL-A	01-Jun-18	NSC	115763	-	900 226000152966	905	1021	6895	M	7
Stephens Lake	STL-A	04-Jun-18	NSC	115763	-	900 226000152966	-	-	-	M	7
Stephens Lake	STL-A	29-Jun-21	NSC	115763	-	900 226000152966	*922*	*1052*	6550	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	115763	-	900 226000152966	*913*	*1044*	7100	-	-
Stephens Lake	STL-B	12-Jun-18	NSC	**115842**	-	900 226000768058	1169	1305	15876	-	-
Stephens Lake	STL-A	02-Jun-21	NSC	117623	-	900 226000768058	*1200*	*1340*	20000	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	117623	-	900 226000768058	*1191*	*1329*	13000	-	-
Stephens Lake	STL-B	23-Sep-16	NSC	109997	-	900 226000153448	717	810	3230	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	109997	-	900 226000153448	818	922	5600	-	-
Keeyask Reservoir	GL-C	15-Sep-21	NSC	121160	-	900 226001224884	815	909	3750	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	121160	-	900 226001224884	825	926	6000	-	-
Stephens Lake	STL-B	18-Sep-12	NSC	94966	-	-	804	900	4000	-	-
Stephens Lake	STL-A	29-Jun-22	NSC	94966	-	900 226001224635	1035	1150	9525	-	-
Stephens Lake	STL-B	26-Jun-23	NSC	94966	-	900 226001224635	1051	1171	9300	-	-
Stephens Lake	STL-B	27-Jun-23	NSC	94966	-	900 226001224635	-	-	-	-	-
Keeyask Reservoir	BR-D	03-Jun-21	NSC	117053	-	900 226001225583	*907*	*1017*	6200	M	7
Stephens Lake	STL-B	27-Jun-23	NSC	117053	-	900 226001225583	*901*	*1006*	6700	-	-
Gull Lake	GL-A	25-Jun-14	NSC	91376	-	900 226000629127	783	896	3629	-	-
Gull Lake	BR-D	19-Jun-18	NSC	91376	-	900 226000629127	878	996	5851	-	-
Gull Lake	BR-D	29-May-19	NSC	91376	-	900 226000629127	880	1010	5897	-	-
Stephens Lake	STL-A	28-Jun-23	NSC	91376	-	900 226000629127	890	1002	6060	-	-
Gull Lake	GL-B	05-Sep-12	NSC	100147	-	-	488	555	700	-	-
Stephens Lake	STL-B	29-Jun-23	NSC	100147	-	900 226001230543	793	895	5100	-	-

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Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Gull Lake	GL-B	22-Sep-08	NSC	87233	-	-	743	835	-	-	-
Gull Lake	GL-B	06-Sep-12	NSC	87233	-	-	842	945	-	-	-
Gull Lake	GL-A	22-May-16	NSC	87233	-	-	907	1003	6350	-	-
Stephens Lake	STL-A	29-Jun-23	NSC	87233	-	900 226001230413	929	1040	6500	-	-
Stephens Lake	STL-B	22-Sep-12	NSC	94959	-	-	540	814	1225	-	-
Stephens Lake	STL-B	16-Sep-17	NSC	94959	-	900 226000893942	*746*	*840*	3600	-	-
Stephens Lake	STL-A	30-May-18	NSC	94959	-	900 226000893942	*741*	*833*	3350	-	-
Stephens Lake	STL-B	27-Jun-18	NSC	94959	-	900 226000893942	-	-	-	-	-
Stephens Lake	STL-B	30-Jun-23	NSC	94959	-	900 226000893942	793	885	4360	-	-
Gull Lake	GL-C	03-Jul-14	NSC	**105112**	-	900 226000629131	1040	1120	9525	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	130692	-	900 226000629131	1136	1272	9120	-	-
Stephens Lake	STL-A	06-Jun-21	NSC	119416	-	900 226001225265	*1056*	*1173*	9600	-	-
Stephens Lake	STL-B	01-Jul-23	NSC	119416	-	900 226001225265	*1028*	*1155*	8500	-	-
Gull Lake	GL-C	17-Jun-06	NSC	76320	-	-	1085	1194	11340	-	-
Gull Lake	GL-C	24-Jun-16	NSC	76320	76406	900 226000768440	1284	1404	20865	-	-
Keeyask Reservoir	BR-D	28-Jun-21	NSC	76320	76406	900 226000768440	*1300*	*1435*	17400	-	-
Stephens Lake	STL-A	01-Jul-23	NSC	76320	76406	900 226000768440	*1295*	*1437*	14600	-	-
Stephens Lake	STL-A	20-Jun-18	NSC	110716	-	900 226000154014	1050	1164	4990	-	-
Stephens Lake	STL-B	03-Jun-19	NSC	110716	-	900 226000154014	1065	1181	12020	-	-
Stephens Lake	STL-A	14-Jun-21	NSC	110716	-	900 226000154014	1090	1205	13000	-	-
Stephens Lake	STL-A	01-Jul-23	NSC	110716	-	900 226000154014	1095	1207	11000	-	-
Stephens Lake	STL-A	25-May-23	NSC	130800	-	900 226001225327	856	954	3100	-	-
Stephens Lake	STL-A	26-May-23	NSC	130800	-	900 226001225327	-	-	-	-	-
Stephens Lake	STL-A	29-May-23	NSC	130773	-	900 226001230519	860	961	5080	-	-
Stephens Lake	STL-A	30-May-23	NSC	130773	-	900 226001230519	-	-	-	-	-
Stephens Lake	STL-A	30-May-23	NSC	130755	-	900 226001230491	896	981	6260	-	-
Stephens Lake	GR-A	07-Jun-23	NSC	130755	-	900 226001230491	-	-	-	-	-
Stephens Lake	STL-A	30-Jun-23	NSC	130755	-	900 226001230491	-	-	-	-	-

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Location	Zone	Date	Prefix	Floy tag 1	Floy tag 2	PIT tag	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex	Maturity
Stephens Lake	STL-B	06-Jun-23	NSC	130723	-	900 226001230490	877	944	4200	-	-
Stephens Lake	STL-B	09-Jun-23	NSC	130723	-	900 226001230490	-	-	-	-	-
Stephens Lake	GR-A	29-May-23	NSC	130767	-	900 226001225211	951	1061	6480	-	-
Stephens Lake	STL-B	11-Jun-23	NSC	130767	-	900 226001225211	-	-	-	-	-
Stephens Lake	STL-A	23-Jun-23	NSC	130767	-	900 226001225211	-	-	-	-	-
Stephens Lake	STL-A	01-Jun-23	NSC	130756	-	900 226001230578	851	958	4970	-	-
Stephens Lake	GR-A	16-Jun-23	NSC	130756	-	900 226001230578	-	-	-	-	-
Stephens Lake	GR-A	09-Jun-23	NSC	130707	-	900 226001230567	1444	1554	19200	-	-
Stephens Lake	STL-A	16-Jun-23	NSC	130707	-	900 226001230567	-	-	-	-	-
Stephens Lake	STL-A	27-Jun-23	NSC	130707	-	900 226001230567	-	-	-	-	-
Stephens Lake	STL-B	02-Jun-23	NSC	130760	-	900 226001230475	923	1012	7700	-	-
Stephens Lake	STL-A	16-Jun-23	NSC	130760	-	900 226001230475	-	-	-	-	-
Stephens Lake	STL-A	27-May-23	NSC	130790	-	900 226001658283	936	1044	6960	-	-
Stephens Lake	STL-B	24-Jun-23	NSC	130790	-	900 226001658283	-	-	-	-	-

APPENDIX 3:
POPULATION ESTIMATE INFORMATION

Table A3-1. Results of POPAN analysis of adult Lake Sturgeon from the Keeyask reservoir.....77
Table A3-2. Results of POPAN analysis of adult Lake Sturgeon from Stephens Lake...........78

Mark-recapture population estimates have been calculated for the Keeyask reservoir during the spring of 15 different years (1995, 2001–2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, and 2021–2023) and for Stephens Lake during the spring of 15 different years (2001–2006, 2008, 2010, 2012, 2014, 2016, 2018, and 2021-2023). Lake Sturgeon were tagged in 1995 in Gull Lake by Manitoba Fisheries Branch and the Split Lake Resource Management Board. All data for the period 2001–2012 were collected annually as part of environmental studies related to the pre-Project environment, while data from 2014 until 2044 will be collected biennially as part of monitoring studies related to the Keeyask Project.

Only Lake Sturgeon classified as adults (*i.e.*, fork length equal to or greater than 800 mm) were included in the population estimate. Floy tag returns from local fishers were also included in the data set to provide information on harvested Lake Sturgeon and to ensure that individuals harvested were removed from the tagged population. Between 2001 and 2012, 29 tags from Lake Sturgeon harvested in the future Keeyask reservoir reach were returned to North/South Consultants (Nelson and Barth 2012). Between 2012 and 2018, there were no reported tag returns from this section of the Nelson River, although field crews have observed resource harvesters in this reach. In 2018, two tags were harvested in Stephens Lake and returned to North/South Consultants. In 2021, one tag was harvested in Stephens Lake and returned to North/South Consultants. No harvested tags were returned to NSC in either 2022 or 2023.

Data were analysed using the program MARK (White and Burnham 1999), which is an industry standard for the analysis of data from marked populations. Program MARK uses binary numbers to represent the encounter history of individuals, and then uses the cumulative pattern of 1's (encountered live capture) and 0's (not encountered) to generate a probability distribution of tag recaptures which form the basis of population estimation. Re-encounters can also be from dead recoveries (*e.g.*, the animal is harvested) in which case the model uses a value of -1. For example, the history "101 -1;" indicates than an animal was captured for the first time at sampling occasion 1, not encountered at sampling occasion 2, and recovered dead at sampling occasion 3, and an animal that was released alive would have the history "101 1;", where the -1 tells the model the animal is dead, and 1 indicates alive.

Several different population model variants exist, most of which can be classified as either closed or open models. Closed models assume there are no births, deaths, immigration, or emigration between sample periods (*i.e.*, marking and recapture periods), while open models assume these processes occur. Prior to 2014, a Robust Design (Kendall 2001) model was used to estimate the annual abundance of adult Lake Sturgeon (outlined in the AEMP). This model incorporates both open (*i.e.*, between sampling years) and closed (*i.e.*, pre- and post-spawning periods within a single year) population models. However, this model requires numerous assumptions, for example that the population is closed between the pre- and post- spawn sampling periods. Estimates may be confounded by variables such as spawning periodicity, inter-annual variation in environmental conditions, the timing of spawning (which was estimated based on water temperature), and harvest during the spawning period. Thus, after 2014, the Jolly-Seber model (POPAN formulation; Arnason and Schwarz 2002), as implemented within MARK, was used to estimate the annual abundance of adult Lake Sturgeon. This is an open model that requires fewer assumptions and modeled variables, and thus likely provides a more reliable estimate of abundance.

Using first-time capture and recapture information, POPAN estimates the survival (*i.e.*, the probability that a fish will survive from one capture to the next), the probability of recapture (p; *i.e.*, the probability that a fish will be recaptured given that the animal is alive and in the study area), and abundance (N; *i.e.*, the number of adult Lake Sturgeon in the area during each capture period) (Tables A3-1 and A3-2).

The model recommends how best to split the data for survival estimates.

- Due to a high number of fish emigrating out of the Keeyask reservoir between 2021 and 2023, the best-fit model indicated a marked decrease in adult Lake Sturgeon survival in the Keeyask reservoir in both 2022 and 2023. The model interprets fish that move downstream from the Keeyask reservoir to Stephens Lake or upstream into Clark Lake as mortalities as they are not able to return and are lost from the upstream population. Therefore, the marked decrease in survival reflects the large downstream migration observed rather than fish mortality.
  - Although these fish moved downstream after sampling in 2021, the model assumes the event happened over time, impacting the survival rates. This leads to falsely low estimates for 2018 and 2021. To account for this, abundance estimates generated for the Keeyask reservoir in 2021 were used for the years between 1995–2021 and only the 2022 and 2023 estimates were generated for the current study year.
  - Model fit for survival in the Keeyask reservoir was best using four time periods of fish capture corresponding to i) 1995–2001 (93% survival); ii) 2001–2004 (78% survival); iii) 2004–2021 (93% survival); and iv) 2021–2023 (40% survival).
- Model fit for survival in Stephens Lake was best using two time periods of fish capture: 2001–2014 (88% survival) and 2016–2023 (99% survival). Survival rate within each period was constant.
  - Between 2001 and 2014, fish were sampled opportunistically (*e.g.*, for acoustic tagging), while 2014–2021 marked the beginning of biennial studies. Sampling has occurred annually between 2021 and 2023.
- As more data is added to each model, the best fit for survival may change, and additional time periods may be added (even if sampling methods remain consistent). For example, should survival be very different in one year, the model may recommend that the data be divided.

The probability of recapture varied among years and locations.

- Recapture rates for the Keeyask reservoir varied annually with a mean of 0.24 ± 0.22 (Range: 0.09 and 1.00). Recapture rates have varied since 2014 between 0.13 and 0.38.

- Recapture rates for Stephens Lake varied annually with a mean of 0.15 ± 0.14 (Range: 0.01 and 0.57). Recapture rates have varied since 2014 between 0.04 and 0.57.

An abundance estimate is provided for each year sampling was conducted for both the Keeyask reservoir and Stephens Lake. As sampling continues (*i.e.*, year to year) and data is added to the model, the parameters are recalculated. Thus, although survival rates and abundance estimates are calculated for the same time periods, they may differ among reporting periods. This allows the estimates to become more refined and precise over time.

References

Arnason, A.N. and Schwarz, C.J. 2002. POPAN-6: Exploring convergence and estimate properties with SIMULATE. Journal of Applied Statistics 29: 649–668.

Kendall, W.L. 2001. The robust design for capture-recapture studies: Analysis using Program MARK. In Wildlife, Land, and People: Priorities for the 21st Century. Proceedings of the Second International Wildlife Management Congress. Edited by R. Field, R.J. Warren, H. Okarma, and P.R. Sievert. The Wildlife Society, Bethesda, Maryland, USA. p. 350–356.

Nelson, P.A. and Barth, C.C. 2012. Lake Sturgeon population estimates in the Keeyask Study Area: 1995-2011. A report prepared for Manitoba Hydro by North/South Consultants Inc., December 2012. x + 36 pp.

White, G.C. and Burnham, K.P. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 Supplement: p. 120–138.

Table A3-1. Results of POPAN analysis of adult Lake Sturgeon from the Keeyask reservoir. Best model was variable survival and variable recapture. Confidence intervals are rounded. A different model was used from 1995–2021 and 2022–2023 to account for a large number of fish that moved downstream through the Keeyask GS after sampling in 2021.

Period	Mean	SE	95% Confidence Interval	
			Low	High
1995 to 2001 Survival Constant	0.93	0.03	0.84	0.97
2001 to 2004 Survival Constant	0.76	0.03	0.73	0.83
2004 to 2021 Survival Constant	0.91	0.01	0.90	0.95
2021 to 2023 Survival Constant	0.40	0.15	0.16	0.70
1995 Recapture	0.58	6.84	0.00	1.00
2001 Recapture	0.17	0.04	0.11	0.26
2002 Recapture	0.17	0.04	0.11	0.25
2003 Recapture	0.26	0.03	0.20	0.33
2004 Recapture	0.20	0.03	0.14	0.27
2006 Recapture	0.25	0.03	0.20	0.32
2008 Recapture	0.11	0.02	0.08	0.15
2010 Recapture	0.08	0.02	0.05	0.13
2012 Recapture	0.08	0.01	0.06	0.11
2014 Recapture	0.18	0.03	0.14	0.24
2016 Recapture	0.24	0.03	0.19	0.31
2018 Recapture	0.15	0.02	0.11	0.20
2021 Recapture	0.13	0.02	0.09	0.19
2022 Recapture	0.17	0.06	0.08	0.33
2023 Recapture	0.38	0.29	0.05	0.87
1995 Abundance	106	1249	1	8268
2001 Abundance	579	112	397	844
2002 Abundance	440	84	303	638
2003 Abundance	481	54	387	598
2004 Abundance	364	52	276	480
2006 Abundance	722	80	581	896
2008 Abundance	599	68	479	748
2010 Abundance	851	168	581	1248
2012 Abundance	927	106	742	1160
2014 Abundance	776	99	605	994
2016 Abundance	767	89	611	962
2018 Abundance	909	122	700	1180
2021 Abundance	913	143	673	1239
2022 Abundance	326	119	163	653
2023 Abundance	123	94	32	464

Table A3-2. Results of POPAN analysis of adult Lake Sturgeon from Stephens Lake. Best model was variable survival and variable recapture. Confidence intervals are rounded.

Period	Mean	SE	95% Confidence Interval	
			Low	High
2001 to 2014 Survival Constant	0.88	0.00	0.87	0.88
2016 to 2023 Survival Constant	0.99	0.00	0.98	0.99
2001 Recapture	0.13	0.01	0.11	0.15
2002 Recapture	0.04	0.01	0.02	0.06
2003 Recapture	0.27	0.04	0.21	0.35
2004 Recapture	0.06	0.01	0.04	0.09
2005 Recapture	0.03	0.00	0.03	0.05
2006 Recapture	0.21	0.02	0.18	0.24
2008 Recapture	0.01	0.01	0.00	0.05
2010 Recapture	0.22	0.03	0.18	0.28
2012 Recapture	0.08	0.01	0.06	0.11
2014 Recapture	0.04	0.01	0.03	0.06
2016 Recapture	0.16	0.01	0.13	0.19
2018 Recapture	0.57	0.02	0.54	0.61
2021 Recapture	0.16	0.01	0.14	0.19
2022 Recapture	0.11	0.01	0.10	0.13
2023 Recapture	0.10	0.01	0.08	0.11
2001 Abundance	61	8	47	79
2002 Abundance	104	20	71	152
2003 Abundance	91	18	62	133
2004 Abundance	80	16	54	117
2005 Abundance	200	29	150	266
2006 Abundance	175	26	132	233
2008 Abundance	135	20	101	180
2010 Abundance	104	15	77	139
2012 Abundance	530	82	392	716
2014 Abundance	468	59	366	599
2016 Abundance	455	57	356	582
2018 Abundance	442	56	345	567
2021 Abundance	797	163	537	1185
2022 Abundance	1309	49	1217	1409
2023 Abundance	1291	50	1196	1393