Keeyask Generation Project

Aquatic Effects Monitoring Plan

Adult Lake Sturgeon Movement Monitoring Report

AEMP-2023-01

KEEYASK

Manitoba Environment and Climate Client File 5550.00
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KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING PLAN

REPORT #AEMP-2023-01

ADULT LAKE STURGEON ACOUSTIC TRACKING IN THE NELSON RIVER BETWEEN CLARK LAKE AND THE LIMESTONE GENERATING STATION, OCTOBER 2021 TO OCTOBER 2022: YEAR 1 OPERATION

Prepared for

Manitoba Hydro

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SUMMARY

Background

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

Construction of the Keeyask GS began in mid-July 2014 and instream work was completed in 2020. The reservoir was impounded with water levels being raised to full supply level between August 31 and September 5, 2020. Commissioning of the powerhouse turbines was initiated after impoundment. They were brought into service one at a time with the final of seven turbines completed on March 9, 2022.

Lake Sturgeon were identified as one of the key species for monitoring. They were chosen because they are culturally important to partner First Nations, local sturgeon populations have been previously impacted, and construction and operation of the GS will change or may 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.*, over GSs or rapids) through movement studies.

The movements of Lake Sturgeon over Birthday and Gull rapids were monitored before 2011, but because different methods were used from 2011 onward, the results of the two monitoring periods are not directly comparable. While pre-2011 studies did not record detailed fish movement patterns between Clark Lake and Stephens Lake, the data showed that most tagged Lake Sturgeon continued to live in the area where they had been tagged and did not move across rapids into different parts of the river. When fish occasionally crossed either Birthday or Gull rapids, they did so in the summer or fall, which suggests that these movements were not a necessary part of spring egg-laying behaviour. No fish moved downstream over the Kettle GS.

This report provides the results of adult sturgeon movement monitoring conducted from October 2021 to October 2022. Monitoring was initiated in June 2011 and 2012 when 59 adult Lake Sturgeon were tagged with acoustic transmitters with a 10-year battery life. Over the years, more transmitters were applied to replace those that had gone missing or were captured

including one in 2013, 11 in 2014, and one in 2018. Most of these tags have now expired except for seven in Stephens Lake.

An additional 51 adult Lake Sturgeon were tagged with acoustic transmitters in spring 2019 to continue monitoring through GS operation. Movements have been monitored for approximately three years before any changes to the river occurred (June 2011 to July 2014), approximately six years and two months of construction (July 2014 to September 2020), and just over two years after impoundment (September 5, 2020 to October 10, 2022). The Keeyask GS was finished in March 2022 so this open-water period is the first year when changes associated with GS operation may be seen both upstream and downstream of the GS.

Adult Lake Sturgeon.

Why is the study being done?

Monitoring during the time when the Keeyask GS is operational is being done to answer three questions:

How many adult Lake Sturgeon are moving through and/or away from the generating station during operation and how far are they going?

Movement studies tell us how many sturgeon are moving up or down past the generating station, how far they travel up or downstream away from the site, whether they are leaving the Keeyask area completely and when they are making these movements. The distance they travel is monitored as far upstream as the inlet to Clark Lake and downstream as far as the Limestone reservoir.

Are fish moving downstream through the GS and are these fish surviving passage?

Now that the reservoir is flooded, fish may react to changes in habitat by leaving the area. If they move downstream through the GS, they cannot move back, and may be injured or killed during passage. This could decrease the number of fish living upstream of the GS.

Did adult Lake Sturgeon change where they live after the reservoir was flooded?

Flooding of Gull Lake has caused changes to available habitat in the area. This may cause adult Lake Sturgeon to move away or to use different areas of the river.

Are Lake Sturgeon gathering downstream of Birthday Rapids and the Keeyask GS during the spawning season or are they going somewhere else?

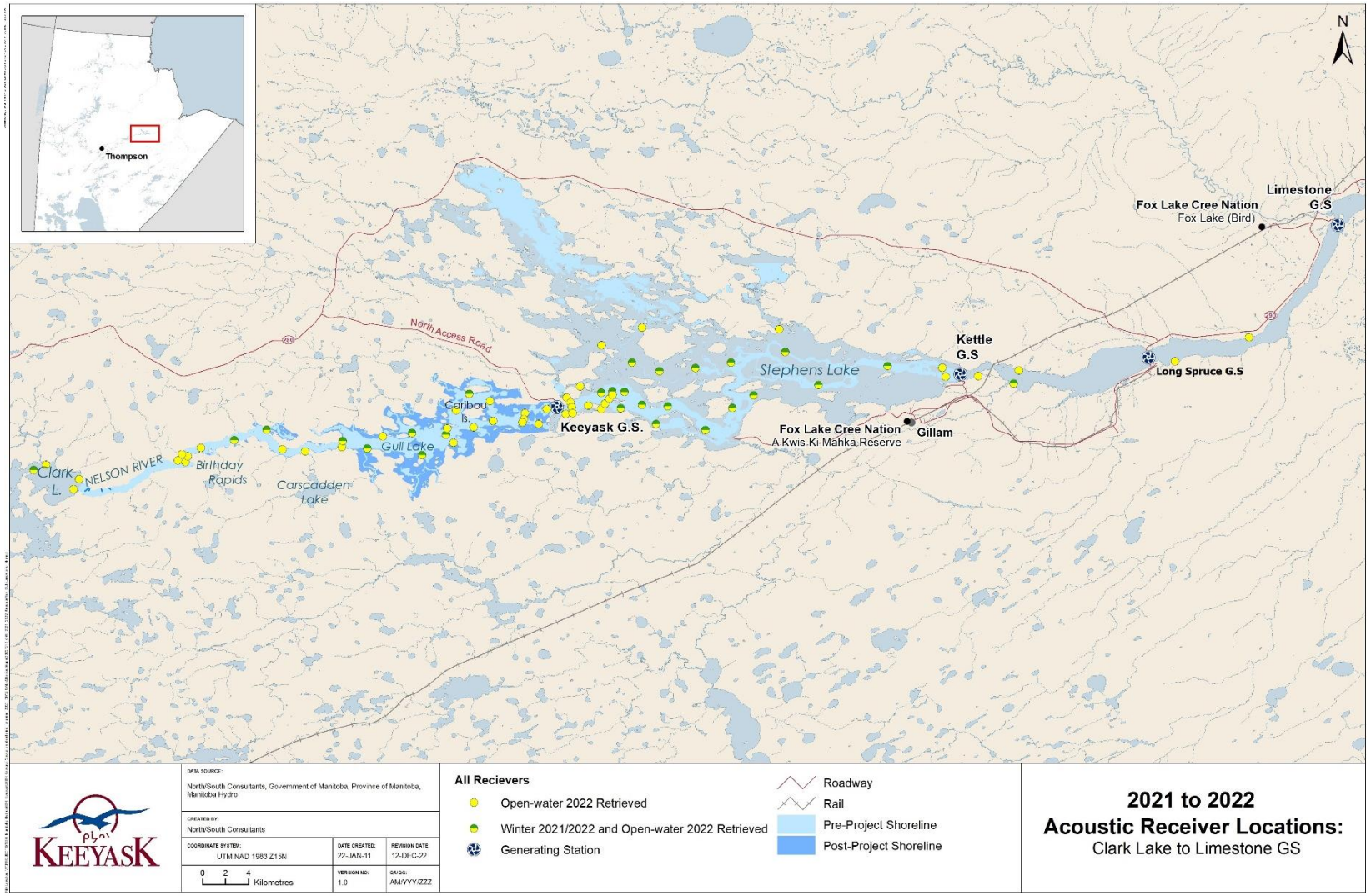
Before the Keeyask GS was built, Lake Sturgeon in Gull Lake spawned at Birthday Rapids and Lake Sturgeon in Stephens Lake spawned at the base of Gull Rapids. After the GS was built and the reservoir was flooded, flow patterns changed in both areas. Because Lake Sturgeon are attracted to fast water when they spawn, they may go somewhere else to spawn if conditions at Birthday Rapids and downstream of the GS aren't right for spawning.

What was done?

The movements of adult sturgeon were tracked using acoustic telemetry. This is a technique in which a tag is surgically implanted inside a fish. Each tag sends out a sound signal (called a "ping") that is picked up by receivers placed along the Nelson River between Clark Lake and the Limestone GS (see study area map below). Each fish is given a transmitter that sends out a unique ping, which can be detected up to 1 kilometre (km) from a receiver. By looking at the detections that were recorded by different receivers, the movements of each fish can be tracked. The tags are powered by batteries with a 10-year lifespan.

Adult Lake Sturgeon being held in a tank prior to surgery (left). Acoustic tag being implanted in an adult Lake Sturgeon (middle). Adult Lake Sturgeon released into the river after acoustic surgery (right).

Adult Lake Sturgeon were tagged with acoustic transmitters in 2011, 2012, 2013, 2014, and 2018. All of these transmitters have now expired except for seven in Stephens Lake. Fifty-one adult Lake Sturgeon were tagged in spring 2019, 26 upstream and 25 downstream of the Keeyask GS. These fish will be tracked both before and after reservoir impoundment. Because a large number of tagged fish moved downstream through the Keeyask GS in 2021, 22 more fish were tagged in the Keeyask reservoir in the spring of 2022.



Map showing the study area. The dots represent the locations of receivers in the river. The different colours represent receivers that were in the river at different times of the year.

What was found?

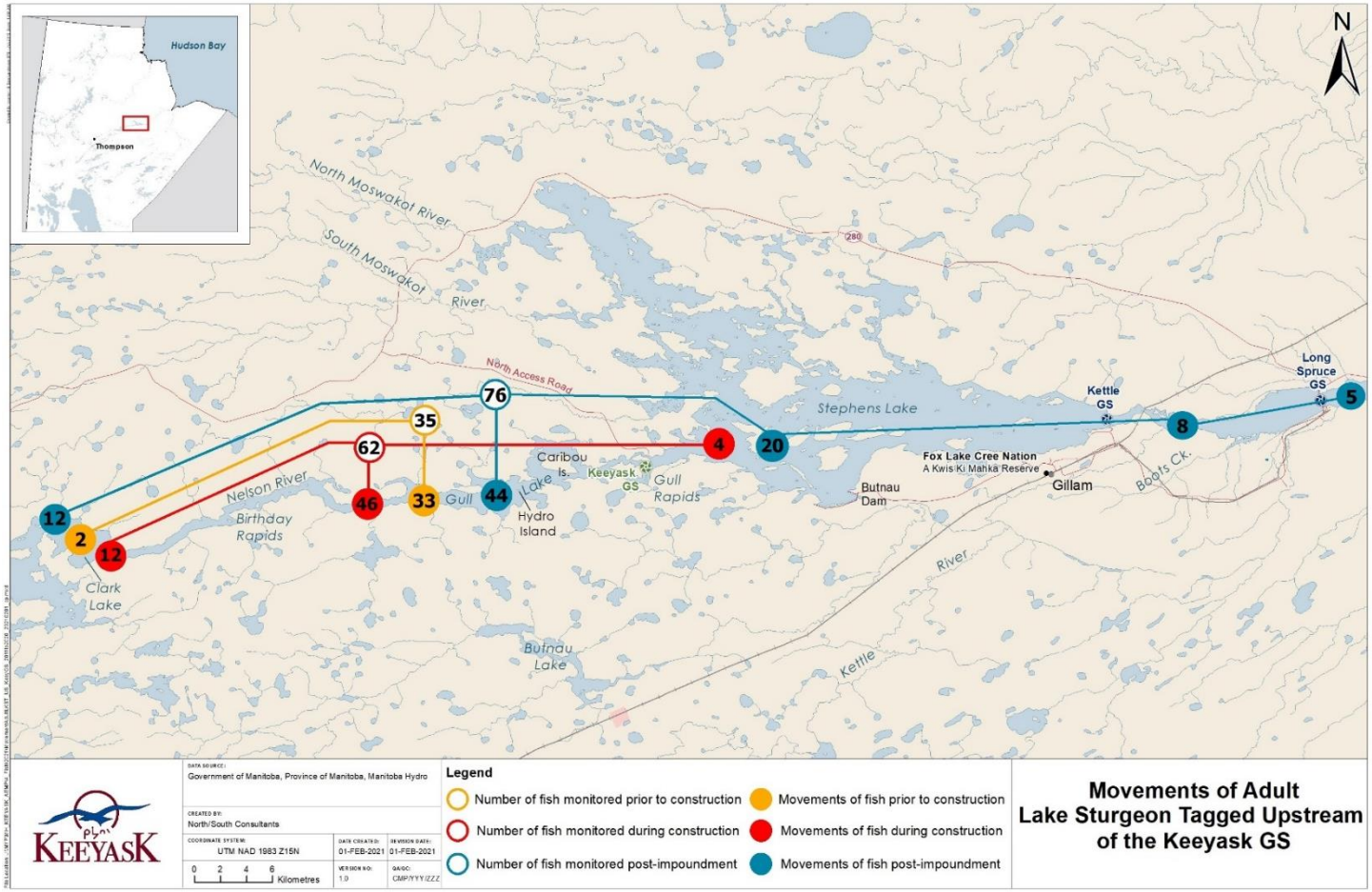
Lake Sturgeon are different from other fish in Manitoba because they do not begin to reproduce (spawn) until they are at least 15 years old, do not spawn every year, and they can live a very long time (more than 60 years and even up to 100 years). This means that where an individual sturgeon moves may change between years depending on how old it is, whether it is spawning, and what its individual habits are. Sturgeon spawn in spring in the fast-flowing water of large rapids and spend the rest of the open-water season feeding in areas of rivers or lakes. During the winter, they move to areas where they are protected from ice and fast water.

During this study, movements of tagged fish were monitored year-round including in the winter when the river is covered with ice. Monitoring movements in winter is challenging because the ice conditions can damage or move the receivers. For this reason, receivers are left in only a few locations over the winter, making it less likely that sturgeon will be detected. More suitable areas for receivers were available (deep areas with low flow) after the reservoir was flooded and more receivers were set in winter 2020/2021 and 2021/2022 than in previous years.

Before 2021, adult Lake Sturgeon that were tagged upstream of the Keeyask GS tended to stay in the same areas year after year. They were divided into three groups: fish that usually lived in Gull Lake (sometimes these fish leave for short periods of time then return); fish that usually stayed in the channel of the Nelson River between Birthday Rapids and Gull Lake; and fish that usually stayed in Clark Lake. In open-water 2021, most fish moved differently often travelling farther distances, including 13 fish that moved downstream through the Keeyask GS into Stephens Lake. This continued in 2022, and fish tagged in the Keeyask reservoir continued to move long distances. One more fish moved downstream through the Keeyask GS in winter 2021/2022 and six moved downstream in open-water 2022.

The 20 fish that moved downstream through the GS between 2021 and 2022 shows an increase over previous years. Between 2011 and 2020, only six fish moved downstream. All movements through Gull Rapids/the Keeyask GS are shown in the maps below. All fourteen fish that moved downstream in open-water 2021 and winter 2021/2022 and three that moved downstream in 2022 displayed upstream and downstream movements within Stephens Lake. This shows that they survived passage through the GS. Based on a lack of detections in Stephens Lake, it is not clear if the last three fish survived.

Upstream movements out of the reservoir also seem to have increased in 2022. Before construction of the Keeyask GS started (before 2014), two fish (7% of all tagged fish) moved from Gull Lake through Clark Lake, while twelve fish (19%) moved during construction. Two fish (5%) moved upstream through Clark Lake in 2021 while nine (31%) moved upstream in 2022.



Map showing how many adult Lake Sturgeon moved upstream out of Gull Lake, stayed in Gull Lake, moved into Stephens Lake, downstream through the Kettle GS, and Long Spruce GS before construction (yellow), during construction (red) and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected. The total number of fish includes all fish tagged during a period although all fish may not have been trackable through the entire period.

Downstream movements out of Stephens Lake through the Kettle GS also increased in 2022. Three fish moved downstream through the Kettle GS before construction and one during construction. Two moved downstream through the Long Spruce GS during construction. During the operation period, 14 fish moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through the Long Spruce GS. Most of these fish (eight that moved through the Kettle GS and five that moved through the Long Spruce GS) were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

The fish that stayed in Stephens Lake continued to show the same movements as in previous years. Fish tagged in Stephens Lake tend to stay in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Fish tagged in Stephens Lake continue to be split into two groups: those that remain in upper Stephens Lake within about 10 km of the Keeyask GS; and those that periodically move downstream into lower Stephens Lake.

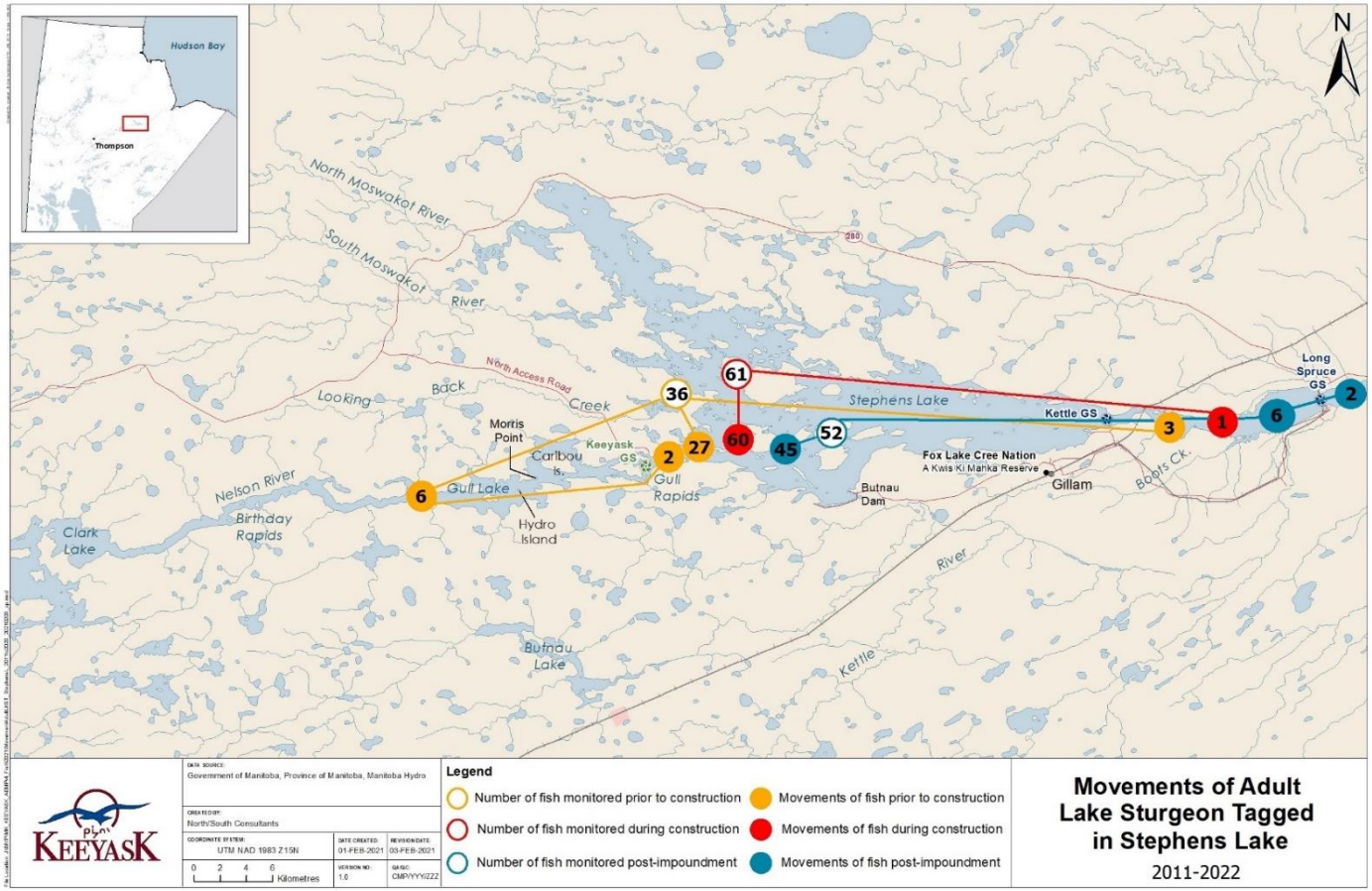
Fish upstream of the GS continued to move to Birthday Rapids during the spring spawning period. Fish also continued to be detected immediately downstream of the Keeyask GS during the spring spawning period. During this time, most fish were detected along the south shore about 2 km downstream of the Keeyask GS spillway.

What does it mean?

Before the Keeyask GS reservoir was flooded, monitoring upstream of the GS showed that each sturgeon did not usually move great distances and that most preferred to live in similar locations year after year. The same patterns were seen immediately after impoundment in September 2020, during winter 2020/2021, and during the early part of open-water 2021. However, beginning in June 2021 and continuing into 2022, differences in adult Lake Sturgeon movement patterns were observed, with most fish moving to different areas, some staying in the reservoir and some leaving. There was an increase in the number of Lake Sturgeon that moved downstream through the GS into Stephens Lake and an increase in the number of fish that moved upstream through Clark Lake past the receiver array. The EIS predicted that adult Lake Sturgeon fish would move out of the Keeyask reservoir, both upstream and downstream, after impoundment

More fish also moved downstream out of Stephens Lake in 2022, but most of these fish were tagged upstream of the Keeyask GS and moved downstream in 2021. The fish that stayed in Stephens Lake showed the same movement patterns as in previous years.

Many sturgeon continue to use habitat immediately downstream of Birthday Rapids and the Keeyask GS during the spawning period. This suggests they have continued to spawn in both areas.



Map showing how many adult Lake Sturgeon moved upstream through Gull Rapids, stayed in Stephens Lake and moved downstream through the Kettle GS and Long Spruce GS during before construction (yellow), during construction (red), and after reservoir impoundment (blue). Movements due to tagging stress and mortality were not included. Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected. Two fish moved upstream and then returned to Stephens Lake. The total number of fish includes all fish tagged during a period although all fish may not have been trackable through the entire period.

What will be done next?

The tags that were implanted in 2019 will last until 2029. Because of the large number of fish that moved downstream and expiring tags, only 28 active tags remain upstream of the Keeyask GS and nine of these fish have moved upstream out of the study area through Clark Lake. During the 2023 open-water period there should be 30 active tags in Stephens Lake. Additional tags will be applied in 2023 to try to increase the number of tagged fish in the Keeyask reservoir to 30. Following the movements of individual fish over such a long time will provide a better idea of what kinds of habitats these fish need to use over many years, and if fish continue to change their movements in the Keeyask reservoir. We will also be able to see if fish continue to move out of the reservoir and if any that moved upstream will come back.

ACKNOWLEDGEMENTS

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The collection of biological samples described in this report was authorized by Natural Resources and Northern Development, Fish and Wildlife Branch, under terms of the Scientific Collection Permit #41767128 (SCP 08-2022).

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1.0 INTRODUCTION

The Keeyask Generation Project (the Project) is a 695-megawatt (MW) hydroelectric generating station 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 in 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* (AE SV). As part of the licensing process for the Project, an Aquatic Effects Monitoring Plan (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment, including the focus of this report, adult Lake Sturgeon movement, for the construction and operation phases of the Project.

A pre-Project study of adult Lake Sturgeon movements in the Keeyask Study Area (*i.e.*, in support of the Keeyask Generation Project EIS) using acoustic and radio telemetry began in 2001 and was conducted until 2011. One of the main objectives associated with radio and acoustic telemetry studies was detecting upstream and downstream movements of fish over rapids in the study area (Birthday Rapids and Gull Rapids). Pre-Project movement data revealed that the majority of Lake Sturgeon did not move upstream or downstream over rapids into adjacent study reaches; instead, they remained within the reach where they had been tagged. Those few fish that moved over one or more sets of rapids did so in the summer or fall, suggesting that these movements were not associated with a life history event such as spawning. Movement data collected from telemetry studies conducted prior to 2011 are not directly comparable to those described herein given that receiver coverage has improved considerably; the pre-Project acoustic receiver array was comprised of 20 receivers, while the array used after 2011 consists of as many as 60 receivers. Also, radio telemetry has not been used since 2004.

Adult Lake Sturgeon movement monitoring for the AEMP began in 2011 and 2012, when 59 fish (measuring > 796 mm fork length) were tagged with acoustic transmitters with a 10-year battery lifespan. Thirty-one fish were captured and tagged upstream of Gull Rapids, and 29 fish were captured and tagged downstream of Gull Rapids. An additional fish was tagged in Stephens Lake in 2013 to replace a tag returned by a local resource user. By 2013, 11 tags were either missing or lost. Additional tags were implanted in 2014 to restore the sample size to 59 fish. An additional 51 adult Lake Sturgeon were tagged in 2019 to track changes before and up to nine years after reservoir impoundment. After data were analyzed in 2021, it was discovered that a large number of tagged fish moved downstream out of the Keeyask reservoir into Stephens

Lake. An additional 22 fish were tagged in the Keeyask reservoir in spring 2022 to compensate for this loss.

Results from all studies dating back to 2011 are presented in Hrenchuk and McDougall (2012); Hrenchuk and Barth (2013); Hrenchuk *et al.* (2014); Hrenchuk and Barth (2015); Hrenchuk and Barth (2016); Hrenchuk and Barth (2017); Hrenchuk *et al.* (2018), Hrenchuk and Lacho (2019), Hrenchuk (2020), Hrenchuk (2021), and Hrenchuk and Small (2022).

Adult Lake Sturgeon movement monitoring during the construction period (2014–2020) was conducted between Clark Lake and the upper portion of the Limestone reservoir (Map 1) to determine if disturbances associated with construction alter habitat use and coarse-scale movement patterns upstream and downstream of the Project. Results assisted in identifying:

- The use of key habitats (*i.e.*, spawning, rearing, and foraging) during construction;
- The potential vulnerability of sturgeon to activities at the construction site (*i.e.*, if sturgeon use the area in the immediate vicinity of the construction site they may be vulnerable to construction effects such as stranding during dewatering, releases of suspended sediment); and
- The potential for increased emigration or avoidance of the construction site due to disturbance (*i.e.*, blasting, suspended sediment inputs, *etc.*).

Impoundment of the Keeyask reservoir was completed on September 5, 2020. Monitoring in the Keeyask reservoir in 2021 represented the first year of monitoring when the reservoir was at full supply level. Monitoring in Stephens Lake, however, represented a transition between construction and operation as a considerable portion of the flow was still being passed through the spillway in spring and early summer when only a few units were in-service. All powerhouse units were commissioned by March 22, 2022. Therefore, monitoring in 2022 represents the first year of operation monitoring. Key questions identified in the AEMP relating to monitoring adult Lake Sturgeon movements during the operation period include:

- Will the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by Lake Sturgeon increase during construction and operation of the Project?
- Are fish moving downstream past the GS and, if so, is there an indication that they have survived passage?
- Will there be a change in the proportional distribution of adult Lake Sturgeon following reservoir creation (i.e., will there be a population level shift in distribution patterns following reservoir creation)?

This report provides adult Lake Sturgeon movement monitoring results from October 2021 to October 2022. This report includes data collected during the second winter after impoundment of the Keeyask reservoir in September 2020 and the first open-water period after construction of the Keeyask GS was completed in March 2022.

2.0 STUDY SETTING

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

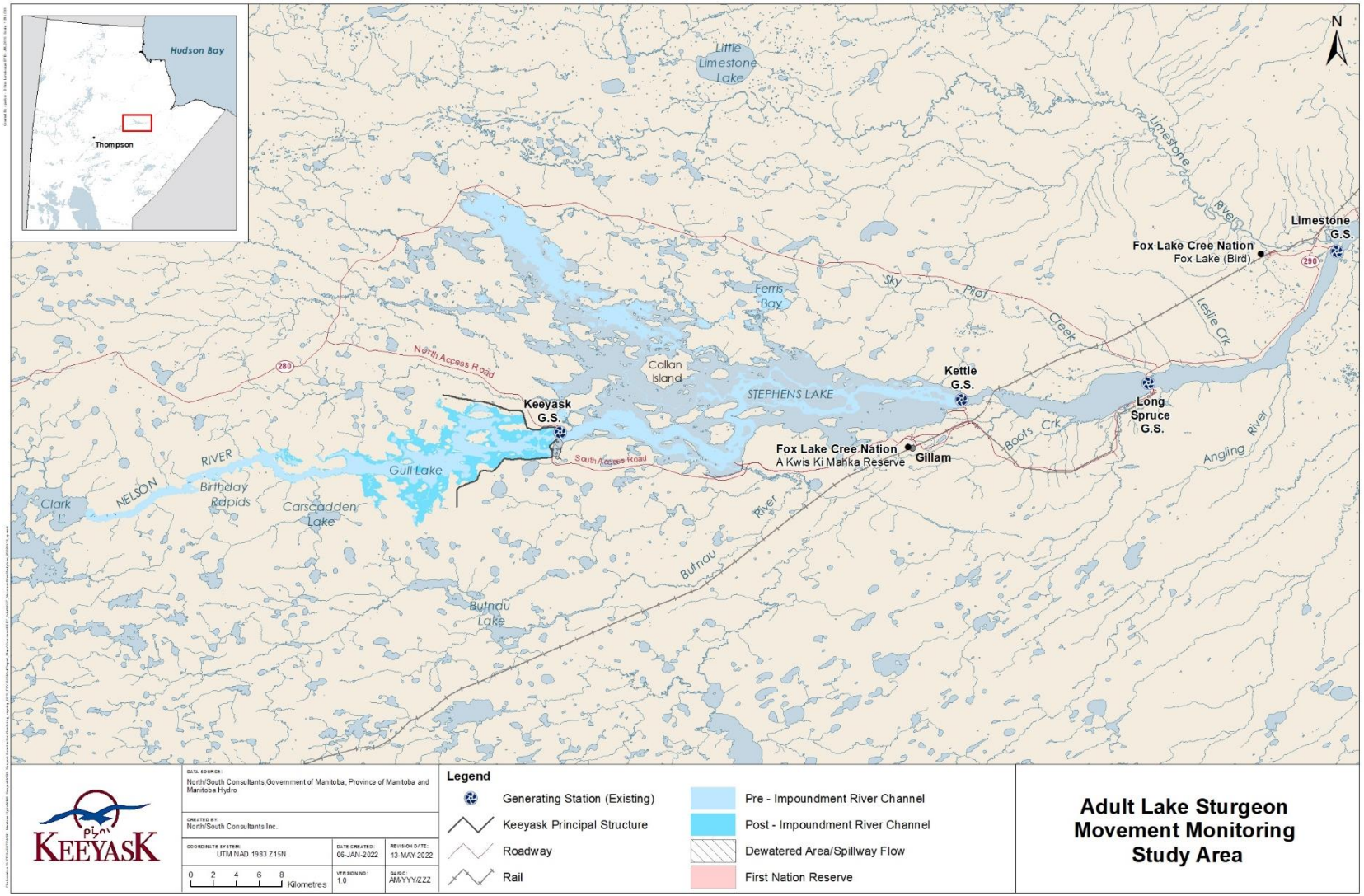
Just below the Keeyask GS, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Construction of the Keeyask GS has altered the flow distribution immediately downstream of the station.

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.

The Long Spruce reservoir was formed in 1979 by the construction of the Long Spruce GS. It is a 16 km reach of the Nelson River extending from Long Spruce GS upstream to Kettle GS (Manitoba Hydro Public Affairs 1999). Kettle River and Boots Creek are the only major

tributaries flowing into Long Spruce reservoir, with both tributaries entering the reservoir on the south shore.

The Limestone reservoir was formed in 1990 by the construction of the Limestone GS. It is a 23 km reach of the Nelson River extending from Limestone GS upstream to Long Spruce GS. Four tributaries of the Nelson River enter the reservoir; Wilson Creek and Brooks Creek enter from the south, and Sky Pilot Creek and Leslie Creek enter from the north. Aquatic habitat within the reservoir ranges from a riverine environment in the upper reach, to more lacustrine conditions just upstream of the Limestone GS.



Map 1: **Map of the Nelson River showing the site of the Keeyask Generating Station and the adult Lake Sturgeon movement monitoring study setting.**

3.0 METHODS

3.1 ACOUSTIC TELEMETRY

Acoustic telemetry involves tracking movements of fish surgically implanted with internal acoustic transmitters (tags). Each transmitter emits a unique signal, recognizable by stationary receivers. When tagged fish come into the detection range of a receiver (generally within 500 m to 1 km, depending on conditions), the transmitter code number, as well as the date and time, are stored in the receiver.

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Thirty-one fish were tagged with acoustic transmitters (VEMCO V16-4x, estimated 3,650-day battery life) upstream of Gull Rapids (now referred to as the Keeyask GS) in 2011 and 2012, and four additional transmitters were applied in June 2014 (Table 1). One additional female used as broodstock was tagged in 2018 (with a three-year tag). All tags applied to fish in 2011, 2012, 2014, and 2018 upstream of the Keeyask GS have now expired. Tagging date, date of last detection, and subsequent recaptures for fish with expired tags are outlined in Appendix A7-1.

Table 1: Number of acoustic transmitters applied, missing tags, immigrants and emigrants, and harvested adult Lake Sturgeon upstream of Gull Rapids[1], indicating the number of fish remaining in the area at the end of each study period between June 2011 and October 2022.

Year	Tags Applied	Missing Tags	In[2]	Out[3]	Harvest	# Active Tags
2011	30	-	1	-	-	31
2012	1	-	4	-	1	35
2013	0	-	1	-	-	36
2014	4	6	-	2	-	32
2015	0	6	-	1	-	31
2016	0	5	-	2	-	30
2017	0	5	-	1	-	29
2018	1	6	-	-	-	28
2019	26	6	-	-	-	54
2020	0	6	-	-	1	54
2021	0	16	-	14	-	15
2022	22	0	-	6	-	28

1. Referred to as the Keeyask GS after spillway commissioning in 2018.
2. Immigration from Stephens Lake.
3. Emigration to Stephens Lake.

Twenty-eight fish were originally tagged in Stephens Lake in 2011 and 2012. Additional tags were applied in 2013 (n = 1) and 2014 (n = 7) (Table 2). The majority of tags applied to fish in 2011, 2012, 2013, and 2014 in Stephens Lake have now expired. Tagging date, date of last detection, and subsequent recaptures for fish with expired tags are outlined in Appendix A7-2. Two fish (#16043 and #32170) have been recaptured since their last detection date.

Table 2: Number of acoustic transmitters applied, missing tags, immigrants and emigrants, and harvested adult Lake Sturgeon in Stephens Lake, indicating the number of fish remaining in the area at the end of each study period between June 2011 and October 2022.

Year	Tags Applied	Missing Tags	In[1]	Out (Gull Rapids)[2]	Out (Kettle GS)[3]	Harvest	# Active Tags
2011	19	-	-	1	-	-	18
2012	9	-	-	4	2	-	21
2013	1	-	-	1	-	-	21
2014	7	4	2	-	1	-	25
2015	0	4	1	-	-	-	26
2016	0	4	2	-	-	-	28
2017	0	4	1	-	-	-	29
2018	0	5	-	-	1	-	28
2019	25	5	-	-	-	-	52
2020	0	5	-	-	-	-	52
2021	0	14	14	-	-	-	56
2022	0	0	6	-	14	-	30

1. Immigration from upstream of Gull Rapids.
2. Emigration to upstream of Gull Rapids.
3. Emigration to downstream of the Kettle GS.

Acoustic transmitters (VEMCO V16-4x, estimated 3,650-day battery life) were applied to an additional 51 fish in 2019: 26 upstream and 25 downstream of the Keeyask GS. These transmitters will allow tracking of Lake Sturgeon through GS construction, and the first eight years of GS operation (to 2029). Additional transmitters (VEMCO V16-4x, estimated 3,650-day battery life) were applied to 22 fish upstream of the Keeyask GS in 2022. These transmitters were applied to increase the sample size of tagged adult lake Sturgeon upstream of the Keeyask GS to compensate for the loss of tagged fish that moved downstream out of the Keeyask reservoir in 2021.

Following capture, Lake Sturgeon receiving tags were placed in a 76 L nesting fish tub fitted with an aquarium aerator. All tagging was conducted on shore near the site of capture. Prior to transmitter implantation, Lake Sturgeon were anaesthetized in a solution of clove oil and ethanol, adapted from Anderson et al. (1997). When the Lake Sturgeon became immobile, they

were placed in a surgery cradle ventral side up. Because the anesthetic renders a fish unable to ventilate on its own, fresh water was continuously pumped over the gills. A small incision was made through the ventral body wall using a sterilized scalpel. An acoustic transmitter was inserted into the body cavity and the incision was closed with sutures. Lake Sturgeon were monitored in a recovery tank until they were able to maintain equilibrium and had regained their strength. They were released in off-current areas near the original capture site.

3.1.2 ACOUSTIC RECEIVERS

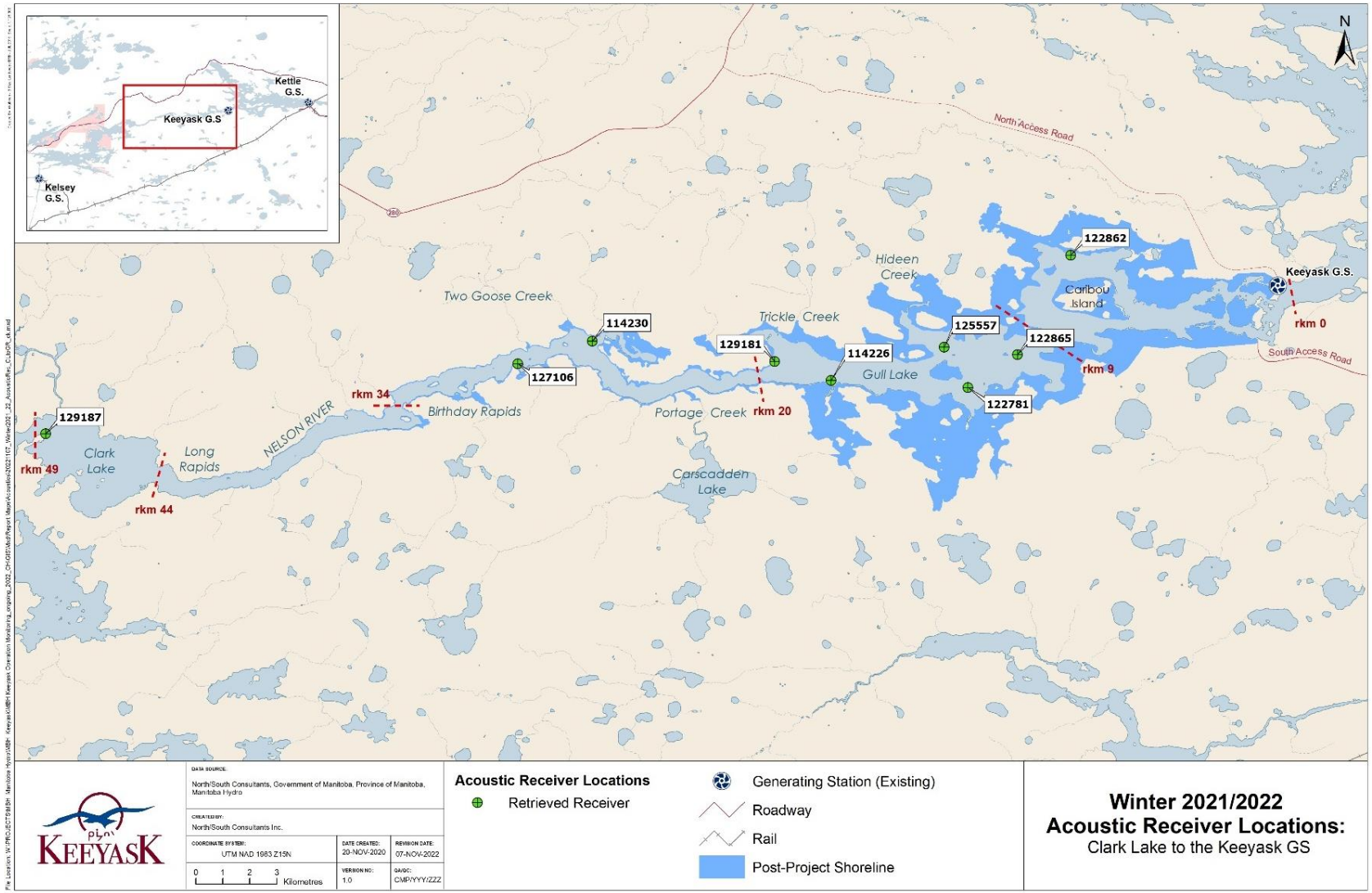
Since 2011, stationary acoustic receivers (VEMCO model VR2W) have been used to continuously monitor tagged adult Lake Sturgeon in the Nelson River between Clark Lake and the Long Spruce GS. In spring 2016, the receiver array was extended to the upper Limestone reservoir, with the placement of two receivers downstream of the Long Spruce GS. The intent of adding these receivers was to determine whether fish that had moved into the Long Spruce reservoir had continued to move downstream.

During the six years of the construction phase of the Project (beginning in July 2014), receivers were deployed at the same sites as those established during the pre-construction phase (2011–2013). During the open-water period, receivers were deployed in calm water with a flat bottom free of large debris to maximize detection range and spaced along the main river channel throughout the study area to maximize spatial coverage. In Stephens Lake, receivers were placed at locations within pre-flood river channels, based on the observation that sturgeon tend to stay within river channels, even in flooded environments. At constrictions within the river channel, a series of receivers were deployed to create “gates” with the intent of recording all fish that passed by the river cross-section (described in Section 3.1.2.2).

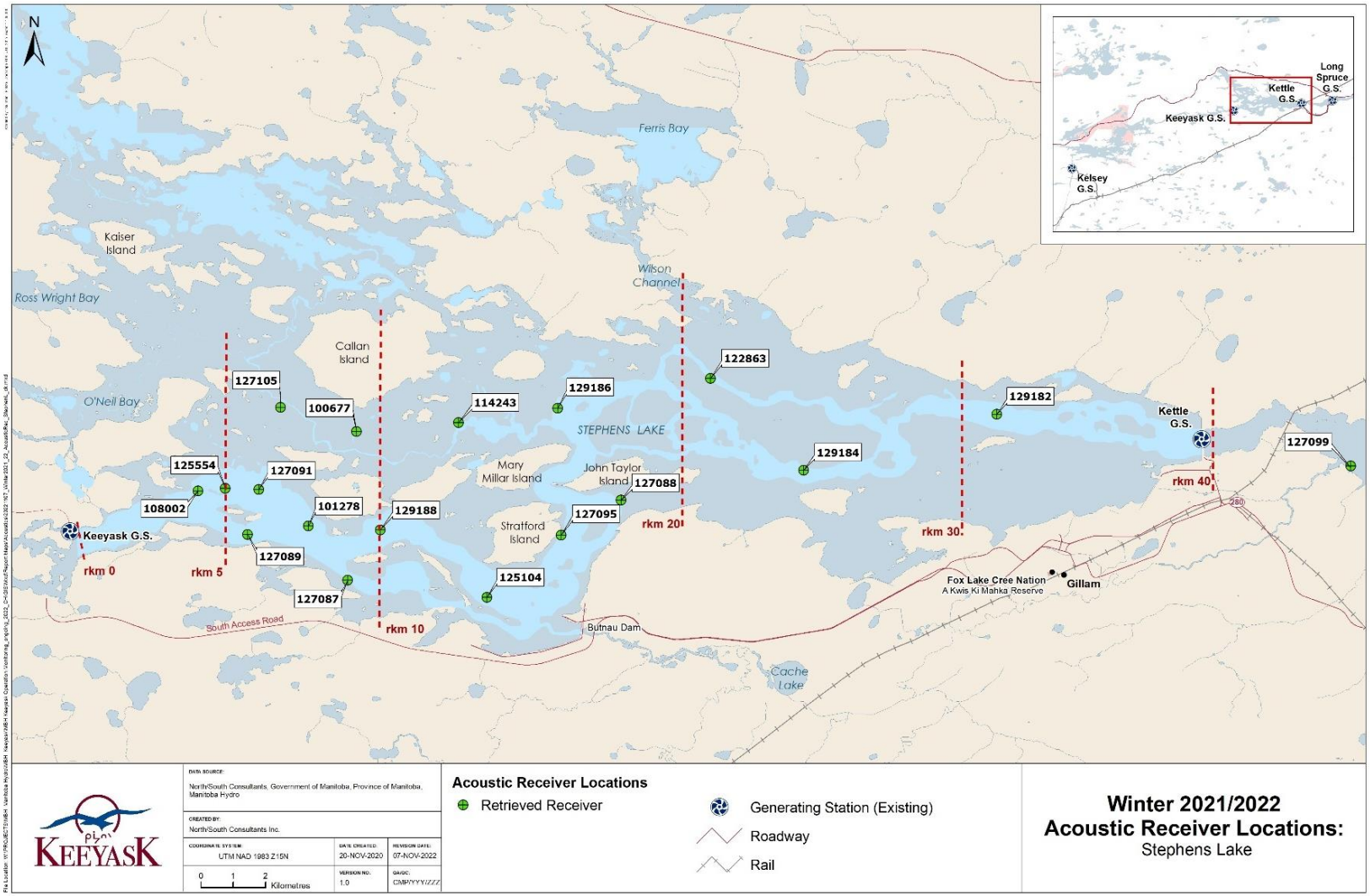
The retrieval of receivers deployed during winter has proven challenging and several were lost in previous winters, likely moved by ice (Hrenchuk and Barth 2013). Because it appears that receivers will only remain safe from ice if deployed in calm areas at depths greater than 10 m, the number of possible receiver locations during winter is limited, especially in areas upstream of the Keeyask GS.

3.1.2.1 WINTER 2021/2022

The stationary acoustic receiver array for the winter 2021/2022 (October 11, 2021, to May 15, 2022) period consisted of 27 receivers. Nine were set upstream of the Keeyask GS, 17 throughout Stephens Lake, and one in the Long Spruce forebay (Maps 2 and 3). The 2021/2022 winter array was the same that was set during winter 2020/2021.



Map 2: **Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between October 2021 and May 2022. River kilometer (rkm) distances are indicated with a dotted line. The former (pre impoundment) river channel is shown in light blue.**



Map 3: **Locations of stationary receivers set in Stephens Lake from the Keeyask GS to Kettle GS between October 2021 to May 2022. River kilometer (rkm) distances are indicated with a dotted line. The former (pre-impoundment) river channel is shown in light blue.**

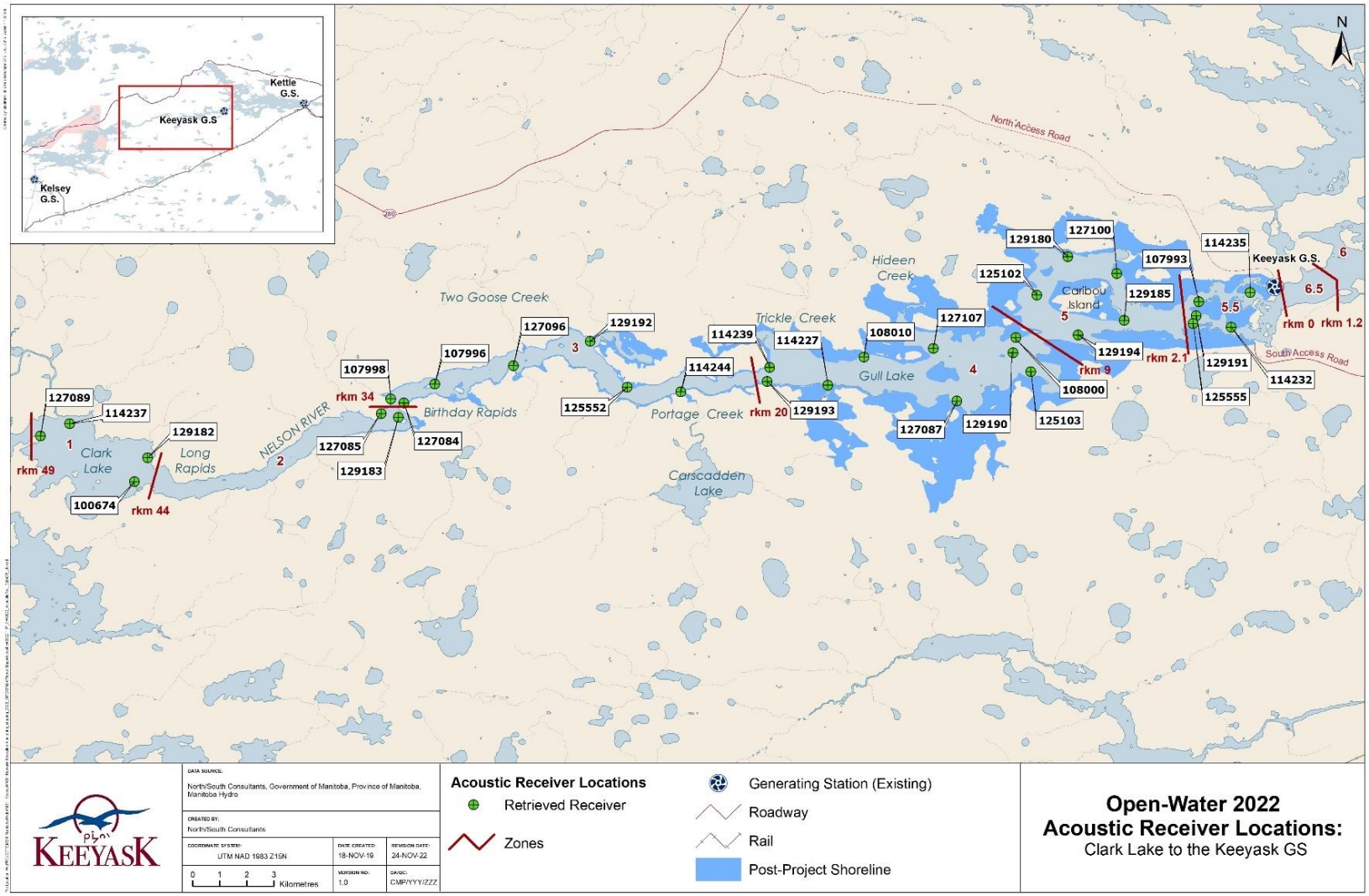
3.1.2.2 OPEN-WATER 2022

An array of 70 acoustic receivers was used during the 2022 open-water period (defined as May 16 to October 10, 2022). Thirty-two were set upstream of the Keeyask GS, 33 in Stephens Lake, three downstream of the Kettle GS, and two downstream of the Long Spruce GS (Maps 4–6). The 2022 open-water array differed slightly from the array used in 2021. Three receivers (#107993, #129191, and #125555; rkm -2.1) were set as a "gate" (described below) upstream of the GS to detect fish movements close to the station (Map 4). One (#114232; rkm -0.8) was set immediately upstream of the powerhouse and an additional (#114235; rkm -0.3) was set immediately upstream of the spillway). One receiver (#122779; rkm 1.2) was added in Stephens Lake to create a "gate" downstream of the GS (Map 5).

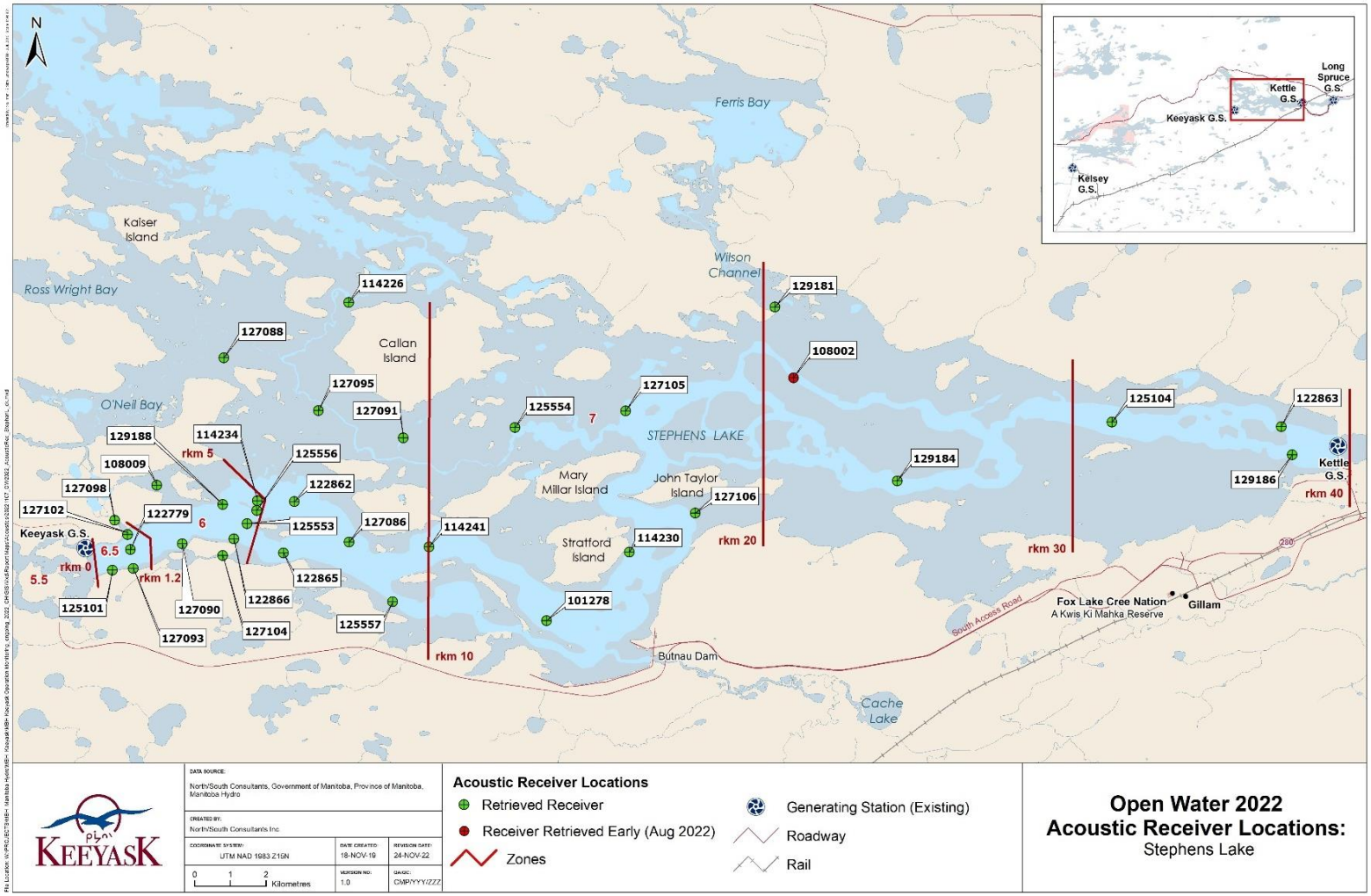
Similar to previous years, receiver "gates" were established in several key areas selected by river morphology (channel restrictions) and habitat characteristics (areas with low velocity adjacent to the main flow of the river). Receiver "gates" consisted of two or more acoustic receivers set parallel to flow to provide complete (or nearly complete) signal coverage of a river cross-section. Areas between the "gates" were referred to as river zones. Receiver gates provide confidence that movements past key points are being detected, which allows for extrapolation of coarse-scale positions (*i.e.*, which zone) during periods when fish remain undetected. When analyzing data, fish detected within a zone that subsequently go undetected for a period of time without passing through a gate, are assumed to be within the zone in which they were last detected.

Five gates were established between Clark Lake and the Keeyask GS (44.0, 34.0, 20.0, 9.0, and 2.1 rkms upstream of the GS), dividing the river into six zones (Zones 1, 2, 3, 4, 5, and 5.5; Map 4). Three were established in Stephens Lake (1.2, 4.5, and 40.0 rkms downstream of the GS), dividing the lake into three zones (Zones 6.5, 6, and 7; Map 5). The location of the "gates" has remained consistent since 2013 except for the two gates closest to the station which were added in 2022 to track movements of fish close to and through the GS.

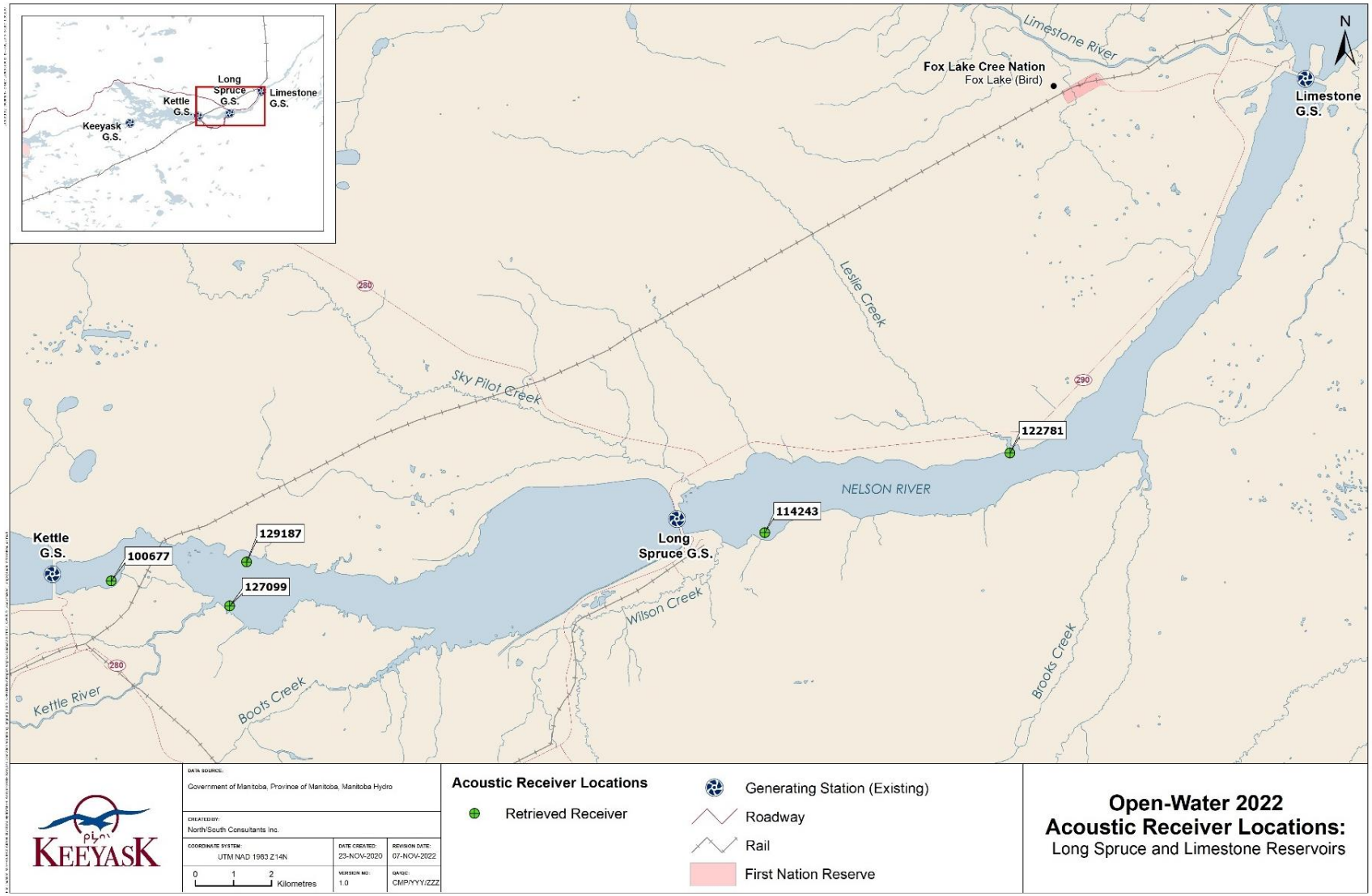
To describe fish movements for reporting purposes, the study area was divided into eleven different zones. The area upstream of the Keeyask GS was divided into six zones (Zones 1–5.5), while Stephens Lake was divided into three zones (Zones 6.5, 6, and 7). The Long Spruce reservoir is referred to as Zone 8 and the Limestone reservoir as Zone 9. Two additional zones were created in 2022 close to the Keeyask GS. Zone 5.5 is located within 2.1 rkm upstream of the GS, and Zone 6.5 is located within 1.2 rkm downstream of the GS.



Map 4: **Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between May and October 2022. The river is divided into six "zones" (numbers 1 to 5.5) based on placement of receiver "gates" indicated within the river in red. River kilometer (rkm) distances at zone divisions are indicated in red.**



Map 5: **Locations of stationary receivers set in Stephens Lake between May and October 2022. The river is divided into three "zones" (numbers 5.5 to 7) based on placement of receiver "gates" indicated within the river in red. The pre-impoundment river channel is shown in light blue. River kilometer (rkm) distances are indicated with a dotted red line.**



Map 6: Locations of stationary receivers set between the Kettle and Limestone Generating Stations, May to October 2022.

Water temperature within the Nelson River mainstem was recorded with a HOBO Water Temperature Pro data logger from October 10, 2021, to October 11, 2022. Lake Sturgeon generally spawn in the spring when water temperature ranges from 8–13˚C (KHLP 2014). In 2022, there were indications that the spawning period lasted beyond these temperatures. During population monitoring studies, adult Lake Sturgeon were captured in spawning condition when water temperature measured 14°C (Ambrose et al. 2023). Thus, data collected when water temperature measured between 8 and 14°C was considered as the “spawning period”.

By October 11, 2022, the majority of receivers were removed, and a subset (n = 32) were redeployed to monitor movements during winter 2022/2023.

3.1.3 DATA ANALYSIS

False detections can arise on acoustic telemetry receivers due to code collisions and/or environmental noise (Pincock 2012). To filter out false detections, a fish was required to be detected at least two times within a 30-minute interval at a given stationary receiver. Single detections were filtered and not used in most analyses; however, in instances when fish went undetected for lengthy periods, and/or rapid movements were suspected, raw data were also explored. In no instance did examination of raw data suggest that consideration of a single detection would result in a different behaviour or movement pattern compared with the result when single detections were removed.

Movements were analysed in terms of rkm distance, with the base of the Keeyask GS representing a distance of 0 rkm. The area located downstream of the Keeyask GS (*i.e.*, Stephens Lake) was given a positive (+) distance value from the GS, while the area located upstream (*i.e.*, Gull and Clark lakes) was given negative (-) distance values (Figures 1 and 2). The average rkm distance from the GS was calculated over a 4-hour interval and plotted versus time for each fish. Total detection ranges were calculated by subtracting the farthest downstream detection location from the location of the farthest upstream detection. The proportion of time that all fish spent within each river zone during each 4-hour interval was plotted and presented as a percentage of the study period. For example, a fish spent 44% of the time between May 1 and May 31 within Zone 4 means that the fish was detected within Zone 4 for 44% of the 186 4-hour intervals between May 1 and May 31.

Rapid downstream movements observed within two weeks of tagging were classified as caused by tagging mortality or stress. It the fish made a rapid downstream movement within two weeks of tagging followed by upstream and downstream movements, it was classified as tagging stress. If a fish made a rapid downstream movement within two weeks of tagging and was not detected again or did not display upstream movements, it was classified as a tagging mortality. If a fish was not detected for more than one year, it was classified as missing.

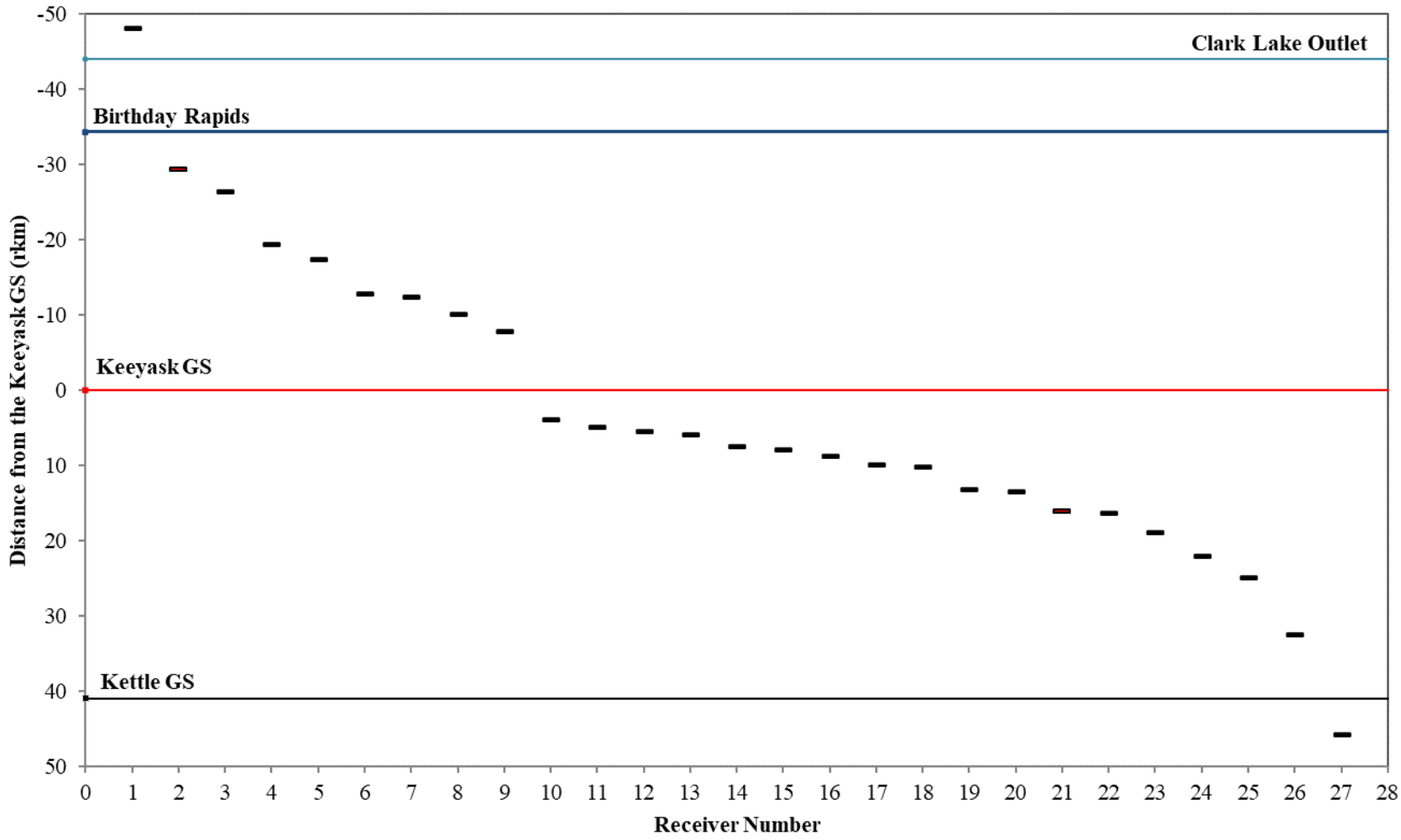


Figure 1: **Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Kettle GS between October 2021 and May 2022. A red dash indicates a receiver that was lost.**

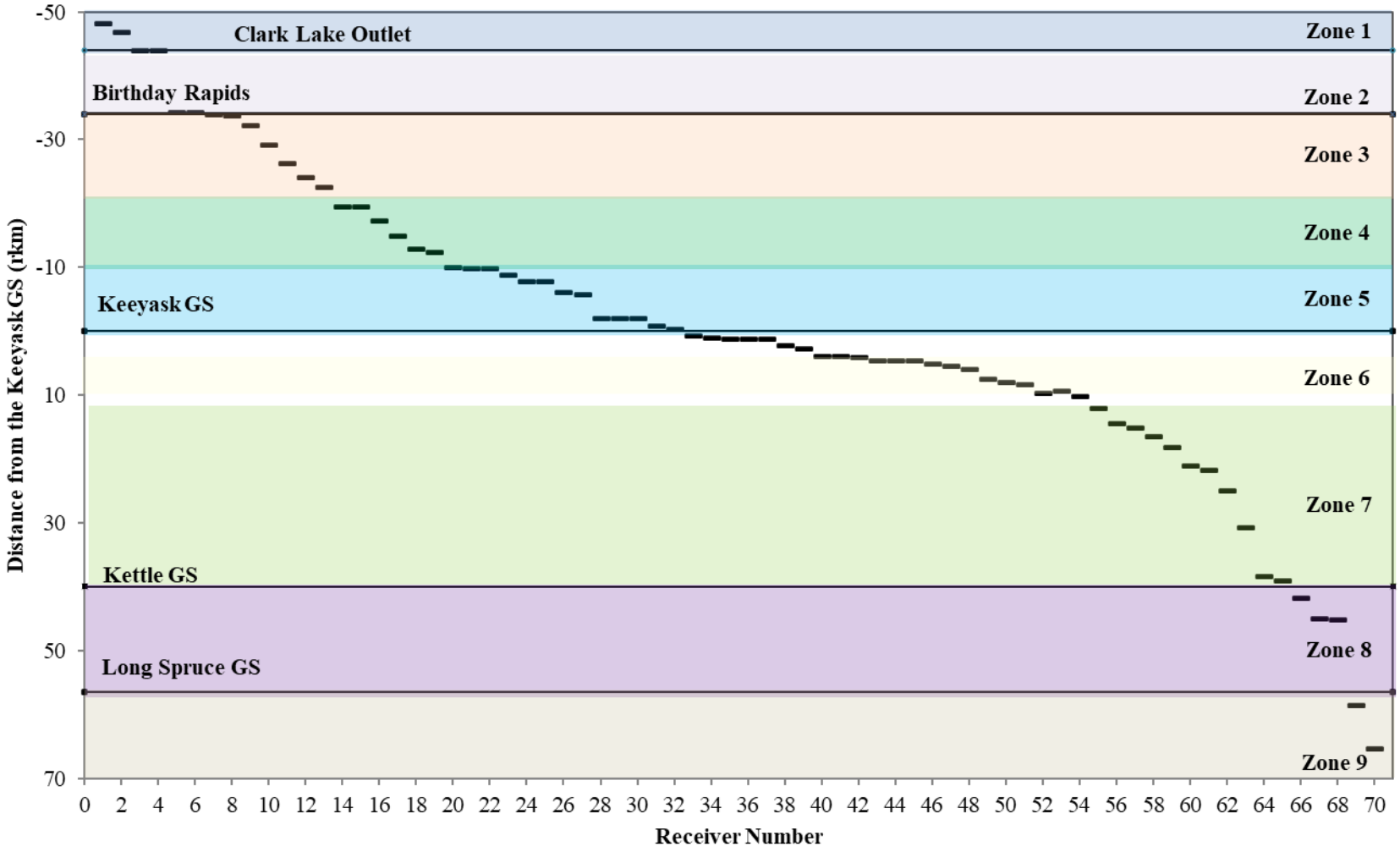


Figure 2: **Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake (Zone 1) and the Limestone GS (Zone 9) between May and October, 2022. River zones upstream and downstream of The Keeyask GS are indicated by shading.**

3.1.3.1 MAXIMUM LIKELIHOOD APPROACH

A maximum likelihood approach was used to compare pre- and post-construction movements, both between river zones and through Gull Rapids (now the Keeyask GS), Kettle GS, and Long Spruce GS. This method is broadly applicable and simple to apply.

A standard binomial coefficient was used to assess the probability of movement estimators.

$$f(y|N,p) = \left(\frac{N}{n}\right) p^{y}(1-p)^{(N-y)}$$

Where:

$$\left(\frac{N}{n}\right) = \frac{N!}{n!\,(N-n)!}$$

A simple example is the chance of observing 5 heads in 20 coin tosses, if *p* = 0.50, would be:

$$f(5|20,0.5) = \left(\frac{20}{5}\right) 0.5^{5}(1-0.5)^{(20-5)} = 0.0148$$

For any observed set of results, the binomial coefficient is constant so we can ignore it when evaluating p. The values of *p* were evaluated using the maximum likelihood approach given the observed data for the following:

- Movement or no movement between zones;
- Upstream movement from zone to zone;
- Downstream movement from zone to zone; and
- Movement past barriers.

4.0 RESULTS

Section 4.1 provides a summary of movements observed for all active tags since date of tagging to the end of the 2022 open-water period (October 10, 2022). Appendix A1 provides farthest upstream and downstream detection locations by river kilometre for each tagged fish (2011–2022) while Appendices A2 to A4 provide movement summaries, by river kilometre, for each tagged sturgeon since the study began in June 2011. Appendices A5 and A6 illustrate movement ranges and detection distributions of fish tagged upstream and downstream of the GS during each open-water season since 2011. Appendix 7 provides tagging and recapture information for Lake Sturgeon whose tags have now expired.

4.1 2011–2021 RESULTS SUMMARY

4.1.1 UPSTREAM OF THE KEEYASK GS

Thirty-one fish were tagged upstream of Gull Rapids (now referred to as the Keeyask GS) in 2011 and 2012, and four additional transmitters were applied in June 2014. One additional female used as broodstock was tagged in 2018 (with a smaller, three-year tag). None of these fish were detected in 2022. Tagging date, date of last detection, and subsequent recaptures for fish with expired tags are outlined in Appendix A7-1. Three fish (#16061, #16067, and #16070) have been recaptured since their last detection date.

Twenty-six tags were applied in spring 2019 in the Keeyask reservoir to replace tags that had moved downstream. Tagging date, biological information, and tag status is outlined in Table 3.

Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS.

Tag ID	Date Tagged	Expiry Date	Status	Floy Tag	Fork Length	Total Length	Weight
16026	6/12/2019	6/17/2022	Active	100450	955	1070	7711
7017	6/8/2019	6/5/2029	Active	114771	949	1160	7257
7018	6/5/2019	6/2/2029	Active	114248	825	907	3629
7019	6/5/2019	6/2/2029	Active	76330	1172	1293	14061
7020	6/9/2019	6/6/2029	Active	105417	1000	1112	5443
7021	6/6/2019	6/3/2029	Active	91388	971	1080	7257
7022	6/7/2019	6/4/2029	Active	114774	1020	1142	7257
7023	6/8/2019	6/5/2029	Active	114770	955	1075	5897
7024	6/8/2019	6/5/2029	Active	103456	953	1070	6350
7025	6/7/2019	6/4/2029	Active	114773	902	1000	5443
7026	6/9/2019	6/6/2029	Active	114769	1070	1173	8165
7027	6/9/2019	6/6/2029	Active	50836	1280	1325	13154
7028	6/8/2019	6/5/2029	Active	79711	1285	1413	17236
7029	6/9/2019	6/6/2029	Active	114768	1135	1259	9525
7030	6/9/2019	6/6/2029	Active	64705	1065	1167	9072
7031	6/8/2019	6/5/2029	Active	114772	920	1040	6804
7032	6/9/2019	6/6/2029	Active	101388	890	1000	4990
7033	6/5/2019	6/2/2029	Active	114777	868	981	4990
7034	6/5/2019	6/2/2029	Active	77504	968	1090	6577
7053	5/25/2019	5/22/2029	Active	114648	866	994	4800
7056	5/25/2019	5/22/2029	Active	64726	1217	1346	-
7059	5/25/2019	5/22/2029	Active	86137	923	1042	6400
7061	6/5/2019	6/2/2029	Active	114776	930	1058	5897
7064	5/29/2019	5/26/2029	Active	114643	1016	1128	7938
7065	5/28/2019	5/25/2029	Active	107113	1034	1145	8165
7066	5/29/2019	5/26/2029	Active	91376	880	1010	5897
7067	5/29/2019	5/26/2029	Active	46424	1317	1445	-
57485	5/28/2022	5/25/2032	Active	112000	897	1033	5910
57478	5/29/2022	5/26/2032	Active	120437	962	1062	6400
57486	5/31/2022	5/28/2032	Active	121679	859	962	4800
57480	6/2/2022	5/30/2032	Active	-	928	1044	7400
57483	6/2/2022	5/30/2032	Active	111971	1081	1157	9500
57492	6/6/2022	6/3/2032	Active	121693	911	1001	5050
57489	6/6/2022	6/3/2032	Active	121694	885	991	5000
57495	6/7/2022	6/4/2032	Active	121683	1108	1294	12600

Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS (continued)

Tag ID	Date Tagged	Expiry Date	Status	Floy Tag	Fork Length	Total Length	Weight
57494	6/8/2022	6/5/2032	Active	121696	954	1100	5750
57479	6/9/2022	6/6/2032	Active	119124	1030	1136	7050
57482	6/9/2022	6/6/2032	Active	105409	1021	1113	7960
57488	6/10/2022	6/7/2032	Active	103474	834	936	5300
57491	6/11/2022	6/8/2032	Active	80299	1125	1229	9700
57439	6/11/2022	6/8/2032	Active	121923	1367	1472	21000
57490	6/12/2022	6/9/2032	Active	121922	1325	1404	19100
57487	6/12/2022	6/9/2032	Active	76410	1100	1212	9600
57484	6/13/2022	6/10/2032	Active	111768	837	932	3950
57481	6/14/2022	6/11/2032	Active	121919	1040	1177	10810
57507	6/24/2022	6/21/2032	Active	75288	1081	1165	9950
57506	6/24/2022	6/21/2032	Active	119116	900	1000	4100
57504	6/24/2022	6/21/2032	Active	117039	995	1099	6600
57505	6/28/2022	6/25/2032	Active	116621	841	933	4350
57502	7/2/2022	6/29/2032	Active	117034	895	985	5000

Prior to winter 2021/2022, thirteen fish moved downstream through the Keeyask GS into Stephens Lake:

- Three (#7020, #7024, and #7034) moved upstream out of the reservoir into Clark Lake in June. All three fish returned downstream in July and were last detected immediately upstream of the Keeyask GS (rkm -2.5 and -2.2) between July 2 and 16.
    - All fish were next detected in Stephens Lake immediately downstream of the spillway (rkm 0.8) in July (#7034) or September (#7020 and #7024).
- Three (#7021, #7026, and #7066) made a single upstream movement to Birthday Rapids during the spawning period, followed by a single downstream movement.
    - #7021 and #7066 moved from Birthday Rapids directly downstream and were later detected in the reservoir at the end of June.
        - #7021 was located downstream of the spillway (rkm 0.8) on June 23.
        - #7066 was located in Stephens Lake (rkm 0.8) on September 13.
    - #7026 returned to Gull Lake after the spawning period. It remained here until August 5, when it was last detected immediately upstream of the spillway. It was detected downstream of the spillway on August 30.
- Three (#7028, #7030, and #7061) moved into the middle Keeyask reservoir during the spawning period. Each then moved downstream between June 17 and 23, when they were last detected upstream of the Keeyask GS.

  - #7028 was detected downstream of the spillway on September 16.
  - #7030 was detected downstream of the powerhouse (rkm 1.2) on July 18.
  - #7061 was detected farther downstream in Stephens Lake (rkm 2.7) on June 23.
- One (#7017) made extensive movements within the reservoir, moving between lower Gull Lake and Birthday Rapids several times between May 21 and August 10, 2021. It was last detected in lower Gull Lake on August 10. It was first detected downstream of the spillway on September 16.
- Three (#7025, #7027, and #7031) remained within Gull Lake and did not show extensive movements prior to moving downstream. Each were last detected in lower Gull Lake in mid-June.
  - #7025 was detected downstream of the spillway on September 12.
  - #7027 was detected downstream of the spillway on June 27.
  - #7031 was detected farther downstream in Stephens Lake (rkm 2.7) on June 14.

Therefore, a total of 13 tagged sturgeon were available to be detected upstream of the Keeyask GS during winter 2021/2022.

One additional Lake Sturgeon moved downstream through the Keeyask GS prior to the 2022 open-water period (described further in Section 4.2.1). An additional 22 adult Lake Sturgeon were tagged in the Keeyask reservoir in spring 2022 (described further in Section 4.3.1.1). Therefore, 34 adult Lake Sturgeon were available to be detected in the Keeyask reservoir during the 2022 open-water period.

4.1.2 STEPHENS LAKE

Twenty-eight fish were originally tagged in Stephens Lake in 2011 and 2012. Additional tags were applied in 2013 (n = 1) and 2014 (n = 7). The majority of tags applied to fish in 2011, 2012, 2013, and 2014 in Stephens Lake have now expired. Tagging date, date of last detection, and subsequent recaptures for fish with expired tags are outlined in Appendix A7-2. Two fish (#16043 and #32170) have been recaptured since their last detection date.

Seven fish tagged in 2012 were detected in Stephens Lake in 2022, and their movements are discussed herein. An additional 25 tags were applied in spring 2019. Tagging date, biological information, and tag status is outlined in Table 4. Thirteen fish moved into Stephens Lake from the Keeyask reservoir in 2021. Therefore, 45 fish were available to be detected in Stephens Lake during winter 2021/2022.

Two fish moved downstream through the Kettle GS during winter 2021/2022 and one fish moved into Stephens Lake from the Keeyask reservoir. Therefore, 44 fish were available to be detected in Stephens Lake during the 2022 open-water period.

Table 4: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters in Stephens Lake.

Tag ID	Date Tagged	Expiry Date	Status	Floy Tag	Fork Length (mm)	Total Length (mm)	Weight (g)
16019	06/13/12	06/11/22	Active	93922	850	951	6577
16020	06/08/12	06/06/22	Active	55557	992	1100	-
16022	06/13/12	06/11/22	Active	81628	810	900	5443
16027	06/13/12	06/11/22	Active	93921	894	991	6804
16031	06/13/12	06/11/22	Active	92925	906	1011	6804
7035	5/31/2019	5/28/2029	Active	115802	1086	1206	9072
7036	5/31/2019	5/28/2029	Active	100151	890	996	5897
7037	5/31/2019	5/28/2029	Active	114626	896	994	5670
7038	5/31/2019	5/28/2029	Active	114627	1032	1153	8618
7039	6/3/2019	5/31/2029	Active	46844	1115	1230	11340
7040	6/3/2019	5/31/2029	Active	114780	1050	1174	9072
7041	5/31/2019	5/28/2029	Active	56152	1090	1211	10886
7042	6/3/2019	5/31/2029	Active	114778	965	1074	6804
7043	9/15/2019	9/12/2029	Active	116091	1060	1182	-
7044	5/31/2019	5/28/2029	Active	88477	850	936	4536
7045	9/12/2019	9/9/2029	Active	116010	830	921	4850
7046	9/14/2019	9/11/2029	Active	91714	950	1100	-
7047	5/31/2019	5/28/2029	Active	100162	830	917	4536
7048	6/3/2019	5/31/2029	Active	69834	990	1114	9072
7049	6/3/2019	5/31/2029	Active	114781	931	1035	6350
7050	6/1/2019	5/29/2029	Active	114791	935	1043	6577
7051	6/3/2019	5/31/2029	Active	50808	1371	1510	19504
7052	6/3/2019	5/31/2029	Active	93921	980	1075	7938
7054	6/3/2019	5/31/2029	Active	110710	1003	1123	8618
7055	6/1/2019	5/29/2029	Active	114790	930	1040	5443
7057	6/3/2019	5/31/2029	Active	115843	893	1021	5443
7058	6/3/2019	5/31/2029	Active	115740	1135	1277	14515
7060	6/3/2019	5/31/2029	Active	112911	820	910	3402
7062	6/3/2019	5/31/2029	Active	110716	1065	1181	12020
7063	6/3/2019	5/31/2029	Active	101041	830	951	4536

4.2 WINTER 2021/2022

4.2.1 UPSTREAM OF THE KEEYASK GS

All nine receivers deployed between Clark Lake and the Keeyask GS during the 2021/2022 winter period were retrieved. Six of the 13 adult Lake Sturgeon (46%) were located a total of 123,702 times (range: 9,460–29,183 detections per individual) (Appendix A1-2). Fish were detected on 82 to 190 days of the 217-day winter period (38–88% of the time) for an average of 137 days, or for 63% of the study period (standard deviation [StDev] = 39 days). The farthest upstream detections occurred at rkm -26.4 (by two fish; 33%), while the farthest downstream occurred at rkm -7.9 (by four fish; 67%) (Appendix A1-2). The average movement range was 11.0 rkm (range 2.8–18.5 rkm).

One fish (#7032) was detected in Stephens Lake early during the 2021/2022 winter period. Because of the timing of detections, it is not clear when this fish passed through the GS.

- It was last detected in the Keeyask reservoir on June 28, 2021, upstream of the Keeyask GS (rkm -2.2). It was next detected in Stephens Lake on October 15 at rkm 3.9. Based on the location and numbers of upstream and downstream detections, it appears this fish survived passage.

The majority of detections were logged by receivers located in the middle basin of Gull Lake at rkm -12.9 and -10.1 (n = 102,240; 79%; Figure 3). Individual movement graphs can be found in Appendix 2.

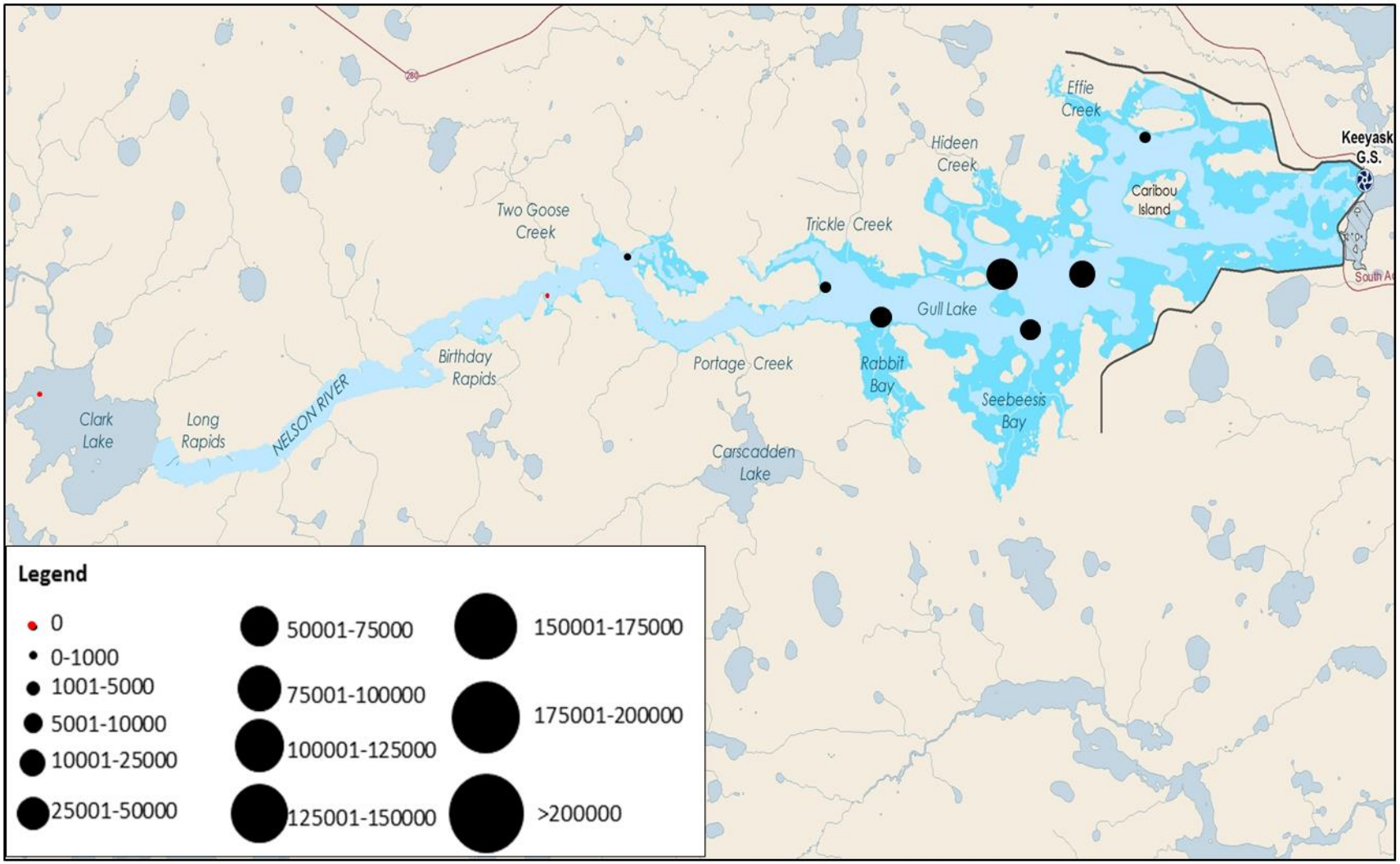


Figure 3: Relative number of detections at each acoustic receiver set between Clark Lake and the Keeyask GS during winter 2021/2022 (October 11, 2021 to May 15, 2022). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

4.2.2 STEPHENS LAKE

All of the 17 receivers deployed in Stephens Lake during the 2021/2022 winter period were retrieved. Forty-three of 45 fish (96%) were located for a total of 1,016,257 detections (range: 113–68,779 detections per individual) (Appendix A1-1; A1-3). On average, fish were detected for 128 days of the 217-day winter period (59%) (range: 3–212 days). The farthest upstream detections occurred at rkm 3.9 (by 32 fish; 74%), while the farthest downstream occurred at rkm 32.5 (by four fish; 9%). Two fish (#7017 and #7030) moved downstream through the Kettle GS. The average movement range was 11.5 rkm (range 0.0–41.8 rkm) (Appendix A1-1; A1-3).

The majority of detections were logged by receivers located in the southern portion of Stephens Lake between rkm 3.9 and 10.2 (n = 832,274; 93%; Figure 4). Movements were as follows:

- Thirteen fish (30% of all fish detected) were detected exclusively in the upstream portion of Stephens Lake, moving no farther downstream than rkm 10.2.
- Twenty-eight (65%) moved between the upstream and downstream portions of Stephens Lake.
    - Twenty-one moved no farther downstream than rkm 18.8.
    - Seven moved into lower Stephens Lake, as far downstream as rkm 32.5.
- Two (5%) moved downstream through the Kettle GS. Based on few detections, it is unclear whether either fish survived passage.
    - #7017 was tagged upstream of the Keeyask GS in 2019. It was last detected in the Keeyask reservoir August 10, 2021, and was first detected downstream of the spillway on September 16, 2021.
        - It remained briefly in Stephens Lake displaying upstream and downstream movements indicating it survived passage through the Keeyask GS.
        - It moved downstream through the Kettle GS between October 28 and 29.
    - #7030 was tagged upstream of the Keeyask GS in 2019. It was last detected in the Keeyask reservoir June 26, 2021, and was first detected downstream of the powerhouse on July 18, 2021.
        - It moved extensively within Stephens Lake displaying upstream and downstream movements indicating it survived passage through the Keeyask GS.
        - It was last detected in Stephens Lake on November 5 and was detected downstream of the Kettle GS for a single day on November 6, 2021.

Individual movement graphs can be found in Appendix 3.

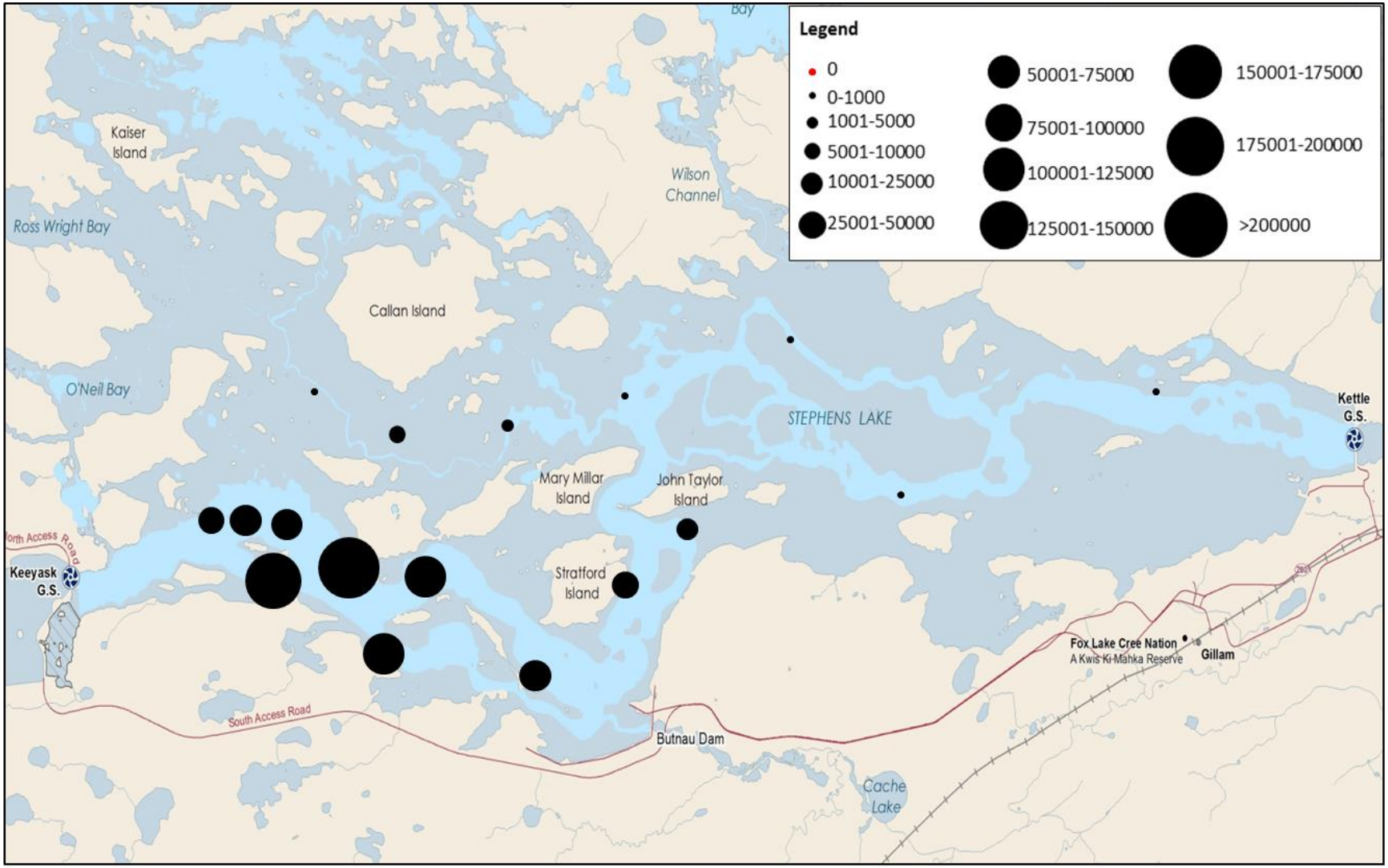


Figure 4: Relative number of detections at each acoustic receiver set in Stephens Lake during winter 2021/2022 (October 11, 2021 to May 15, 2022). Number of detections indicated by size of bubble (defined in legend).

4.3 OPEN-WATER 2022

All stationary acoustic receivers deployed upstream of the Keeyask GS (n = 32), downstream of the Kettle GS (n = 3), and downstream of the Long Spruce GS (n = 2) during the 2022 open-water period were successfully retrieved (Maps 5 and 7). One of the 33 receivers deployed in Stephens Lake (#108002; rkm 21.7) went missing part way through the open-water period. No data were retrieved from this receiver after August 19, 2022 (Map 6).

Water temperature, as measured in the Nelson River mainstem, reached 8˚C on June 5, 2022, and increased to 13˚C by June 16 (Figure 5). Based on these water temperatures, the time between June 5 and 13 is referred to as the spawning period.

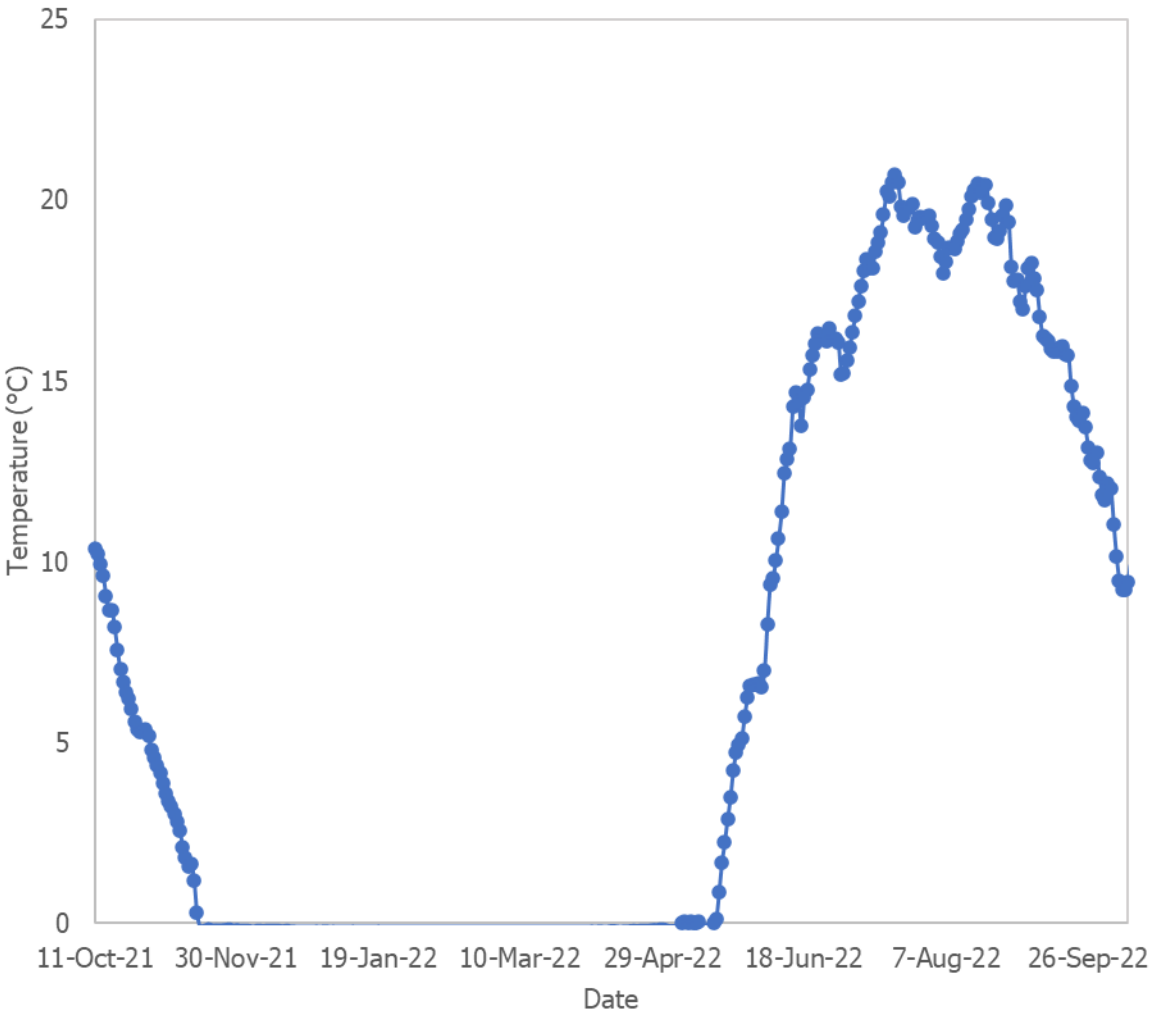


Figure 5: Water temperature in the Nelson River mainstem from October 4, 2021, to October 16, 2022.

4.3.1 UPSTREAM OF THE KEEYASK GS

Thirty-four adult Lake Sturgeon were available to be detected upstream of the Keeyask GS during the 2022 open-water period (Section 4.1.1). Twenty-nine of 34 fish (85%) were detected between 883 and 18,579 times for 12–132 days of the 149-day open-water period (8–89% of the time) for an average of 56 days, or for 38% of the study period (standard deviation [StDev] = 33 days). The average total movement range was 29.2 rkm (StDev = 12.7 rkm; range: 7.9–58.8 rkm) (Appendix A1-5). The farthest upstream detections occurred at the inlet of Clark Lake at rkm -48.2 (by 11 fish; 39%). Six fish moved downstream through the Keeyask GS (discussed further in Section 4.3.1.2). Not including these fish, the farthest downstream detections occurred in lower Gull Lake immediately upstream of the powerhouse at rkm -0.3 (by one fish; 3%).

Of the five fish that were not detected:

- Three were last detected in Clark Lake in open-water 2021 and likely moved upstream past the receiver array.
    - #7022 was tagged on June 7, 2019, downstream of Birthday Rapids. It moved upstream into Clark Lake immediately following reservoir impoundment in 2020. It returned to Birthday Rapids during the 2021 spawning period and was last detected in Clark Lake at the end of July.
    - #7033 was tagged on June 5, 2019 in lower Gull Lake. It was last detected at the inlet to Clark Lake (rkm -48.2) on July 21, 2020.
    - #7053 was tagged on May 25, 2019, at the inlet of Gull Lake. It was detected within upper Gull Lake until June 15, 2021, when it moved upstream into Clark Lake and was last detected on June 23.
- Two were last detected in Gull Lake.
    - #7029 was tagged on June 9, 2019, at the inlet of Gull Lake. It remained in Gull Lake, briefly moving upstream to Clark Lake in July 2021. It was last detected in lower Gull Lake (rkm -2.5) in August 2021.
    - #7056 was tagged on May 25, 2019, at the inlet of Gull Lake. It remained within Gull Lake, briefly moving upstream to Birthday Rapids in 2021. It was last detected in lower Gull Lake (rkm -3.8) in July 2021.

Two fish (#7064 and #7065) were captured during adult Lake Sturgeon population monitoring conducted from May 2 and July 3, 2022. Capture details can be found in Ambrose et al. (2023).

4.3.1.1 PROPORTIONAL DISTRIBUTION

Individual adult Lake Sturgeon that remained in the Keeyask reservoir (not including the six fish that moved downstream through the Keeyask GS) spent a larger proportion of the open-water

period in 2022 in Clark Lake (Zone 1) and the middle Keeyask reservoir (Zone 3) than in previous years (Table 5; Figure 6). The proportion of time spent in each zone was as follows:

- Zone 1 for 30% of the time (StDev = 36%; range: 0–93%);
- Zone 2 for 3% of the time (StDev = 6%; range: 0–22%);
- Zone 3 for 28% of the time (StDev = 32%; range: 0–100%);
- Zone 4 for 20% of the time (StDev = 26%; range: 0–77%);
- Zone 5 for 15% of the time (StDev = 29%; range: 0–93%); and
- Zone 5.5 for 5% of the time (SdDev = 13%; range:0–70%).

Table 5: Average proportion of time spent in each river zone by adult Lake Sturgeon tagged upstream of the Keeyask GS during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to October 10) open-water periods.

Study Year	1	2	3	4	5	5.5
2013	6.4	0.1	12.4	72.5	8.6	-
2014	9.0	0.1	10.8	52.3	27.7	-
2015	4.7	0.1	9.9	43.6	41.7	-
2016	7.3	0.1	12.1	56.5	24.1	-
2017	5.3	0.0	10.7	62.6	21.4	-
2018	7.4	0.1	14.8	48.5	29.2	-
2019	7.8	0.1	11.1	62.0	19.0	-
2020	2.0	0.1	9.9	66.2	21.8	-
2021	19.5	0.7	13.9	37.2	28.7	-
2022	29.5	3.1	27.6	20.1	15.1	4.5

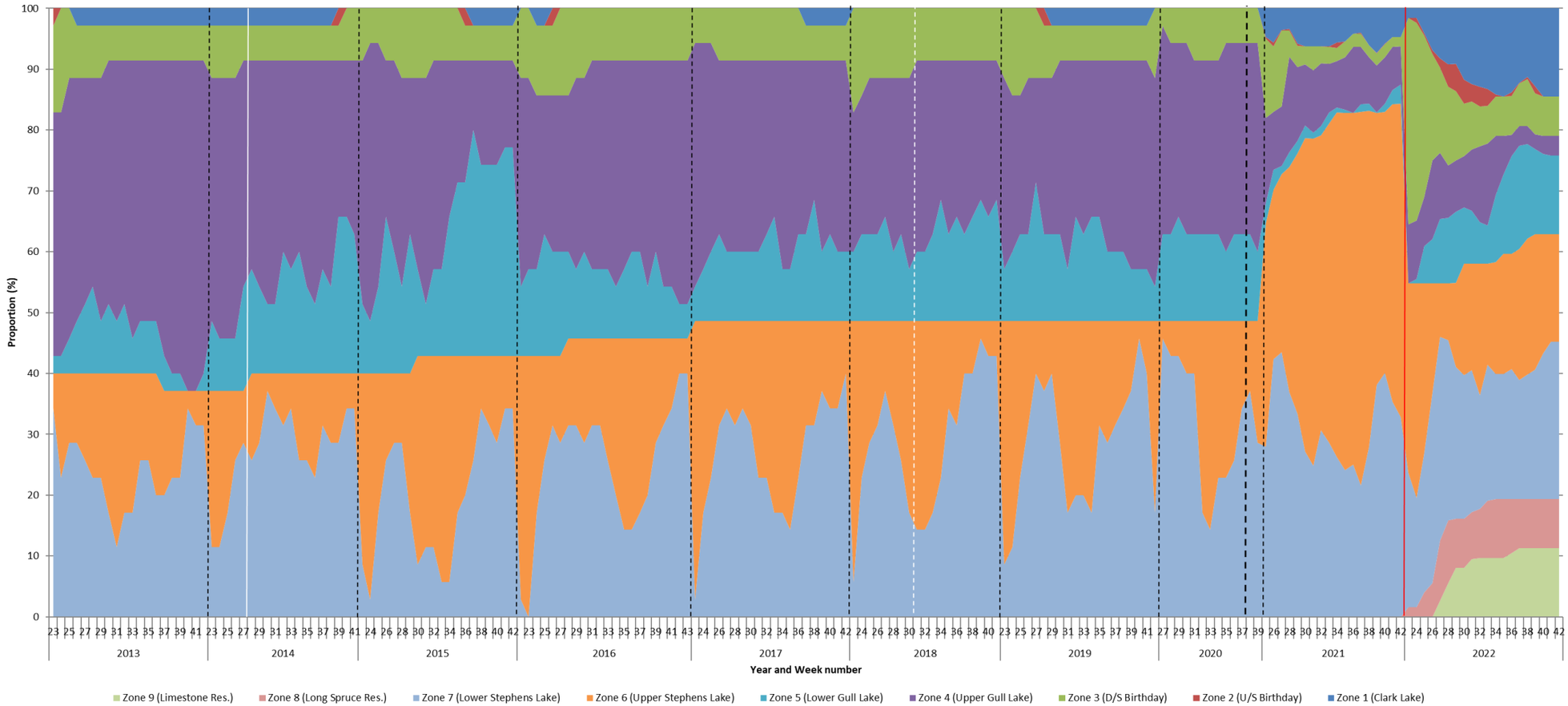


Figure 6: **Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters in 2011 in the Keeyask GS Area during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16) 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (May 1 to October 10) and 2022 (May 16 to October 10) open-water periods. Black dashed lines indicate study years. Solid white line indicates start of Keeyask construction. Dashed white line indicates spillway commissioning. Thick black dashed line indicates end of reservoir impoundment. Solid red line indicated beginning of the operation period.**

4.3.1.2 MOVEMENT PATTERNS

During the 2022 open-water period, most detections were logged in the middle Keeyask reservoir (rkm -26.4; n = 20,915; 12%; Figure 7) and in lower Gull Lake north-west of Caribou Island (rkm -8.9; n = 21,296; 13%). As observed in 2021, individual Lake Sturgeon generally moved farther compared to the habitual movement patterns shown pre-impoundment.

A single fish (#7023) remained in Gull Lake for the entire study period, moving no farther upstream than the inlet to Gull Lake (-19.5).

Eight fish moved throughout the reservoir, moving as far upstream as Birthday Rapids and as far downstream as the area immediately upstream of the Keeyask GS.

Three (#57484, #57490, and #57494) fish remained in the middle Keeyask reservoir.

Eleven fish moved upstream into Clark Lake. Nine of these fish were last detected in Clark Lake and likely moved upstream past the receiver array prior to the end of the open-water period.

- Six were detected between the inlet of Clark Lake (rkm -48.2) and the inlet of Gull Lake (rkm -19.5).
    - Five (#7067, #57485, #57492, #57505, and #57507) were last detected at the inlet to Clark Lake and likely moved upstream past the array.
    - One (#57488) moved briefly into Clark Lake before returning to the Keeyask reservoir prior to the end of the open-water period.
- Five moved between Clark Lake and Gull Lake (as far downstream as rkm -0.8).
    - Four (#57482, #57483, #57486, and #57487) were last detected at the inlet to Clark Lake and likely moved upstream past the array.
    - One (#57491) moved briefly into Clark Lake before returning to the Keeyask reservoir prior to the end of the open-water period.

Six fish moved downstream through the Keeyask GS to Stephens Lake.

- Three fish displayed upstream and downstream movements within Stephens Lake, indicating they survived passage.
    - #7019 was tagged on June 2, 2019, at the inlet to Gull Lake. It was regularly detected moving within Gull Lake until August 2022. It was last detected immediately upstream of the Keeyask GS spillway (rkm -0.8) on August 25. It was next detected in Stephens Lake (downstream of the spillway at rkm 1.2) on September 12.

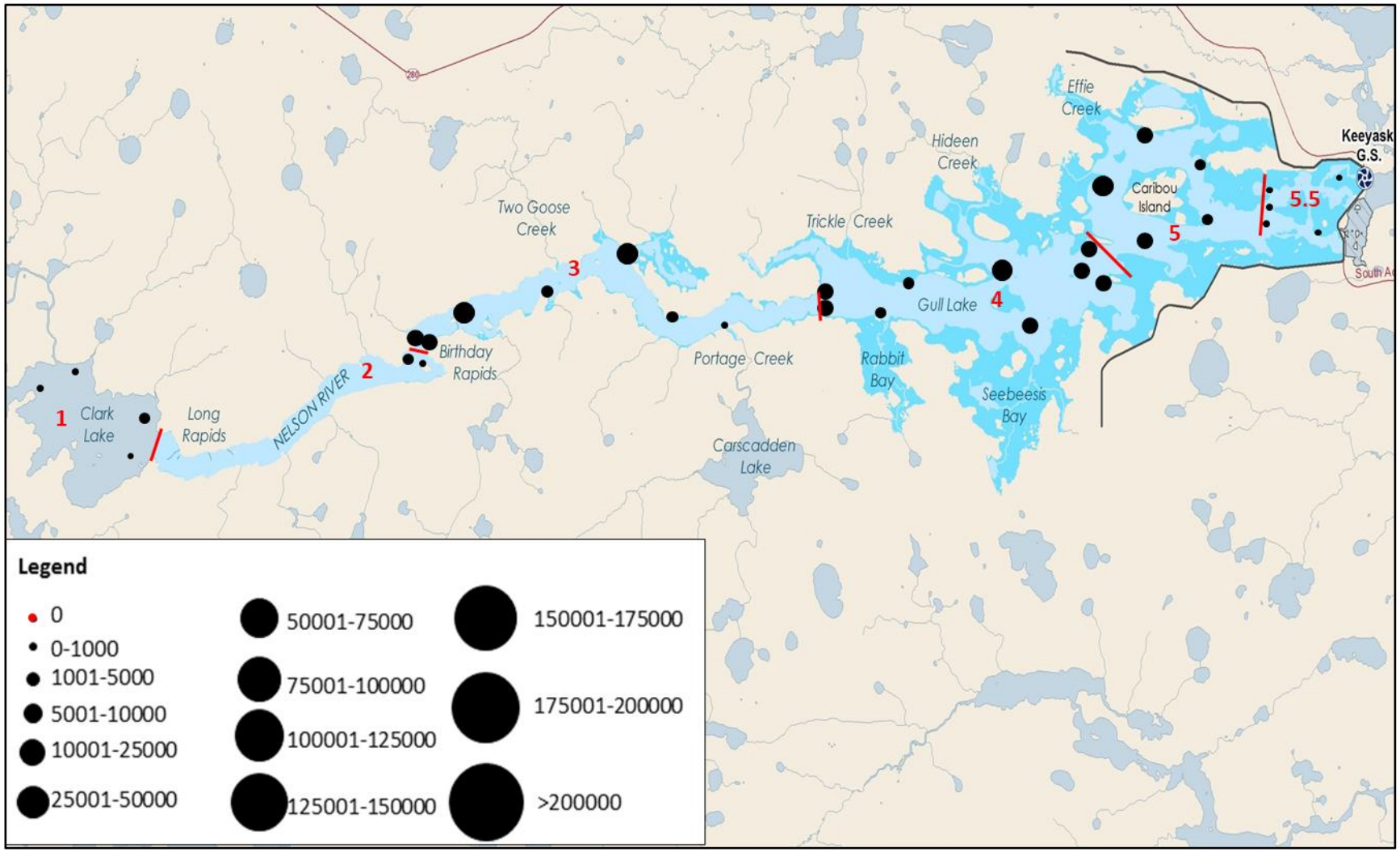


Figure 7: Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keeyask GS during the 2022 open-water period (May 16 to October 10). Number of detections indicated by size of circle (defined in legend). The river is divided into six "zones" based on placement of receiver "gates."

- #57495 was tagged on June 6, 2022, downstream of Birthday Rapids. It was detected in Gull Lake at rkm -2.1 on June 11. It was detected in Stephens Lake on July 16, after which it moved between rkm 1.2 and 24.9 until October 8.
    - Based on the short time between tagging and downstream movements (#57495), it is possible that this fish moved downstream due to tagging stress.
- #57502 was tagged on July 2, 2022, within Gull Lake. It then moved upstream into Clark Lake before returning to the reservoir. It was last detected immediately upstream of the Keeyask GS spillway (rkm -0.8) on September 29. Although it was only detected in Stephens Lake for two days (October 1 and 2), it displayed numerous upstream and downstream movements.

- Three fish were located briefly in Stephens Lake, and it is unclear whether or not they survived passage.
    - #57478 was tagged on May 29, 2022, downstream of Birthday Rapids. It displayed movements within the reservoir until June 26, when it was last detected immediately upstream of the Keeyask GS spillway (rkm -0.8). It was detected in Stephens Lake for a single day (July 17) downstream of the spillway (rkm 0.7).
    - #57479 was tagged on June 9, 2022, at the inlet to Gull Lake. It moved within the reservoir until August 27, when it was last detected immediately upstream of the Keeyask GS spillway (rkm -0.8). It was detected for two days (September 7 and 8) in Stephens Lake immediately downstream of the spillway (rkm 0.7).
    - #57506 was tagged on June 24, 2022, in the middle Keeyask reservoir. It moved within this area until August 19 when it was detected immediately upstream of the Keeyask GS powerhouse (rkm -0.3). It was detected on August 20 in the middle of the river channel at rkm 1.2. It then moved upstream to rkm 0.7 (immediately downstream of the spillway channel) where it was detected until September 27.

Individual movement graphs can be found in Appendix 3.

4.3.1.3 SPAWNING MOVEMENTS

During the spawning period (June 5 to 19, 2022), ten fish (34% of all detected) were detected downstream of Birthday Rapids between rkms -33.9 and -32.2. A total of 5,157 (representing 23% of all detections) were logged in this area (Figure 8).

- Six (#7018, #7059, #57480, #57483, #57489, #57495) fish made distinct upstream movements to Birthday Rapids and returned downstream to Gull Lake following the spawning period. It is likely that these movements were for spawning.

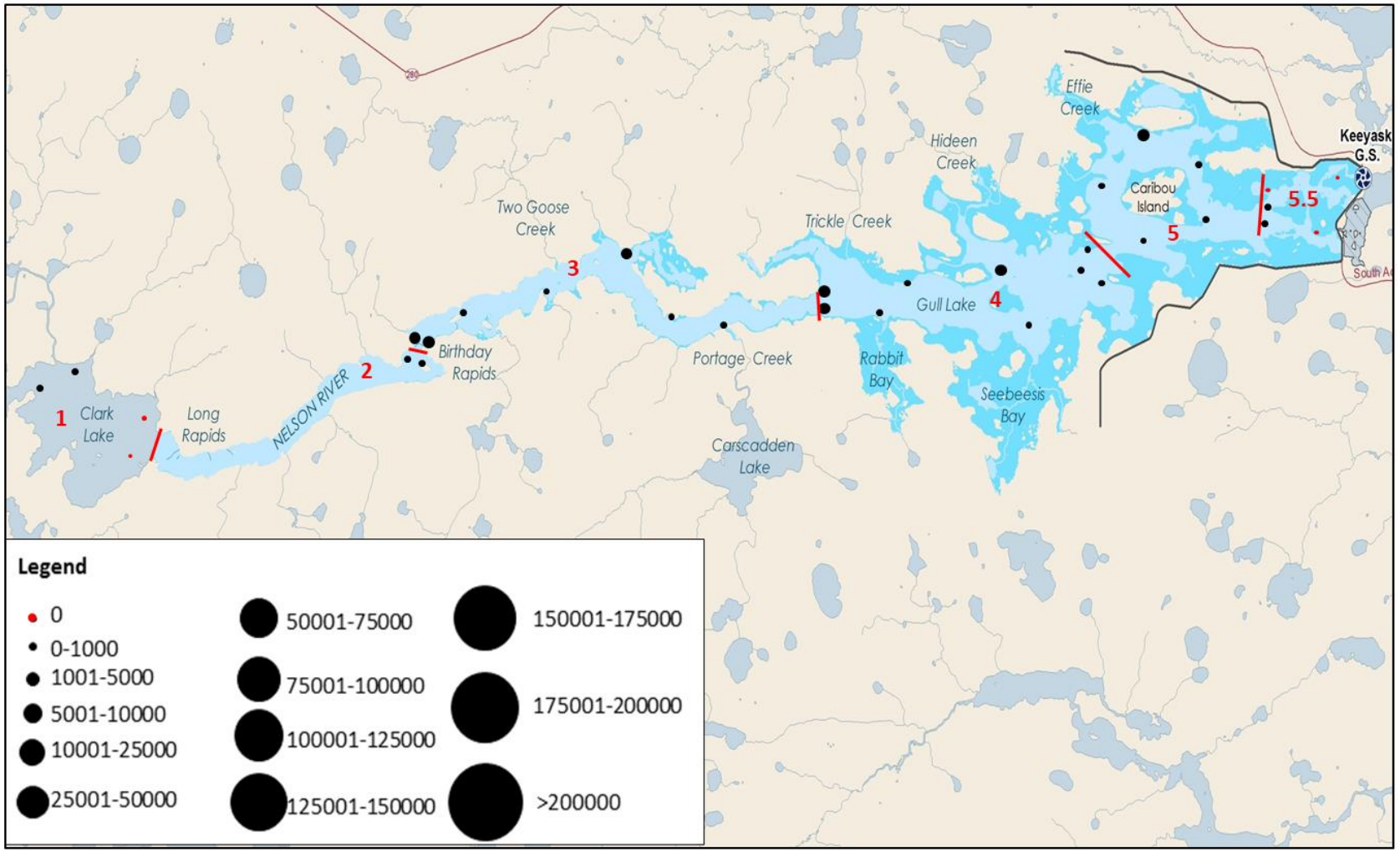


Figure 8: **Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keeyask GS during the 2022 spawning period (June 5 to 13). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into six "zones" based on placement of receiver "gates."**

- Two (#57488 and #57492) were captured and tagged downstream of Birthday Rapids in spring 2022. Both fish remained at Birthday Rapids until June and July before moving upstream into Clark Lake.
- Two (#57485 and #57486) made multiple movements to Birthday Rapids throughout the open-water period in addition to those made during the spawning period. It is not clear if upstream movements observed in spring were related to spawning.

Five fish (#7018, #7059, #57483, #57486, and #57488) were also detected immediately upstream of Birthday Rapids during the spawning period. However, these movements were brief and all five fish returned downstream within the same day.

There is no evidence that fish moved upstream to Long Rapids to spawn.

4.3.2 STEPHENS LAKE

Forty-four adult Lake Sturgeon were available to be detected in Stephens Lake during the 2022 open-water period (Section 4.1.2). Forty-one fish (93%) were detected between two and 47,737 times over 1–131 days of the 149-day open-water period (1–88% of the time; Appendix A1-4) for an average of 62 days, or for 42% of the study period (standard deviation [StDev] = 39 days). Mean movement range was 28.4 rkm (StDev = 18.6 rkm; range: 0.0–64.6rkm) (Appendix A1-4; A1-6). The farthest upstream detections occurred immediately downstream of the Keeyask GS spillway at rkm 0.7 (by 24 fish; 60%). Twelve fish moved downstream through the Kettle GS (described further in Section 4.3.2.2). Not including these fish, the farthest downstream detections occurred at the receiver immediately upstream from the Kettle GS at rkm 38.4 (by one fish; 3%).

Of the three fish that were not detected:

- One was originally tagged in Stephens Lake.
  - #7037 was tagged on May 31, 2019, in upper Stephens Lake. It moved between upper and lower Stephens Lake and was last detected on September 30, 2021, at rkm 16.3.
- Two were originally tagged upstream of the GS and moved downstream into Stephens Lake in 2021.
  - #7024 was tagged on June 8, 2019, downstream of Birthday Rapids. It moved downstream through the Keeyask GS and was first detected in Stephens Lake on September 28, 2021. It continued to move downstream and was last detected in lower Stephens Lake (rkm 32.5) on October 16.
  - #7061 was tagged on June 5, 2019, in lower Gull Lake. It moved downstream through the Keeyask GS on July 23, 2021. It was detected for a single day in Stephens Lake.

Four fish were captured during adult Lake Sturgeon population monitoring conducted from May 27 and July 3, 2022 including one fish tagged in the Keeyask reservoir (#7028) and three tagged in Stephens Lake (#7041, #7058, and #16073 [expired tag]). Capture details can be found in Ambrose et al. (2023).

Of the 14 fish that moved downstream from the Keeyask reservoir into Stephens Lake in 2021.

- Two (#7024 and #7061) were not detected during the 2022 open-water period.
- Four (#7028, #7031, #7034, and #7066) remained in Stephens Lake during the 2022 open-water period.
- Two (#7017 and #7030) moved downstream through the Kettle GS during winter 2021/2022.
- One moved downstream through the Kettle GS (#7021) and five moved downstream through both the Kettle and Long Spruce GSs (#7020, #7025, #7026, #7027, and #7032) during open-water 2022.

4.3.2.1 PROPORTIONAL DISTRIBUTION

Fish tagged in Stephens Lake (not including the six fish that moved downstream through the Keeyask GS or the 11 that moved through the Kettle GS) used all three zones of Stephens Lake (Table 6). The proportion of time spent in each zone was as follows:

- Zone 6.5 for 26% of the time (StDev = 34%; range: 0–100%);
- Zone 6 for 17% of the time (StDev = 25%; range: 0–100%); and
- Zone 7 for 56% of the time (StDev = 38%; range: 0–100%).

Table 6: Average proportion of time spent in each river zone by adult Lake Sturgeon tagged in Stephens Lake during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16), 2018 (June 6 to October 10), 2019 (June 2 to October 7), 2020 (July 3 to September 23), 2021 (June 13 to October 10), and 2022 (May 16 to October 10) open-water periods.

Study Year	6.5	6	7
2013	-	45.0	55.0
2014	-	38.2	61.8
2015	-	55.6	44.9
2016	-	41.8	59.2
2017	-	47.6	52.9
2018	-	47.4	53.3
2019	-	50.6	49.4
2020	-	44.2	55.8
2021	-	50.3	49.4
2022	26.3	17.3	56.4

4.3.2.2 MOVEMENT PATTERNS

As observed in the last five years (2017–2021), most detections (n = 299,377; 84%) were logged by receivers located in the southern portion of Stephens Lake between rkms 0.8 and 10.2 during the 2022 open-water period (Figure 9).

Seven fish (#7028, #7031, #7036, #7054, #16019; #16020, and #16027; 13%) remained within upper Stephens Lake (rkms 0.8 to 10.2) for the entire 2022 open-water period.

- #7028 and #7031 were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

Twenty-one fish moved within Stephens Lake, using areas close to (i.e., within 3.8 km) and farther from the Keeyask GS.

- Nine moved as far downstream as the Kettle GS, however, did not pass through.
- Six moved as far downstream as rkm 24.9.
- Six moved only as far as between 12.0 and 18.8 rkm from the Keeyask GS.
    - Three (#16026, #7034, and #7066) were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

Twelve fish moved downstream through the Kettle GS. Five (#7021, #7020, #7026, #7027, and #7032) were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

- Five remained within the Long Spruce Reservoir.
    - Three (#7035, #7040, and #7050) were only detected at a single receiver in the Long Spruce Reservoir (rkm 41.7). It is unclear if these fish survived passage through the Kettle GS.
    - Two (#7038 and #7021) displayed upstream and downstream movements, indicating they survived passage through the Kettle GS.
- Seven continued moving downstream through the Long Spruce GS.
    - #7020 was detected downstream of the Kettle GS from June 14 to 26, 2022. Multiple upstream and downstream movements indicate this fish survived passage. It was then detected downstream of the Long Spruce GS on August 31. It is unclear whether it survived passage.
    - #7025 was detected downstream of the Kettle GS from June 16 to 24, 2022. Multiple upstream and downstream movements indicate this fish survived passage. It was then detected downstream of the Long Spruce GS on July 9 and 10. It is unclear whether it survived passage.

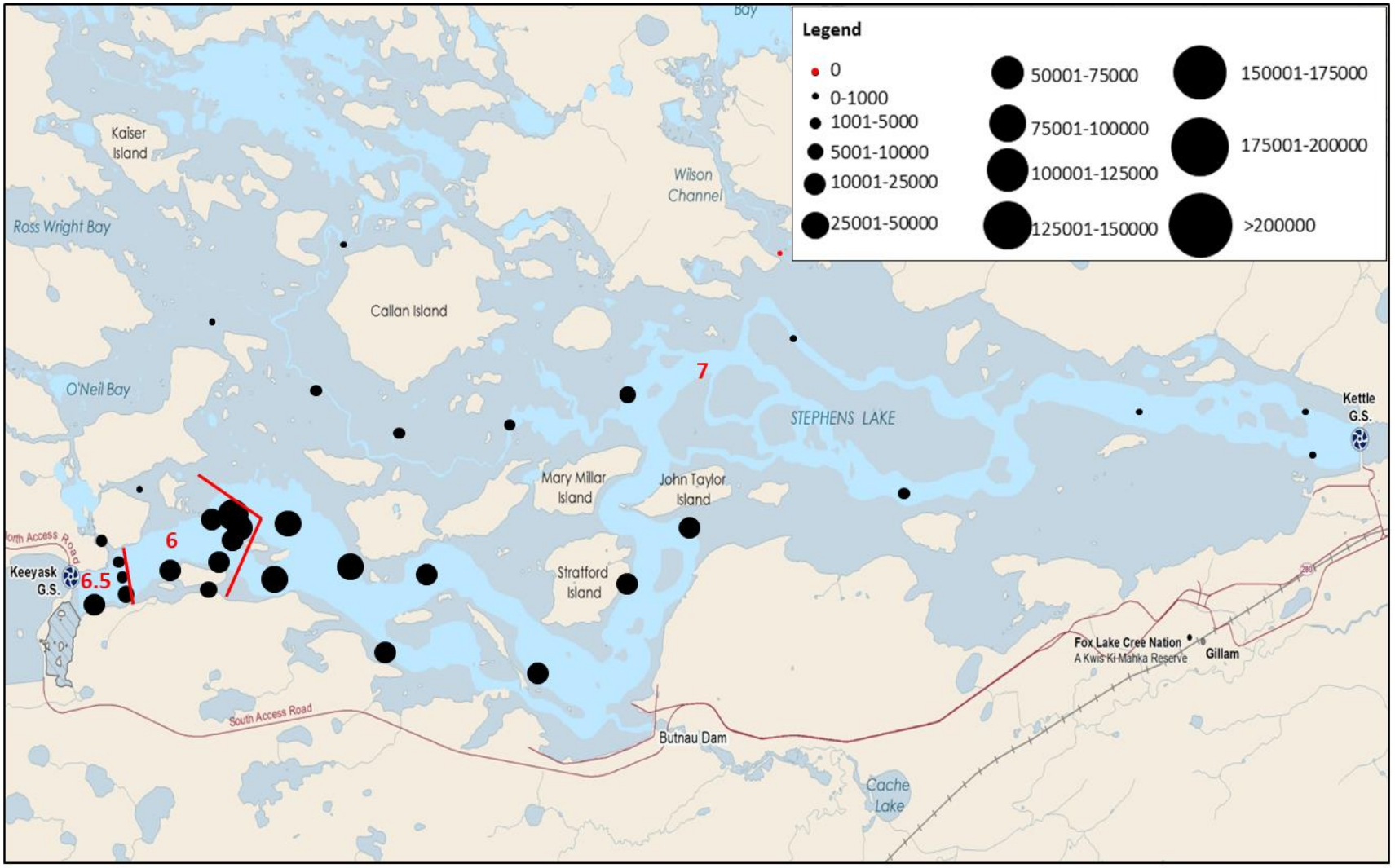


Figure 9: **Relative number of detections at each acoustic receiver set in Stephens Lake during the 2022 open-water period (May 16 to October 10). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into three "zones" based on placement of receiver "gates."**

- #7026 was detected downstream of the Kettle GS from June 13 to July 8, 2022. It was then detected downstream of the Long Spruce GS on July 8. Multiple upstream and downstream movements indicate this fish survived passage through both stations.
- #7027 was detected downstream of the Kettle GS from July 4 to 17, 2022. Multiple upstream and downstream movements indicate this fish survived passage. It was then detected downstream of the Long Spruce GS on July 24. It is unclear whether it survived passage.
- #7032 was detected downstream of the Kettle GS only on June 25, 2022. It was then detected downstream of the Long Spruce GS on July 27. Multiple upstream and downstream movements indicate this fish survived passage through both stations.
- #7051 moved downstream through the Kettle GS on June 23 and the Long Spruce GS on July 1. No upstream movements were observed and it is unclear whether it survived passage through either GS.
- #7052 was detected downstream of the Kettle GS from July 4 to August 3, 2022. Multiple upstream and downstream movements indicate this fish survived passage. It was then detected downstream of the Long Spruce GS on August 31. It is unclear whether it survived passage.

Individual movement graphs can be found in Appendix 4.

4.3.2.3 SPAWNING MOVEMENTS

During the spawning period (June 5 to 19, 2022), 31 fish (76%) were detected downstream of the Keeyask GS between rkms 0.7 to 1.2. A total of 4,159 detections (8%) were logged at receiver #127093 located on the south shore 1.2 rkm downstream of the spillway (by 28 fish) (Figure 10). An additional 843 detections (2%) were logged at receiver #127102 located closest to the tailrace (rkm 1.2; by 24 fish) while 347 detections were logged at receiver #125101 located closest to the spillway (rkm 0.7; by 15 fish).

A total of 31 fish were detected within 1.2 rkm of the GS during the spawning period.

- Twenty-five fish were originally tagged in Stephens Lake made distinct upstream movements to the GS. These movements are likely related to spawning.
- Six fish were migrants from the Keeyask reservoir. All four fish moved downstream through the GS in 2021 and were detected regularly during winter 2021/2022 between rkm 3.9 and 32.5. It is not clear if these movements were related to spawning.
  - Four (#7020, #7028, #7032, #7034) made distinct upstream movements to the GS during the spawning period and were detected between rkm 0.7 and 1.2 from June 7 to 9.
  - #7027 was detected between rkm 0.7 and 1.2 from June 9 to 28. By June 28 water temperature was 16°C, which is beyond the range of usual spawning temperatures. However, one male Lake Sturgeon was captured in pre-spawn

condition in Stephens Lake on June 19 during population monitoring (Ambrose et al. 2023). Therefore, there are indications that the spawning period in 2022 may have been extended and this movement may be related to spawning.

- #7066 made multiple movements to Birthday Rapids throughout the open-water period in addition to those made during the spawning period.

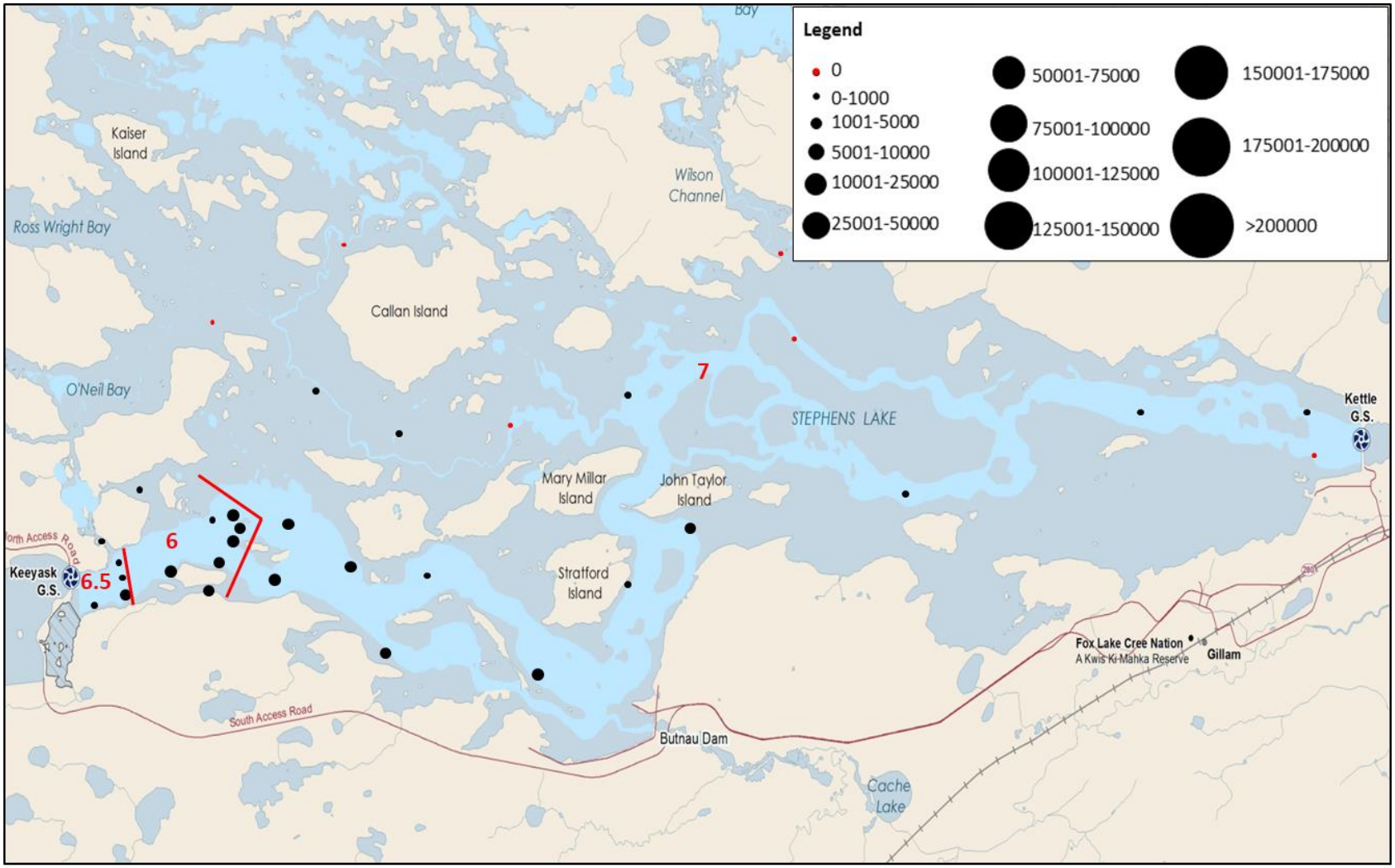


Figure 10: Relative number of detections at each acoustic receiver set in Stephens Lake during the 2022 spawning period (June 5 to 13). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into three "zones" based on placement of receiver "gates."

4.3.3 LONG SPRUCE AND LIMESTONE RESERVOIRS

Two fish (#7017 and #7030) moved downstream through the Kettle GS in winter 2021/2022 and were available to be detected during open-water 2022. Neither fish was detected.

4.4 ADULT LAKE STURGEON DISTRIBUTION

Proportional distributions of fish detected consistently during the open-water period since 2013 (n = 97) were compared, and the likelihood of fish movements between zones before construction, during construction, and after reservoir impoundment were calculated (Figures 11–13). The overall likelihood of a movement (either upstream or downstream) between zones was 12% prior to construction, 14% during construction, and 15% after reservoir impoundment (Figure 11). The likelihood of a fish moving upstream from one zone to another was 43% prior to the onset of construction, 45% during construction, and 36% after impoundment (Figure 12). The likelihood of a fish moving downstream from one zone to another was 57% before construction, 55% during construction, and 64% after impoundment (Figure 13).

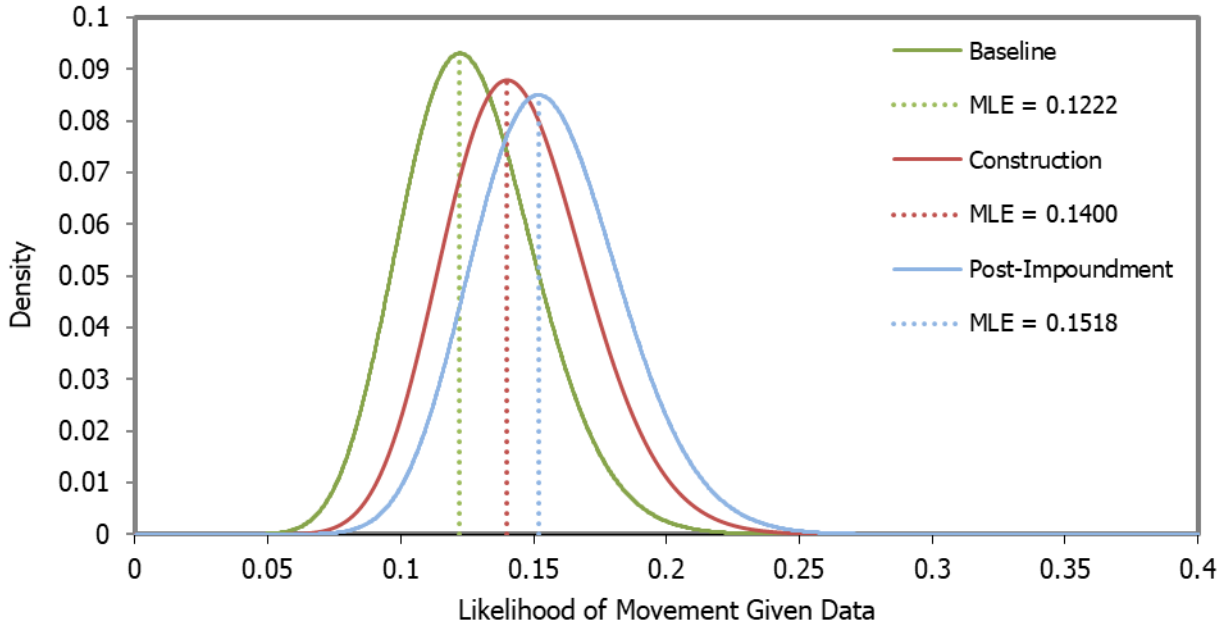


Figure 11: Likelihood of an adult Lake Sturgeon moving between river zones (either upstream or downstream) before construction, during construction, and after impoundment.

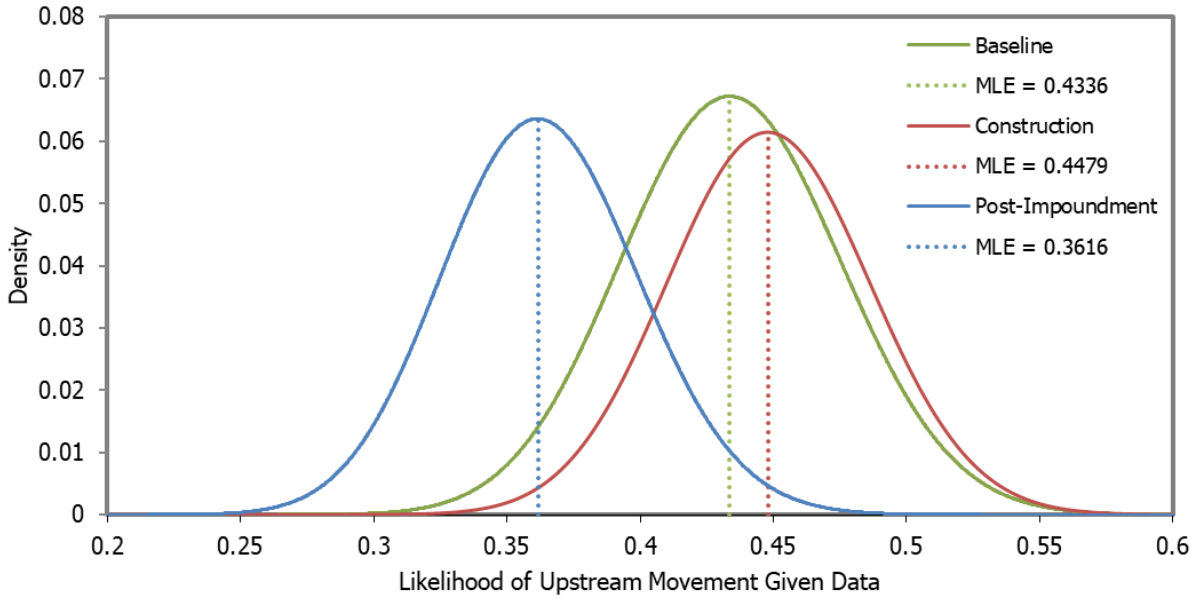


Figure 12: Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be upstream before construction, during construction, and after impoundment.

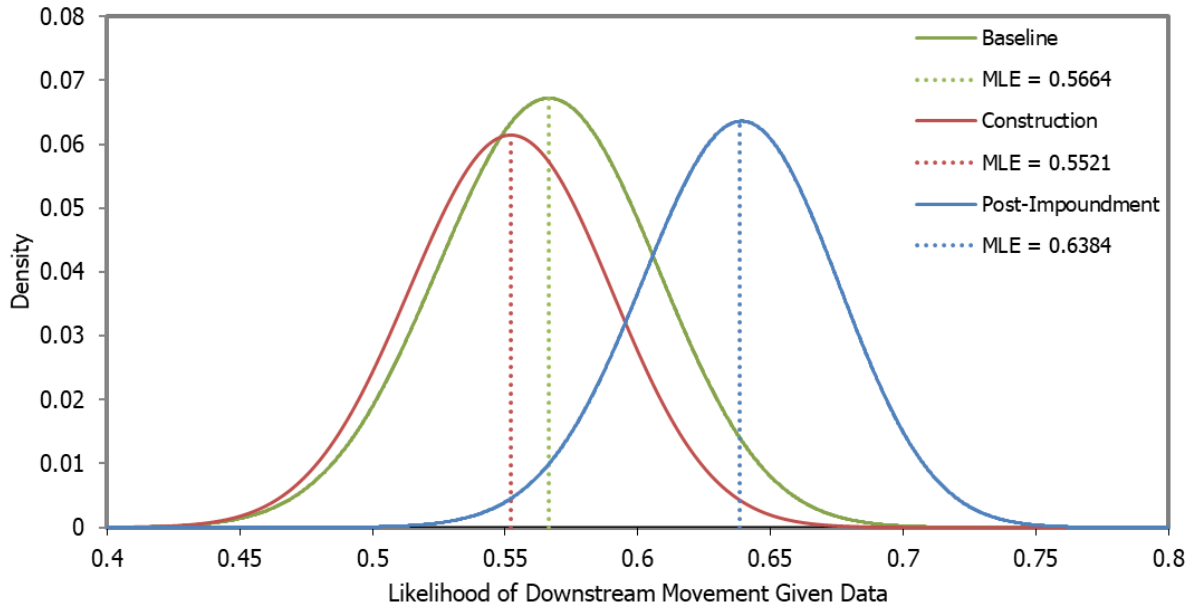


Figure 13: Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be downstream before construction, during construction, and after impoundment.

4.5 MOVEMENTS THROUGH BARRIERS

Prior to the onset of construction in 2014:

- Eight movements through Gull Rapids/the Keeyask GS were observed.
  - Four fish (#16029, #16033, #16038, and #16046) tagged in Stephens Lake moved upstream through Gull Rapids and remained upstream in Gull Lake.
  - Two fish (#16025 and #16037) tagged in Stephens Lake moved upstream into Gull Lake and then returned to Stephens Lake.
- Three fish tagged in Stephens Lake (#16021, #16025, #16034) moved downstream through the Kettle GS.

During the construction period (2014–2020):

- Four fish moved downstream through Gull Rapids (#16060, #16048, #16076, and #32174).
- One fish moved downstream through the Kettle GS (#16035).
- Two fish moved downstream through the Long Spruce GS (#16021 and #16034).

Following impoundment of the Keeyask GS reservoir in fall 2020, 20 Lake Sturgeon moved downstream through the Keeyask GS into Stephens Lake (13 in open-water 2021, one in winter 2021/2022, and six in open-water 2022). This represents a large increase over all previous years.

Further, 14 fish moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through the Long Spruce GS.

The likelihood of a fish moving through Gull Rapids (now the Keeyask GS), Kettle GS, or the Long Spruce GS was calculated for the pre-construction (2011–2014), during construction (2014–2020), and post-impoundment (2020–2022) study periods. Prior to construction, there was a 2% chance that a fish would move past the rapids or a generating station, compared to a 1% chance after the onset of construction. Post-impoundment, this increased to a 12% chance (Figure 14).

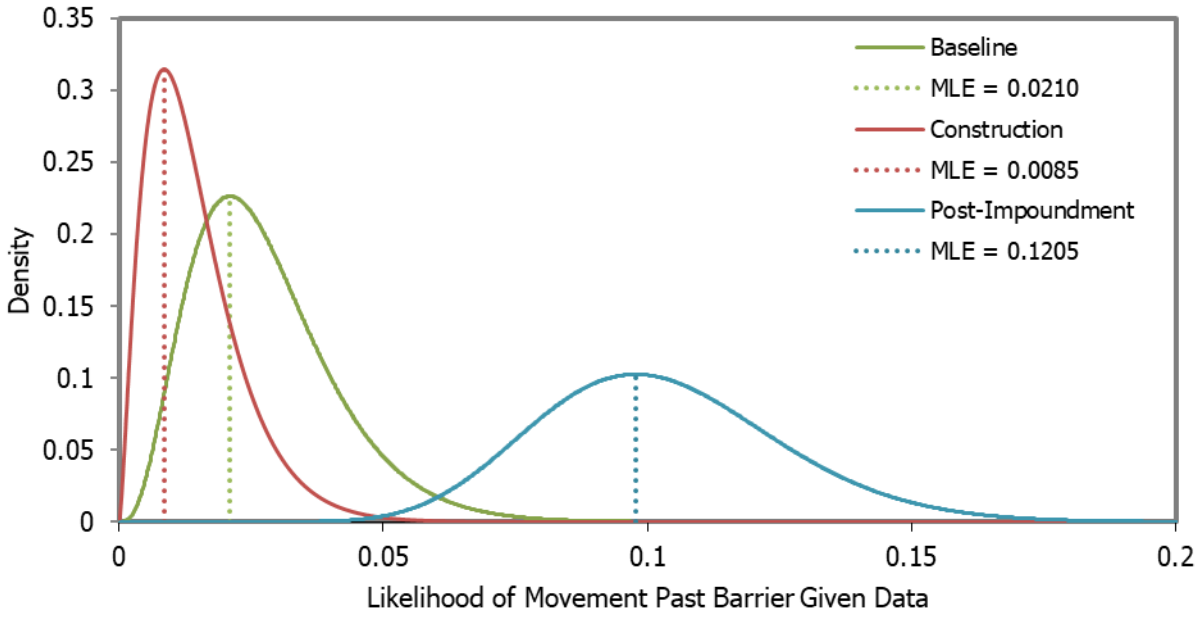


Figure 14: Likelihood of an adult Lake Sturgeon moving past a barrier (either Gull Rapids/the Keeyask GS, Kettle GS, or Long Spruce GS) before and after the onset of Keeyask construction. There were no movements past barriers after impoundment in September 2020.

All movements out of the Keeyask reservoir and Stephens Lake since 2011 are outlined in Table 7 and Figures 15 and 16.

Table 7: Number of Lake Sturgeon tagged with acoustic and radio tags that moved upstream or downstream through the Keeyask GS site during studies conducted in 2001–2004 and 2011–2022.

Life Stage	Year[1]	# Tagged Fish		# Fish Detected		Downstream Movements			Upstream Movements		
		U/S[2]	D/S[3]	U/S	D/S	#	% total	% detected	#	% total	% detected
Adult[4]	2001	21	11	21	11	1	4.8	4.8	0	0	0
	2002	19	12	19	10	0	0	0	3	25	30
	2003	21	9	20	4	1	4.8	5	0	0	0
	2004	19	9	16	4	0	0	0	0	0	0
	2011	30	19	28	19	0	0	0	1	5.3	5.3
	2012	32	27	30	27	0	0	0	4	14.8	14.8
	2013	35	22	28	19	0	0	0	1	4.5	5.3
	2014	34	24	33	24	2	5.9	6.1	0	0	0
	2015	32	25	28	25	1	3.1	3.6	0	0	0
	2016	32	26	29	26	2	6.3	6.9	0	0	0
	2017	30	28	26	27	1	3.3	3.8	0	0	0
	2018	28	28	28	28	0	0	0	0	0	0
	2019	54	53	54	51	0	0	0	-	-	-
	2020	54	52	48	51	0	0	0	-	-	-
	2021	44	41	41	39	14	31.8	34.1	-	-	-
	2022	34	44	29	41	6	17.6	20.7	-	-	-
Juvenile[5]	2013	20	20	18	20	0	0	0	0	0	0
	2014	20	20	20	19	0	0	0	0	0	0
	2015	20	20	19	19	0	0	0	0	0	0
	2016	20	20	19	19	0	0	0	0	0	0
	2017	20	18	18	13	0	0	0	0	0	0
	2018	20	19	20	14	0	0	0	0	0	0
	2019	20	14	17	13	1	5	5.9	-	-	-
	2020	19	13	17	12	0	0	0	-	-	-
	2021	19	13	19	12	3	15.7	15.7	-	-	-
	2022	32	38	31	27	7	22.6	21.9	-	-	-

1. Includes data from the current study (2011–2022), a study conducted between 2001 and 2004 (Barth and Mochnacz 2004; Barth 2005; Barth and Murray 2005; Barth and Ambrose 2006), and the juvenile Lake Sturgeon acoustic telemetry study initiated in Gull and Stephens Lake in 2013 (Hrenchuk and Barth 2014; Lacho *et al.* 2015, Lacho and Hrenchuk 2016; Lacho and Hrenchuk 2017; Lacho *et al.* 2018; Lacho and Hrenchuk 2019a; Hrenchuk 2020; Hrenchuk 2021; and Funk and Hrenchuk 2022).
2. Upstream of Gull Rapids (between Clark Lake and Gull Rapids) now referred to as the Keeyask GS.
3. Downstream of Gull Rapids (in Stephens Lake between Gull Rapids and the Kettle GS) now referred to as the Keeyask GS.
4. Refers to fish greater than 800 mm fork length.
5. Refers to fish less than 800 mm fork length

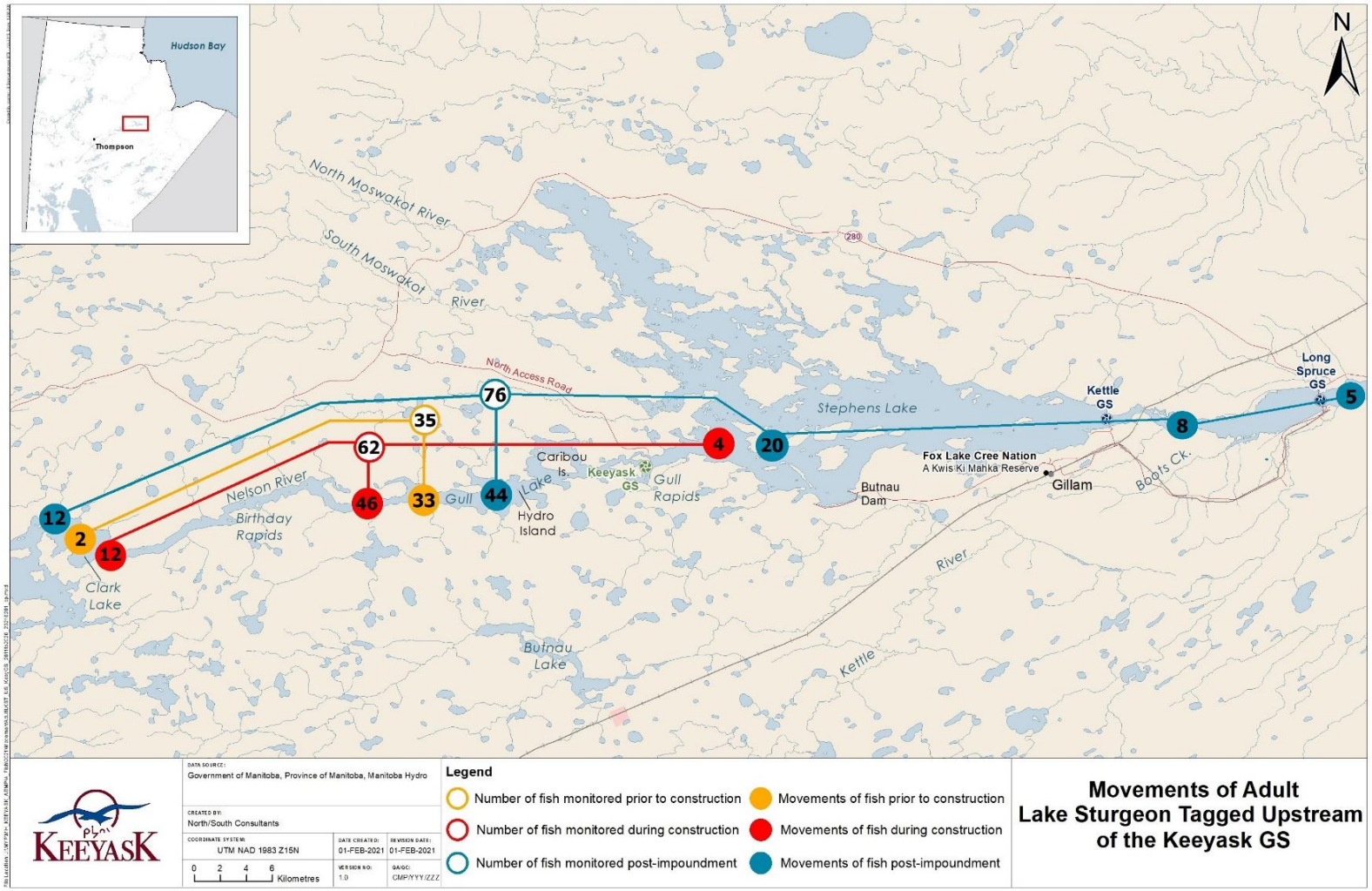


Figure 15: Map showing how many adult Lake Sturgeon moved upstream out of Gull Lake, stayed in Gull Lake, moved into Stephens Lake, and moved downstream through the Kettle GS before construction (yellow), during construction (red) and after reservoir impoundment (blue). Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.

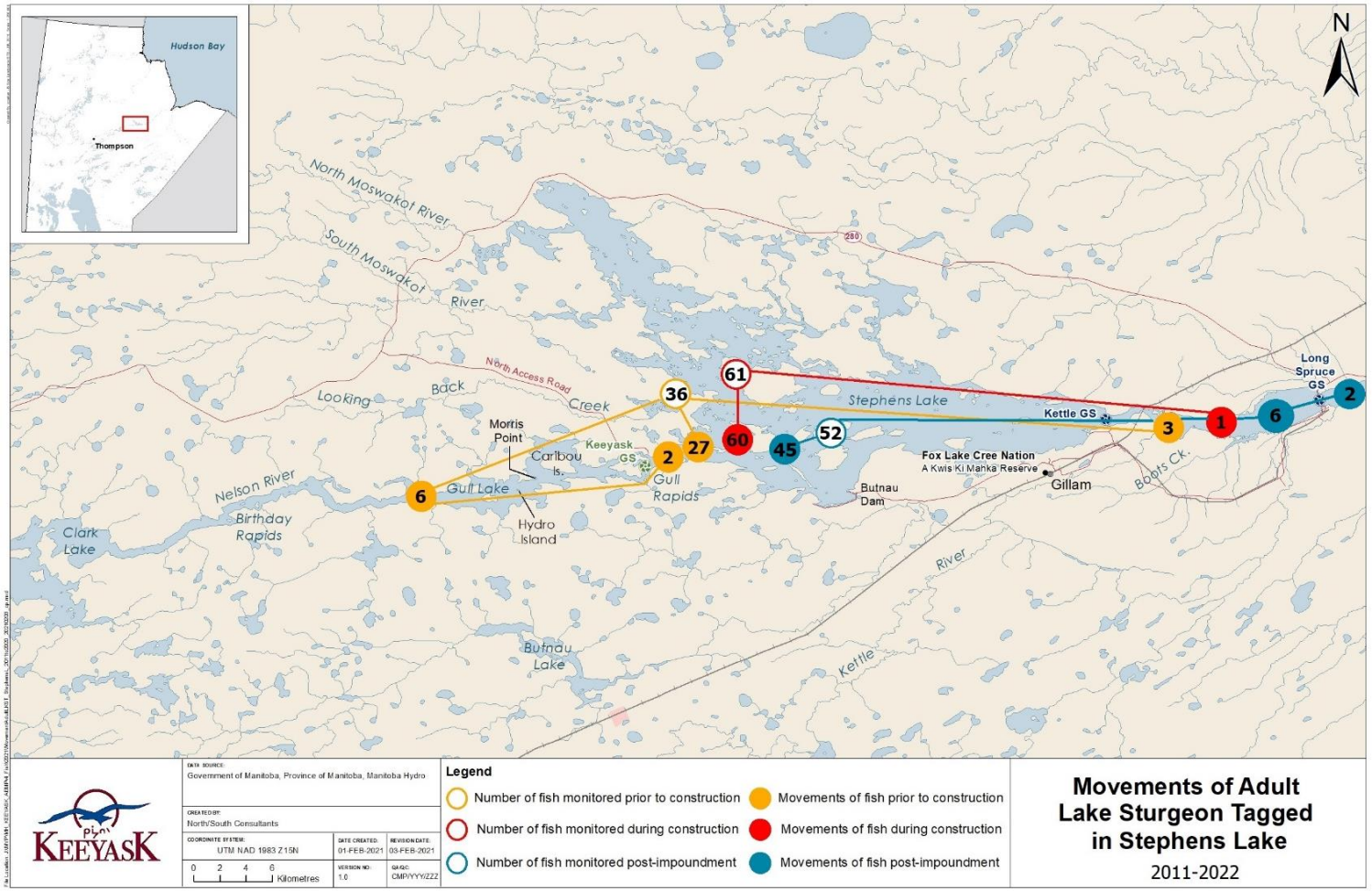


Figure 16: Map showing how many adult Lake Sturgeon stayed in Stephens Lake and moved downstream through the Kettle GS during before construction (yellow), during construction (red), and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected. Two fish moved upstream and then returned to Stephens Lake.

5.0 DISCUSSION

Adult Lake Sturgeon acoustic tracking was initiated in 2011 to describe movements during the pre-construction (2011–2013), construction/commissioning (2014–2021), and operation (2022 onward) phases of the Keeyask Project. The intent of the study was to determine if habitat changes associated with construction and operation of the GS would alter habitat use and coarse-scale movement patterns. The discussion below highlights movement patterns that have been observed and discusses the key questions (presented in the AEMP) with respect to potential impacts of construction and impoundment on adult Lake Sturgeon and their movements.

5.1 EVALUATION OF METHODOLOGY

Acoustic telemetry continues to be an effective method for monitoring movements and habitat use patterns of adult Lake Sturgeon in the Keeyask study area. During the 2022 open-water period, the majority of tagged fish remaining in the study area were located. Upstream of the Keeyask GS fish were detected for 38% of the 2022 open-water period (22–63% in previous years) and downstream in Stephens Lake fish were detected for 42% of the 2022 open-water period (34–77% in previous years). As a result of the frequency of detection in both Gull and Stephens lakes, a good understanding of coarse scale movement and habitat use patterns during the open-water period has been established.

5.2 KEY QUESTIONS

Commissioning of the Keeyask GS was completed in March 2022, when all powerhouse units became functional. Therefore, 2022 represents the first year of operation monitoring in both the Keeyask reservoir and Stephens Lake. Key questions identified in the AEMP are addressed below.

Will the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by Lake Sturgeon increase during operation of the Project?

Prior to impoundment of the Keeyask reservoir, movements through Gull Rapids (or the Keeyask GS construction site) were rare. In all pre-impoundment study years (2011–2020), only six fish moved downstream through Gull Rapids: two before construction began in 2014, and four after (figures 13 and 14). Six fish moved upstream through Gull Rapids, all prior to construction. The Keeyask GS spillway was commissioned in August 2018, after which upstream movement was no longer possible. The EIS predicted Lake Sturgeon may emigrate upstream or downstream away from the Keeyask reservoir in response to habitat disturbances associated with impoundment. Post-impoundment data indicate that the number of adult Lake Sturgeon that have moved downstream through the Keeyask GS has increased, beginning in 2021. During open-water 2021, 13 of 41 (32%) tagged adult Lake Sturgeon moved downstream

from the Keeyask reservoir into Stephens Lake, one of 13 (8%) moved during winter 2021/2022, and six of 34 (18%) moved during open-water 2022.

Mark-recapture data also suggest that the frequency of long-distance movement and entrainment at the Keeyask GS has increased. Prior to spring 2022, only a small proportion of fish recaptured in Stephens Lake (0–7%) were tagged in the Keeyask reservoir. In 2022, 47 fish captured in Stephens Lake (27% of all captures) were originally tagged in the Keeyask reservoir (Ambrose et al. 2023).

Movements upstream out of the Keeyask reservoir have also increased since impoundment. In 2021, only two fish (5% of all detected) moved upstream through Clark Lake past the receiver array. In 2022, nine (31%) moved upstream. Before construction began, two of the tagged fish (7%) moved from Gull Lake through Clark Lake, while twelve fish (19%) moved during construction. The increase was also reflected in Floy-tag recaptures from spring adult Lake Sturgeon population monitoring conducted in 2022 (Ambrose et al. 2023). Downstream of the Kelsey GS, 24% of previously tagged fish were last captured in Gull Lake (now the Keeyask reservoir). In previous years, fish from this area have represented between 0 and 10% of recaptured fish.

Movements downstream out of Stephens Lake also increased in 2022. Prior to construction, three fish tagged in Stephens Lake moved downstream through the Kettle GS. During construction a single fish moved downstream through the Kettle GS while two moved downstream through the Long Spruce GS. During the operation period, 14 fish moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through the Long Spruce GS. Eight fish that moved downstream through the Kettle GS (and five that moved through the Long Spruce GS) were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

Based on maximum likelihood estimates, the chance of an adult Lake Sturgeon moving out (upstream or downstream) of the area upstream of the Keeyask GS or out of Stephens Lake was considerably lower prior to (1.5%) and during (1.0%) construction than in the two years following impoundment (12.1%).

Are fish moving downstream past the GS and, if so, is there an indication that they have survived passage?

Thirteen adult Lake Sturgeon moved downstream past the GS in open-water 2021, one in October 2021, and six in open-water 2022. All fourteen fish that moved downstream in 2021 and three that moved downstream in 2022 displayed upstream and downstream movements within Stephens Lake, indicating they survived passage. Based on few detections in Stephens Lake, it is unclear whether or not three fish that moved downstream in open-water 2022 survived passage.

Fourteen adult Lake Sturgeon moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through

the Long Spruce GS. Based on upstream and downstream detections downstream of the GS, it appears that at least eight fish (57%) survived passage through the Kettle GS and at least two (29%) survived passage through the Long Spruce GS.

Will there be a change in the proportional distribution of adult Lake Sturgeon following reservoir creation (i.e., will there be a population level shift in distribution patterns following reservoir creation)?

Two zones immediately upstream and downstream of the Keeyask GS were added to the study area in 2022. Receiver gates were established 2.1 km upstream and 1.2 km downstream of the GS to monitoring movements near-to and through the GS. Fish tagged in the Keeyask reservoir spent little time in the area immediately upstream of the GS (5% of the study period). In contrast, fish in Stephens Lake regularly used the area immediately downstream of the GS (26% of the study period).

During the second full open-water period after reservoir impoundment, Lake Sturgeon tagged upstream of the GS spent less time in Gull Lake than in previous years. During the construction period (2014–2020), fish spent 78–88% of each open-water study period in Gull Lake (zones 4 and 5). In 2021, the fish that remained upstream of the GS spent 66% of the time in this area, while they only spent 40% of the 2022 open-water period in Gull Lake. Fish spent greater amounts of time in the middle Keeyask reservoir (Zone 3; 28%) and in Clark Lake (Zone 1; 30%) in 2022 than in any other open-water period.

In Stephens Lake, Lake Sturgeon continued to spend nearly equal amounts of time in the two zones closer to and farther from the GS. During the construction period (2014–2020), Lake Sturgeon spent 38–56% of the time in Zone 6 (closer to the GS) and 45–62% of the time in Zone 7 (farther from the GS). Following impoundment, fish spent 44–56% of the time in Zone 6 (zones 6.5 and 6 in 2022) and 49–56% of the time in Zone 7.

Are sturgeon congregating downstream of Birthday Rapids and the Keeyask GS during the spawning season or are they moving elsewhere?

Within the Keeyask reservoir, it was predicted in the EIS that habitat changes at Birthday Rapids following impoundment may make the area unsuitable for Lake Sturgeon spawning and that they may use Long Rapids as an alternative spawning area. Similar to other years, adult Lake Sturgeon were detected downstream of Birthday Rapids during the 2022 spawning period; 34% of tagged fish (ten of 29) were detected near the base of the rapids. Six of these fish made distinct upstream movements out of Gull Lake to Birthday Rapids between June 5 and 19, and it is likely that these movement were related to spawning. Three adult Lake Sturgeon were captured immediately downstream of Birthday Rapids during population monitoring studies in 2022 (Ambrose et al. 2023). In contrast, no Lake Sturgeon were captured downstream of Long Rapids. Five fish were detected immediately upstream of Birthday Rapids during the spawning period, these movements were brief and all five fish returned downstream within the same day. Together, this suggests that adult Lake Sturgeon have continued to spawn at Birthday Rapids in the second year following reservoir impoundment.

It was predicted in the EIS that Lake Sturgeon use of the river reach downstream of the Keeyask GS may change due to channeling flow through the GS and flow cycling. This might, in turn, lead to a loss of spawning habitat. In 2022, the Keeyask GS was fully operational during the spawning period (defined as June 5 to 19, 2022, based on water temperature). During this period, high water levels on the Nelson River necessitated the use of both the Keeyask spillway and powerhouse. Similar to other years, adult Lake Sturgeon were detected close to the GS during the spawning period; 76% of tagged fish (31 of 41) were detected within 0.7 to 1.2 km of the GS. Fish were detected both downstream of the spillway and powerhouse, with the majority of detections logged by the receiver on the south shore located 1.2 km downstream of the spillway (receiver #127093 by 28 fish). Two fish in spawning condition were captured downstream of the Keeyask GS during population monitoring studies; both were captured along the north shore downstream of the powerhouse on June 16 and 19 (Ambrose et al. 2023). Both fish were in pre-spawning condition indicating that the spawning period may have extended longer, however, no additional distinct movements to the Keeyask GS were observed. Together, this suggests Lake Sturgeon continue to use the area downstream of the Keeyask GS for spawning.

6.0 SUMMARY AND CONCLUSIONS

- Acoustic telemetry continues to be an effective method for monitoring adult Lake Sturgeon movement and habitat use. Movement monitoring is generally more effective during the open-water period relative to the winter period due to more locations where receivers can be effectively deployed. Adult Lake Sturgeon were detected for 63% of the 2021/2022 winter period and 38% of the 2022 open-water period upstream of the GS, and 59% of the winter period and 42% of the open-water period in Stephens Lake.
- Five new acoustic receivers were set within 2.1 km upstream of the Keeyask GS in 2022 to create a receiver "gate" to monitor movements near to and through the GS. An additional "gate" was created 1.2 rkm downstream of the GS.
- The key questions, as described in the AEMP, for adult Lake Sturgeon movement monitoring during operation of the Keeyask GS were as follows:
    - *Will the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by Lake Sturgeon increase during operation of the Project?*

      The number of long-distance downstream movements through the Keeyask GS increased during the post-impoundment period (i.e., 2021–2022). Prior to 2021, six adult Lake Sturgeon moved downstream through Gull Rapids/the Keeyask GS since studies began in 2011. Thirteen fish moved downstream through the Keeyask GS in 2021, one moved downstream in winter 2021/2022, and six moved downstream in open-water 2022.

      Movements out of Stephens Lake through the Kettle GS also increased in 2022. Three fish moved downstream through the Kettle GS before construction and one during construction. Two of these fish moved downstream through the Long Spruce GS during construction. During the operation period, 14 fish moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through the Long Spruce GS. Eight fish that moved downstream through the Kettle GS (and five that moved through the Long Spruce GS) were originally tagged upstream of the Keeyask GS and moved downstream into Stephens Lake in 2021.

      Based on maximum likelihood estimates, the chance of an adult Lake Sturgeon moving out (upstream or downstream) of the area upstream of the Keeyask GS or out of Stephens Lake was considerably lower prior to (1.5%) and during (1.0%) construction than in the two years following impoundment (12.1%).

The number of movements upstream out of the Keeyask reservoir also increased in 2022. Before construction began, two fish (7% of tagged fish) moved upstream from Gull Lake through Clark Lake, while twelve fish (19%) moved during construction. Two fish (5%) moved upstream through Clark Lake in 2021 while nine (31%) moved upstream in 2022.

- *Are fish moving downstream past the GS and, if so, is there an indication that they have survived passage?*

  Thirteen adult Lake Sturgeon moved downstream past the GS in open-water 2021, one in October 2021, and six in open-water 2022. All fourteen fish that moved downstream in 2021 and three that moved downstream in 2022 displayed upstream and downstream movements within Stephens Lake, indicating they survived passage. Based on few detections in Stephens Lake, it is unclear whether or not three fish that moved downstream in open-water 2022 survived passage.

  An additional 14 fish moved downstream through the Kettle GS, two in winter 2021/2022 and 12 during open-water 2022. Seven fish continued to move downstream through the Long Spruce GS. Based on upstream and downstream detections downstream of the GS, it appears that at least eight fish (57%) survived passage through the Kettle GS and at least two (29%) survived passage through the Long Spruce GS.

- *Will there be a change in the proportional distribution of adult Lake Sturgeon following reservoir creation (i.e., will there be a population level shift in distribution patterns following reservoir creation)?*

  Two zones immediately upstream and downstream of the Keeyask GS were added to the study area in 2022 to monitor movements near-to and through the GS. Fish tagged in the Keeyask reservoir spent little time in the area immediately upstream of the GS (5% of the study period) while fish in Stephens Lake regularly used the area immediately downstream of the GS (26% of the study period).

  Lake Sturgeon tagged upstream of the GS spent less time in Gull Lake than in previous years and more time in the middle Keeyask reservoir as well as in Clark Lake. In Stephens Lake, Lake Sturgeon continued to spend nearly equal amounts of time in the two zones closer to and farther from the GS.

- *Are sturgeon congregating downstream of Birthday Rapids and the Keeyask GS during the spawning season or are they moving elsewhere?*

  Similar to previous years, adult Lake Sturgeon were detected downstream of Birthday Rapids during the 2022 spawning period (defined as June 5 to 19, 2022, based on water temperature). Ten fish (34%) were detected near the base of the rapids during this time. Six of these fish made distinct upstream

movements out of Gull Lake to Birthday Rapids, and it is likely that these movement were related to spawning.

High water levels on the Nelson River meant that both the Keeyask GS spillway and powerhouse were operational during the spawning period in 2022. Adult Lake Sturgeon continued to be detected close to the GS during the spawning period in 2022, when 76% of fish (31 of 41) were detected within 0.7 to 1.2 km downstream. Fish were detected both downstream of the spillway and powerhouse, with the majority of detections logged on the south shore 1.2 km downstream of the spillway. Two fish in spawning condition were captured downstream of the Keeyask GS during population monitoring studies; both were captured along the north shore downstream of the powerhouse on June 16 and 19 (Ambrose et al. 2023). Both fish were in pre-spawning condition indicating that the spawning period may have extended longer, however, no additional distinct movements to the Keeyask GS were observed. Together, this suggests Lake Sturgeon continue to use the area downstream of the Keeyask GS for spawning.

- During the initial years of Project operation, the EIS predicted that increased numbers of Lake Sturgeon would leave the Keeyask reservoir (both upstream and downstream) leading to a decrease in population abundance. Movement monitoring using acoustic telemetry suggests that both upstream and downstream emigration has occurred. Prior to impoundment, six adult Lake Sturgeon moved downstream through Gull Rapids/the Keeyask GS since studies began in 2011. This number increased following reservoir impoundment: thirteen fish moved downstream through the Keeyask GS in 2021, one moved downstream in winter 2021/2022, and six moved downstream in open-water 2022. The number of movements upstream out of the Keeyask reservoir also increased in 2022. Before construction began, two fish (7% of tagged fish) moved upstream from Gull Lake through Clark Lake, while twelve fish (19%) moved during construction. Two fish (5%) moved upstream through Clark Lake in 2021 while nine (31%) moved upstream in 2022.
- The EIS also predicted that habitat alterations would lead to a decrease in attraction and use of spawning habitat at Birthday Rapids and fish might move upstream to Long Rapids. Although there has been a reduction in the amount of white water present, water velocities have remained high and ten fish were detected downstream of Birthday Rapids during the 2022 spawning period. There was no evidence that fish moved upstream to Long Rapids. Similarly, the EIS predicted that Lake Sturgeon use of the river reach downstream of the Keeyask GS may change due to channeling flow through the GS and flow cycling. This might, in turn, lead to a loss of spawning habitat. However, adult Lake Sturgeon were detected close to the GS during the spawning period in 2022, and 76% of fish (n = 31) were detected within 0.7 to 1.2 km downstream. Fish were detected both downstream of the spillway and powerhouse,

with the majority of detections logged on the south shore 1.2 km downstream of the spillway. Both the spillway and powerhouse were operational during this time.

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APPENDICES

APPENDIX 1: DETECTION SUMMARIES FOR LAKE STURGEON TAGGED AND MONITORED BETWEEN 2011 AND 2022

Table A1-1: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored in Stephens Lake during the winter 2011/2012 (October 20, 2011 to April 30, 2012), 2012/2013 (October 16, 2012 to April 30, 2013), 2013/2014 (October 16, 2013 to April 30, 2014), 2014/2015 (October 13, 2014 to April 30, 2015), 2015/2016 (October 12, 2015 to April 30, 2016), 2016/2017 (October 20, 2015 to April 30, 2017), 2017/2018 (October 17, 2017 to April 30, 2018), 2018/2019 (October 11, 2018 to April 30, 2019), 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021), and 2021/2022 (October 11, 2021 to May 15, 2022) periods. Tag ID highlighted green = moved upstream over Gull Rapids and harvested. Tag ID highlighted blue = moved upstream over Gull Rapids. Tag ID highlighted yellow = lost tags. Tag ID highlighted red = moved downstream through Kettle GS. Tag ID highlighted purple = moved downstream through Gull Rapids/the Keeyask GS. Tag ID highlighted orange = moved downstream through Long Spruce GS.

Tag ID	2012/2013			2013/2014			2014/2015			2015/2016			2016/2017			2017/2018		
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)
16019	887	39	0.6	2959	33	8.8	8761	79	2.8	14035	107	13.3	34307	144	8.7	49386	193	8.7
16020	3625	25	9.5	24335	102	8.8	6183	36	7.2	36598	188	7.2	40522	181	8.7	43215	188	8.7
16022	1227	15	9.5	7508	83	4.1	10649	55	7.2	45870	197	7.2	21329	149	5.1	32696	193	5.1
16026	0	-	-	0	-	-	0	-	-	811	3	0.0	0	-	-	0	-	-
16027	3398	70	4.3	2111	24	1.6	23369	120	2.8	50070	189	13.3	17718	175	4.2	32484	177	5.1
16028	733	7	9.5	2123	8	14.9	21803	84	2.8	59177	199	2.5	5377	104	5.1	52456	184	5.1
16031	7414	26	3.8	45513	147	0.0	36654	117	0.0	58954	198	0.0	537	26	0.0	40104	140	6.5

Tag ID	2018/2019			2019/2020			2020/2021			2021/2022				
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16019	46504	201	0.0	46896	196	30.9	4557	144	8.5	11909	183	3.9	16.1	12.2
16020	42253	177	8.7	41964	199	8.7	24533	155	8.3	41731	202	5.4	16.1	10.7
16022	51590	195	5.1	0	-	-	41855	203	14.9	28577	206	5.4	13.4	8.0
16026	0	-	-	0	-	-	547	23	0.0	1233	24	3.9	5.9	2.0
16027	35350	188	5.1	26437	164	2.7	20881	138	9.5	51207	202	3.9	10.2	6.3
16028	79145	202	0.0	54606	167	5.1	22223	105	12.2	185	11	16.3	32.5	16.2
16031	14016	92	3.6	34404	129	8.3	54753	210	14.9	5259	44	7.8	18.8	11.0

Table A1-2: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the winter 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021) and 2021/2022 (October 11, 2021 to May 15, 2022) periods. Tag ID highlighted red = moved downstream through Kettle GS. Tag ID highlighted purple = moved downstream through the Keeyask GS.

Tag ID	2019/2020					2020/2021					2021/2022				
	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7017	24444	174	-10.3	-10.3	0.0	21752	152	-12.9	-10.1	-2.8	1856	15	3.9	45.7	41.8
7018	1121	19	-12.4	-10.3	2.1	18248	148	-19.5	-10.1	-9.4	9898	82	-26.4	-7.9	18.5
7019	2600	35	-12.4	-10.3	2.1	19171	170	-12.9	-7.9	-5.0	27765	190	-19.5	-7.9	11.6
7020	607	21	-12.4	-12.4	0.0	11929	122	-7.9	-7.9	0.0	34460	191	3.9	16.1	12.2
7021	25206	79	-29.4	-29.4	0.0	22928	95	-29.3	-29.3	0.0	23986	170	13.4	18.8	5.4
7022	456	2	-29.4	-29.4	0.0	-	-	-	-	-	-	-	-	-	-
7023	8685	70	-10.3	-10.3	0.0	26264	191	-12.9	-10.1	-2.8	33022	171	-12.9	-10.1	2.8
7024	27181	168	-10.3	-10.3	0.0	19880	107	-29.3	-7.9	-21.4	458	3	32.5	32.5	0.0
7025	3	1	-12.4	-12.4	0.0	3586	68	-12.9	-12.4	-0.5	1762	28	10.2	24.9	14.7
7026	2214	41	-12.4	-12.4	0.0	9317	174	-10.1	-10.1	0.0	46716	177	3.9	8.7	4.8
7027	11820	105	-10.3	-10.3	0.0	22856	174	-12.9	-2.2	-10.7	21889	161	3.9	32.5	28.6
7028	28985	177	-10.3	-10.3	0.0	25217	128	-12.4	-10.1	-2.3	58972	205	3.9	18.8	14.9
7029	99	18	-10.3	-10.3	0.0	7059	121	-12.9	-10.1	-2.8	-	-	-	-	-
7030	8152	60	-10.3	-10.3	0.0	8291	122	-12.9	-7.9	-5.0	2181	20	8.7	45.7	37.0
7031	27053	148	-10.3	-10.3	0.0	41670	199	-17.4	-10.1	-7.3	-	-	-	-	-
7032	8394	63	-10.3	-10.3	0.0	3671	110	-10.1	-10.1	0.0	30724	158	3.9	18.8	14.9
7033	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7034	0	-	-	-	-	44744	218	-19.5	-7.9	-11.6	18930	100	3.9	16.1	12.2
7053	219	13	-12.4	-10.3	2.1	8571	123	-12.9	-10.1	-2.8	-	-	-	-	-
7056	688	27	-12.4	-12.4	0.0	13204	160	-12.9	-10.1	-2.8	-	-	-	-	-
7059	852	14	-12.4	-10.3	2.1	17168	210	-12.9	-10.1	-2.8	24652	135	-26.4	-7.9	18.5
7061	0	-	-	-	-	213	22	-7.9	-7.9	0.0	-	-	-	-	-
7064	696	37	-12.4	-10.3	2.1	17306	166	-12.9	-10.1	-2.8	18132	125	-19.5	-7.9	11.6
7065	67	11	-10.3	-10.3	0.0	22991	203	-12.4	-10.1	-2.3	15719	116	-12.9	-10.1	2.8
7066	959	39	-12.4	-10.3	2.1	18176	170	-12.9	-10.1	-2.8	7979	68	3.9	10.2	6.3
7067	19911	124	-10.3	-10.3	0.0	15384	139	-12.9	-7.9	-5.0	-	-	-	-	-

Table A1-3: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored in Stephens Lake during the winter 2019/2020 (October 8, 2019 to April 30, 2020), 2020/2021 (September 24, 2020 to April 30, 2021) and 2021/2022 (October 11, 2021 to May 15, 2022) period.

Tag ID	2019/2020					2020/2021					2021/2022				
	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7035	5505	54	5.2	5.8	0.6	12401	74	3.9	8.7	4.8	43021	189	3.9	13.4	9.5
7036	15525	114	5.2	10.3	5.1	40691	209	3.9	10.2	6.3	30186	190	3.9	18.8	14.9
7037	49403	202	5.2	10.3	5.1	41308	194	3.9	10.2	6.3	-	-	-	-	-
7038	28537	127	5.2	7.9	2.7	17429	114	3.9	10.2	6.3	10660	84	3.9	10.2	6.3
7039	0	-	-	-	-	18757	79	3.9	7.8	3.9	59182	208	3.9	10.2	6.3
7040	40531	190	5.2	13.9	8.7	49504	211	3.9	18.8	14.9	46575	206	3.9	16.1	12.2
7041	14379	84	5.2	13.9	8.7	26800	102	3.9	10.2	6.3	2944	34	3.9	18.8	14.9
7042	22913	131	13.9	16.8	2.9	40897	182	13.4	13.4	0.0	3303	76	13.4	16.1	2.7
7043	34656	202	7.9	10.3	2.4	69934	219	3.9	10.2	6.3	19779	152	10.2	22.0	11.8
7044	31446	178	5.2	9.4	4.2	51876	163	3.9	7.8	3.9	21949	117	3.9	10.2	6.3
7045	24721	118	5.2	7.9	2.7	11341	135	3.9	7.8	3.9	6443	46	3.9	5.9	2.0
7046	0	-	-	-	-	98	16	3.9	3.9	0.0	51836	210	3.9	18.8	14.9
7047	24191	165	7.9	10.3	2.4	53403	204	3.9	10.2	6.3	53319	209	3.9	10.2	6.3
7048	40541	160	5.2	13.9	8.7	46907	192	3.9	8.7	4.8	32741	203	3.9	16.1	12.2
7049	33043	177	5.2	13.9	8.7	68196	213	10.2	16.1	5.9	22928	166	3.9	18.8	14.9
7050	24998	152	5.2	18.6	13.4	4630	160	3.9	10.2	6.3	9384	158	3.9	18.8	14.9
7051	18711	120	5.2	13.9	8.7	46586	205	3.9	10.2	6.3	5933	130	10.2	32.5	22.3
7052	36882	196	5.2	36.1	30.9	4836	145	3.9	13.4	9.5	12550	190	3.9	13.4	9.5
7054	26409	175	5.2	9.4	4.2	7666	168	10.2	13.4	3.2	44	5	3.9	3.9	0.0
7055	36130	192	5.2	10.3	5.1	43461	203	3.9	10.2	6.3	12207	106	3.9	7.8	3.9
7057	36308	203	5.2	10.3	5.1	32930	199	3.9	10.2	6.3	50278	212	3.9	13.4	9.5
7058	30636	159	7.9	18.6	10.7	28970	183	10.2	18.8	8.6	23036	182	3.9	24.9	21.0
7060	30137	184	5.2	10.3	5.1	39966	211	3.9	8.7	4.8	12071	86	3.9	10.2	6.3
7062	987	21	5.2	9.4	4.2	8213	50	3.9	8.7	4.8	17206	91	3.9	8.7	4.8
7063	4	1	5.2	5.2	0.0	18786	90	3.9	8.7	4.8	9599	65	3.9	13.4	9.5

Table A1-4: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored in Stephens Lake during the open-water 2011 (June 1 to October 20), 2012 (May 1 to October 16), 2013 (May 1 to October 16), 2014 (May 1 to October 13), 2015 (May 1 to October 11), 2016 (May 1 to October 19), 2017 (May 1 to October 16), 2018 (May 1 to October 10), 2019 (May 1 to October 7), 2020 (May 1 to September 23),), 2021 (May 1 to October 10), and 2022 (May 16 to October 10) periods. Tag ID highlighted purple = moved downstream through Gull Rapids/the Keeyask GS.

Tag ID	2011			2012			2013			2014			2015			2016			2017		
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)
16019	0	-	-	9272	70	26.9	15039	116	18.2	13297	76	39.5	20832	129	27.0	17331	117	22.3	18192	117	17.4
16020	0	-	-	7450	101	11.9	13664	99	14.2	8592	111	19.7	25808	137	19.7	29291	155	17.4	19304	150	23.5
16022	0	-	-	9845	100	16.0	7248	71	20.5	10957	101	20.5	18858	127	16.1	12608	124	22.3	13393	120	17.4
16026	-	-	-	23195	83	9.4	12588	83	0.0	13090	103	0.0	29896	103	7.3	28343	128	7.3	18137	119	14.6
16027	0	-	-	8249	87	16.0	15717	109	14.4	10960	72	9.7	14083	114	13.6	22348	148	9.0	22812	125	9.1
16028	0	-	-	9063	92	16.3	98	8	3.7	6174	58	17.4	16344	108	17.7	19657	109	12.7	29657	142	15.6
16031	0	-	-	12814	104	16.3	10315	106	14.4	12775	99	13.6	17780	125	13.6	18745	141	15.6	14795	131	12.7

Tag ID	2018			2019			2020			2021			2022				
	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16019	19589	99	20.4	17756	128	24.1	9491	89	17.6	6741	73	24.1	1774	18	0.7	10.2	9.5
16020	13674	104	34.9	8865	97	35.5	9754	105	17.4	4500	58	31.2	3843	21	0.7	9.7	9.0
16022	19908	126	17.4	17340	141	24.1	12292	96	17.6	16817	104	18	2919	23.0	1.2	18.8	17.6
16026	29052	129	7.3	15615	107	4.7	5031	44	23.9	1303	17	24.2	2742	19	0.7	14.4	13.7
16027	14092	119	17.4	16367	142	9.7	3342	42	17.6	8757	79	18.0	5254	27	1.2	10.2	9.0
16028	22350	126	17.4	16146	125	24.1	7884	76	15.6	11565	89	18.0	2	1	30.7	30.7	0.0
16031	19537	128	17.4	10698	123	18.0	5722	71	30.8	13805	132	18.0	3380	15	1.2	13.4	12.2

Table A1-5: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the 2019 (June 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to October 10 open-water periods. Tag ID highlighted purple = moved downstream through the Keeyask GS. Tag ID highlighted red = moved downstream through Kettle GS. Tag ID highlighted orange = moved downstream through Long Spruce GS.

Tag ID	2019					2020					2021					2022				
	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)
7017	10934	113	-46.9	-9.9	37.0	5650	72	-29.3	-9.9	19.4	9619	78	-33.9	1.3	35.2	-	-	-	-	-
7018	8505	88	-46.9	-9.9	37.0	6403	72	-17.4	-3.8	13.6	21136	137	-48.2	-2.2	46.0	2909	27	-34.3	-2.1	32.2
7019	9944	102	-19.5	-7.4	12.1	6530	72	-19.5	-5.8	13.7	24954	150	-33.9	-2.2	31.7	12855	103	-19.5	14.4	33.9
7020	11960	94	-24.7	-4.8	19.9	3797	59	-15	-3.8	11.2	7291	53	-48.2	13.2	61.4	3957	41	1.2	65.3	64.1
7021	7937	51	-33.8	-26.5	7.3	10778	71	-34.3	-26.4	7.9	9160	72	-33.9	32	65.9	3547	33	3.8	45.1	41.3
7022	22714	105	-33.8	-24.7	9.1	7286	46	-48.2	-26.4	21.8	7566	40	-48.2	-7.7	40.5	-	-	-	-	-
7023	7212	82	-33.8	-9.9	23.9	3849	84	-17.4	-9.9	7.5	14268	150	-29.3	-2.5	26.8	13354	129	-19.5	-2.1	17.4
7024	6599	80	-33.8	-9.9	23.9	5966	84	-33.8	-2.2	31.6	6973	52	-48.2	24.9	73.1	-	-	-	-	-
7025	17574	114	-46.9	-9.9	37.0	10765	90	-17.4	-9.9	7.5	6099	45	-17.4	5.4	22.8	1444	11	41.7	65.3	23.6
7026	6780	46	-46.9	-9.9	37.0	3840	52	-29.4	-8.9	20.5	15026	97	-34.3	13.4	47.7	6880	43	2.7	65.3	62.6
7027	10611	112	-19.5	-9.9	9.6	12281	69	-19.5	-6.2	13.3	13205	91	-24.2	18.8	43.0	9003	78	0.7	58.6	57.9
7028	18216	108	-19.5	-9.9	9.6	10967	96	-17.4	-8.9	8.5	9251	55	-22.6	18.8	41.4	5360	24	0.7	7.8	7.1
7029	7705	94	-19.5	-9.9	9.6	7584	67	-19.5	-9.9	9.6	11026	79	-48.2	-2.2	46.0	-	-	-	-	-
7030	6345	100	-19.5	-9.9	9.6	5911	72	-19.5	-8.9	10.6	10693	91	-19.5	24.9	44.4	-	-	-	-	-
7031	18594	117	-19.5	-4.8	14.7	9560	92	-19.5	-5.8	13.7	6325	49	-12.9	3.9	16.8	293	18	4.5	4.5	0.0
7032	9883	114	-19.5	-4.8	14.7	3024	55	-19.5	-9.9	9.6	4122	37	-24.2	-2.2	22.0	1308	30	0.7	65.3	64.6
7033	18839	116	-12.5	-4.8	7.7	1428	16	-48.2	-4.8	43.4	0	-	-	-	-	-	-	-	-	-
7034	13573	98	-29.4	-4.8	24.6	10215	69	-17.4	-3.8	13.6	6008	66	-48.2	24.9	73.1	47737	131	0.7	12	11.3
7053	8500	106	-19.5	-9.9	9.6	5183	70	-19.5	-9.9	9.6	2426	29	-48.2	-17.4	30.8	-	-	-	-	-
7056	4253	89	-19.5	-9.3	10.2	3597	71	-19.5	-8.9	10.6	7633	54	-34.3	-2.2	32.1	-	-	-	-	-
7059	9639	97	-19.5	-9.3	10.2	18696	102	-17.4	-9.9	7.5	27824	142	-48.2	-2.2	46.0	8232	74	-34.3	-0.8	33.5
7061	12007	93	-29.4	-4.8	24.6	11986	71	-8.9	-2.2	6.7	1713	33	-24.2	7.5	31.7	-	-	-	-	-
7064	13665	104	-33.8	-9.9	23.9	5783	62	-29.4	-9.9	19.5	13837	106	-48.2	-2.2	46.0	9269	52	-24.2	-0.3	23.9
7065	7891	107	-24.7	-9.9	14.8	6776	60	-19.5	-9.9	9.6	16700	145	-34.3	-3.8	30.5	10366	132	-29.3	-2.1	27.2
7066	12321	108	-19.5	-9.3	10.2	8428	81	-29.4	-9.9	19.5	5690	47	-29.3	0.8	30.1	7232	55	0.7	18.2	17.5
7067	8705	109	-19.5	-5.8	13.7	10238	78	-15	-6.2	8.8	9054	68	-48.2	-2.2	46.0	883	12	-48.2	-33.8	14.4

Table A1-5: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the 2019 (June 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to October 10 open-water periods. Tag ID highlighted purple = moved downstream through the Keeyask GS (continued).

Tag ID	2019					2020					2021					2022				
	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)
57478	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3302	3302	-26.4	0.7	27.1
57479	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9505	9505	-32.2	0.7	32.9
57480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5391	5391	-33.9	-0.8	33.1
57481	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4743	4743	-26.4	-5.8	20.6
57482	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6800	6800	-48.2	-7.8	40.4
57483	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2467	2467	-48.2	-9.9	38.3
57484	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3742	3742	-34.3	-26.4	7.9
57485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1371	1371	-48.2	-19.5	28.7
57486	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1183	1183	-48.2	-9.9	38.3
57487	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1970	1970	-48.2	-9.9	38.3
57488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2303	2303	-48.2	-24.2	24.0
57489	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18516	18516	-33.9	-2.1	31.8
57490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18579	18579	-34.3	-26.4	7.9
57491	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2547	2547	-48.2	-0.8	47.4
57492	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5404	5404	-48.2	-24.2	24.0
57494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9928	9928	-33.9	-24.2	9.7
57495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6355	6355	-33.9	24.9	58.8
57502	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2743	2743	-46.9	10.2	57.1
57504	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6159	6159	-24.2	-5.8	18.4
57505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2905	2905	-48.2	-26.4	21.8
57506	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14601	14601	-34.3	1.2	35.5
57507	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1650	1650	-48.2	-26.4	21.8

Table A1-6: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored in Stephens Lake during the 2019 (June 1 to October 7), 2020 (May 1 to September 23), 2021 (May 1 to October 10), and 2022 (May 16 to October 10) open-water periods. Tag ID highlighted red = moved downstream through Kettle GS. Tag ID highlighted orange = moved downstream through Long Spruce GS.

Tag ID	2019					2020					2021					2022				
	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)	n	# Days Detected	U/S (rkm)	D/S (rkm)	Range (rkm)
7035	19933	119	0.6	10.3	9.7	8021	77	1.2	13.4	12.2	14453	92	0.8	13.4	12.6	13067	119	0.7	41.7	41.0
7036	19903	109	0.6	10.3	9.7	12401	102	2.7	9.4	6.7	16310	135	0.8	18.8	18.0	2984	19	0.7	8.7	8.0
7037	21304	127	1.2	18.6	17.4	8027	68	0.6	18.8	18.2	15981	100	0.8	18.8	18.0	-	-	-	-	-
7038	12726	78	0.6	10.3	9.7	12491	75	0.6	13.0	12.4	6743	62	0.8	24.9	24.1	4290	50	0.7	45.1	44.4
7039	10752	109	0.6	18.6	18.0	4523	69	0.6	18.8	18.2	11024	118	0.8	18.8	18.0	12364	96	1.2	30.7	29.5
7040	5823	89	0.6	18.6	18.0	7485	78	0.6	18.8	18.2	10448	73	0.8	13.4	12.6	11506	99	0.7	41.7	41.0
7041	20381	108	0.6	18.6	18.0	7261	77	1.2	18.8	17.6	12094	75	0.8	18.8	18.0	9647	92	0.7	30.7	30.0
7042	18735	119	0.6	18.6	18.0	10964	98	0.6	16.8	16.2	13836	116	0.8	18.8	18.0	7064	83	0.7	30.7	30.0
7043	3795	22	3.9	18.6	14.7	12258	100	1.2	18.8	17.6	15588	119	0.8	40.9	40.1	7352	86	2.7	24.9	22.2
7044	10107	94	0.6	18.6	18.0	8483	73	1.2	24.7	23.5	12893	94	0.8	18.8	18.0	7267	50	1	24.9	23.9
7045	5079	23	0.6	13.9	13.3	8293	87	0.6	18.6	18.0	5958	44	0.8	18.8	18.0	23139	124	3.8	24.9	21.1
7046	4188	22	1.2	7.9	6.7	10581	86	0.6	9.4	8.8	6506	56	0.8	24.9	24.1	7496	51	0.7	21.7	21.0
7047	11770	101	1.2	13.9	12.7	12139	92	1.2	13.4	12.2	11354	108	0.8	18.8	18.0	12256	105	0.7	30.7	30.0
7048	19411	107	1.2	13.9	12.7	21325	110	0.6	13.4	12.8	13644	98	0.8	18.8	18.0	14557	110	0.7	30.7	30.0
7049	17017	113	0.6	18.6	18.0	7696	100	2.7	24.9	22.2	11804	105	0.8	32.0	31.2	13254	127	4.1	30.7	26.6
7050	20573	116	0.6	13	12.4	10323	80	0.6	16.1	15.5	11679	114	0.8	18.8	18.0	6622	43	0.7	41.7	41.0
7051	13163	108	0.6	18.6	18.0	12468	75	0.6	18.8	18.2	19401	100	0.8	18.8	18.0	5133	40	0.7	65.3	64.6
7052	16243	106	0.6	24.7	24.1	8029	92	1.2	18.8	17.6	7819	74	0.8	24.9	24.1	3415	56	0.7	65.3	64.6
7054	30588	96	0.6	18.6	18.0	22518	109	1.2	18.8	17.6	18679	96	0.8	24.9	24.1	9123	49	0.7	10.2	9.5
7055	18411	112	0.6	10.3	9.7	11888	97	1.2	18.8	17.6	15312	119	0.8	24.9	24.1	7792	95	0.7	30.7	30.0
7057	27099	110	0.6	10.3	9.7	15469	92	1.2	18.8	17.6	8878	86	0.8	24.9	24.1	29941	116	0.7	24.9	24.2
7058	13394	113	0.6	18.6	18.0	6453	101	0.6	18.8	18.2	6086	56	0.8	18.8	18.0	6932	45	2.7	38.4	35.7
7060	16679	120	0.6	10.3	9.7	17039	85	0.6	10.3	9.7	27580	127	0.8	10.2	9.4	8367	71	1.2	24.9	23.7
7062	27646	122	0.6	10.3	9.7	10919	90	1.2	8.7	7.5	8520	48	0.8	18.8	18.0	33437	118	0.7	30.7	30.0
7063	27802	111	0.6	10.3	9.7	9448	85	0.6	13.4	12.8	10433	91	0.8	18.8	18.0	8571	100	1.2	18.2	17.0

APPENDIX 2:
LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, STEPHENS LAKE, JUNE 2011 TO OCTOBER 2022

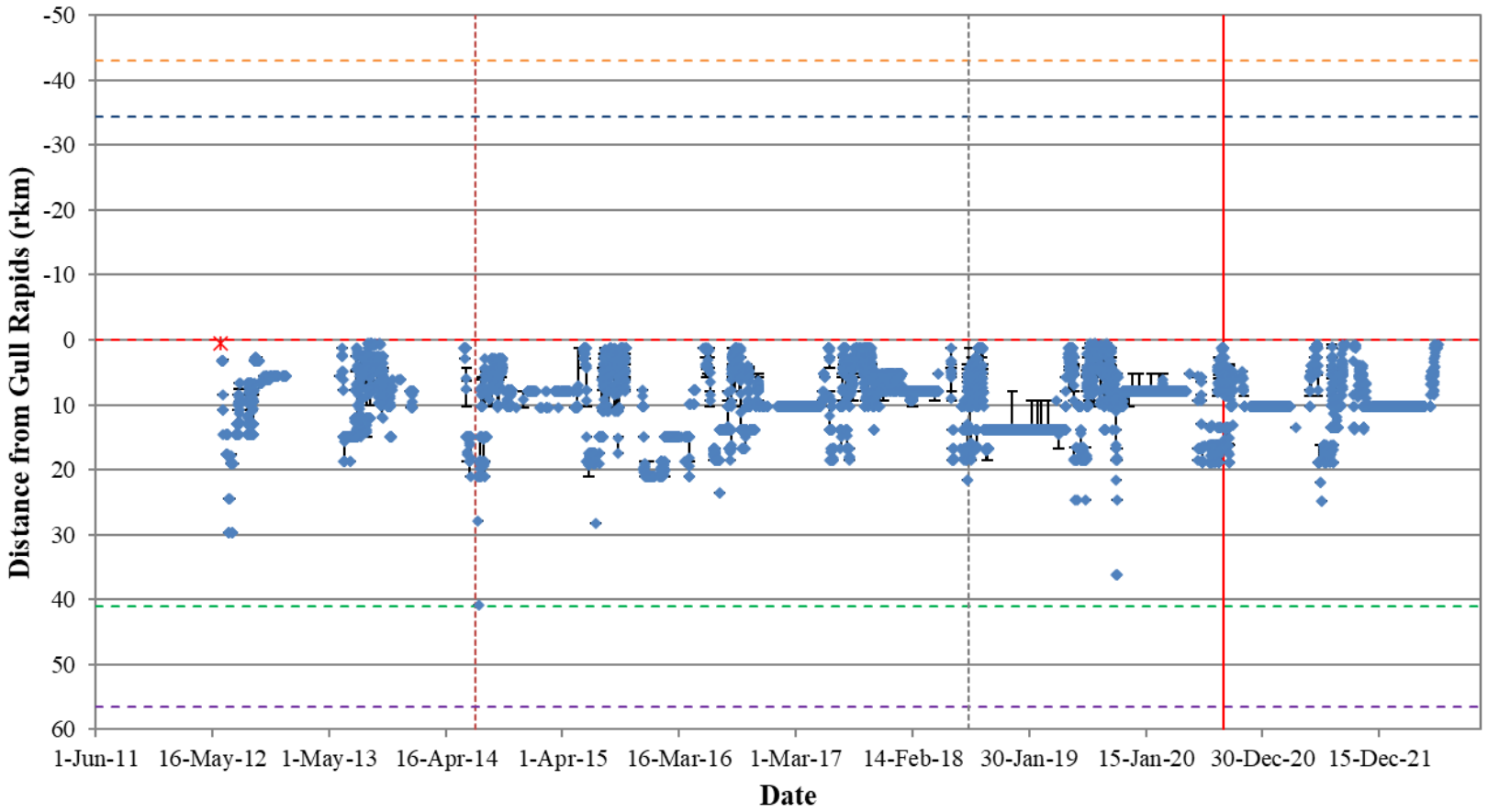

Figure A2-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

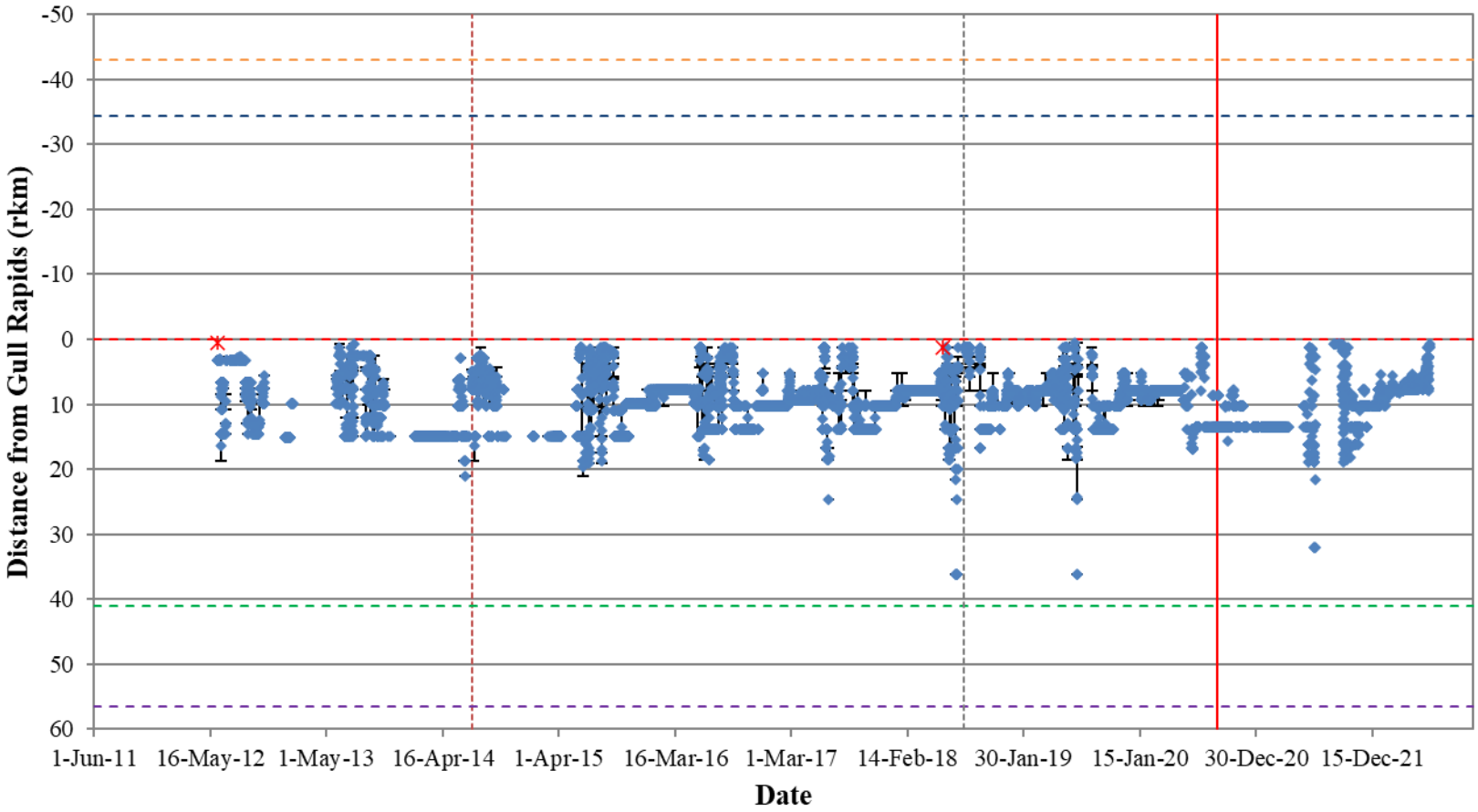

Figure A2-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16020) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

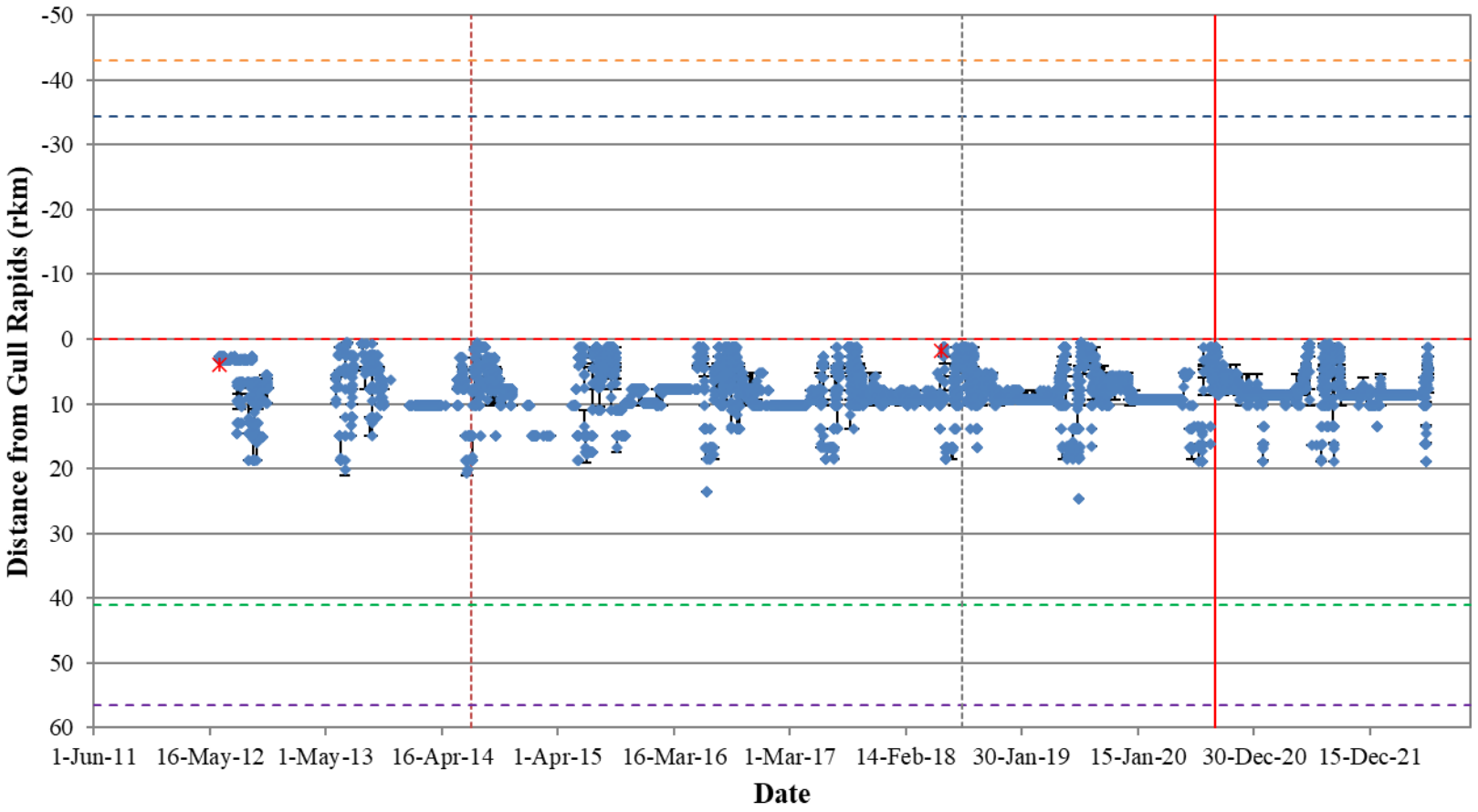

Figure A2-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

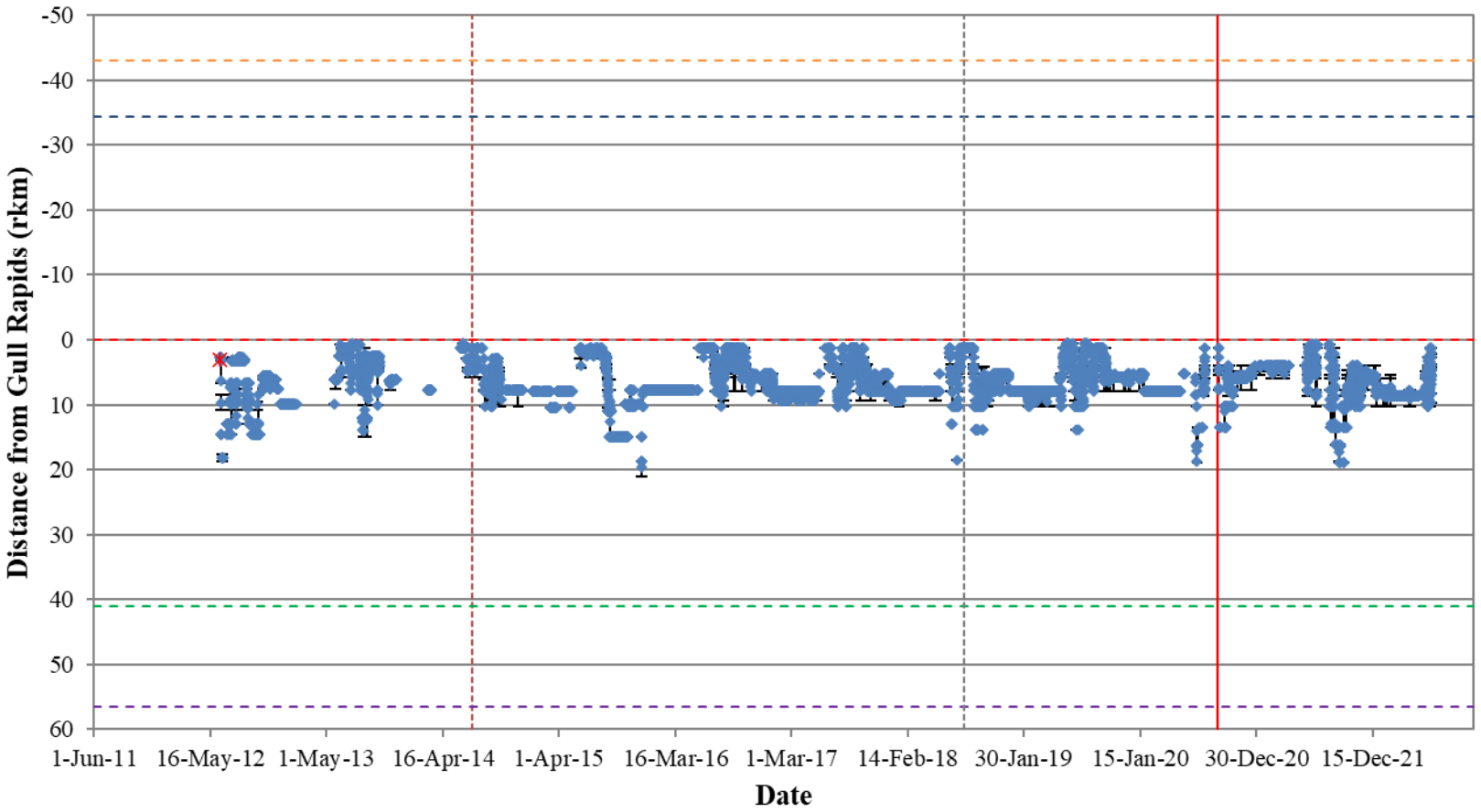

Figure A2-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16027) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

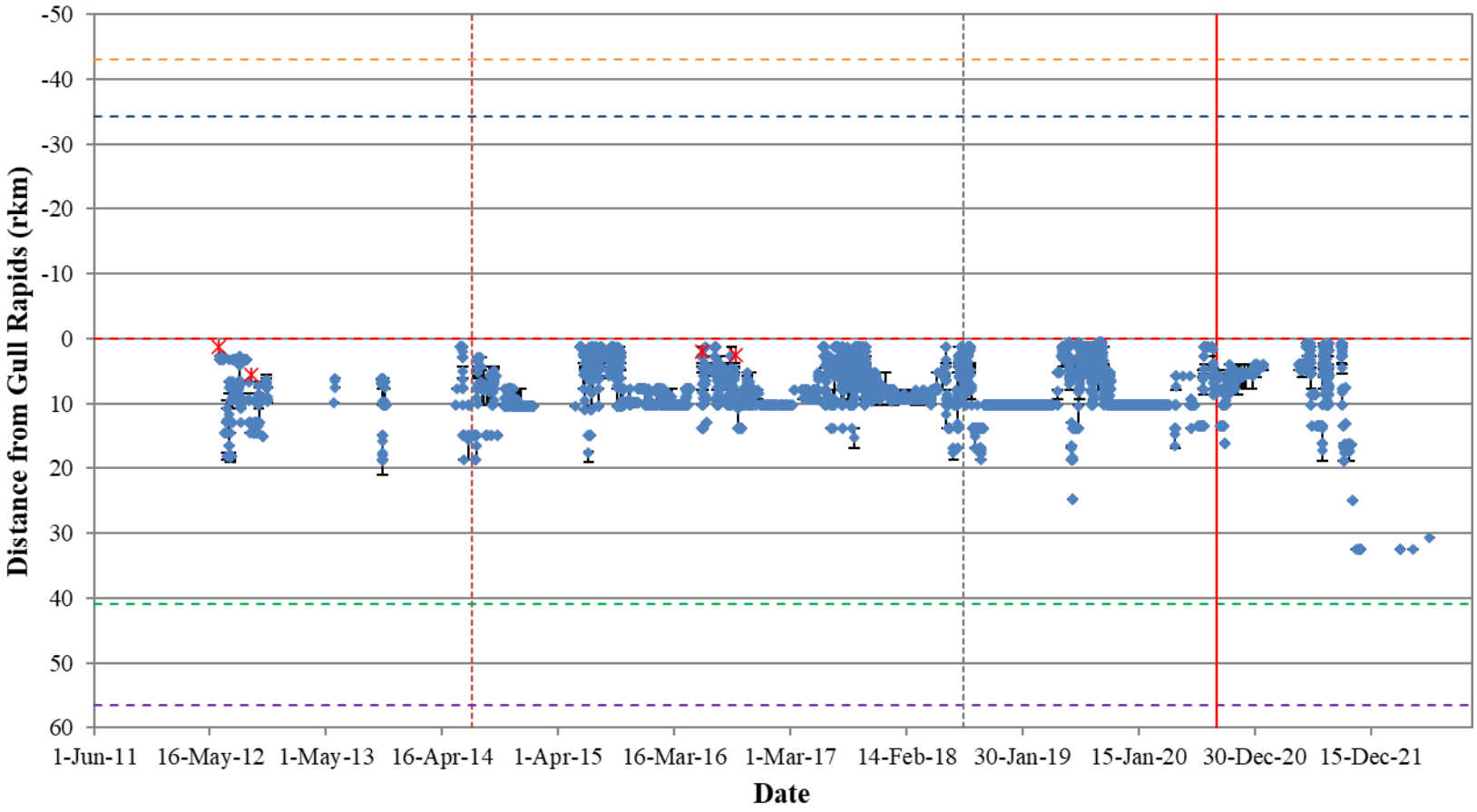

Figure A2-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16028) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

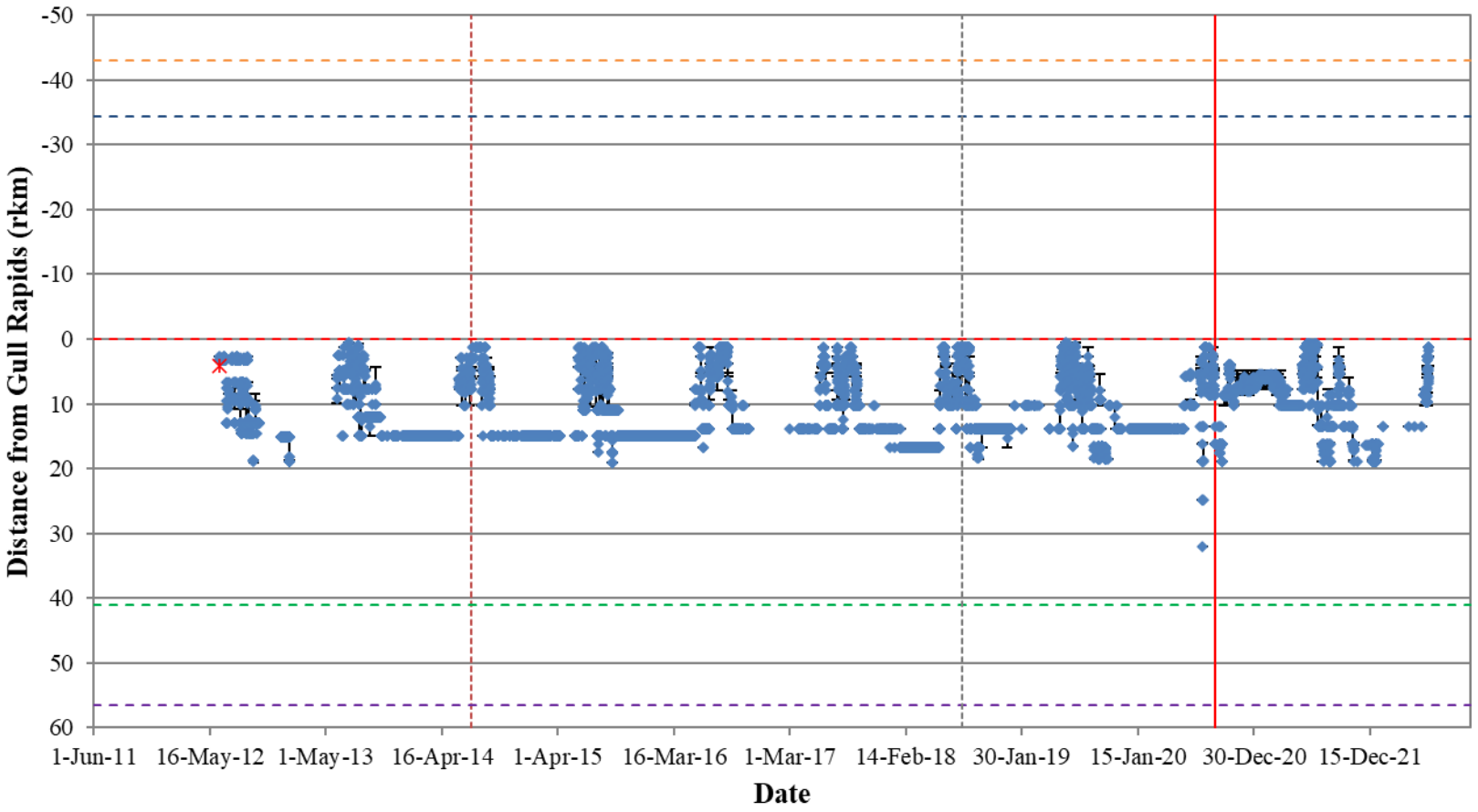

Figure A2-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16031) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to October 10, 2022. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical dotted red line, beginning of spillway commissioning is indicated with a vertical dotted grey line, and end of reservoir impoundment is indicated with a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids, red = the Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 3:
LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF THE KEEYASK GS, MAY 2019 TO OCTOBER 2022

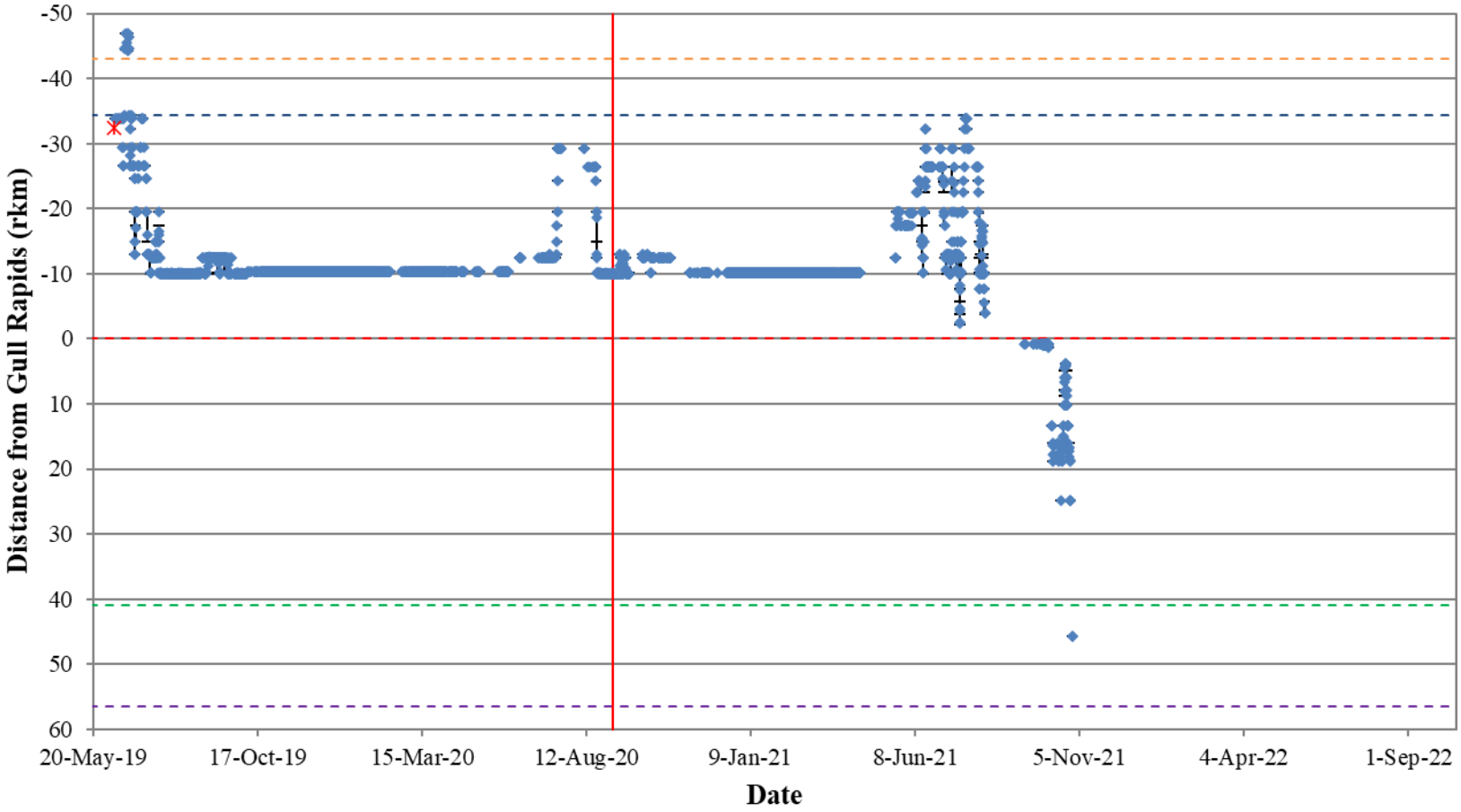

Figure A3-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7017) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

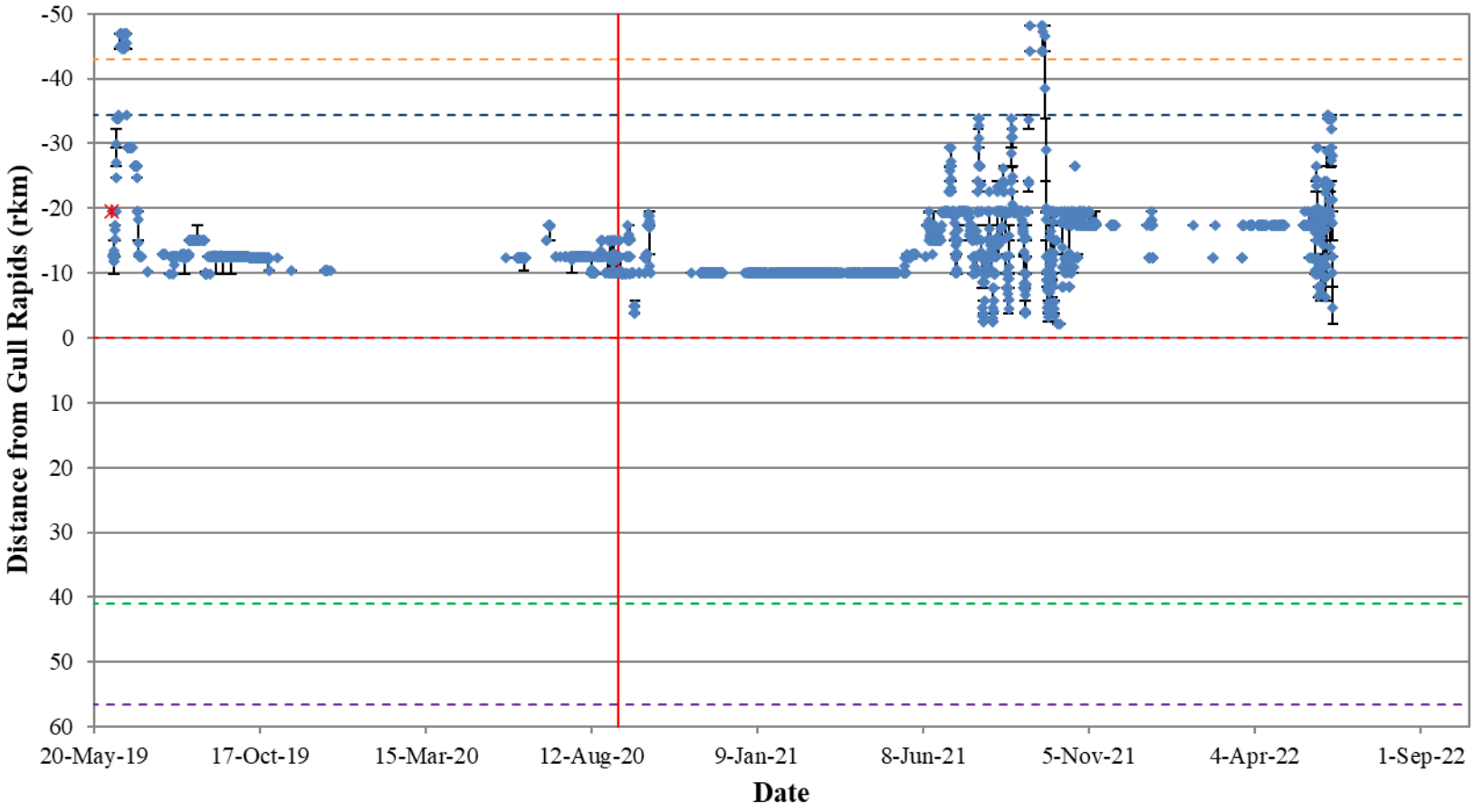

Figure A3-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7018) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

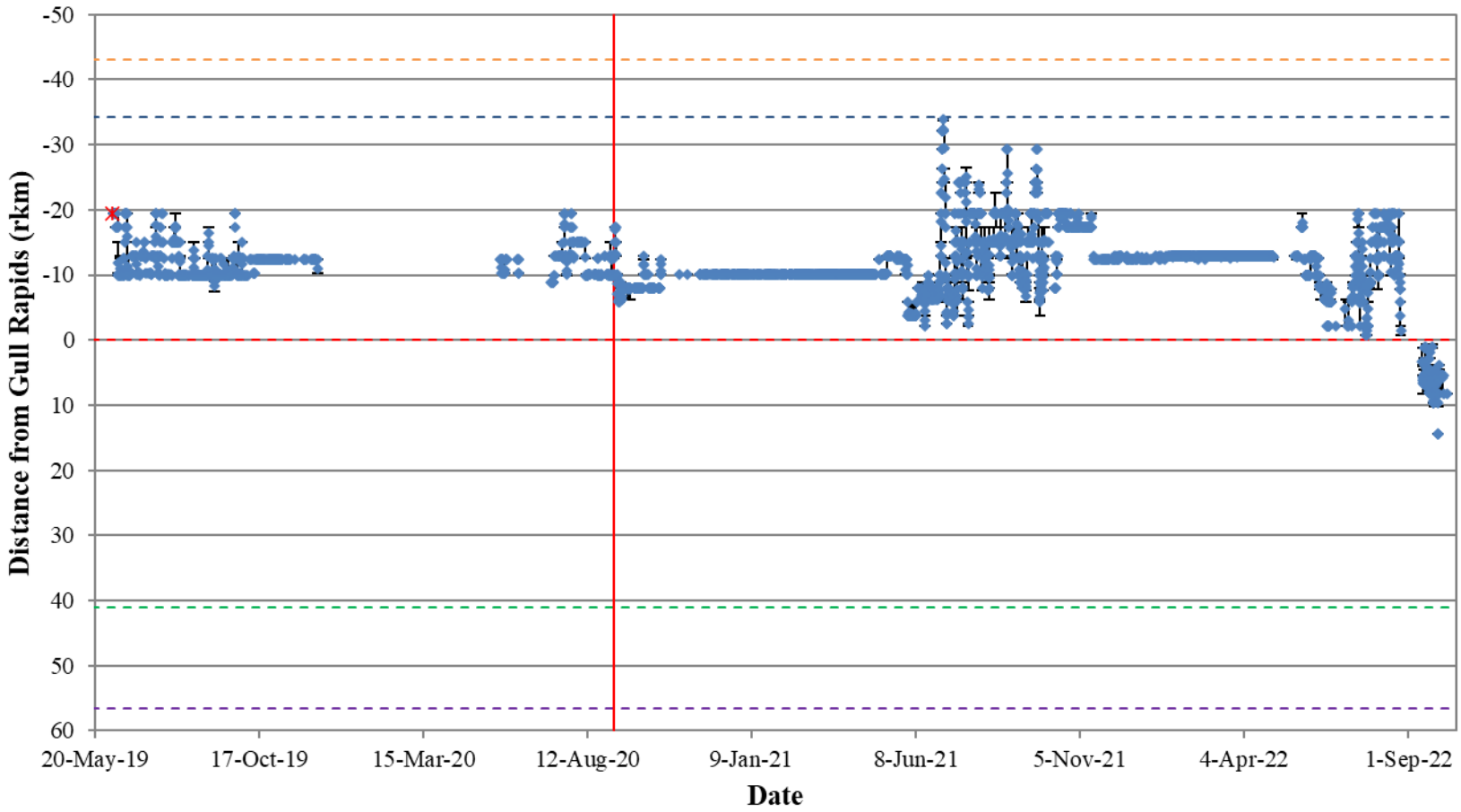

Figure A3-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7019) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

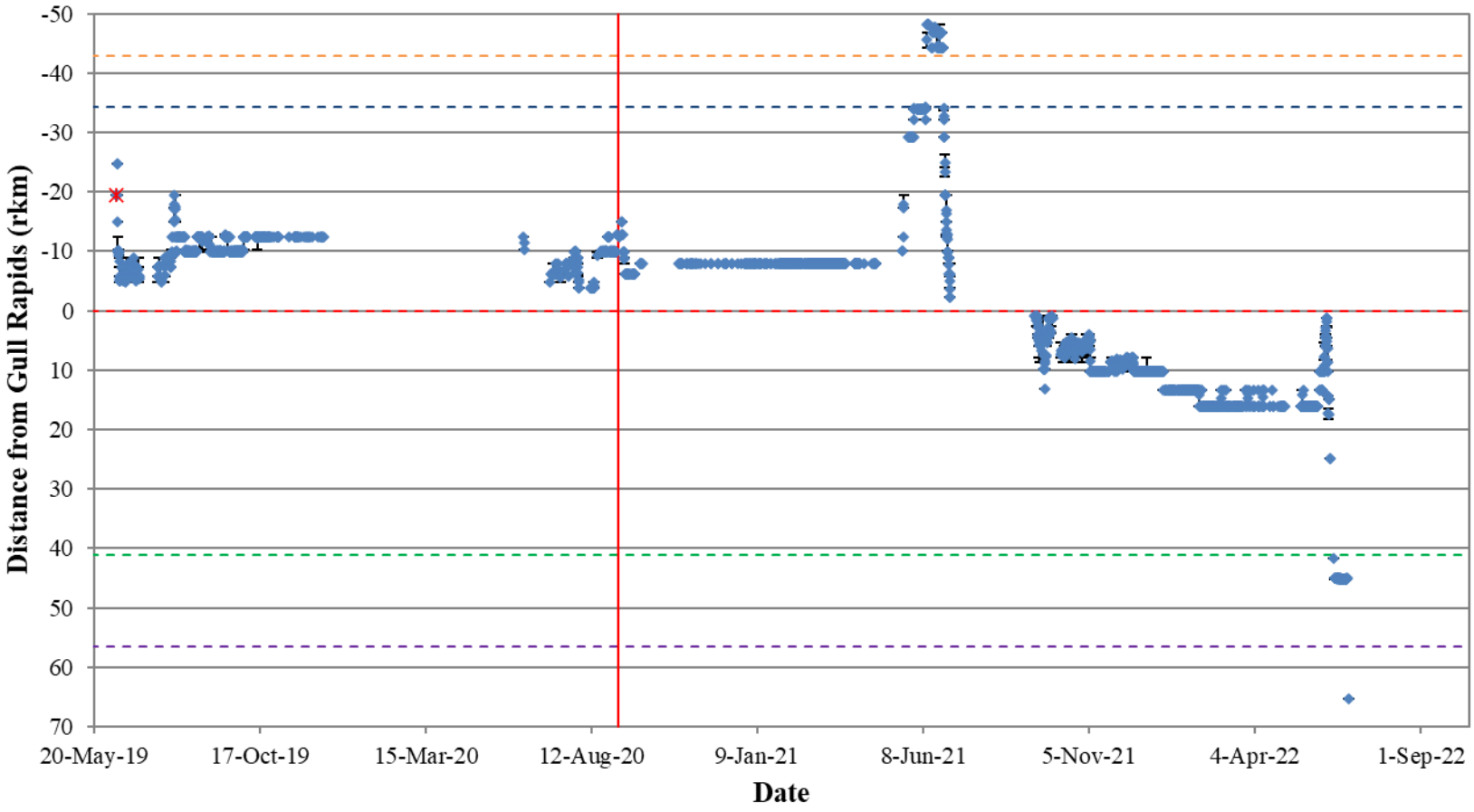

Figure A3-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7020) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

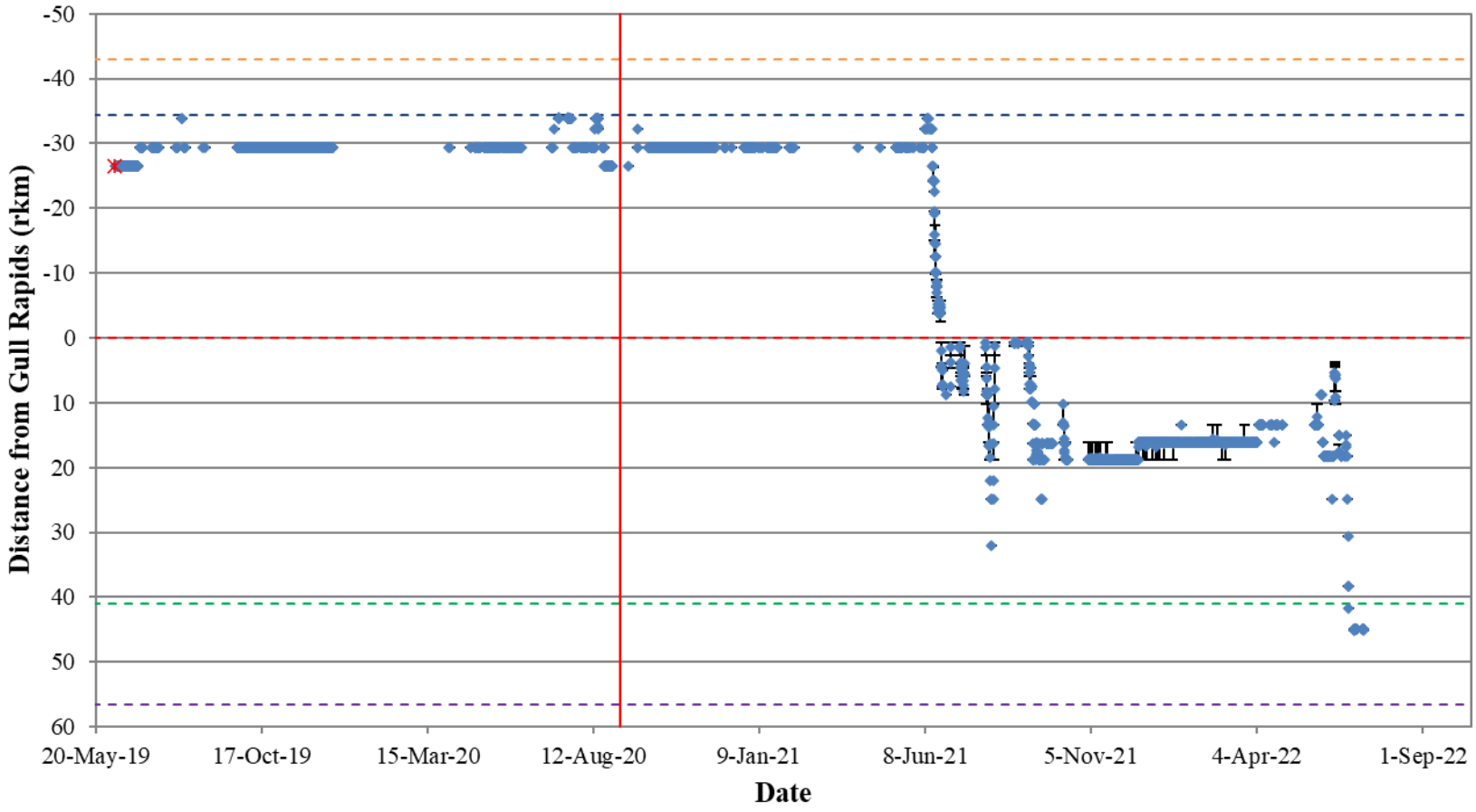

Figure A3-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7021) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

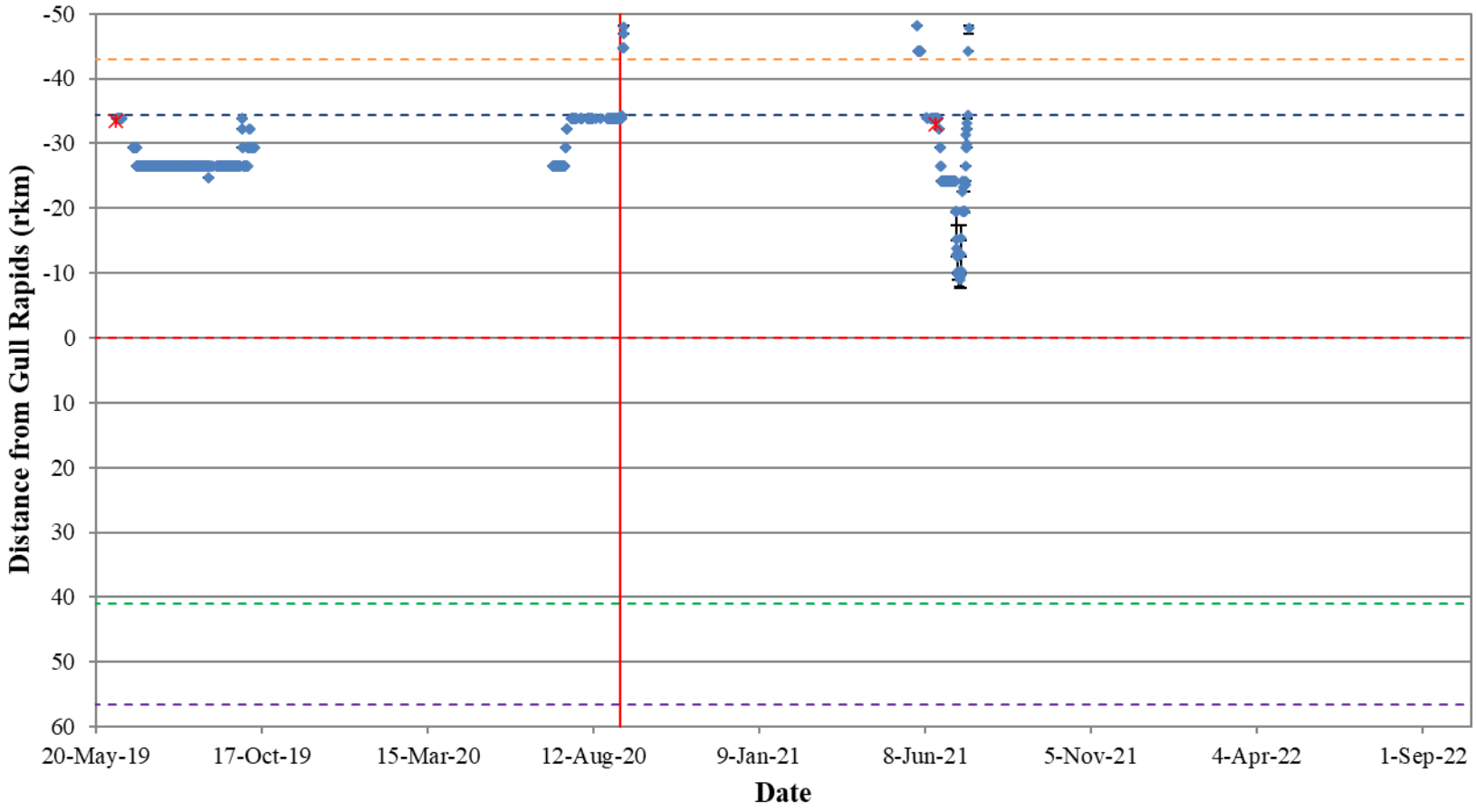

Figure A3-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7022) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

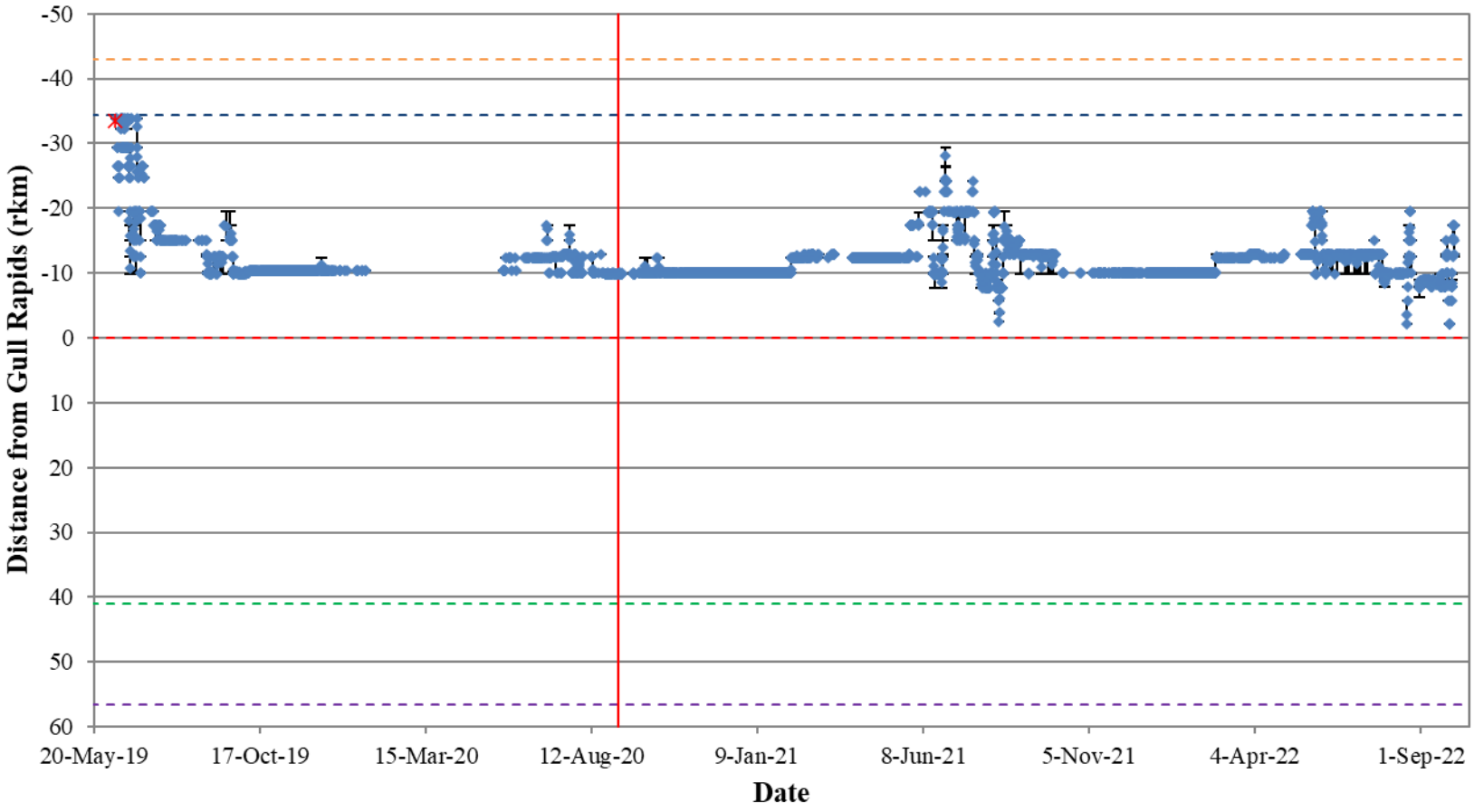

Figure A3-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7023) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

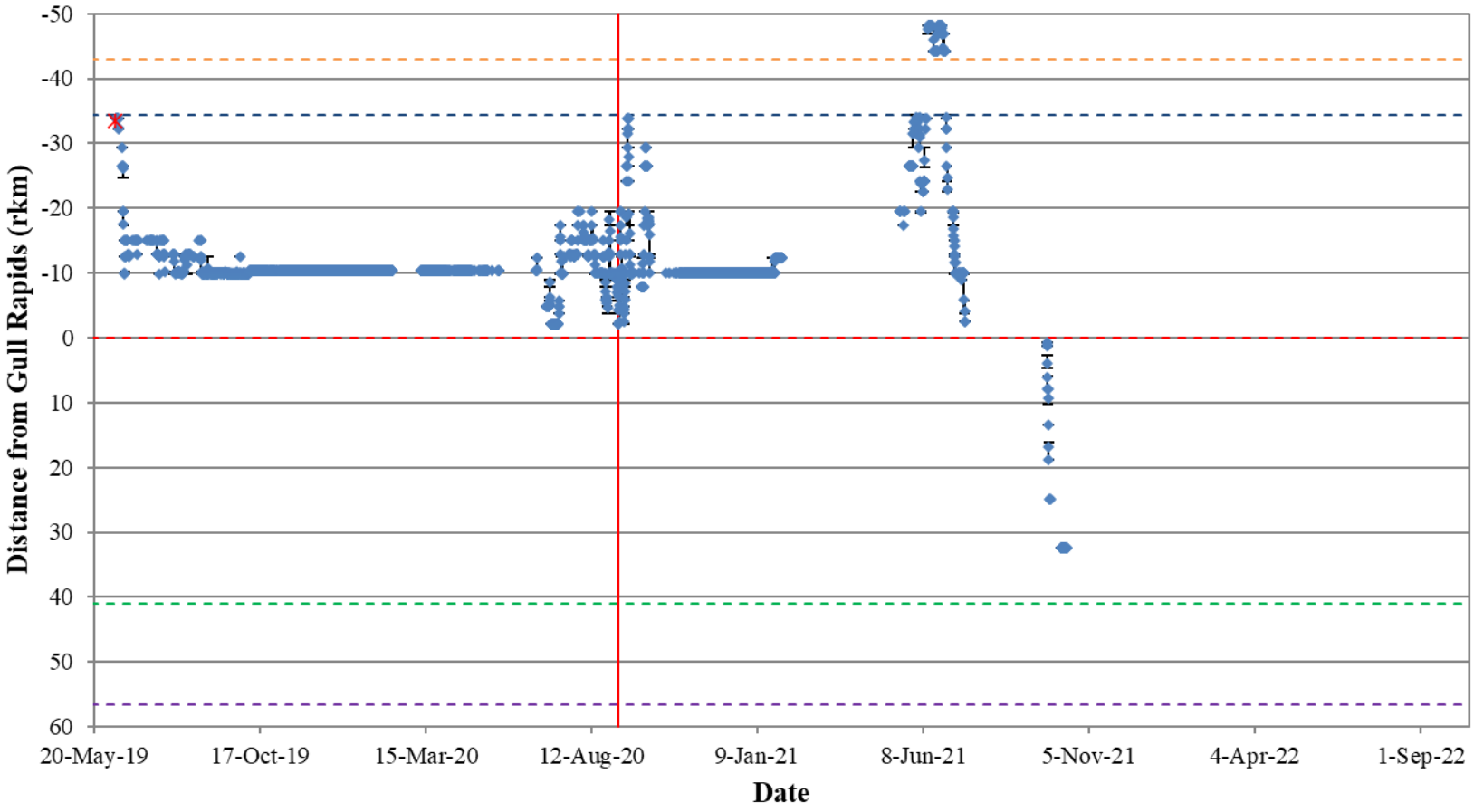

Figure A3-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7024) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

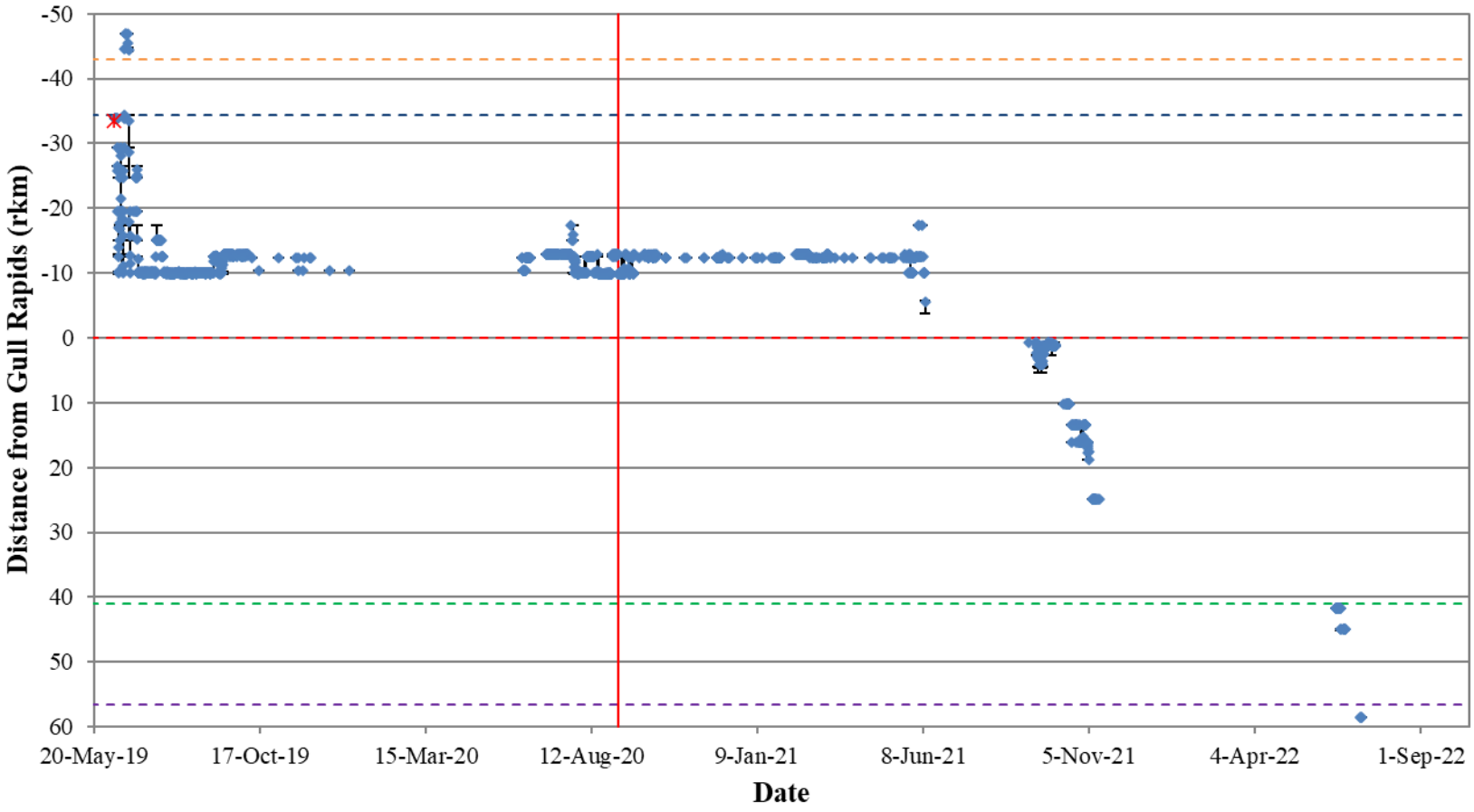

Figure A3-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7025) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

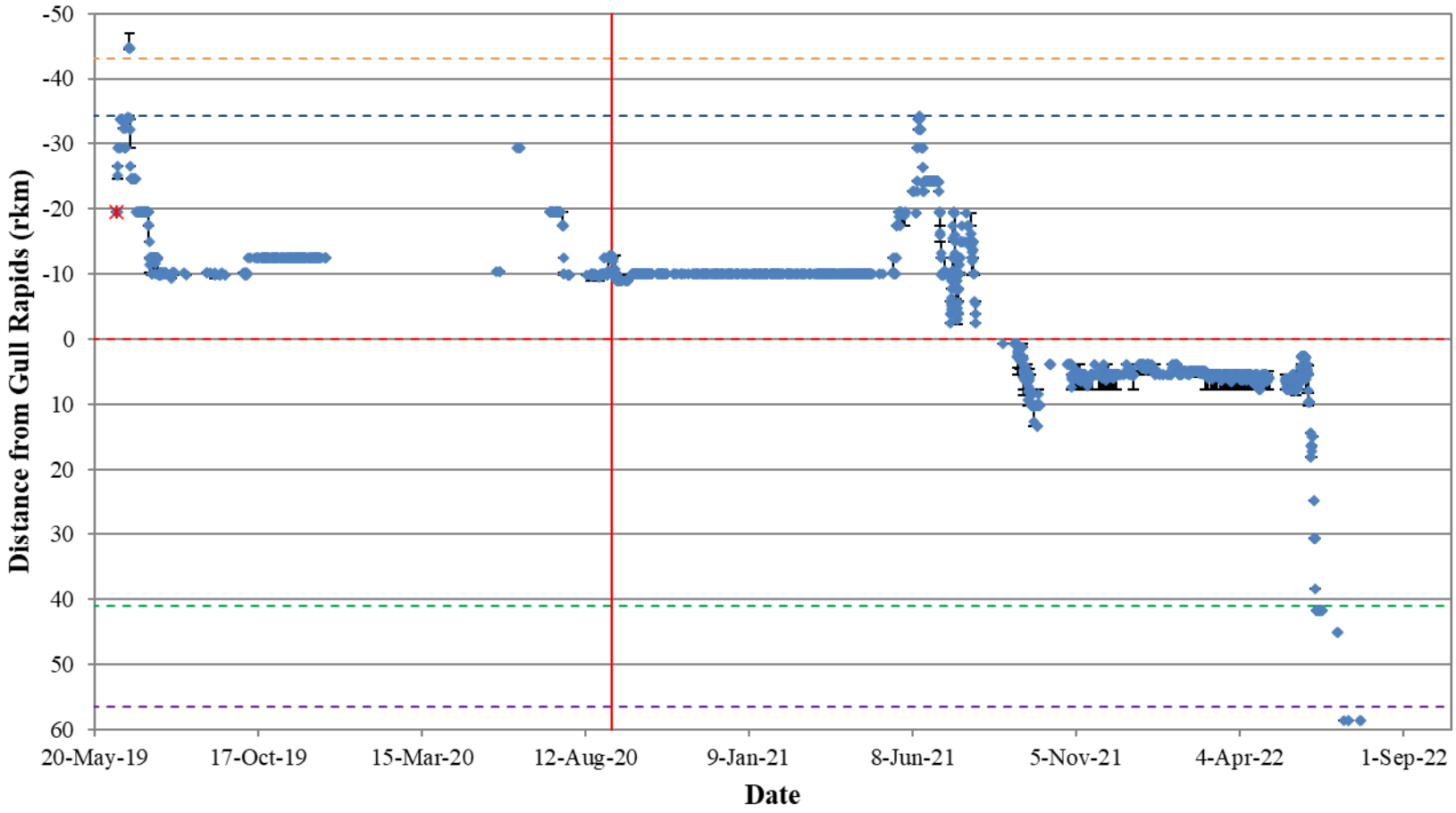

Figure A3-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

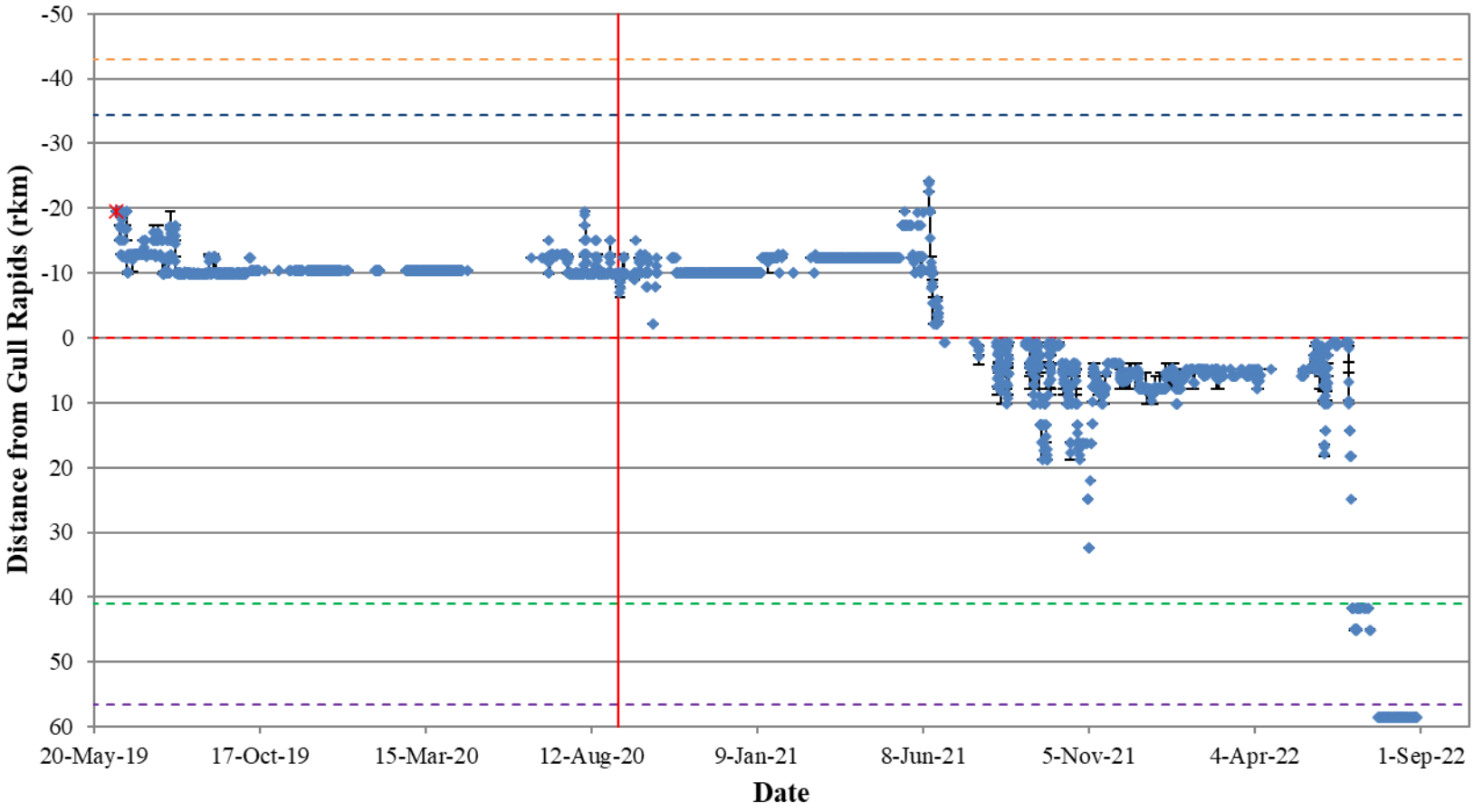

Figure A3-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7027) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

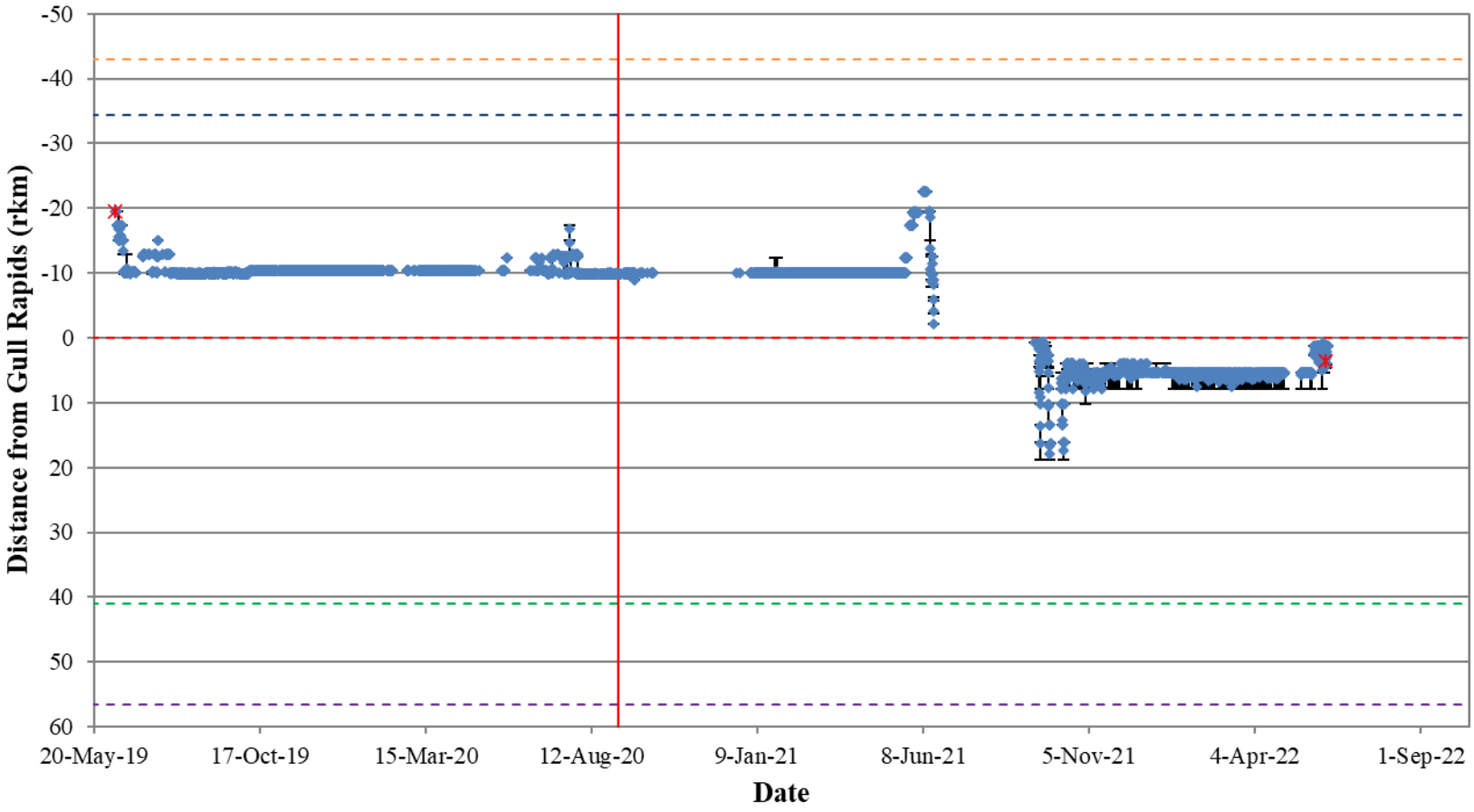

Figure A3-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7028) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

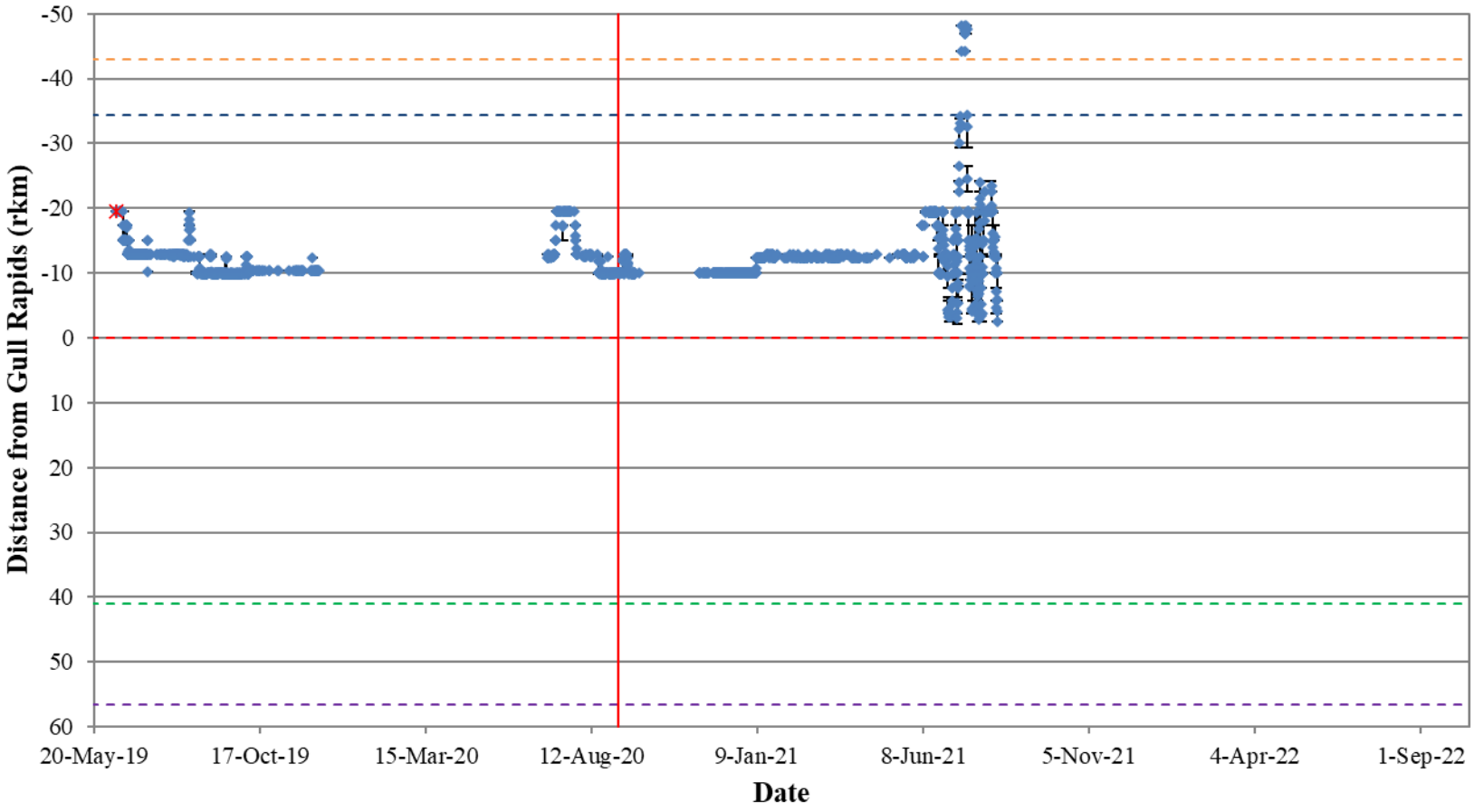

Figure A3-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7029) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

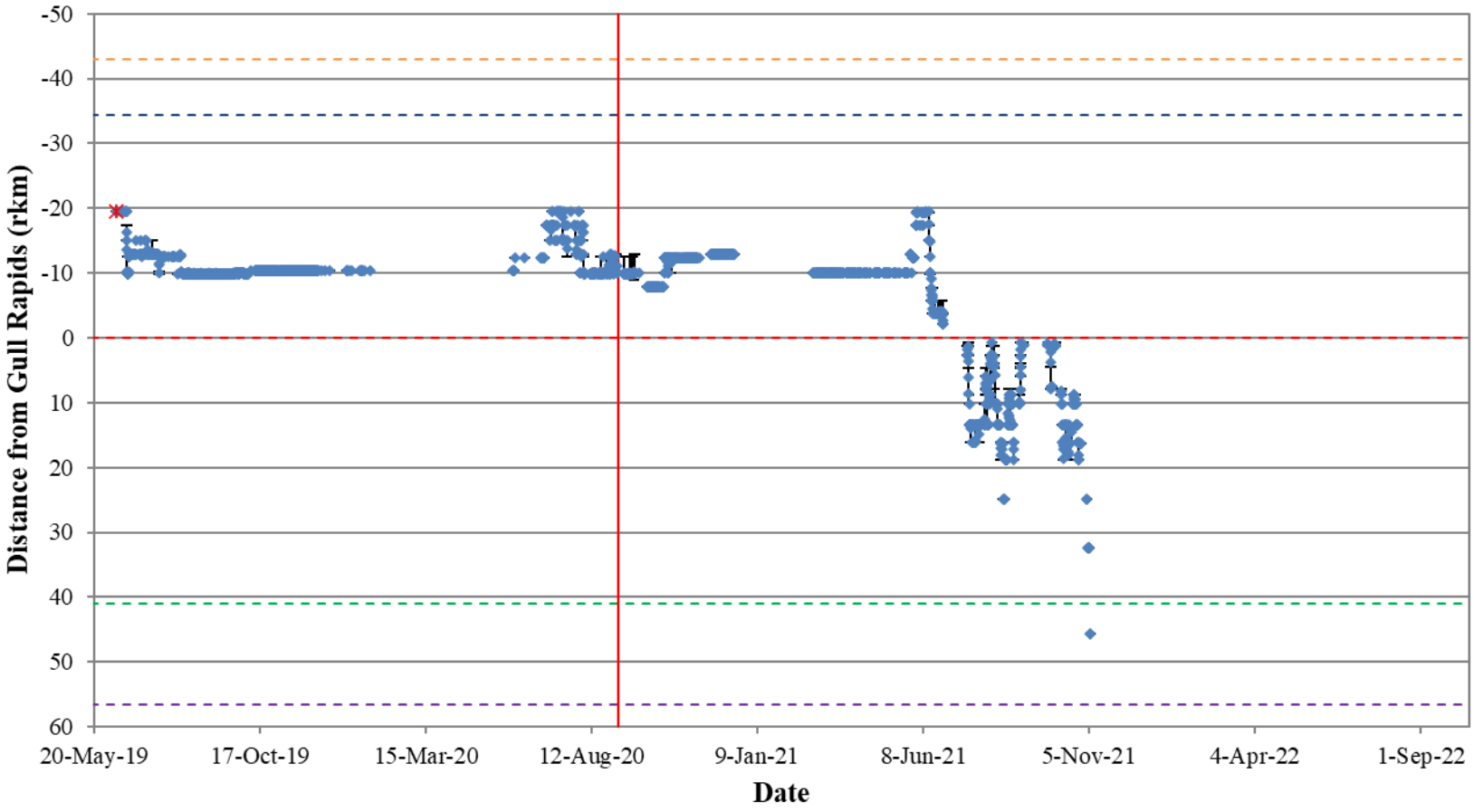

Figure A3-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7030) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

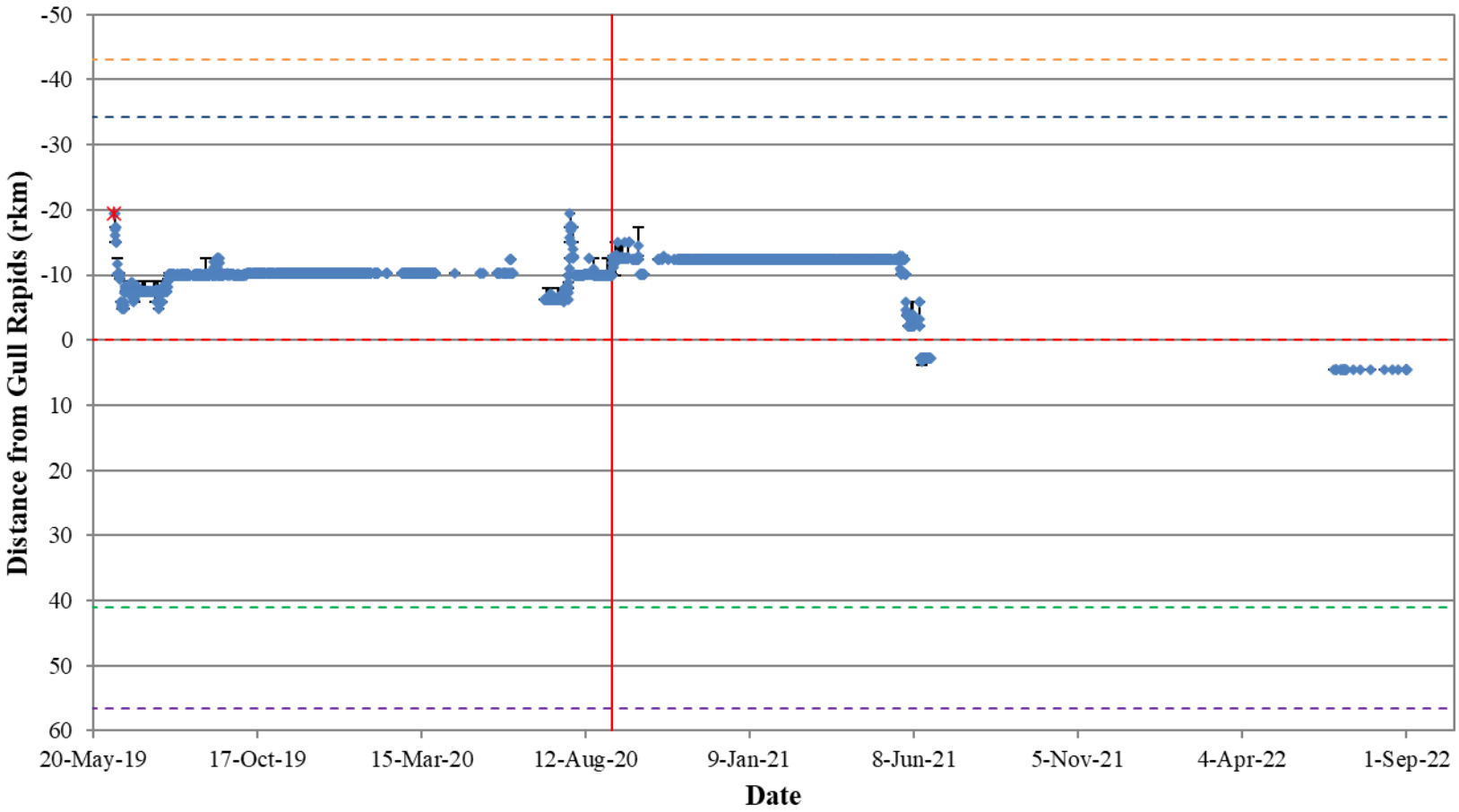

Figure A3-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7031) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

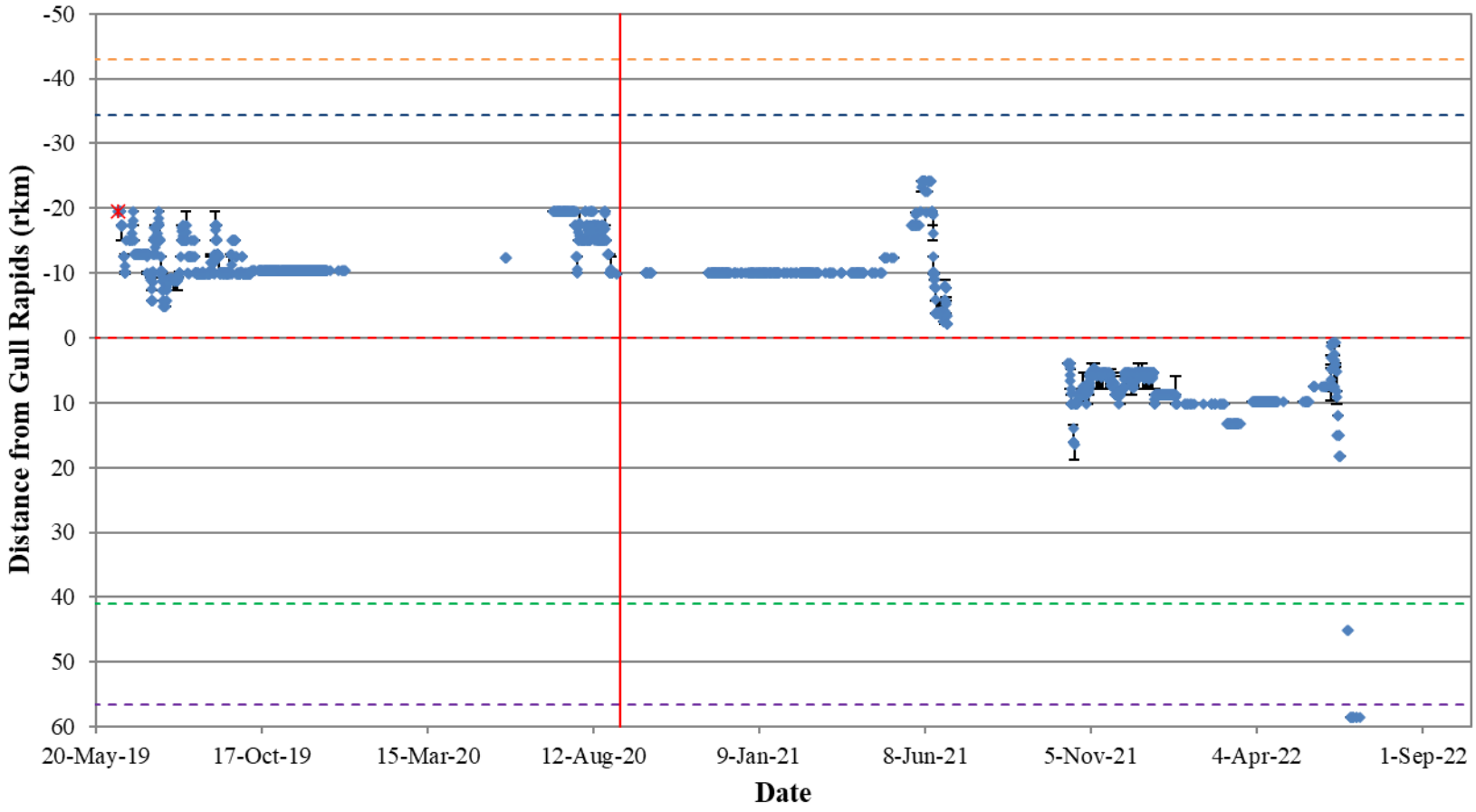

Figure A3-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7032) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

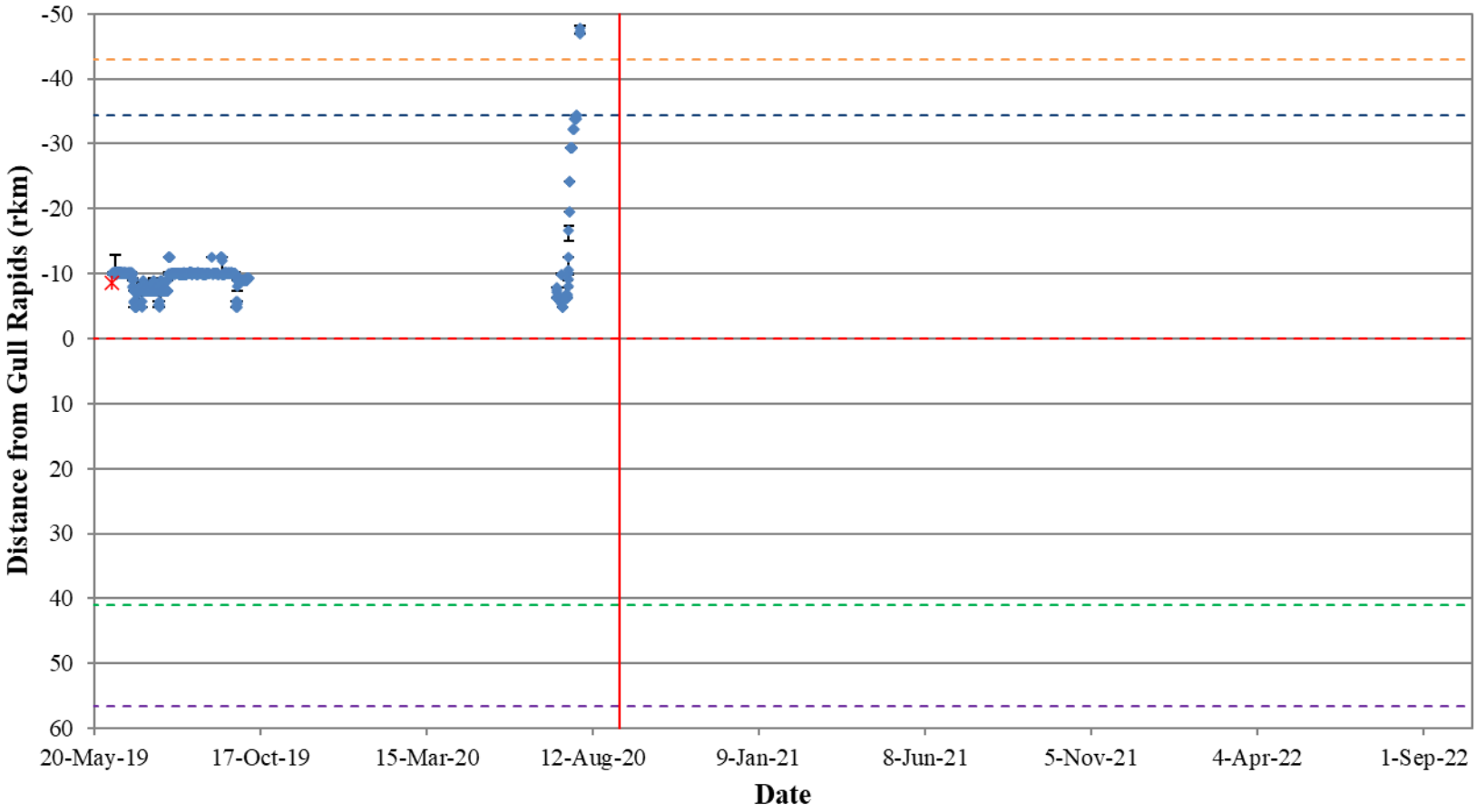

Figure A3-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7033) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

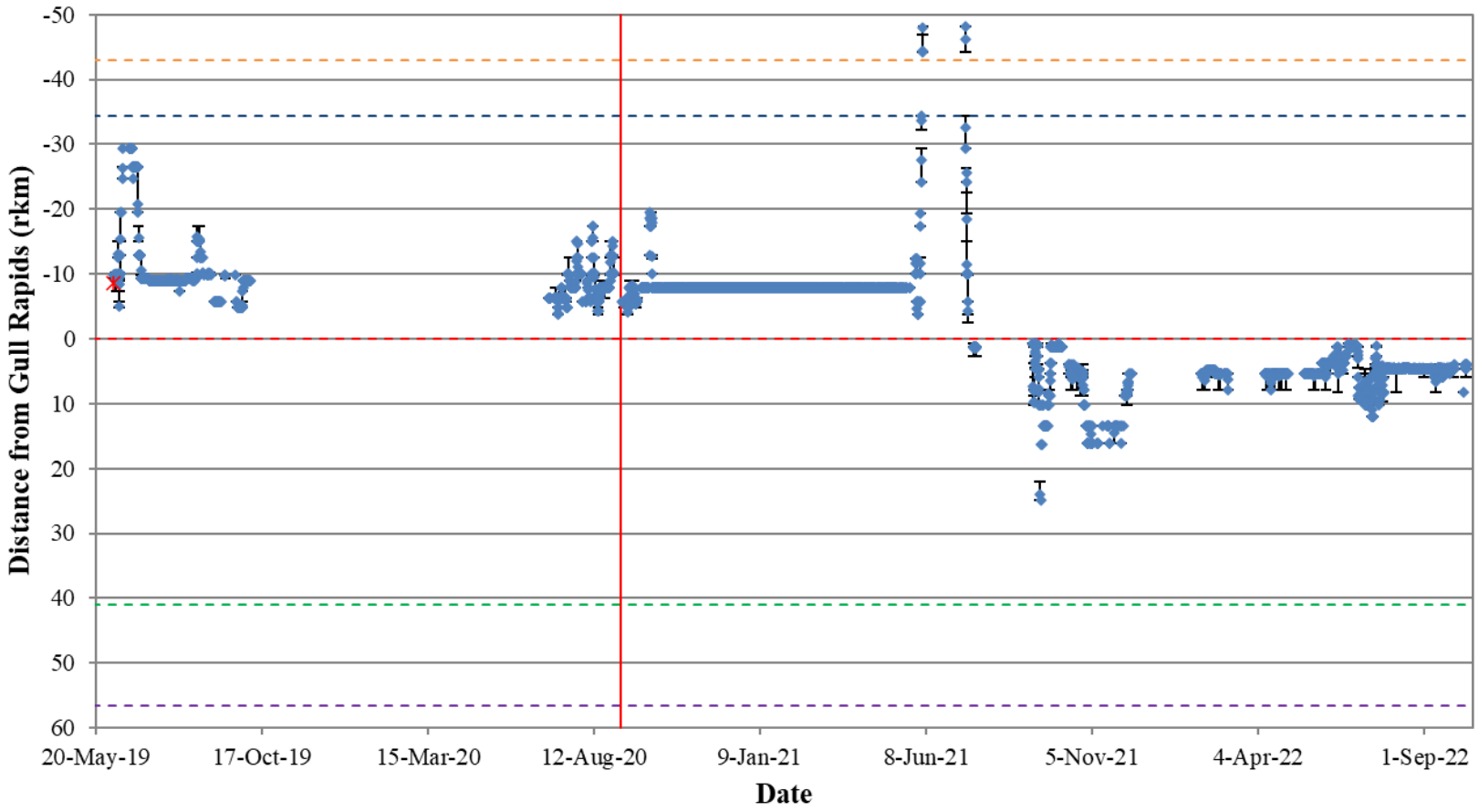

Figure A3-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7034) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

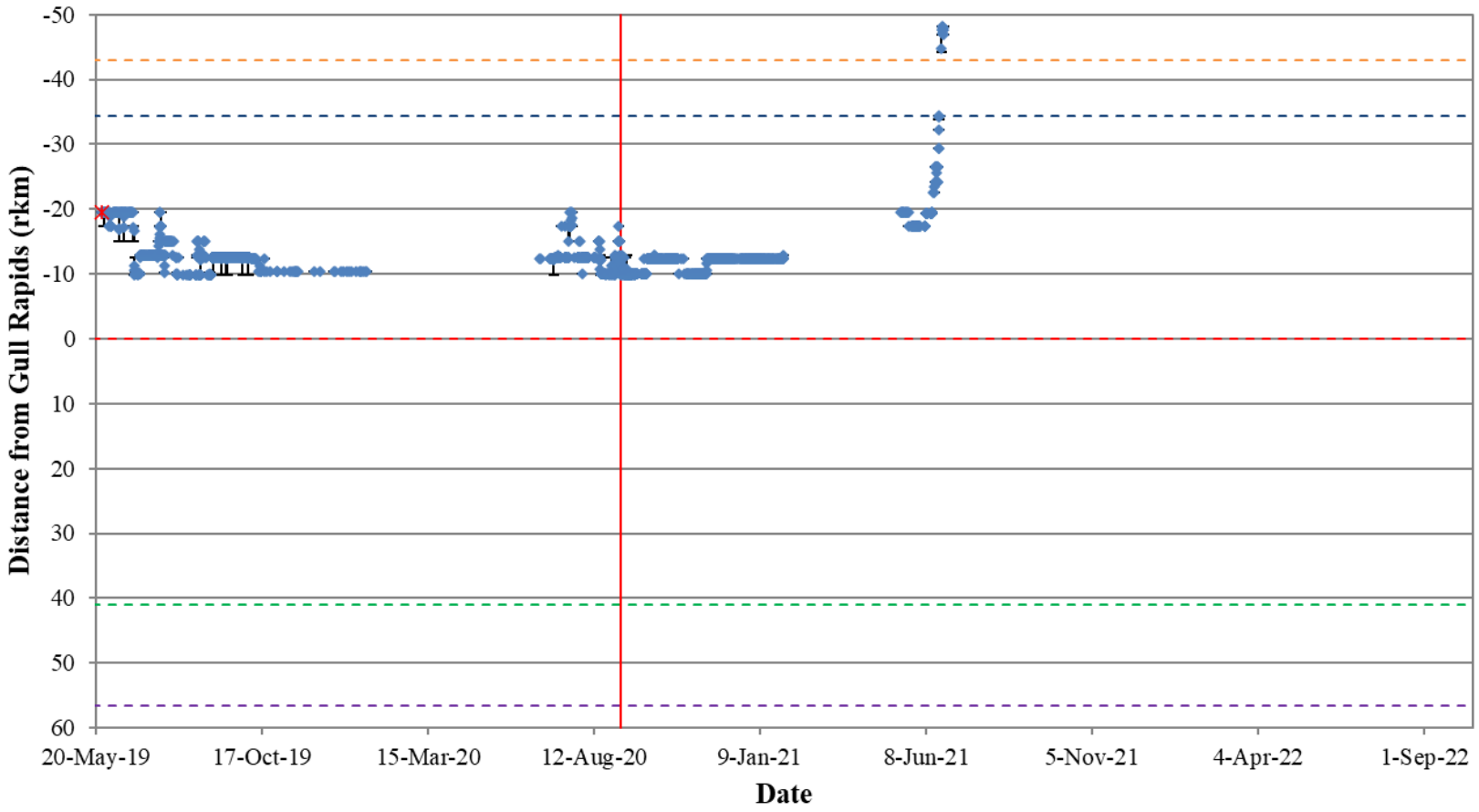

Figure A3-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7053) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

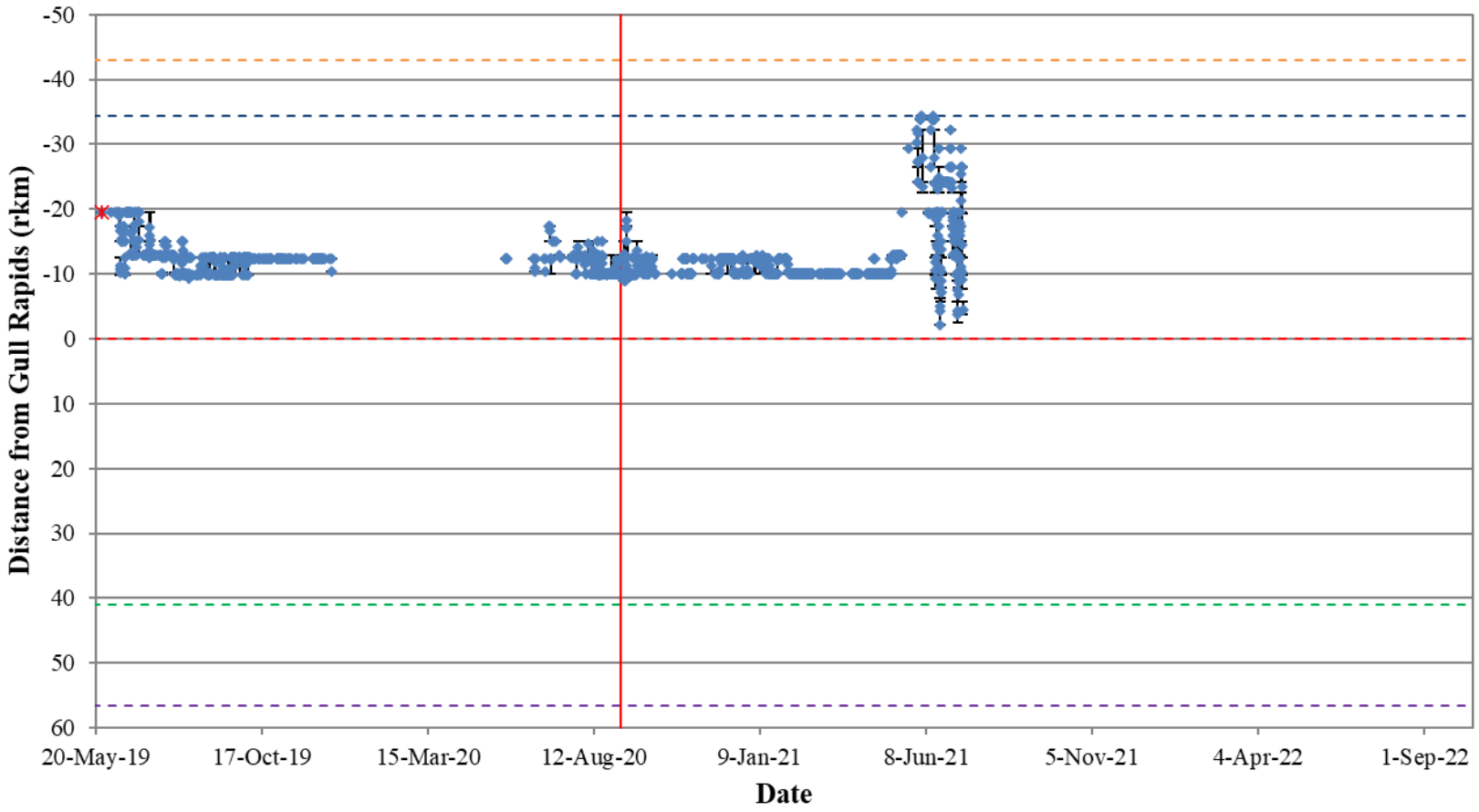

Figure A3-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7056) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

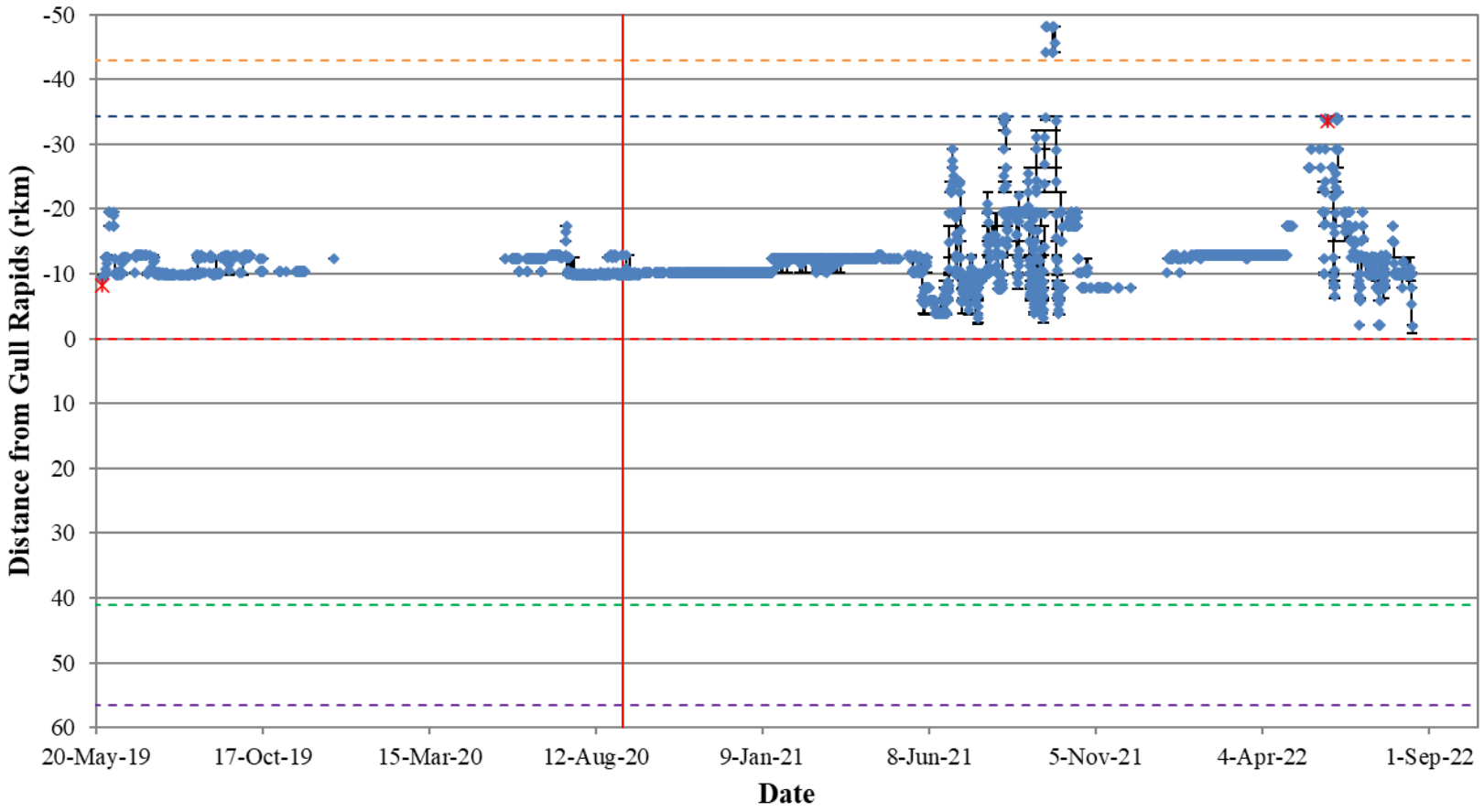

Figure A3-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7059) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

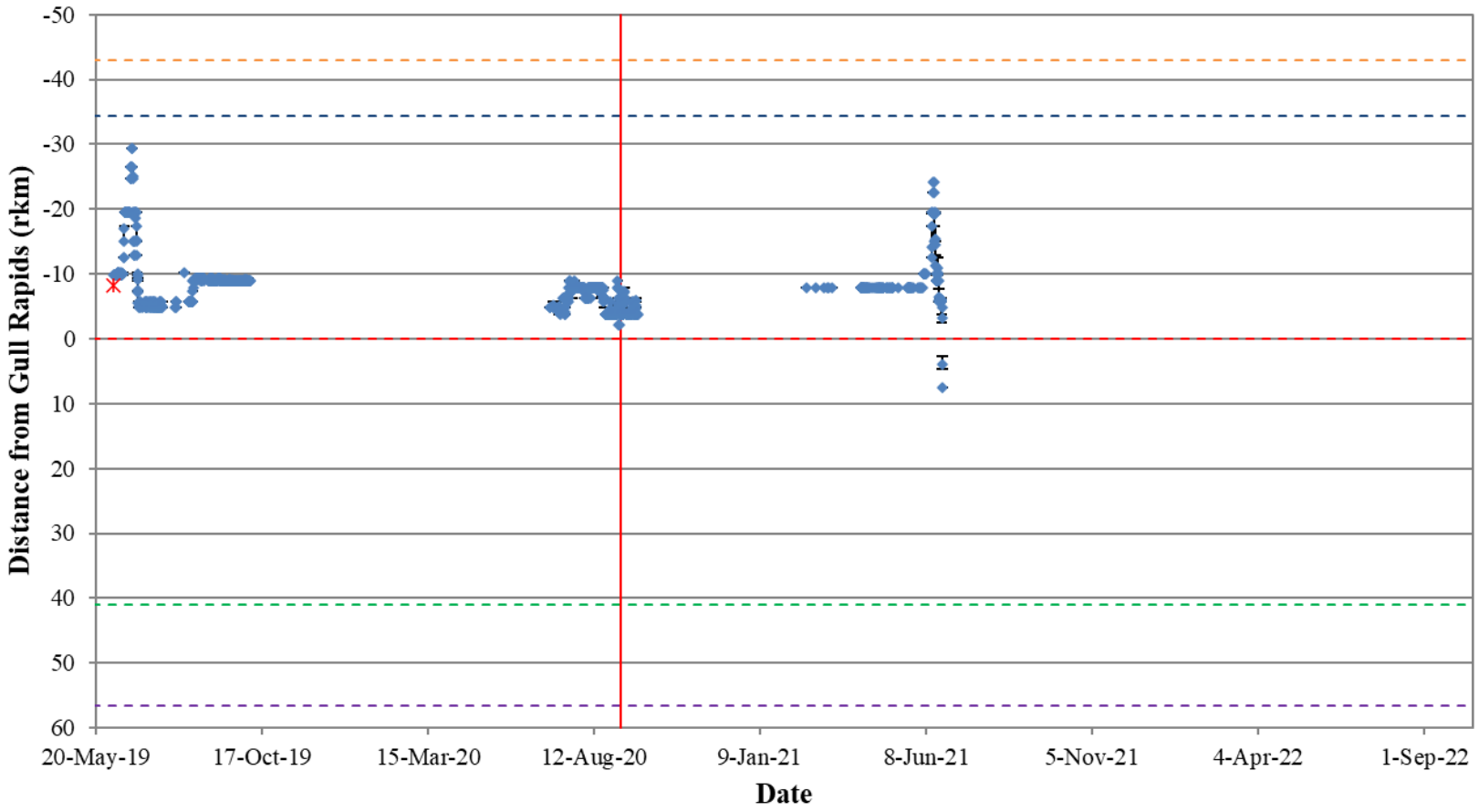

Figure A3-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7061) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

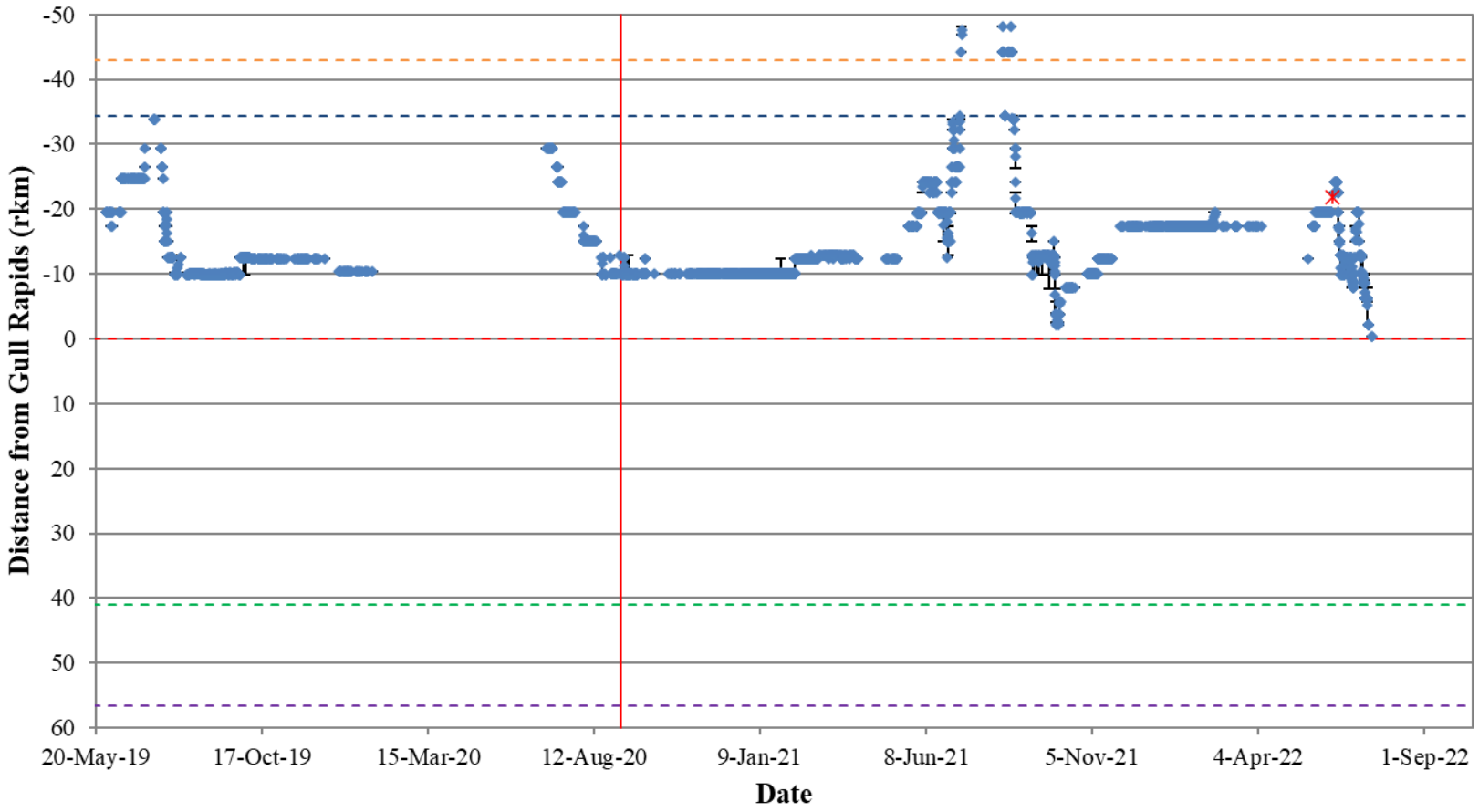

Figure A3-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7064) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

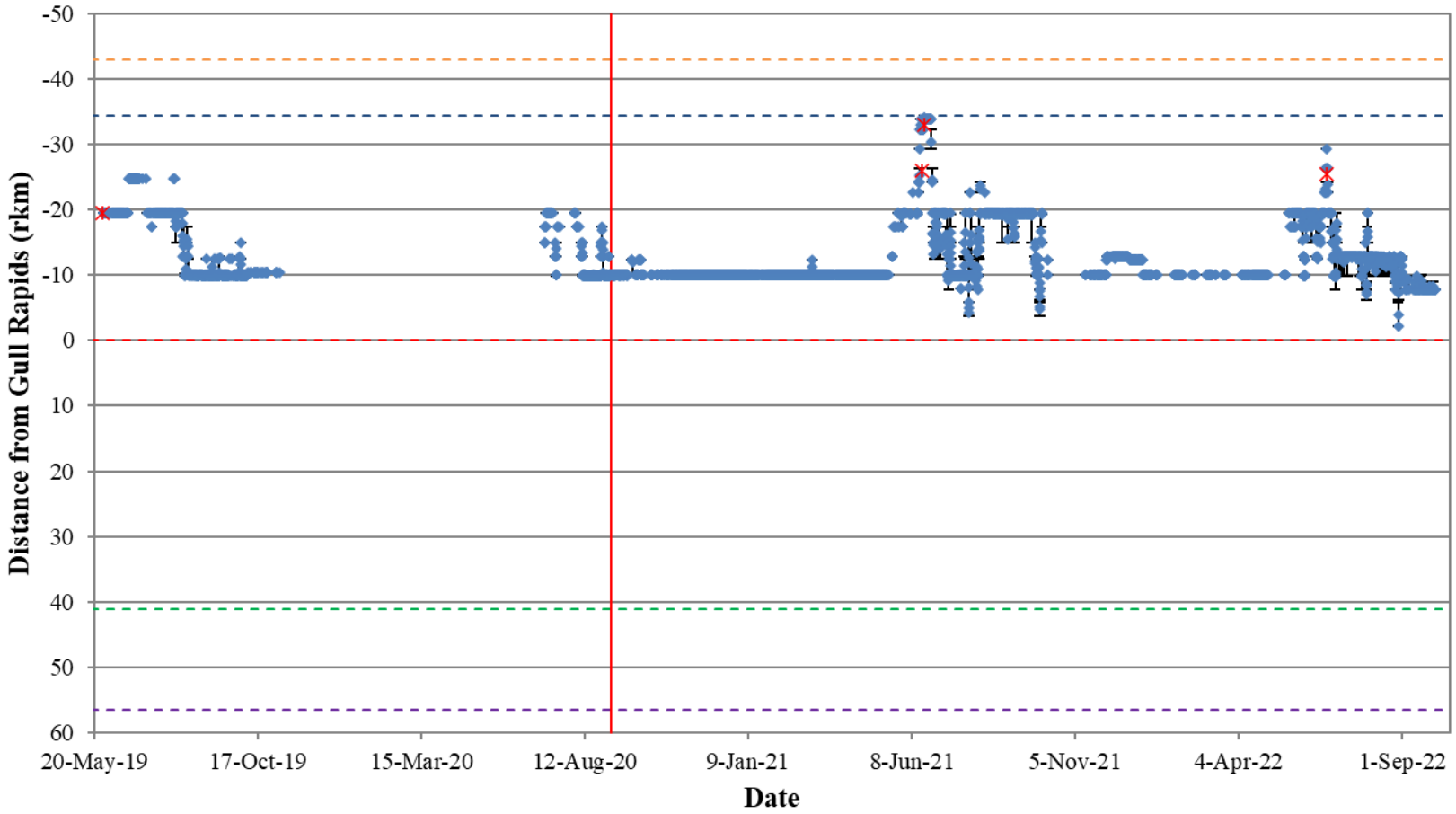

Figure A3-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7065) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

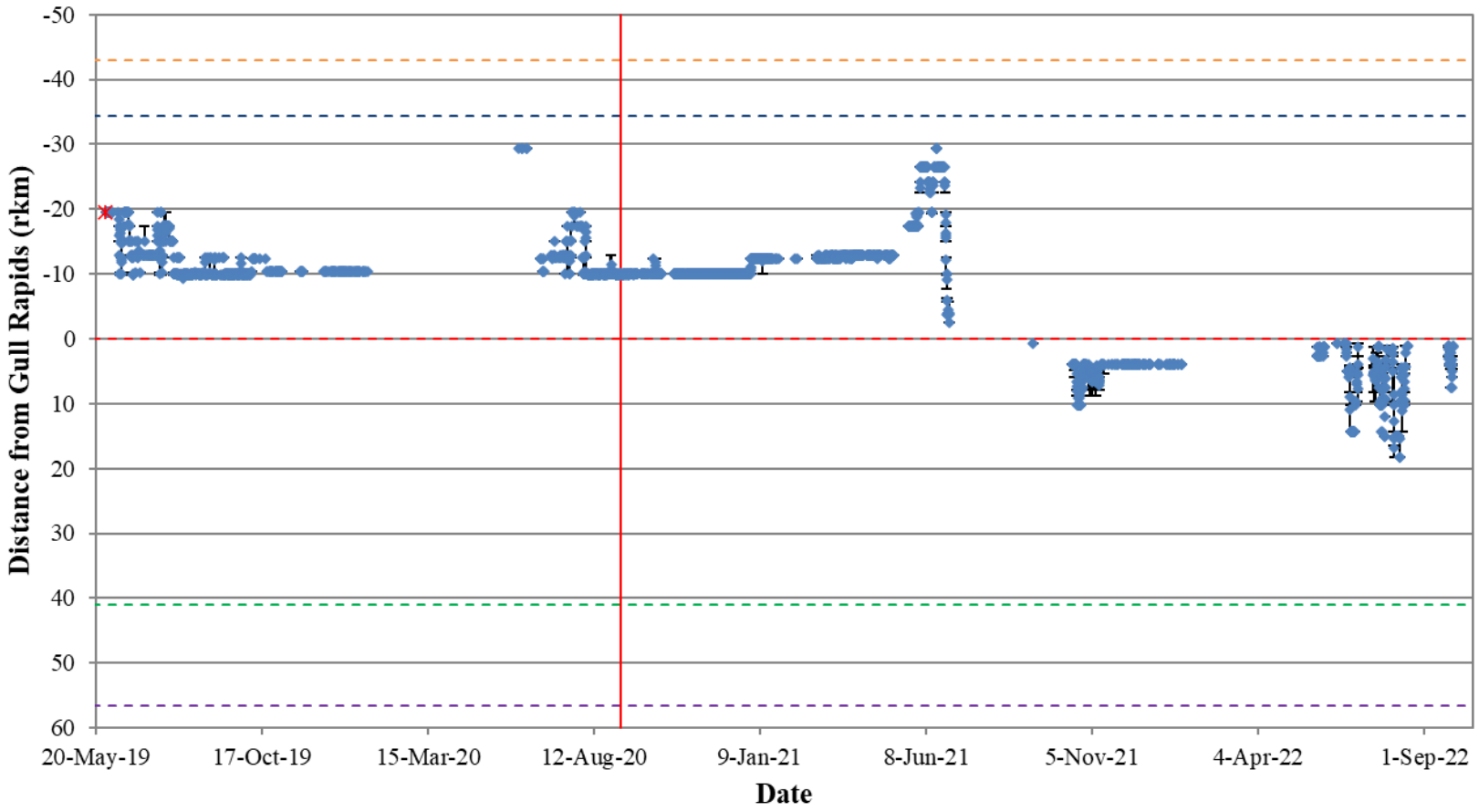

Figure A3-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7066) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

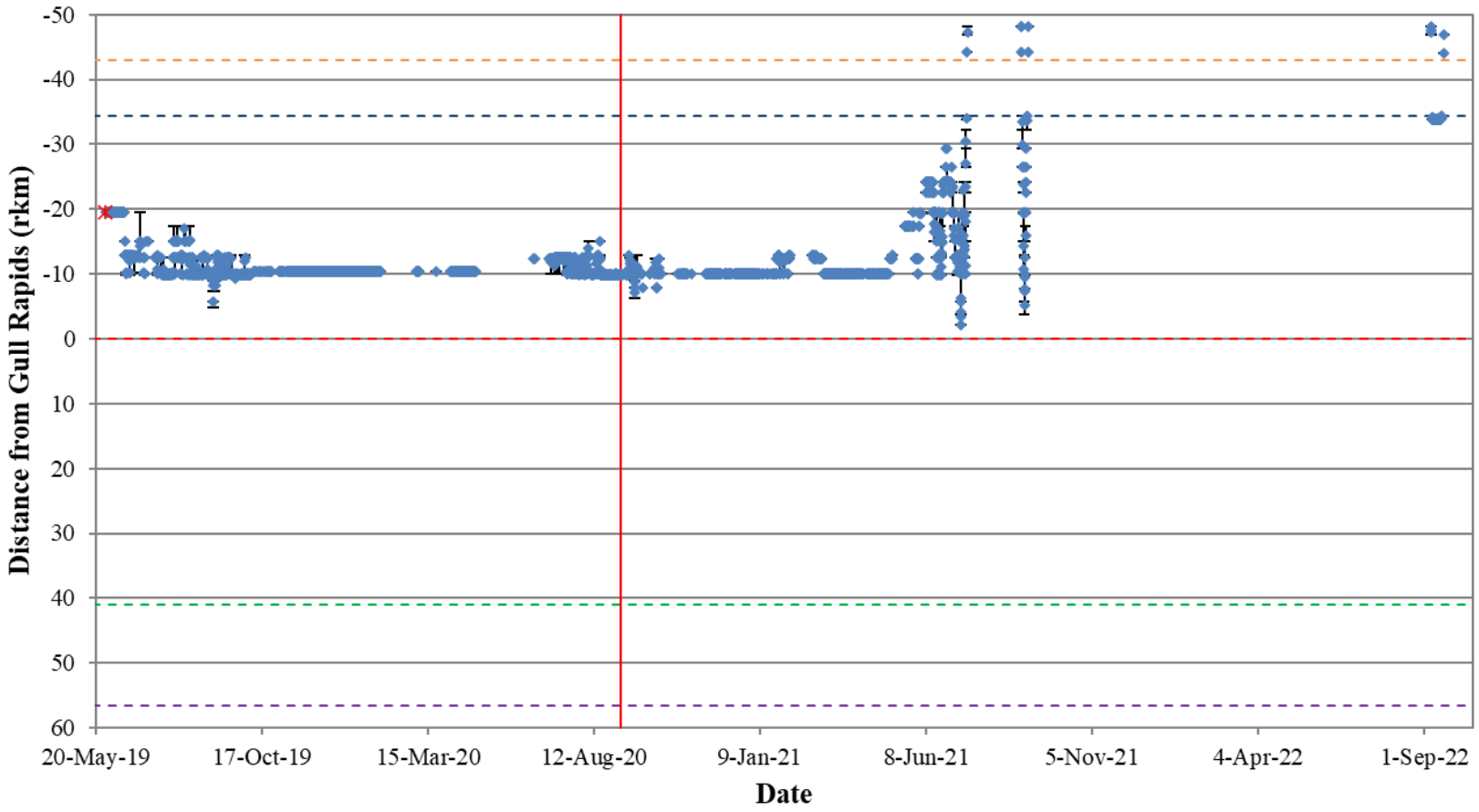

Figure A3-26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7067) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

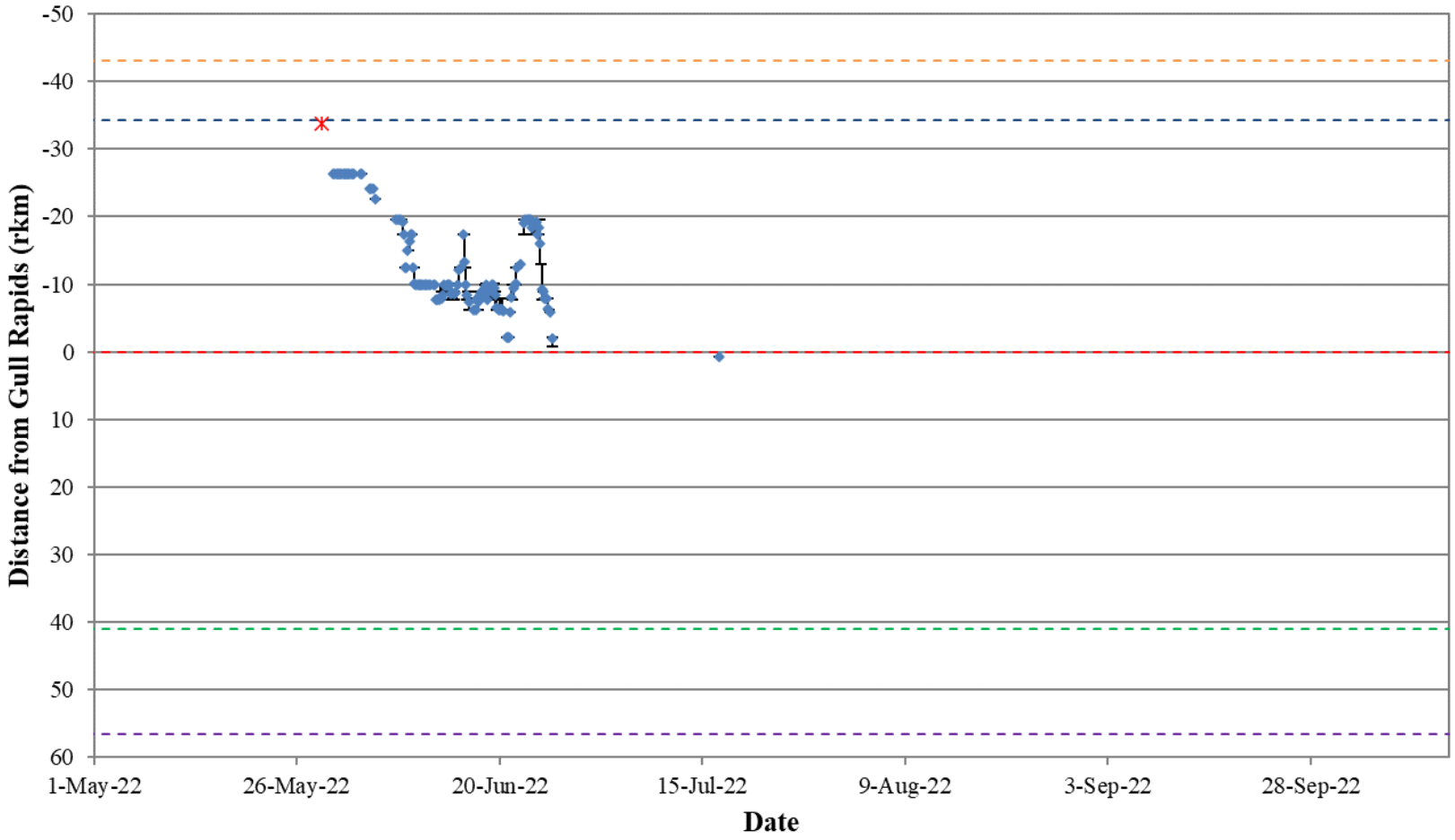

Figure A3-27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57478) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

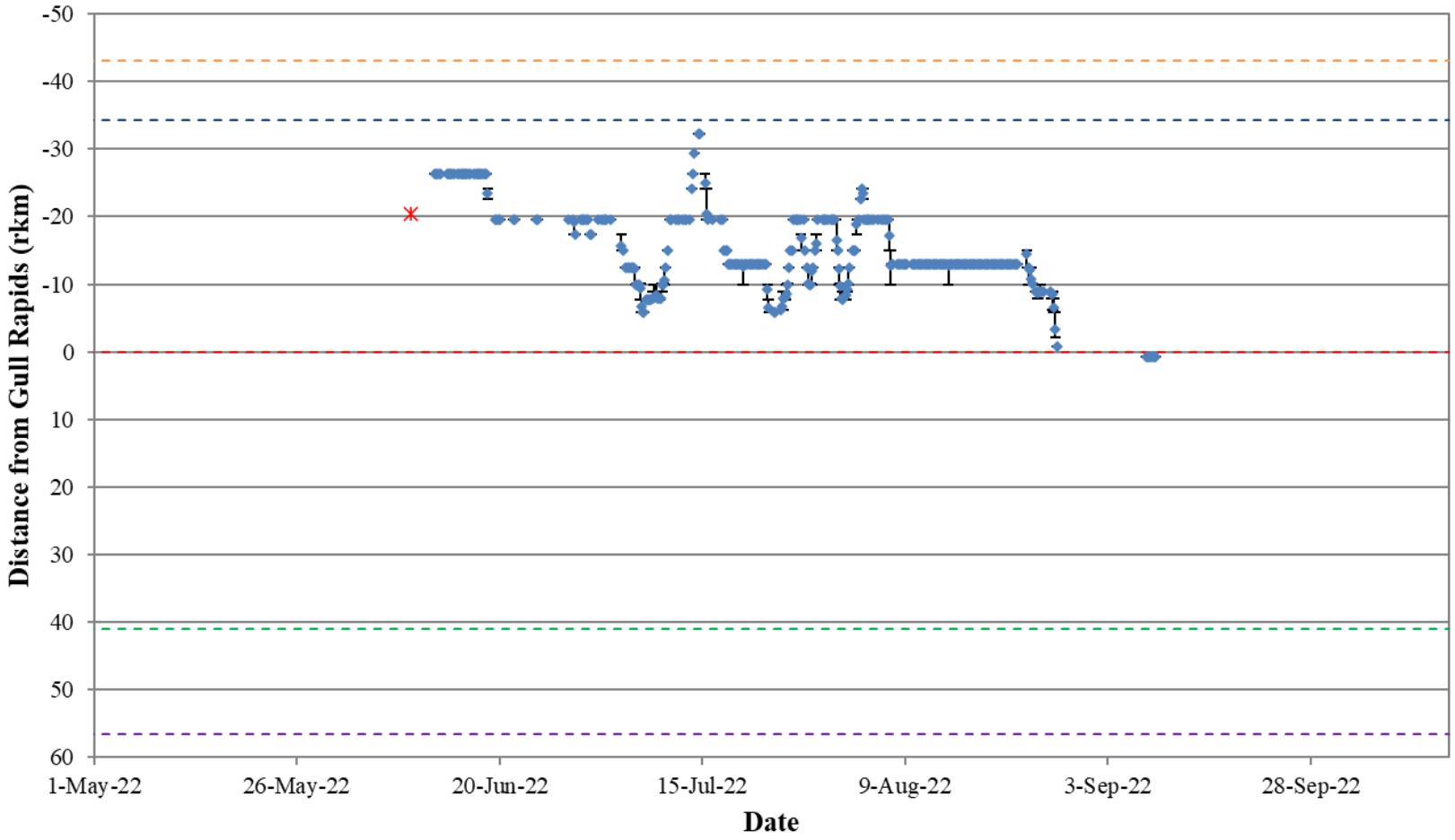

Figure A3-28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57479) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

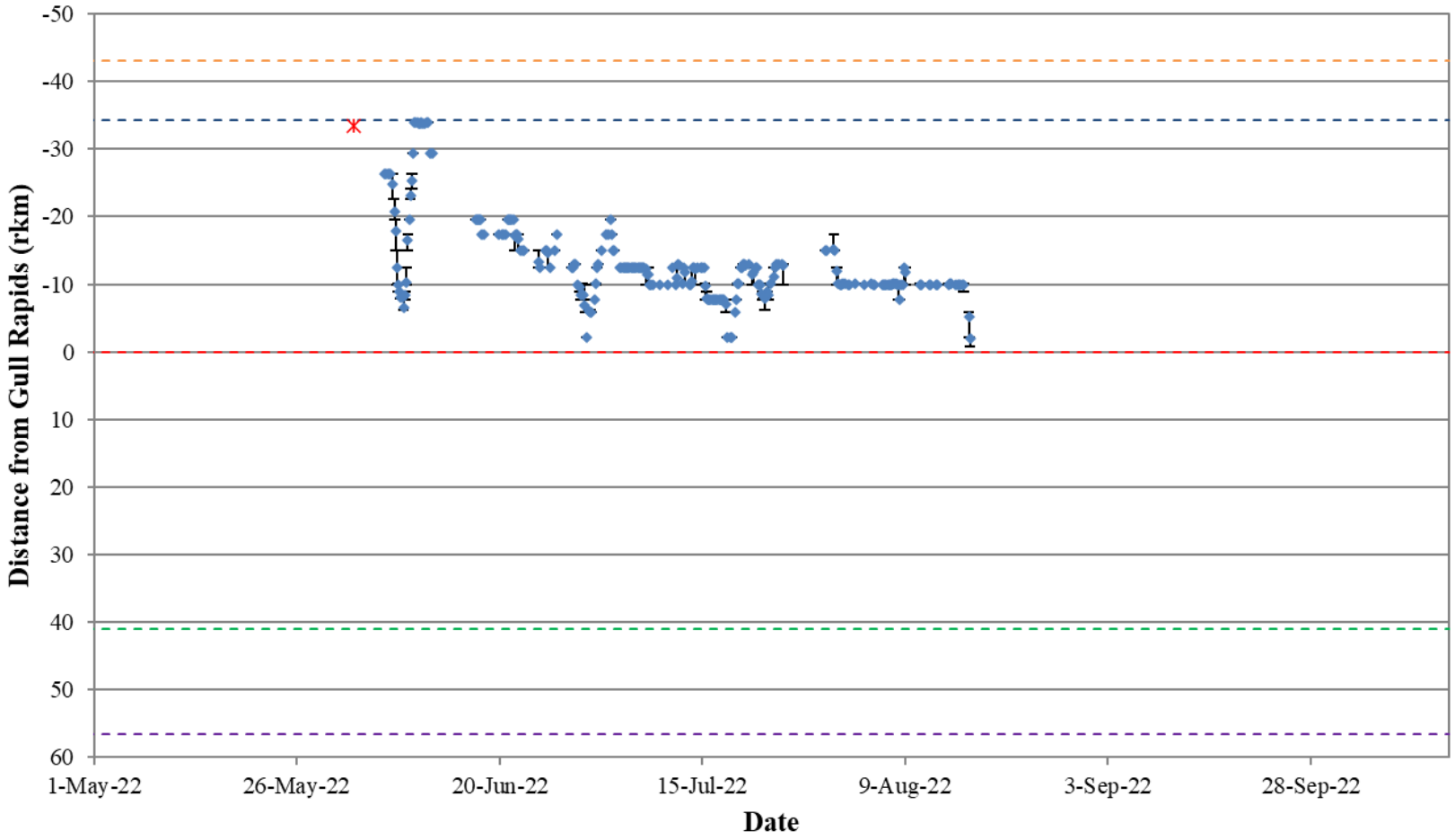

Figure A3-29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57480) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

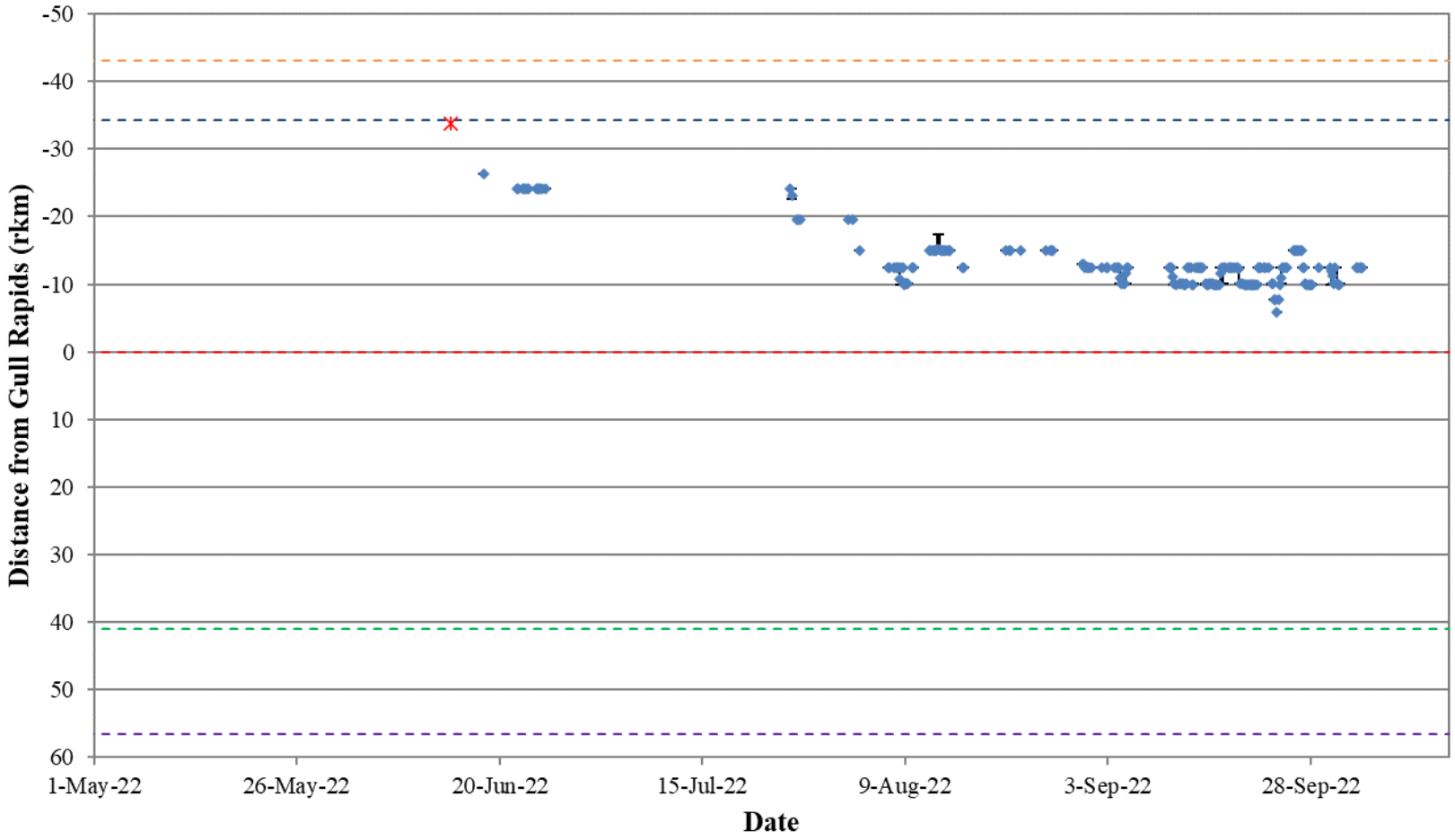

Figure A3-30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57481) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

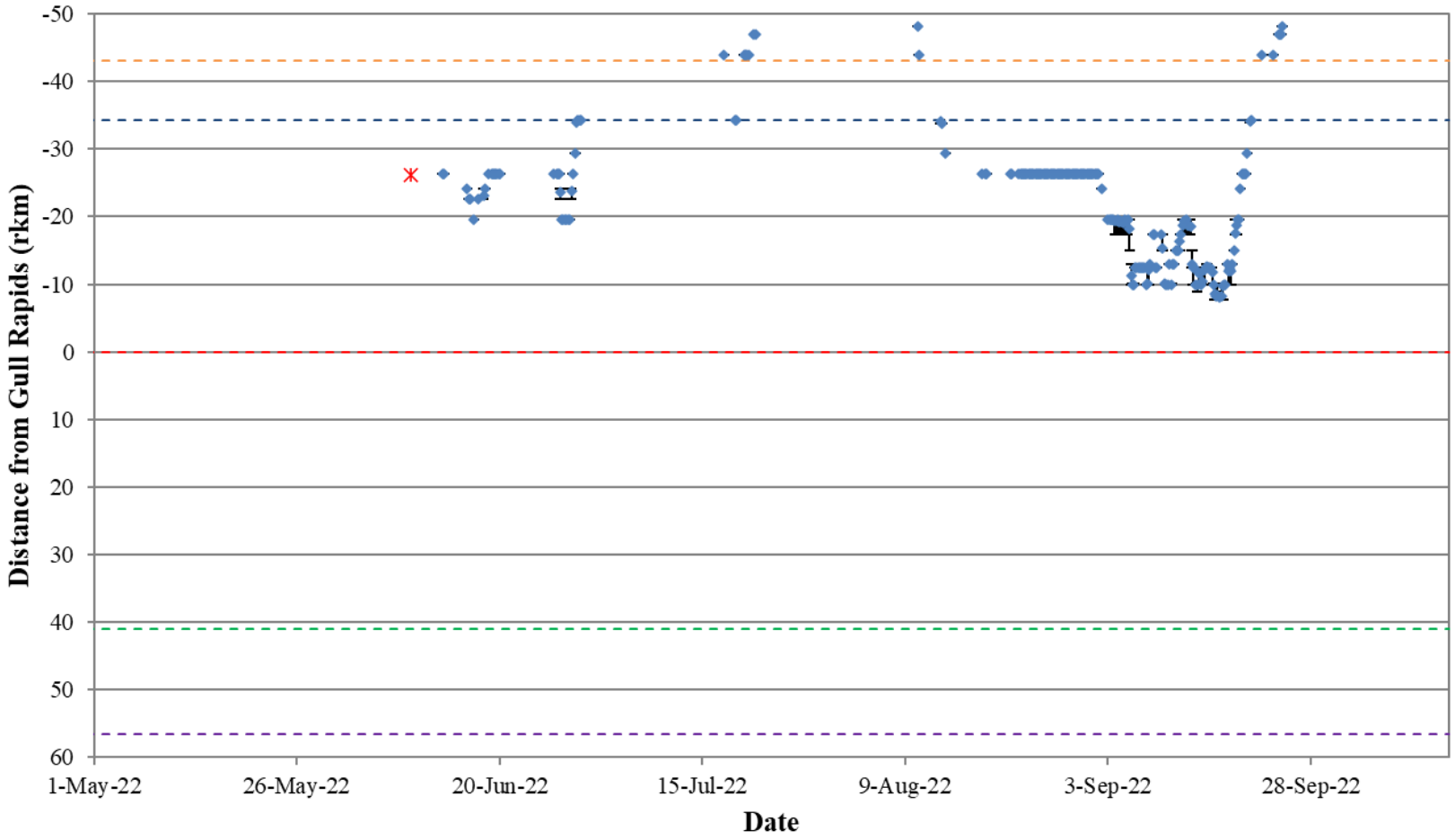

Figure A3-31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57482) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

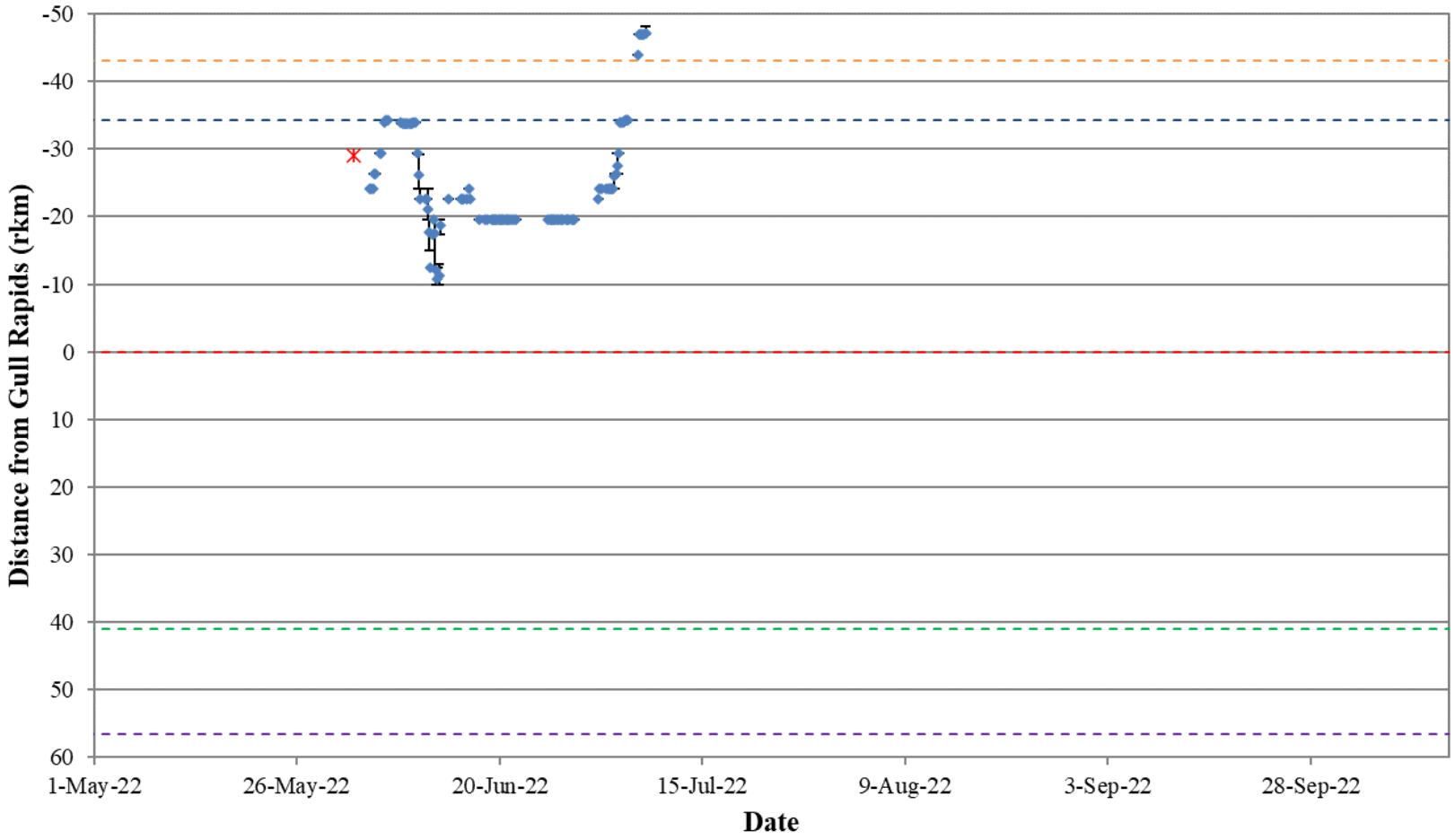

Figure A3-32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57483) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

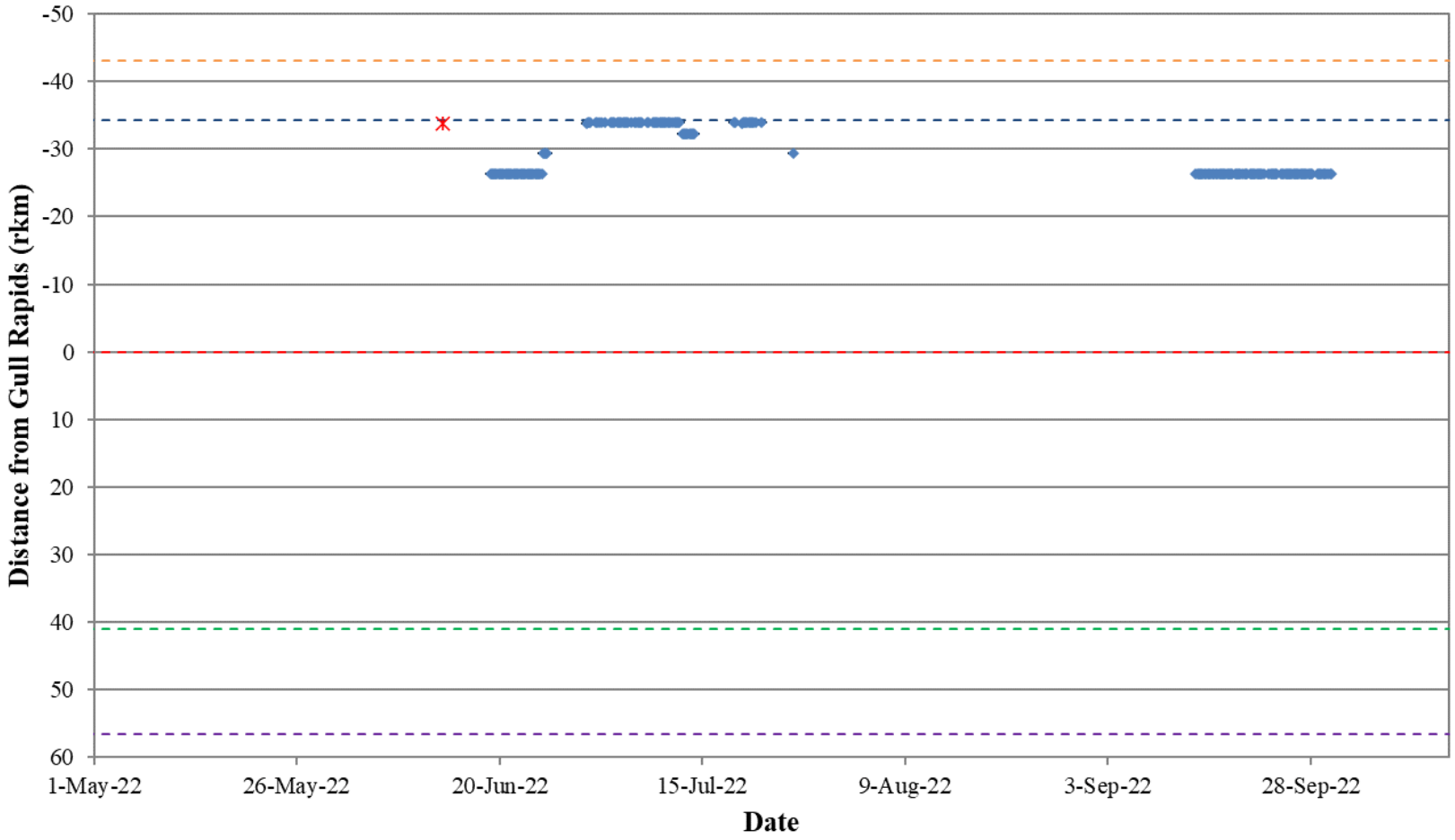

Figure A3-33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57484) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

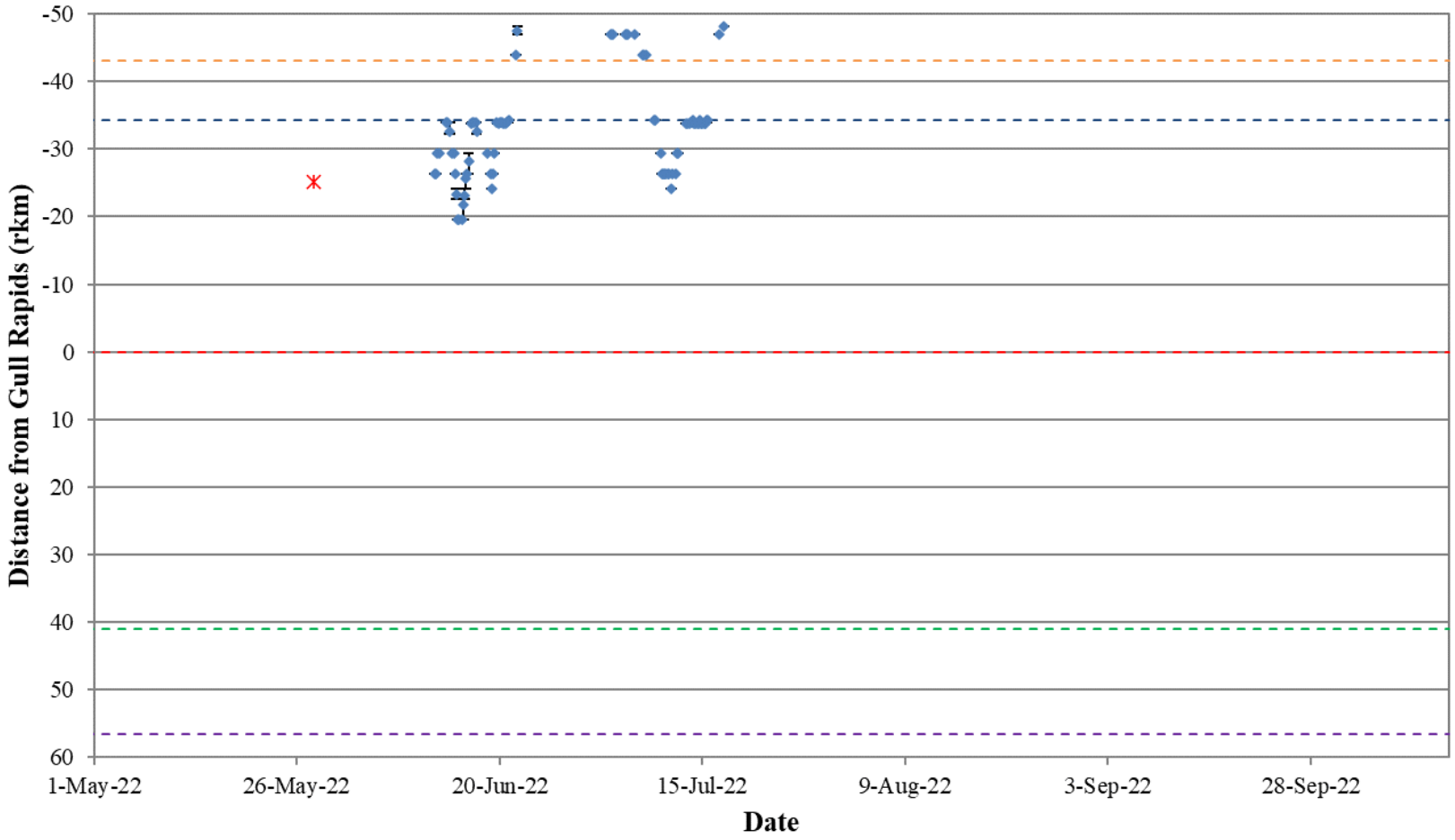

Figure A3-34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57485) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

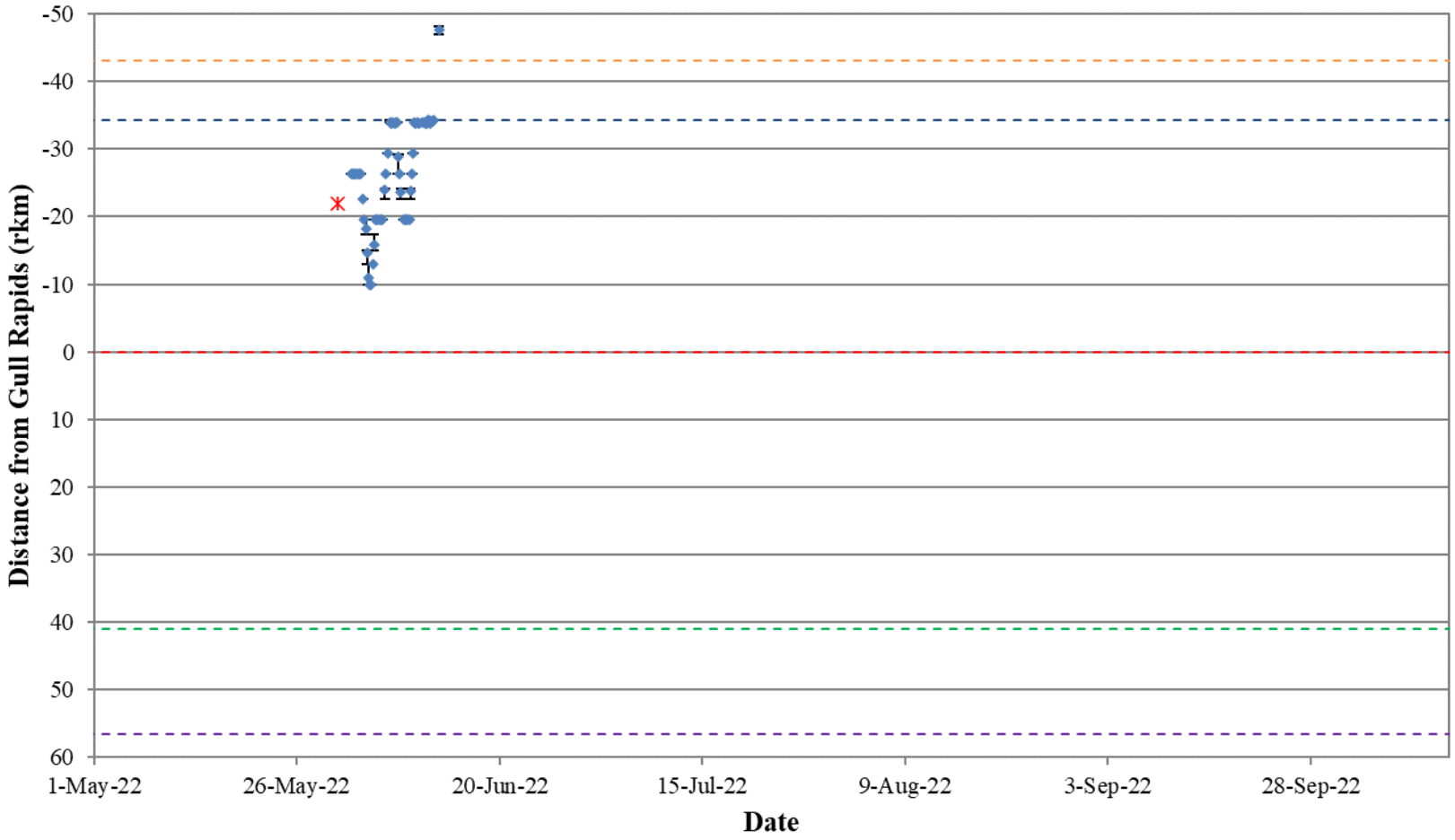

Figure A3-35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57486) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

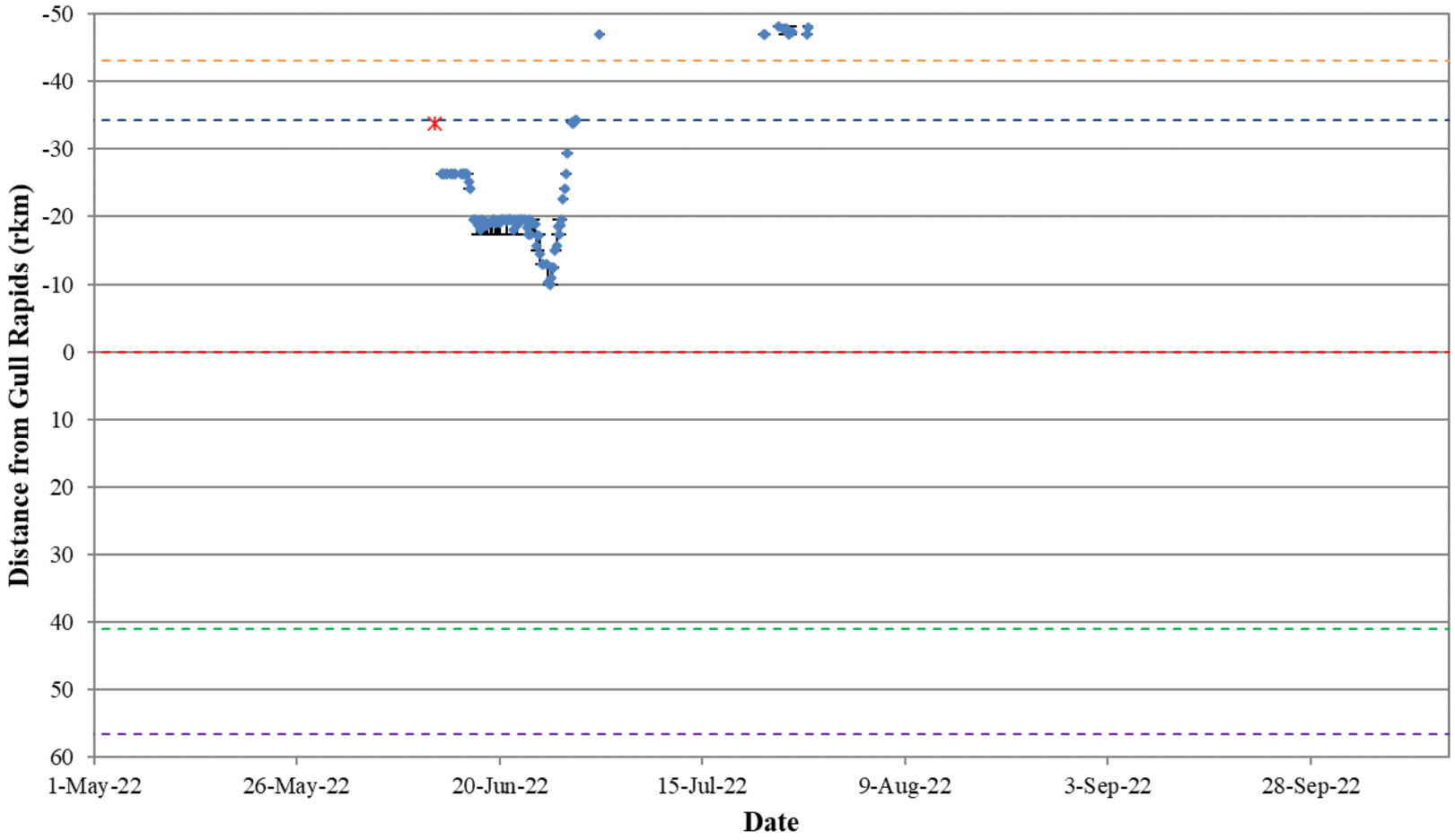

Figure A3-36: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57487) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

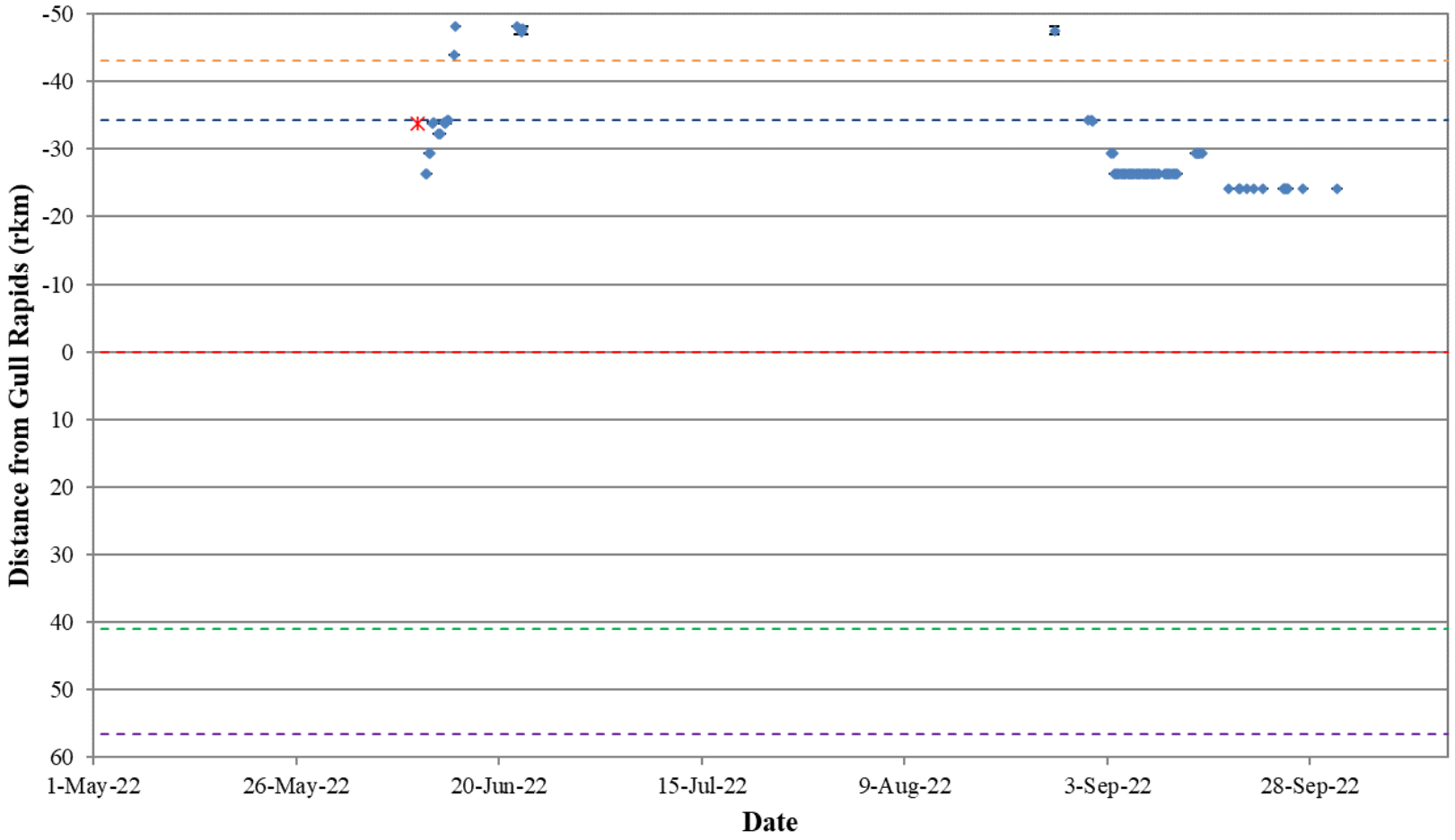

Figure A3-37: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57488) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

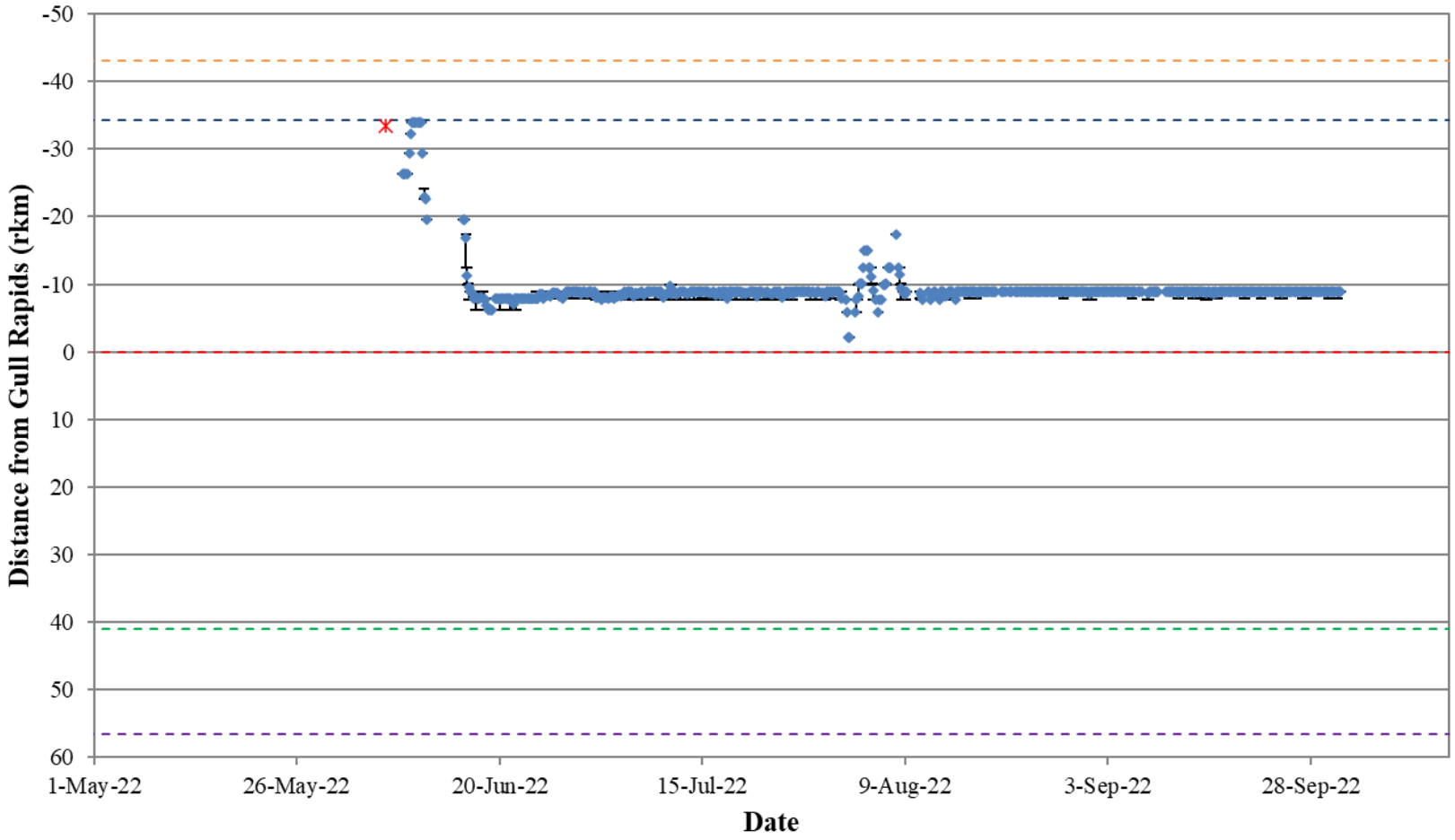

Figure A3-38: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57489) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

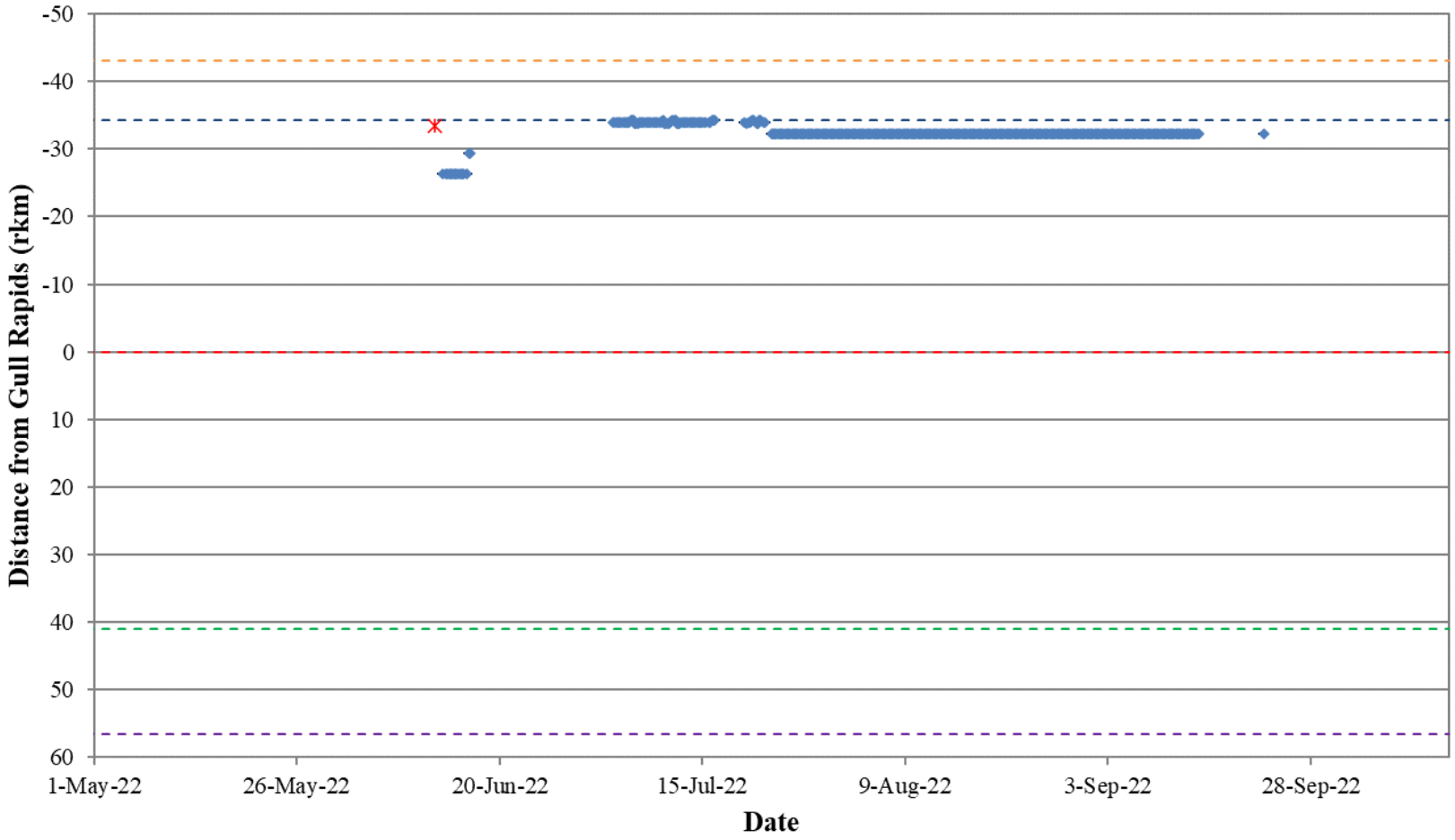

Figure A3-39: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57490) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

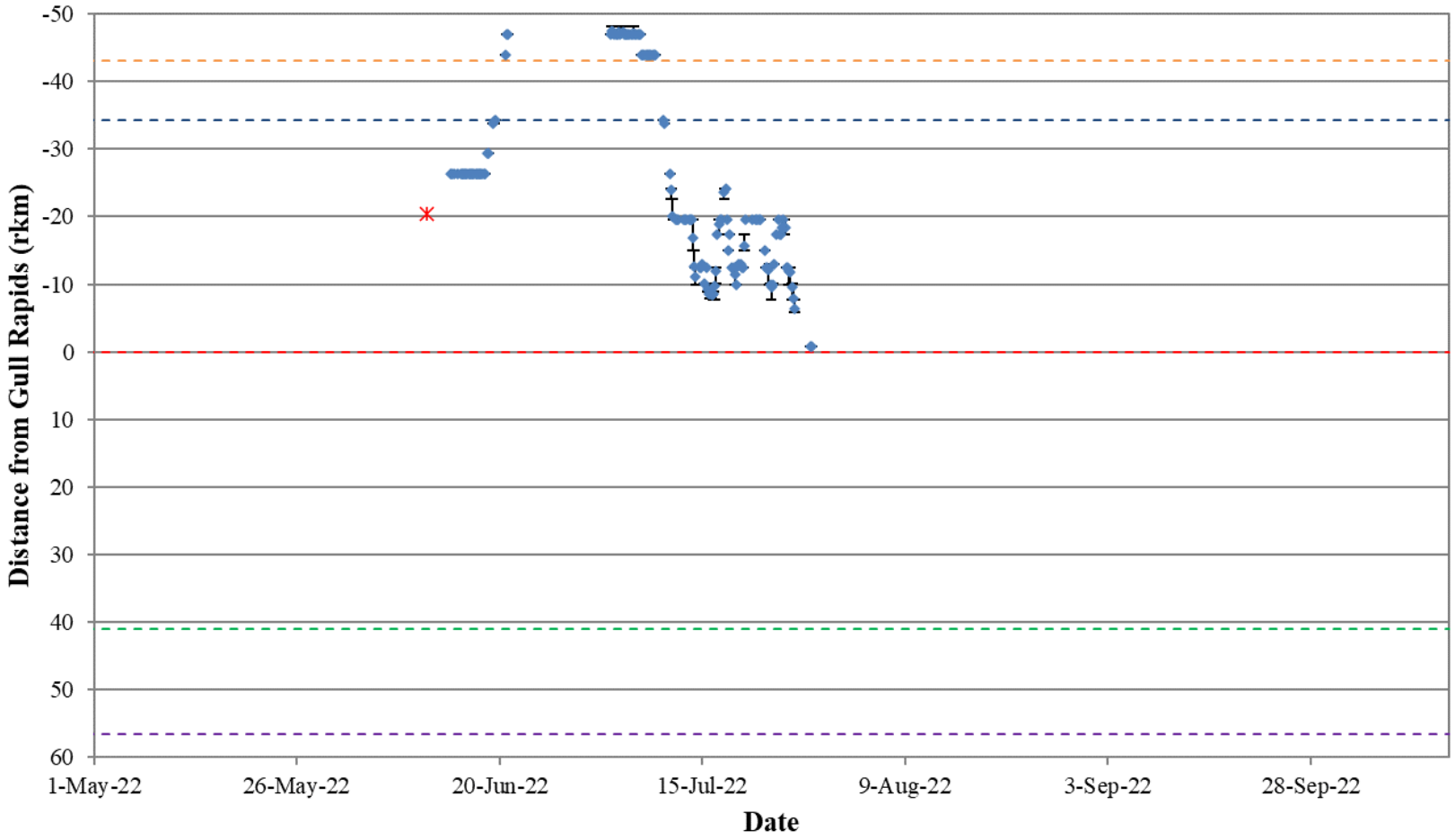

Figure A3-40: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57491) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

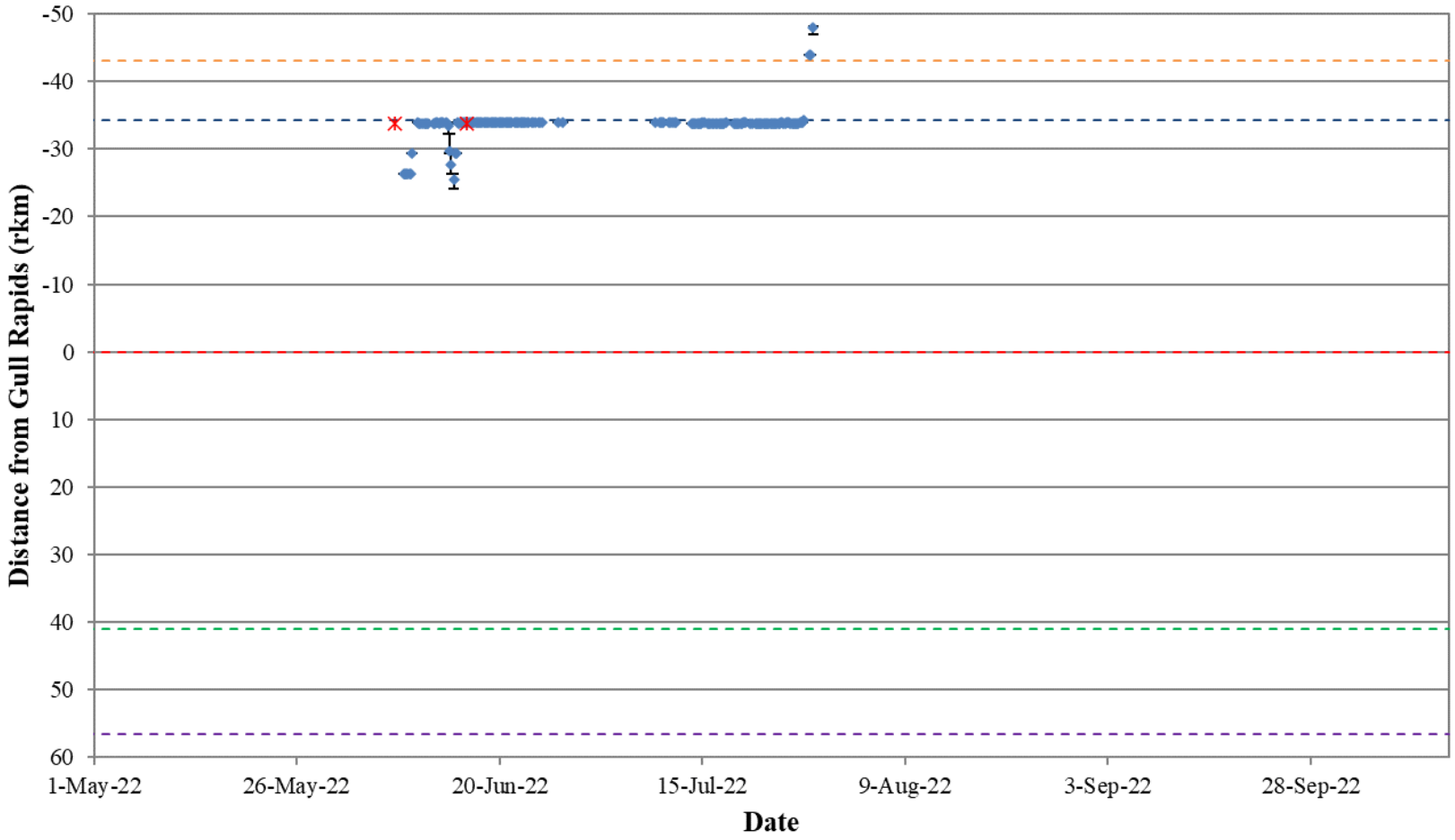

Figure A3-41: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57492) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

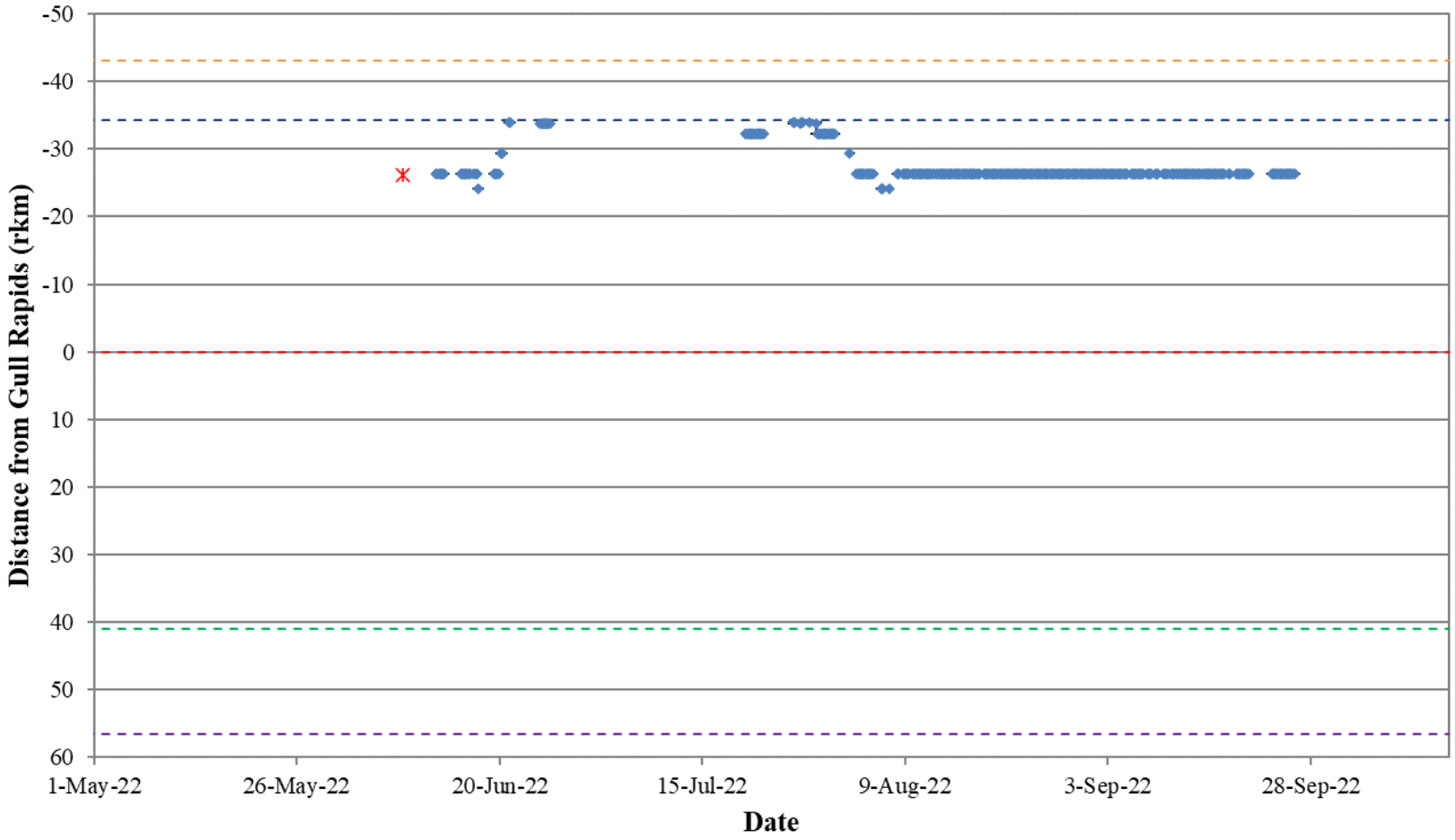

Figure A3-42: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57494) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

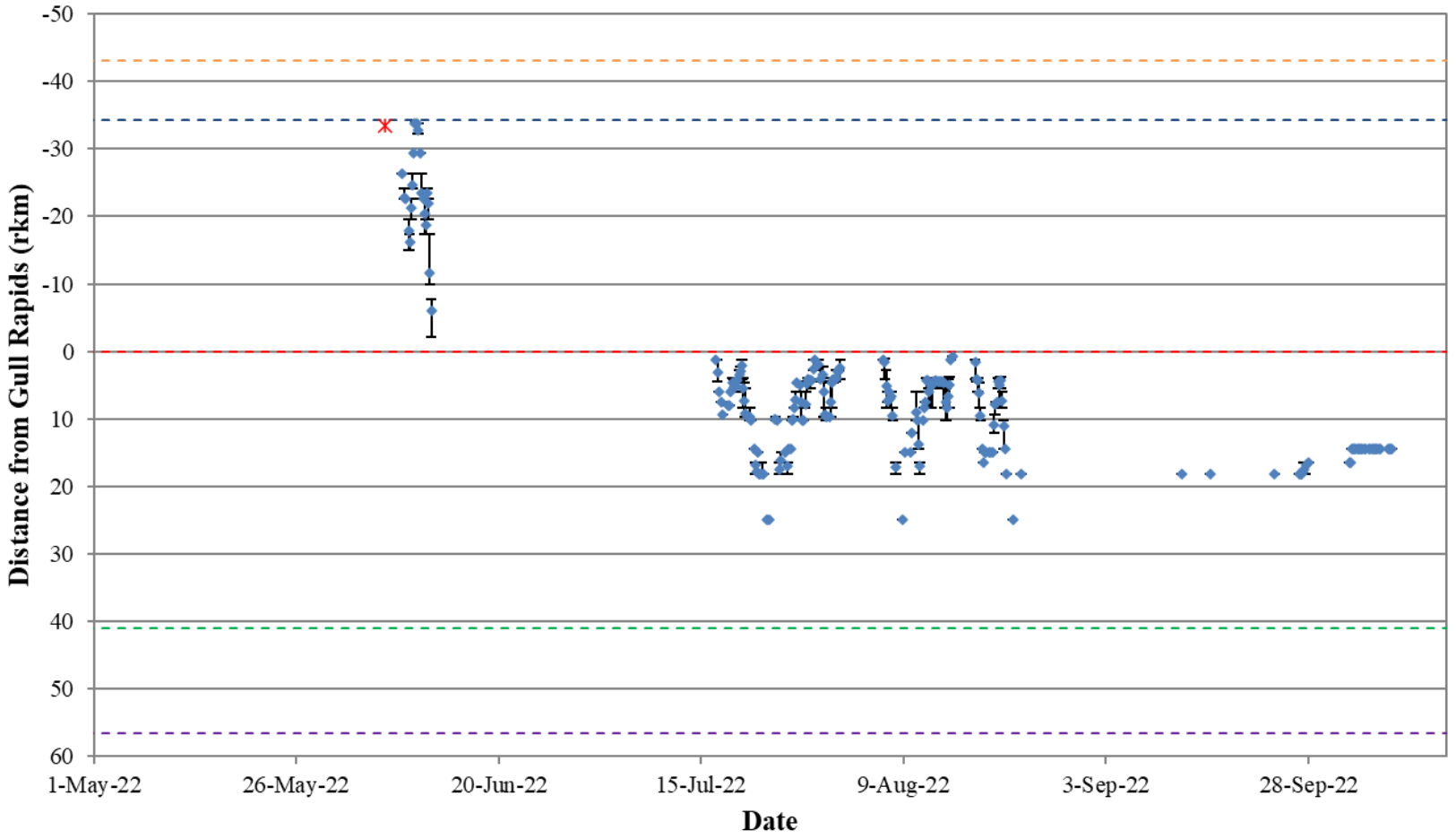

Figure A3-43: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57495) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

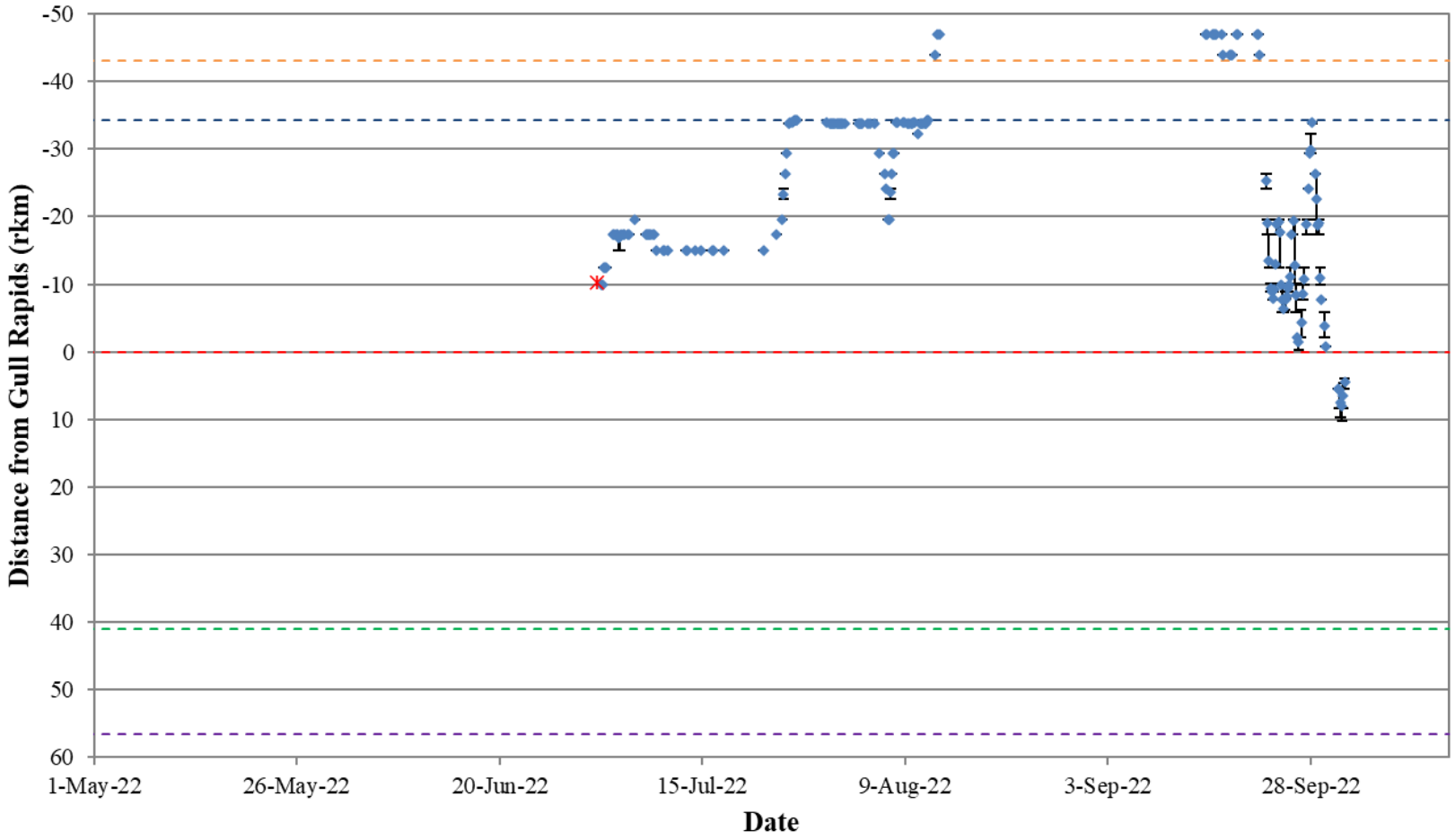

Figure A3-44: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57502) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

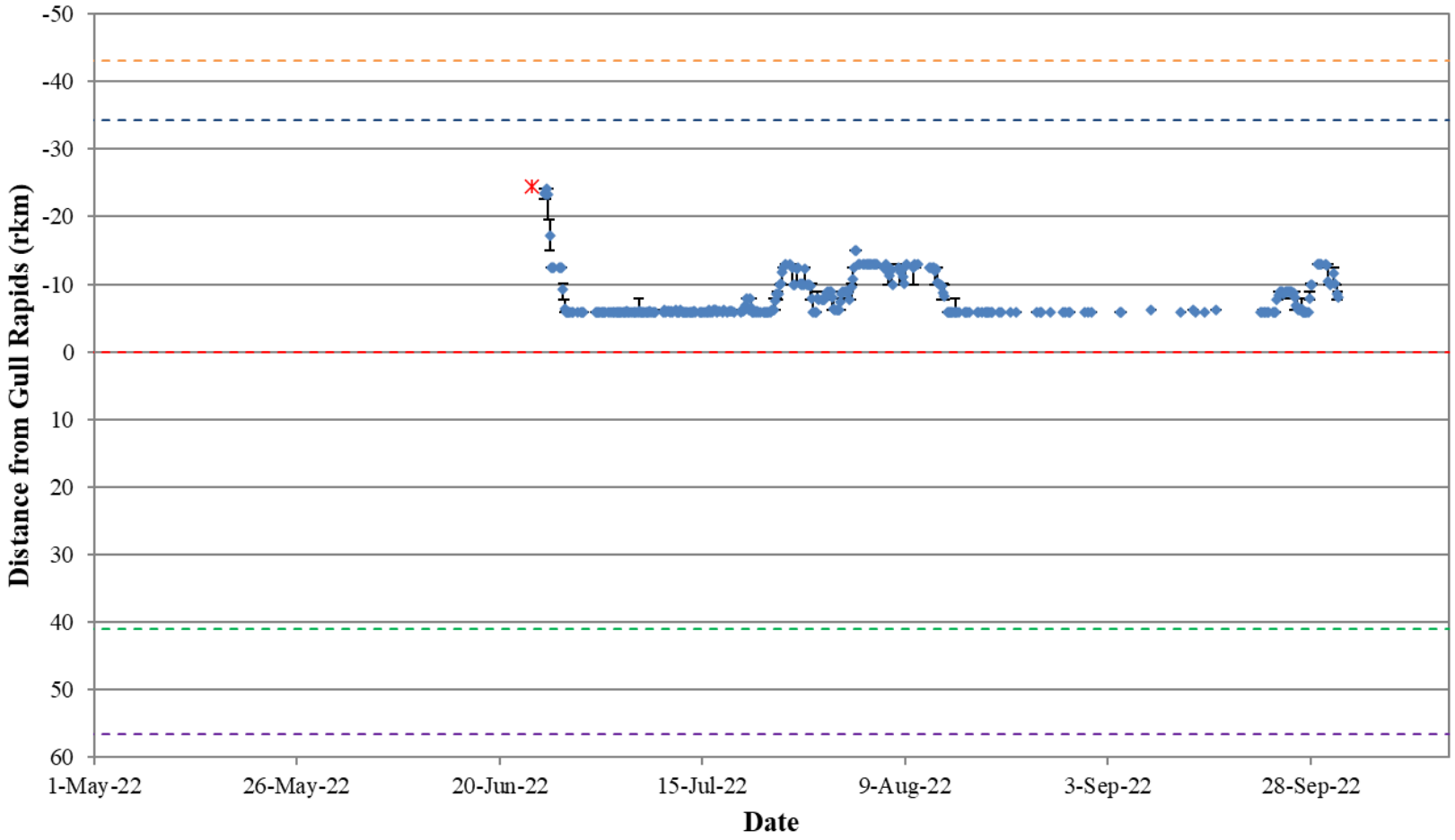

Figure A3-45: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57504) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

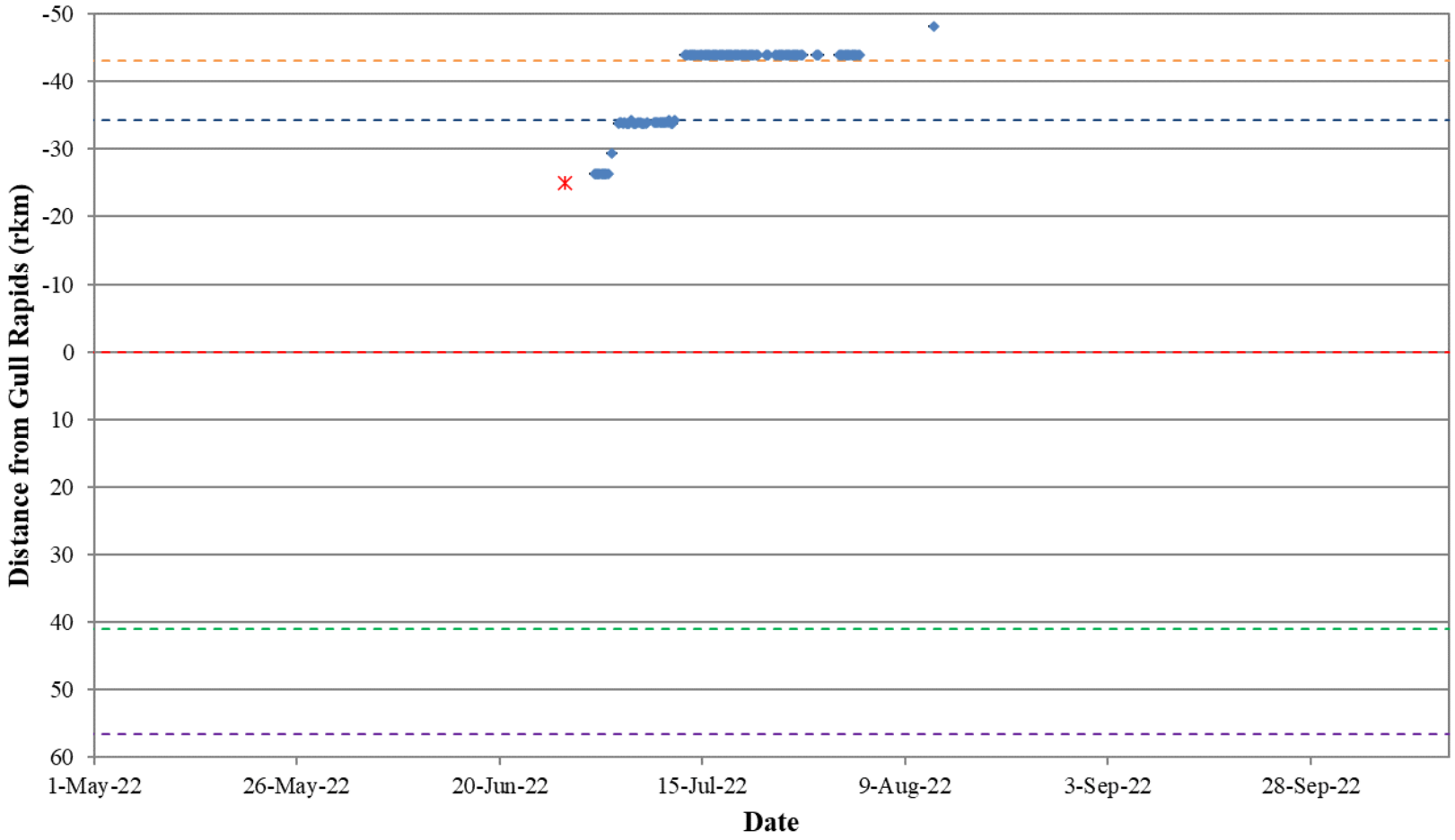

Figure A3-46: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57505) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

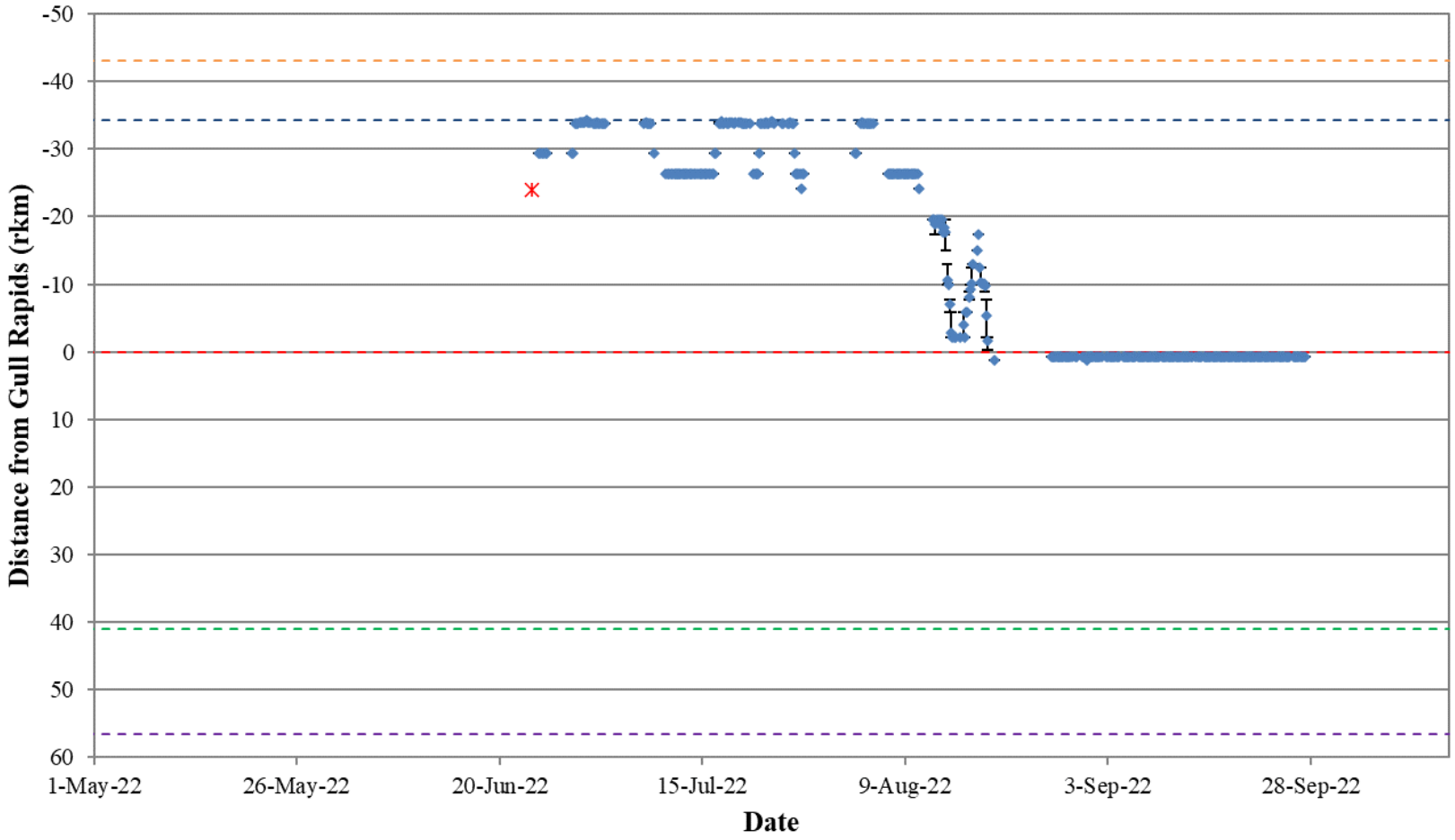

Figure A3-47: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57506) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

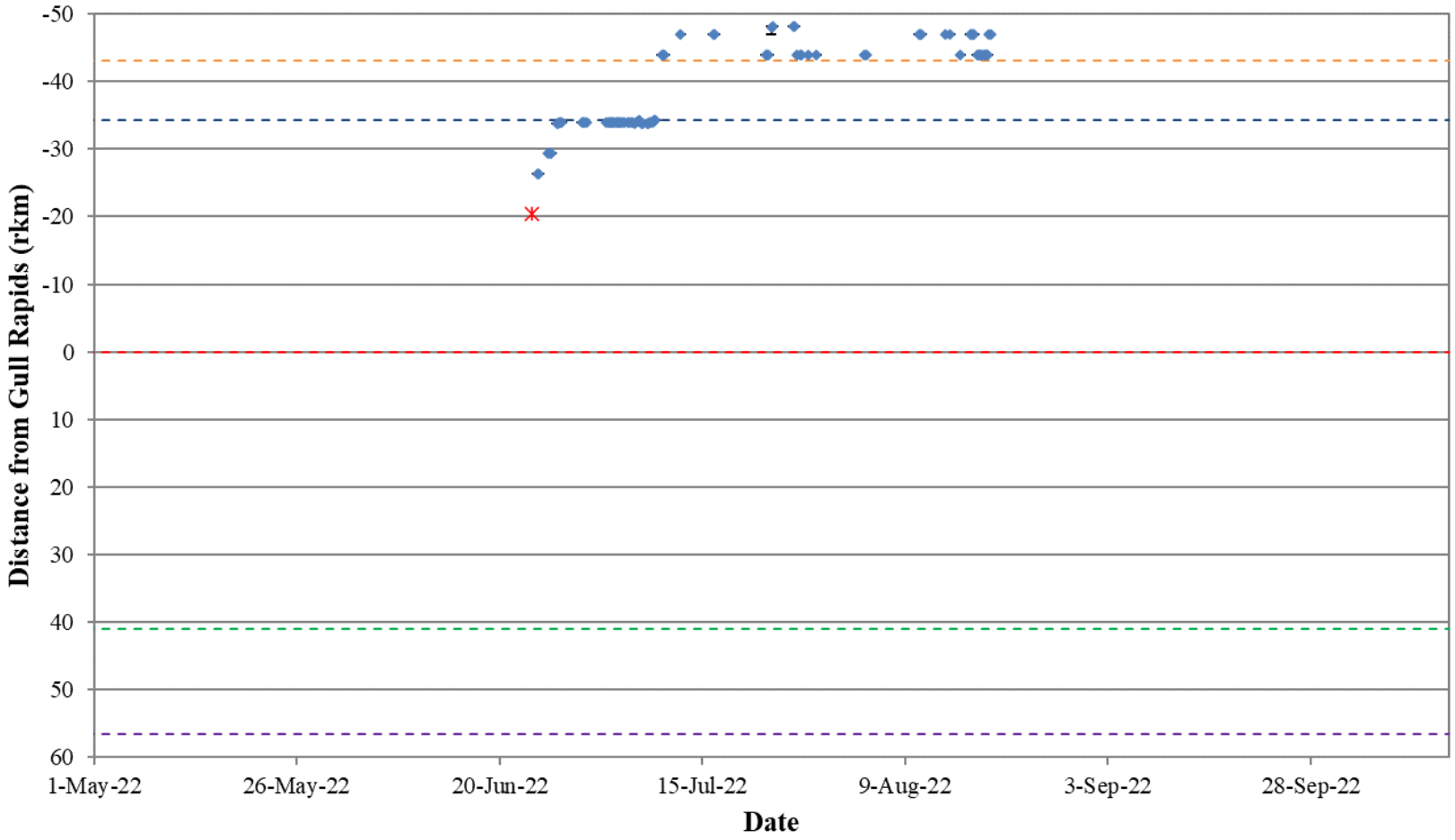

Figure A3-48: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #57507) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 16 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 4:
LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, STEPHENS LAKE, MAY 2019 TO OCTOBER 2022

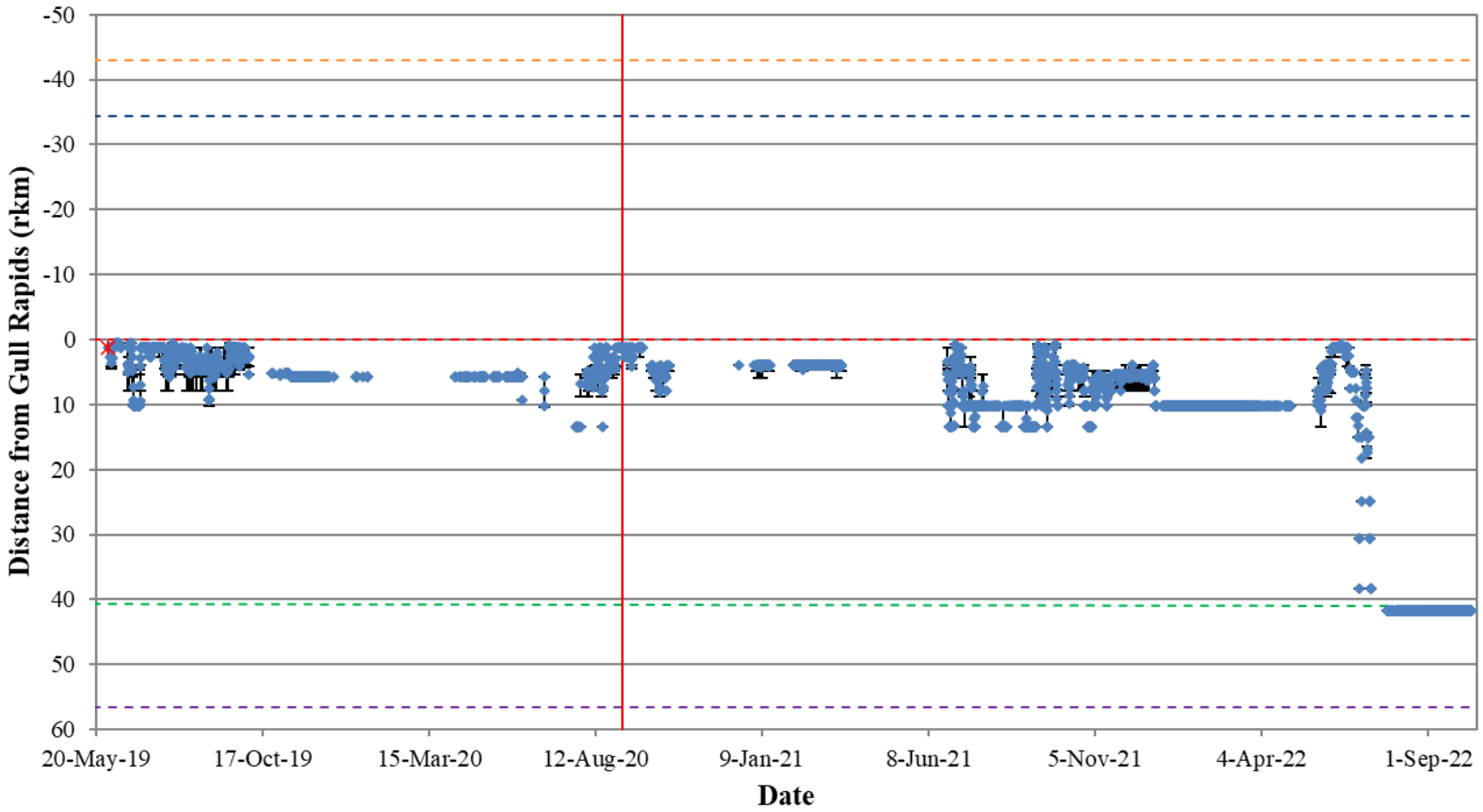

Figure A4-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7035) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

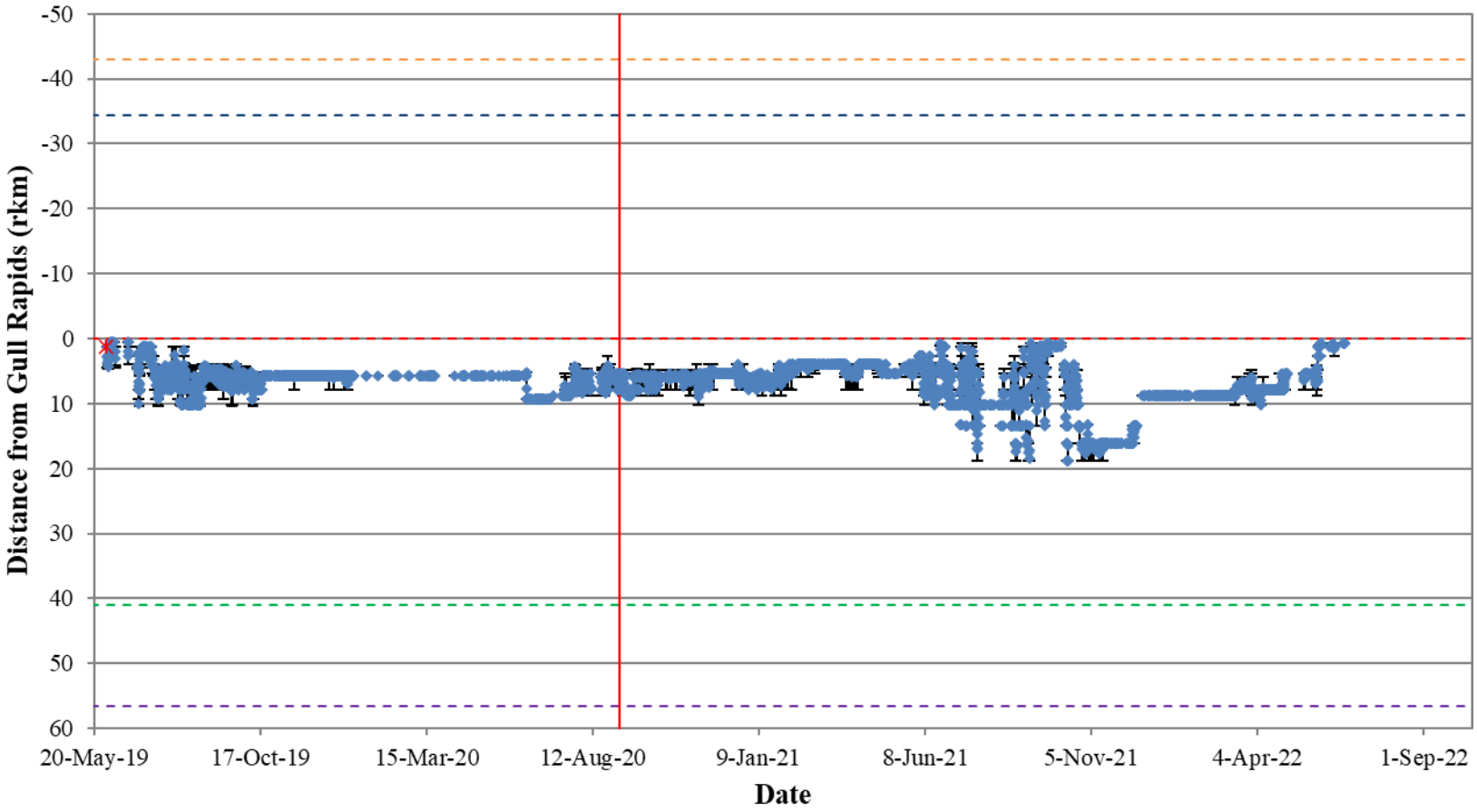

Figure A4-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7036) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

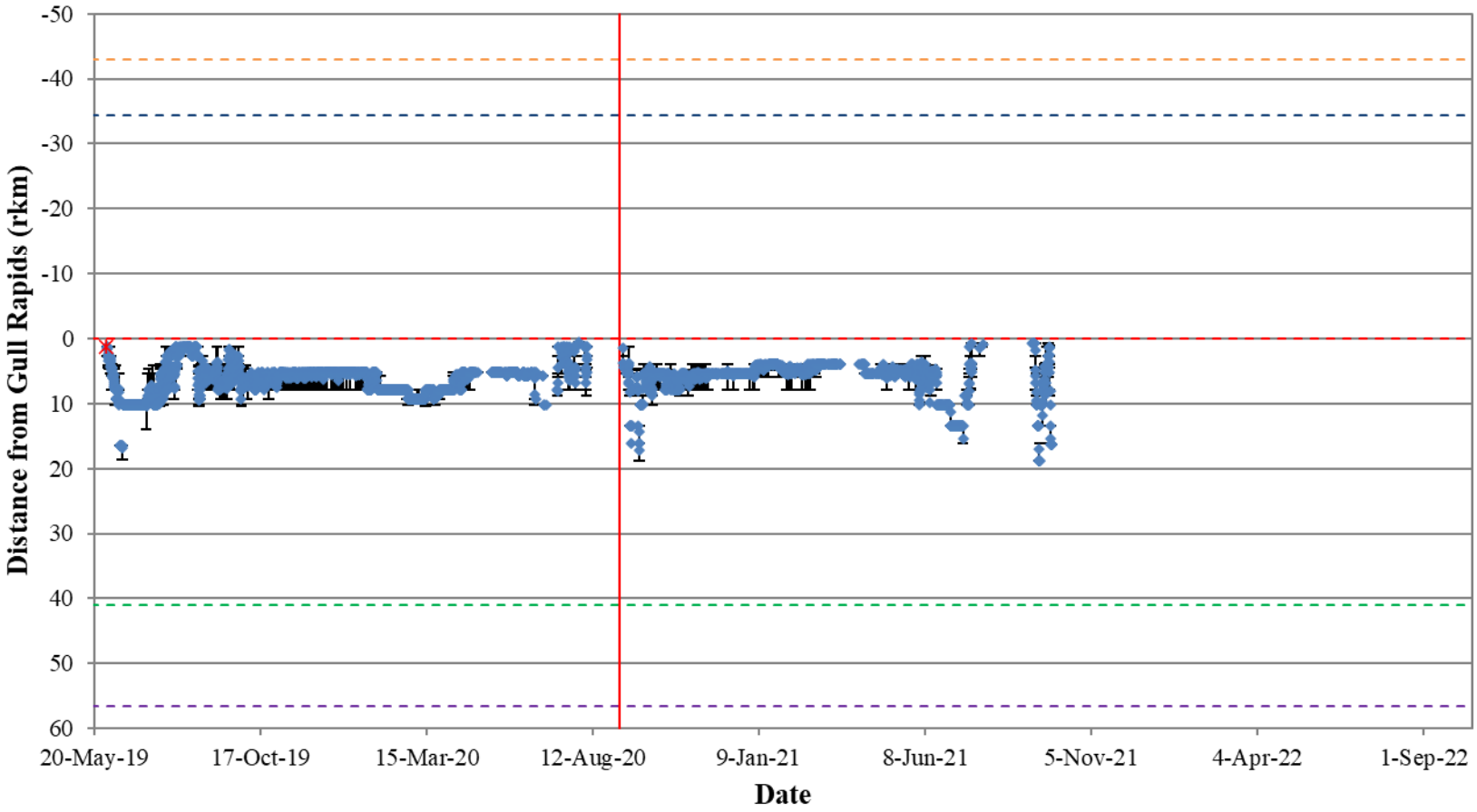

Figure A4-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7037) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

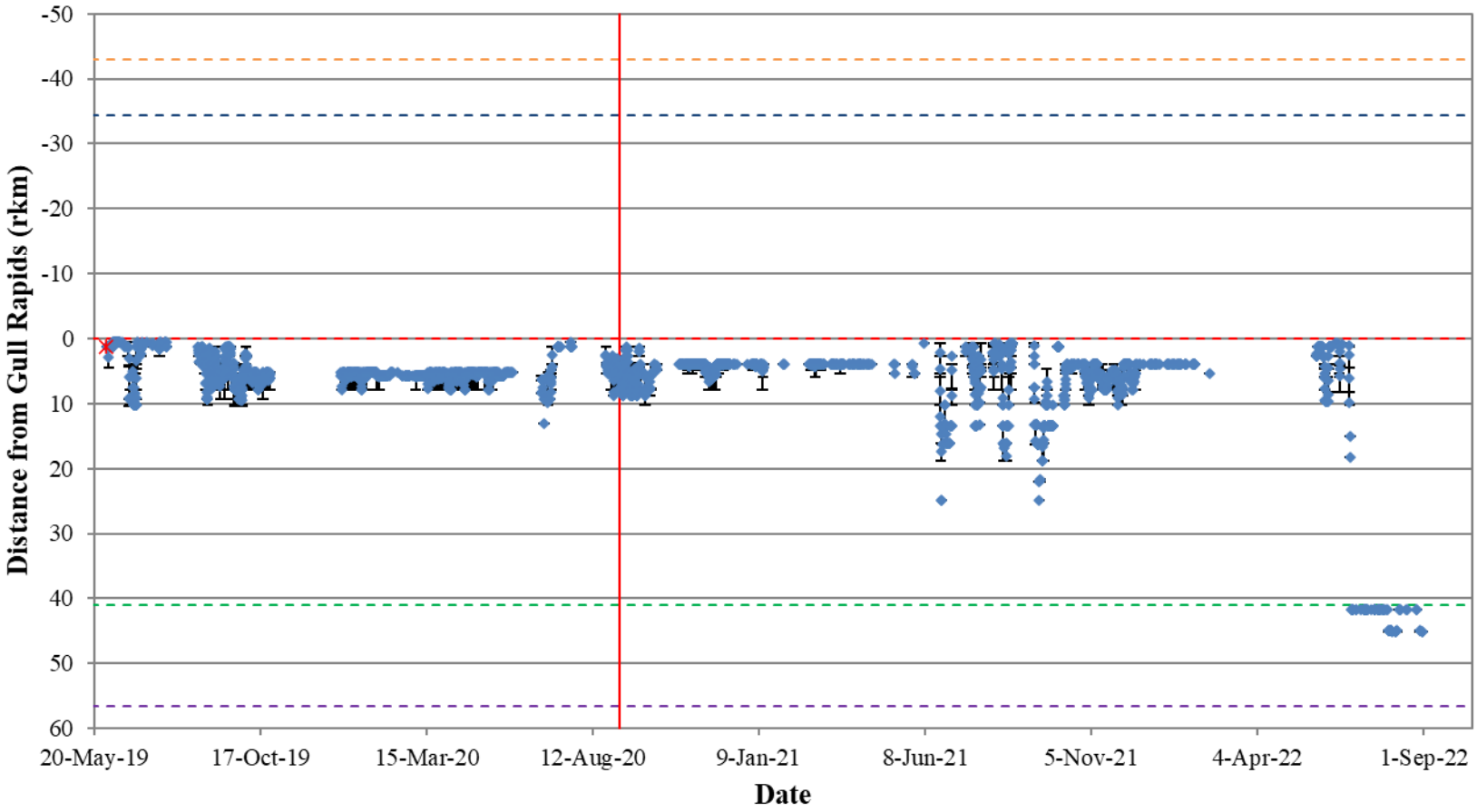

Figure A4-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7038) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

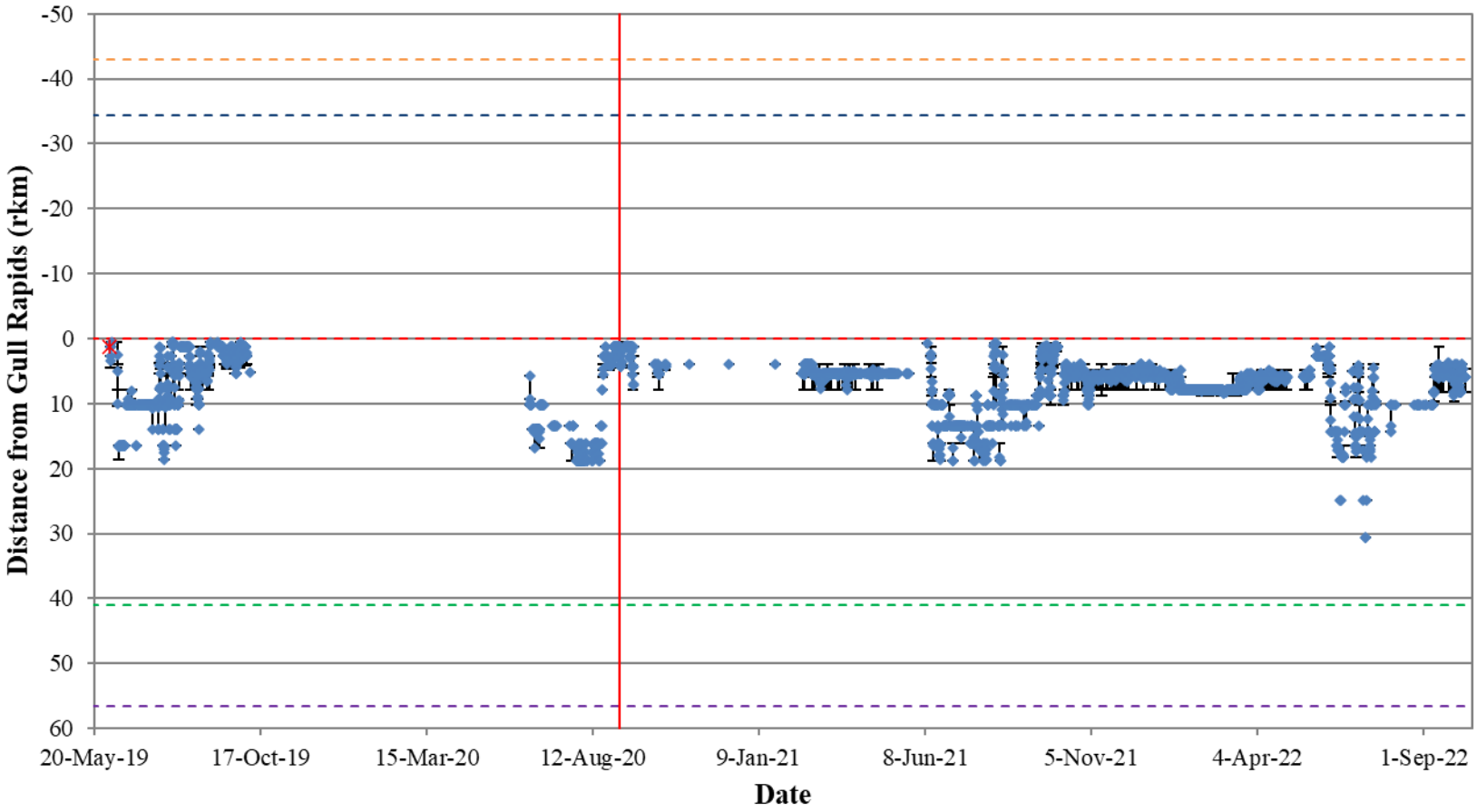

Figure A4-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7039) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

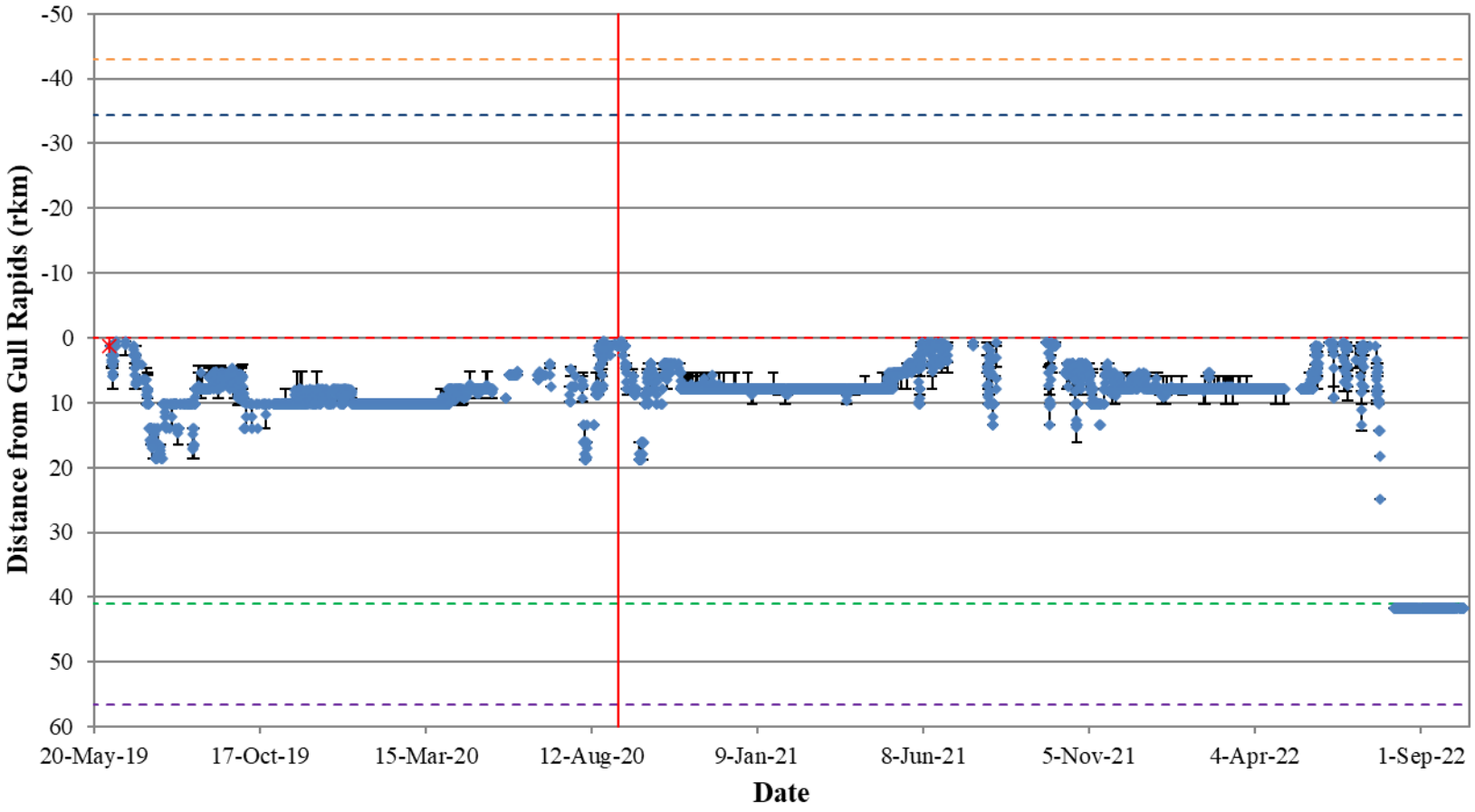

Figure A4-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7040) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

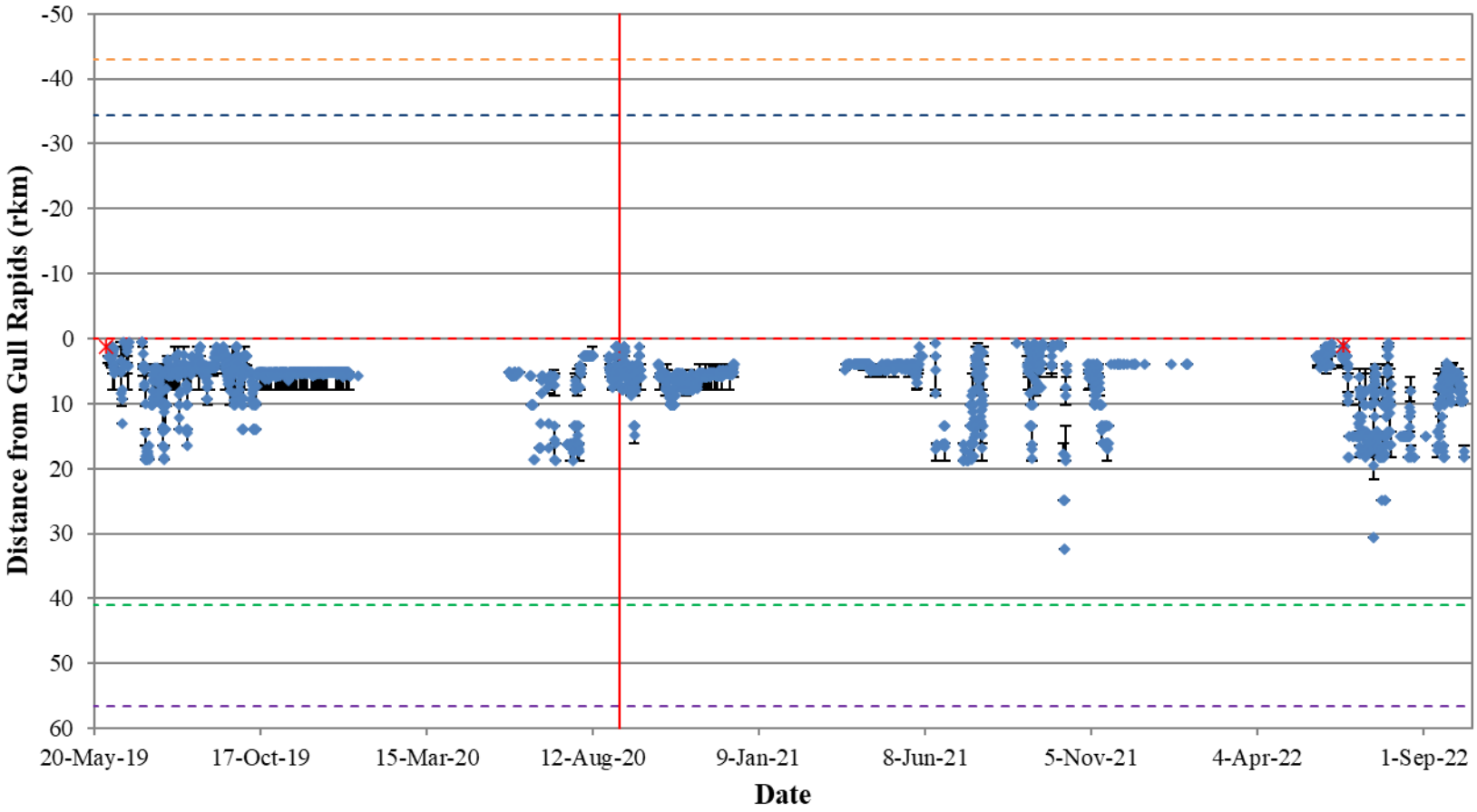

Figure A4-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7041) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

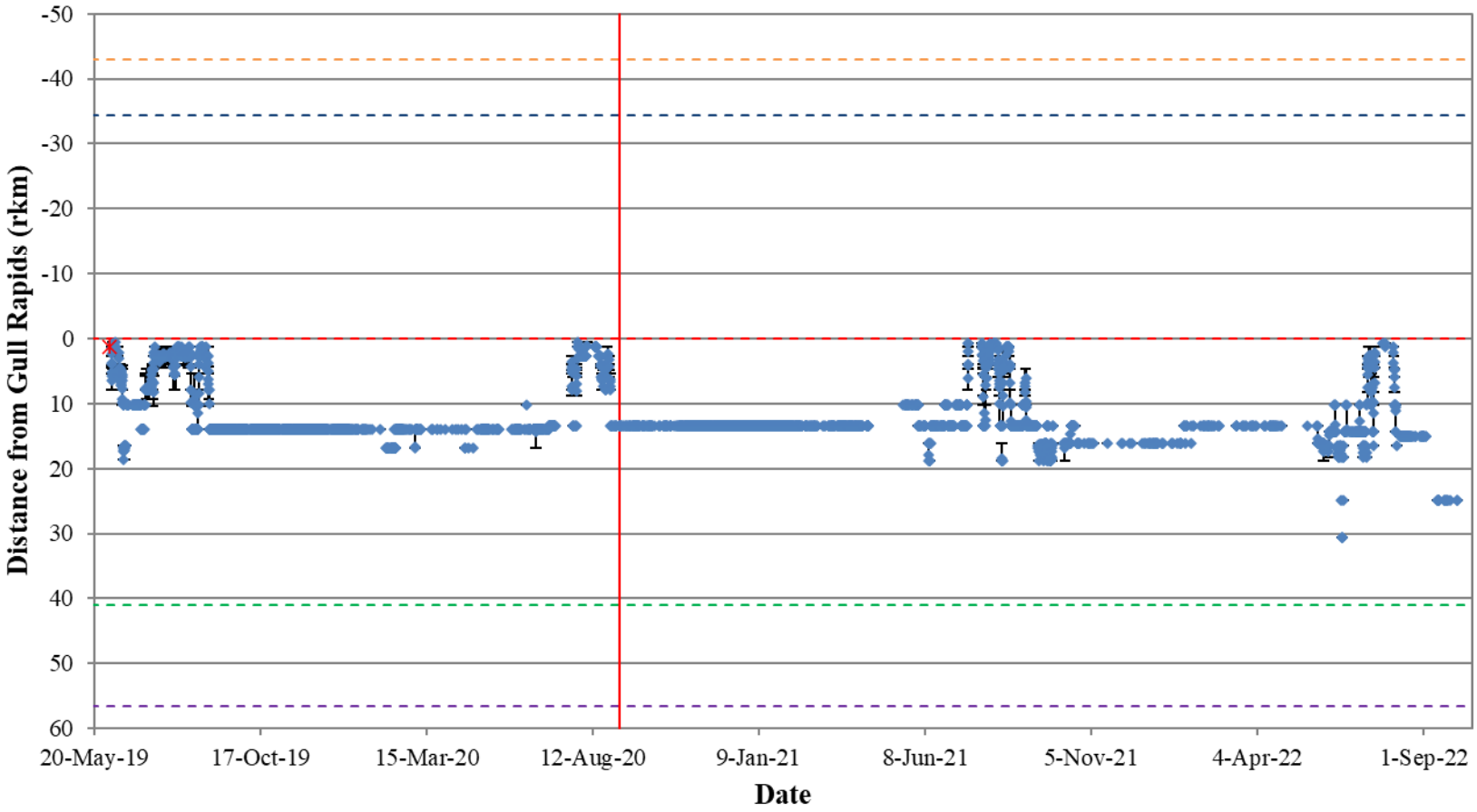

Figure A4-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7042) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

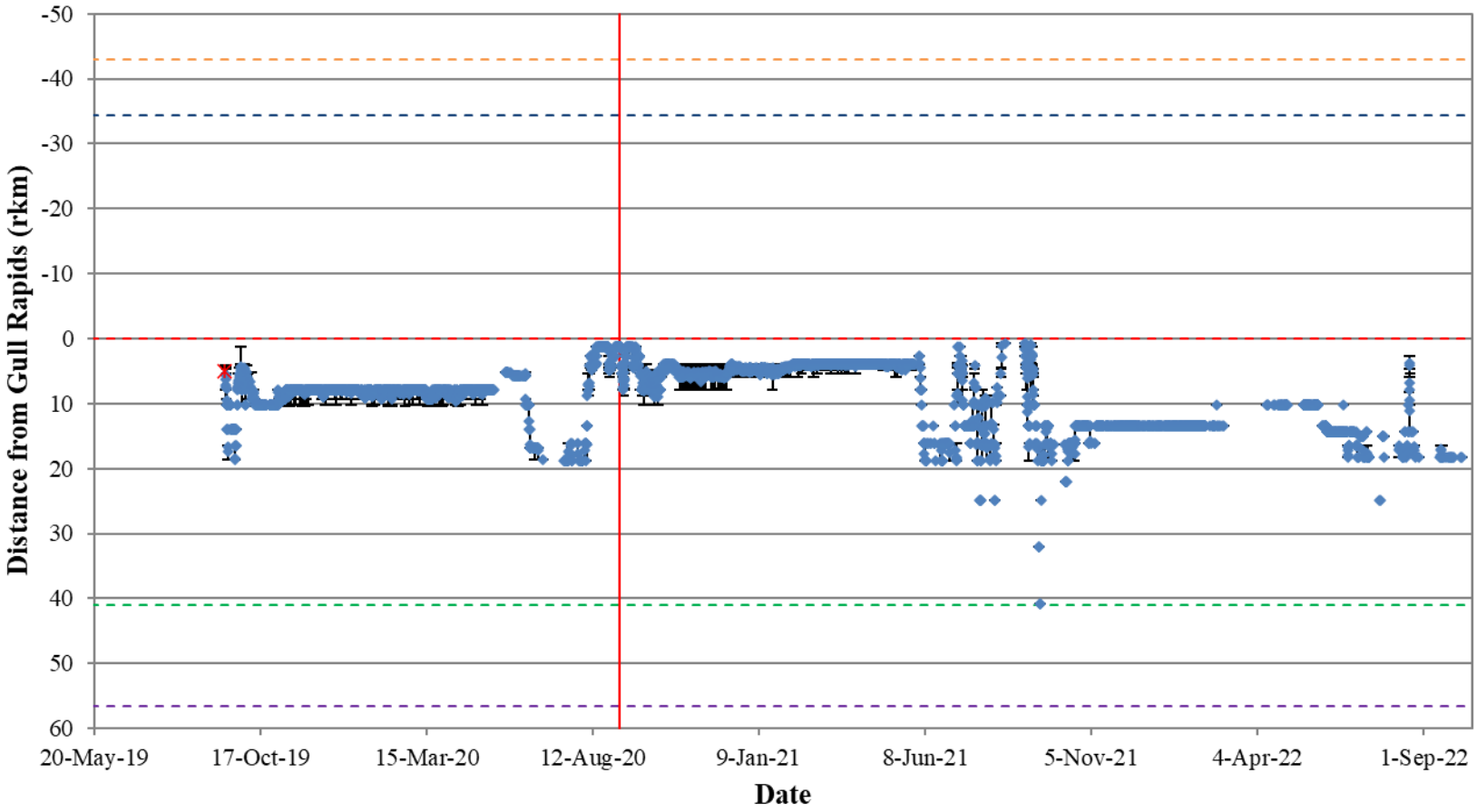

Figure A4-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7043) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

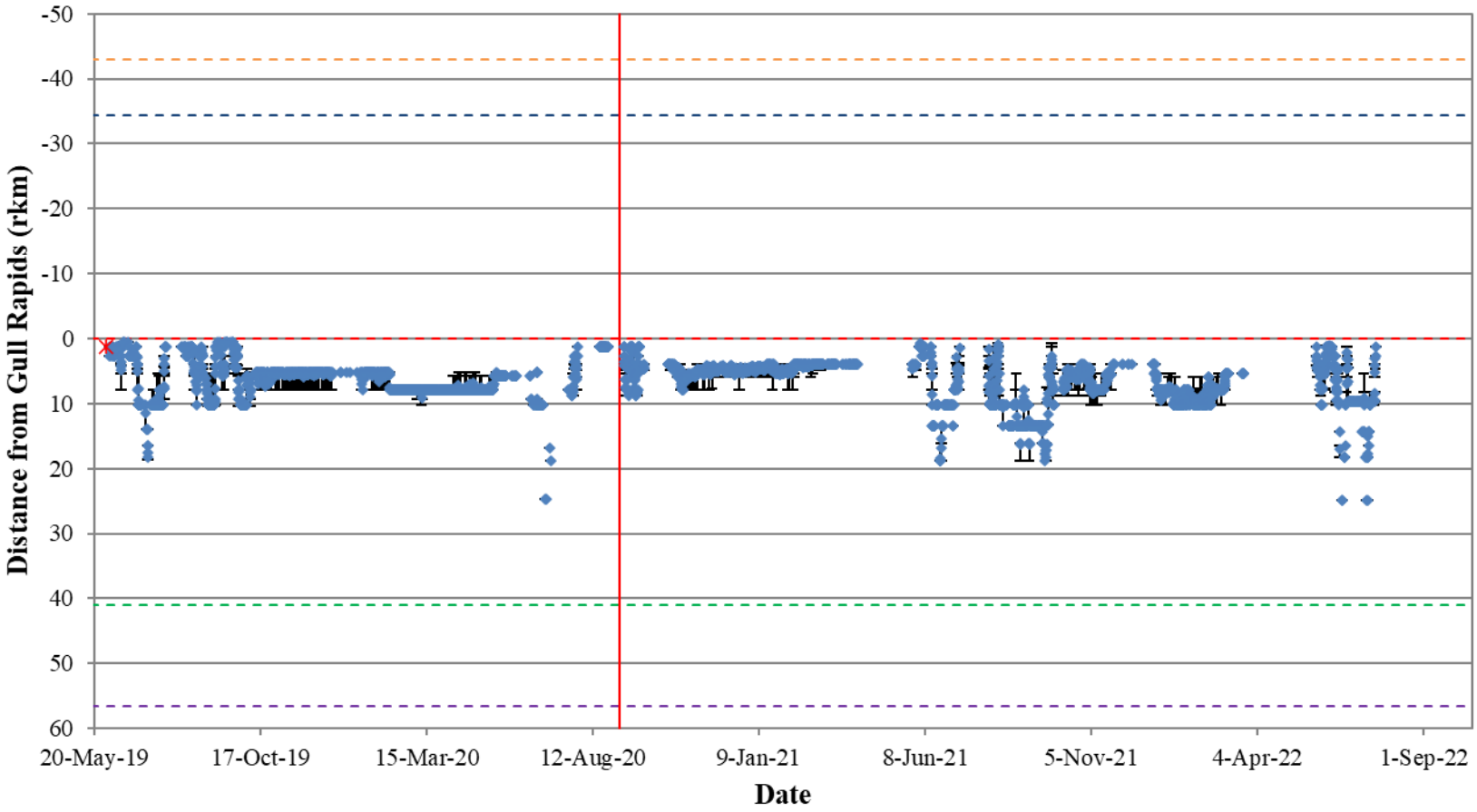

Figure A4-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7044) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

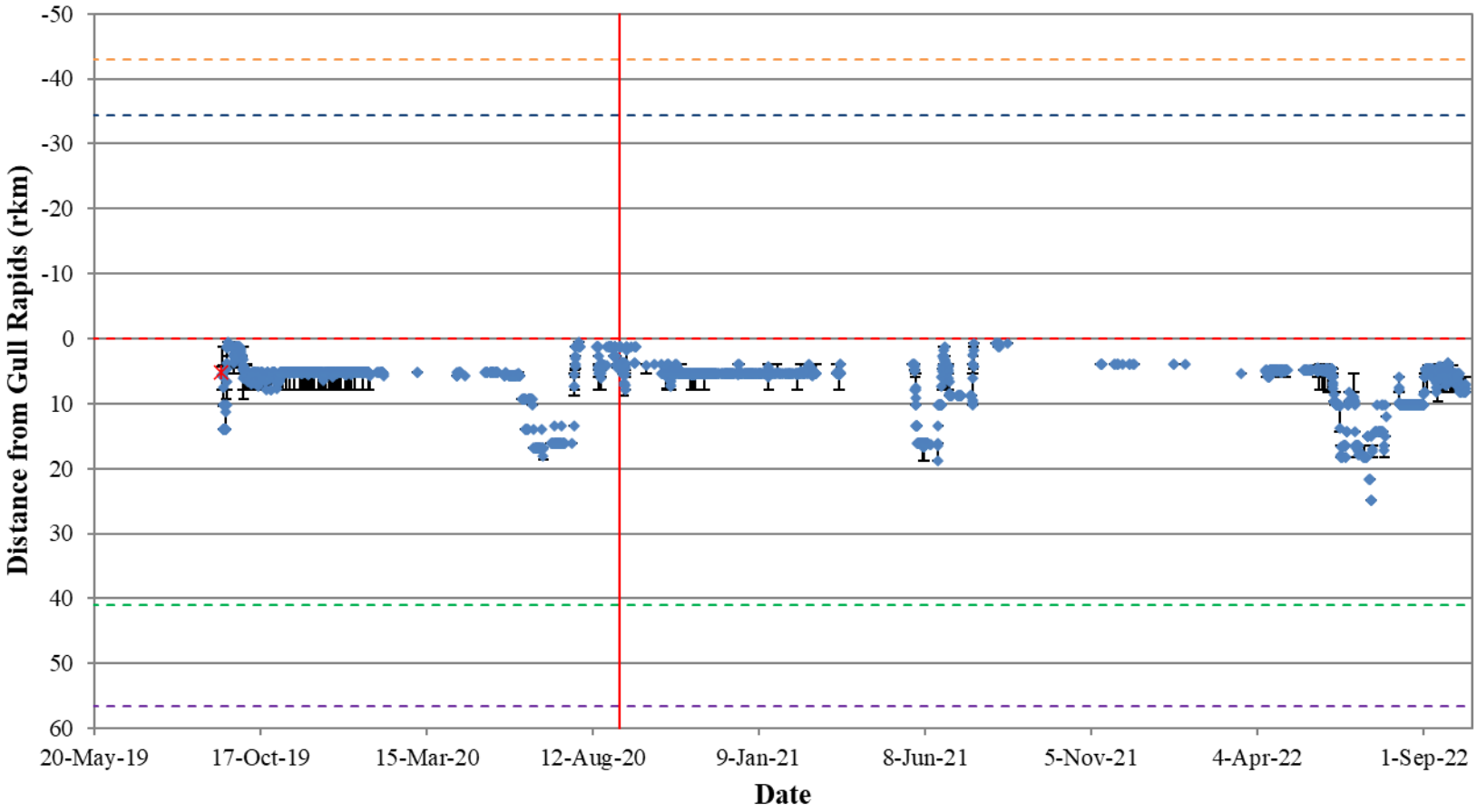

Figure A4-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7045) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

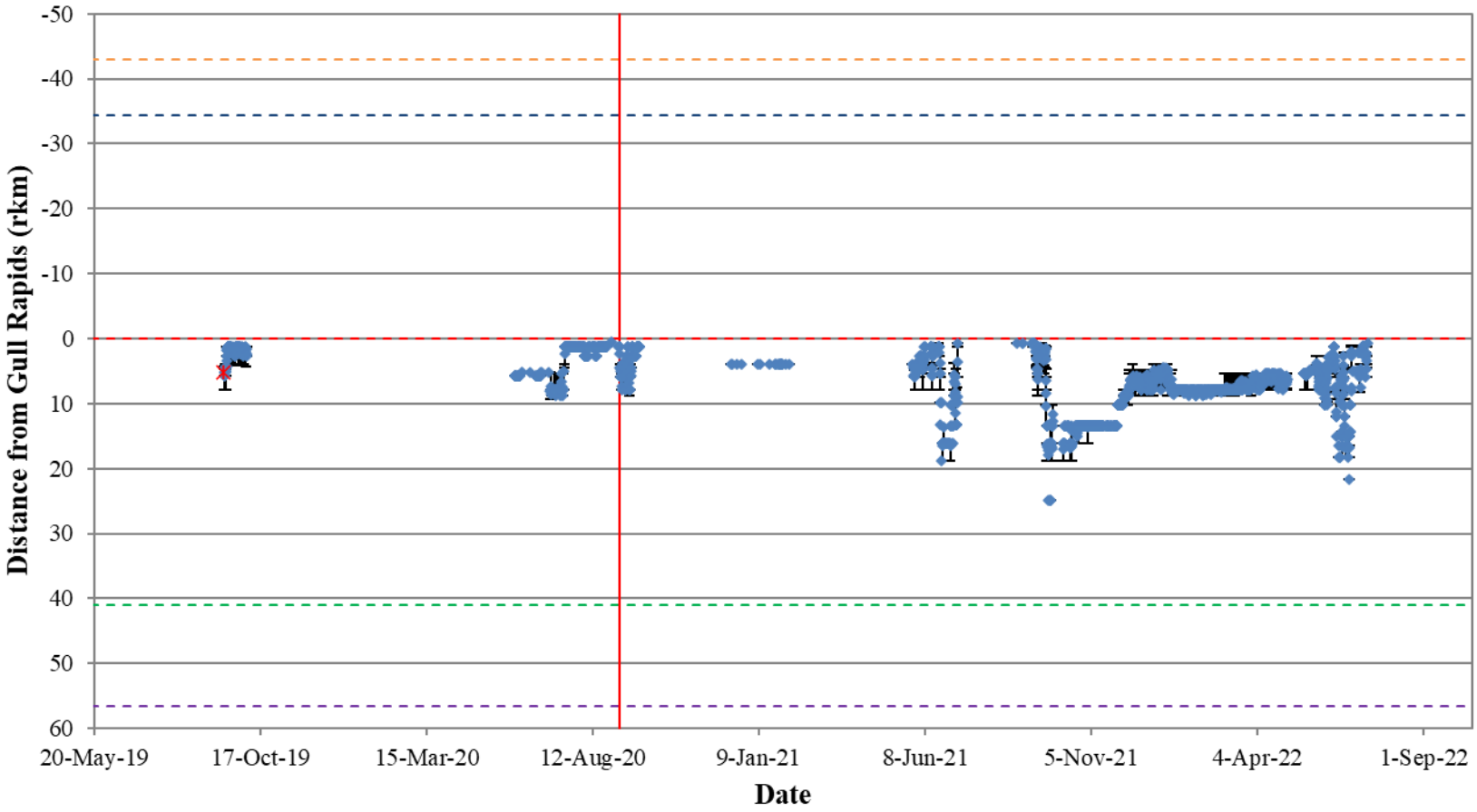

Figure A4-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7046) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

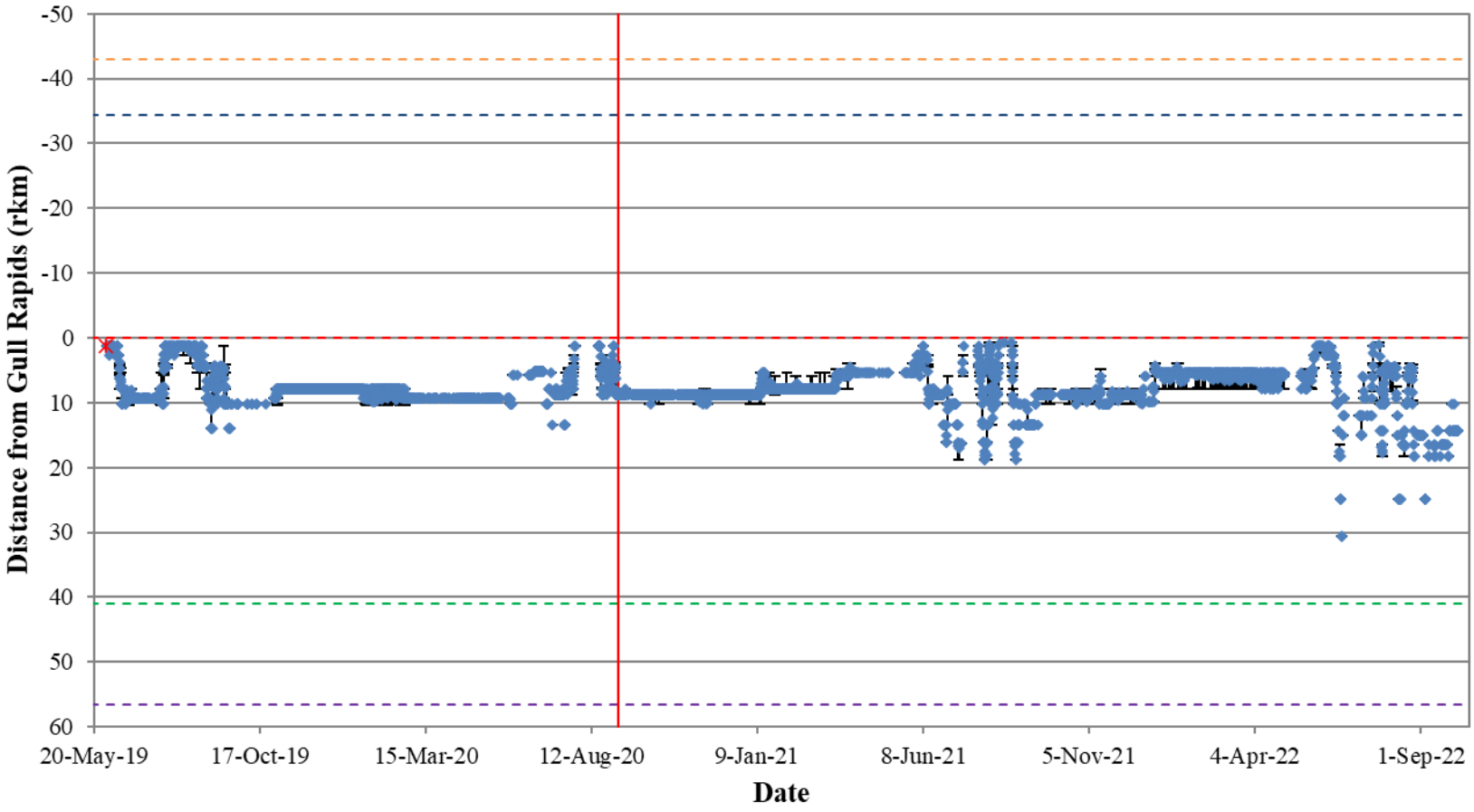

Figure A4-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7047) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

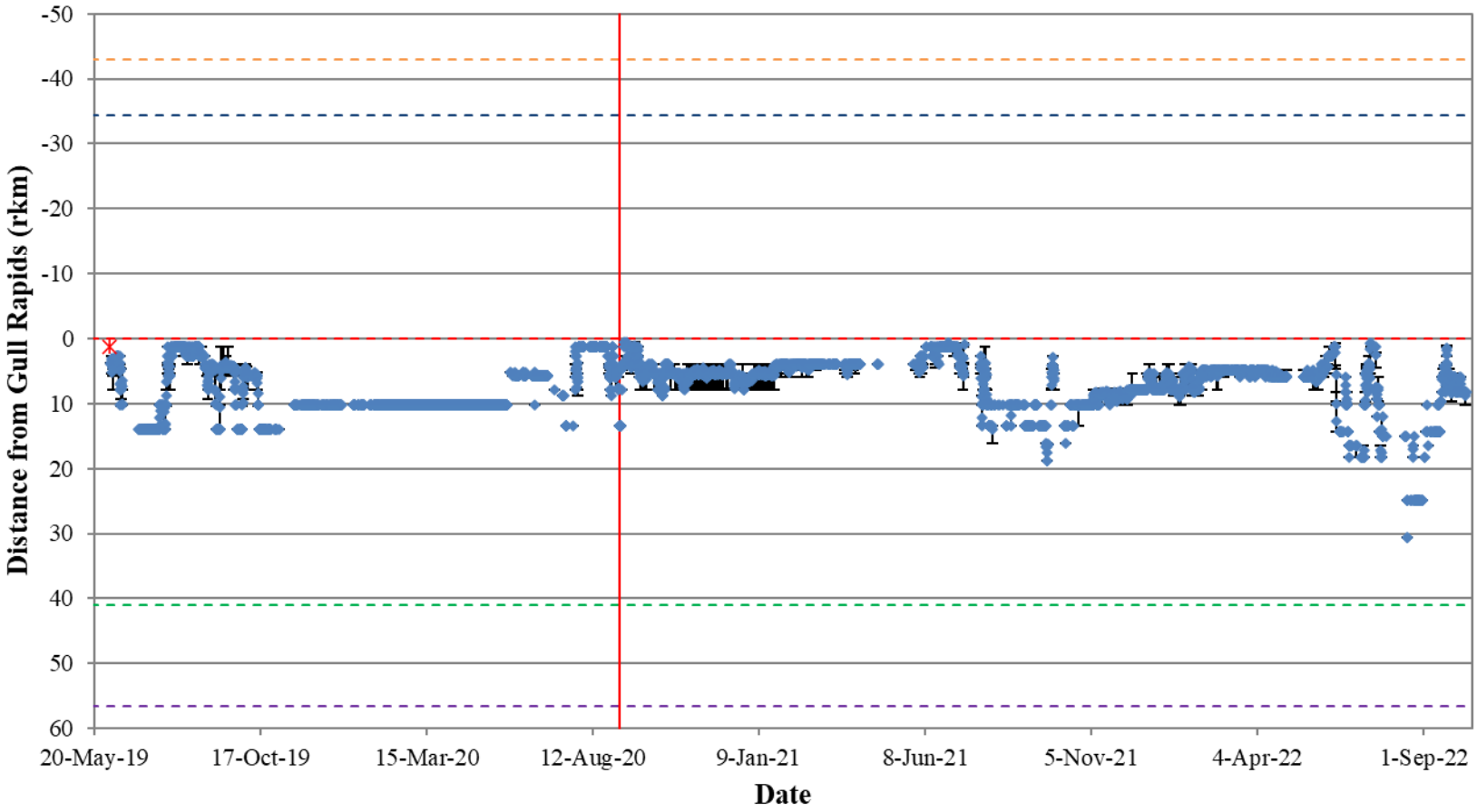

Figure A4-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7048) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

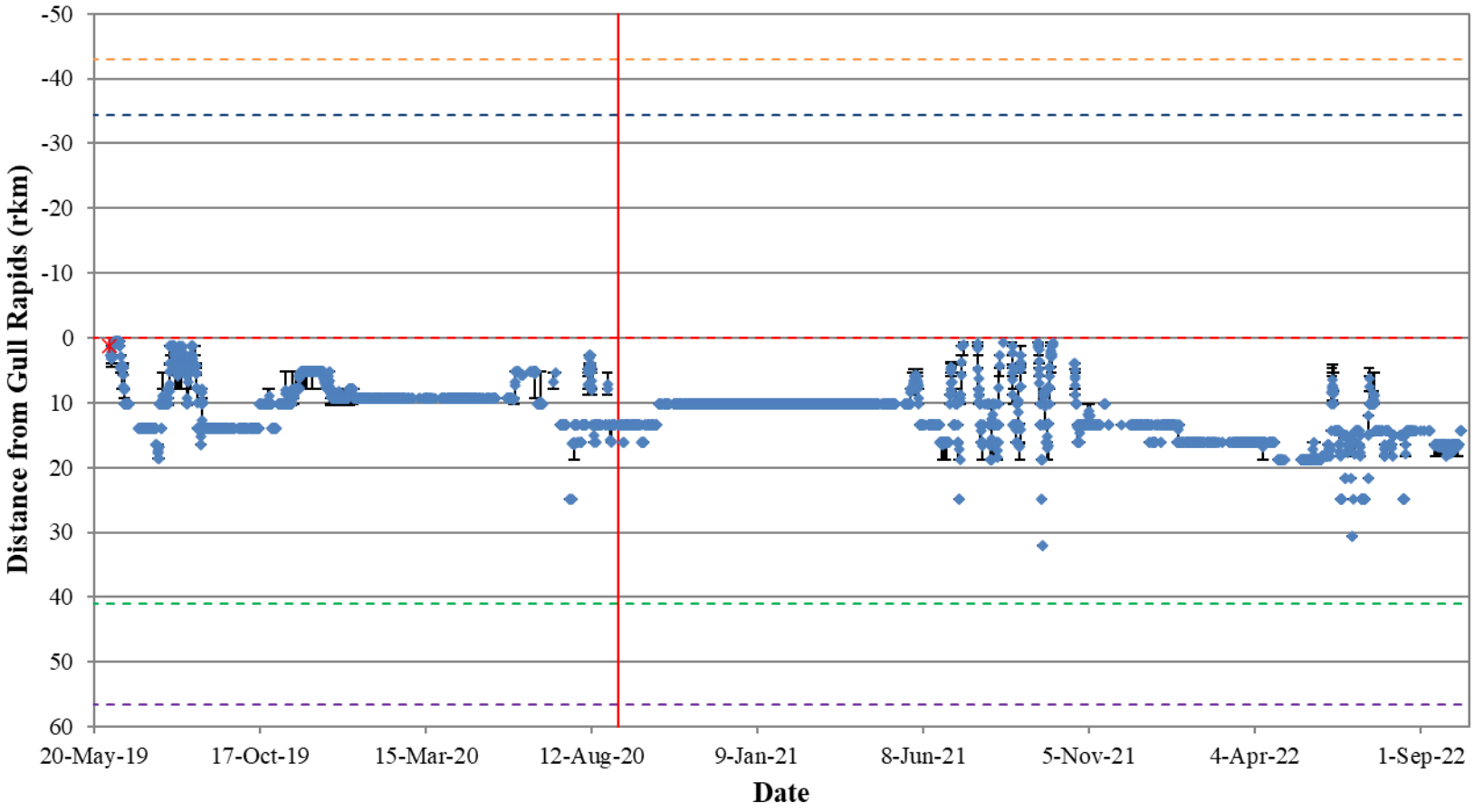

Figure A4-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7049) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

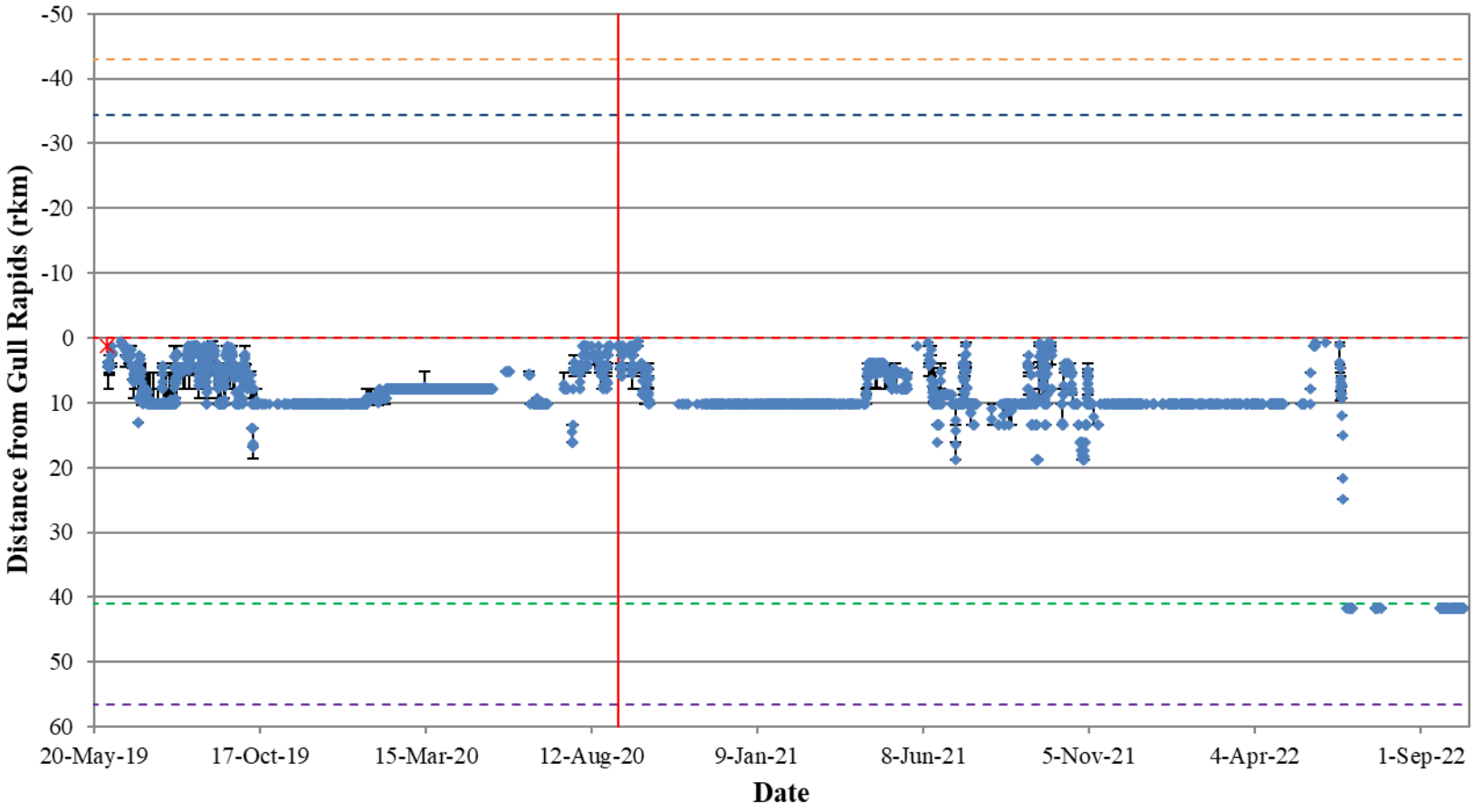

Figure A4-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7050) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

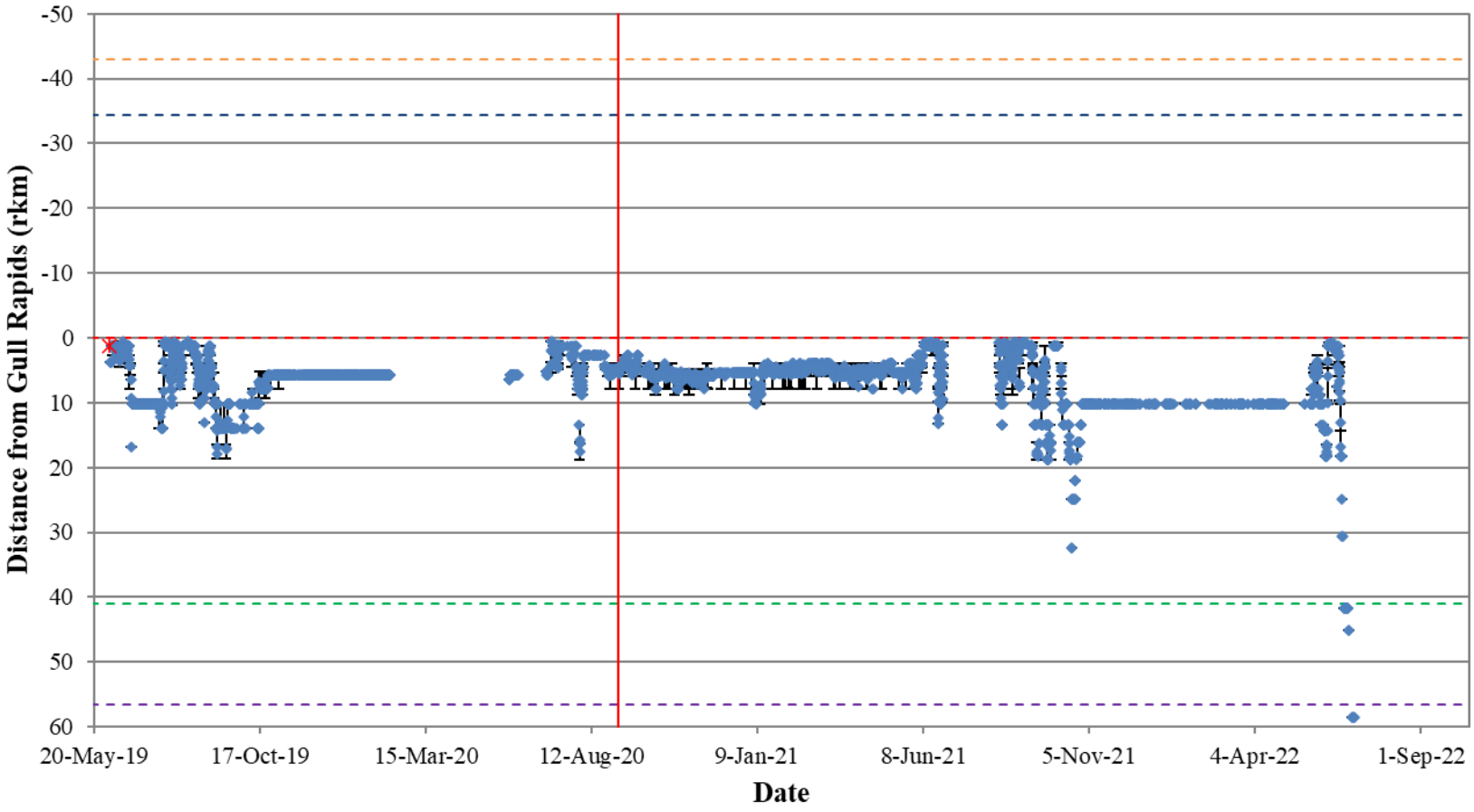

Figure A4-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7051) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

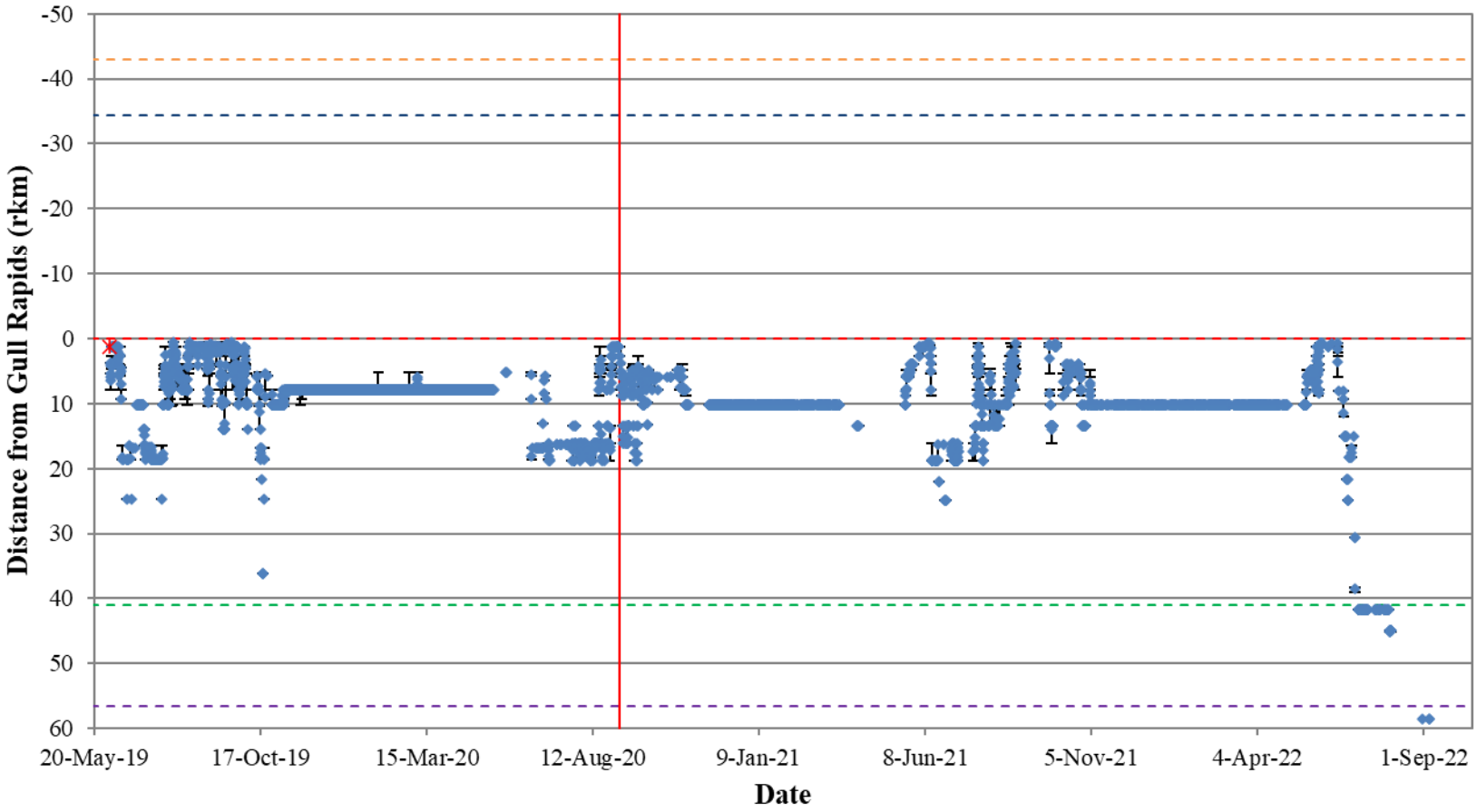

Figure A4-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7052) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

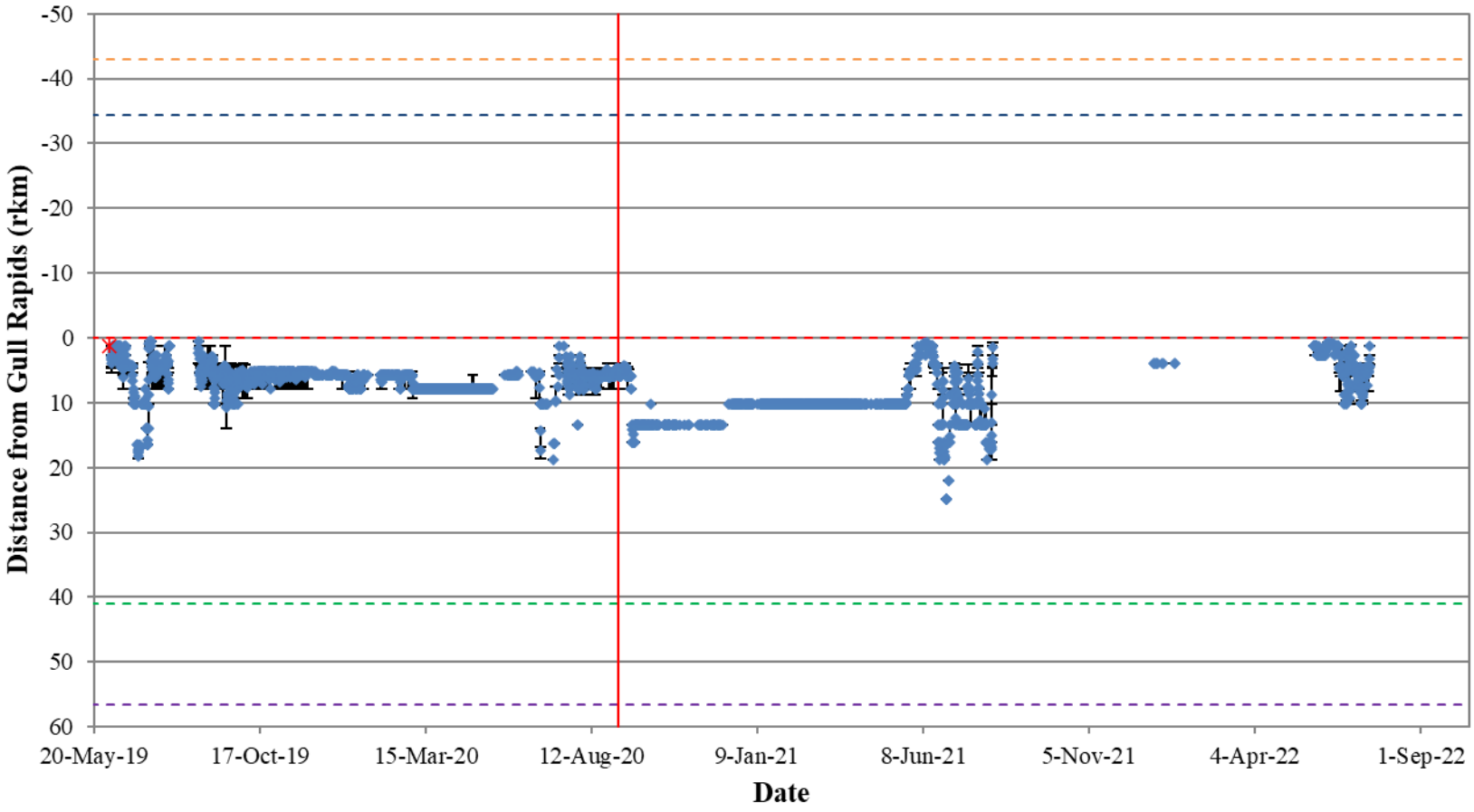

Figure A4-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7054) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

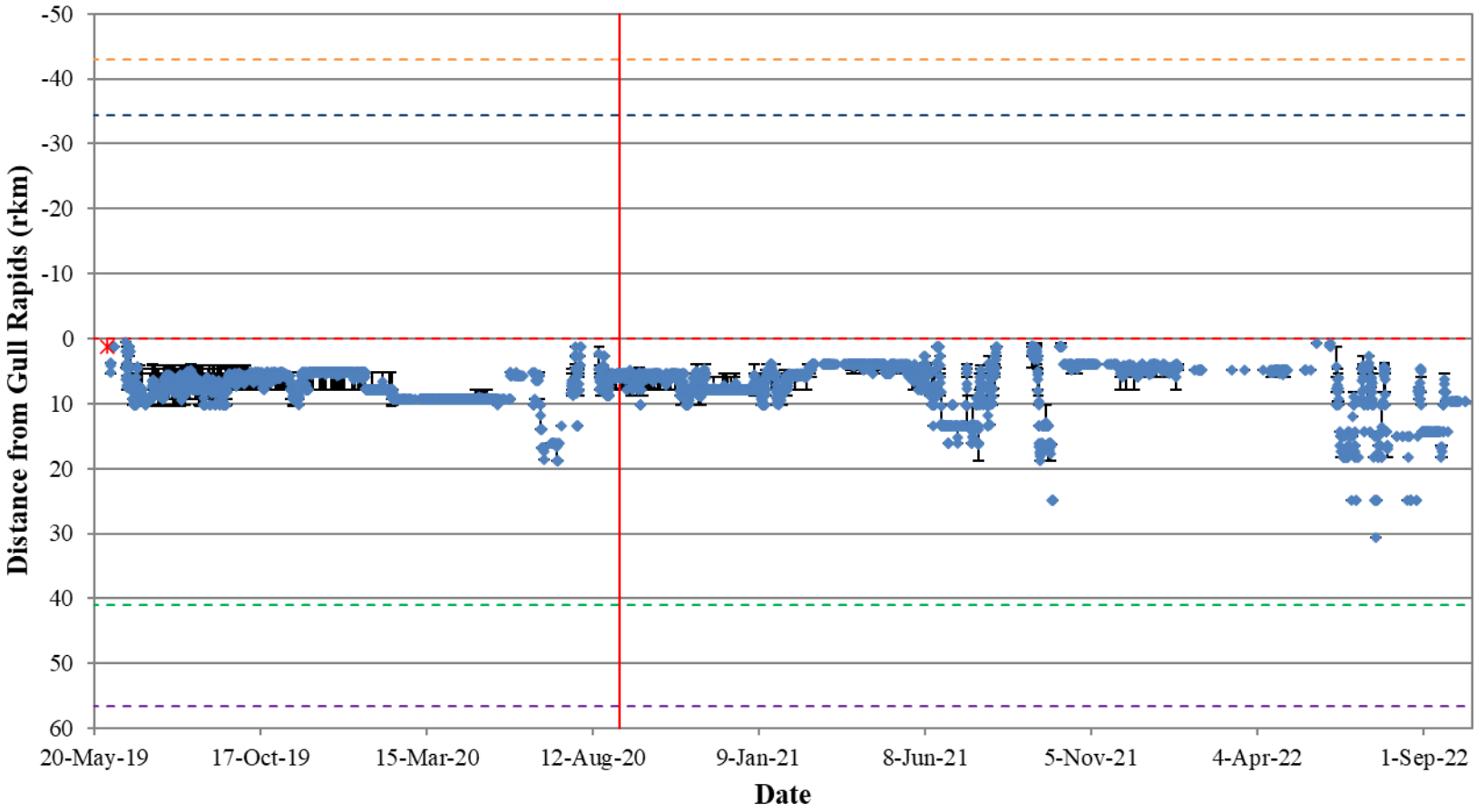

Figure A4-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7055) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

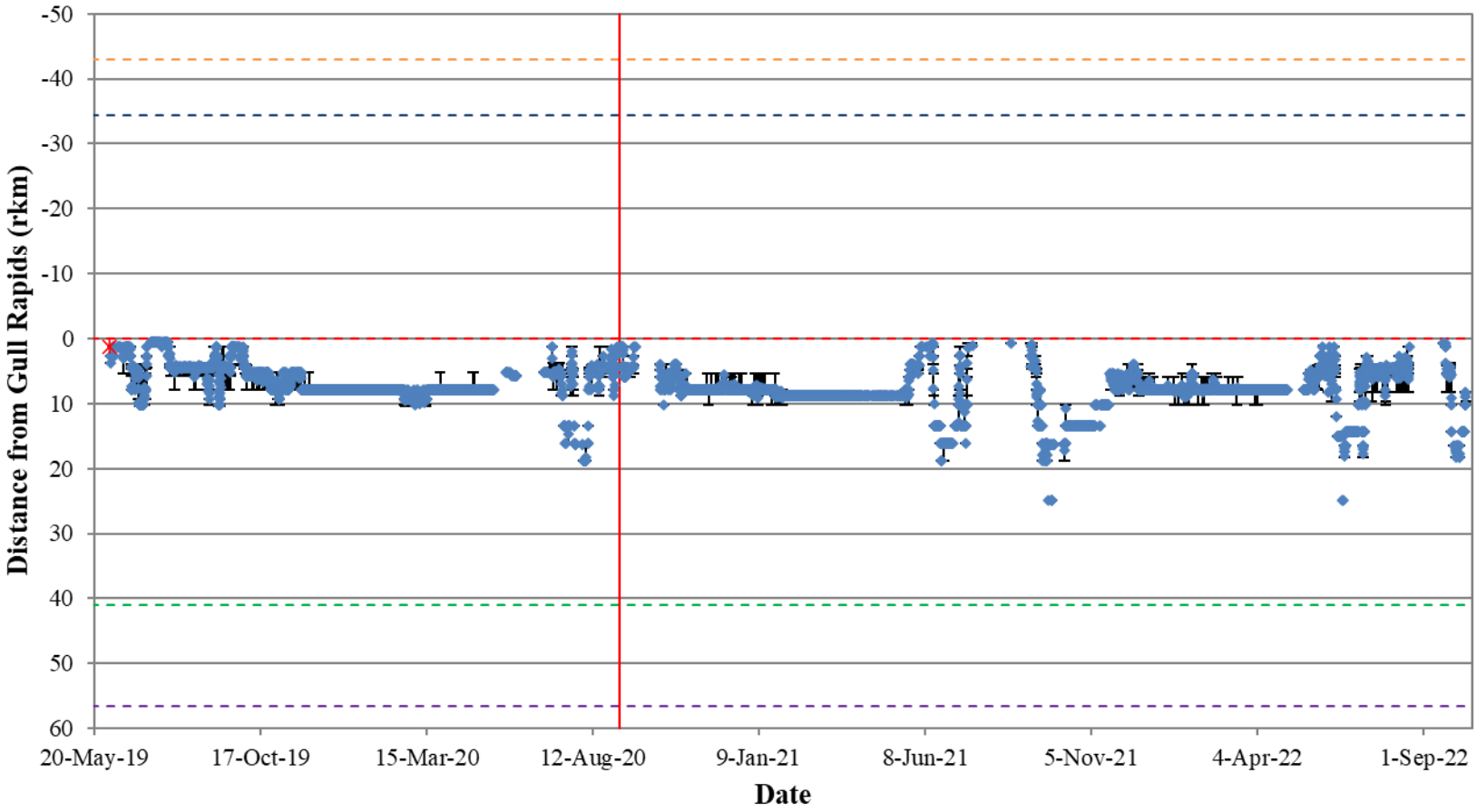

Figure A4-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7057) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

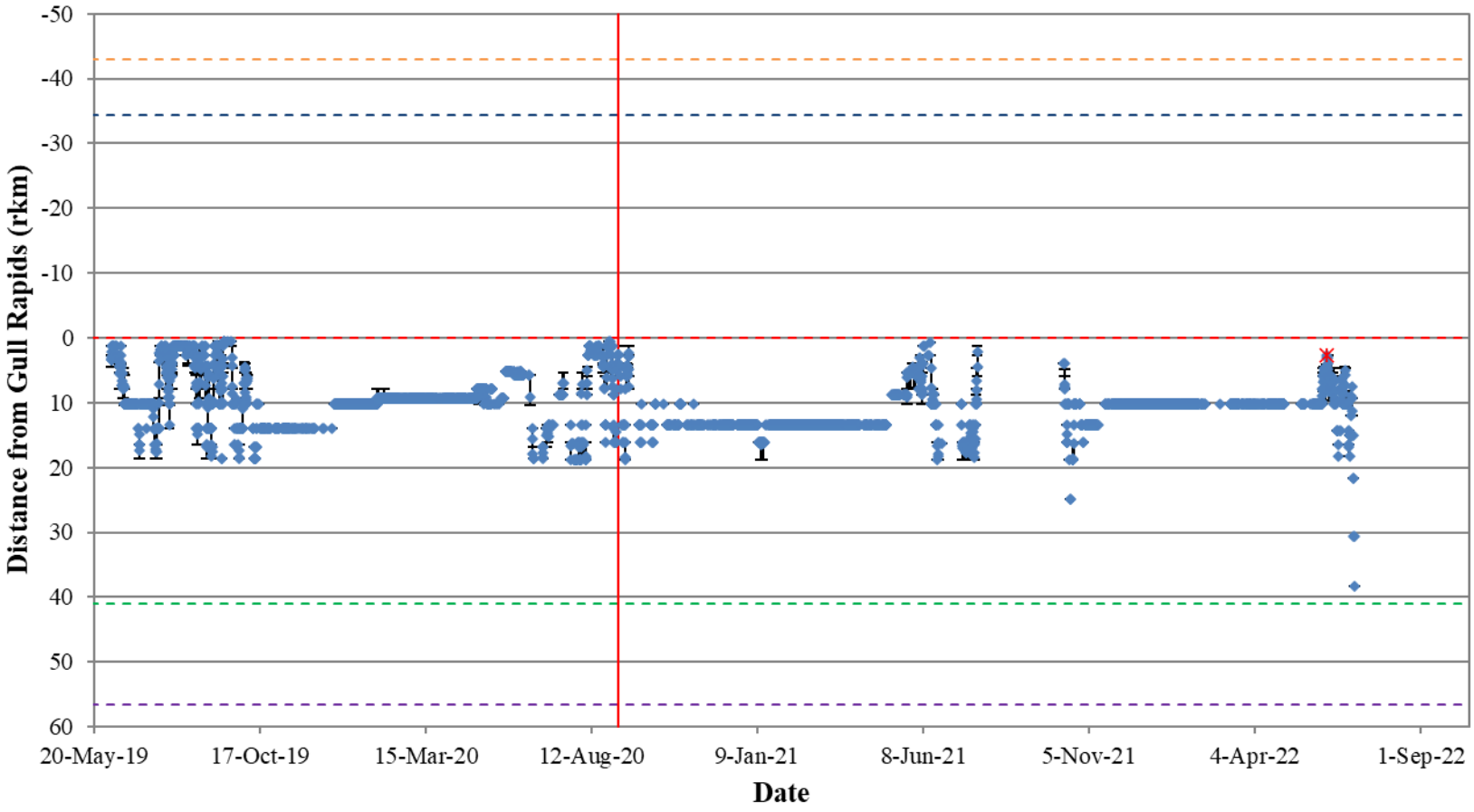

Figure A4-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7058) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

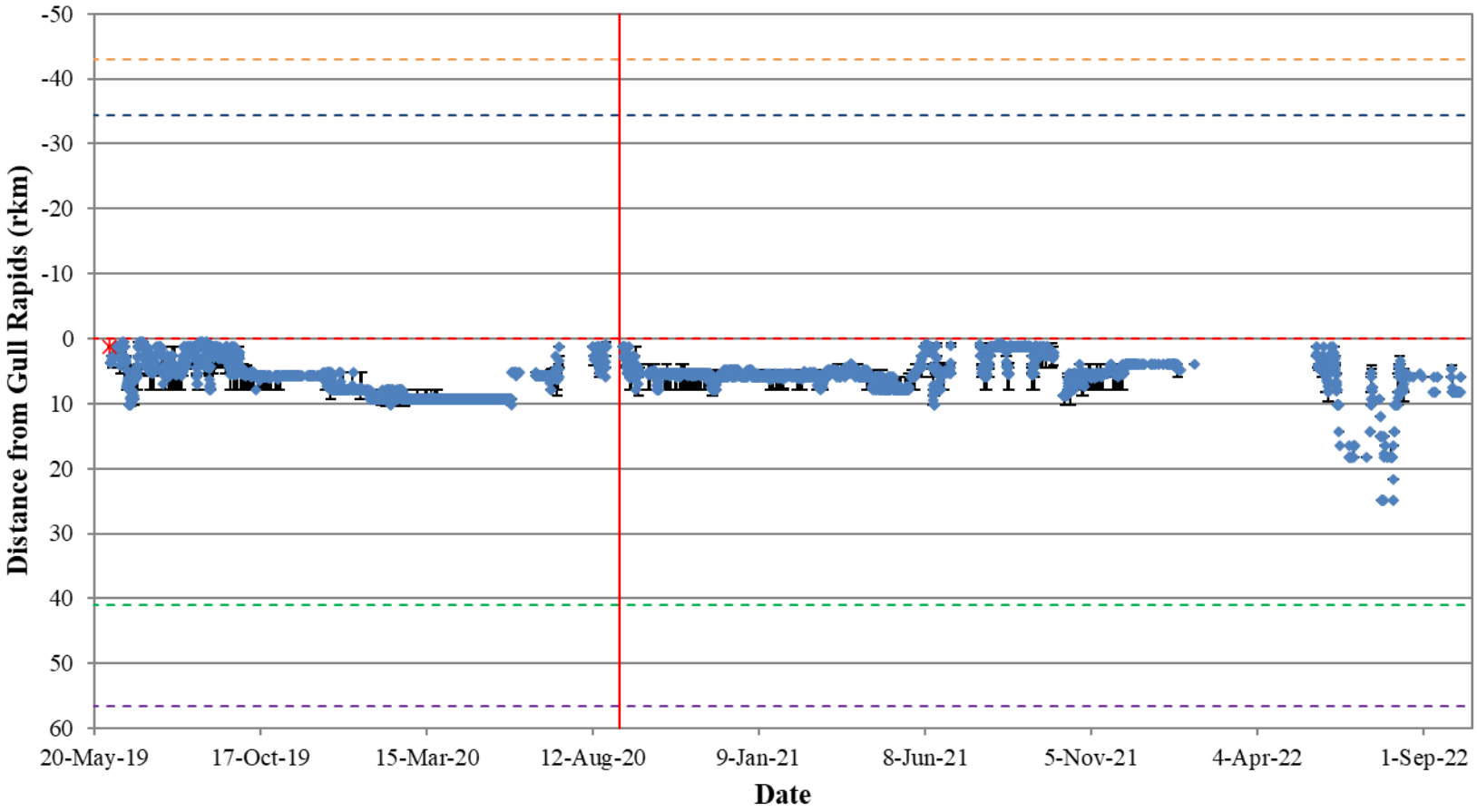

Figure A4-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7060) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

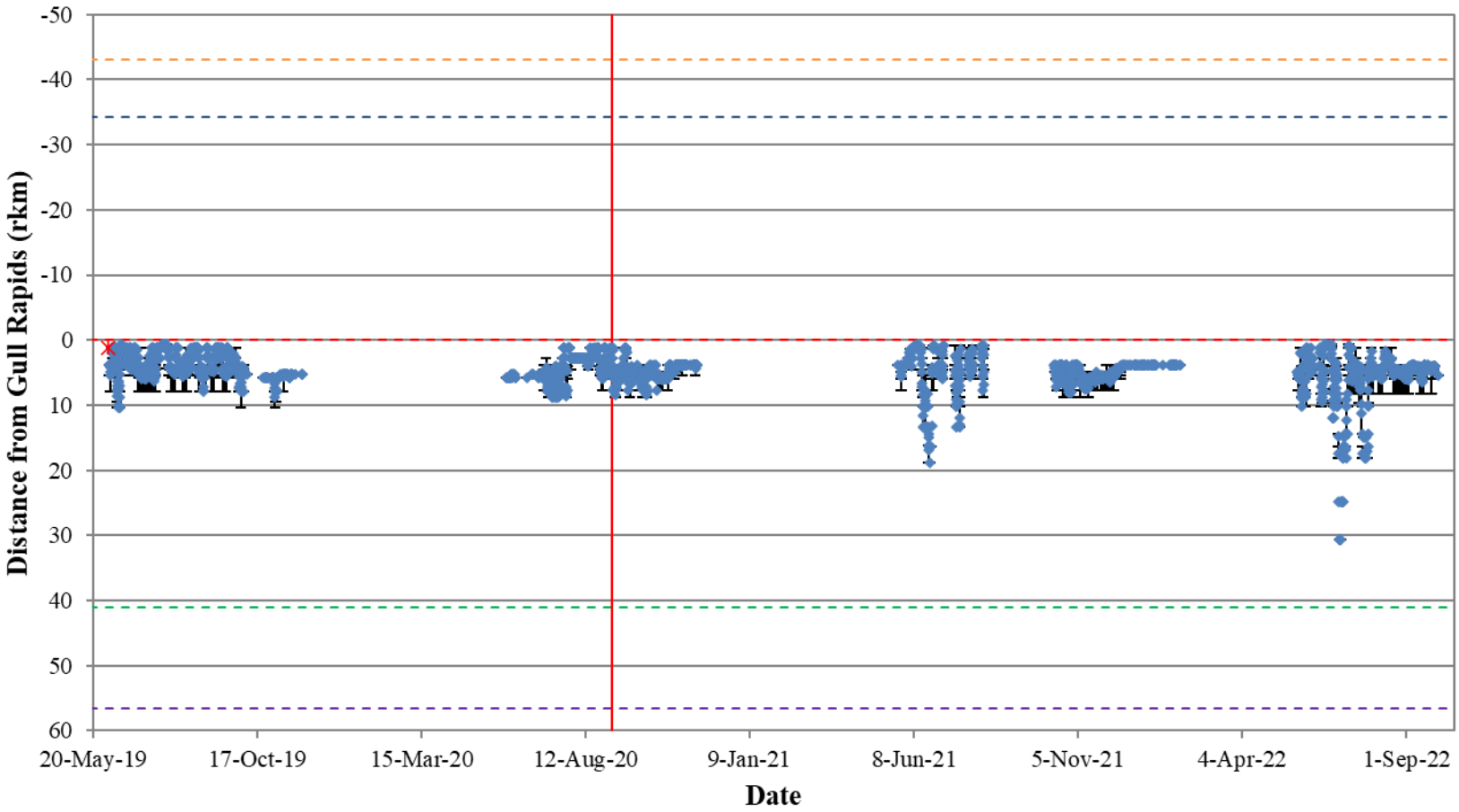

Figure A4-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7062) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

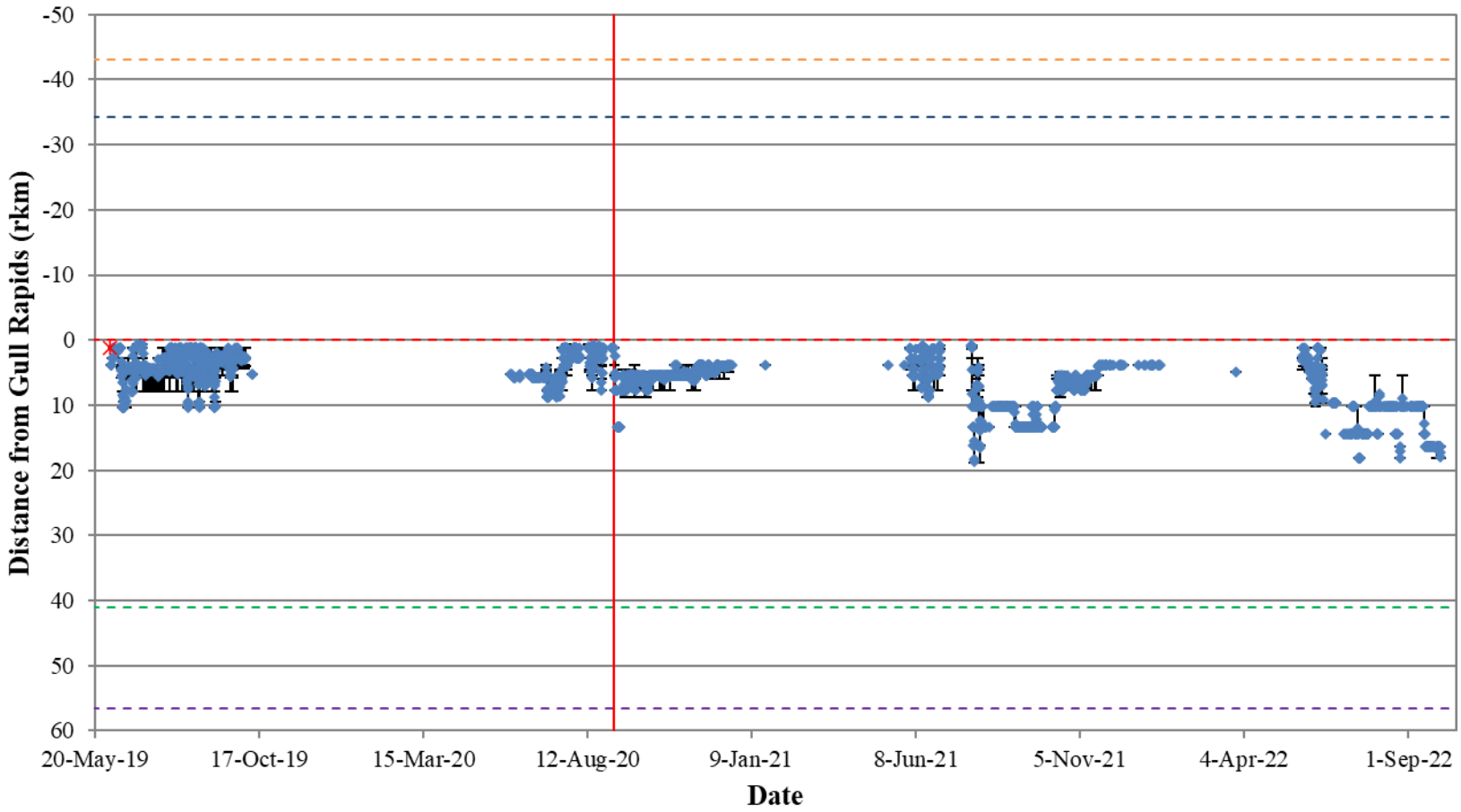

Figure A4-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7063) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to October 10, 2022. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical solid red line. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 5:
DETECTION RANGES FOR LAKE STURGEON TAGGED AND MONITORED BETWEEN 2019 AND 2022 UPSTREAM OF THE KEEYASK GS

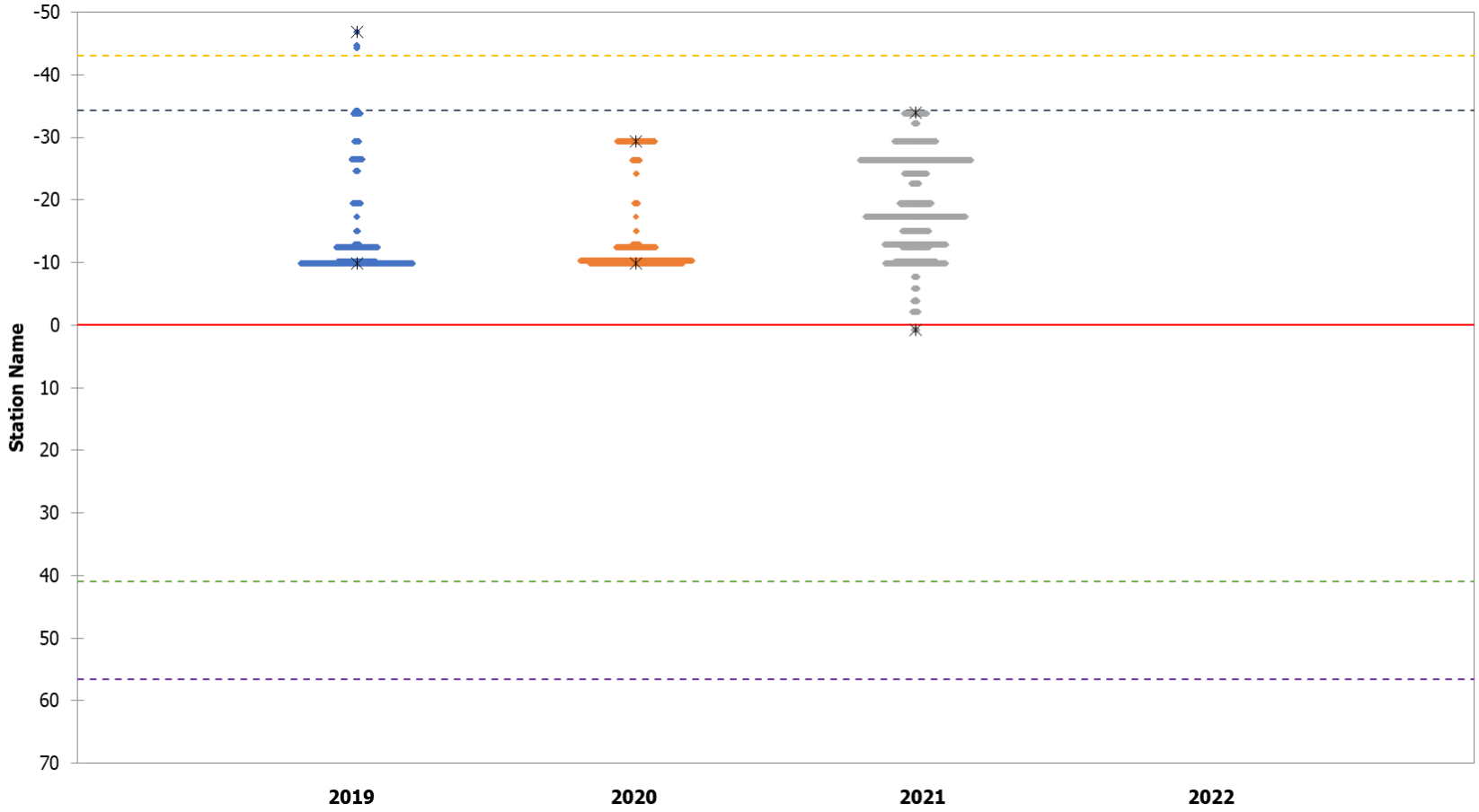

Figure A5-1: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7017) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

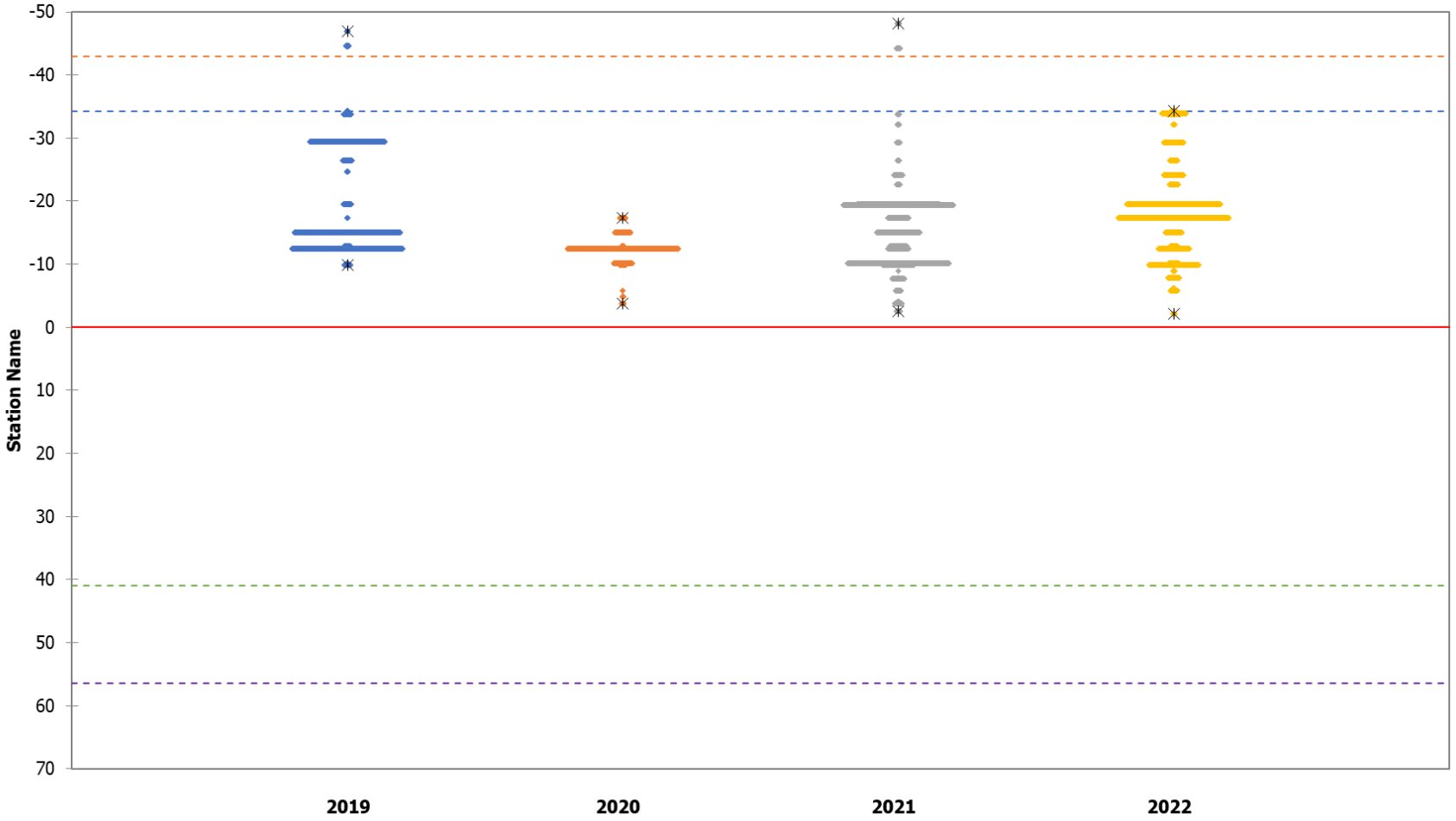

Figure A5-2: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7018) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

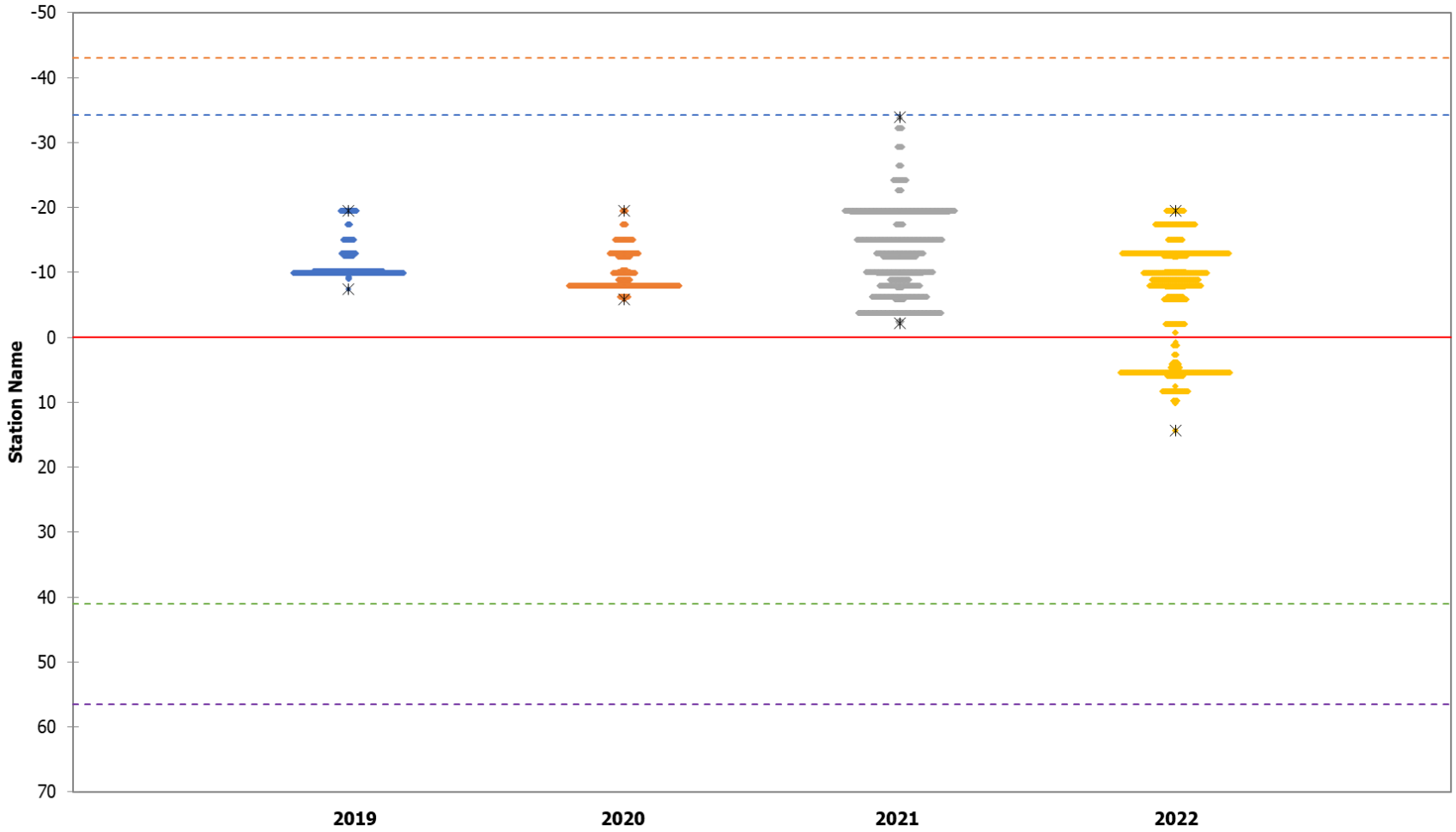

Figure A5-3: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7019) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

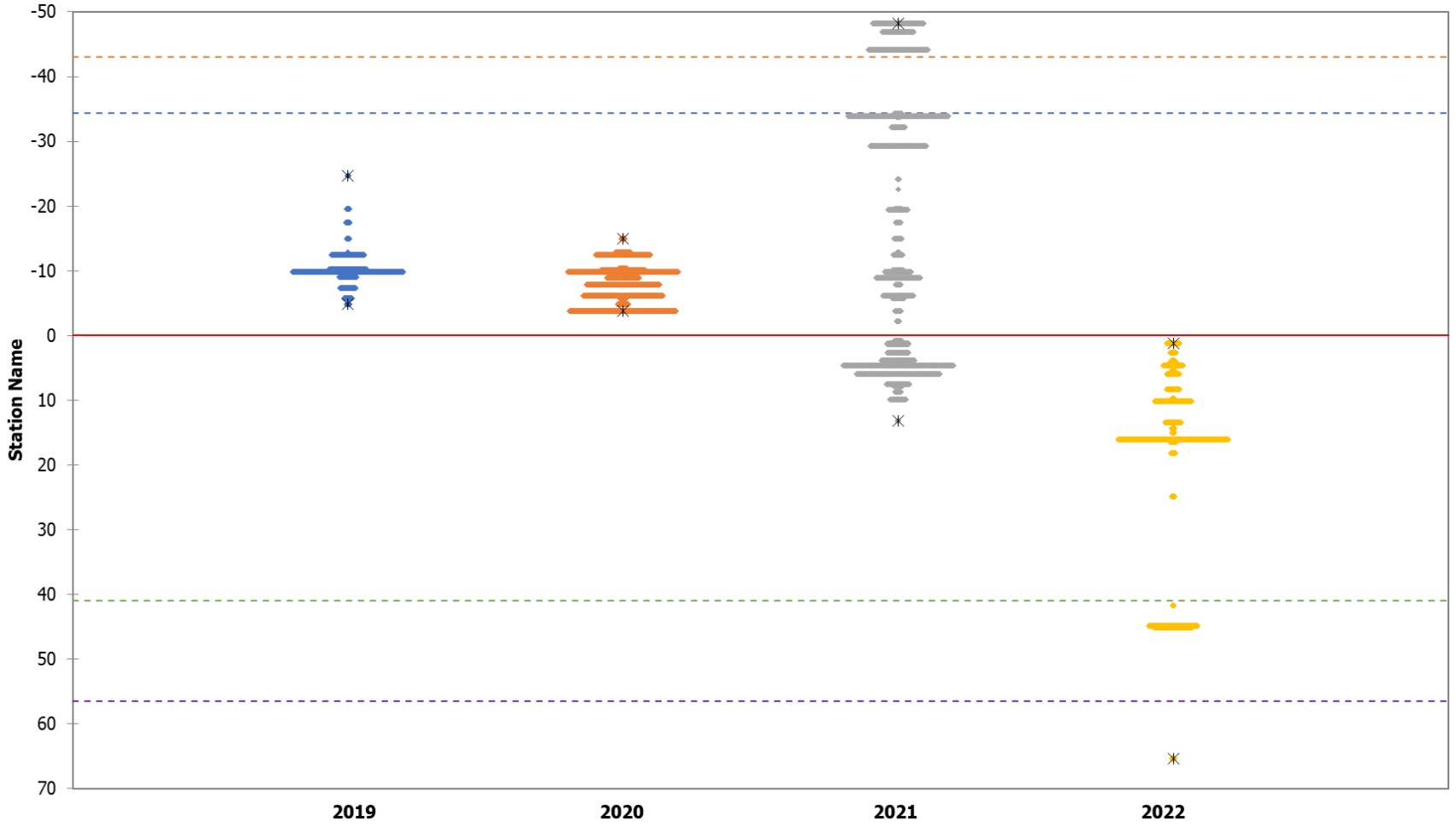

Figure A5-4: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7020) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

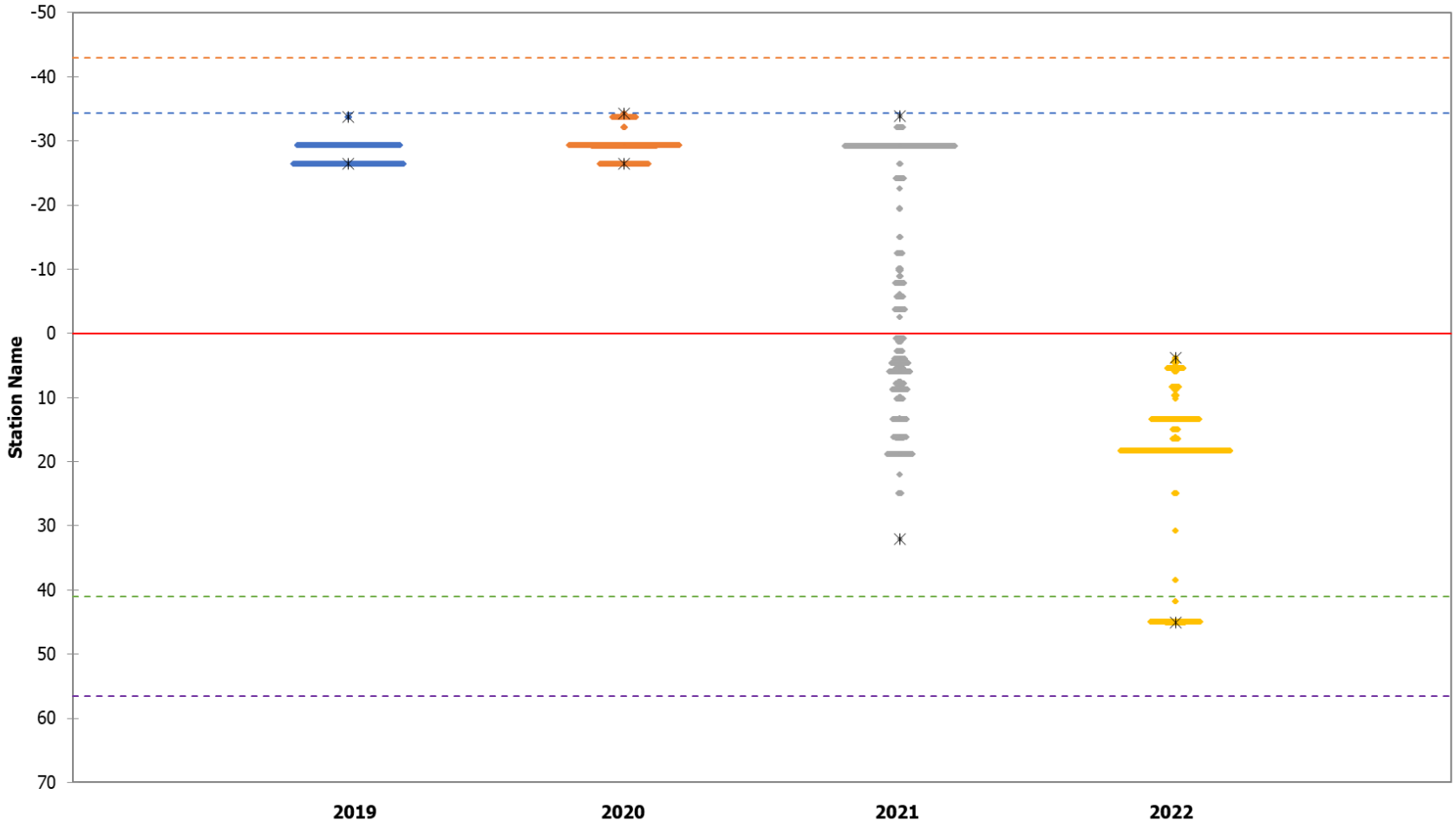

Figure A5-5: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7021) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

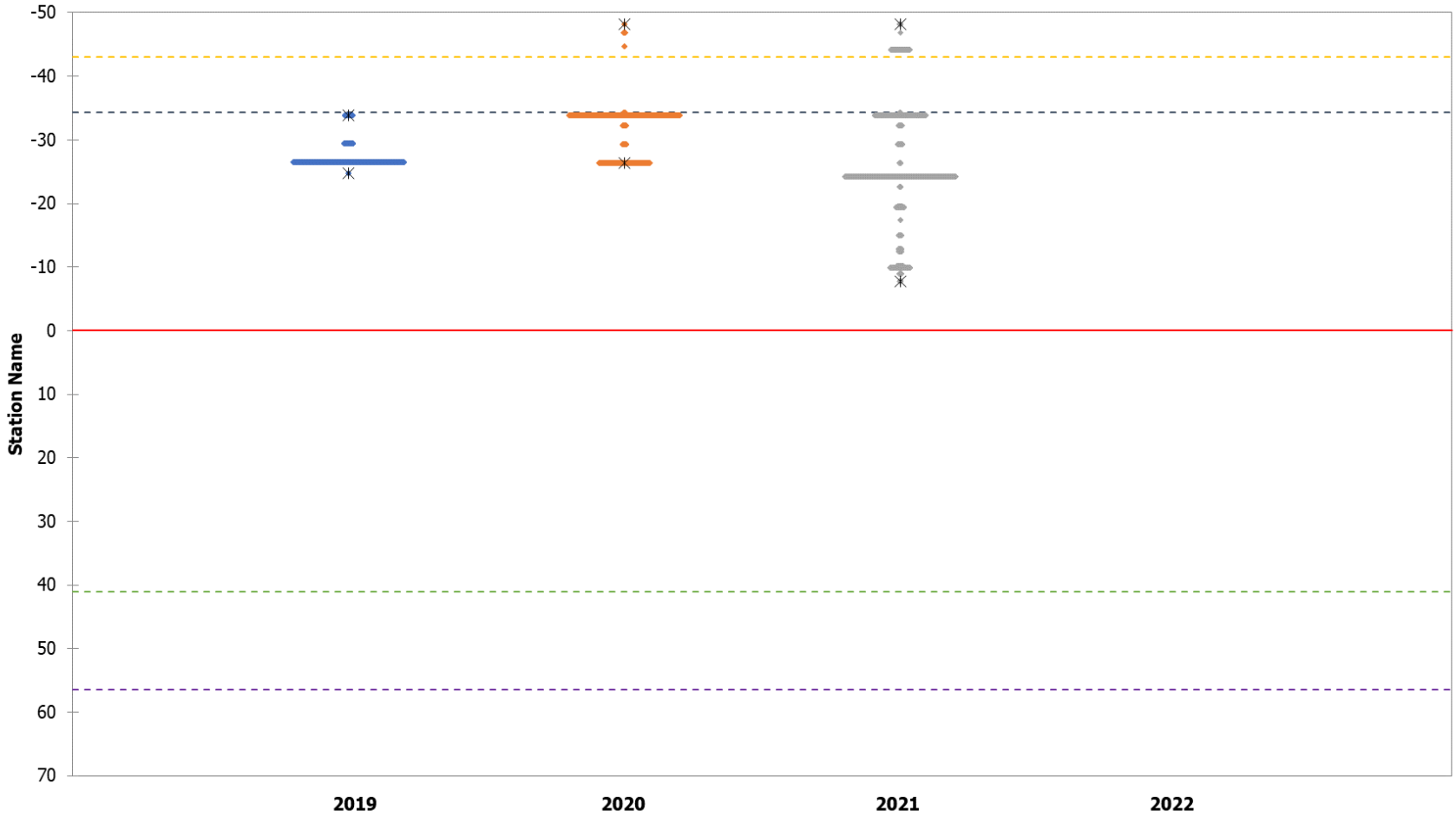

Figure A5-6: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7022) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

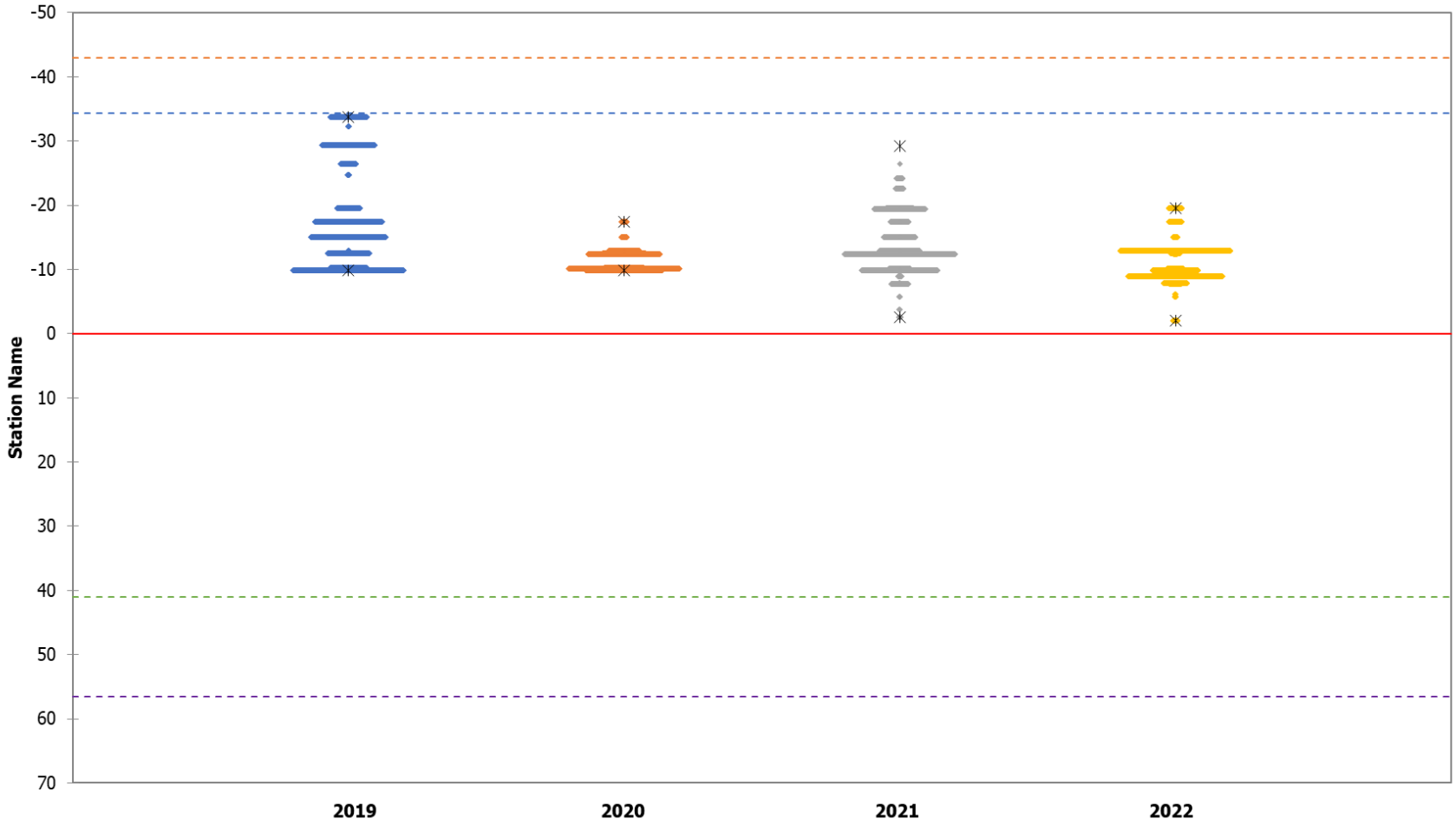

Figure A5-7: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7023) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

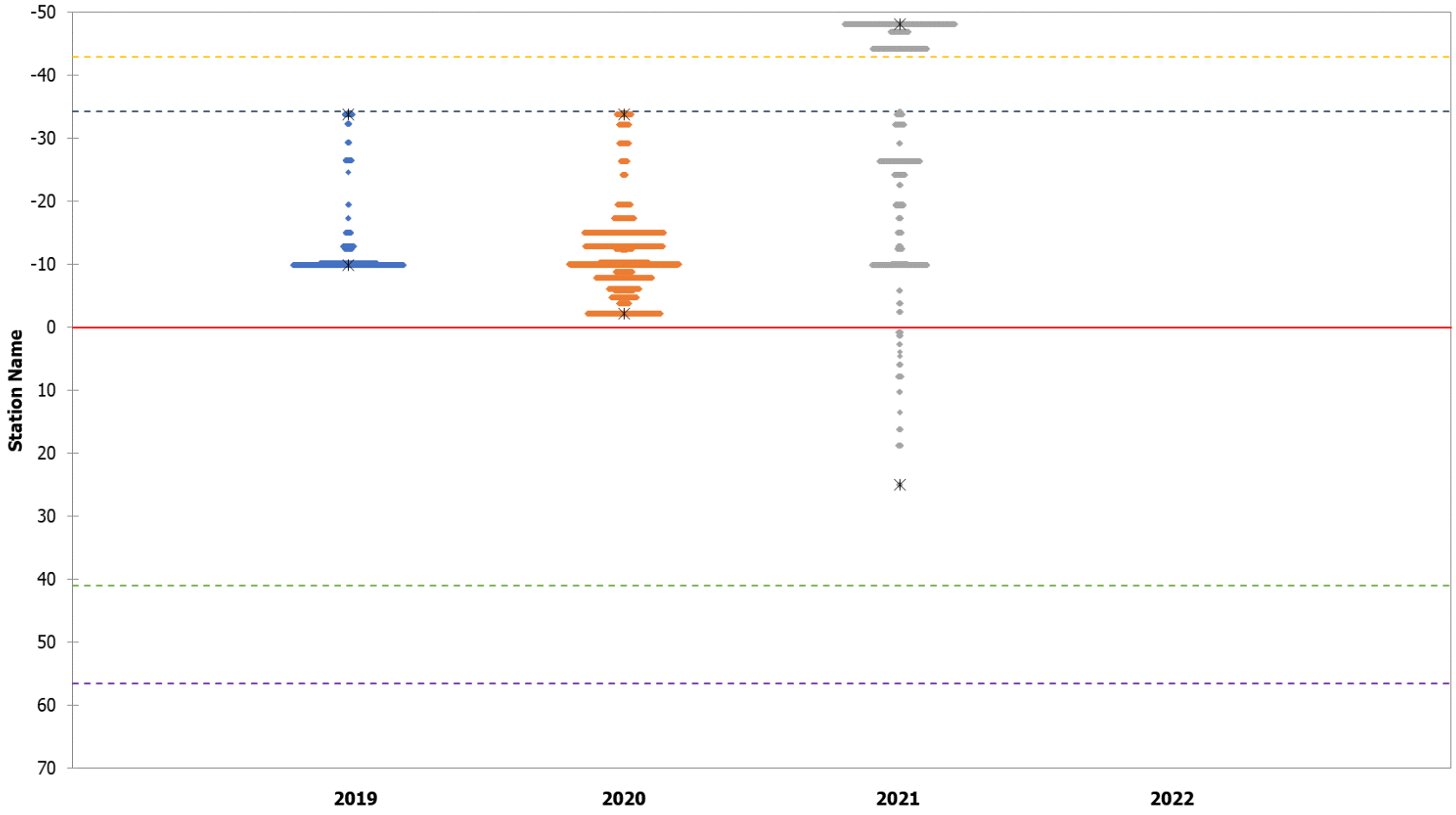

Figure A5-8: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7024) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

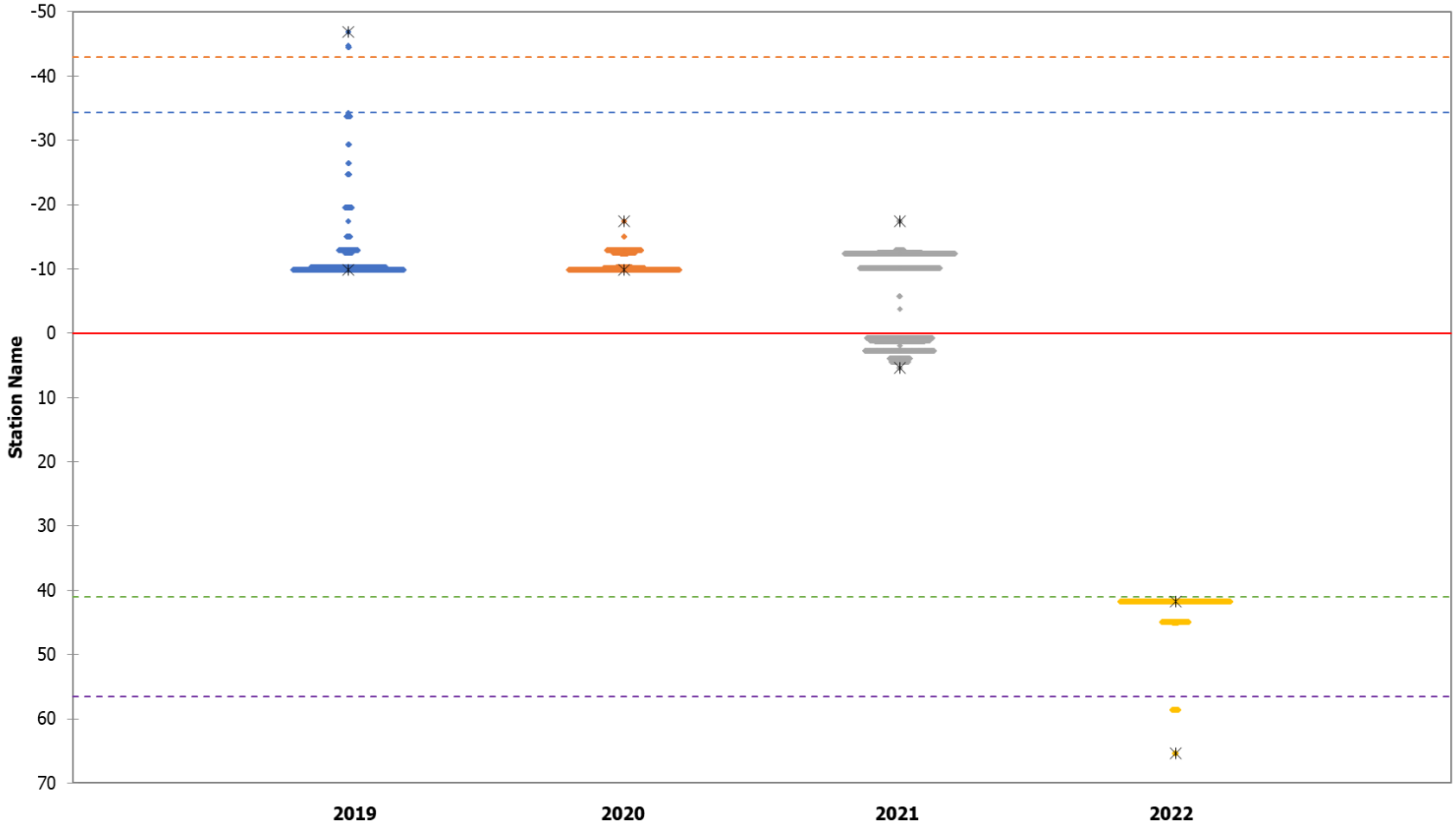

Figure A5-9: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7025) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

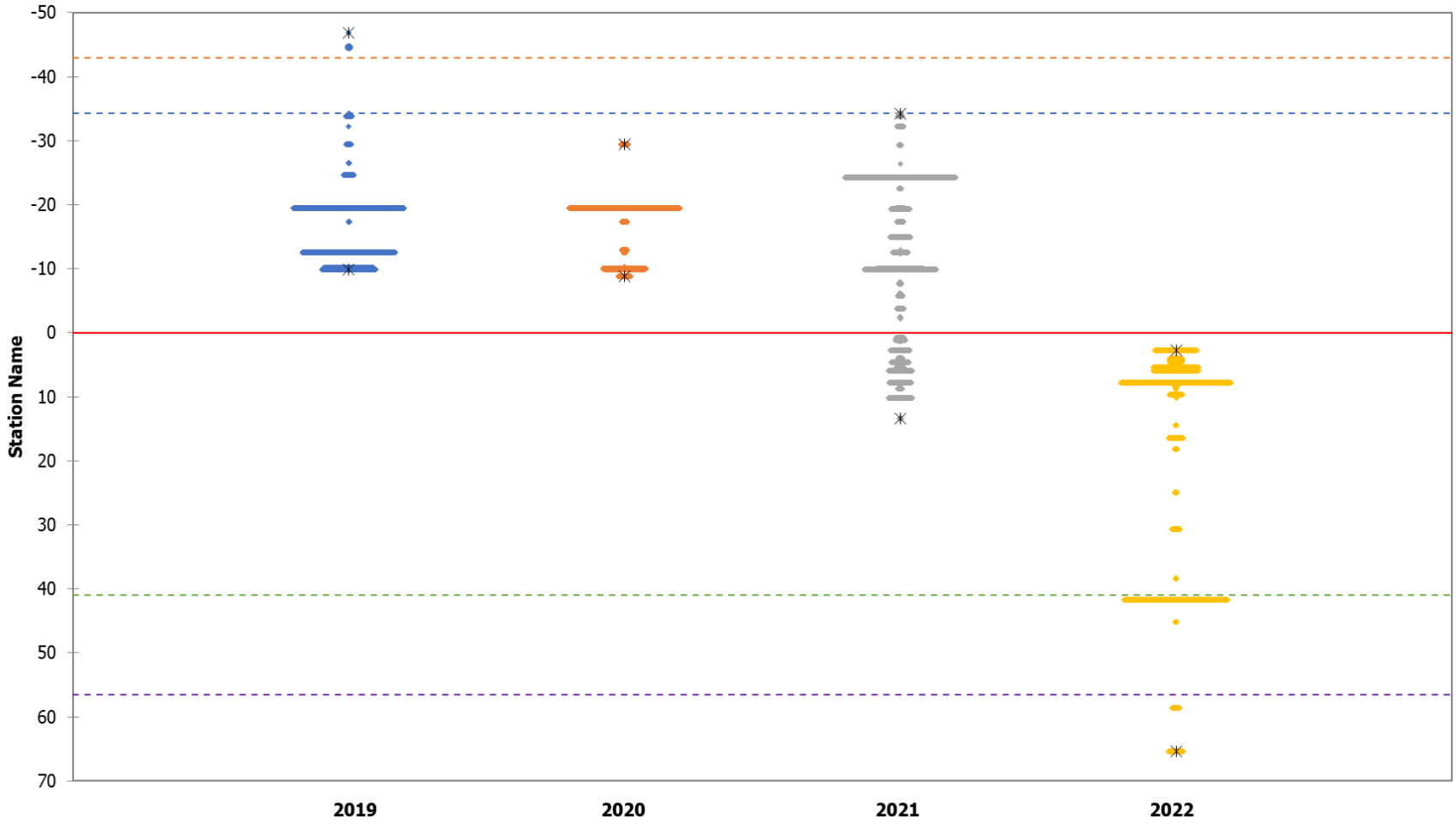

Figure A5-10: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7026) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

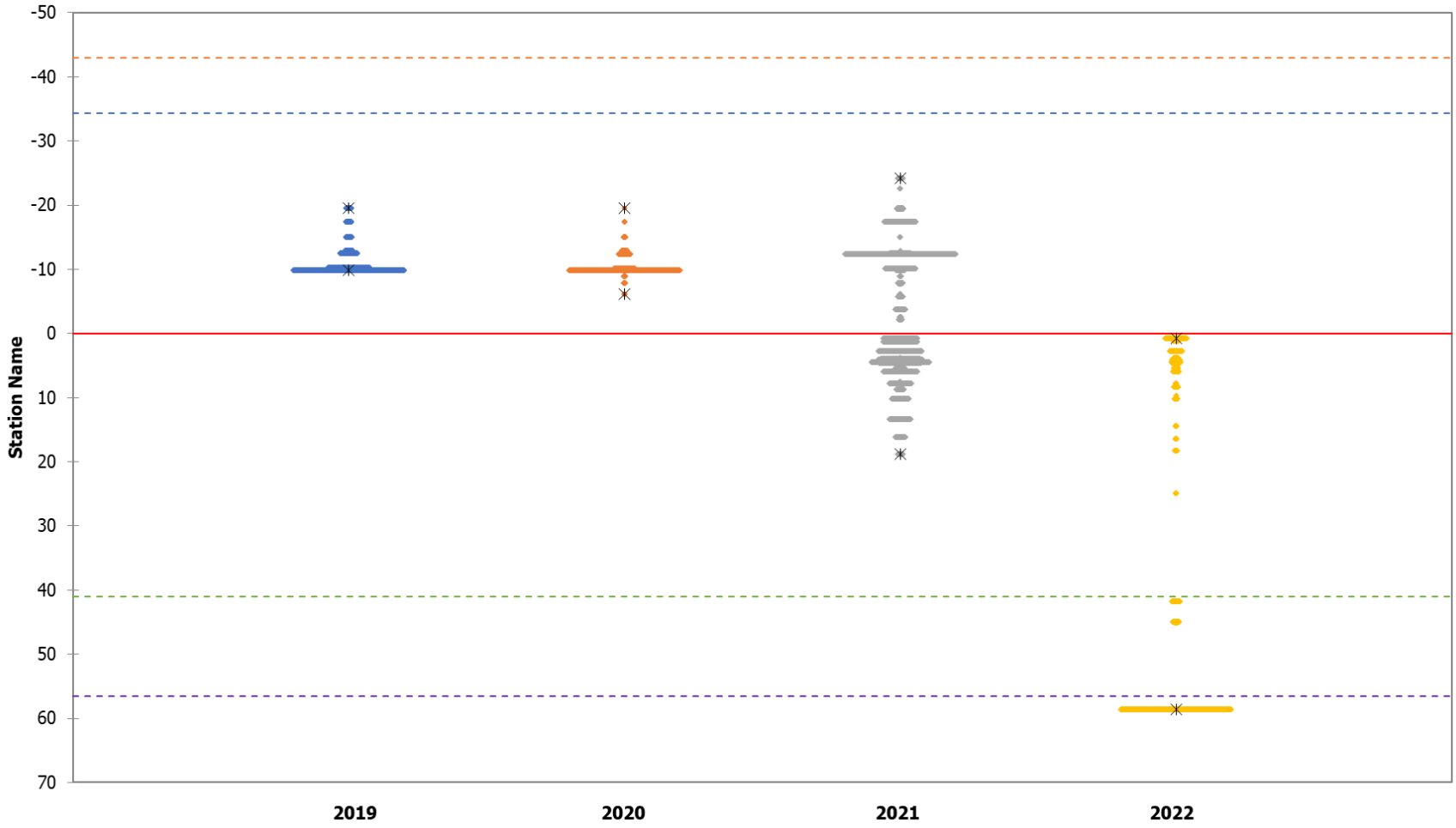

Figure A5-11: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7027) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

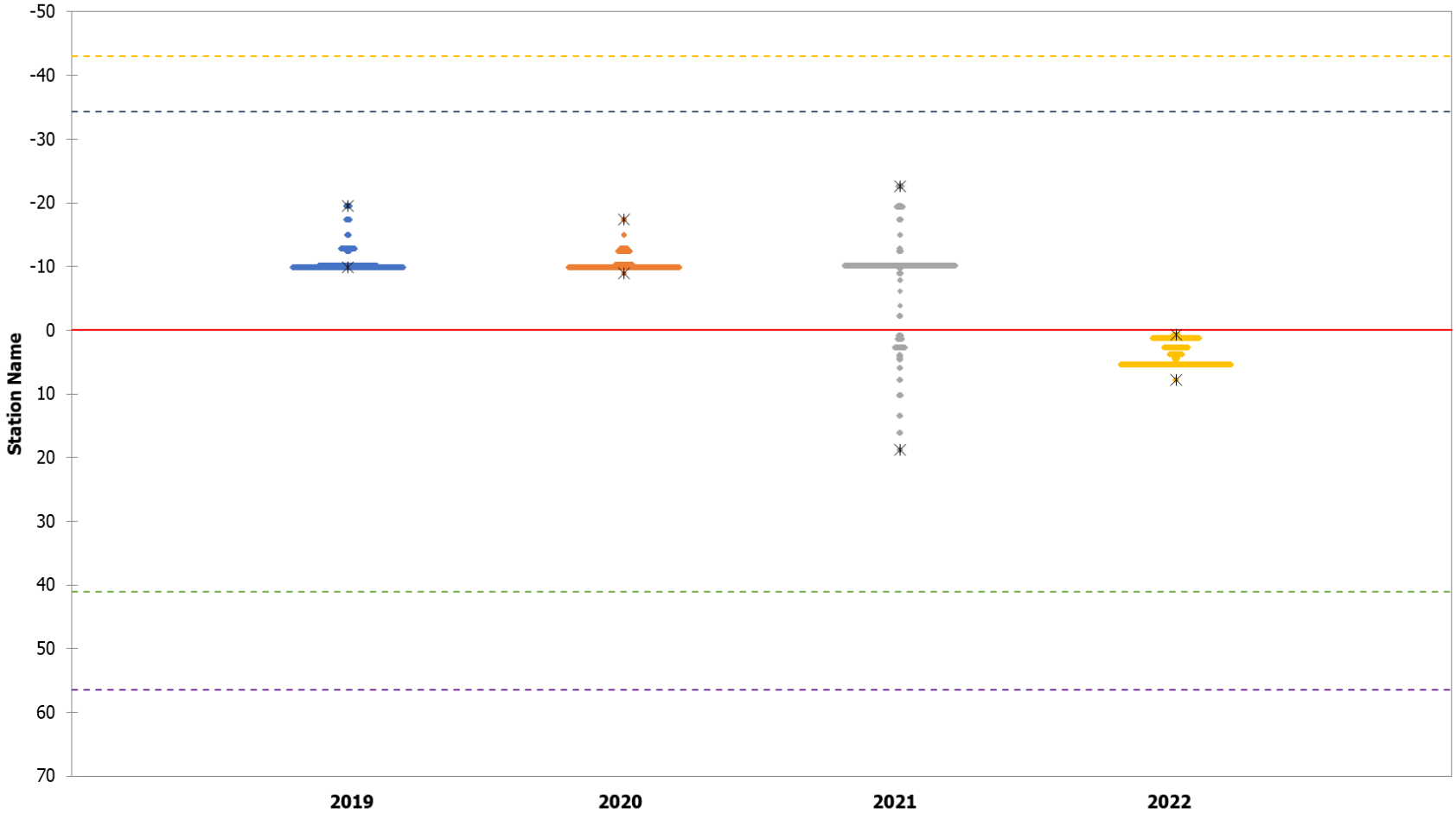

Figure A5-12: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7028) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

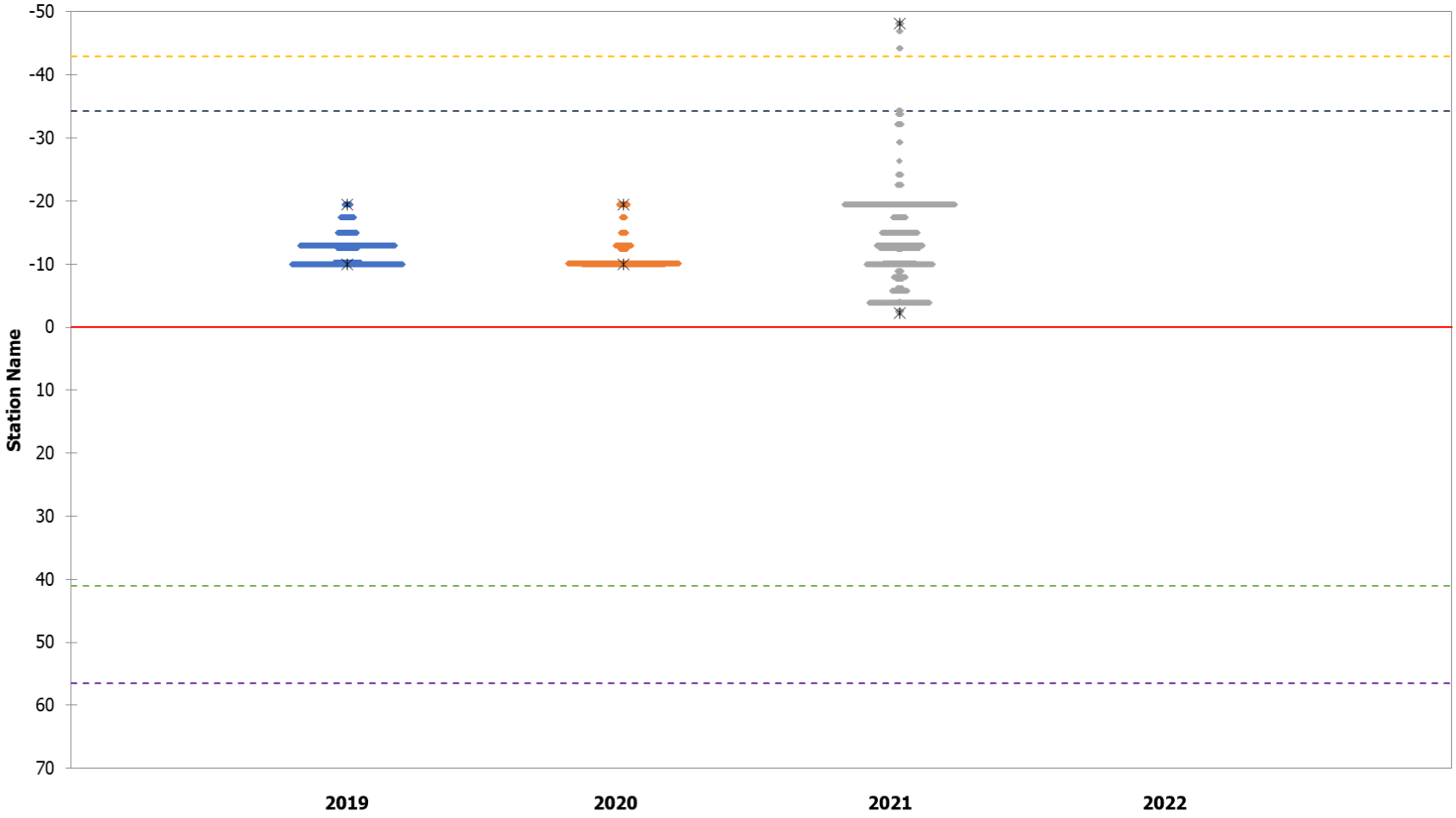

Figure A5-13: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7029) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

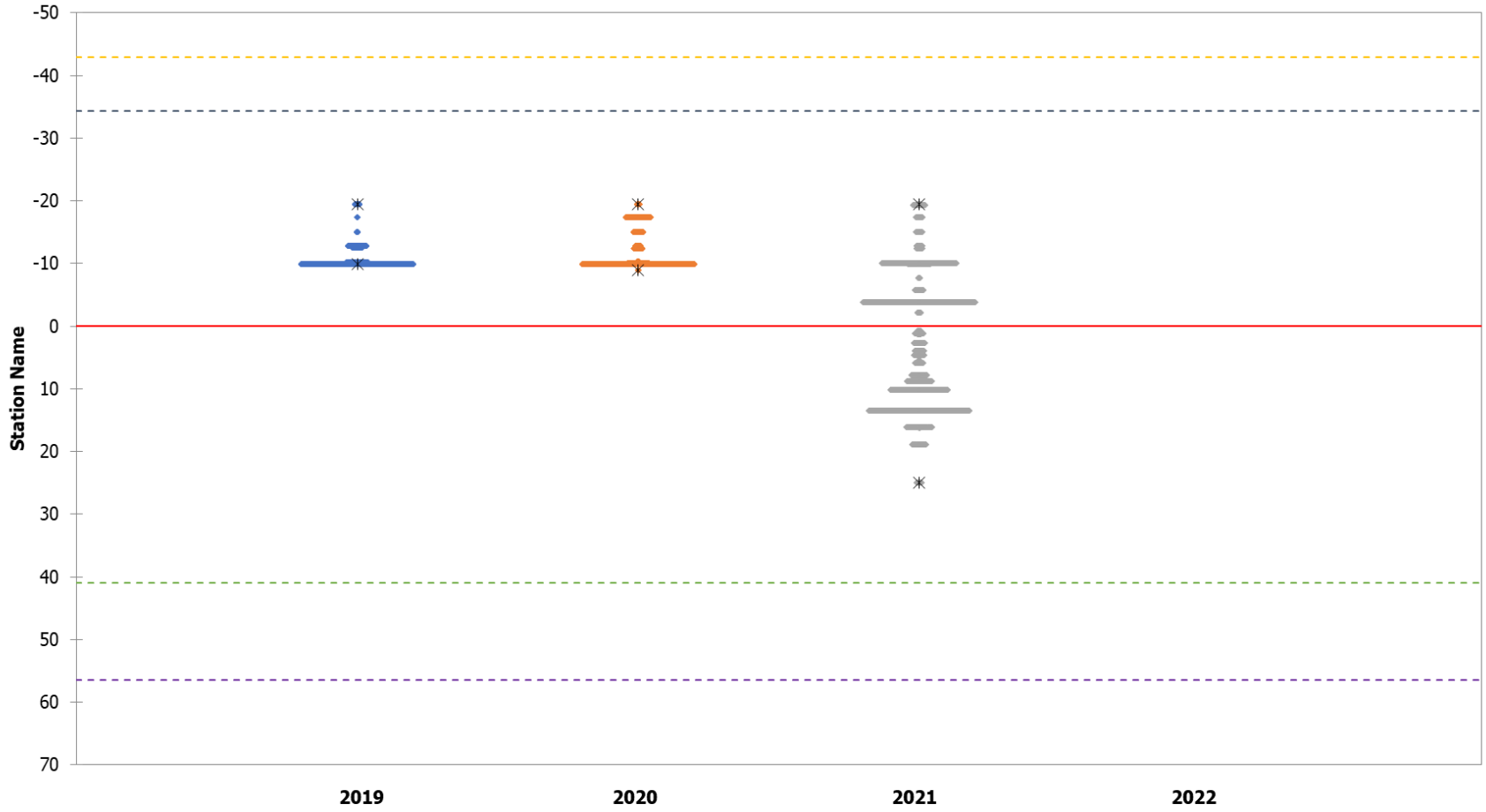

Figure A5-14: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7030) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

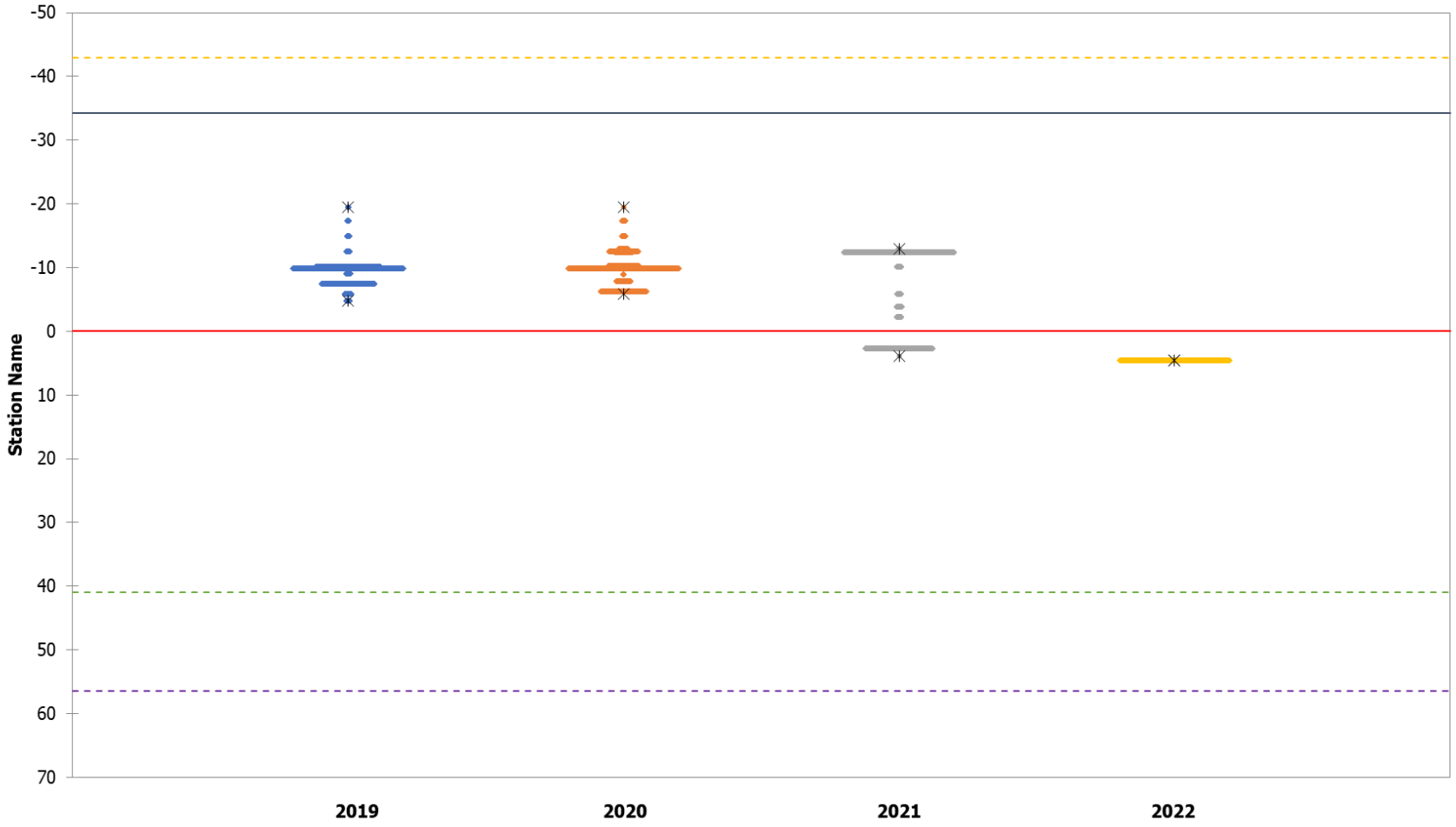

Figure A5-15: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7031) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

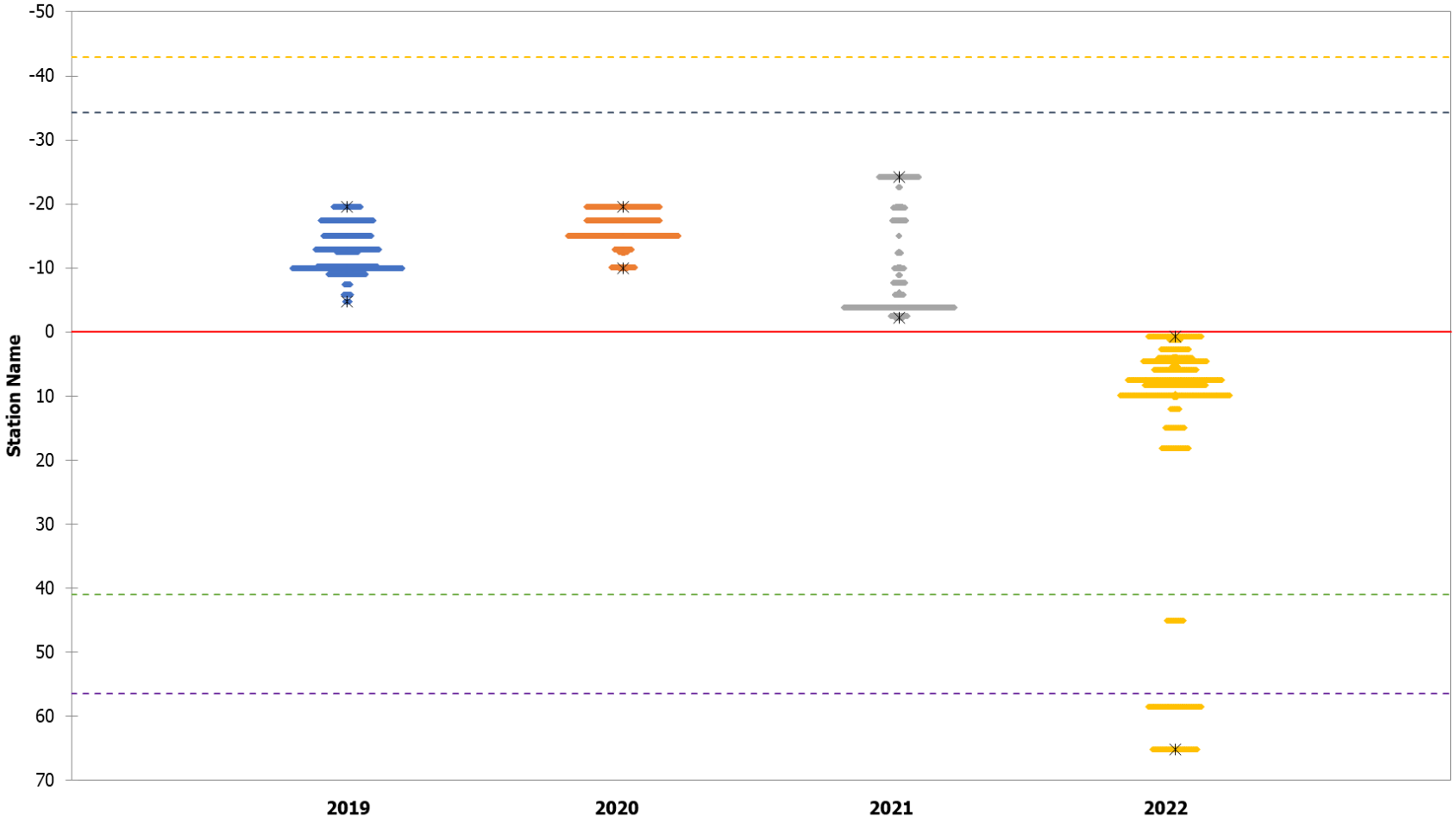

Figure A5-16: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7032) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

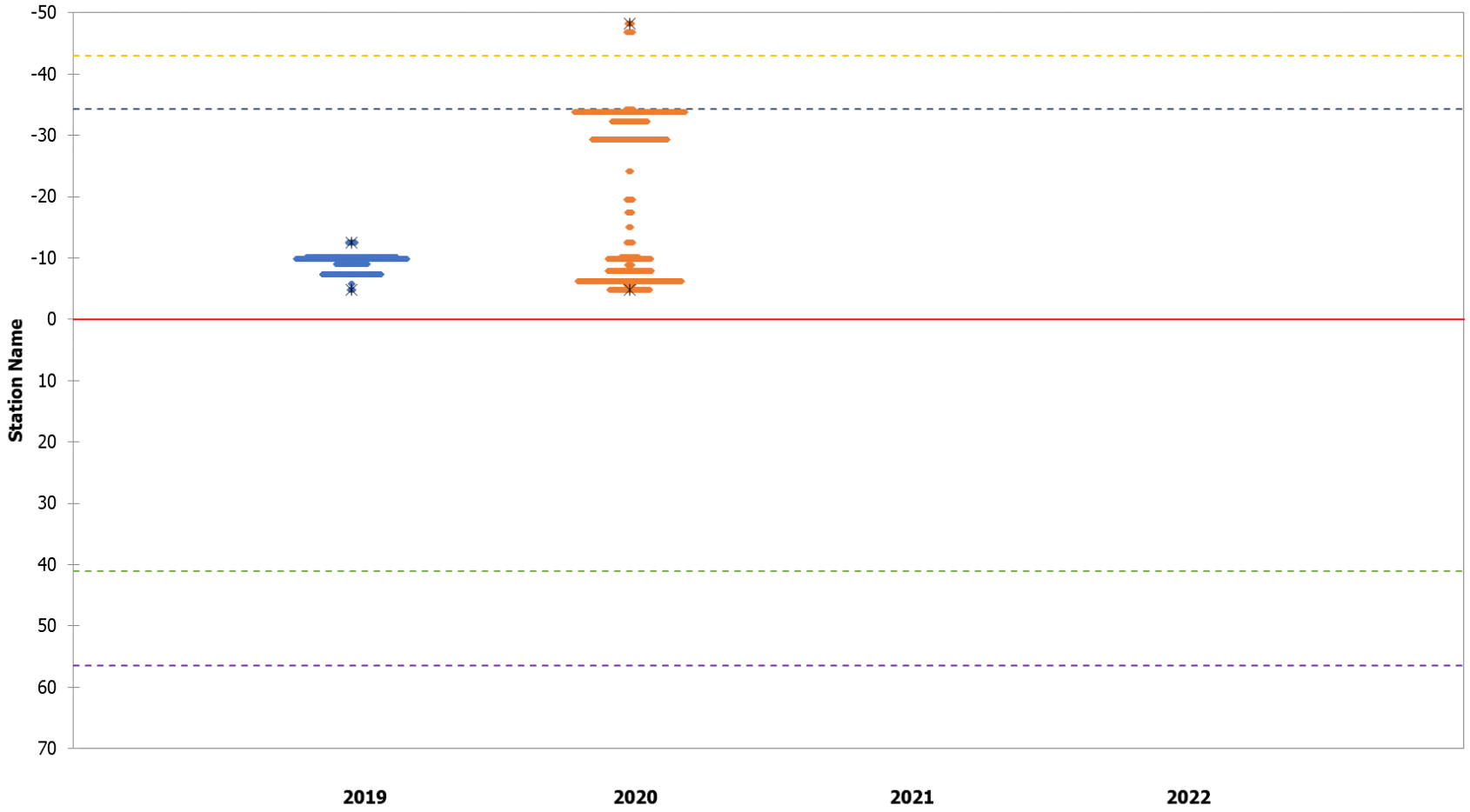

Figure A5-17: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7033) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

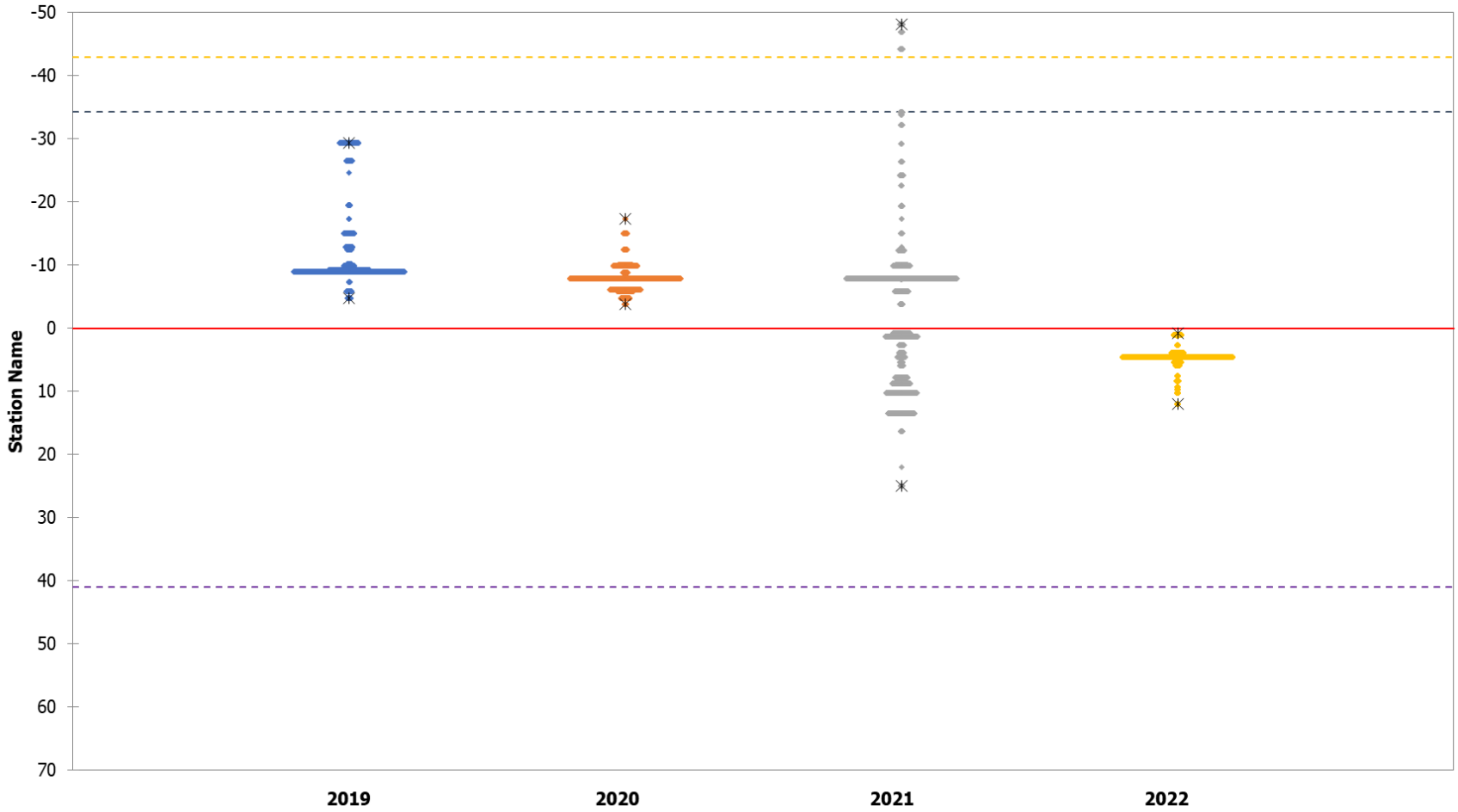

Figure A5-18: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7034) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

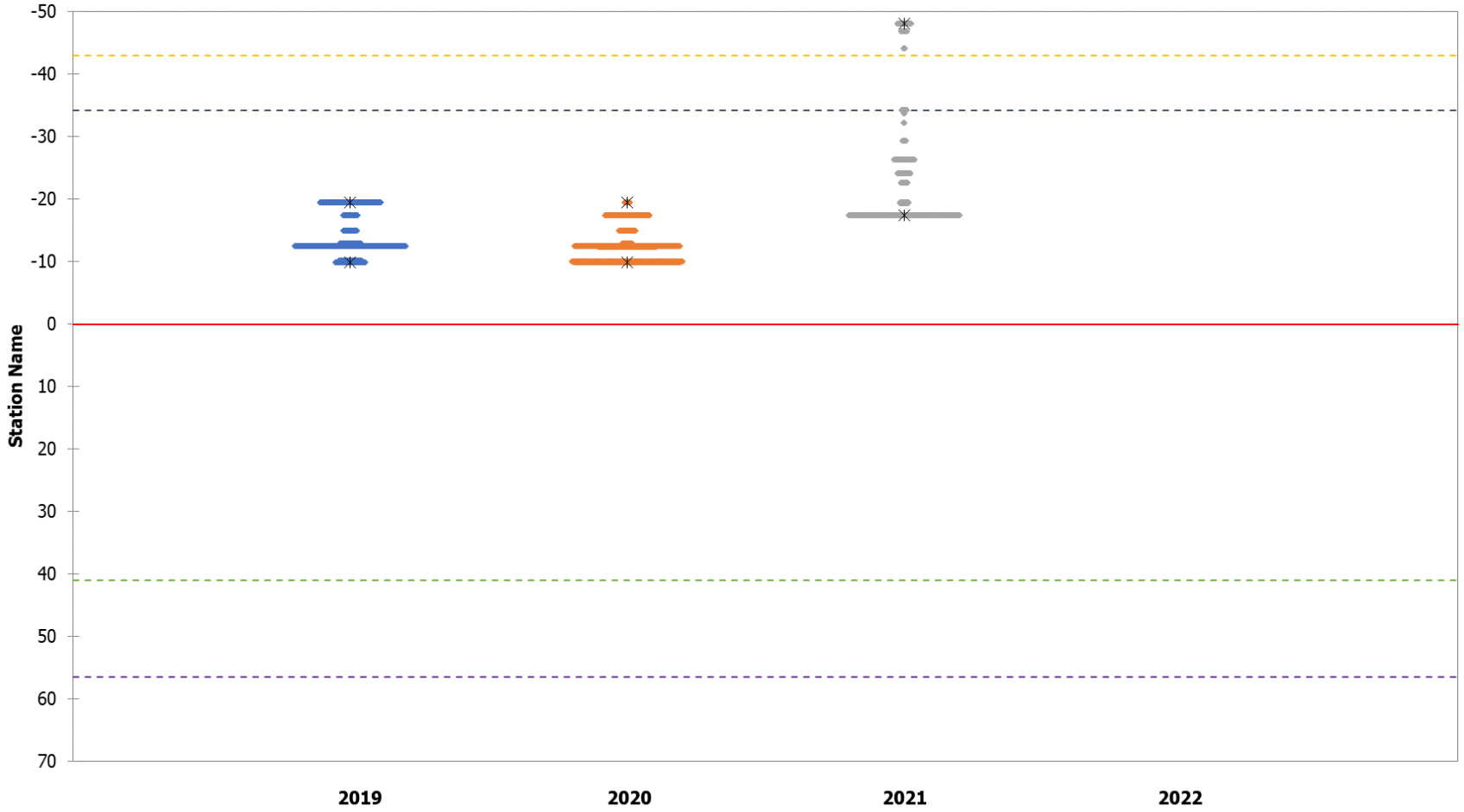

Figure A5-19: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7053) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2021. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

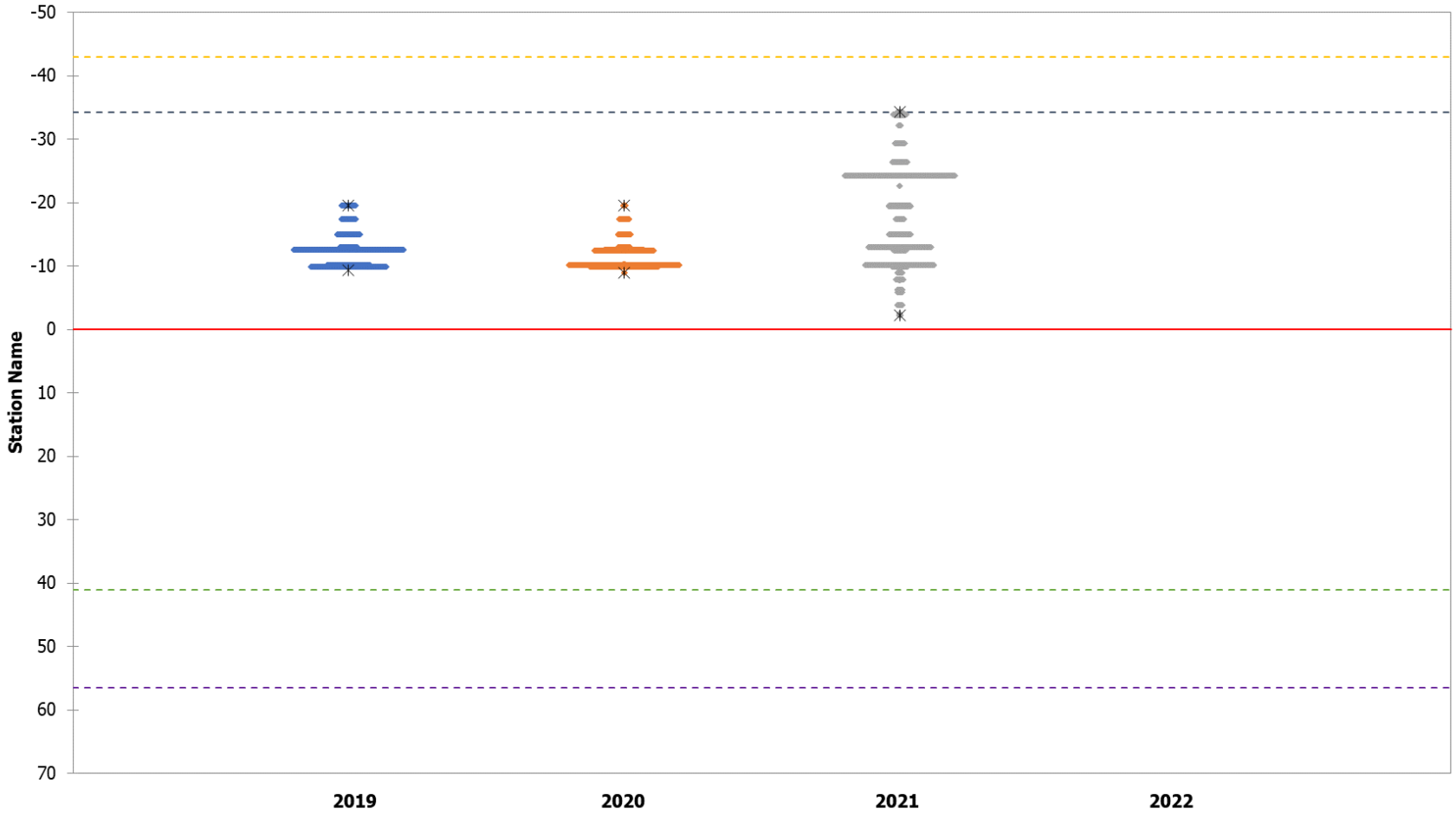

Figure A5-20: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7056) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

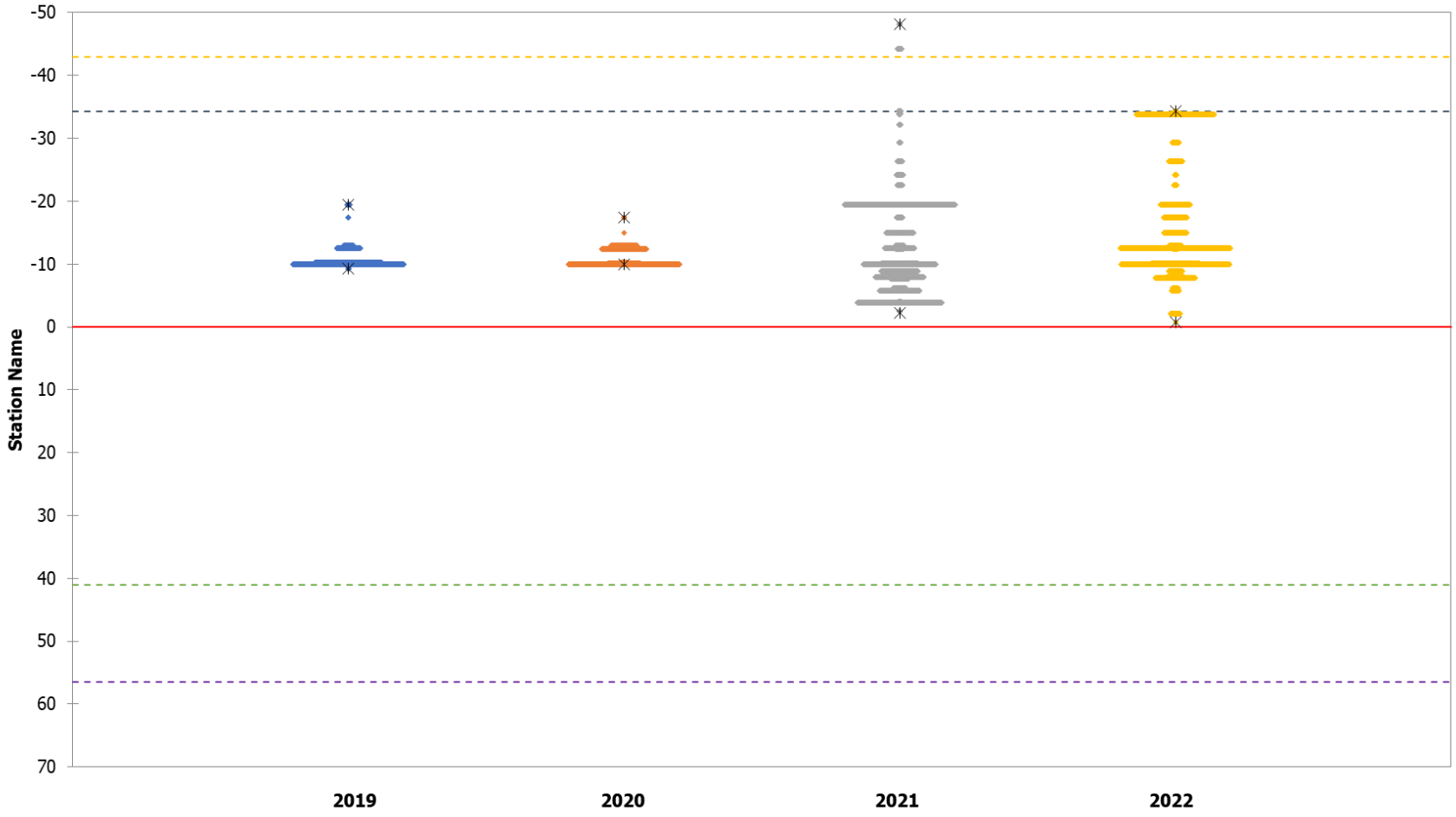

Figure A5-21: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7059) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2021. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

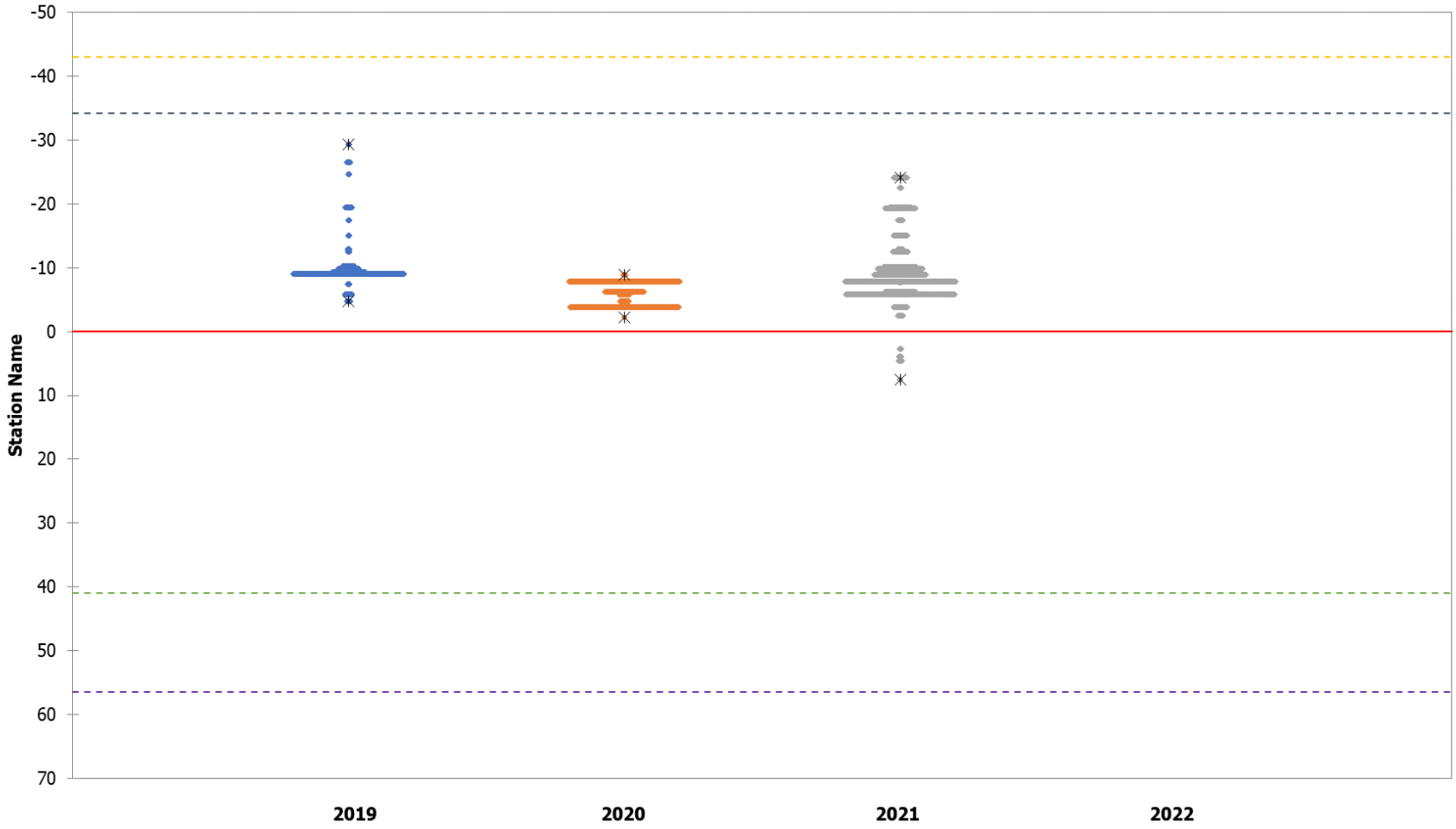

Figure A5-22: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7061) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

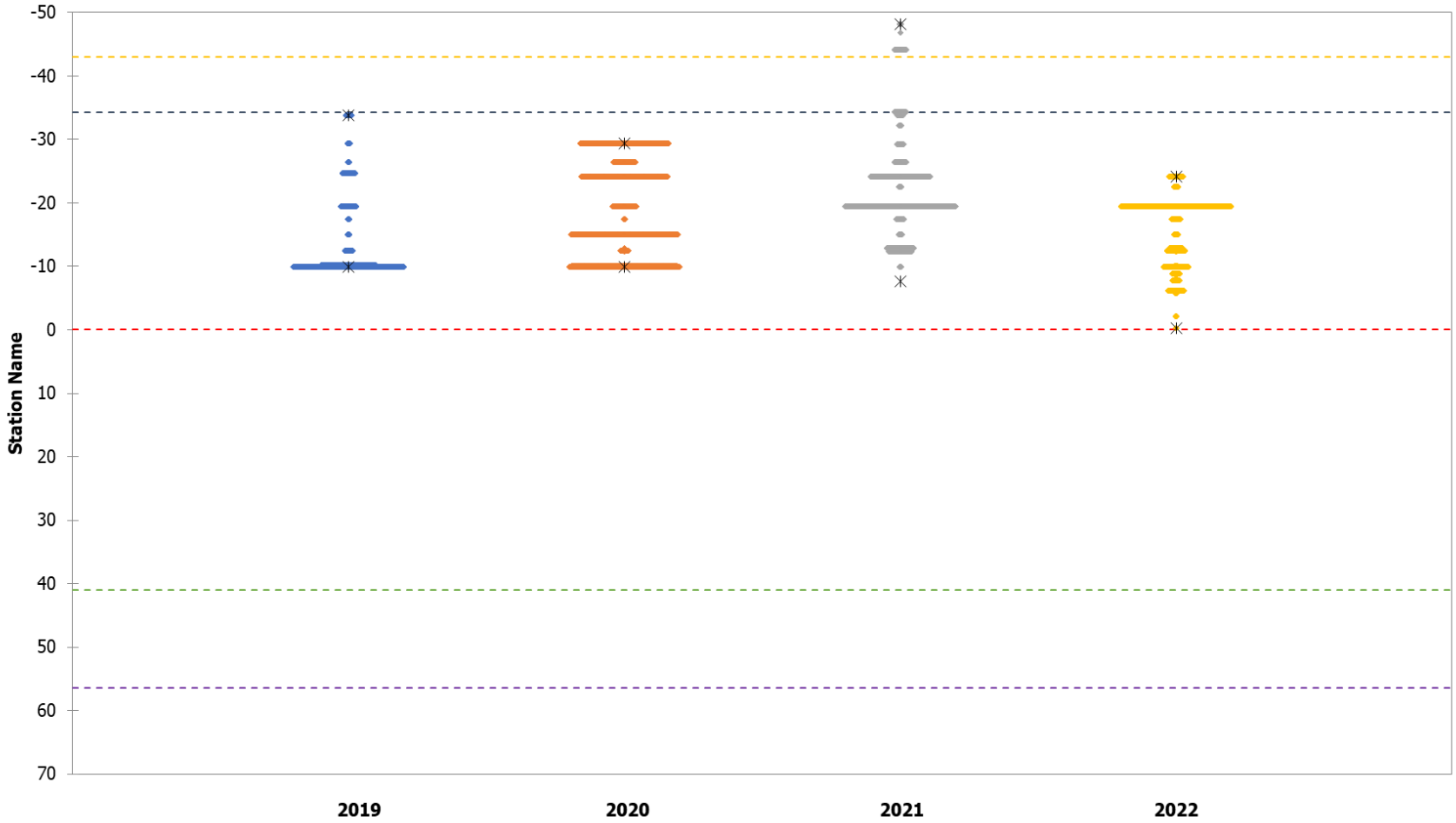

Figure A5-23: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7064) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

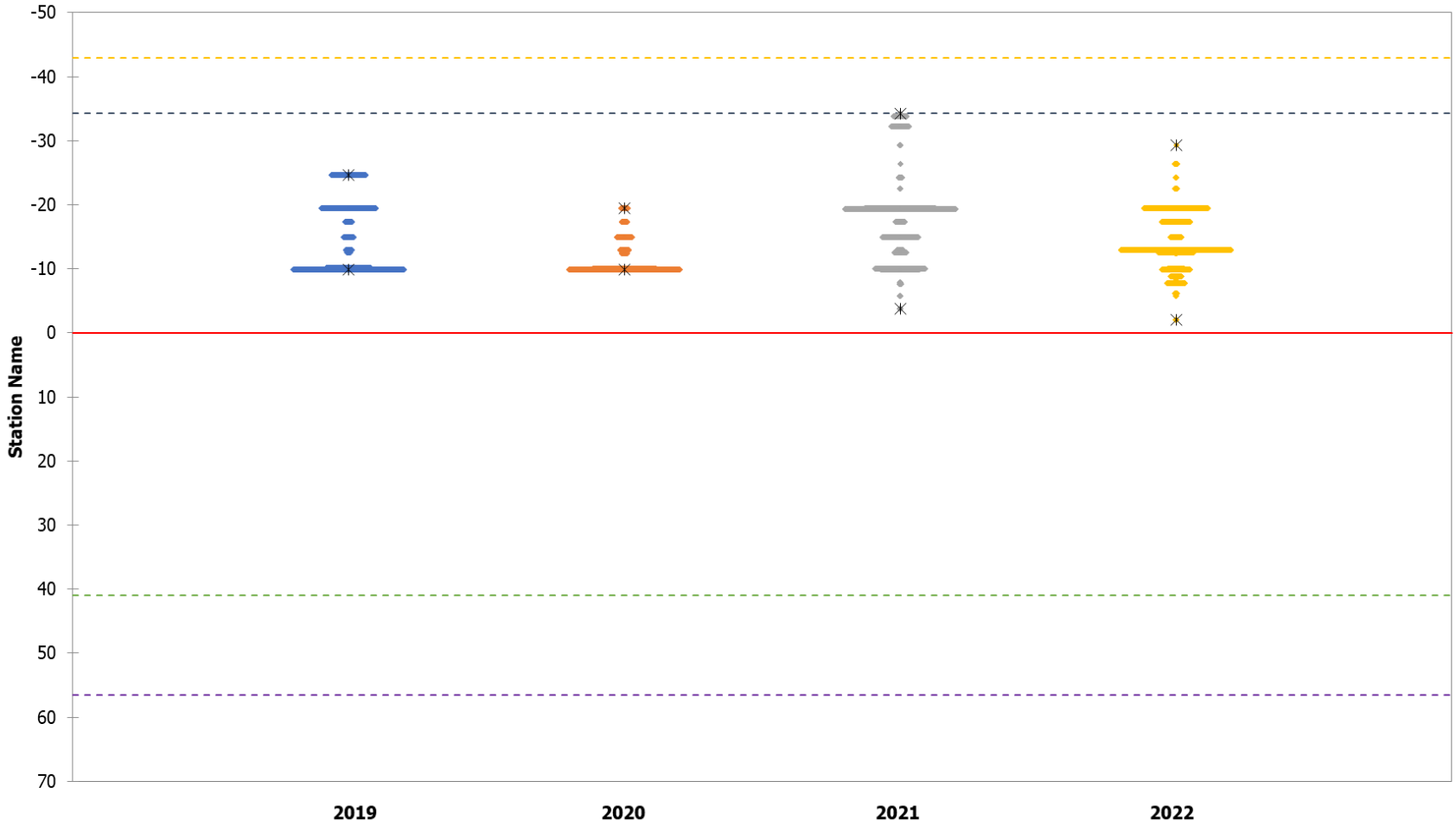

Figure A5-24: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7065) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

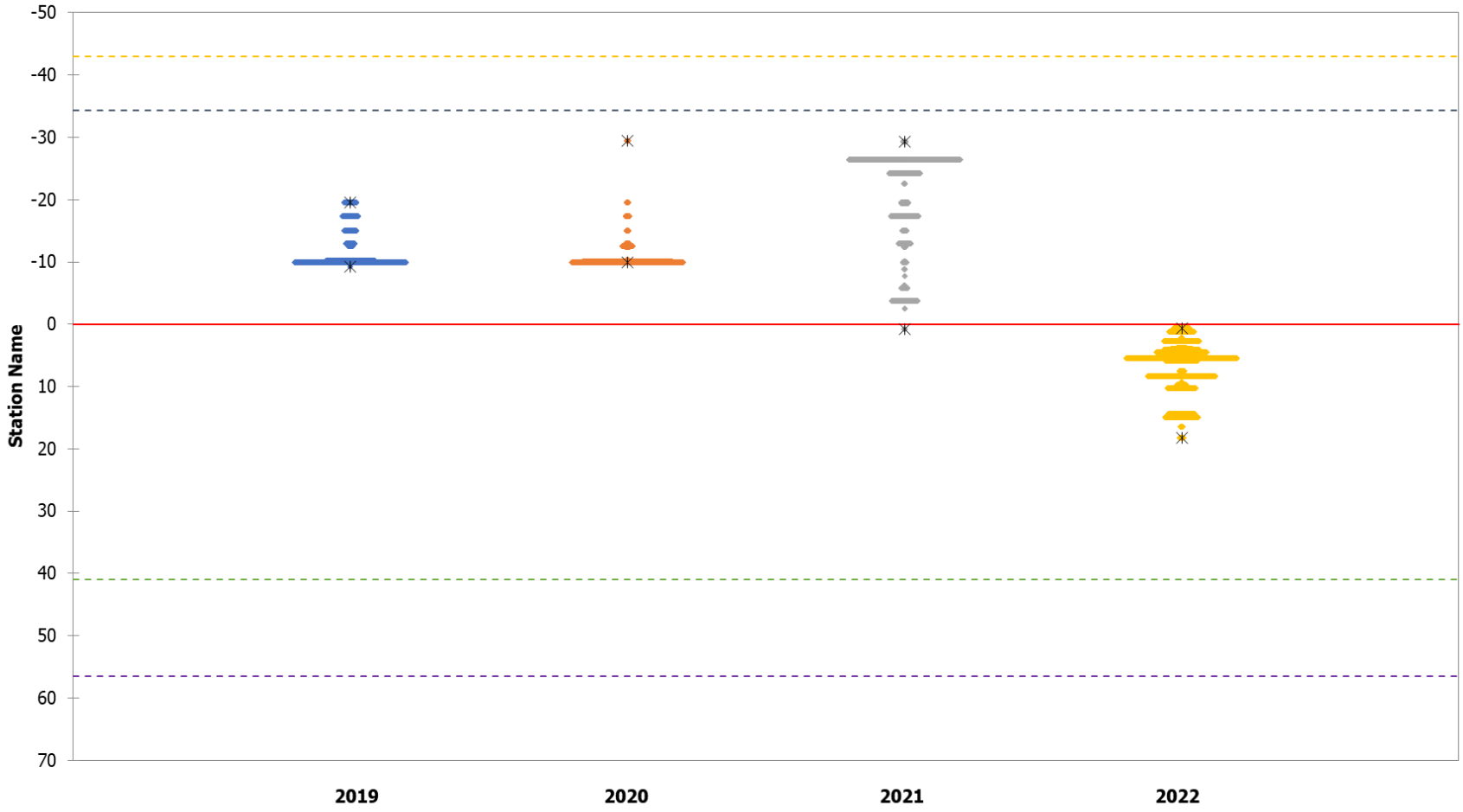

Figure A5-25: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7066) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

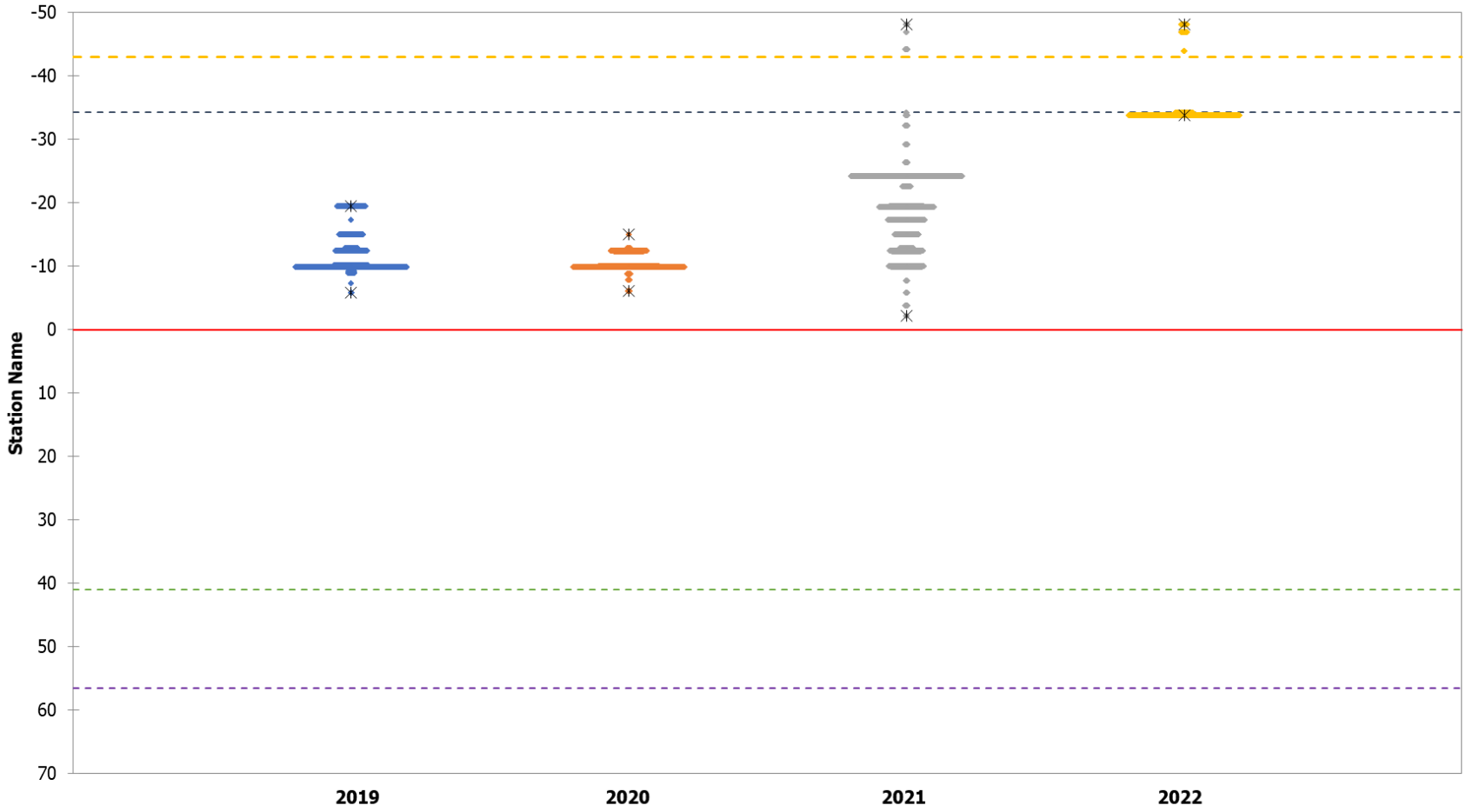

Figure A5-26: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7067) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

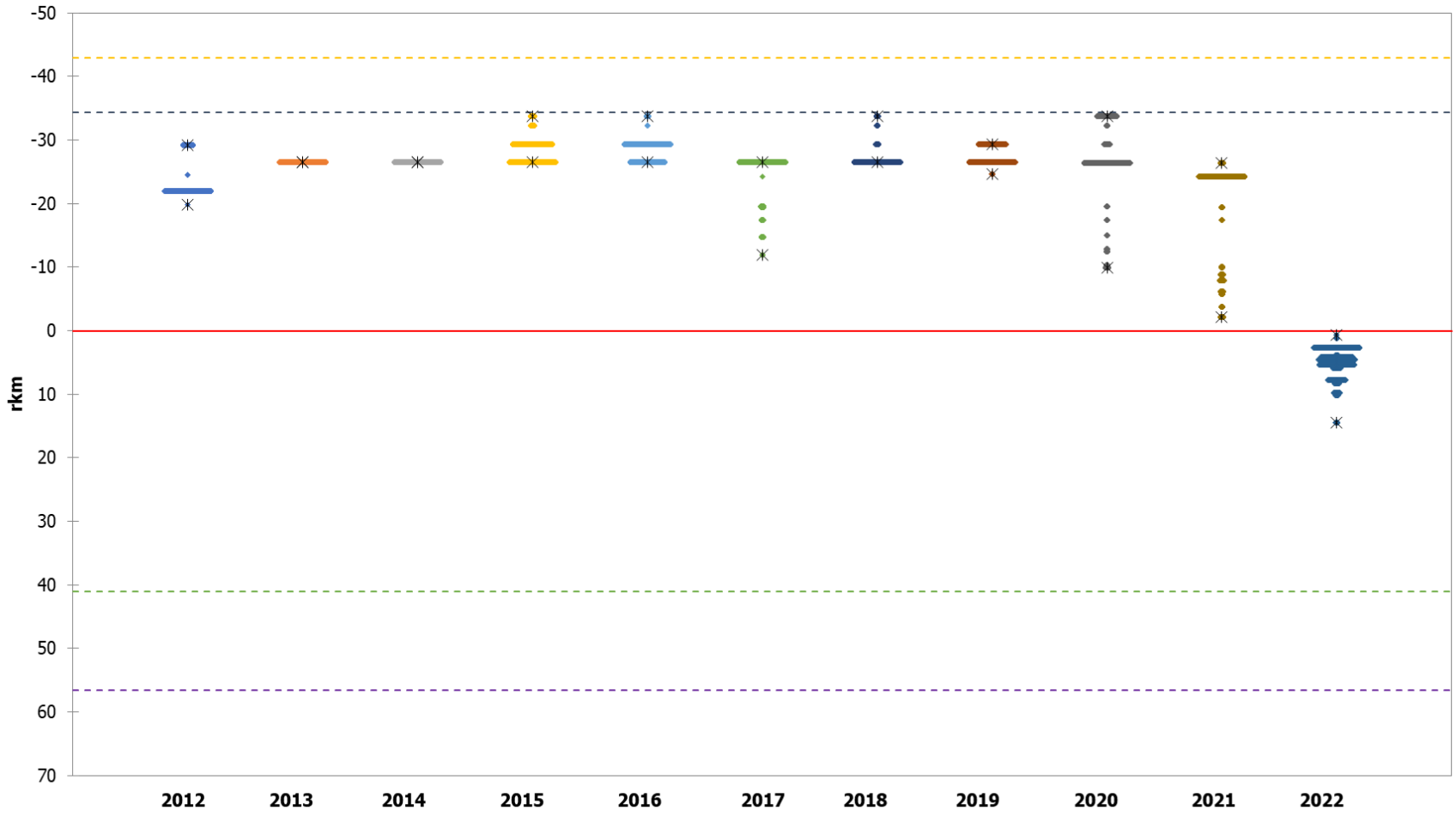

Figure A5-27: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16026) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

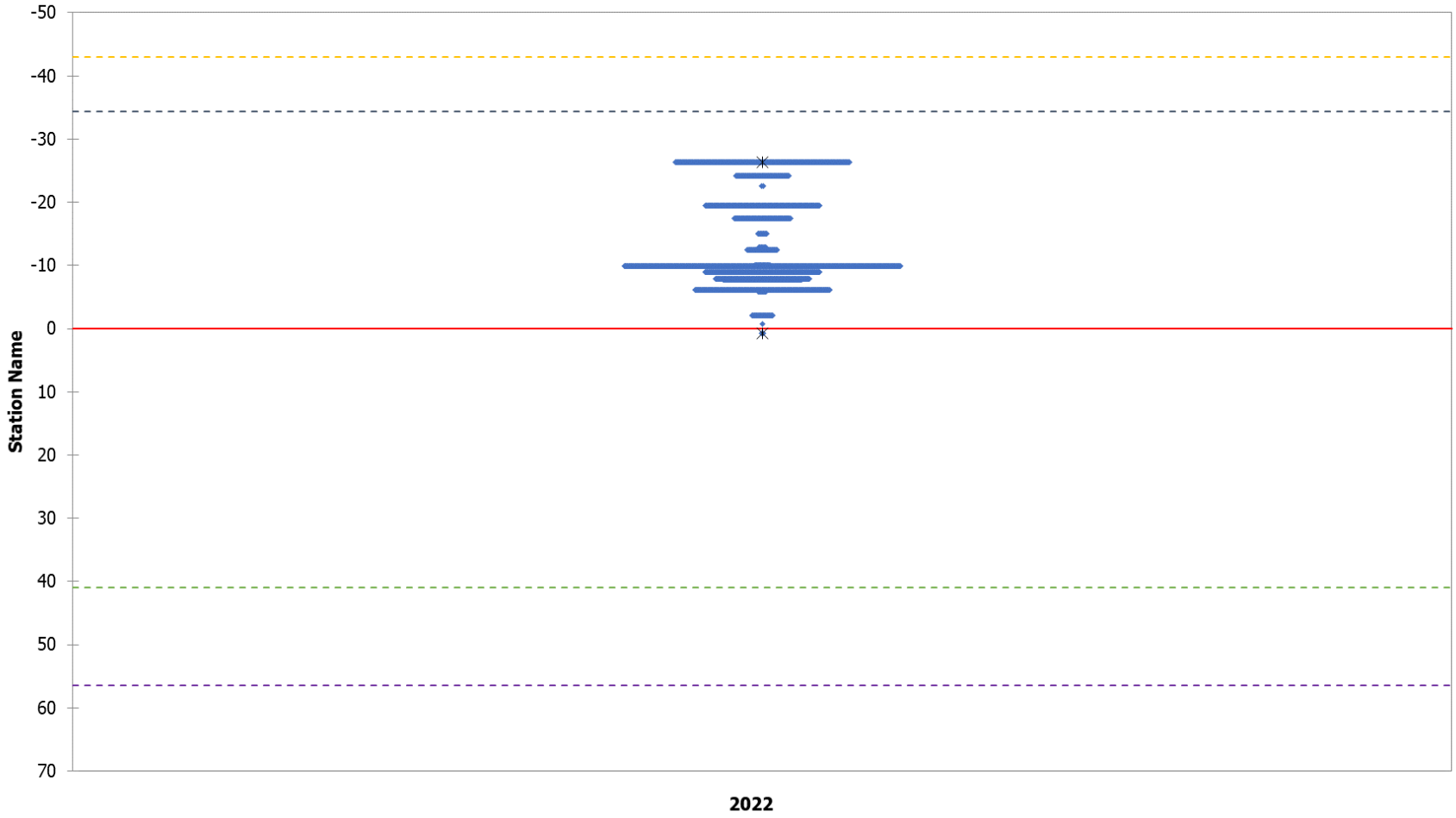

Figure A5-28: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57478) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

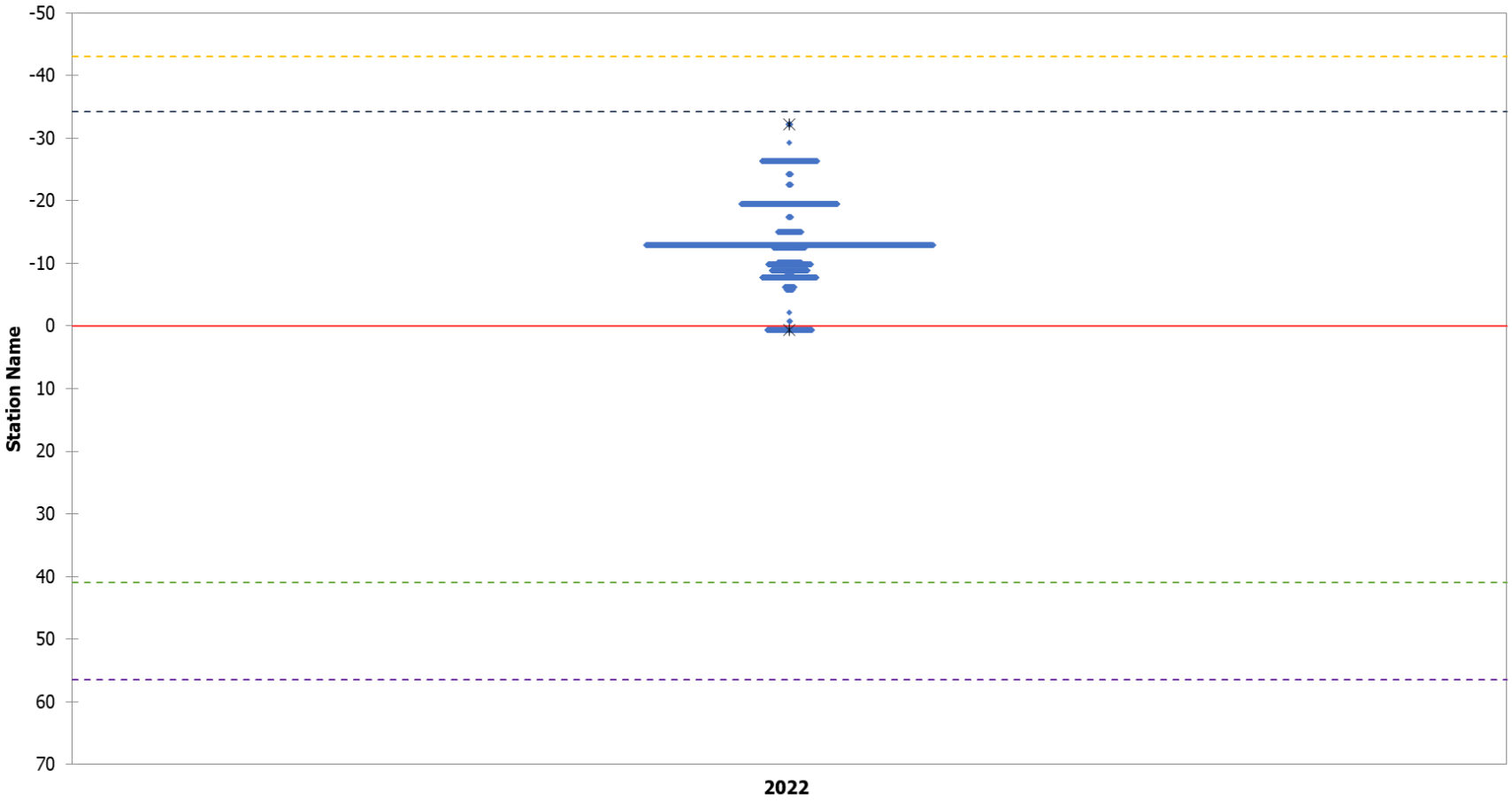

Figure A5-29: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57479) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

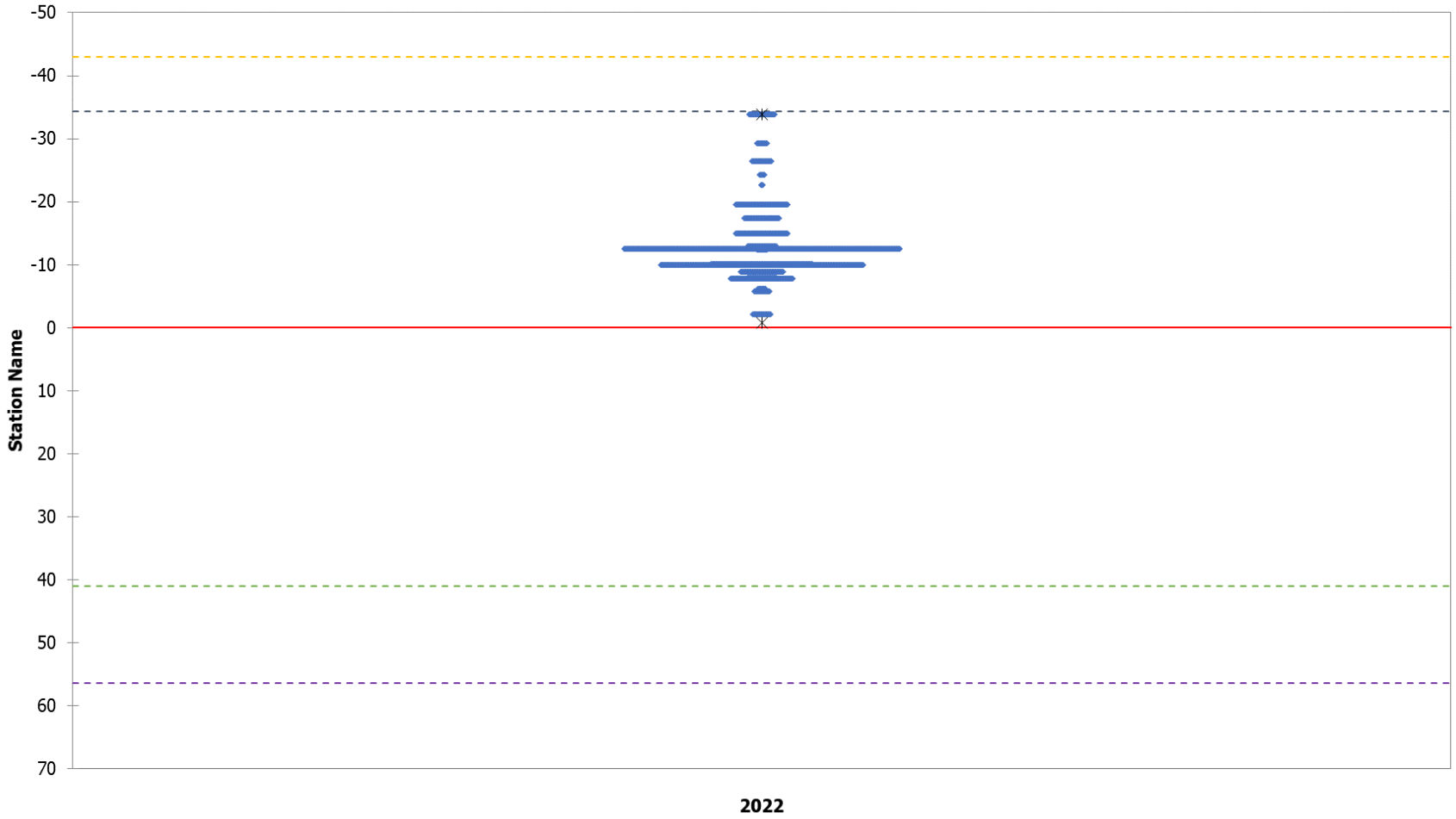

Figure A5-30: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57480) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

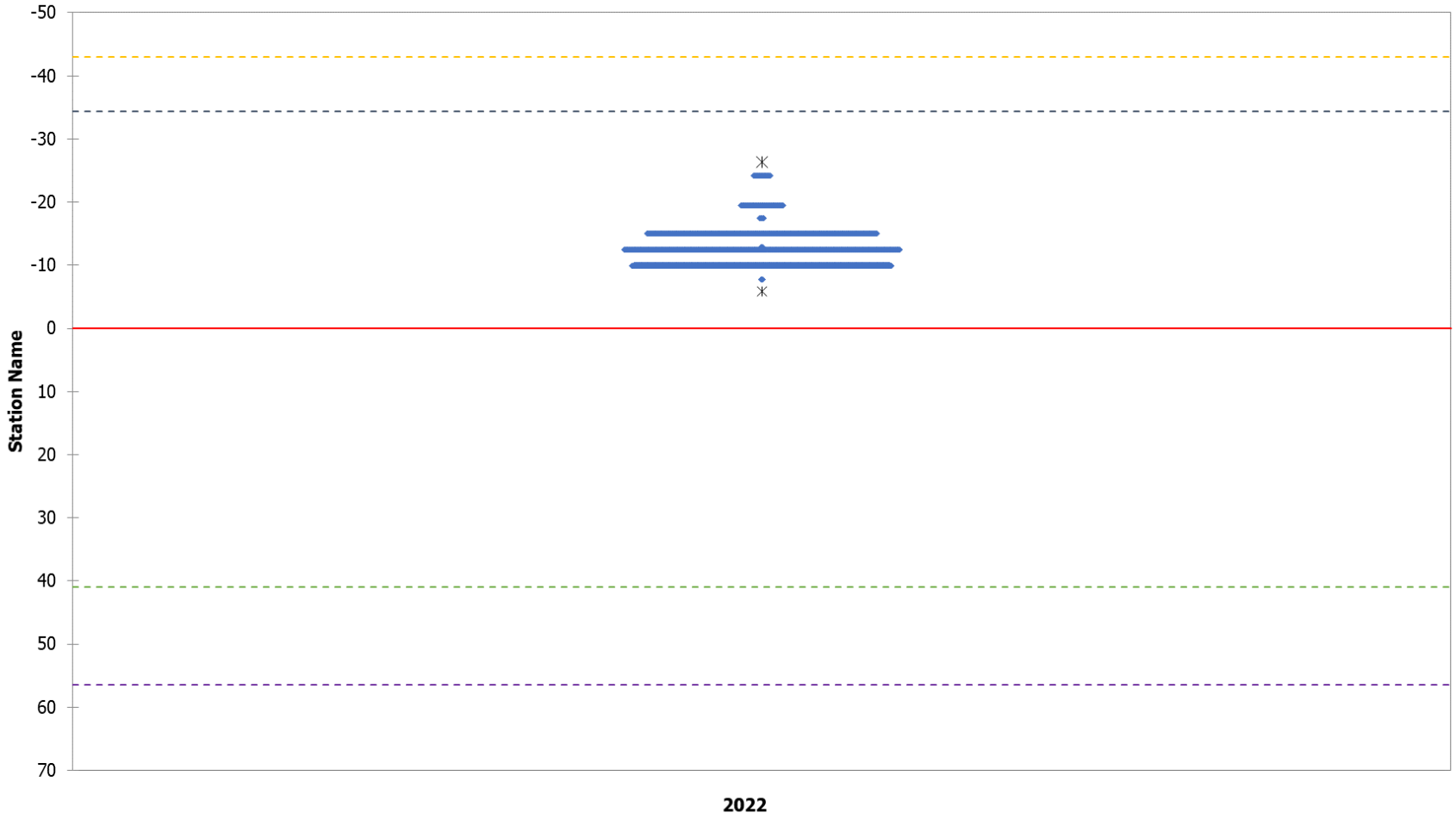

Figure A5-31: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57481) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

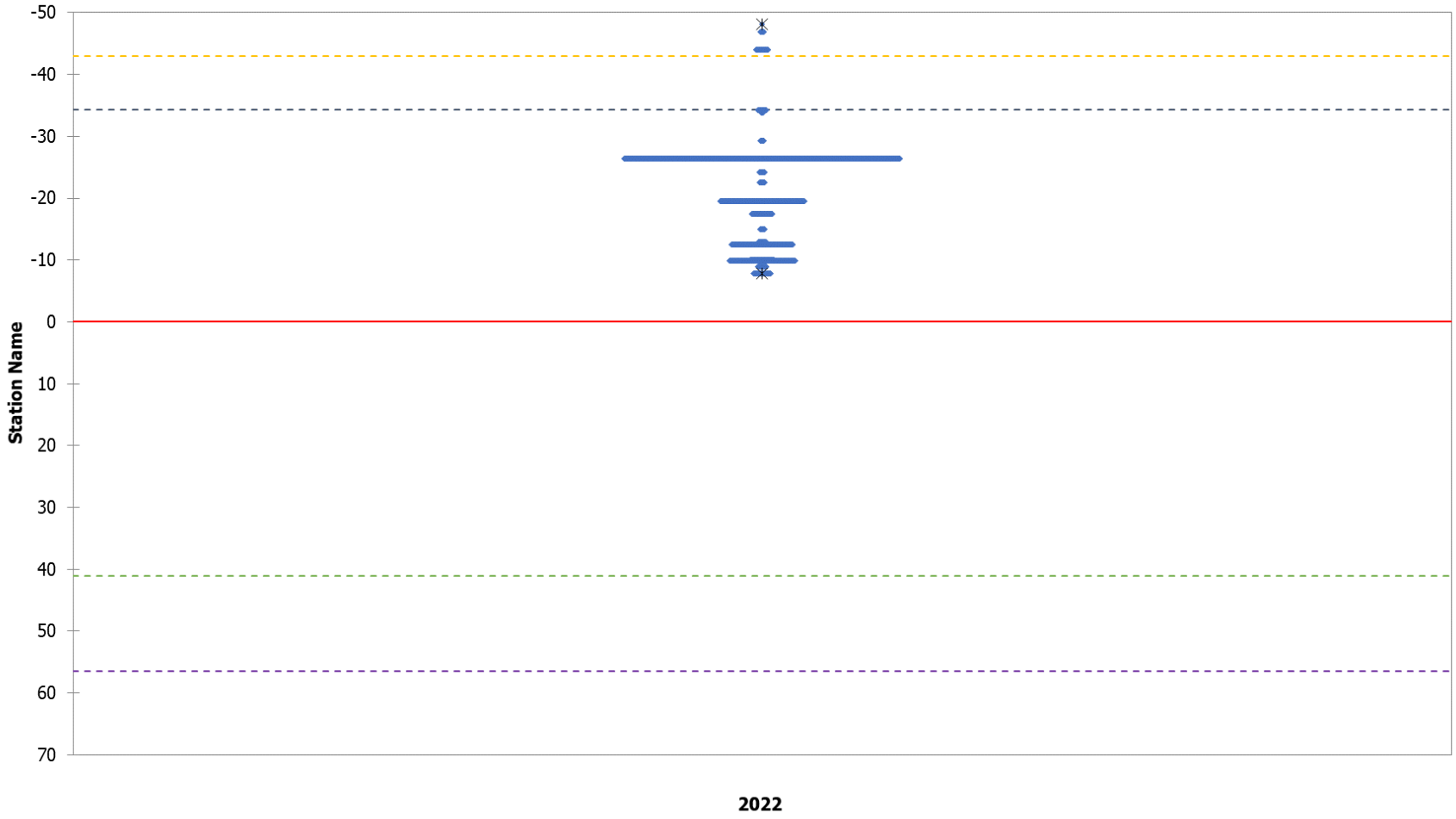

Figure A5-32: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57482) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

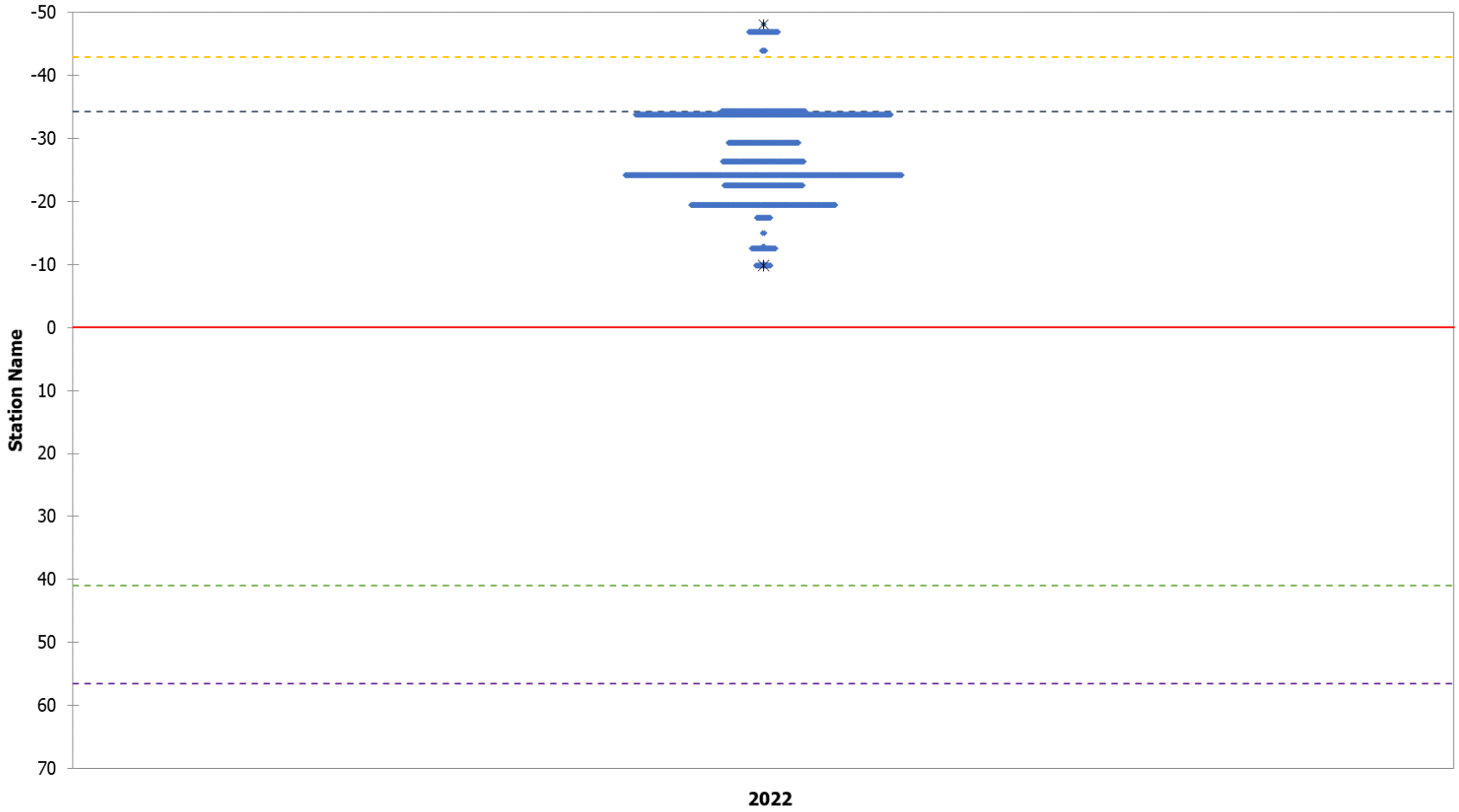

Figure A5-33: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57483) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

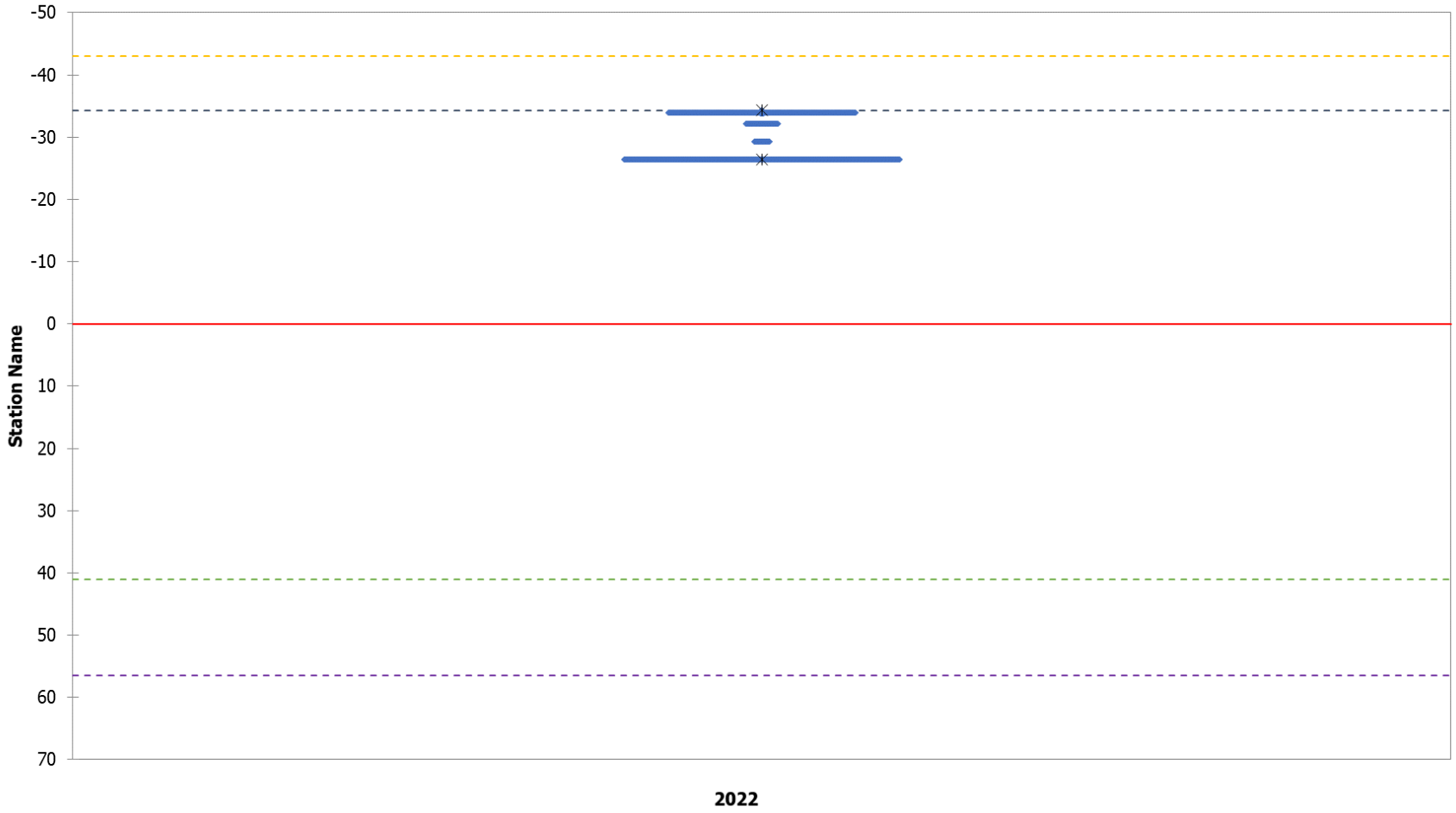

Figure A5-34: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57484) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

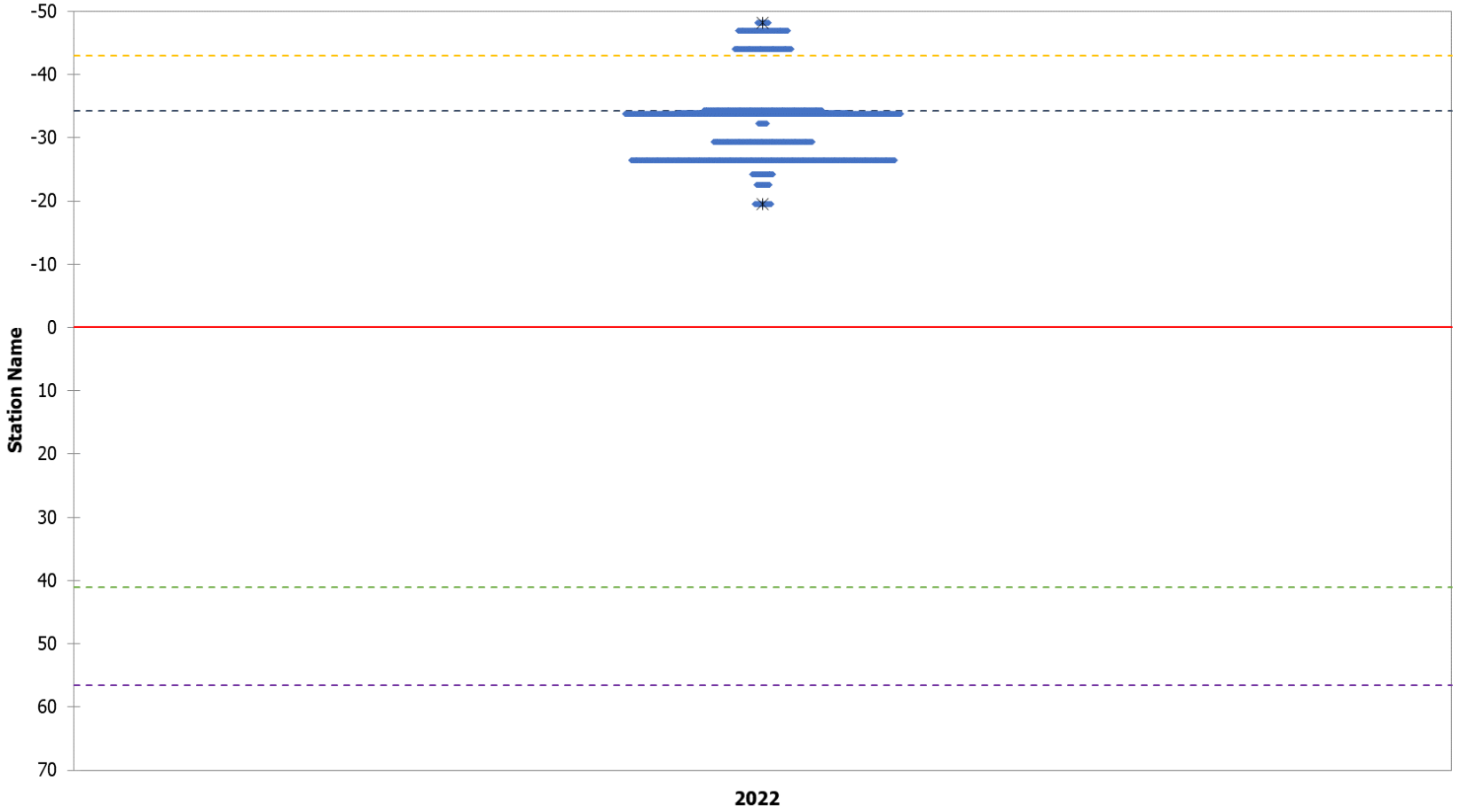

Figure A5-35: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57485) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

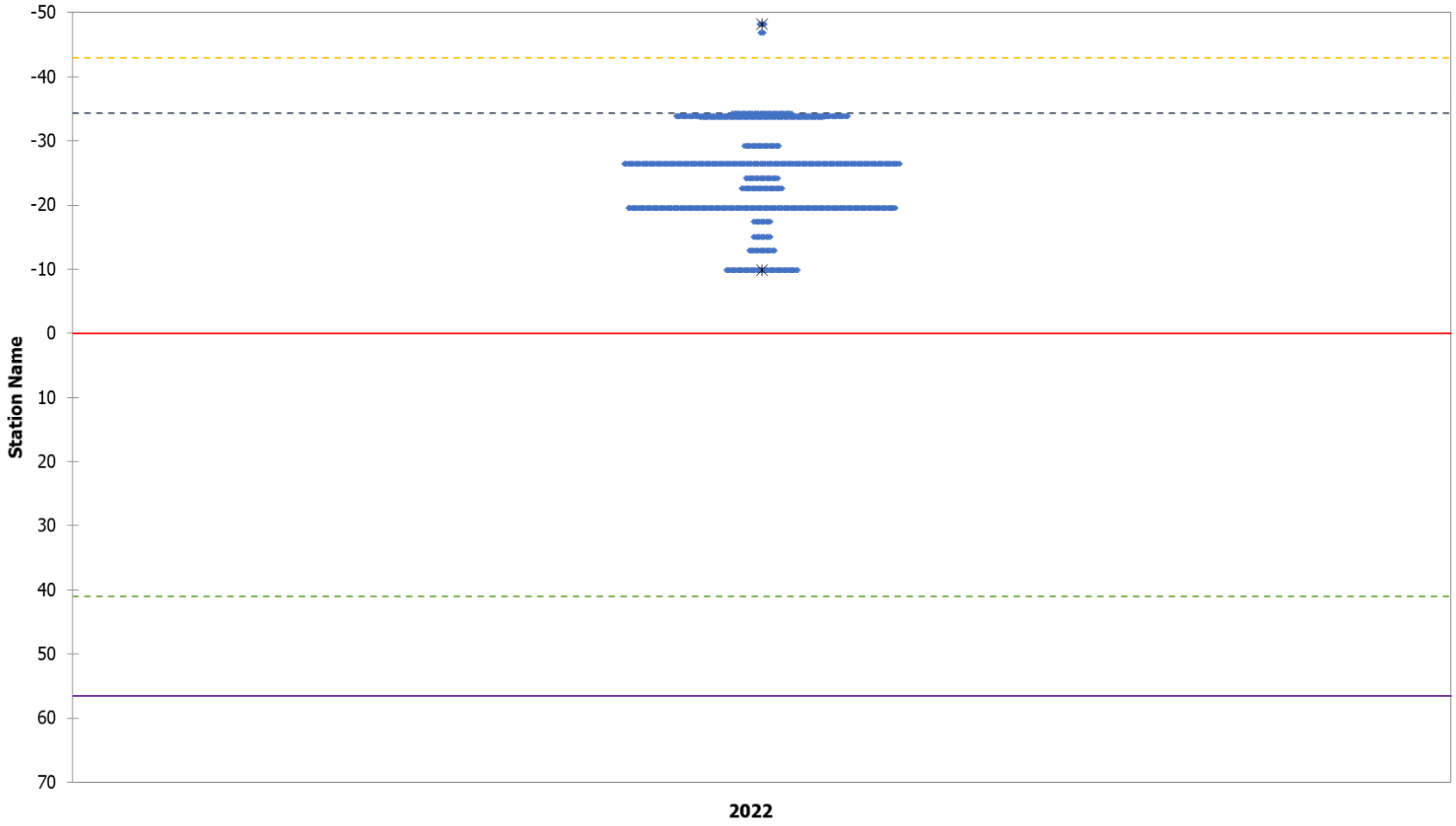

Figure A5-36: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57486) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

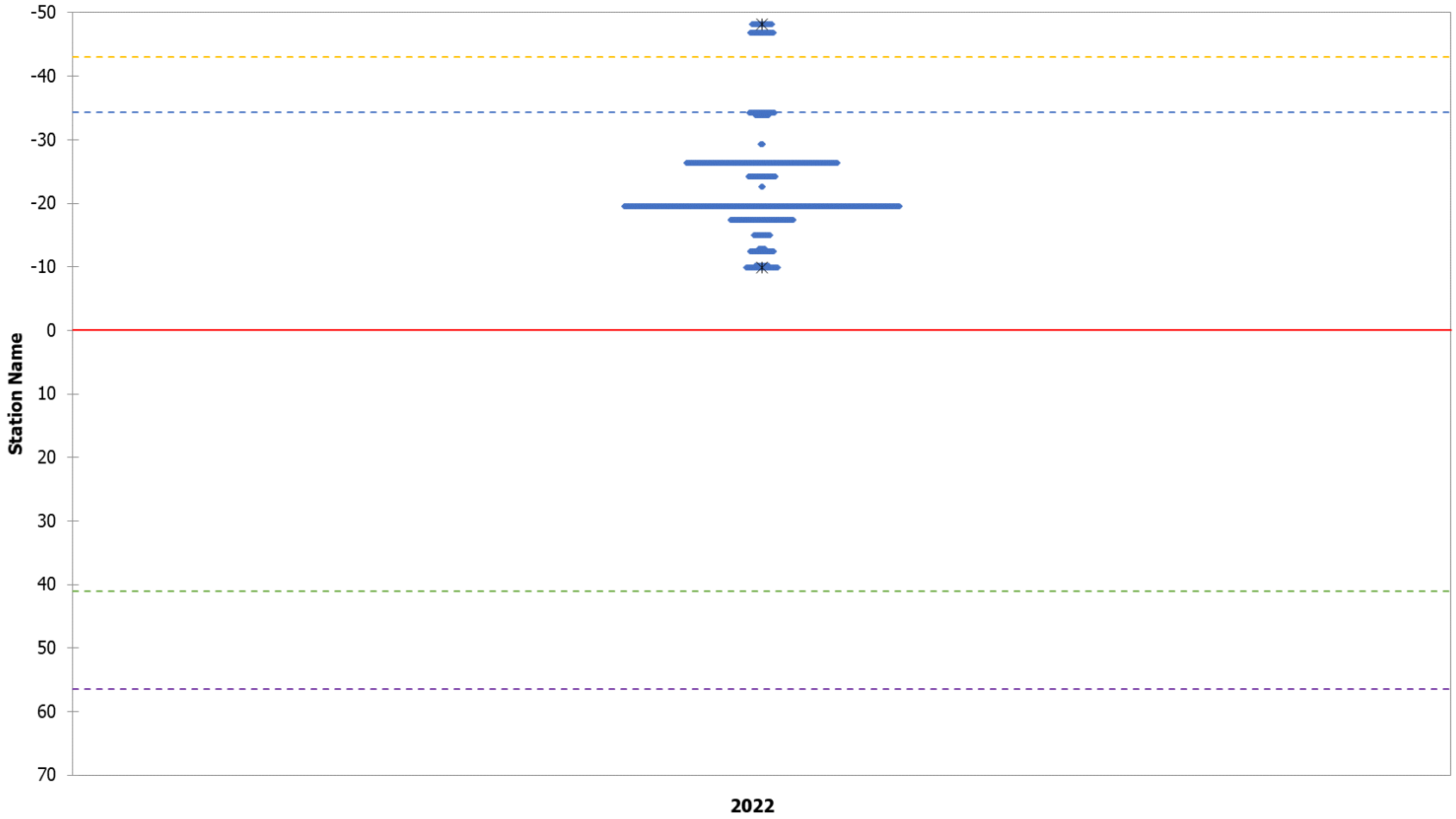

Figure A5-37: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57487) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

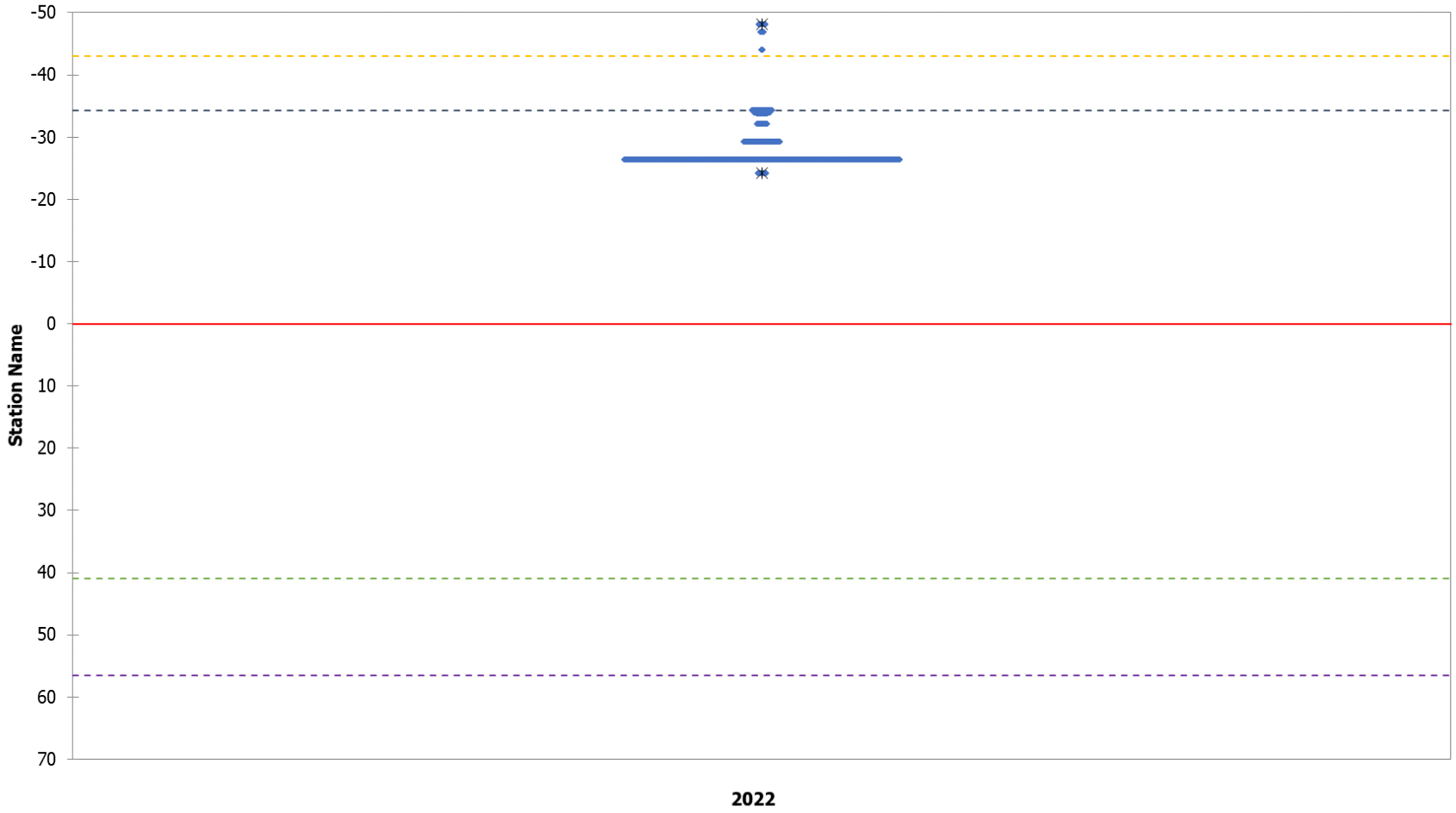

Figure A5-38: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57488) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

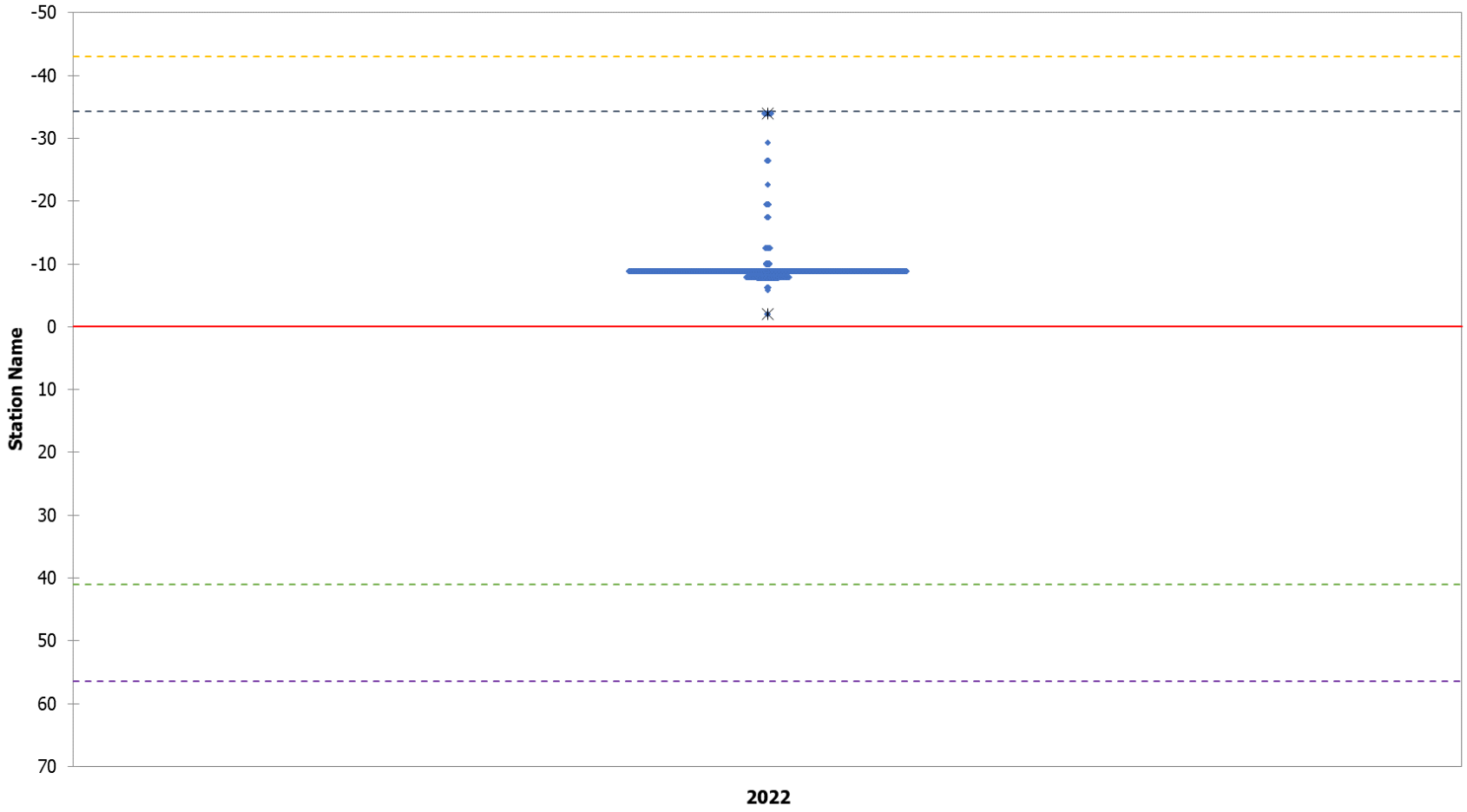

Figure A5-39: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57489) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

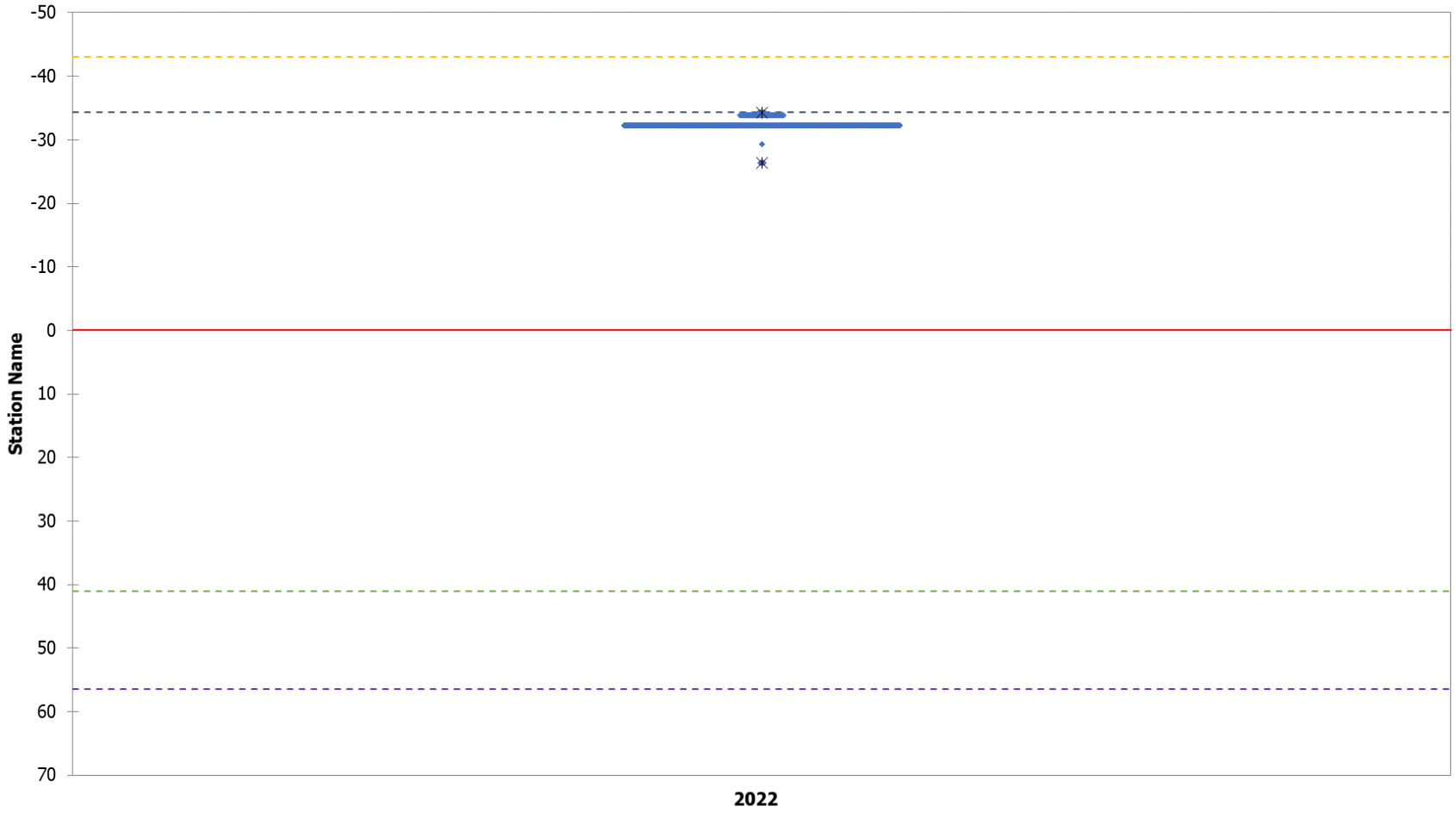

Figure A5-40: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57490) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

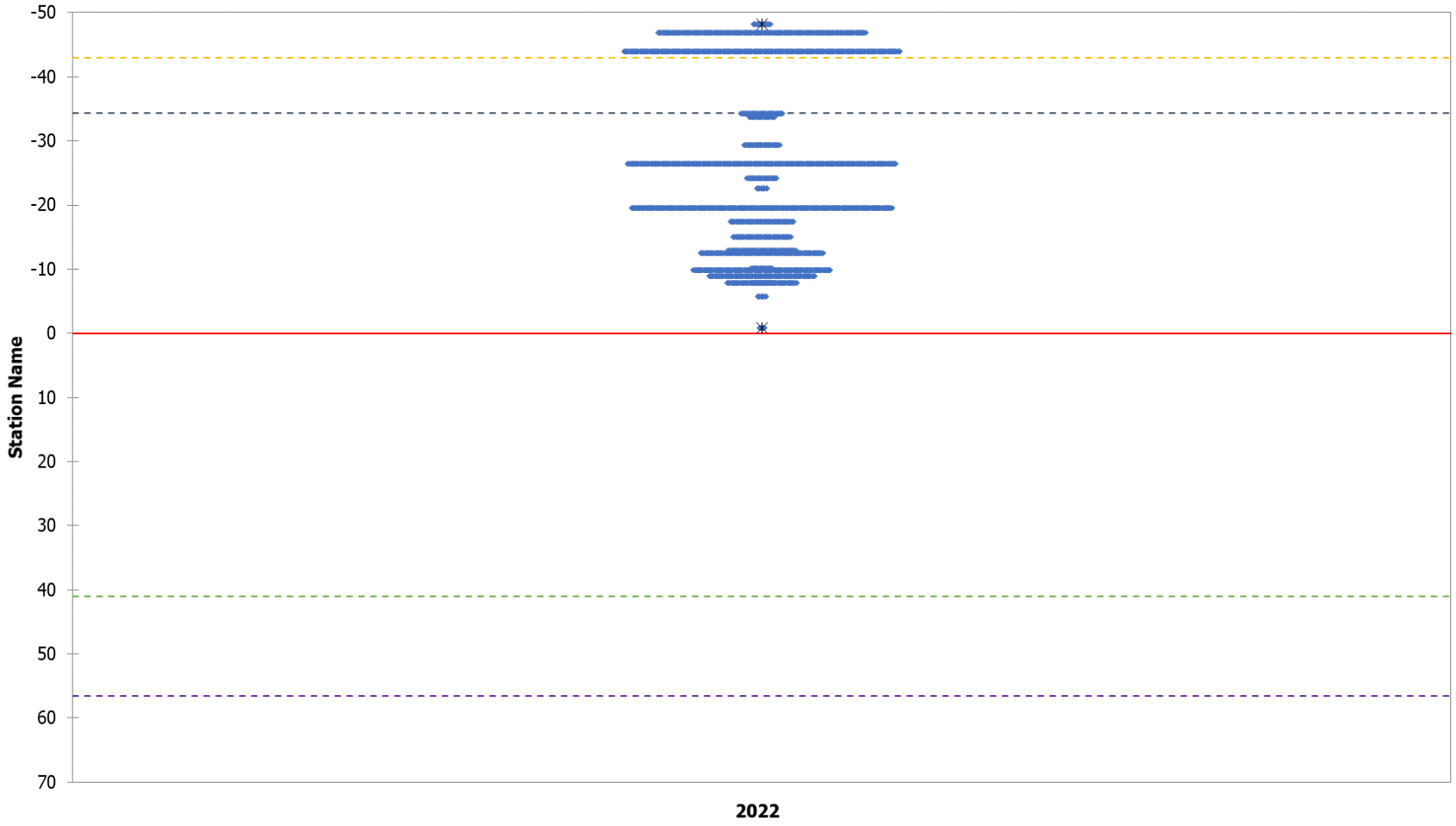

Figure A5-41: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57491) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

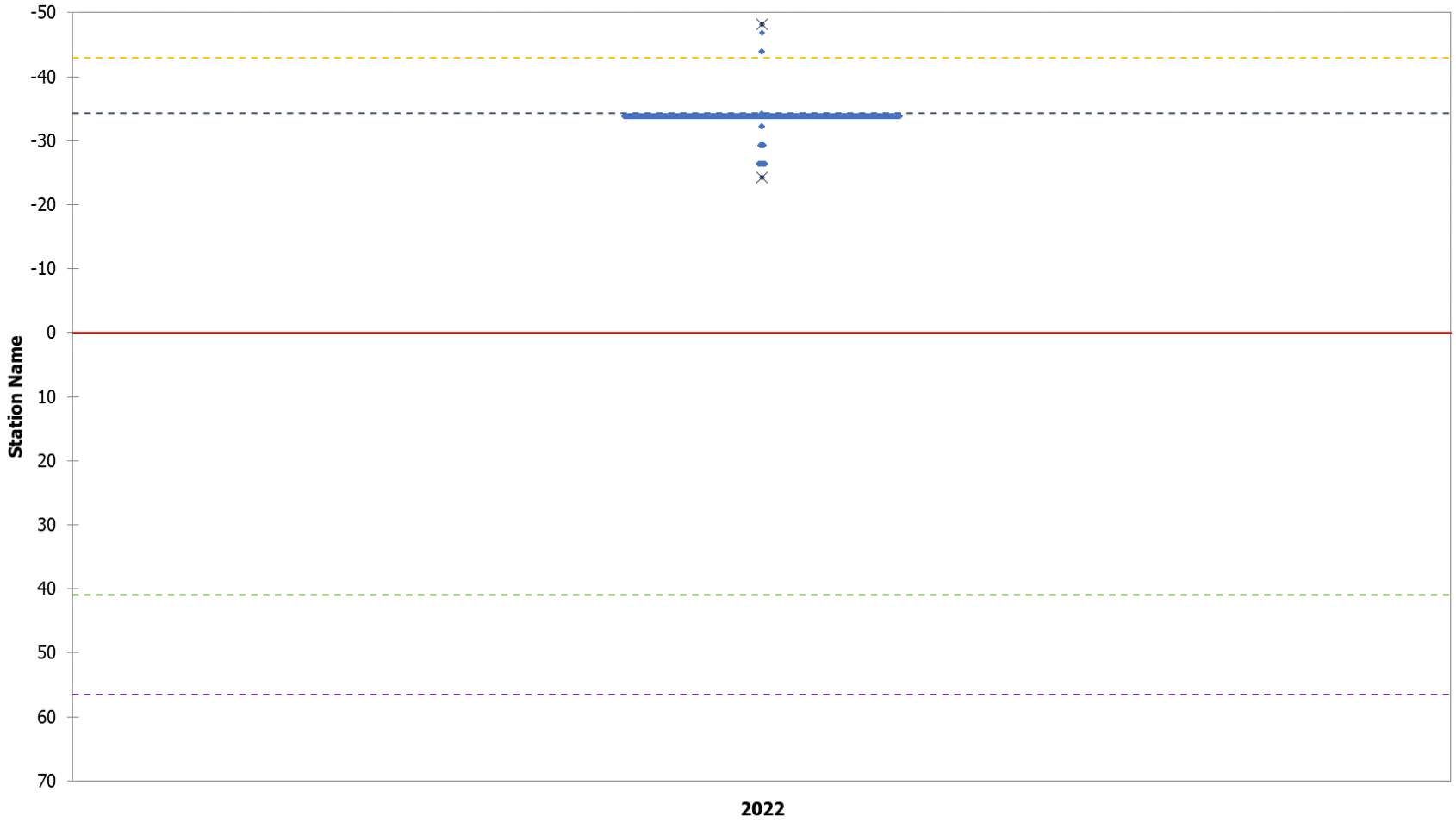

Figure A5-42: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57492) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

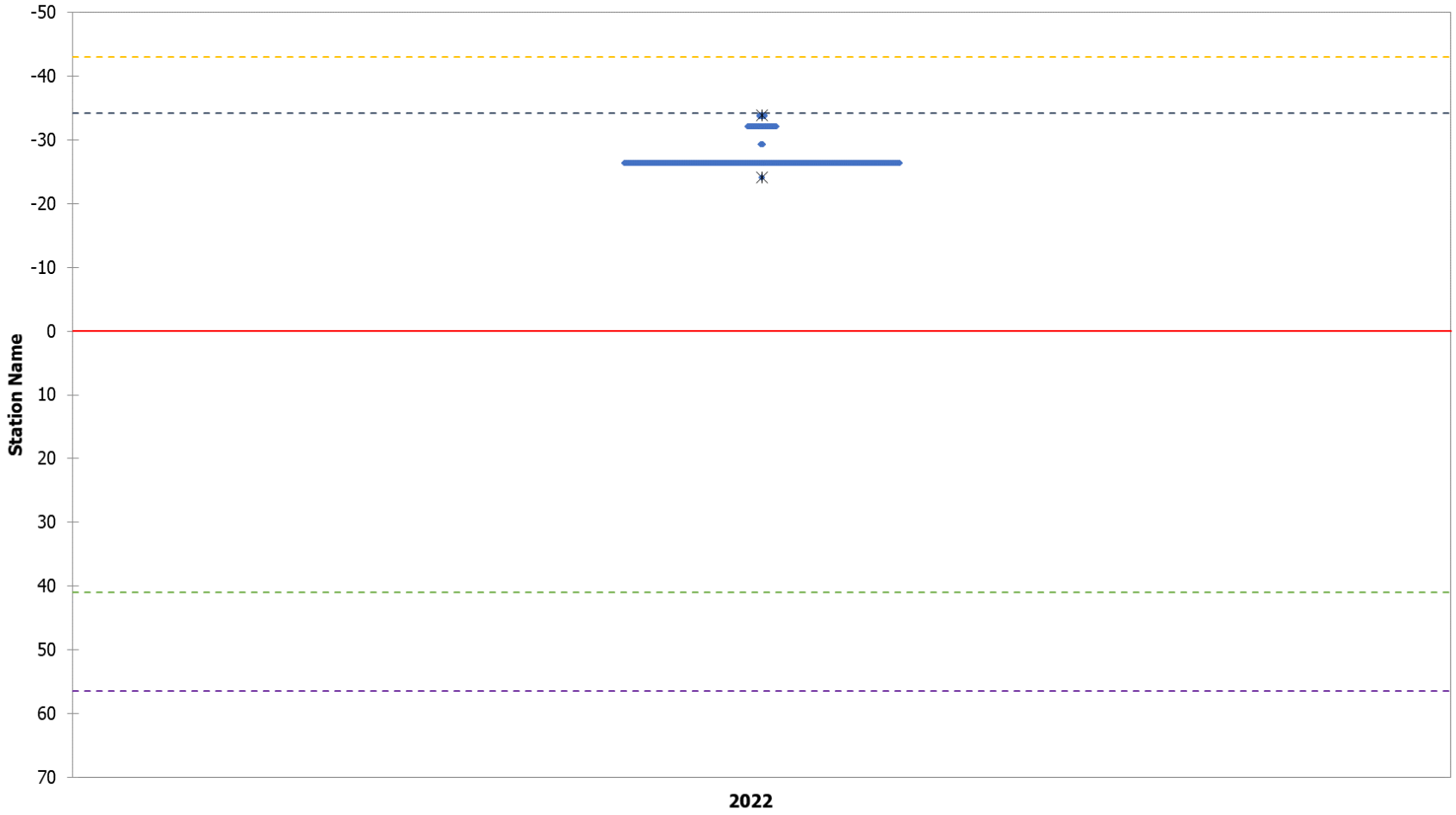

Figure A5-43: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57494) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

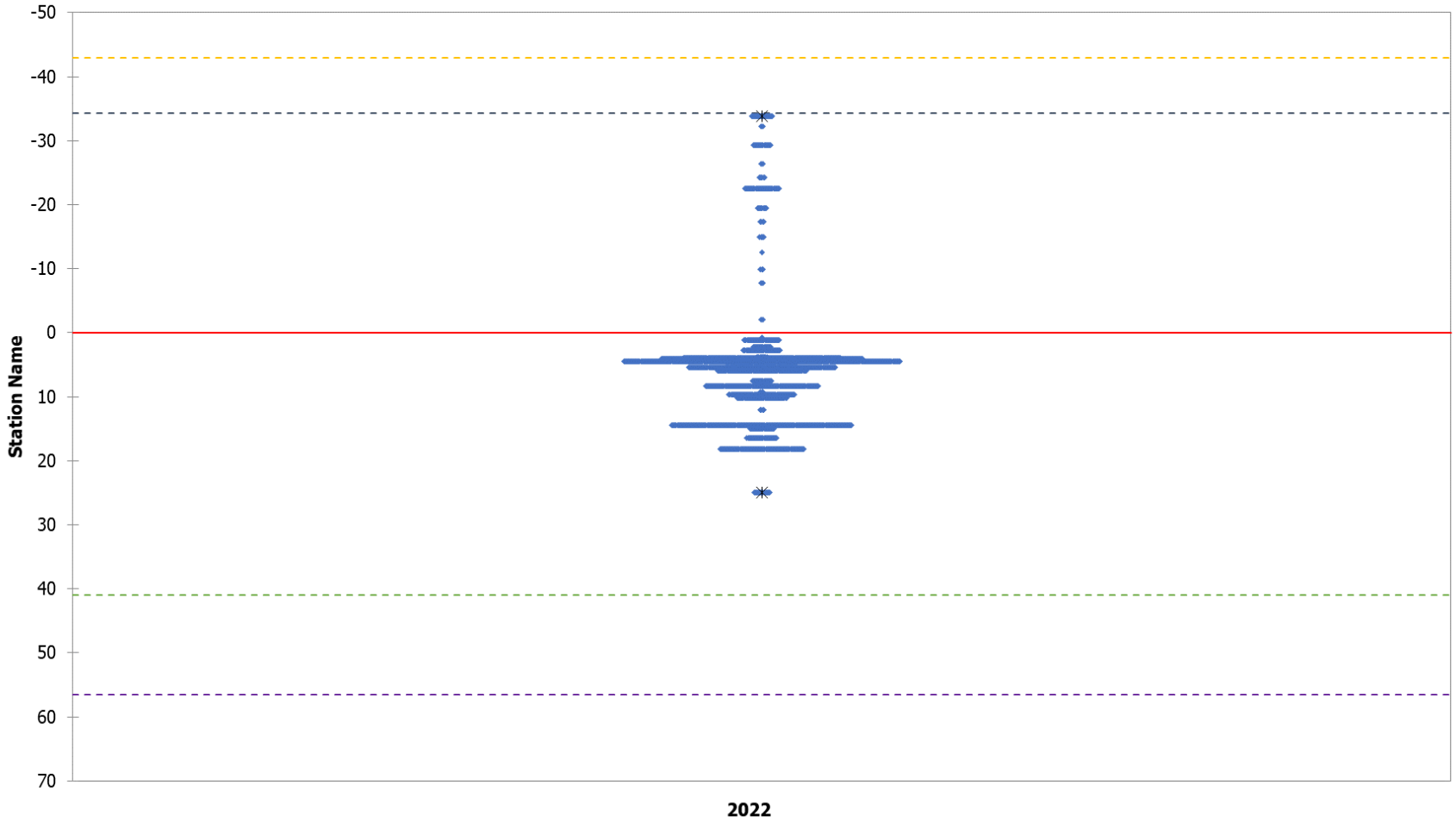

Figure A5-44: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57495) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

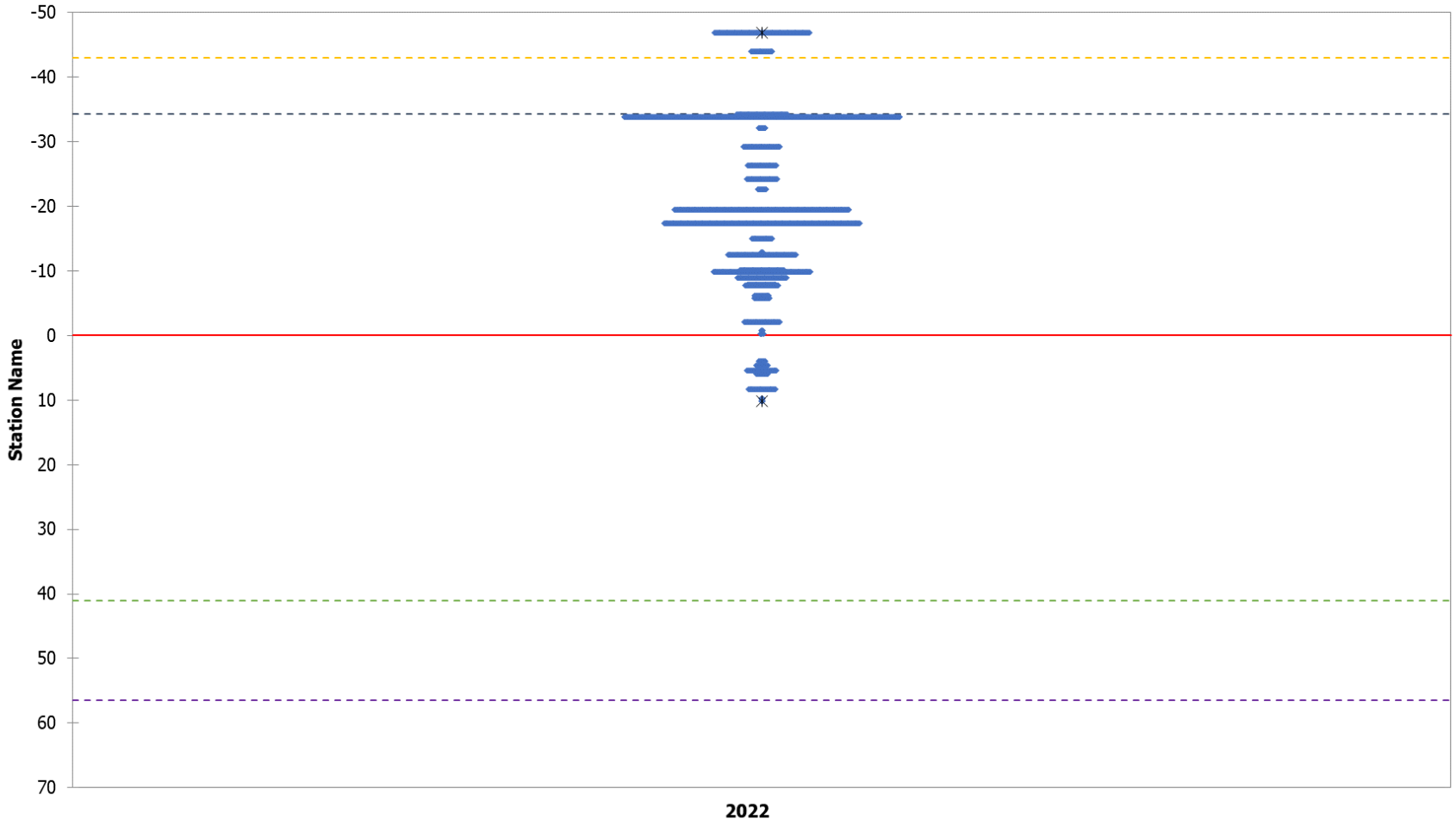

Figure A5-45: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57502) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

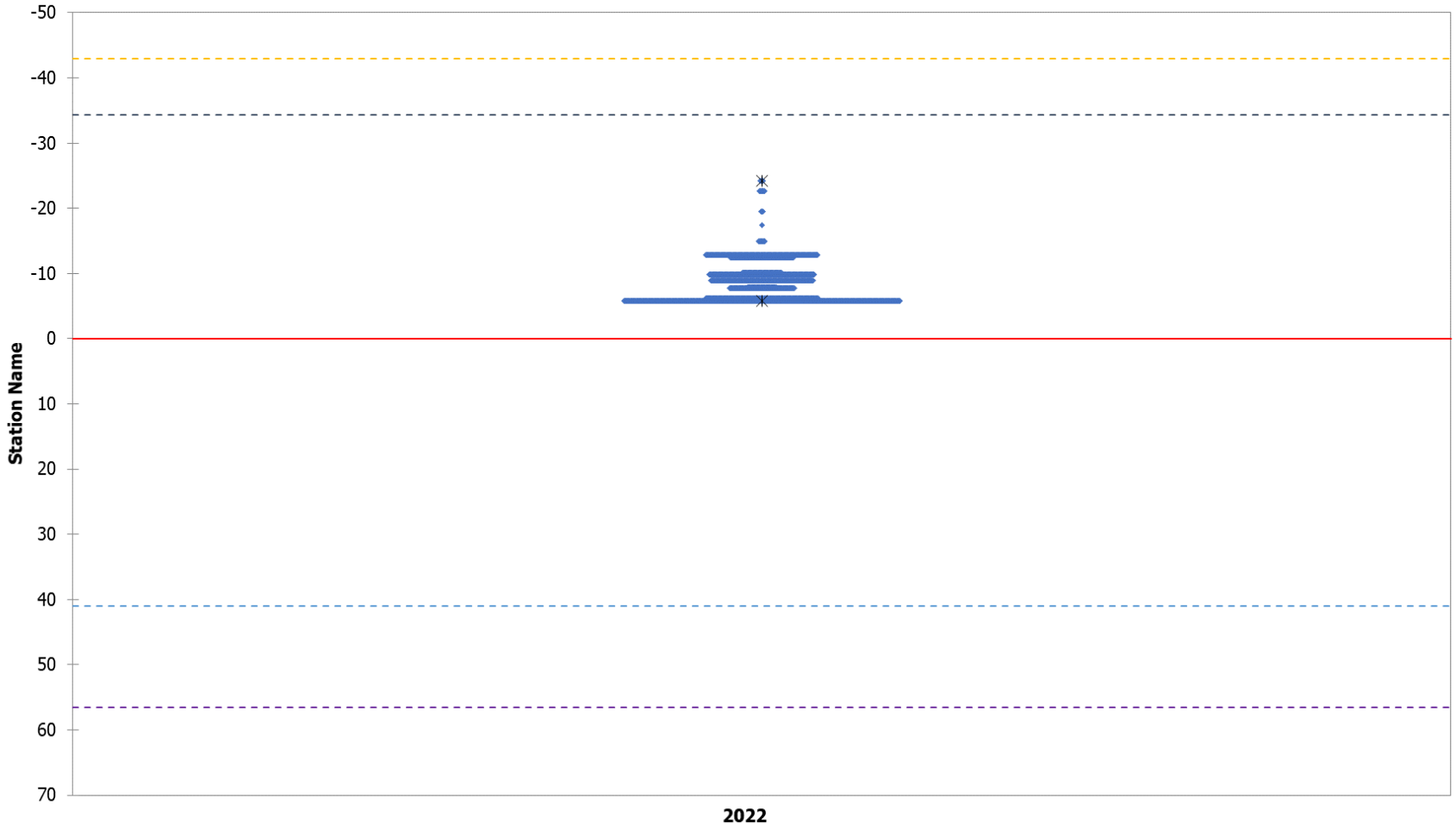

Figure A5-46: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57504) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

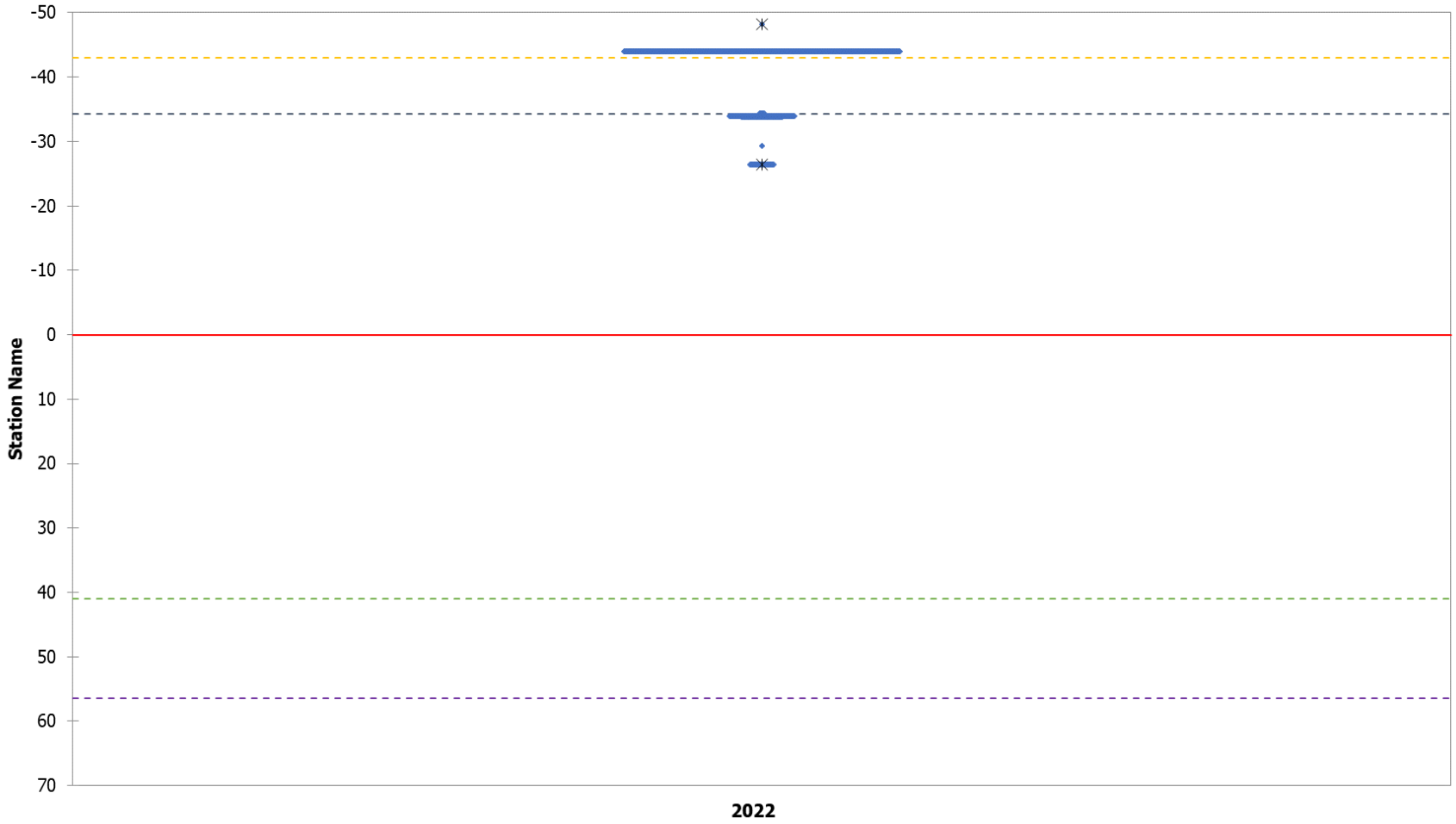

Figure A5-47: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57505) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

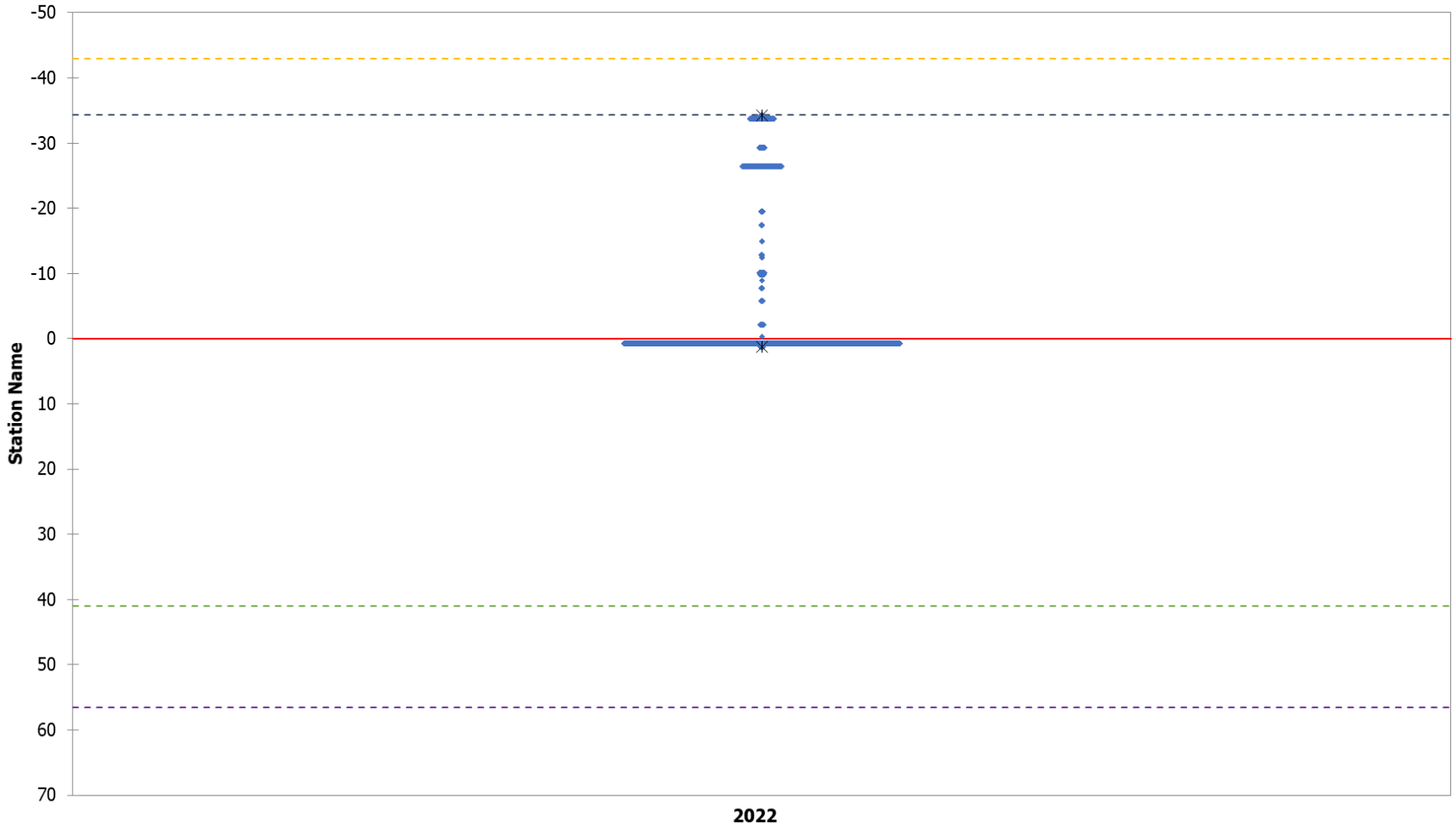

Figure A5-48: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57506) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

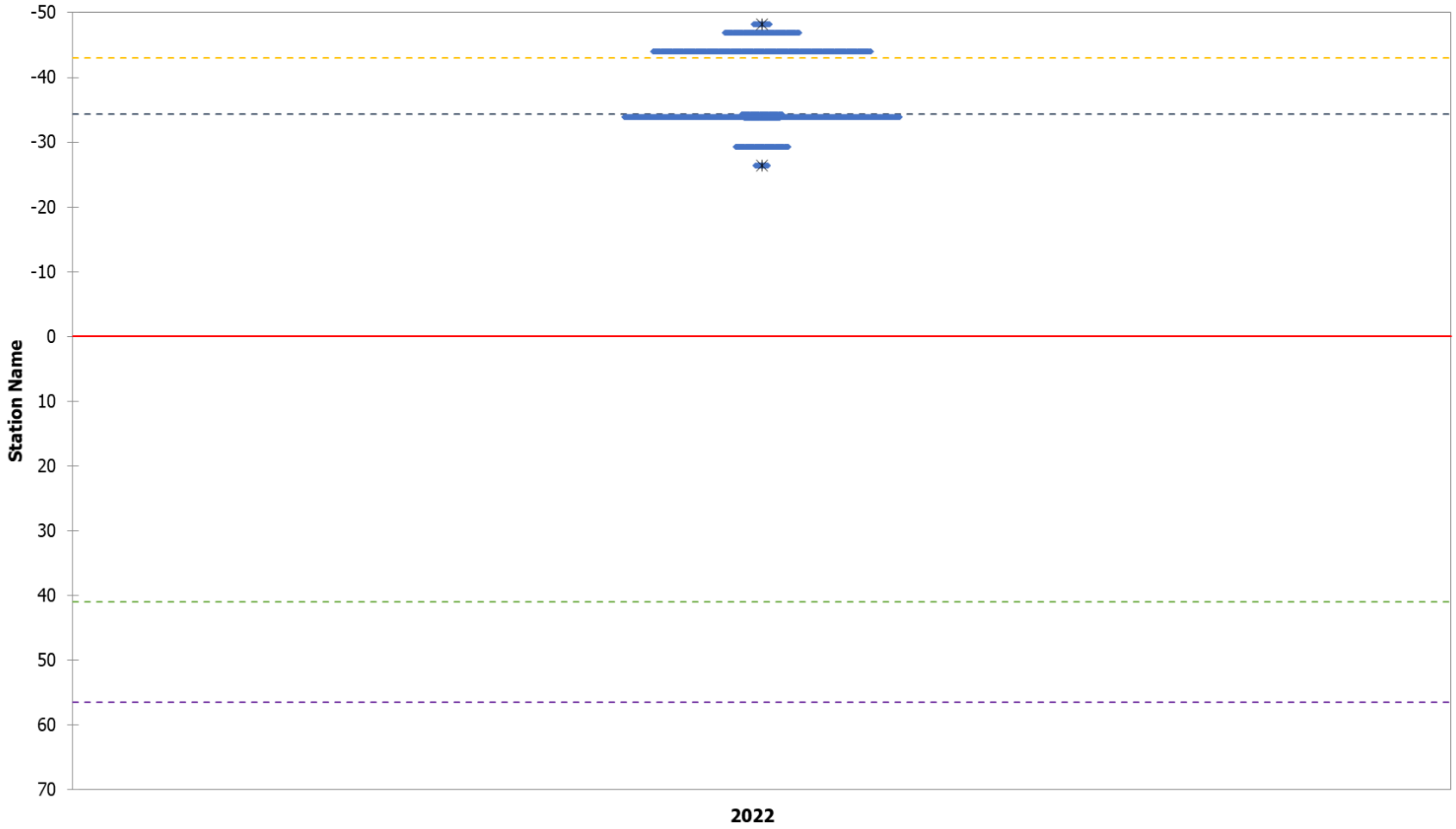

Figure A5-49: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #57507) in the Keeyask reservoir in relation to the Keeyask GS (rkm 0), during each open-water period from May 16 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple = Long Spruce GS).

APPENDIX 6:
DETECTION RANGES FOR LAKE STURGEON TAGGED AND MONITORED BETWEEN 2011 AND 2022 IN STEPHENS LAKE

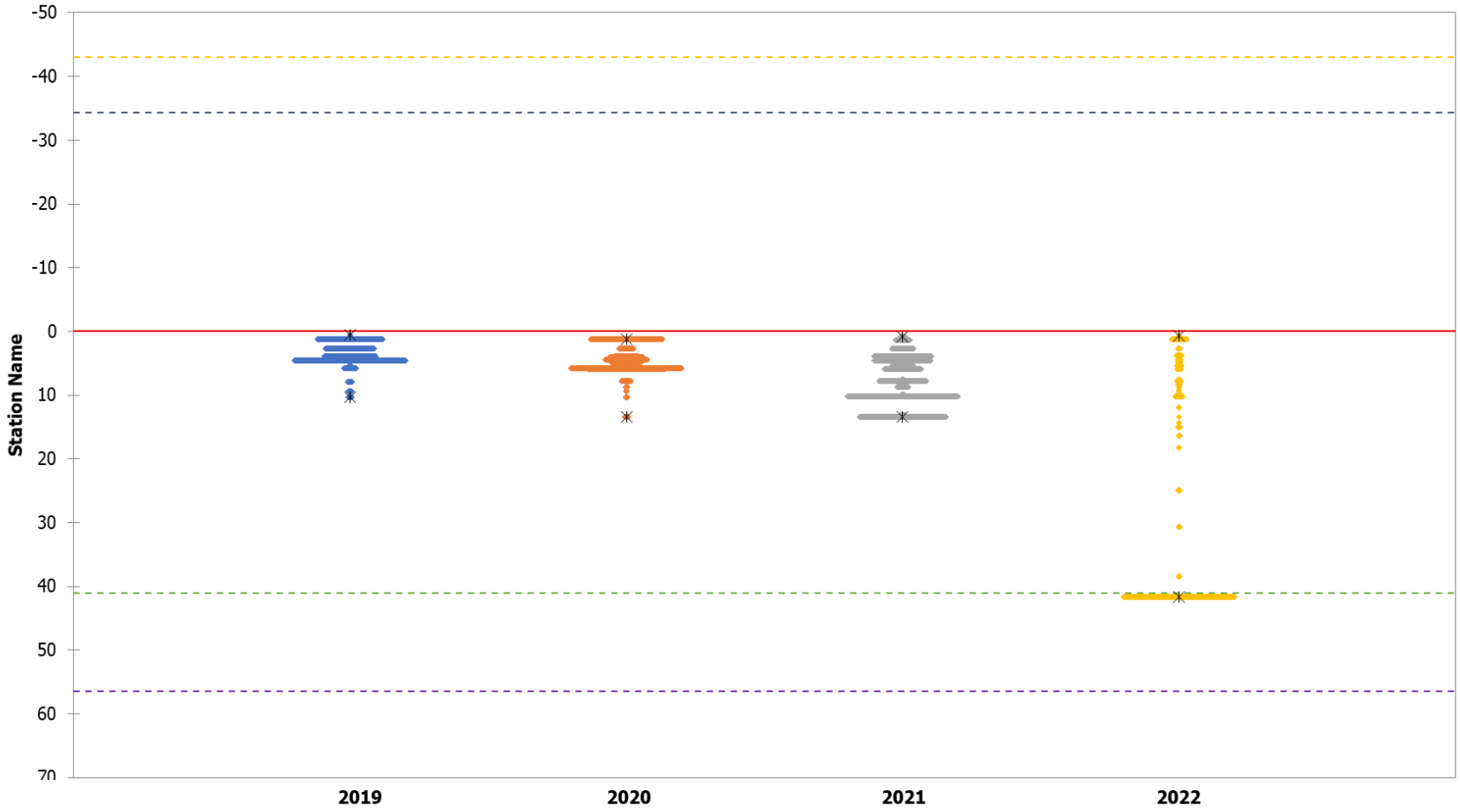

Figure A6-1: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7035) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

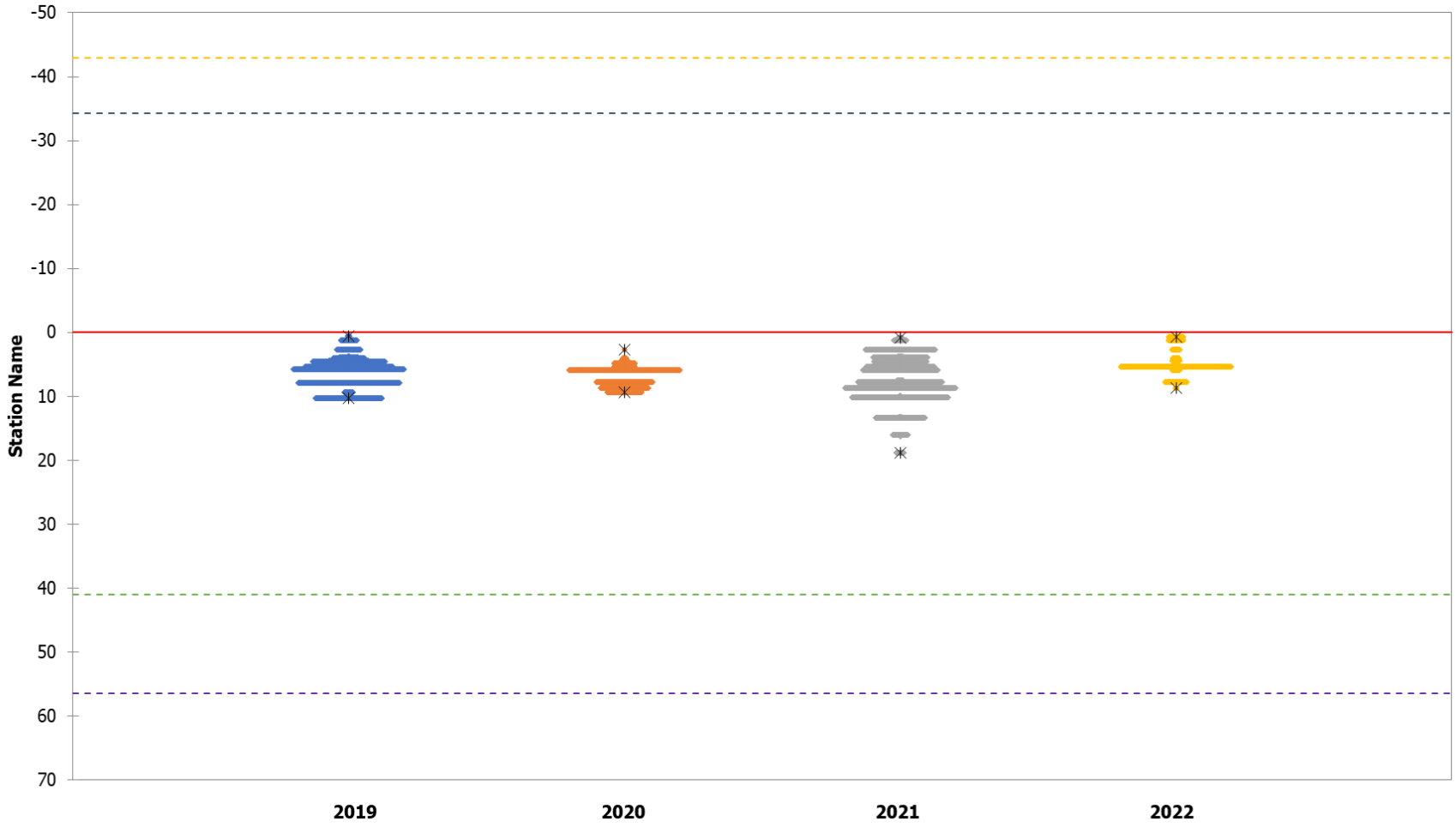

Figure A6-2: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7036) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

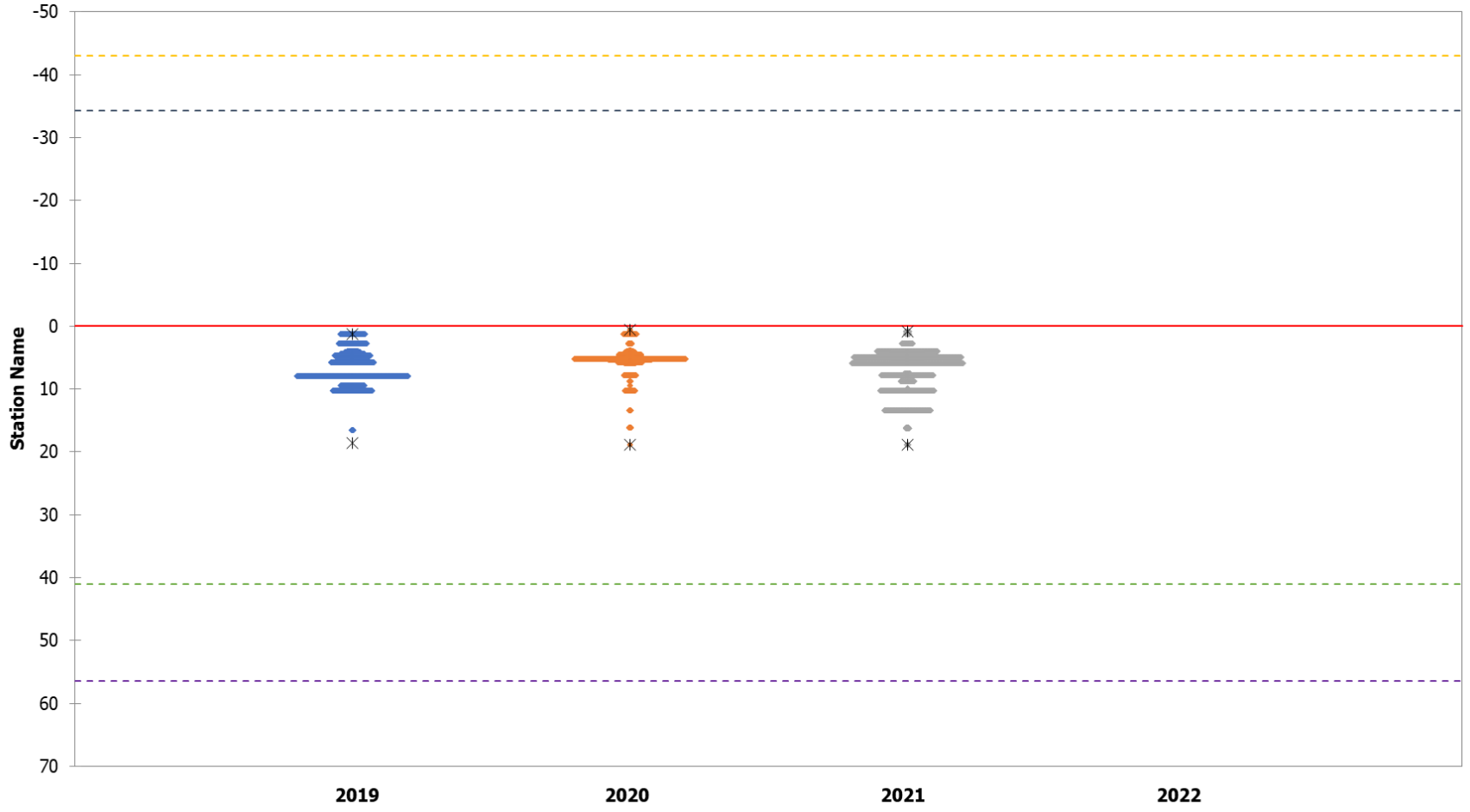

Figure A6-3: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7037) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

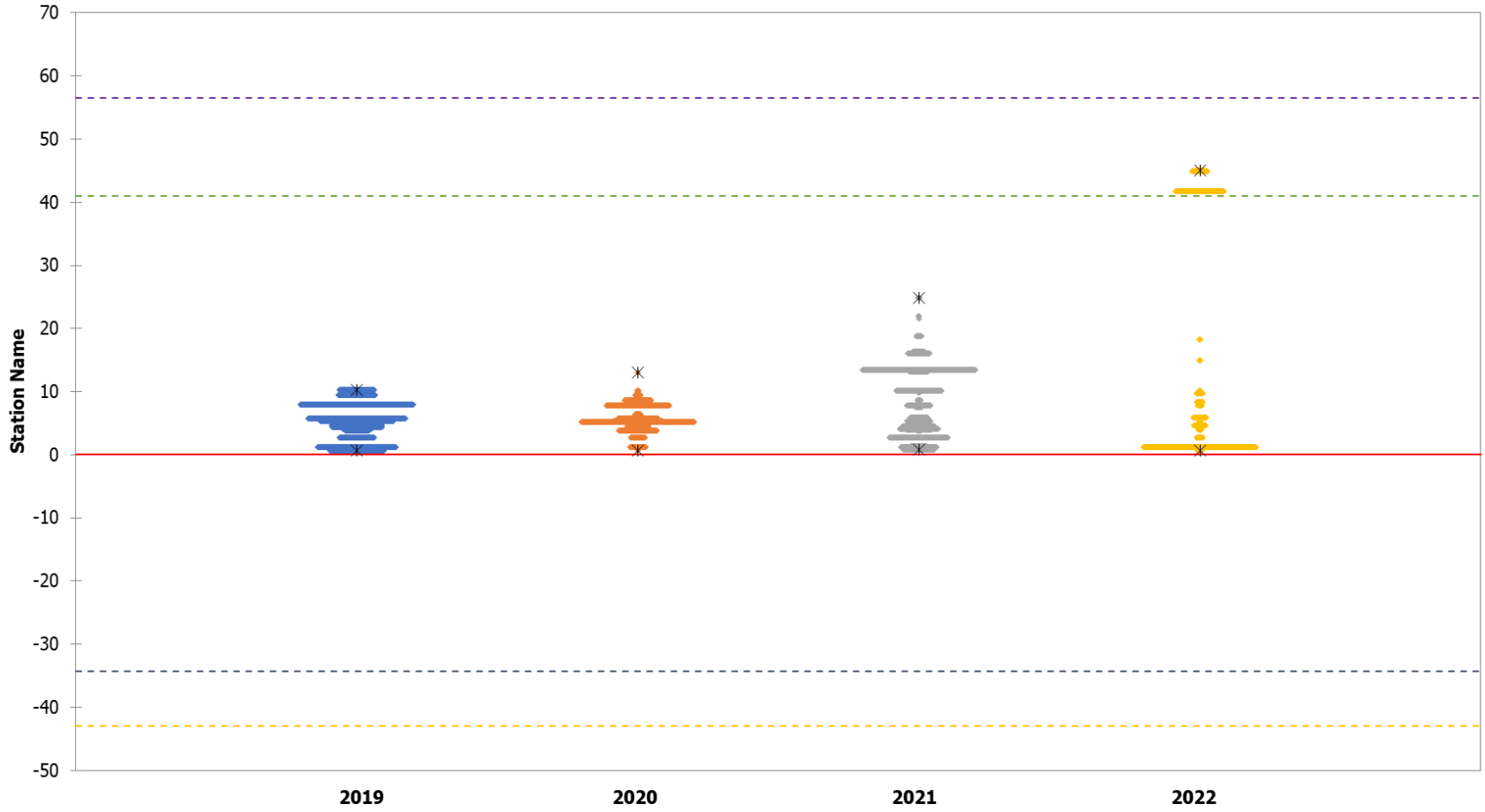

Figure A6-4: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7038) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

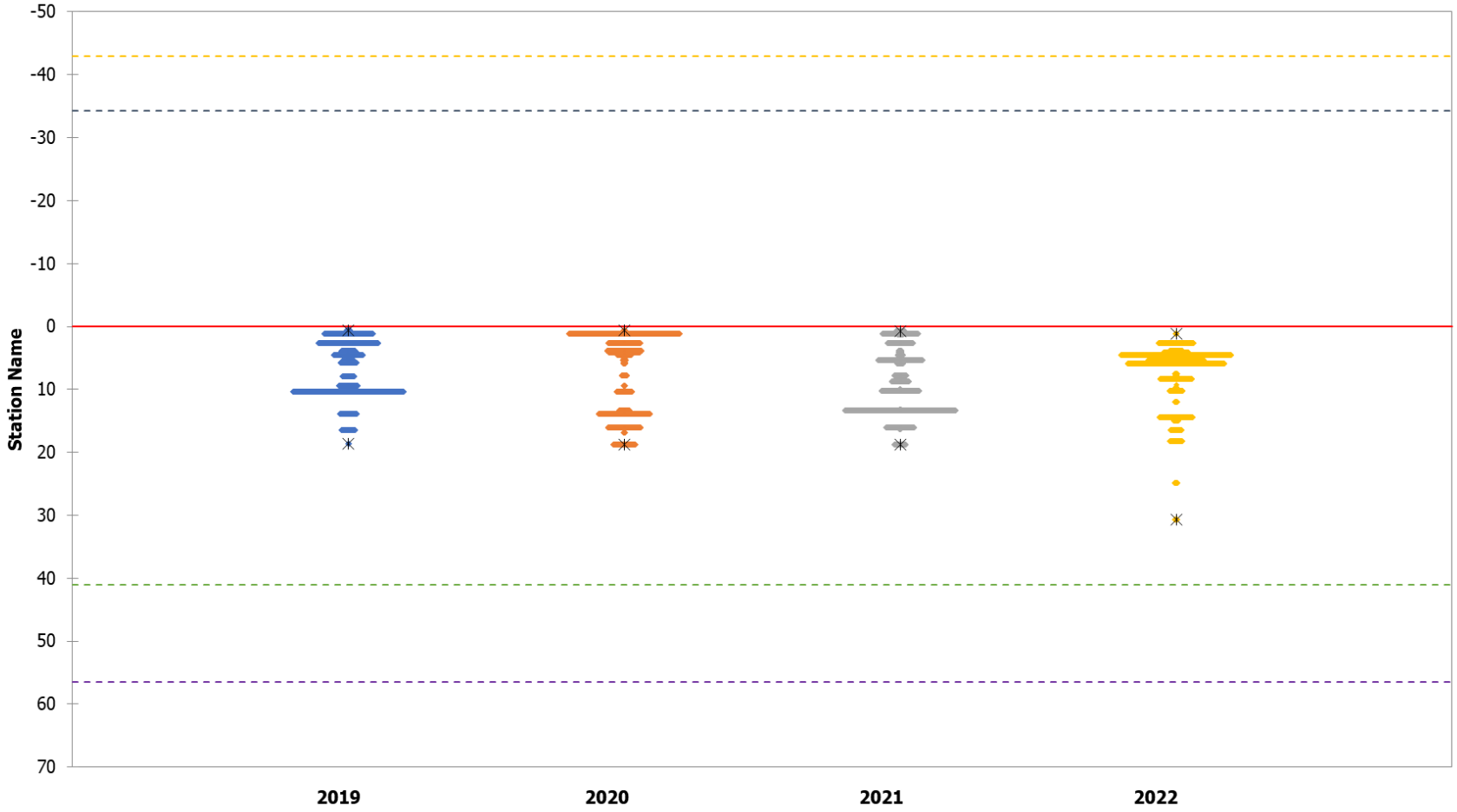

Figure A6-5: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7039) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

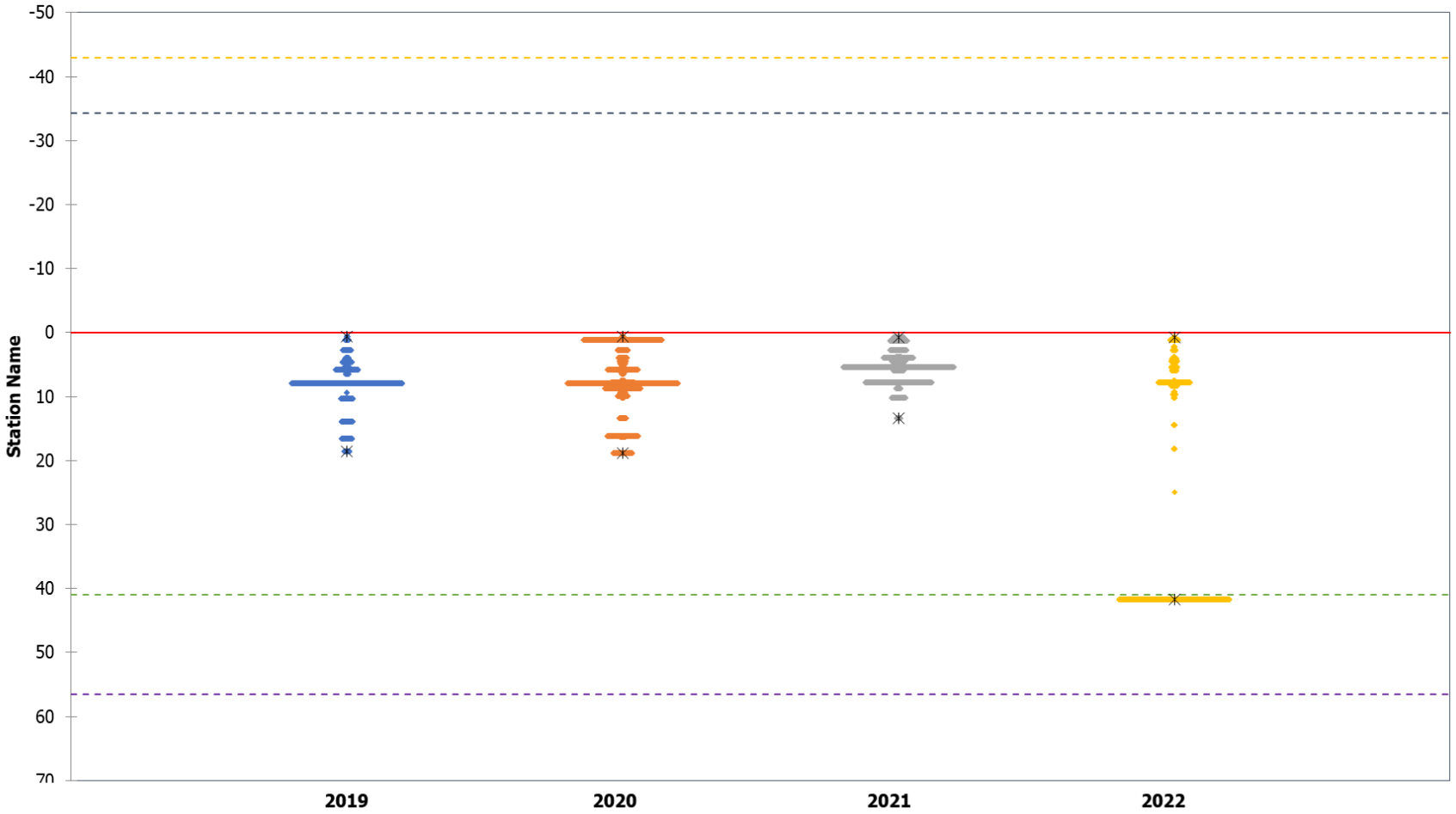

Figure A6-6: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7040) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

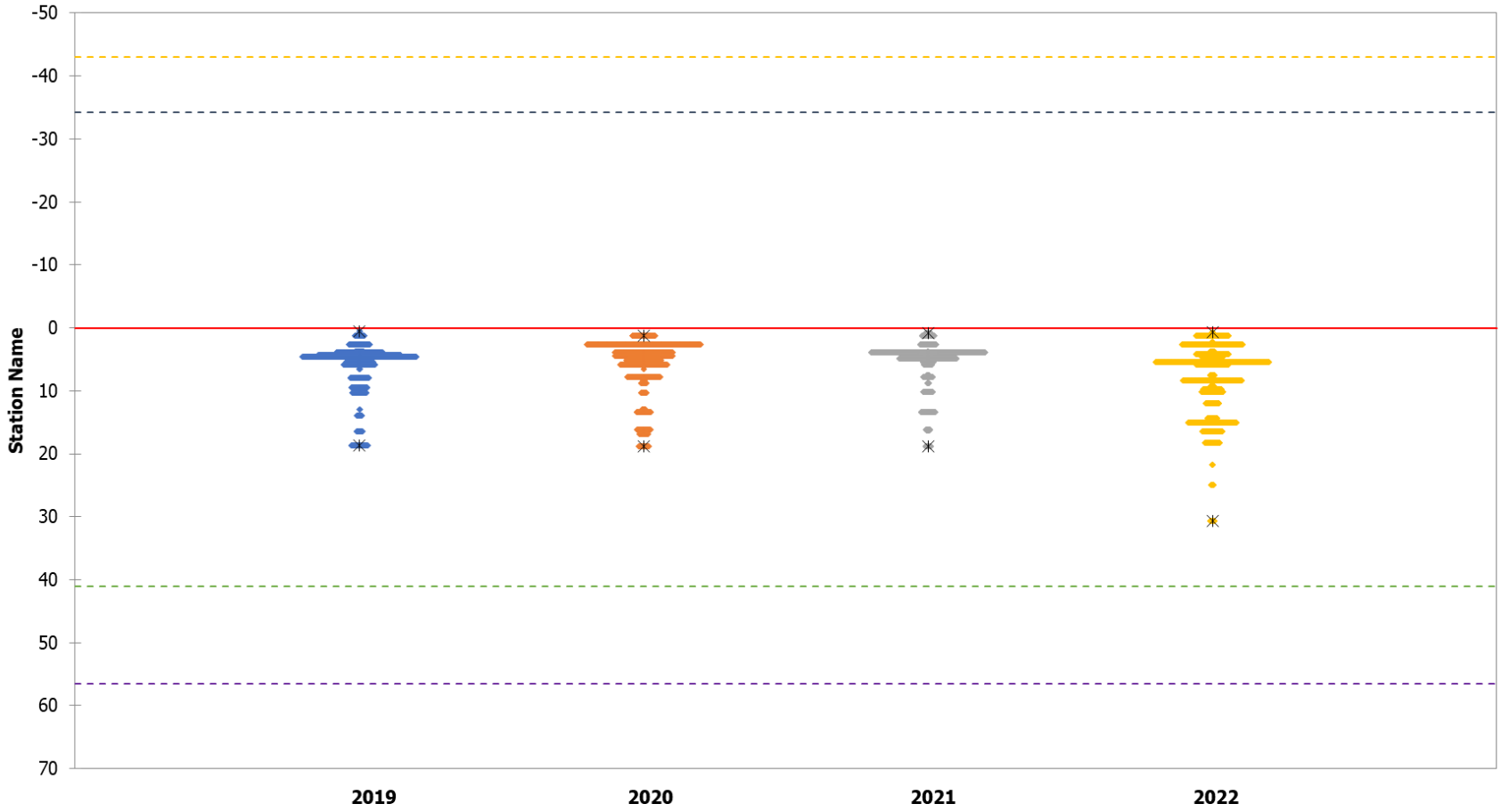

Figure A6-7: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7041) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

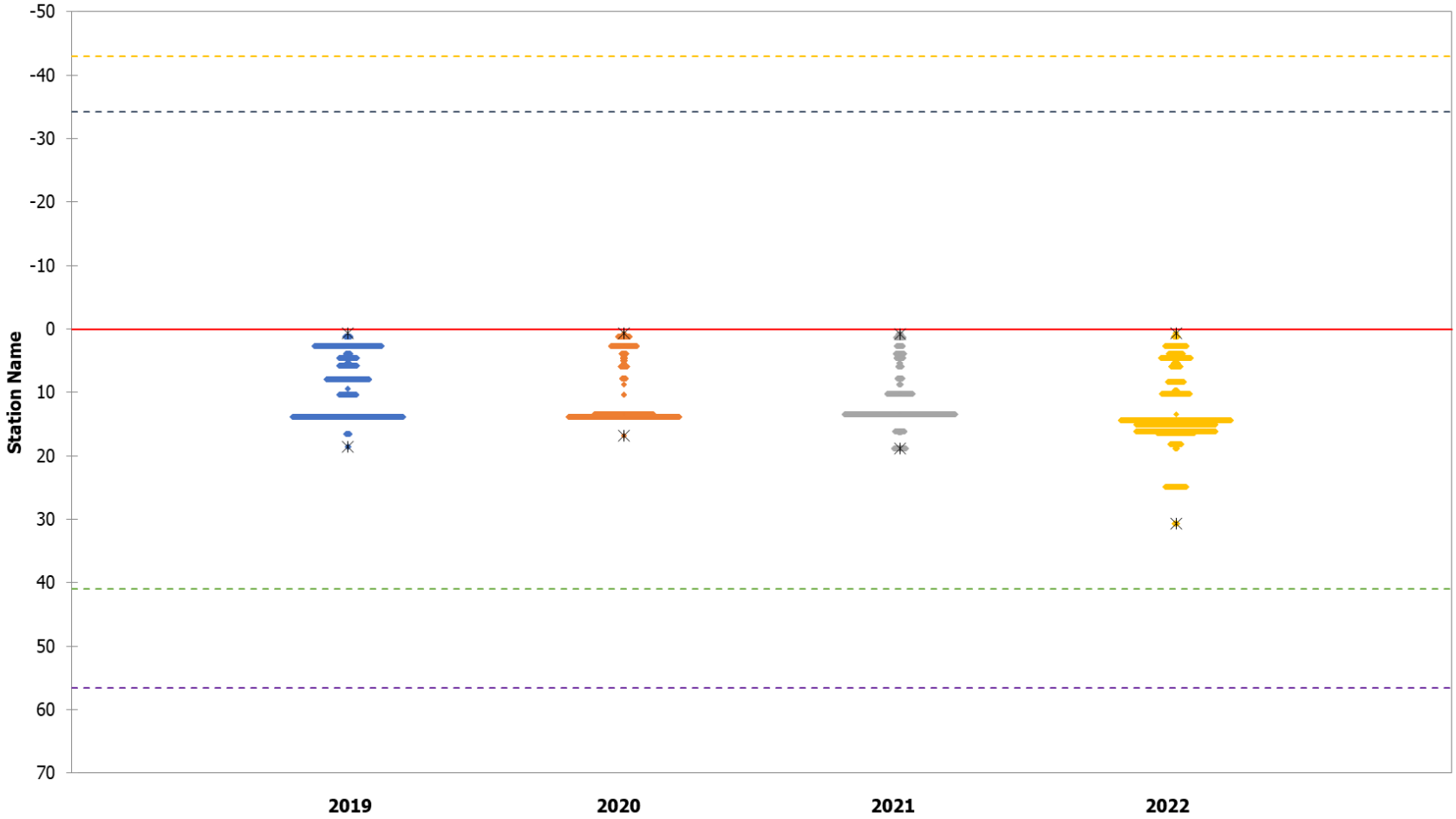

Figure A6-8: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7042) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

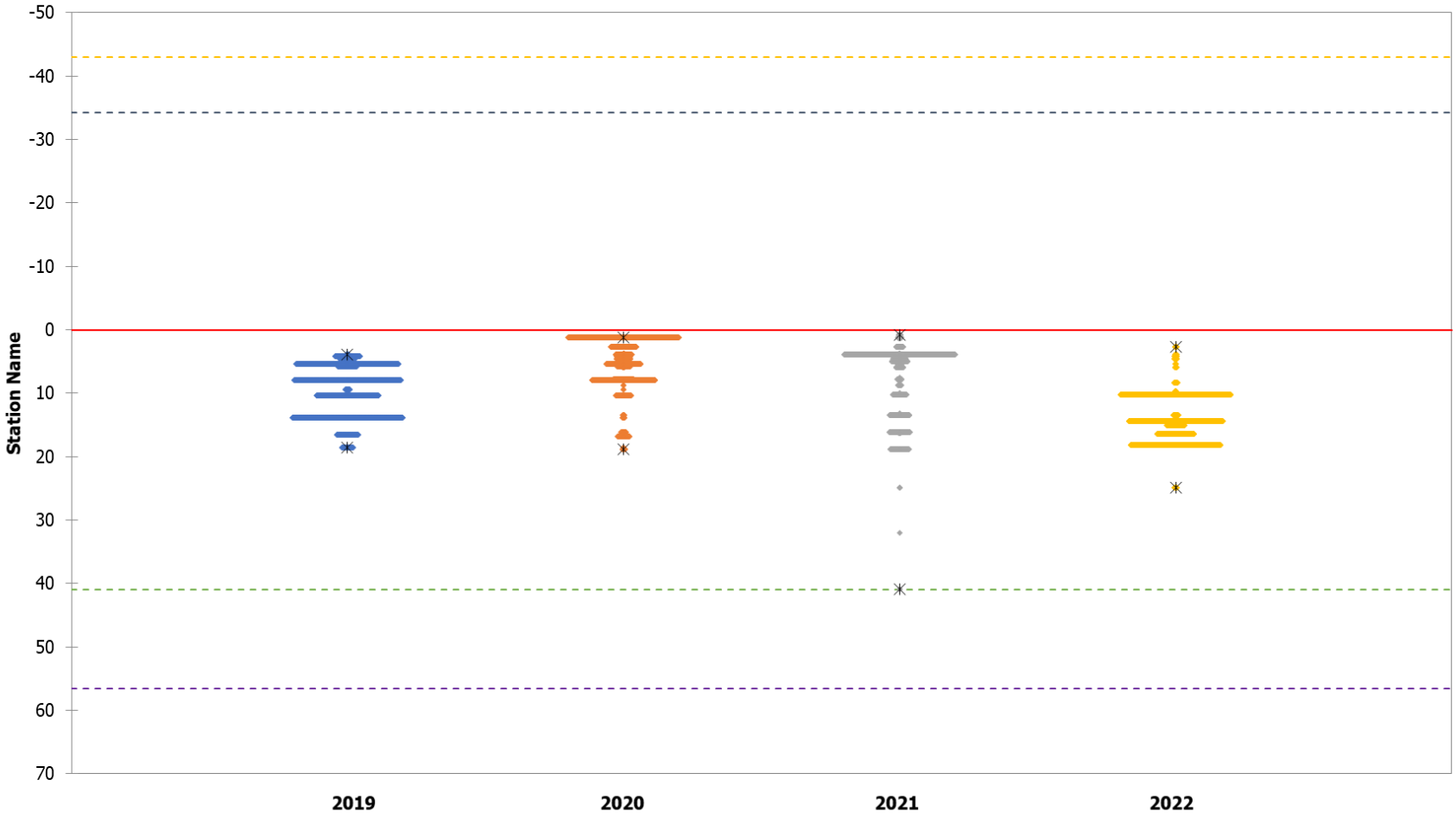

Figure A6-9: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7043) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

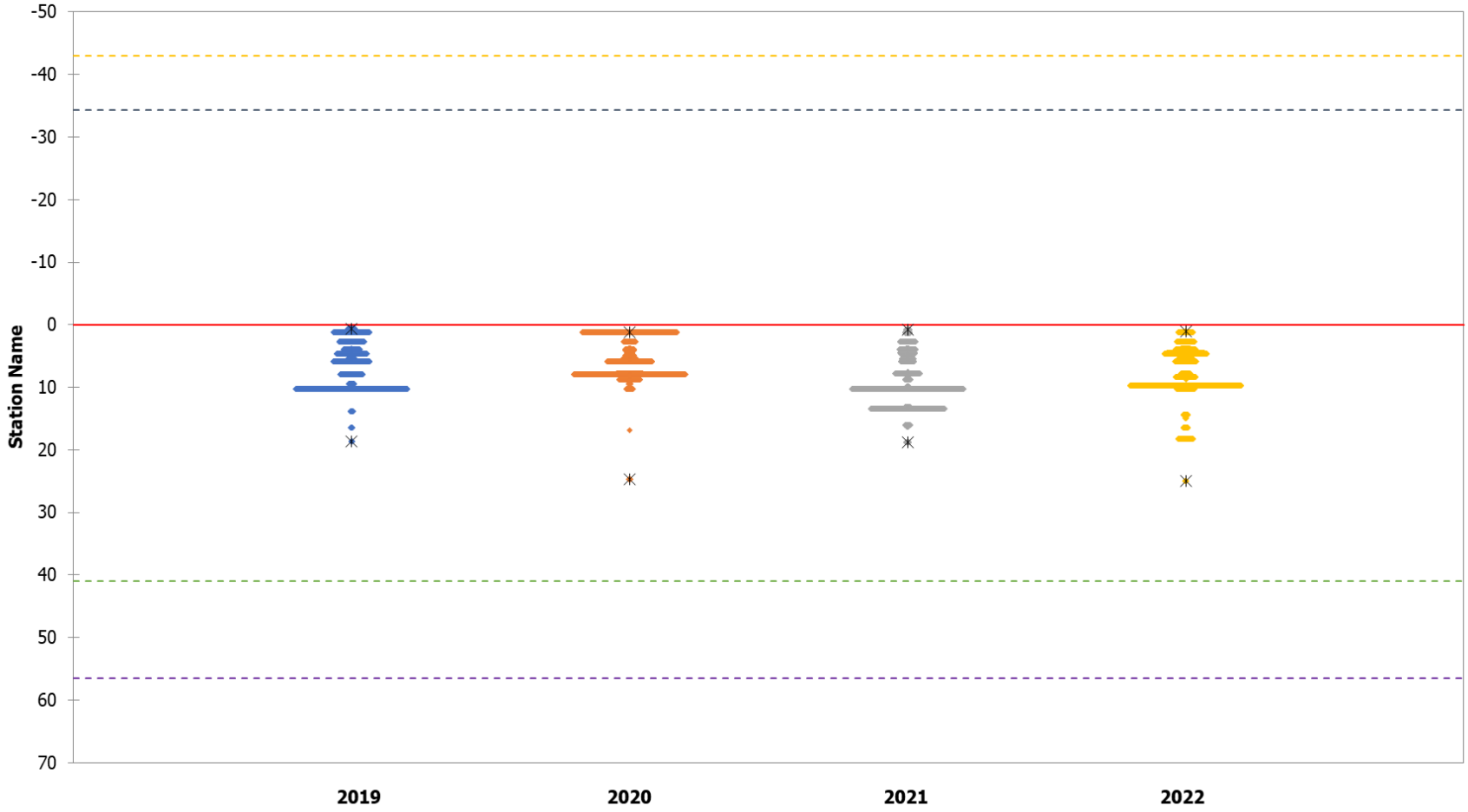

Figure A6-10: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7044) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

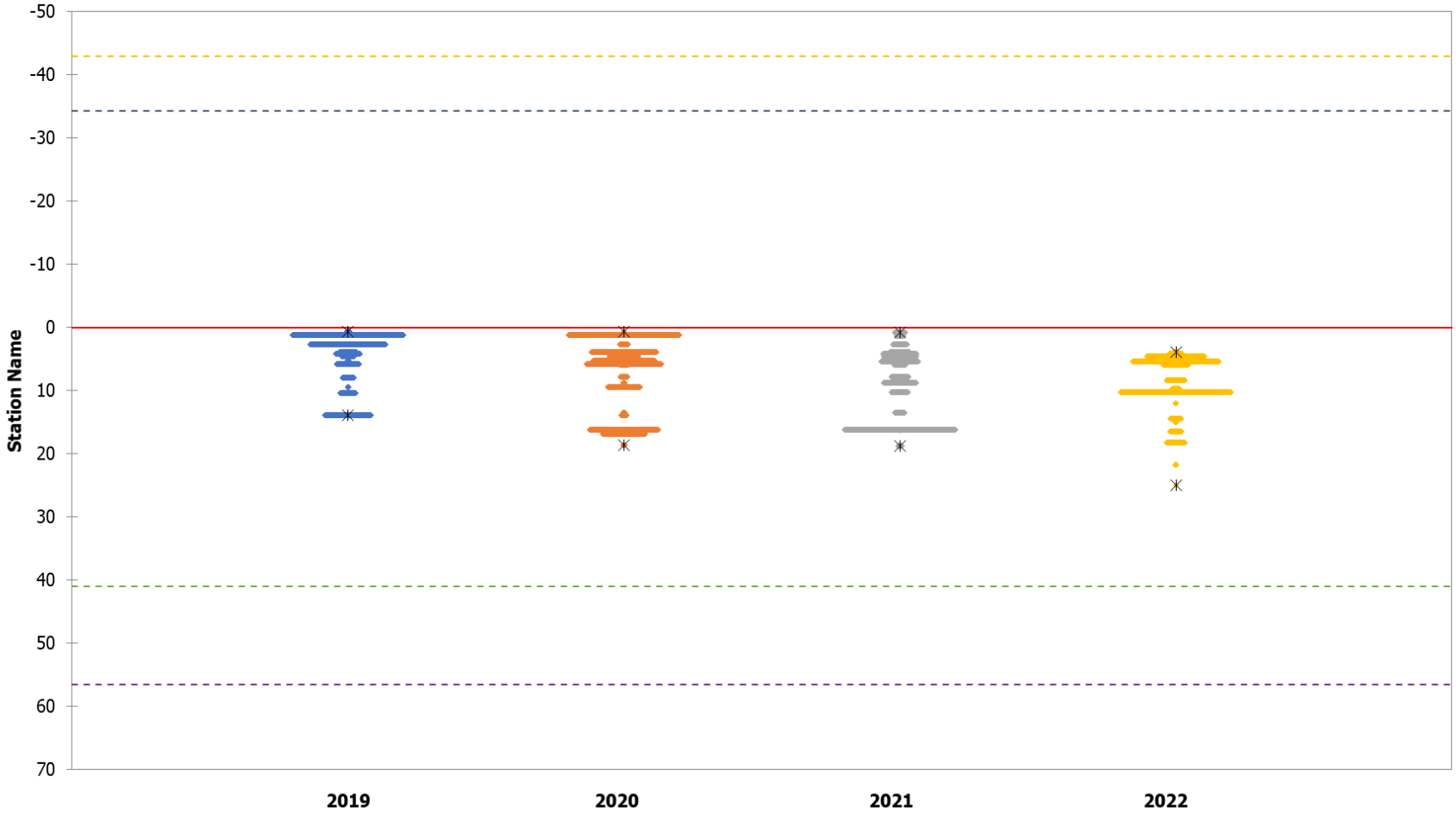

Figure A6-11: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7045) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

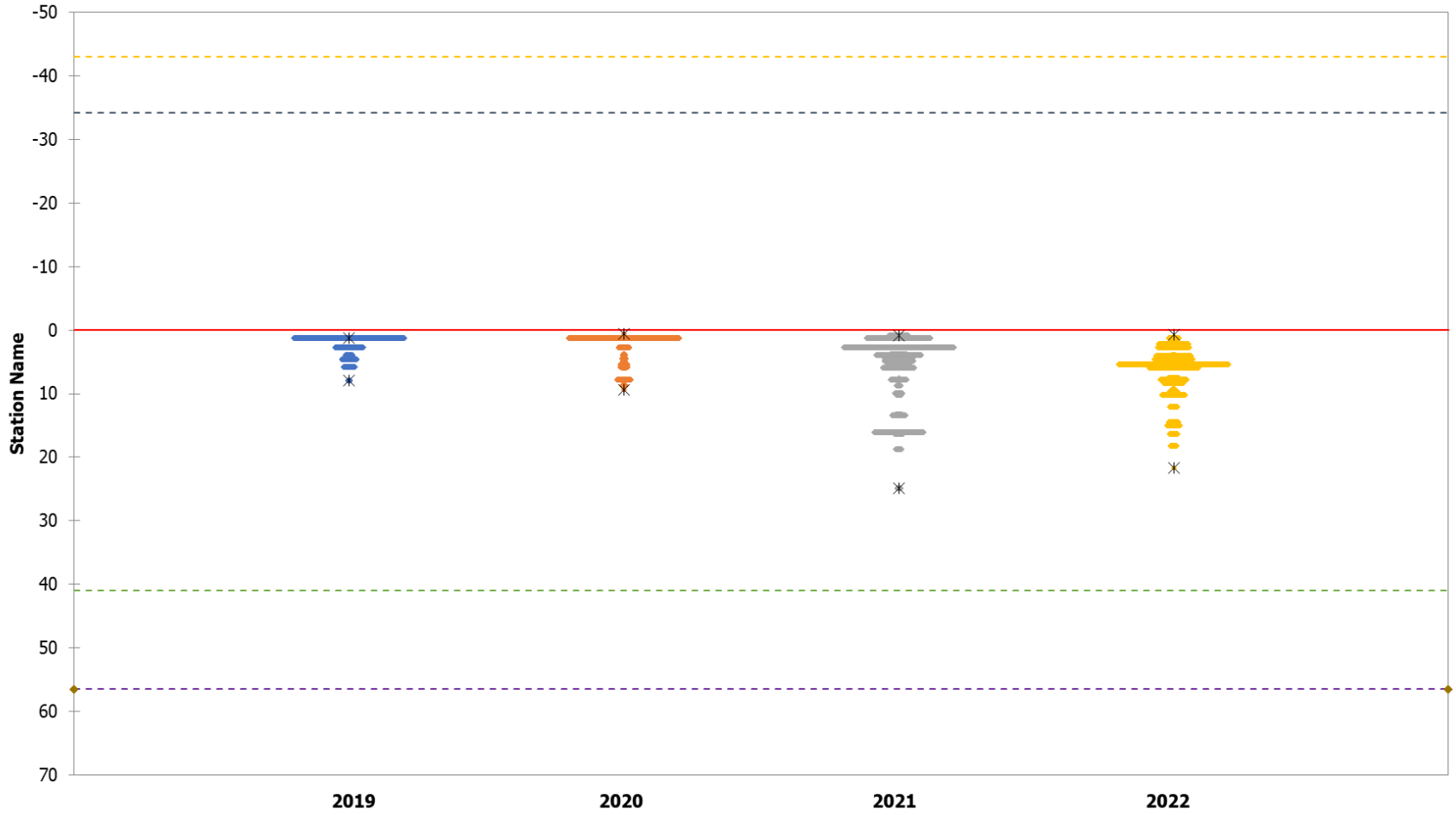

Figure A6-12: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7046) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

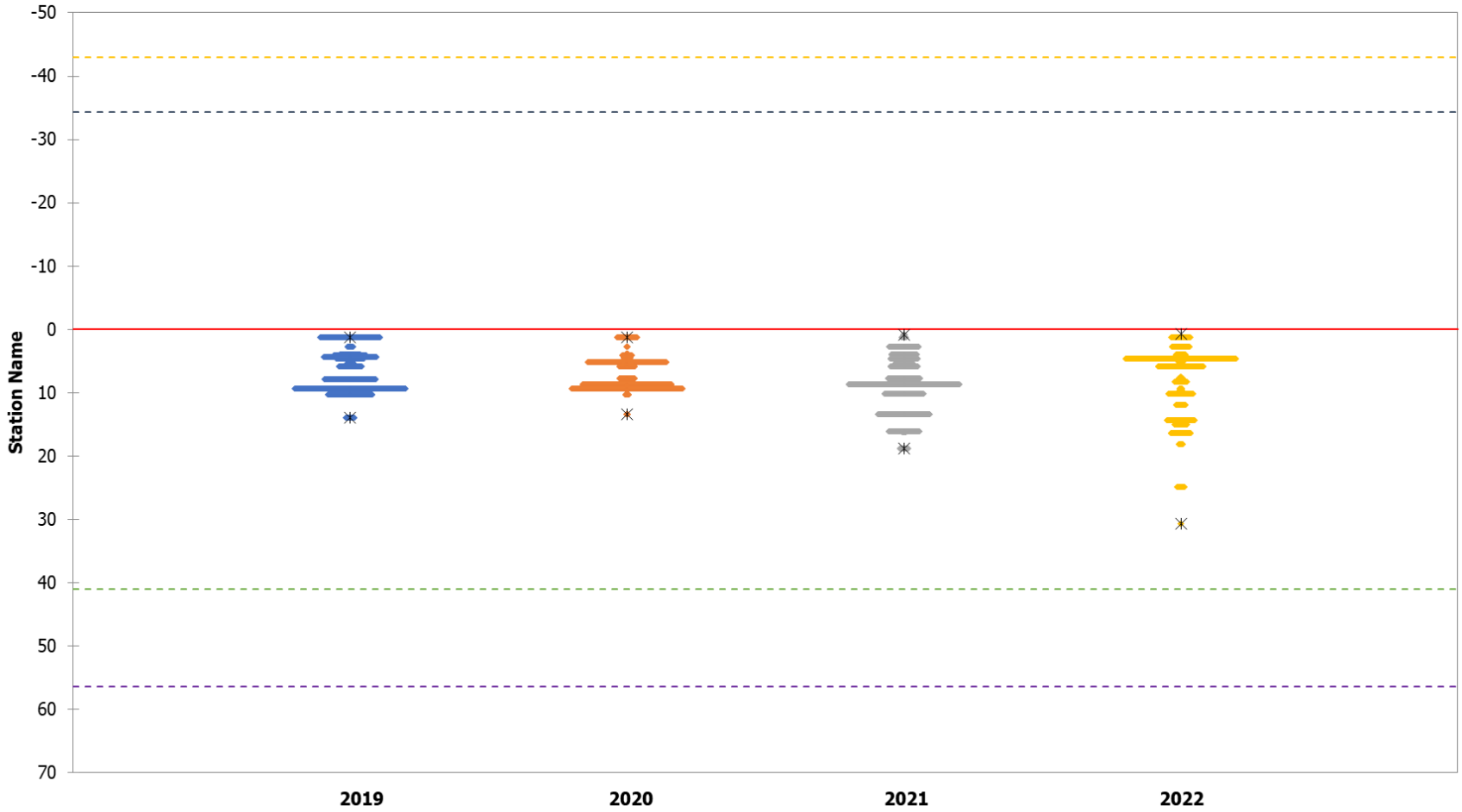

Figure A6-13: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7047) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

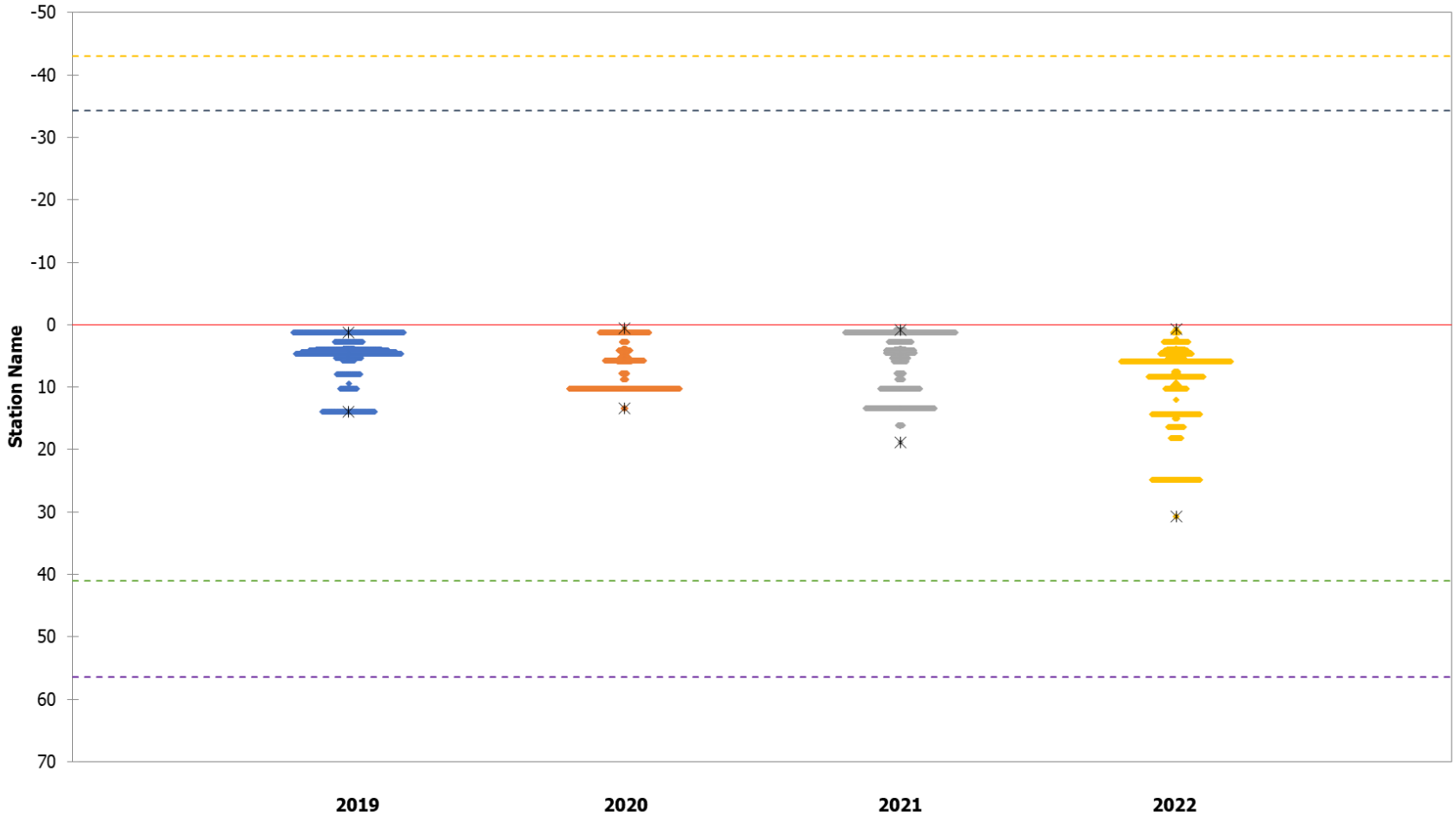

Figure A6-14: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7048) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

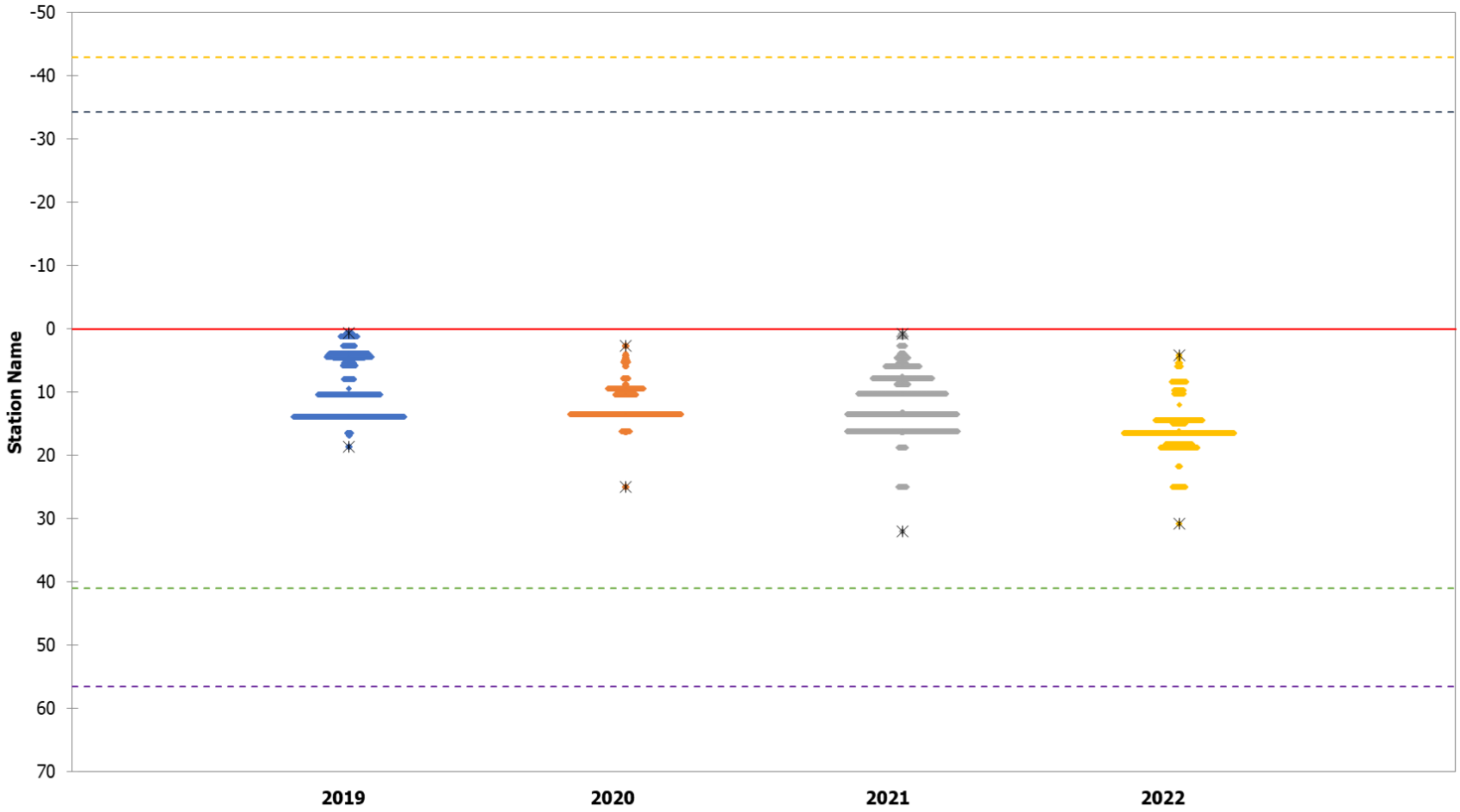

Figure A6-15: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7049) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

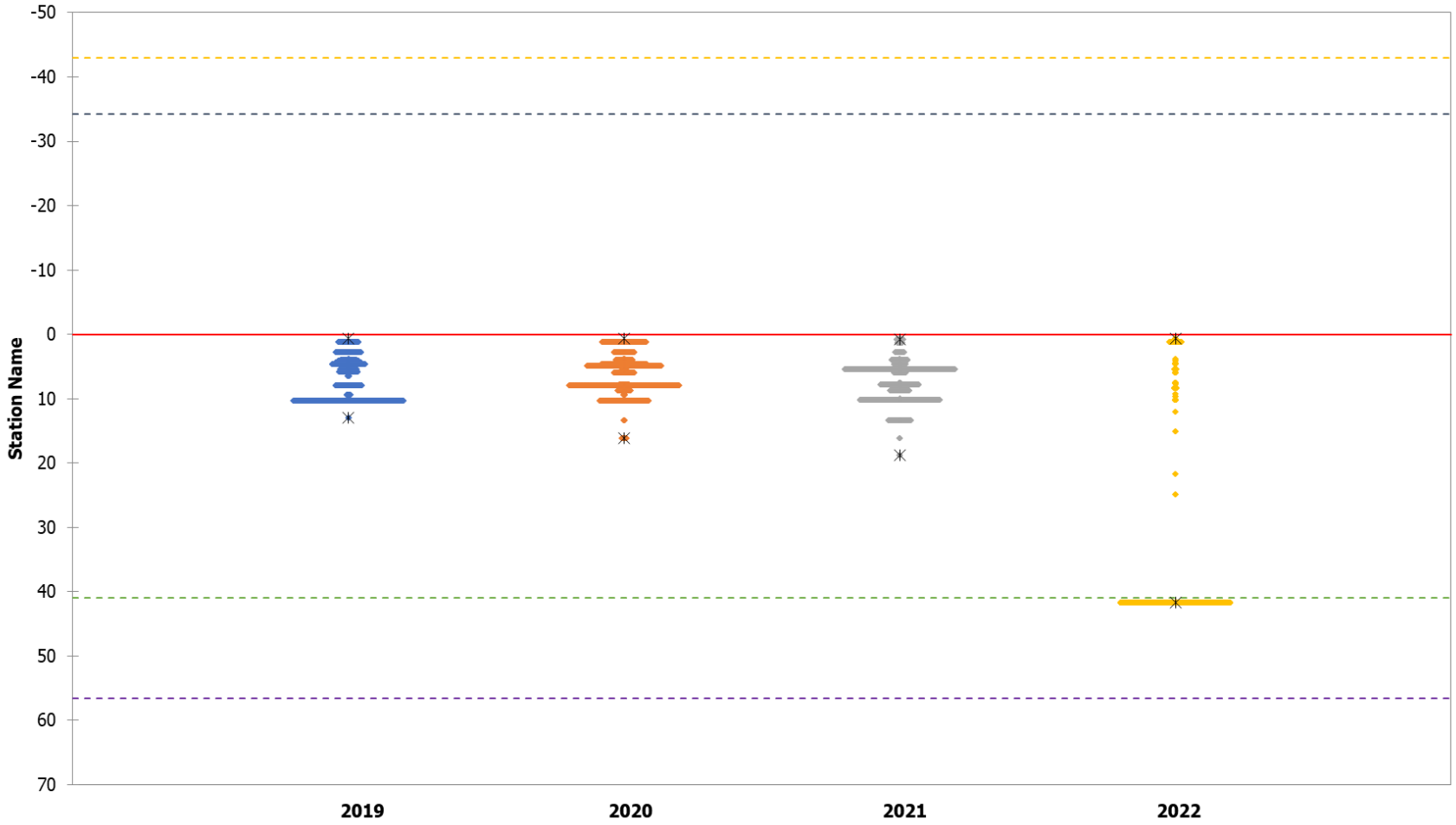

Figure A6-16: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7050) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

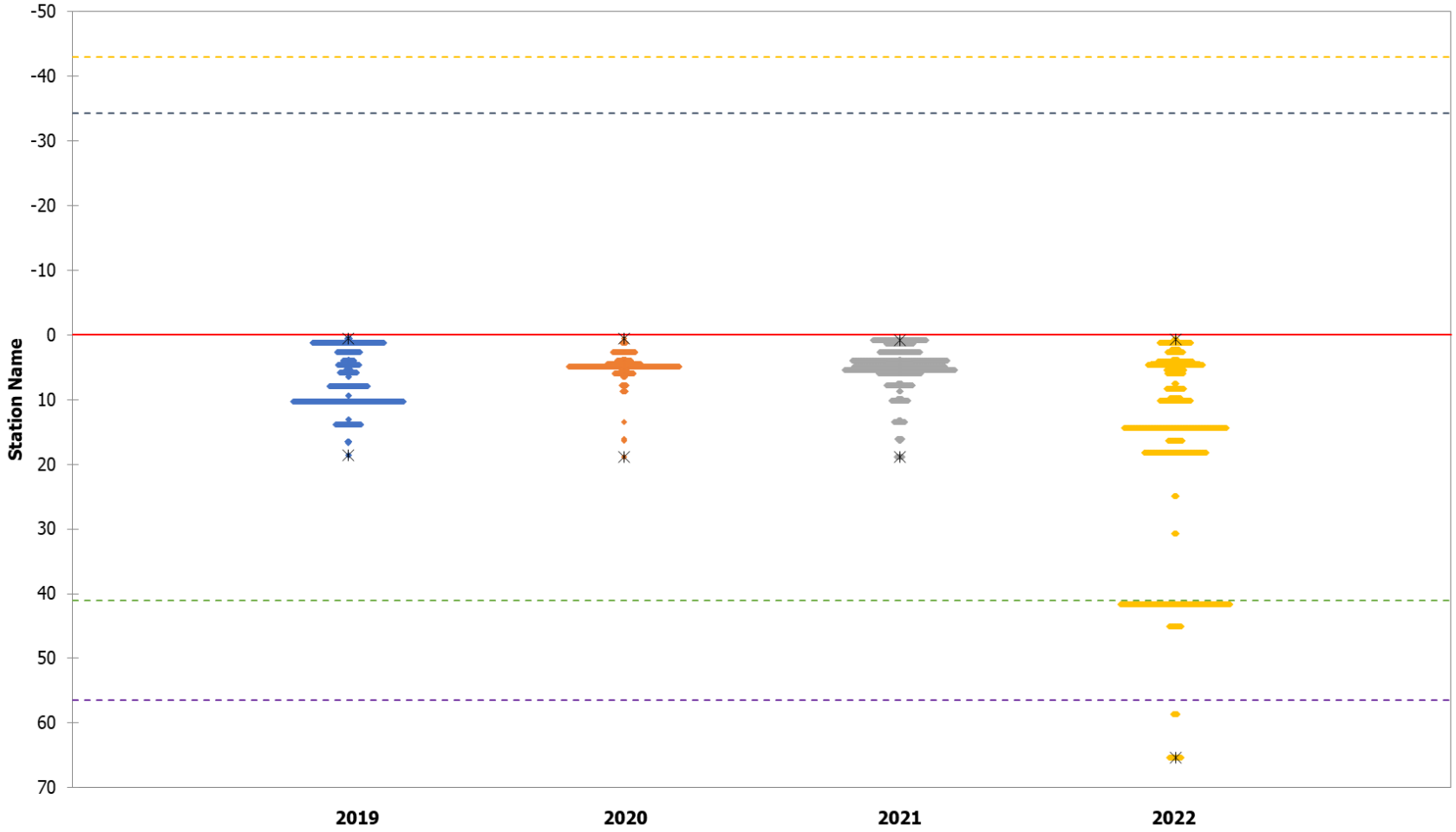

Figure A6-17: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7051) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

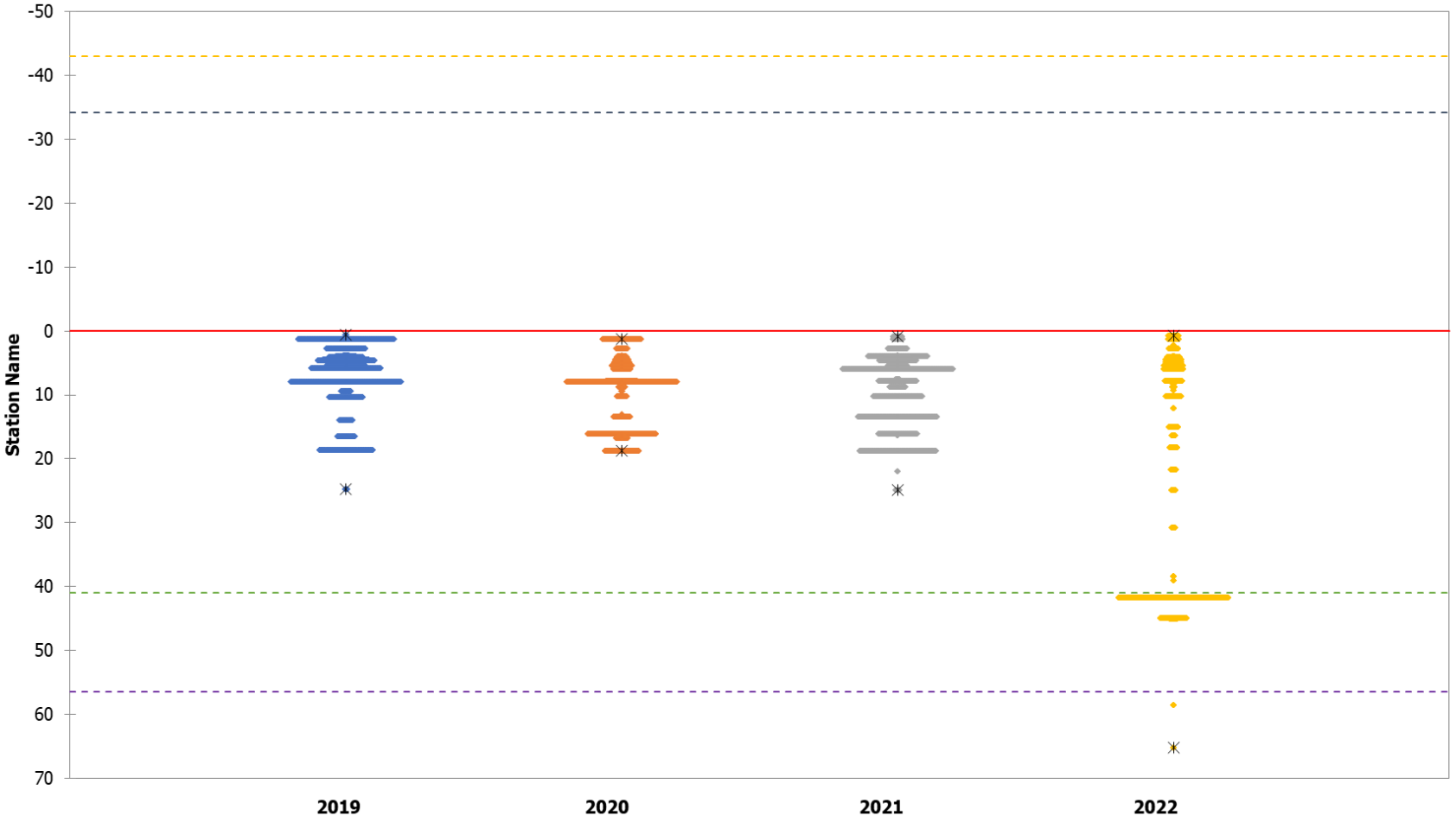

Figure A6-18: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7052) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

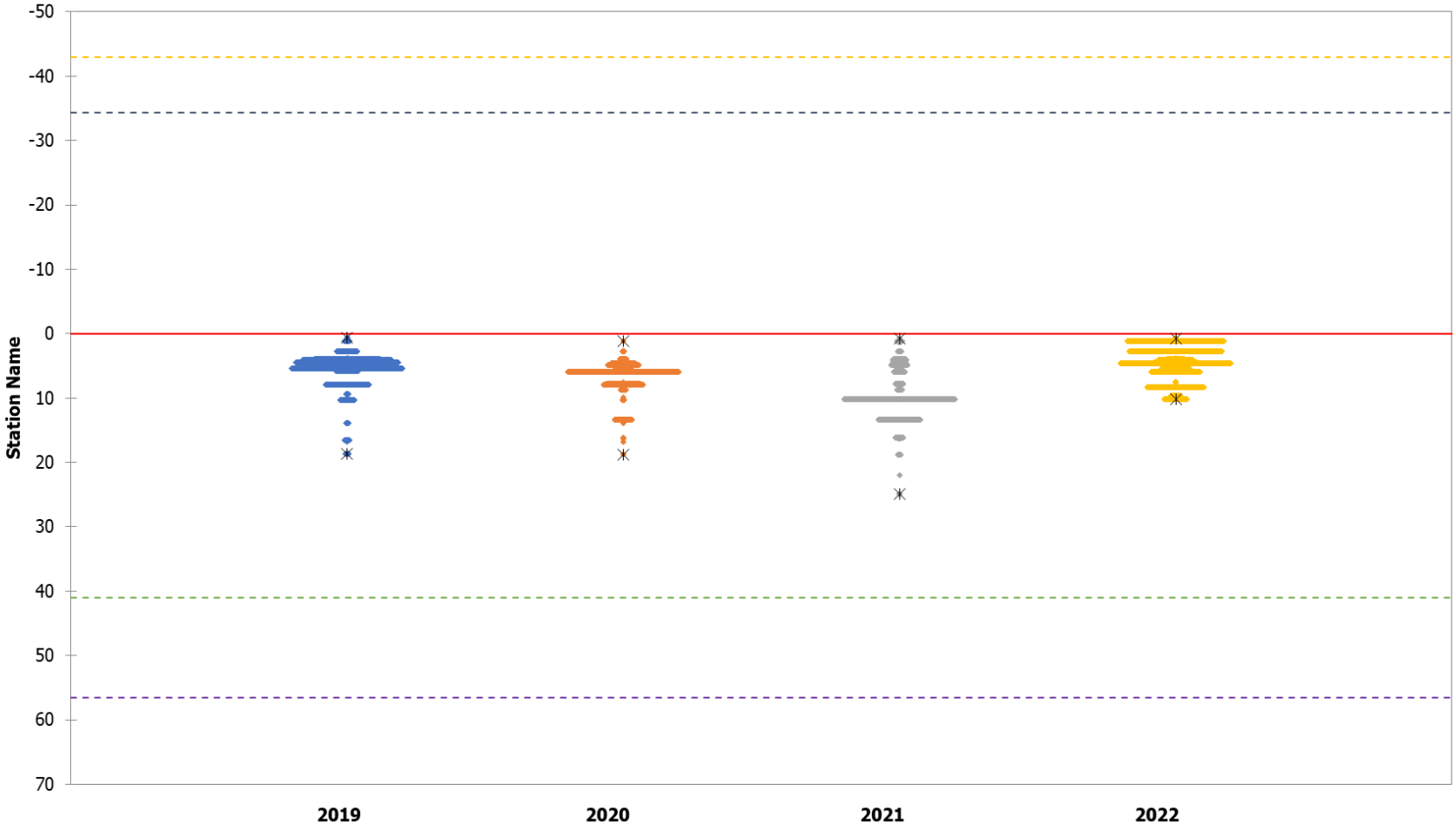

Figure A6-19: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7054) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

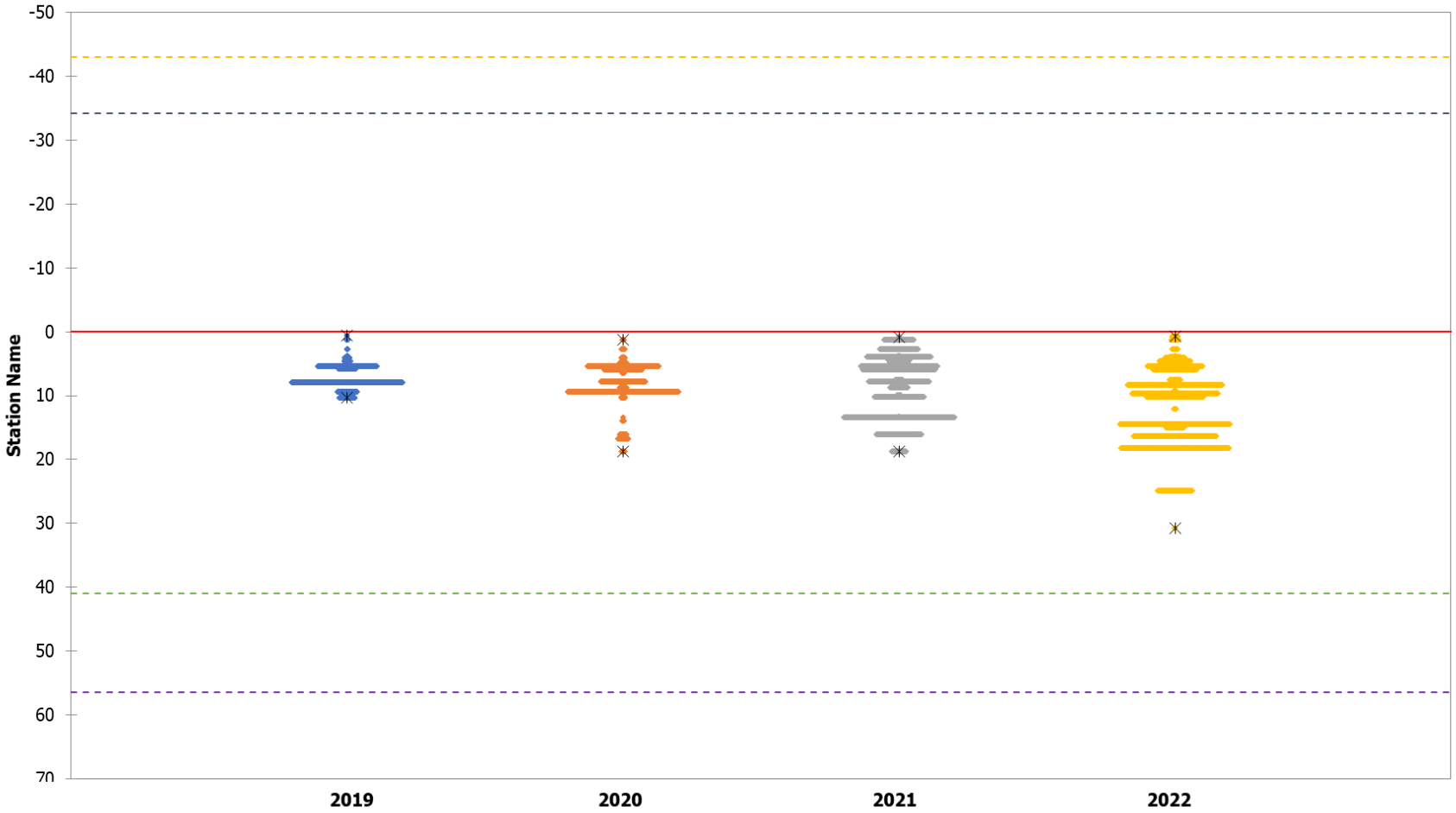

Figure A6-20: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7055) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

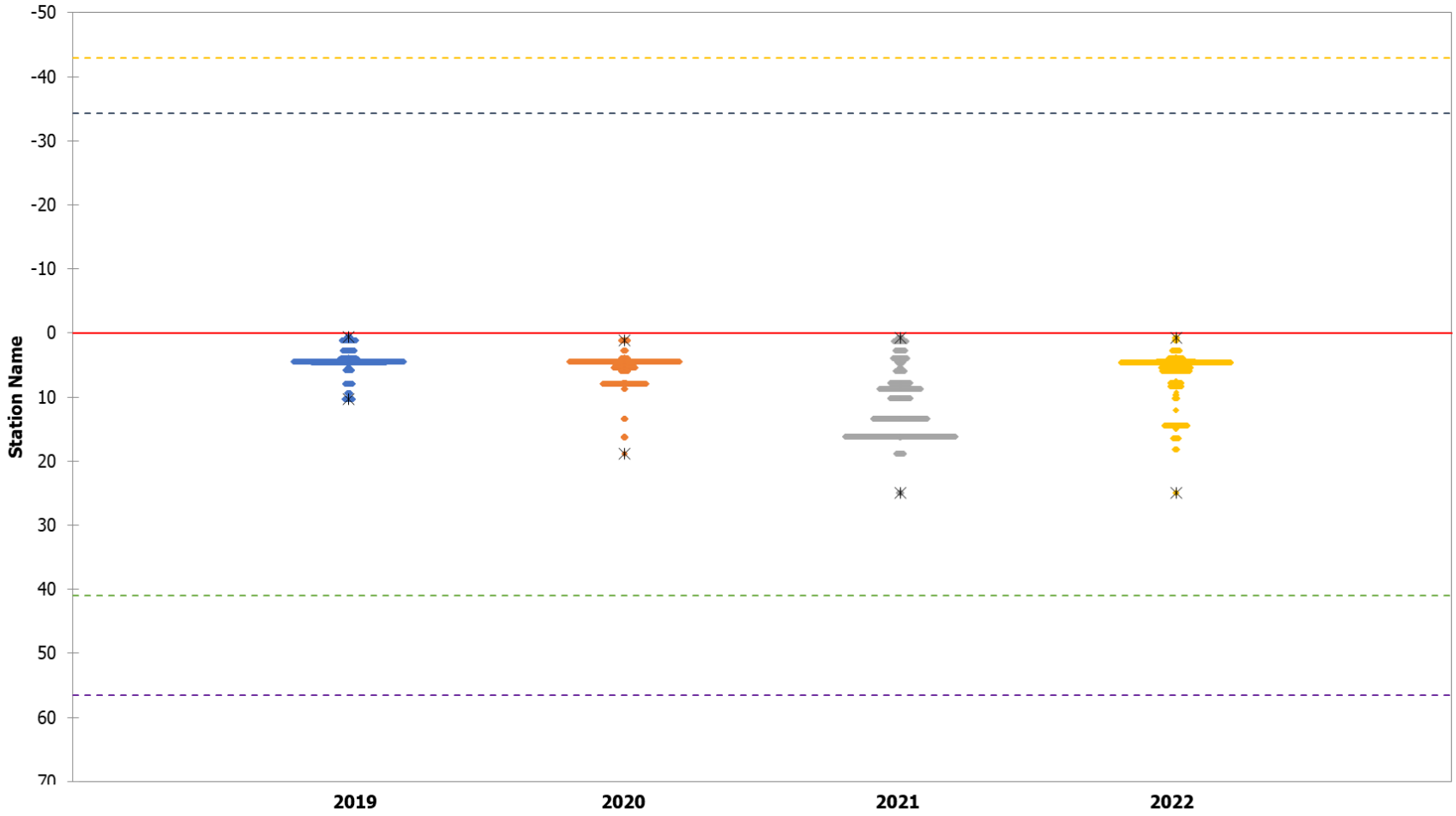

Figure A6-21: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7057) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

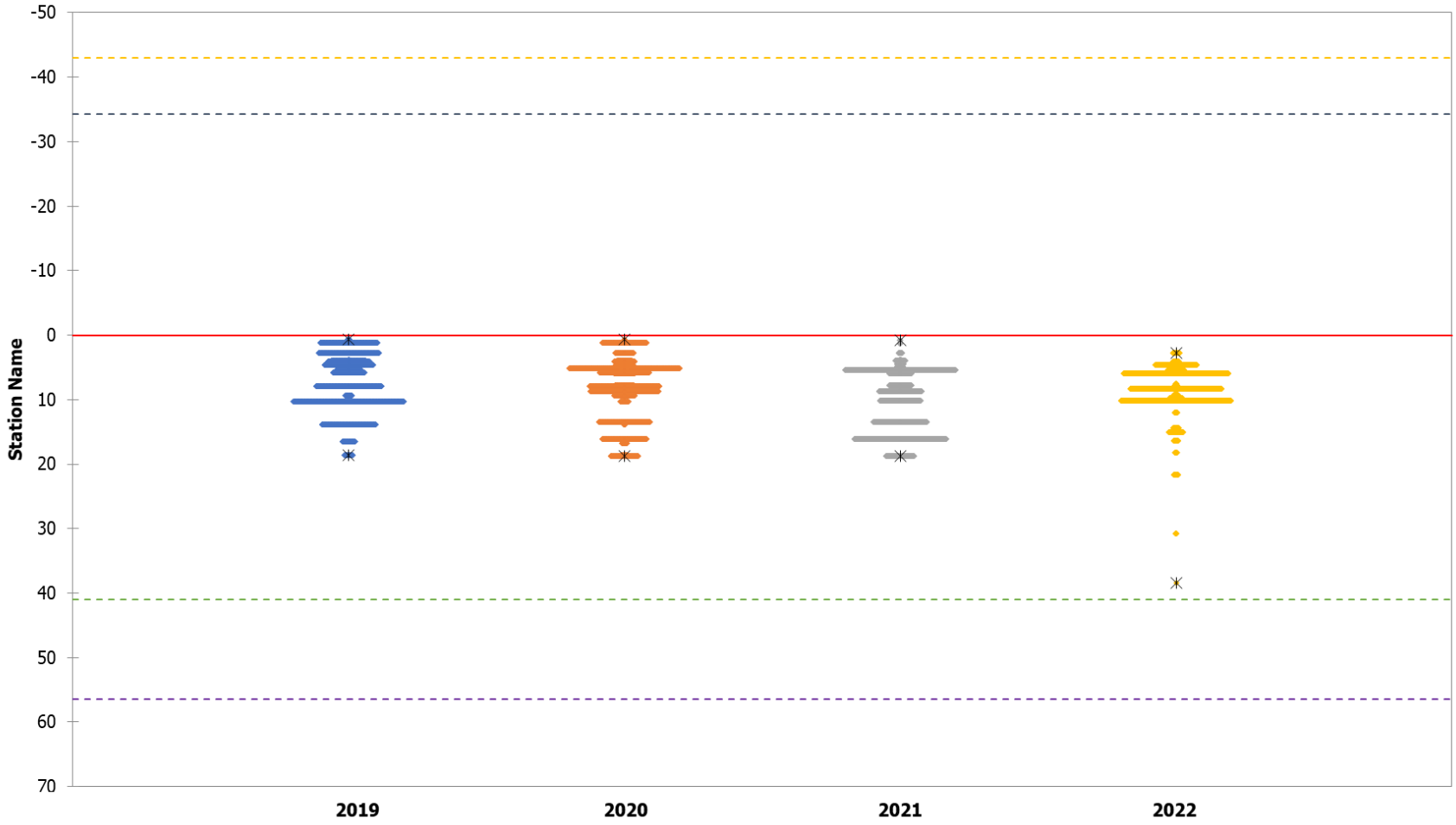

Figure A6-22: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7058) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

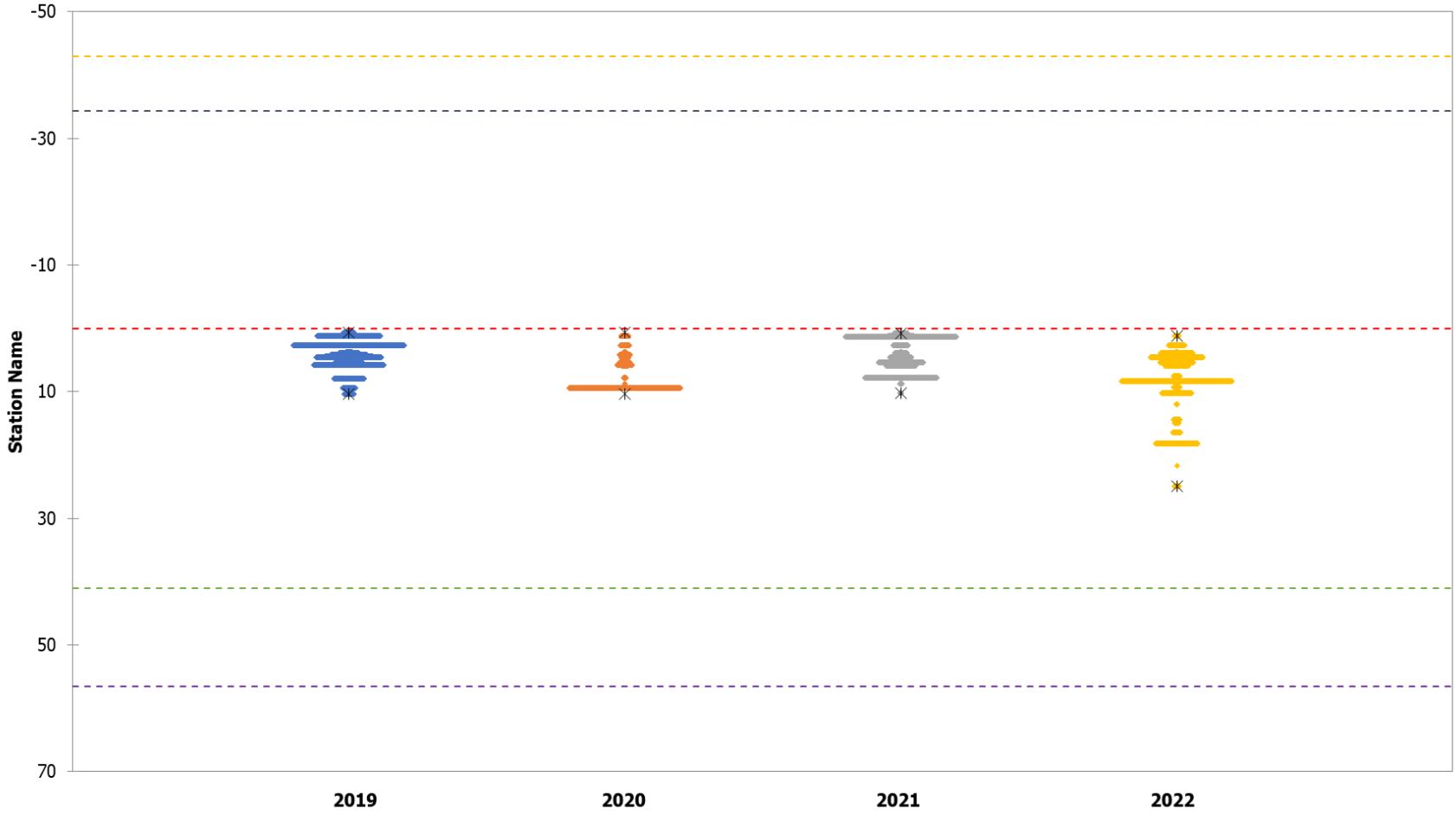

Figure A6-23: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7060) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

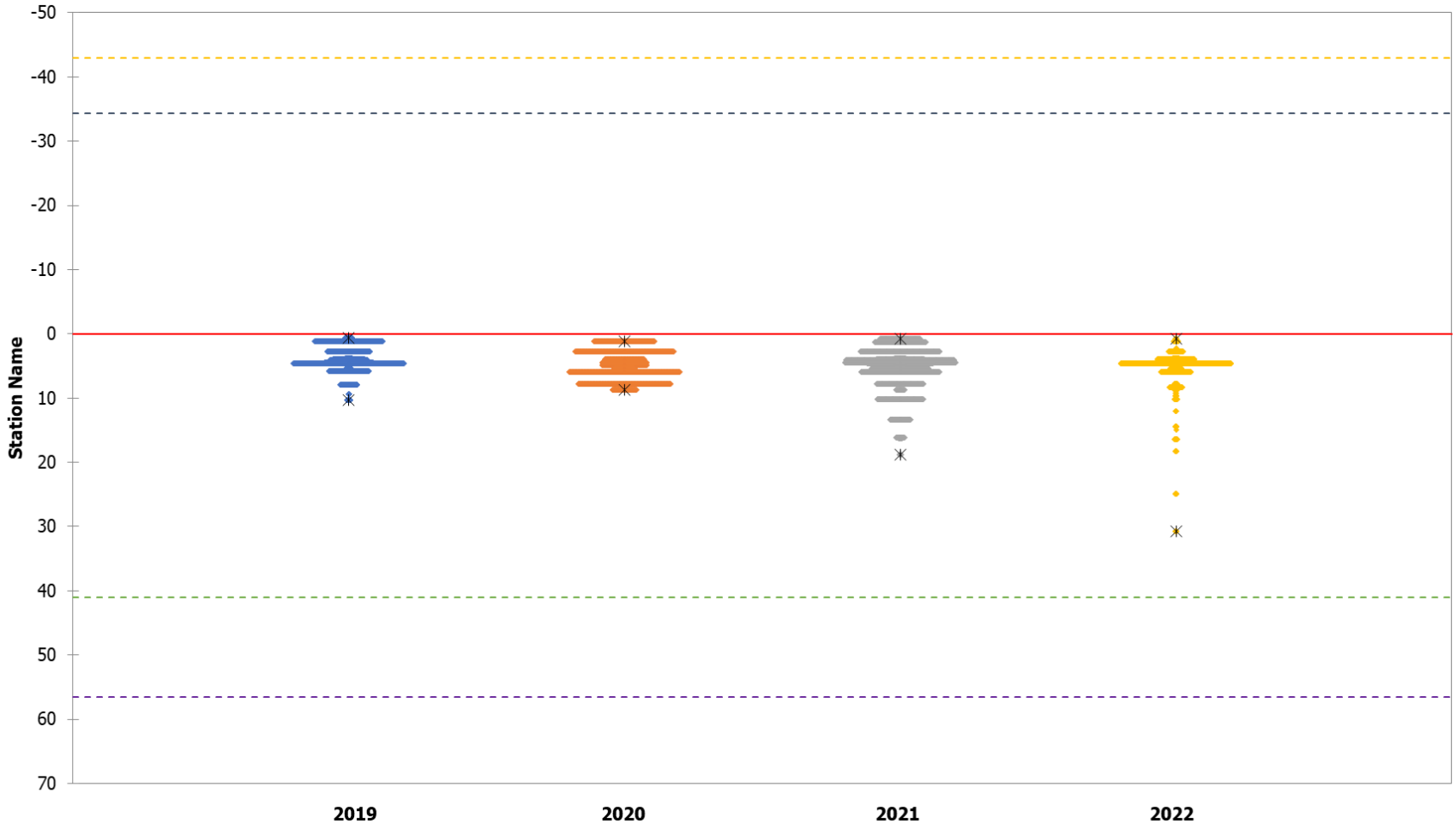

Figure A6-24: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7062) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

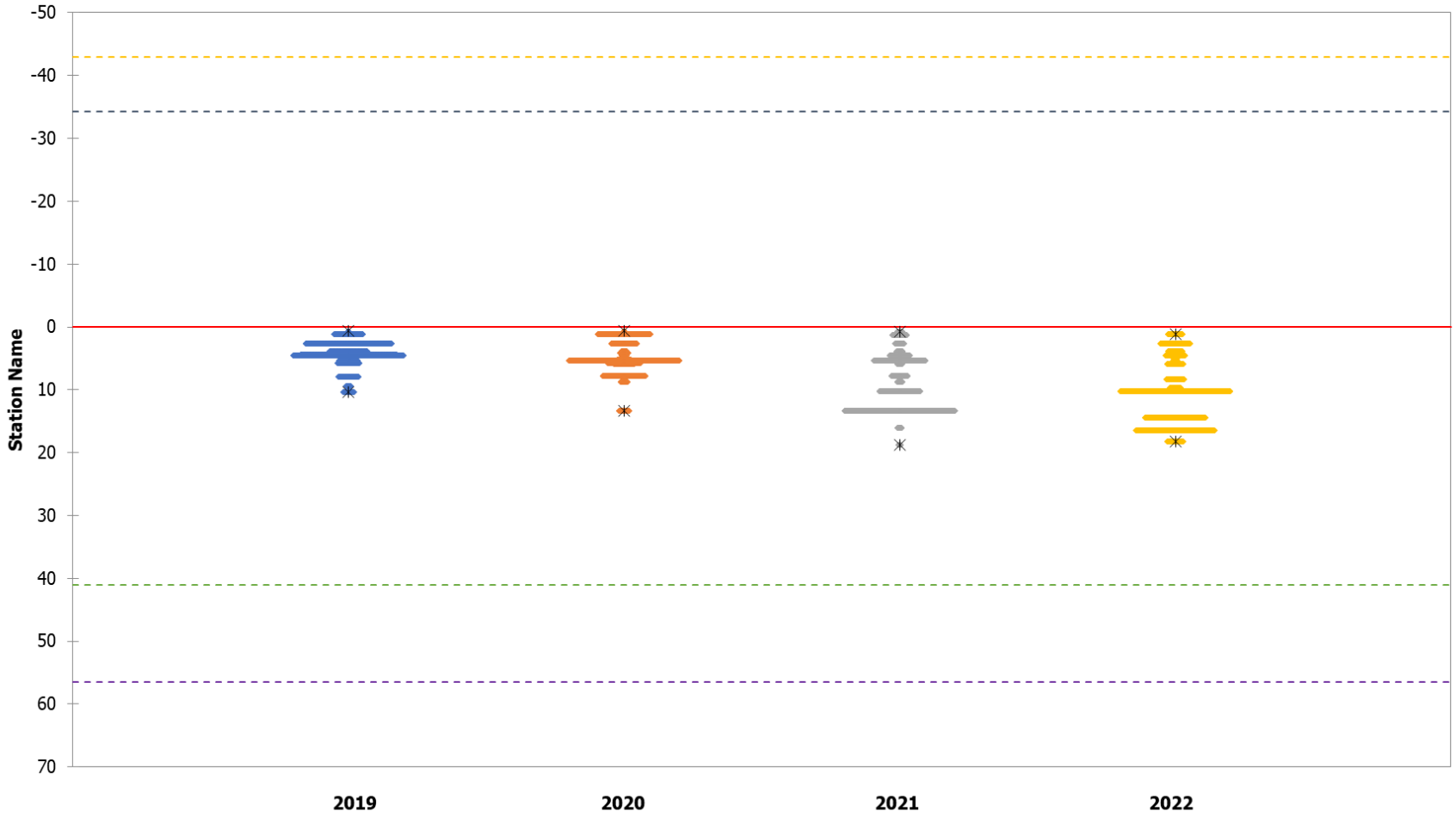

Figure A6-25: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #7063) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2019 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

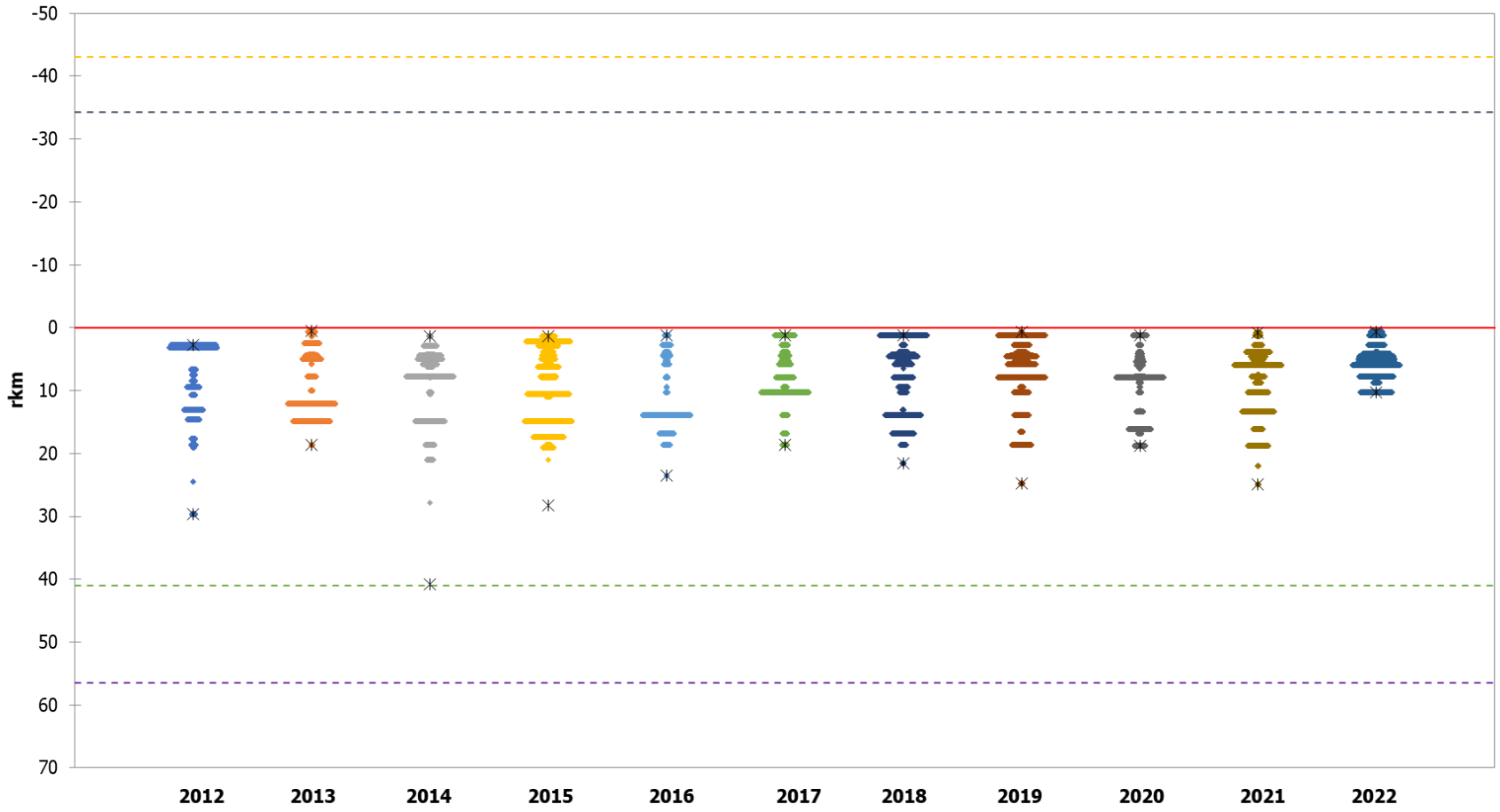

Figure A6-26: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

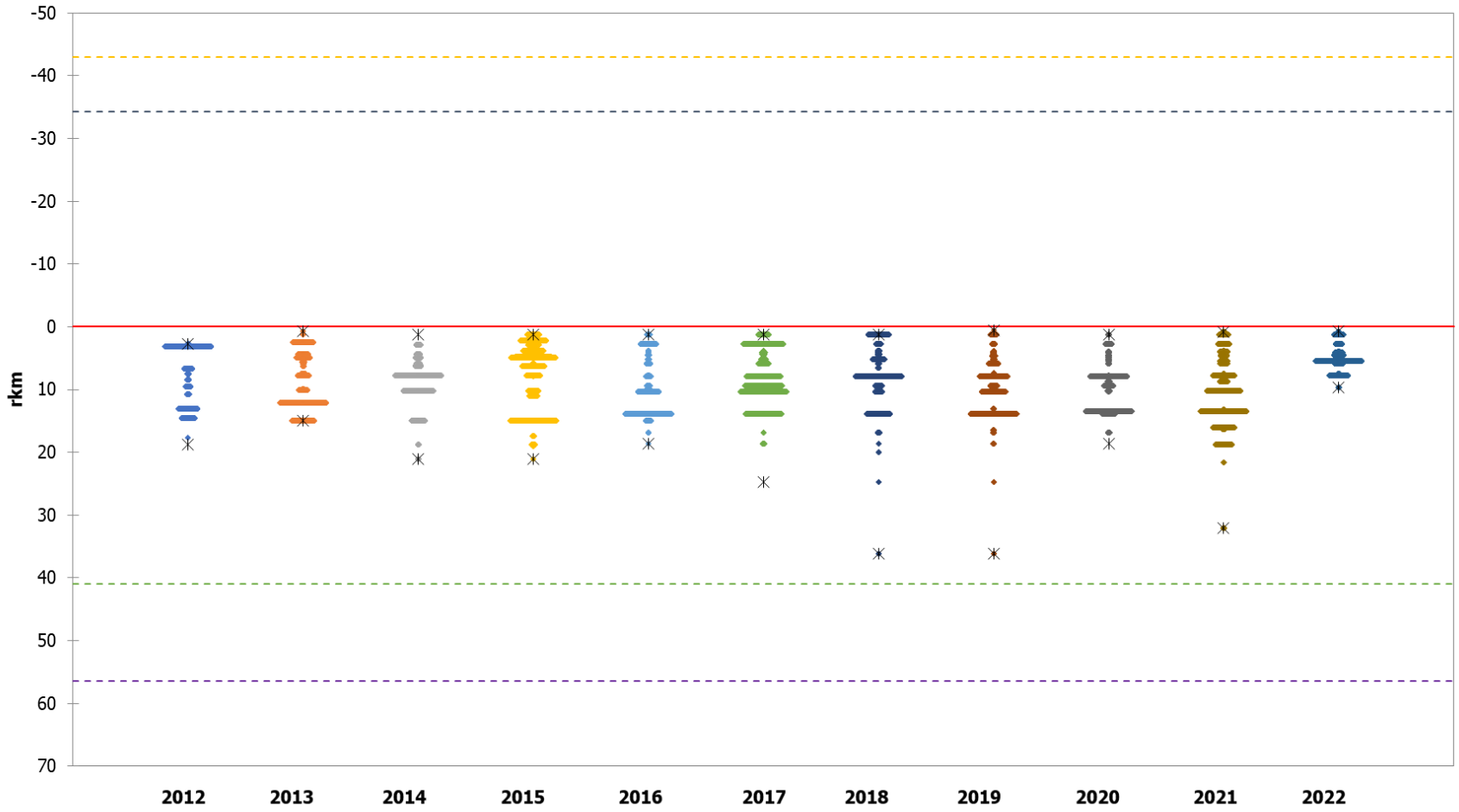

Figure A6-27: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16020) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

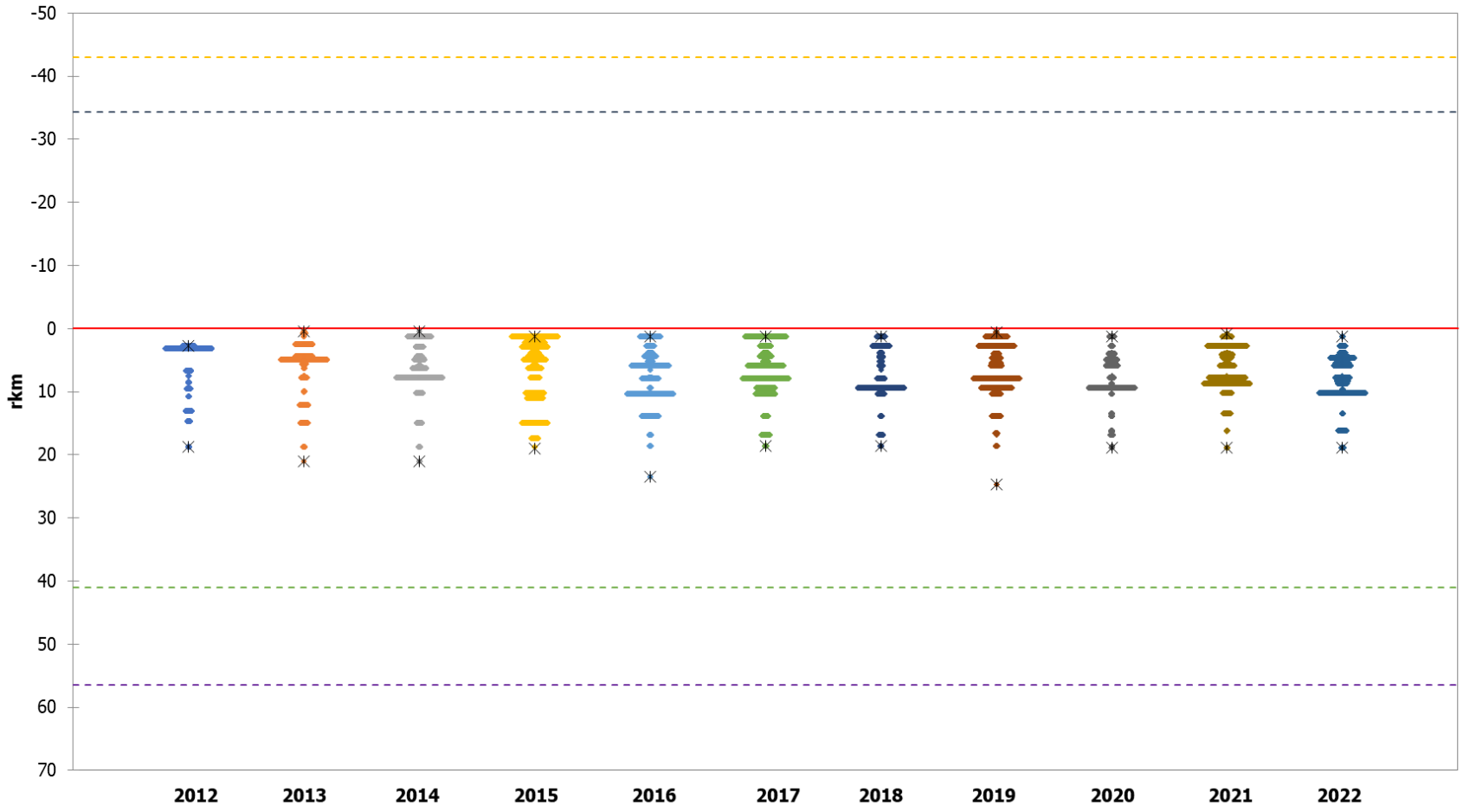

Figure A6-28: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

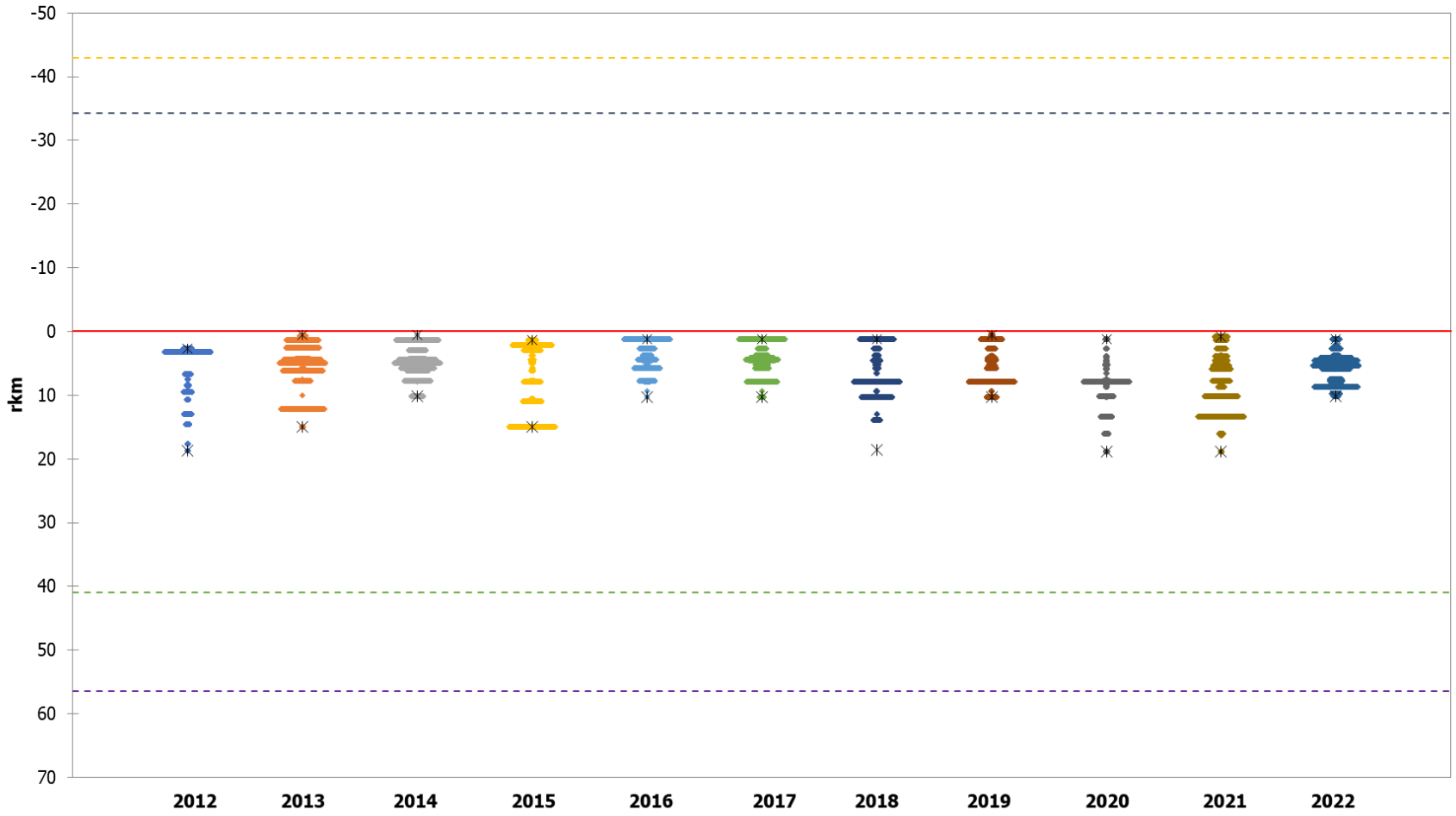

Figure A6-29: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16027) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

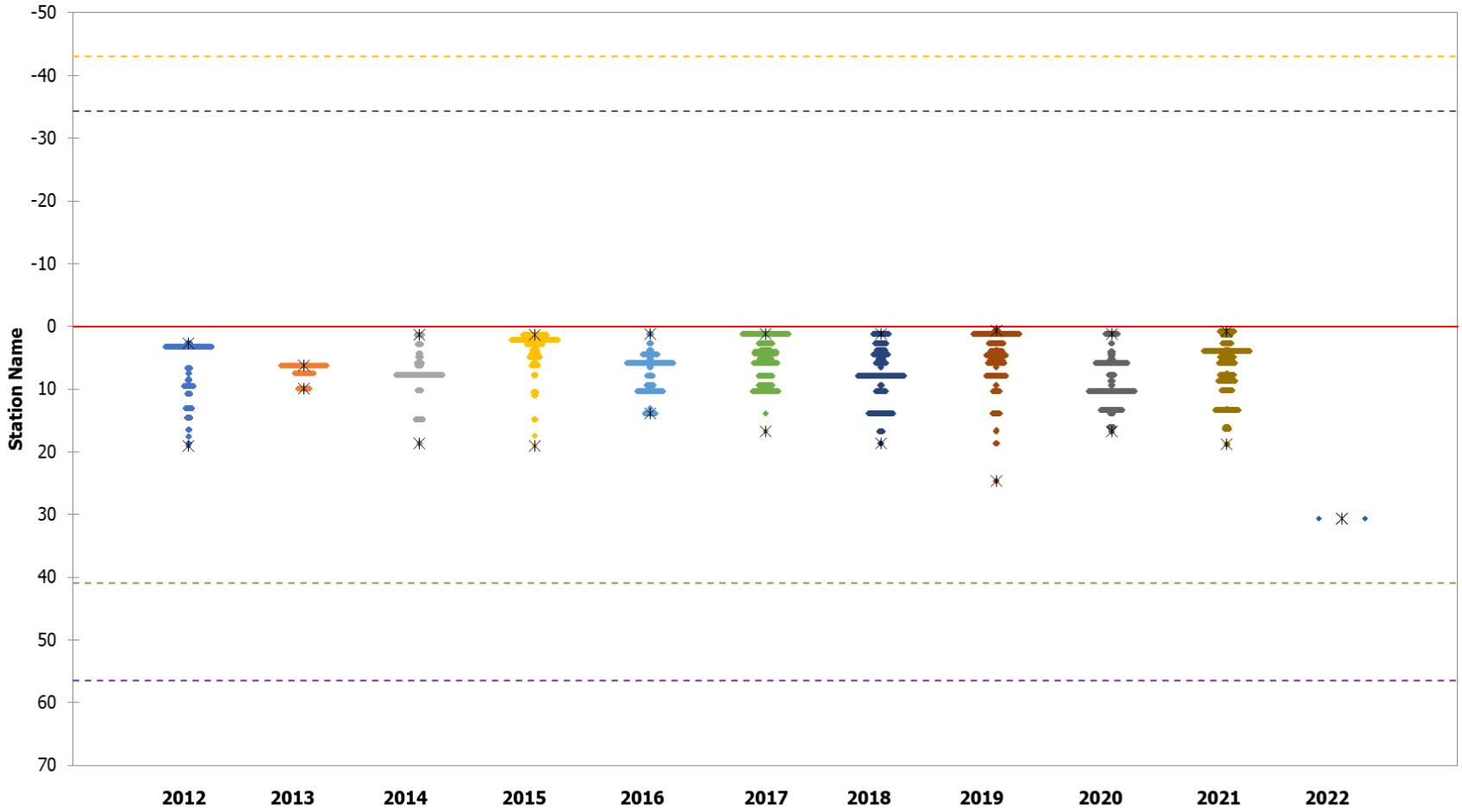

Figure A6-30: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16028) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

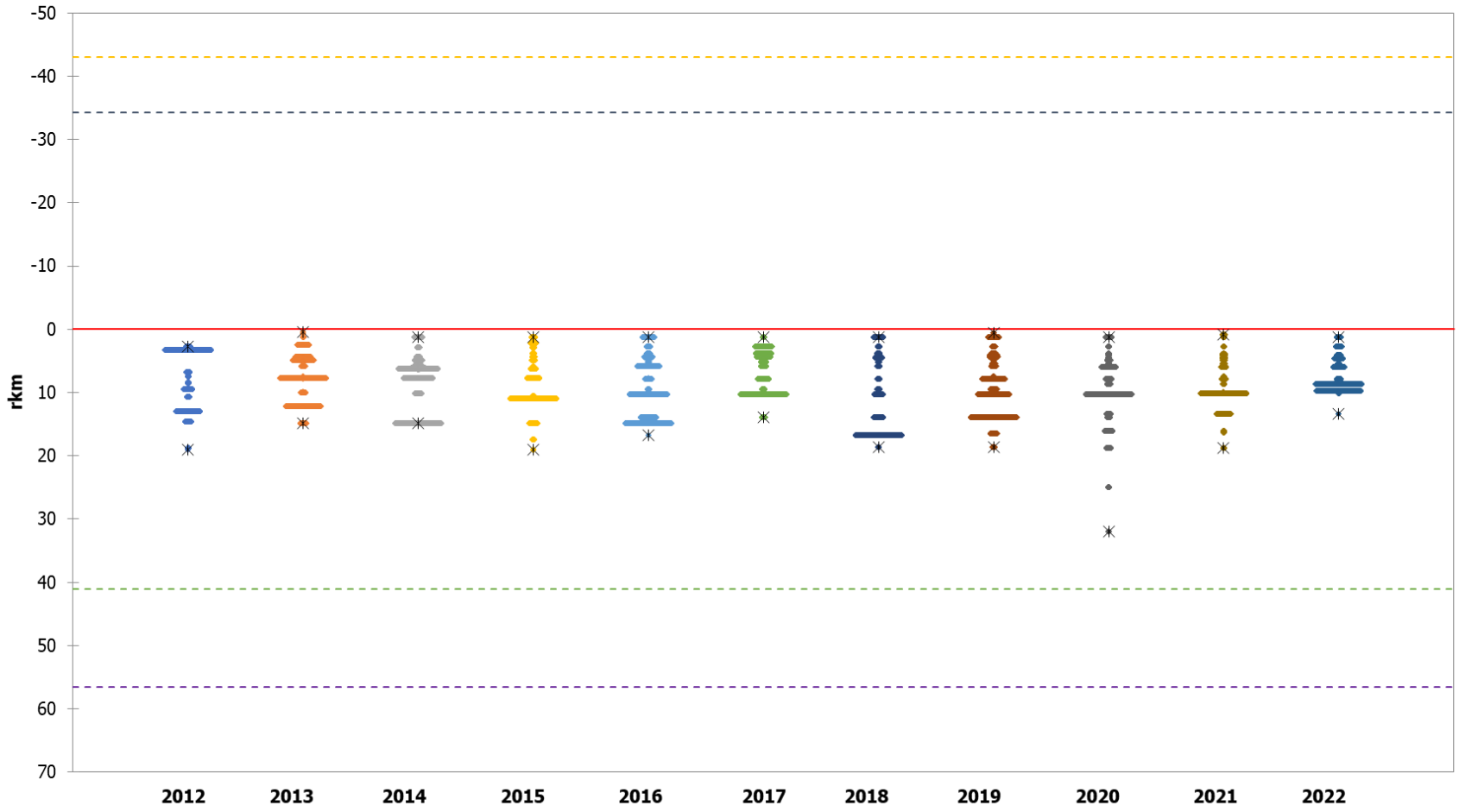

Figure A6-31: Detection ranges and distribution for Lake Sturgeon tagged with an acoustic transmitter (code #16031) in Stephens Lake in relation to the Keeyask GS (rkm 0), during each open-water period from May 1, 2012 to October 10, 2022. Minimum and maximum distances from the Keeyask GS are indicated with a star. Landmarks are indicated with horizontal dotted lines (orange = Clark Lake outlet; blue = Birthday Rapids; red = Keeyask GS; green = Kettle GS; purple= Long Spruce GS).

APPENDIX 7:
TAGGING AND RECAPTURE INFORMATION ASSOCIATED WITH ADULT LAKE STURGEON IMPLANTED WITH ACOUSTIC TRANSMITTERS THAT HAVE EXPIRED BETWEEN 2011 AND 2022.

Table A7-1: Tagging, tag expiry, and subsequent recapture information for adult Lake Sturgeon tagged with acoustic transmitters in the Keeyask reservoir following tag expiry.

Acoustic Tag	Floy Tag	Tagging Date	Estimated Tag Expiry Date	Date of Last Detection	Location of Last Detection	Recapture Date	Recapture Location	Recapture Program
16036	74400	05-Jun-11	02-Jun-21	02-Jun-21	Gull Lake	-	-	-
16039	48596	05-Jun-11	02-Jun-21	02-Jun-21	Gull Lake	-	-	-
16042	74399	05-Jun-11	02-Jun-21	08-Aug-14	Clark Lake	-	-	-
16045	77516	18-Aug-11	07-Jun-21	10-Jun-11	Gull Lake	-	-	-
16048	94396	07-Jun-11	04-Jun-21	25-Sep-20	Stephens Lake	-	-	-
16051	74394	10-Jun-11	07-Jun-21	04-Jun-21	Gull Lake	-	-	-
16054	74398	06-Jun-11	03-Jun-21	03-Jun-21	Upstream Birthday Rapids	-	-	-
16055	74396	06-Jun-11	03-Jun-21	03-Jun-21	Gull Lake	-	-	-
16056	77515	10-Jun-11	07-Jun-21	04-Jun-21	Gull Lake	-	-	-
16057	77509	16-Jun-11	13-Jun-21	17-Jun-14	Clark Lake	-	-	-
16058	82631	09-Jun-11	06-Jun-21	06-Oct-19	Clark Lake	-	-	-
16059	64718	16-Jun-11	13-Jun-21	07-Jun-21	Birthday Rapids	-	-	-
16060	80188	21-Jun-11	18-Jun-21	03-Aug-20	Stephens Lake	-	-	-
16061	77503	21-Jun-11	18-Jun-21	21-Jun-11	Gull Lake	15-Jun-12	Gull Lake	2012 Adult Lake Sturgeon Population Monitoring (Hrenchuk 2013)
						13-Jun-18	Gull Lake	2018 Adult Lake Sturgeon Population Monitoring (Holm and Hrenchuk 2019)
						18-Jun-21	Birthday Rapids	2021 Adult Lake Sturgeon Population Monitoring (Loeppky and Hrenchuk 2022)
						27-Jun-21	Gull Lake (rkm -12.9)	2021 Adult Lake Sturgeon Population Monitoring (Loeppky and Hrenchuk 2022)
16062	77510	12-Jun-11	09-Jun-21	04-Jun-21	Nelson River between Birthday Rapids and Gull Lake	-	-	-
16063	77514	11-Jun-11	08-Jun-21	02-Jul-19	Clark Lake	-	-	-
16064	80370	12-Jun-11	09-Jun-21	02-Jun-16	Gull Lake	-	-	-
16065	77511	12-Jun-11	09-Jun-21	18-Jan-21	Gull Lake	-	-	-
16066	77507	20-Jun-11	17-Jun-21	04-Jun-21	Nelson River between Birthday Rapids and Gull Lake	-	-	-
16067	50826	19-Jun-11	16-Jun-21	24-Jun-19	Clark Lake	16-Jun-20	Kelsey GS	Tag returned by a local resource user in September 2020 and was expired.
16068	80368	19-Jun-11	16-Jun-21	06-Jun-21	Birthday Rapids	-	-	-

Table A7-1: Tagging, tag expiry, and subsequent recapture information for adult Lake Sturgeon tagged with acoustic transmitters in the Keeyask reservoir following tag expiry (continued).

Acoustic Tag	Floy Tag	Tagging Date	Estimated Tag Expiry Date	Date of Last Detection	Location of Last Detection	Recapture Date	Recapture Location	Recapture Program
16069	48909	17-Jun-11	14-Jun-21	03-Jun-21	Birthday Rapids	-	-	-
16070	77508	16-Jun-11	13-Jun-21	13-Dec-19	Gull Lake	18-Jun-21	Birthday Rapids	2021 Adult Lake Sturgeon Population Monitoring (Loeppky and Hrenchuk 2022)
16071	76484	16-Jun-11	13-Jun-21	08-Jun-21	Gull Lake	-	-	-
16072	77506	21-Jun-11	18-Jun-21	08-Jul-20	Gull Lake	-	-	-
16073	77512	12-Jun-11	09-Jun-21	03-Oct-20	Gull Lake	22-Jun-22	Stephens Lake	2022 Adult Lake Sturgeon Population Monitoring (Ambrose et al. 2023)
16074	94030	13-Jun-11	10-Jun-21	19-Jul-20	Gull Lake	-	-	-
16075	50888	10-Jun-11	07-Jun-21	20-Sep-20	Gull Lake	-	-	-
16076	50808	16-Jun-11	13-Jun-21	06-Jun-21	Stephens Lake	-	-	-
16077	80265	10-Jun-11	07-Jun-21	21-Jun-11	Gull Lake	-	-	-
32174	94117	18-Jun-14	15-Jun-24	25-Aug-20	Stephens Lake	-	-	-
32175	105480	18-Jun-14	15-Jun-24	25-Aug-20	Gull Lake	-	-	-
32176	50853	18-Jun-14	15-Jun-24	25-Aug-20	Gull Lake	-	-	-
32177	105479	18-Jun-14	15-Jun-24	14-Jun-15	Gull Lake	-	-	-
54799	111765	6-Jun-18	7-Mar-21	16-Jun-21	Gull Lake	-	-	-

Table A7-2: Tagging, tag expiry, and subsequent recapture information for adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake following tag expiry.

Acoustic Tag	Floy Tag	Tagging Date	Estimated Tag Expiry Date	Date of Last Detection	Location of Last Detection	Recapture Date	Recapture Location	Recapture Program
16018	93923	13-Jun-12	11-Jun-22	02-Jul-12	Upstream Kettle GS	-	-	-
16021	91705	28-Sep-11	25-Sep-21	05-Sep-16	Long Spruce Reservoir	-	-	-
16024	74416	13-Jun-12	11-Jun-22	25-Jun-12	Stephens Lake	-	-	-
16025	80374	15-Jun-12	13-Jun-22	14-Jul-14	Long Spruce Reservoir	-	-	-
16028	93924	13-Jun-12	11-Jun-22	02-Oct-21	Stephens Lake	-	-	-
16029	56202	21-Jun-11	18-Jun-21	17-Jun-21	Nelson River between Birthday Rapids and Gull Lake	-	-	-
16030	56152	12-Jun-11	09-Jun-21	08-Jun-21	Stephens Lake	-	-	-
16032	46892	11-Jun-11	08-Jun-21	21-Jan-19	Stephens Lake	-	-	-
16033	74419	18-Jun-11	15-Jun-21	30-Jul-12	Gull Lake	01-Aug-12	Unknown	Tag returned by a local resource user
16033b	103230	16-Sep-13	15-Jun-21	10-Sep-21	Stephens Lake	-	-	-
16034	74418	18-Jun-11	15-Jun-21	19-Jun-17	Limestone Reservoir	-	-	-
16035	69868	26-Sep-11	23-Sep-21	08-Aug-18	Long Spruce Reservoir	-	-	-
16037	-	08-Jun-11	05-Jun-21	23-May-21	Stephens Lake	-	-	-
16038	74415	12-Jun-11	09-Jun-21	03-Jun-21	Gull Lake	-	-	-
16040	74411	09-Jun-11	06-Jun-21	26-Apr-21	Stephens Lake	-	-	-
16041	74421	26-Jun-11	23-Jun-21	23-Jun-21	Stephens Lake	-	-	-
16043	88788	10-Jun-11	07-Jun-21	17-Sep-12	Stephens Lake	06-Jun-21	Stephens Lake	2021 Adult Lake Sturgeon Population Monitoring (Loeppky and Hrenchuk 2022)
16044	56208	09-Jun-11	06-Jun-21	17-Sep-12	Stephens Lake	-	-	-
16046	74413	11-Jun-11	08-Jun-21	08-Jun-13	Gull Lake	-	-	-
16047	88789	26-Jun-11	23-Jun-21	28-Jun-11	Stephens Lake	-	-	-
16049	91174	24-Sep-11	21-Sep-21	25-Jun-20	Stephens Lake	-	-	-
16050	74415	13-Jun-11	10-Jun-21	07-Jun-21	Stephens Lake	-	-	-
16052	69865	26-Sep-11	23-Sep-21	03-Sep-21	Stephens Lake	-	-	-
16053	69867	26-Sep-11	23-Sep-21	23-Sep-21	Stephens Lake	-	-	-
32167	-	11-Jun-14	08-Jun-24	18-Aug-20	Stephens Lake	-	-	-
32168	94234	11-Jun-14	08-Jun-24	18-Aug-20	Stephens Lake	-	-	-

Table A7-2: Tagging, tag expiry, and subsequent recapture information for adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake following tag expiry (continued).

Acoustic Tag	Floy Tag	Tagging Date	Estimated Tag Expiry Date	Date of Last Detection	Location of Last Detection	Recapture Date	Recapture Location	Recapture Program
32169	-	13-Jun-14	10-Jun-24	20-Aug-20	Stephens Lake	-	-	-
32170	46844	11-Jun-14	08-Jun-24	30-Oct-16	Stephens Lake	04-Jun-18	Base of Keeyask GS	2018 Adult Lake Sturgeon Population Monitoring (Holm and Hrenchuk 2019)
						08-Jun-18	Stephens Lake	2018 Adult Lake Sturgeon Population Monitoring (Holm and Hrenchuk 2019)
32171	-	13-Jun-14	10-Jun-24	20-Aug-20	Stephens Lake	-	-	-
32172	86136	13-Jun-14	10-Jun-24	18-Aug-20	Stephens Lake	-	-	-
32173	-	13-Jun-14	10-Jun-24	20-Aug-20	Stephens Lake	-	-	-