



Keeyask Generation Project  
Aquatic Effects Monitoring Plan

Adult Lake Sturgeon Movement Monitoring Report  
AEMP-2021-01



# **KEEYASK GENERATION PROJECT**

## **AQUATIC EFFECTS MONITORING PLAN**

REPORT #AEMP-2021-01

### **ADULT LAKE STURGEON MOVEMENT MONITORING IN THE NELSON RIVER BETWEEN CLARK LAKE AND THE LIMESTONE GENERATING STATION, OCTOBER 2019 TO SEPTEMBER 2020: YEAR 7 CONSTRUCTION**

Prepared for

Manitoba Hydro

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# SUMMARY

## Background

The Keeyask Hydropower Limited Partnership (KHLPP) 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 with the construction of cofferdams in the north and central channels of Gull Rapids. These cofferdams resulted in the dewatering of the north and central channels and the diversion of all flow to the south channel. Construction of the Spillway Cofferdam (SWCD), which extends into the south channel of Gull Rapids, was completed in 2015. The rock placement for the inner and outer groins of the Tailrace Cofferdam (TRCD) started in late 2016 and the impervious fill placement was completed in fall 2017. The spillway was commissioned between August 3 and 7, 2018. Closing the south channel with the upstream South Dam Cofferdam (SDCD) commenced at the beginning of August and river closure was achieved on August 16. This closure and the work that continued to seal the cofferdam forced the entire river flow through the spillway. In 2020 water-up of the areas kept dry by cofferdams for construction occurred between the end of February and mid-April. The cofferdams upstream of Keeyask and the North Channel Rock Groin were removed and/or lowered throughout the water-up process. Excavation of the TRCD occurred from mid-April to May 14 and then resumed on July 16 and was completed in October. Impoundment of the Keeyask reservoir took place between August 31 and September 5, 2020. Commissioning of the first generator unit started on August 31, 2020 and was still underway at the end of 2020.

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 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 prior to 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 indicated that the majority of 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 2019 to September 2020. This monitoring was initiated in June 2011 when 59 adult Lake Sturgeon were tagged with acoustic transmitters with a 10-year battery life. Therefore, movements of these fish were 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 19 days after reservoir impoundment (September 5 to September 23, 2020). An additional 51 adult Lake Sturgeon were tagged with acoustic transmitters in spring 2019 to continue monitoring through GS operation.



### **Adult Lake Sturgeon.**

#### **Why is the study being done?**

Monitoring during construction is being done to answer three questions:

*Is construction affecting the area that adult Lake Sturgeon occupy upstream and downstream of the construction site?*

Monitoring sturgeon movement shows what areas of the river the sturgeon are using and where they are choosing to stay relative to the construction site.

*Are there adult Lake Sturgeon close to the construction site?*

If sturgeon are in the river close to the construction area, they could be harmed by high amounts of mud in the water or they could be trapped inside an area that will be drained.

*How many adult Lake Sturgeon are moving through and/or away from the generating station (formerly Gull Rapids) during construction 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.

In 2020, monitoring was conducted for the first 19 days after the reservoir was flooded on September 5. This means an additional AEMP key question can begin to be addressed.

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

Flooding of Gull Lake will cause changes to available habitat in the area. This may cause adult Lake Sturgeon to move away or to use different areas of the river. Monitoring data collected from the first 19 days after the reservoir was created are presented in this report.

### **What was done?**

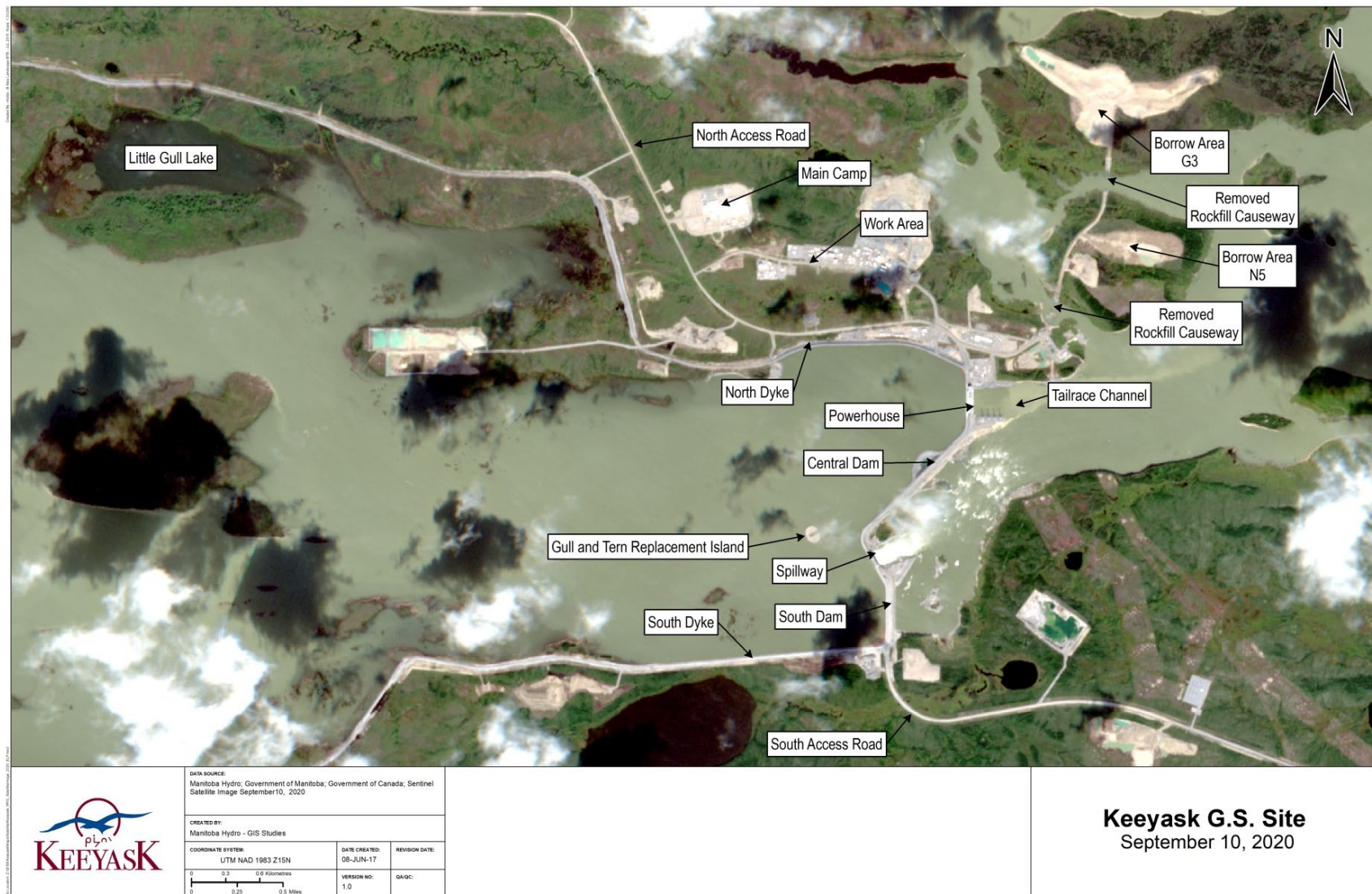
The movements of adult sturgeon were tracked using acoustic telemetry. This is a technique in which a tag is surgically implanted inside a fish. Each tag sends out a sound signal (called a “ping”) that is picked up by receivers placed along the Nelson River between Clark Lake and the Limestone GS (see 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 life-span.

Fifty-nine adult Lake Sturgeon were tagged in 2011 and 2012, 30 upstream and 29 downstream of Gull Rapids. The transmitters are powered by batteries with a 10-year life-span. By the end of 2013, some fish were missing so 11 more tags were applied in 2014 (four upstream of Gull Rapids and seven in Stephens Lake) to return the number of tagged fish to the original sample size. One additional tag was applied in spring 2018 to a female sturgeon used for broodstock (eggs) in a stocking program. This tag was applied to track her survival after egg collection.

Fifty-one new 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.

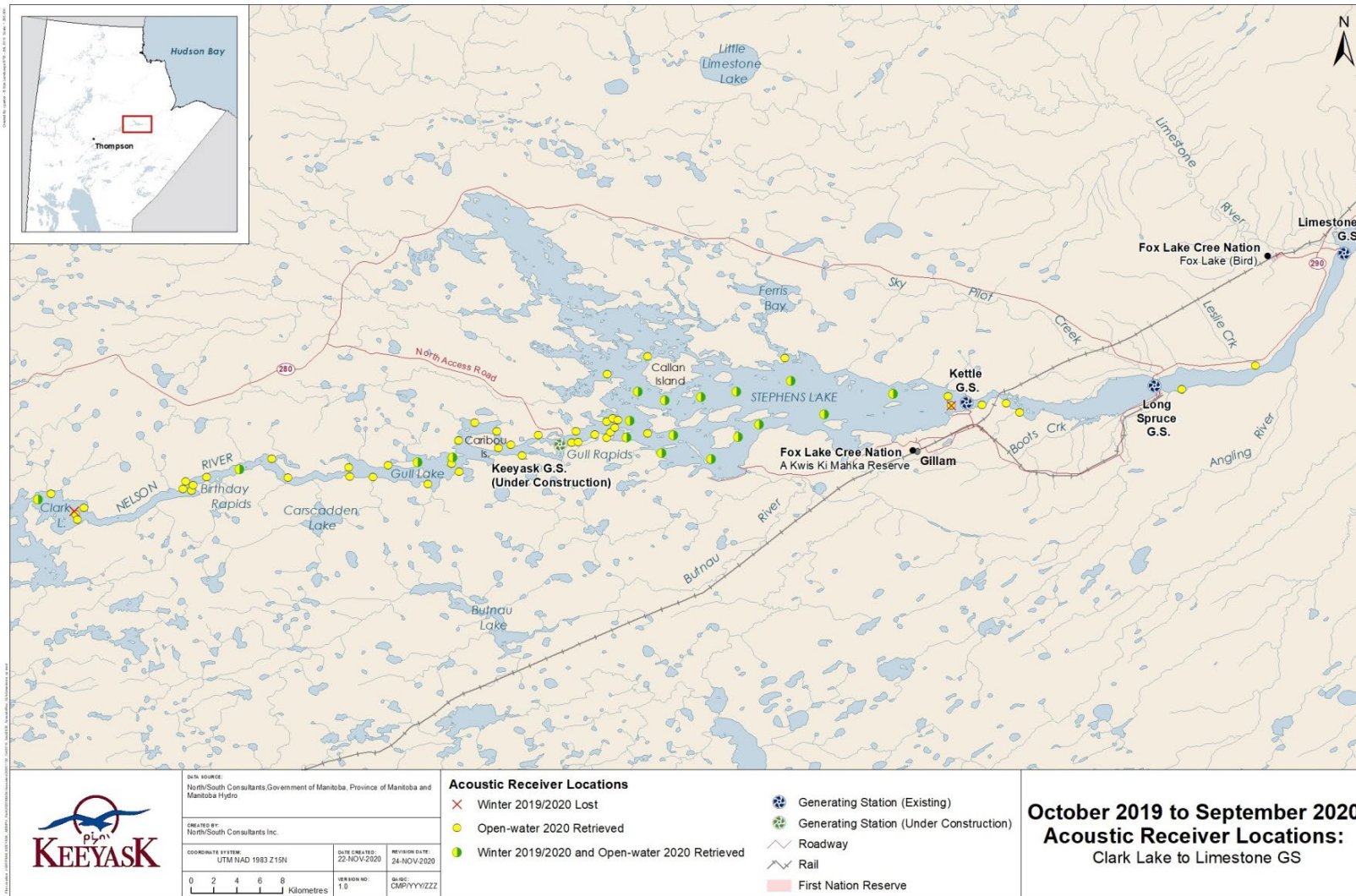


**Adult Lake Sturgeon being held in a tank prior to surgery (left). Acoustic tag being implanted in an adult Lake Sturgeon (middle). Adult Lake Sturgeon released into the river after acoustic surgery (right).**



**Map illustrating instream structures at the Keeyask Generating Station site after reservoir flooding, September 2020.**





**Map showing the study area (pre-flooding shoreline). 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?

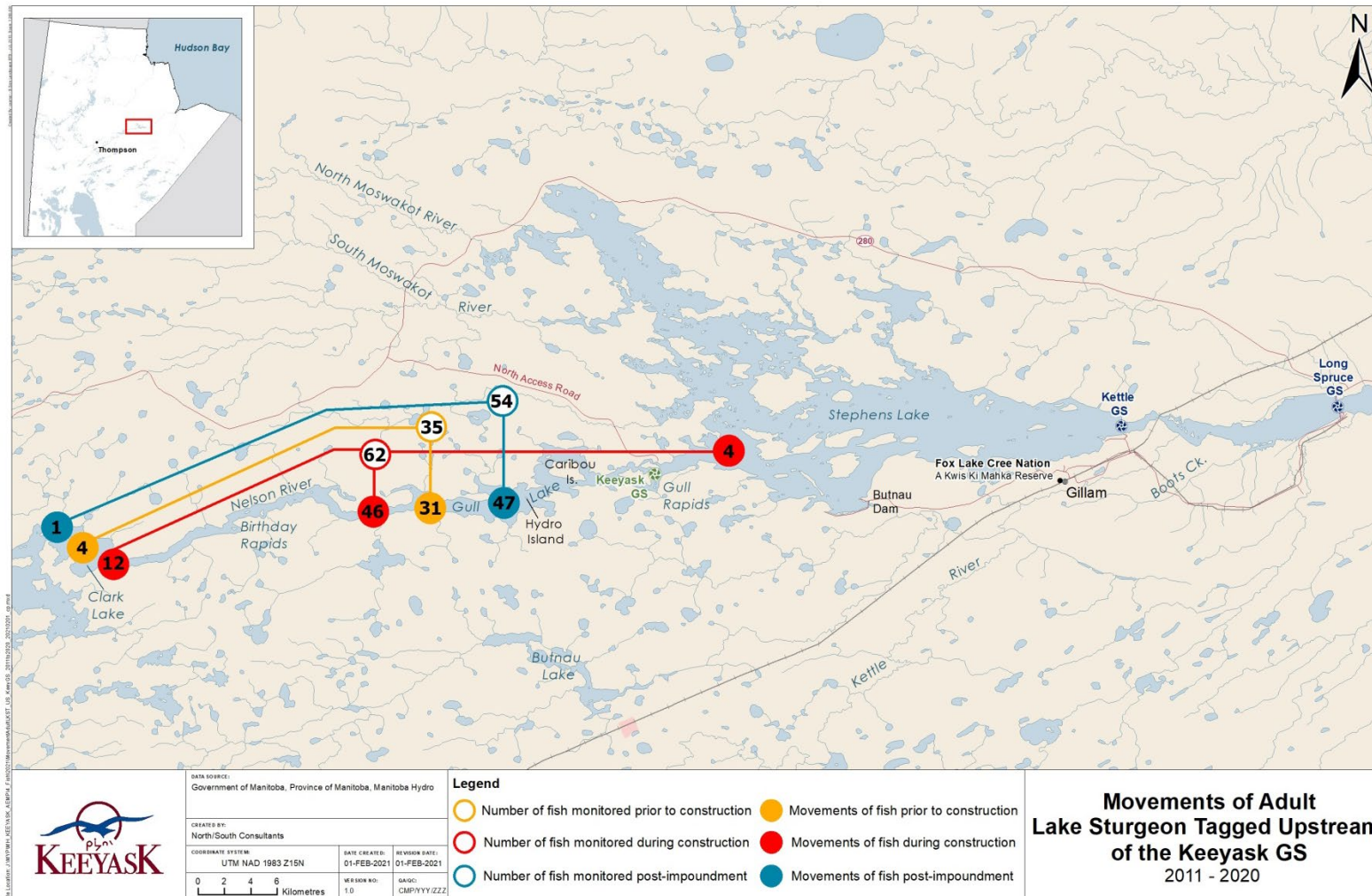
Sturgeon are unique fish in Manitoba because they can live for a long time (100 or more years), become adults when they are 20 to 25 years old, and only spawn every two to five years. This means that where an individual sturgeon moves may change between years depending on how old it is, whether it is 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 the tagged fish were monitored year-round including 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.

After nine-and-a-half years of monitoring, the sturgeon that were tagged in Gull Lake continue to be divided into three groups: those that usually live in Gull Lake (sometimes these fish leave for short periods of time then return); those that usually stay in the channel of the Nelson River between Birthday Rapids and Gull Lake; and those that usually stay in Clark Lake.

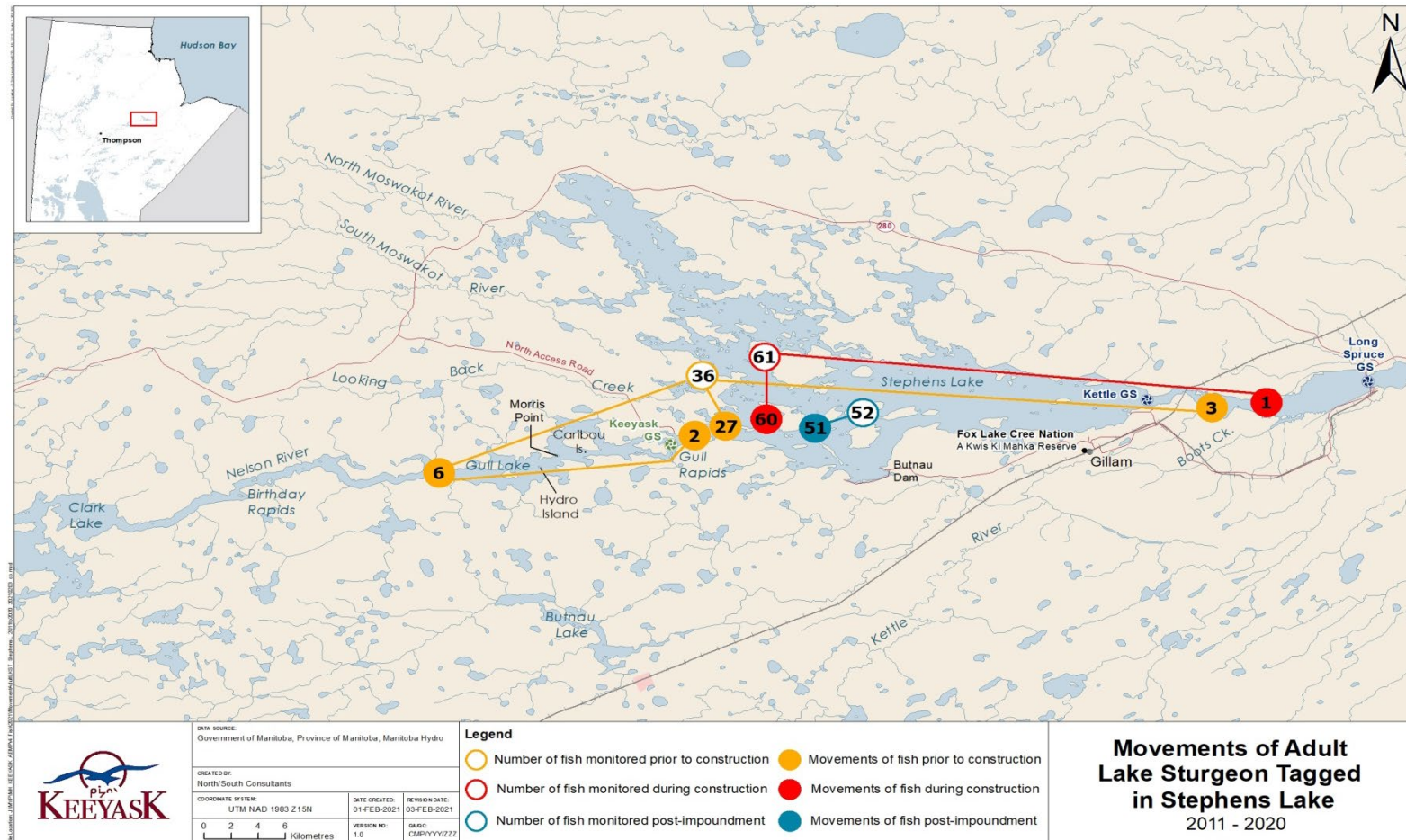
Adult Lake Sturgeon tagged in Stephens Lake tend to stay in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Fish tagged in Stephens Lake continue to be split into two groups: those that remain in upper Stephens Lake within about 13 km of the Keeyask GS; and those that periodically move downstream into lower Stephens Lake.

No adult Lake Sturgeon moved downstream through the Keeyask GS in 2020. Since studies began in 2011, six fish moved upstream (one in 2011, four in 2012, one in 2013; all prior to 2014 when construction began) and six moved downstream (two in 2014 prior to construction, one in 2015, two in 2016, and one in 2017). In August 2018, the river channel was completely blocked off and the Keeyask GS spillway was opened for the first time. Because of this, fish are no longer able to move upstream past the Keeyask GS. All movements through Gull Rapids/the Keeyask GS are shown in the maps below.



**Map showing how many adult Lake Sturgeon moved upstream out of Gull Lake, stayed in Gull Lake, and moved into Stephens Lake 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.**





Map showing how many adult Lake Sturgeon moved upstream through Gull Rapids, stayed in Stephens Lake and moved downstream through the Kettle 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.

Since 2011, four sturgeon have moved downstream out of Stephens Lake into the Long Spruce reservoir after passing through the Kettle GS (one through a turbine, while the other three either moved over the spillway or went through a turbine). Three fish moved before construction started (two in 2012 and one in 2014) and one moved during construction (in 2018). These movements are shown in the map above.

Flooding of the Keeyask GS reservoir to the full supply level was undertaken over six days ending on September 5, 2020. No fish moved out of the reservoir during these six days. Monitoring was conducted for 19 days after impoundment was complete. During this time, one moved upstream out of Gull Lake, through Clark Lake, and out of the study area. Another fish moved upstream as far as Birthday Rapids after impoundment but returned to the reservoir before the end of the study period. One fish tagged in Stephens Lake started moving further downstream, but stayed in the lake.

### **What does it mean?**

So far, monitoring has shown that each sturgeon has a place where it likes to live. At times each fish may move to a different habitat, particularly if it is spawning. To date we have seen that sturgeon usually do not move great distances and that most prefer to live in similar locations year after year. Construction of the Keeyask GS does not appear to have affected the movements of adult sturgeon upstream or downstream of the site. Many sturgeon use habitat immediately downstream of the construction site in Stephens Lake. They do not seem to be disturbed by construction activity.

During the first 19 days after reservoir impoundment, most fish continued to show the same movements as before. Two of the 48 fish upstream of the GS (4%) moved out of Gull Lake in September immediately following impoundment: one moved to Birthday Rapids and returned to the reservoir; while one moved upstream out of the study area. One of 51 fish in Stephens Lake, one (2%) started moving farther downstream but remained in the Lake. During previous years of this study, similar movements were observed in Stephens Lake at this time of year.

The number of sturgeon moving past the Keeyask GS or the Kettle GS does not seem to have increased during construction. However, sturgeon can no longer move upstream from Stephens Lake to Gull Lake (now the Keeyask reservoir) since the Keeyask GS spillway was opened in 2018. No fish moved downstream through the Keeyask GS or the Kettle GS in 2020.

### **What will be done next?**

The tags that were implanted in 2011 will last until 2021, the tags implanted in 2014 will last until 2024, and the tags that were implanted in 2019 will last until 2029. During the 2021 open water period there should be 54 active tags upstream of Keeyask and 52 downstream in Stephens Lake that will be monitored. Following the movements of individual fish over such a long time will give us a better idea of what kinds of habitats these fish need to use over many years and whether construction and operation of the GS is changing their movement patterns.

# ACKNOWLEDGEMENTS

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The collection of biological samples described in this report was authorized by Manitoba Conservation and Water Stewardship, Fisheries Branch, under terms of the Scientific Collection Permit #10-20.



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# 1.0 INTRODUCTION

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

The *Keeyask Generation Project: Response to EIS Guidelines*, completed in June 2012, provides a summary of predicted effects and planned mitigation for the Project. Technical supporting information for the aquatic environment, including a description of the environmental setting, effects and mitigation, and a summary of proposed monitoring and follow-up programs is provided in the *Keeyask Generation Project Environmental Impact Statement: Aquatic Environment Supporting Volume* (AE SV). As part of the licensing process for the Project, an Aquatic Effects Monitoring Plan (AEMP) was developed detailing the monitoring activities of various components of the aquatic environment, including the focus of this report, adult Lake Sturgeon movement, for the construction and operation phases of the Project.

One of the main objectives associated with radio and acoustic telemetry studies conducted prior to 2011 (*i.e.*, in support of the Keeyask Generation Project EIS) 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.

This report provides eleven months of results (October 2019 to September 2020) from the multi-year adult Lake Sturgeon movement monitoring program described in the AEMP. The report also discusses what has been learned since adult Lake Sturgeon movement monitoring began in 2011. In 2011, 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 28 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. To compensate for this loss, additional tags were implanted in 2014 to restore the sample size to 59 fish. 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), and Hrenchuk (2020). An

additional 51 adult Lake Sturgeon were tagged in 2019 to track changes before and up to nine years after reservoir impoundment.

Adult Lake Sturgeon movement monitoring during the construction phase is being 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 (Map 2). Results assist 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.*).

The key questions for adult movement monitoring during the construction phase are as follows:

- Do disturbances associated with construction alter coarse-scale movement/habitat use upstream and/or downstream of the construction site?
- Are sturgeon using habitat in the immediate vicinity of the construction site?
- Does the frequency of long-distance movements (and subsequent downstream emigration/entrainment) by adult Lake Sturgeon increase during construction?

Reservoir impoundment occurred over six days ending on September 5. Monitoring was conducted for 19 days after impoundment, which made it possible to begin to address another key question:

- Will there be a statistically significant 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 results from October 2019 to September 2020, which is the fifth winter and sixth open-water period of monitoring conducted since construction of the Keeyask GS began in July 2014. This report includes data collected during the first 19 days (September 5 to September 23, 2020) after impoundment of the Keeyask reservoir.

## 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. Water velocities were classified as low (0.2–0.5 metres per second [m/s]), moderate (0.5–1.5 m/s), or high (greater than 1.5 m/s), as described in the Keeyask AE SV.

Clark Lake is located immediately downstream of Split Lake, and approximately 42 km upstream of the Keeyask GS (Map 1). Current is restricted to the main section of the lake, with off-current bays outside the main channel. The Assean River is the only major tributary to Clark Lake, and flows into the north side. Downstream from the outlet of Clark Lake, the Nelson River narrows and water velocity increases for a 3 km stretch, known as Long Rapids. For the next 7 km, the river widens, and water velocity decreases.

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of the Keeyask GS (Maps 1 and 3). The drop in elevation from the upstream to downstream side of Birthday Rapids is approximately 2 m. The 14 km reach of the Nelson River between Birthday Rapids and Gull Lake is characterized as a large and somewhat uniform channel with medium to high water velocities. There are a few large bays with reduced water velocity and a number of small tributaries that drain into the Nelson River.

Gull Lake is a section of the Nelson River where the river widens, with moderate to low water velocity. Gull Lake is herein defined as the reach of the Nelson River beginning approximately 19.5 km upstream of the Keeyask GS and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Maps 1 and 3), and extending to the downstream end of Caribou Island, approximately 3 km upstream of the Keeyask GS. Gull Lake has three distinct basins, the first extending from the upstream end of the lake downstream approximately 6 km to a large island; the second extending from the large island to Morris Point (a constriction in the river immediately upstream of Caribou Island); and the third extending from Morris Point to the downstream end of Caribou Island (Map 3).

In fall 2020, Gull Lake was impounded by the Keeyask GS and became part of the Keeyask reservoir, which will operate at a full supply level (FSL) of 159 m above sea level (ASL) on a permanent basis. The Keeyask reservoir is comprised of the mainstem of the original Nelson River from the outlet of Clark Lake as far as the Keeyask GS, plus 45 km<sup>2</sup> of adjacent, flooded terrestrial area. Reservoir impoundment formed relatively shallow bays due to flooding of terrestrial areas, which generally have low water velocities and limited mixing with the mainstem flow. Over time the total area of the reservoir will increase as the terrestrial (peat) areas erode.

Gull Rapids, now the site of the Keeyask GS, was located approximately 3 km downstream of Caribou Island on the Nelson River (Map 1). Prior to construction, the rapids were approximately 2 km in length, and the river elevation dropped approximately 11 m along the 2 km length. Two large islands and several small islands occurred within the rapids, prior to the

river narrowing; these features are within the Project footprint and have now been either dewatered, incorporated into the GS or were flooded after impoundment (Map 2). A summary of construction activities is provided in Section 2.1.

Construction of the Kettle GS flooded Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River, as well as the old channels of the Nelson River that now lie within the southern portion of the lake (Map 4). Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. Looking Back Creek is a second order stream that drains into the north arm of Stephens Lake (Map 1). Kettle GS is located approximately 40 km downstream of 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 (Maps 1 and 6).

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.

## 2.1 CONSTRUCTION SUMMARY

Construction of the Keeyask GS began in mid-July 2014 with the construction of cofferdams in the north and central channels of Gull Rapids. These cofferdams resulted in the dewatering of the north and central channels and the diversion of all flow to the south channel. Construction of the Spillway Cofferdam (SWCD), which extends into the south channel of Gull Rapids, was completed in 2015. The rock placement for the inner and outer groins of the Tailrace Cofferdam (TRCD) started in late 2016 and the impervious fill placement was completed in fall 2017. The spillway was commissioned between August 3 and 7, 2018. Closing the south channel with the upstream South Dam Cofferdam (SDCD) commenced at the beginning of August and river closure was achieved on August 16. This closure and the work that continued to seal the cofferdam forced the entire river flow through the spillway. In 2020 water-up of the areas kept dry by cofferdams for construction occurred between the end of February and mid-April. The cofferdams upstream of Keeyask and the North Channel Rock Groin were removed and/or lowered throughout the water-up process. Excavation of the TRCD occurred from mid-April to May 14 and then resumed on July 16 and was completed in October. Impoundment of the Keeyask reservoir took place between August 31 and September 5, 2020. Commissioning of the first generator unit started on August 31, 2020 and was still underway at the end of 2020.

## 2.2 FLOWS AND WATER LEVELS

From October 2019 to October 2020 the calculated Split Lake outflow ranged between 2,600 m<sup>3</sup>/s in October 2019 and 5,900 m<sup>3</sup>/s in May 2020. Flows increased from about 2,600 m<sup>3</sup>/s in October 2019 to about 4,000 m<sup>3</sup>/s in December 2019 and remained fairly steady between 4,000–4,400 m<sup>3</sup>/s until the end of April 2020. In summer the flows were high and ranged between 5,000–6,000 m<sup>3</sup>/s from May through August before dropping in September through October until it reached 3,500 m<sup>3</sup>/s, slightly above the existing environment average flow.

Water levels on Gull Lake generally varied with flow and ice conditions between October 2019 and February 2020. Levels on Gull Lake rose from a low of about 153.5 m to 156 m from October to December and remained near that level until February while upstream levels varied with flow and ice conditions. From February to April, water-up activities at the construction site caused Gull Lake levels to rise about 0.3 m. After water-up, the spillway gates were used to keep levels relatively steady between about 156.3–156.8 m until the end of August prior to impoundment. The Keeyask reservoir was impounded to its operating level (158 to 159 m) from August 31 to September 5. During this period, Gull Lake was raised about 2 m to a maximum level of 158.9 m, 0.1 m below the full supply level. Upstream of Gull Lake the water level increase diminished with distance, with increases of about 0.8 m and 0.2 m immediately below and above Birthday Rapids while no increases occurred at the water level gauges immediately below and on Clark Lake. Gull Lake has since been held near 158.8 m while upstream levels vary with flow. With impoundment the Keeyask reservoir has entered its operating condition. Water levels on Gull Lake and upstream areas within the project's open water hydraulic zone of influence, which extends to about 3 km below Clark Lake, will now be permanently elevated relative to pre-project conditions.



## 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. Initially, the receiver array was designed to monitor adult Lake Sturgeon (the focus of this report); however, the same array is also used to monitor movements of juvenile Lake Sturgeon (Hrenchuk 2021a), Walleye (Hrenchuk 2021b), and Lake Whitefish (Hrenchuk 2021c).

#### 3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (VEMCO V16-4x, estimated 3,650-day battery life) were first applied to 59 fish in 2011 and 2012: 31 upstream and 28 downstream of Gull Rapids (Table 1). A single transmitter was reapplied to a fish in Stephens Lake in 2013 after being returned by a local resource user. At the beginning of the 2014 open-water period, it was suspected that 11 fish had either shed their tags, suffered mortality, or were captured by local resource users. In order to return the number of tagged fish to the original sample size, additional acoustic transmitters were applied to adult Lake Sturgeon upstream of Gull Rapids ( $n = 4$ ) and in Stephens Lake ( $n = 7$ ) in June 2014 (Hrenchuk and Barth 2015) (Table 1).

One additional fish was tagged with an acoustic transmitter (VEMCO V13-1x, estimated 1,735-day battery life) upstream of the Keeyask GS (rkm -26.0) on June 6, 2018 (Table 2). This fish was a female used as broodstock for the Project's stocking program (details can be found in Klassen *et al.* 2019). The acoustic transmitter was applied to monitor survival post egg collection.

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 (Table 1). These transmitters will allow tracking of Lake Sturgeon through GS construction, and the first eight years of GS operation (to 2029).

#### 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 Gull Lake.

### **3.1.2.1 WINTER 2019/2020**

The stationary acoustic receiver array for the winter 2019/2020 (October 8, 2019, to April 30, 2020) period consisted of 21 receivers. Five were set upstream of the Keeyask GS and 16 throughout Stephens Lake (Maps 3 and 4). Low water levels prevented boat access to the river section between Kettle GS and Long Spruce GS, and therefore, an acoustic receiver could not be set downstream of the Kettle GS during winter 2019/2020. The 2019/2020 winter array differed slightly from the array used in 2018/2019. An additional receiver (#107999) was set near the outlet of Clark Lake at rkm -45.0 (Map 3). One receiver (#122776) was set immediately upstream of the Kettle GS, at rkm 40.0 (Map 4).

### **3.1.2.2 OPEN-WATER 2020**

An array of 64 acoustic receivers was used during the 2020 open-water period (defined as May 1 to September 23, 2020). Twenty-nine were set upstream of the Keeyask GS and 30 were set in Stephens Lake (Maps 5 and 6). The 2020 open-water array differed slightly from the array used in 2019. Two additional receivers were set upstream of the GS, one close to the spillway (#127091 at rkm -3.8) and one close to the powerhouse (#127100 at rkm -2.2) (Map 6).

Water levels were higher in 2020 than in previous sampling years, and receivers were set in the Long Spruce (n = 3) and Limestone (n = 2) reservoirs (Map 7). A single receiver deployed in the Long Spruce reservoir prior to winter 2017/2018 was retrieved. The battery was no longer active, but data was recorded from October 13, 2017, to August 15, 2019.

Due to complications associated with conducting field work during the COVID-19 pandemic, the open-water receiver array was deployed later than in previous years. The open-water array was

completely deployed by July 3, 2020, whereas in previous years, the array was deployed in late May or early June.

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.

Four gates were established between Clark Lake and the Keeyask GS (44.0, 34.0, 19.0, and 10.0 rkms upstream of the GS), and two were established in Stephens Lake (4.5 and 40.0 rkms downstream of the GS) (Maps 5 and 6). The location of the “gates” has remained consistent since 2013.

To describe fish movements for reporting purposes, the study area was divided into nine different zones. The area upstream of the Keeyask GS was divided into five zones (Map 5; Zones 1–5), while Stephens Lake was divided into two zones (Map 6; Zones 6 and 7). The Long Spruce reservoir is referred to as Zone 8 and the Limestone reservoir as Zone 9.

Water temperature within the Nelson River mainstem was recorded with a HOBO Water Temperature Pro data logger from October 8, 2019, to September 23, 2020. Lake Sturgeon generally spawn in the spring when water temperature ranges from 8–13°C (KHLP 2014). Thus, data collected during this temperature range was considered as “spawning period”.

Between August 31 and September 5, 2020, the Keeyask GS reservoir was impounded to full-supply level. Prior to impoundment, all acoustic receivers set within the reservoir (*i.e.*, between Birthday Rapids and the Keeyask GS) were sunk as is done prior to the winter study period. This was done to minimize the potential to lose receivers due to increased water levels and potential debris. All receivers were retrieved prior to the end of the open-water period.

By September 23, 2020, the majority of receivers were removed and a subset ( $n = 26$ ) were redeployed to monitor movements during winter 2020/2021.

### 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. If 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.

### 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.

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

Where:

$$\binom{N}{n} = \frac{N!}{n! (N-n)!}$$

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

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



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 fish tagged since inception of the study in June 2011 to the end of the 2019 open-water period (October 7, 2019). Numbers of fish tagged upstream of the Keeyask GS and in Stephens Lake, by year, are provided in Table 1. Tables 2 and 3 provide acoustic tag and biological information associated with each tagged fish. Table 4 summarizes the proportional distribution of tagged fish upstream and downstream of the construction site (2013–2020). Table 5 summarizes all movements through Gull Rapids by fish tagged during the current (2011–2020) and previous (2001–2004) telemetry studies. Figure 3 provides water temperatures measured in the Nelson River mainstem from October 8, 2019, to September 23, 2020. Figures 4 to 15 illustrate movement range and proportional distribution of tagged fish both upstream and downstream of the Keeyask GS by season. Appendix A1 provides furthest upstream and downstream detection locations by river kilometre for each tagged fish (2011–2020) while Appendices A2 to A4 provide movement summaries, by river kilometre, for each tagged sturgeon since the study began in June 2011.

### 4.1 2011–2019 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, four additional transmitters were applied in June 2014, and one in June 2018 (Table 1). An additional 26 tags were applied in spring 2019 to replace the tags originally applied in 2011 that will expire in spring, 2021.

Six fish are considered missing (*i.e.*, have not been detected for more than a year) due to a lack of detections.

- #16042 was tagged at the outlet of Clark Lake on June 5, 2011. It was detected regularly within Clark Lake until August 8, 2014 and has not been detected since (Appendix A2-4).
- #16045 has not been detected since August 18, 2011. It moved downstream immediately after being tagged in Gull Lake on June 10, 2011 and displayed few upstream movements (Appendix A2-5).
- #16057 was tagged in Gull Lake on June 16, 2011. It remained in this area until June 17, 2014, when it moved upstream through Birthday Rapids into Clark Lake and has not been detected since (Appendix A2-11).

- #16064 was tagged downstream of Birthday Rapids on June 12, 2011 (Appendix A2-18). It moved downstream into Gull Lake, where it was detected until June 21, 2012. It was next detected briefly in Gull Lake on two days in June and July 2016.
- #16077 moved downstream immediately after tagging on June 10, 2011. It was last detected in Gull Lake on June 21, 2011 (Appendix A2-31).
- #32177 was tagged in Gull Lake on June 18, 2014. It remained in Gull Lake and was last detected here on June 14, 2015 (Appendix A2-35).

These six missing fish are not discussed in the remainder of this report.

Prior to winter 2019/2020, six fish had moved upstream from Stephens Lake into Gull Lake, two of which returned to Stephens Lake during the 2014 open-water period:

- #16025 was tagged in Stephens Lake on June 16, 2012, and moved upstream through Gull Rapids on August 22, 2012. This fish subsequently moved back downstream into Stephens Lake, where it was first located on June 18, 2014. In August 2014, this fish moved downstream through the Kettle GS (Appendix A3-7).
  - This fish is now considered missing and is not discussed in the remainder of the report.
- #16029 was tagged in Stephens Lake on June 21, 2011, and moved upstream through Gull Rapids between July 29 and August 2, 2011. This fish has remained in Gull Lake (for nine years) since making this movement (Appendix A3-10).
- #16033 was tagged in Stephens Lake on June 18, 2011, and moved upstream through Gull Rapids on July 28, 2012. However, shortly after it was captured by a local resource user and the tag was returned and reapplied to another fish in Stephens Lake in 2013.
- #16037 was tagged in Stephens Lake on June 8, 2011, and moved upstream through Gull Rapids between September 3 and 6, 2013. It then moved downstream and was detected in Stephens Lake on July 1, 2014 (Appendix A3-17). Since 2014 this fish has remained in Stephens Lake.
- #16038 was tagged in Stephens Lake on June 12, 2011, and moved upstream through Gull Rapids on September 13, 2012. It continues to be detected in Gull Lake (Appendix A3-18).
- #16046 was tagged in Stephens Lake on June 11, 2011, and moved upstream through Gull Rapids between June 27 and July 4, 2012. This fish was detected in Gull Lake until 2013, but has not been located since (Appendix A3-23).
  - This fish is now considered missing and is not discussed in the remainder of the report.

Four fish have moved downstream through Gull Rapids into Stephens Lake:

- #16048 was tagged in Gull Lake on June 7, 2011. It moved upstream into Clark Lake in 2013, where it remained for over one year before moving downstream through Gull Rapids on June 28, 2015. It has remained in Stephens Lake since 2015 (Appendix A2-6).
- #16060 was tagged in Gull Lake on June 21, 2011. It was detected exclusively within the upper basin of Gull Lake between 2011 and 2016. It moved downstream through Gull Rapids and was detected in Stephens Lake on July 2, 2016. It has remained in Stephens Lake since 2016 (Appendix A2-14).
- #16076 was tagged in Gull Lake on June 6, 2011. It moved downstream through Gull Rapids between June 6 and 9, 2017. It has remained in Stephens Lake since 2017 (Appendix A2-30).
- #32174 was tagged in Gull Lake on June 18, 2014. It moved downstream through Gull Rapids into Stephens Lake on August 6, 2016. It has remained in Stephens Lake since 2016 (Appendix A2-32).

In summary, 62 adult Lake Sturgeon were tagged upstream of the Keeyask GS between 2011 and 2019. Six fish are considered missing, four fish moved downstream into Stephens Lake, six moved upstream from Stephens Lake. Of the six that moved upstream into Gull Lake, two returned to Stephens Lake, one was harvested, and one is considered missing.. Therefore, a total of 54 tagged sturgeon were available to be detected upstream of the Keeyask GS during winter 2019/2020.

#### **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 ( $n = 7$ ) (Table 1). An additional 25 tags were applied in spring 2019 to replace the tags originally applied in 2011 that will expire in spring, 2021. This will allow for tracking through the end of construction into operation of the GS.

Five tags are considered missing due to a lack of detections:

- #16018 moved downstream immediately after being tagged on June 13, 2012. It was last detected on July 2, 2012, immediately upstream of Kettle GS (Appendix A3-1).
- #16024 moved downstream immediately after being tagged on June 13, 2012. It was last detected in Stephens Lake on June 25, 2012 (Appendix A3-6).
- #16044 moved downstream immediately after being tagged on June 9, 2011. It subsequently moved back upstream and was last detected in upper Stephens Lake on September 17, 2012 (Appendix A3-22).
- #16047 moved downstream immediately after being tagged on June 26, 2011. It was last detected in Stephens Lake on June 28, 2011 (Appendix A3-24).



- #32170 was tagged immediately downstream of Gull Rapids on June 11, 2014. It was regularly detected moving throughout Stephens Lake until October 30, 2016 (Appendix A3-32).
  - This fish was captured twice during adult Lake Sturgeon population monitoring conducted during spring 2018 (at the base of the Keeyask GS on June 4 and 8, respectively). Capture details can be found in Holm and Hrenchuk 2019. Due to its proximity to a receiver but lack of detections since 2016, it is likely that the tag was shed or has malfunctioned.

These five fish are not discussed in the remainder of the report.

Four fish are known to have moved downstream out of Stephens Lake through the Kettle GS into the Long Spruce reservoir. All four fish are considered missing (*i.e.*, have not been detected for over a year) and are not discussed in the remainder of the report.

- #16021 was tagged in Stephens Lake on September 28, 2011, and moved downstream through the Kettle GS on September 16, 2012. As the Kettle GS spillway was open on this day, it is unknown whether the Lake Sturgeon moved through the spillway or passed through a turbine. It was last detected in the Long Spruce reservoir on September 18, 2012. It was subsequently detected in the Limestone reservoir between August 1 and September 5, 2016 (Appendix A3-4).
- #16025 was tagged in Stephens Lake on June 15, 2012. It moved upstream into Gull Lake in 2012 but returned to Stephens Lake in 2014 (Section 4.1.1). This fish subsequently moved downstream through Kettle GS between June and July, 2014. The Kettle GS spillway was open during June and July 2014, so it is not possible to determine if the fish moved through either the turbines or spillway. It was last detected in the Long Spruce reservoir on July 14, 2014 (Appendix A3-7).
- #16034 was tagged in Stephens Lake on June 18, 2011, and moved downstream through the Kettle GS between October 9, 2012, and June 10, 2013. This fish must have passed downstream through one of the Kettle GS turbines as the spillway was closed between October 2012 and June 2013. It was detected in the Long Spruce reservoir in open-water 2015. It passed through the Long Spruce GS between July 6 and 30, 2016, therefore, it is not possible to determine if the fish moved through either the turbines or spillway. It was last detected within the Limestone reservoir between July 30, 2016 and June 19, 2017 (Appendix A3-15).
- #16035 was tagged in Stephens Lake on September 2011 and was last detected in Stephens Lake on June 2, 2018, immediately upstream of the Kettle GS. It was subsequently detected in the Long Spruce reservoir from June 15 to August 8, 2018 (Appendix A3-16). Because of the timing of this downstream movement, is not possible to determine if the fish moved through either the turbines or spillway.

Six fish have moved upstream out of Stephens Lake into Gull Lake (as discussed in Section 4.1.1); however, one of these fish (#16033) was captured by a local resource user and the tag

was reapplied to a fish in Stephens Lake (#16033b). Two (#16025 and #16037) returned to Stephens Lake in 2014; however, #16025 moved downstream through the Kettle GS into the Long Spruce reservoir (discussed above). An additional four fish (#16048, #16060, #16076, and #32174) initially tagged in Gull Lake moved downstream through Gull Rapids into Stephens Lake (Section 4.1.1).

To summarize, 61 adult Lake Sturgeon were tagged in Stephens Lake between 2011 and 2019. Five are considered missing, four moved downstream through Kettle GS, four moved upstream into Gull Lake and did not return to Stephens Lake (including one fish that was harvested), and four moved downstream from Gull Lake. Therefore, 52 fish were available to be detected in Stephens Lake during winter 2019/2020.

## 4.2 WINTER 2019/2020

### 4.2.1 UPSTREAM OF THE KEEYASK GS

The 2019/2020 winter receiver array consisted of five receivers deployed in the Nelson River between Clark Lake and the Keeyask GS at rkms -48.2, -45.0, -29.4, -12.4, and -10.3 (Figure 1). Four of the five acoustic receivers were retrieved; the near the outlet of Clark Lake (rkm -45.0) could not be located (Map 3).

Thirty-seven of the 54 adult Lake Sturgeon (69%) were located a total of 335,198 times (range: 3–40,570 detections per individual) (Appendix A1-1). Fish were detected on one to 177 days of the 206 day winter period (0–86% of the time) for an average of 61 days, or for 30% of the study period (standard deviation [StDev] = 54.8 days). The average movement range was 0.6 rkm (range 0.0–2.1 rkm) (Figure 4; Appendix A1-1).

Detections were logged at all four receivers (Figure 5):

- #114237 (Clark Lake; rkm -48.2) logged 65 detections by one fish;
- #125552 (downstream of Birthday Rapids; rkm -29.4) logged 25,662 detections by two fish;
- #127099 (upper Gull Lake; rkm -12.4) logged 27,058 detections by 17 fish; and
- #114244 (Gull Lake between upper and lower basins; rkm -10.3) logged 282,413 detections by 28 fish.

Individual movement graphs can be found in Appendix 2.

## 4.2.2 STEPHENS LAKE

Fifteen of the 16 receivers deployed in Stephens Lake during the 2019/2020 winter period were retrieved. The receiver located immediately upstream of the Kettle GS (at rkm 40.0) was lost.

Forty-eight of 52 fish (92%) were located a total of 1,426,037 times (range: 4–55,567 detections per individual) (Appendix A1-2). On average, fish were detected for 146 days of the 206 day winter period (71%) (range: 1–204 days). The farthest upstream detections occurred at rkm 5.2 (by 38 fish; 79%), while the farthest downstream occurred at rkm 36.1 (by two fish; 4%) (Appendix A1-2). The average movement range was 6.6 rkm (range 0.0–30.9 rkm) (Figure 6; Appendix A1-2).

### 4.2.2.1 MOVEMENTS

The majority of detections were logged by receivers located in the southern portion of Stephens Lake between rkm 5.2 and 13.9 ( $n = 1,254,790$ ; 88%; Figure 7). Movements were as follows:

- Twenty-eight fish (58% of all fish detected) were detected exclusively in the upstream portion of Stephens Lake, moving no farther downstream than rkm 10.3.
- Twenty moved between the upstream and downstream portions of Stephens Lake.
  - Ten (21%) moved as far downstream as rkm 13.9.
  - Five (10%) moved as far downstream as rkm 16.8.
  - Three (6%) moved as far downstream as rkm 18.6.
  - Two (4%) moved as far downstream as rkm 36.1.

Individual movement graphs can be found in Appendix 3.

## 4.3 OPEN-WATER 2020

All stationary acoustic receivers deployed upstream of the Keeyask GS ( $n = 29$ ), in Stephens Lake ( $n = 30$ ), and the Long Spruce ( $n = 3$ ) and Limestone ( $n = 2$ ) reservoirs during the 2020 open-water period were successfully retrieved (Maps 5 and 6).

Water temperature, as measured in the Nelson River mainstem, reached 8°C on June 6, 2020, and increased to 13°C by June 23 (Figure 3). Based on these water temperatures, the time between June 6 and 23 is referred to as the spawning period. Due to complications associated with conducting field work during the COVID-19 pandemic, the open-water receiver array was deployed after the spawning period (the entire array was in place by July 3, 2020). Because of this, there were no receivers located at known Lake Sturgeon spawning sites (*i.e.*, Birthday Rapids, the small set of rapids at the inlet of Gull Lake, or downstream of the Keeyask GS) during the spawning period.

### 4.3.1 UPSTREAM OF THE KEEYASK GS

Fifty-four adult Lake Sturgeon were available to be detected upstream of the Keeyask GS during the 2020 open-water period (Section 4.1.1). Forty-eight (89%) were detected between 281 and 60,063 times for 5–102 days of the 146 day open-water period (3–70% of the time). The average total movement range was 12.5 rkm (StDev = 8.1 rkm; range: 0.0–43.4 rkm) (Figure 8; Appendix A1-3). The farthest upstream detections occurred at the inlet of Clark Lake at rkm -48.2 (by three fish; 6%), while the farthest downstream occurred in lower Gull Lake at the receiver closest to the powerhouse (by two fish; 4%). No fish moved downstream through the Keeyask GS.

It is possible that the tags for the six fish that were not detected expired. The acoustic tag returned by a resource user described below (#16067) was expired when it was returned to NSC in September 2020. Of the six fish that were not detected:

- Three were last detected in Clark Lake at the end of the 2019 open-water period and likely moved upstream out of the study area.
  - #16058 was last detected near the outlet (rkm -44.5) on October 6, 2019 (Appendix A2-12).
  - #16063 was last detected near the outlet of the Assean River (rkm -46.9) on July 2, 2019 (Appendix A2-17).
  - #16067 was last detected near the outlet of the Assean River (rkm -46.9) on June 26, 2019 (Appendix A2-21).
    - This fish was captured by a local resource user approximately 50 km upstream near the Kelsey GS on June 16, 2020, and the tag was returned to North/South Consultants Inc.
- Three were last detected in the upper basin of Gull Lake.
  - #16054 was last detected on September 30, 2019, in Gull Lake at rkm -9.9 (Appendix A2-8).
  - #16061 was last detected on November 4, 2019, in Gull Lake at rkm -12.4 (Appendix A2-15).
  - #16070 was last detected on December 13, 2019, in Gull Lake at rkm -12.4 (Appendix A2-24).

#### 4.3.1.1 PROPORTIONAL DISTRIBUTION

Individual adult Lake Sturgeon spent a similar proportion of the open-water period in 2020 as in previous study years. Lake Sturgeon used Zones 4 (upper basin of Gull Lake) and 5 (lower basin of Gull Lake) most often, spending a total of 66% (StDev = 40%; range: 0–100%) and 21% (StDev = 35%; range: 0–100%) of the study period in these areas, respectively (Table 4;



Figures 9 to 11). Zones 1 (Clark Lake), 2 (river reach from Clark Lake to Birthday Rapids), and 3 (river reach from Birthday Rapids to Gull Lake) were used less frequently:

- Zone 1 at 1% (StDev = 8%; range: 0–56%);
- Zone 2 at 0.1% (StDev = 1%; range: 0–5%); and
- Zone 3 at 11% (StDev = 28%; range: 0–100%) of the study period before impoundment.

After reservoir impoundment in early September, adult Lake Sturgeon continued to spend a similar proportion of time in each river zone, using Zones 4 and 5 most often. After impoundment fish were detected in:

- Zone 1 for 4% of the time (StDev = 19%; range: 0–100%);
- Zone 2 for 0.2% of the time (StDev = 1%; range: 0–8%);
- Zone 3 for 6% of the time (StDev = 24%; range: 0–100%);
- Zone 4 for 66% of the time (StDev = 43%; range: 0–100%); and
- Zone 5 for 23% of the time (StDev = 37%; range: 0–100%).

#### **4.3.1.2 MOVEMENT PATTERNS**

During the 2020 open-water period, the majority of detections were logged in Gull Lake at or downstream of the boundary between upper and lower Gull Lake (rkm -10.1; n = 273,051; 72%) (Figure 12). As described in previous reports, individual Lake Sturgeon in this study area exhibit habitual movement patterns. In 2020, 41 of the 48 detected fish continued to display the same general pattern of movement observed in previous years:

- Thirty-three remained exclusively within Gull Lake, making multiple upstream and downstream movements, as far upstream as the inlet of the lake (rkm -19.5) and as far downstream as the receiver located closest to the Keeyask GS spillway (rkm -3.8).
- Five (#7026, #7064, #7066, #16056, and #16039) were located within Gull Lake for the majority of the study period but made distinct upstream movements to the receiver set closest to Birthday Rapids (rkm -29.4) during spring.
- Two (#16069 and #7021) remained within the riverine area between Birthday Rapids and Gull Lake (rkm -34.3 to -26.4).
- One (#16026) was largely located within the riverine area between Birthday Rapids and Gull Lake, but was briefly located further downstream early in the 2020 open-water period (June 26 to July 8). This fish displayed a similar pattern of movement in 2017.

Five fish displayed movements that differed from previous years:

- Two (#7017 and #7025) moved upstream over Birthday Rapids in open-water 2019. Neither repeated the movement during open-water 2020.
- #7033 moved upstream into Clark Lake prior to reservoir impoundment in 2020. It was tagged on June 5, 2019, in lower Gull Lake (rkm -8.6) and remained within the lake throughout the 2019 open-water period.
  - It was located in lower Gull Lake (between rkm -9.9 and -4.8) at the beginning of the 2020 open-water period. On July 21, 2020, it began to move upstream and was last located at the inlet of Clark Lake (rkm -48.2) on July 31, 2020.
- #16074 moved downstream from Clark Lake prior to reservoir impoundment in 2020. It moved upstream into Clark Lake in June 2015 where it was located for the next four years. On July 12, 2020, it moved downstream and was last located at the inlet to Gull Lake (rkm -19.5) on July 19.
- #7065 was located between the riverine area downstream of Birthday Rapids and Gull Lake during open-water 2019, but spent the entire 2020 open-water period within the upper basin of Gull Lake (between rkm -19.5 and -9.9).

The remaining two fish displayed long distance movements immediately after reservoir impoundment.

- #7022 was tagged on June 7, 2019 immediately downstream of Birthday Rapids (rkm -33.5). It remained in the riverine area between Birthday Rapids and Gull Lake during open-water 2019 and 2020.
  - It moved upstream through Birthday Rapids on September 6, 2020, immediately after reservoir impoundment. It was last detected at the inlet of Clark Lake on September 8, 2020.
- #7024 was tagged on June 8, 2019 immediately downstream of Birthday Rapids (rkm -33.5). It moved downstream to Gull Lake and was located between rkm -19.5 and -5.8 until September 2020.
  - It moved upstream on September 12, 2020, moving as far upstream as Birthday Rapids (rkm -33.8). It then returned to Gull Lake by September 15 and was located between rkm -9.9 and -10.1 until the end of the study period.

Individual movement graphs can be found in Appendix 2.

### 4.3.2 STEPHENS LAKE

Fifty-two adult Lake Sturgeon were available to be detected in Stephens Lake during the 2020 open-water period (Section 4.1.2). Fifty-one fish (98%) were detected between 41 and 27,308

times over 12–132 days of the 146 day study period (8–90% of the time; Appendix A1-4). Mean movement range was 15.9 rkm (StDev = 4.2 rkm; range: 6.7–30.8 rkm) (Figure 13; Appendix A1-4). The farthest upstream detections occurred immediately downstream of the Keeyask GS spillway at rkm 0.6 (by 21 fish; 41%), while the farthest downstream detections occurred in lower Stephens Lake at rkm 32.0 (by one fish; 2%) (Figure 13; Appendix A1-4).

The single fish not detected (#16032) was last located during winter 2018/2019 (on January 21, 2019) in upper Stephens Lake (rkm 7.9) (Appendix A3-13).

#### 4.3.2.1 PROPORTIONAL DISTRIBUTION

As in the majority of past study years (*i.e.*, 2013 and 2015–2019), Lake Sturgeon spent a larger proportion of the 2020 open-water prior to impoundment in the lower basing of Gull Lake (Zone 7), further from the GS. Lake Sturgeon used Zone 7 slightly more frequently than Zone 6 (the upper basin of Gull Lake), spending 55% (StDev = 26%; range: 6–100%), and 45% (StDev = 26%; range: 0–94%) of the time in each zone, respectively (Table 4; figures 9 and 14).

After reservoir impoundment in early September, Lake Sturgeon continued to use Zone 7 slightly more frequently than Zone 6, spending 60% (StDev = 39%; range: 0–100%), and 40% (StDev = 39%; range: 0–100%) of the time in each zone, respectively.

#### 4.3.2.2 MOVEMENT PATTERNS

As observed in 2017, 2018, and 2019, the majority of detections ( $n = 462,566$ ; 95%) were logged by receivers located in the southern portion of Stephens Lake between rkm 0.6 and 13.4 during the 2020 open-water period (Figure 15).

Two general movement patterns were displayed:

- Fourteen (#7035, #7036, #7038, #7046, #7047, #7048, #7060, #7062, #7063, #16033, #16043, #16048, #16060, and #32173) remained in the upstream portion of Stephens Lake, moving only as 13.9 rkm downstream of the Keeyask GS.
- Thirty-six fish moved farther downstream into Stephens Lake:
  - Thirty-three made regular upstream and downstream movements (closer and farther from the GS), moving as far downstream as rkm 18.8.
  - Three moved farther downstream into lower Stephens Lake. In 2019, all three fish moved only as far downstream as rkm 18.8.
    - #7044 displayed a single downstream movement to rkm 24.7 on July 5.
    - #7049 moved as far downstream as rkm 24.9 over two days (July 23 to 25) before returning upstream.

- #16031 has moved between rkm 0.6 and 18.6 since 2012, moving upstream during open-water and further downstream during winter. In 2020, it moved downstream as far as rkm 32.0 on July 28.

One fish displayed a long-distance movement following reservoir impoundment.

- #7037 was tagged near the Keeyask GS (rkm 1.3) on May 31, 2019. Since that time, it has largely remained in upper Stephens Lake, moving between rkm 1.2 and 10.3. Following GS commissioning on September 5, 2020, this fish moved as far downstream as rkm 18.8 (Appendix A5-3)

Individual movement graphs can be found in Appendix 3.

### 4.3.3 LONG SPRUCE RESERVOIR

Due to low water levels that prevented boat access downstream of the Kettle GS, no acoustic receivers were set in the Long Spruce reservoir between October 2017 and August 2020. Water levels were higher in 2020 than in previous sampling years, and receivers were set in the Long Spruce ( $n = 3$ ) and Limestone ( $n = 2$ ) reservoirs (Map 7). A single receiver deployed in the Long Spruce reservoir prior to winter 2017/2018 was retrieved. The battery was no longer active, but data was recorded from October 13, 2017, to August 15, 2019.

The movement of a single fish through the Kettle GS was confirmed with the retrieval of this receiver.

- #16035 was tagged in Stephens Lake on September 2011. It was last detected in Stephens Lake on June 2, 2018, immediately upstream of the Kettle GS at rkm 40.8. It was detected in the Long Spruce reservoir at rkm 45.7 from June 15 to August 8, 2018 (Appendix A3-16).

No adult Lake Sturgeon were detected by the two receivers deployed within the Long Spruce reservoir during the 2020 open-water period.

## 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<sup>1</sup> (September 5 to September 23, 2020) were calculated (Figures 16, 17, and 18). The overall likelihood of a movement (either upstream or downstream) between zones was 12.3% prior to construction, 14.0% during

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<sup>1</sup> Comparisons involve only 2.5 weeks of post-impoundment data compared to 23 weeks before construction and 124 weeks during construction.

construction, and 16.3% after reservoir impoundment (Figure 16). The likelihood of a fish moving upstream from one zone to another was 44.8% prior to the onset of construction, 45.1% during construction, and 42.9% after impoundment (Figure 17). The likelihood of a fish moving downstream from one zone to another was 55.2% before construction, 54.9% during construction, and 57.1% after impoundment (Figure 18).

## 4.5 MOVEMENTS THROUGH BARRIERS

Since the inception of the study in 2011, 12 movements through Gull Rapids have occurred: six upstream, and six downstream (Table 5).

- Four (#16029, #16033, #16038, and #16046) tagged in Stephens Lake moved upstream and remained upstream in Gull Lake.
- Four (#16048, #16060, #16076, and #32174) tagged in Gull Lake moved downstream into Stephens Lake and remained in Stephens Lake.
- Two (#16025 and #16037) tagged in Stephens Lake moved upstream into Gull Lake and then returned to Stephens Lake.

Additionally, four (#16021, #16025, #16034, and #16035) moved downstream through the Kettle GS. Two of these (#16021 and #16034) have since moved downstream through the Long Spruce GS.

Four downstream movements through Gull Rapids (#16060, #16048, #16076, and #32174) occurred following the start of Keeyask GS construction. Upstream movements through Gull Rapids have not been observed since 2013 and, since spillway commissioning in 2018, are no longer possible.

The likelihood of a fish moving through Gull Rapids (now the Keeyask GS), Kettle GS, or the Long Spruce GS was calculated both pre- and post-construction. Prior to construction, there was a 2.1% chance that a fish would move past the rapids or a generating station, compared to a 1.0% chance after the onset of construction (Figure 19). No long distance upstream or downstream movements through barriers were observed during the 19 days of monitoring following reservoir impoundment in 2020.



## 5.0 DISCUSSION

Adult Lake Sturgeon movement monitoring was initiated in 2011 to describe movements during the pre-construction (2011–2013), construction/commissioning (2014–ongoing), and operation 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 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 study area. During the 2020 open-water period, the majority of tagged fish remaining in the study area were located. Upstream of the Keeyask GS fish were detected for 46% of the 2020 open-water period (22–63% in previous years) and downstream in Stephens Lake fish were detected for 58% of the 2020 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.

Frequency of detection during winter is generally lower relative to the open-water period given that fewer receivers are used (only four upstream of the Keeyask GS and 15 in Stephens Lake were retrieved). Despite this, upstream of the Keeyask GS, 69% of fish tagged were detected for 30% of the winter 2019/2020 period. In Stephens Lake, receiver coverage is more extensive and, as a result, fish are detected more regularly (92% of fish tagged in Stephens Lake were detected for 71% of the 2019/2020 winter period).

In open-water 2020, the full array of acoustic receivers could not be deployed until July 3 due to complications associated with COVID 19. Therefore, receivers were not deployed at known spawning areas (*i.e.*, Birthday Rapids, a small set of rapids at the inlet of Gull Lake at rkm -19.5, and downstream of the Keeyask GS) during the spawning period. Because of this, spawning movements were not monitored in 2020.

### 5.2 KEY QUESTIONS

The AEMP identified key questions for adult Lake Sturgeon movement monitoring, three of which are relevant to the construction period (July 2014 to impoundment). Keeyask reservoir impoundment was completed on September 5 and monitoring was conducted for 19 days after GS impoundment. An additional key question presented in the AEMP is relevant to this period. Key questions are addressed below:

*Will disturbances associated with construction alter coarse-scale movements upstream and/or downstream of the construction site?*

Adult Lake Sturgeon movement patterns have changed little since the study began in 2011. Fish tend to display habitual movements, with a few fish making movements each year that do not fit into their previous patterns. Upstream of the Keeyask GS, fish continue to remain in distinct portions of the study area: a) Clark Lake; b) the riverine portion of the Nelson River between Birthday Rapids and Gull Lake; and c) Gull Lake. Within Stephens Lake, Lake Sturgeon tend to remain in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Some fish tend to remain in the upper portion of Stephens Lake, while others use both the upper and lower portions.

Based on the maximum likelihood analysis comparing data before construction, during construction, and immediately after reservoir impoundment to full supply level, the frequency of Lake Sturgeon movement between zones has not changed since construction began. The likelihood that an adult Lake Sturgeon would move between zones was similar, and generally low, during all time periods (12% before construction, 14% during construction, and 16% after impoundment). If a movement was made between zones, the likelihood of an upstream movement or a downstream movement was very similar. It should be noted that the reported period of post-impoundment monitoring was very brief and movements associated with impoundment may be observed during 2020/2021.

*Are sturgeon using habitat in the immediate vicinity of the construction site?*

Adult Lake Sturgeon continued to use the area upstream and downstream of the Keeyask GS construction site in 2020. Upstream, fish spent an average of 21% of the study period in lower Gull Lake. Two additional receivers were added to the receiver array during the 2020 open-water period to monitor movements in close proximity to the Keeyask GS. Receivers were deployed on the south side of the river at rkm -3.8 (near the spillway) and on the north side at rkm -2.2 (near the powerhouse). During open-water 2020, 11 fish (23%) were detected at the receiver closest to the spillway while two fish (4%) were briefly detected near the powerhouse. No fish moved downstream through the Keeyask GS during the 2019/2020 study period.

In Stephens Lake, fish spent an average of 45% of the study period within 5.0 rkm of the Keeyask GS. This was slightly lower compared to 2019 (51%), but likely reflects the lack of acoustic receivers in the area during the spawning period. Adult Lake Sturgeon have consistently spent more time closer to the Keeyask GS in spring, as the area downstream of the Keeyask GS is the only suitable spawning habitat for Lake Sturgeon in Stephens Lake. In 2020, no receivers were set in the area until early July, after the spawning period. Therefore, these movements were missed.

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

No adult Lake Sturgeon moved downstream through the Keeyask GS in 2020. Since the study began in 2011, six fish have moved downstream through Gull Rapids: two before construction began in 2014, and four after (figures 20 and 21). Six fish have moved upstream through Gull Rapids, all prior to construction. 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 marginally lower during construction (1.0%) than prior to construction (2.1%). The Keeyask GS spillway was commissioned in August 2018, after which upstream movement was no longer possible. No downstream movements have been observed since GS commissioning.

No adult Lake Sturgeon moved downstream through the Kettle GS in 2020. In total four fish have moved downstream through the Kettle GS, three prior to construction (in 2012 and 2014) and one during construction (in 2018). Data suggest that adult Lake Sturgeon prefer upper Stephens Lake and rarely use habitat in proximity to the Kettle GS.

*Will there be a statistically significant 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)?*

After the reservoir was impounded to full supply level, adult Lake Sturgeon tagged upstream of the GS continued to spend the greatest amount of time in both basins of Gull Lake (now the Keeyask reservoir). Prior to impoundment during the 2020 open-water period, Lake Sturgeon spend 66% of the time in Zone 4 and 21% in Zone 5. After impoundment, fish spent 66% of the time in Zone 4 and 23% of the time in Zone 5.

Two fish tagged upstream of the Keeyask GS displayed long distance movements immediately after impoundment, both moving upstream. One of the two fish moved as far upstream as Birthday Rapids before returning to the reservoir for the remainder of the open-water period. The second fish (one of 48 tagged fish [2%]) moved upstream through Birthday Rapids into Clark Lake and likely continued upstream out of the study area. The EIS predicted Lake Sturgeon may move away from the Keeyask reservoir in response to habitat disturbances associated with impoundment. It is not unusual for adult Lake Sturgeon to move upstream out of the study area. Before construction started, two fish (7% of tagged fish) moved from Gull Lake through Clark Lake, while twelve fish (19%) moved during construction. These initial observations are based on a very short period of record and further monitoring will identify if additional fish move upstream out of the reservoir following impoundment.

In Stephens Lake, during the 19 days of monitoring after impoundment, Lake Sturgeon continued to spend slightly more time in the area farther from the Keeyask GS. Prior to impoundment in 2020, Lake Sturgeon spent 55% of the time in Zone 7 and 45% of the time in Zone 6. After impoundment, Lake Sturgeon spent 60% of the time in Zone 7 and 40% of the time in Zone 6.

As discussed previously, movements of Lake Sturgeon were monitored for 19 days after reservoir impoundment. An array of acoustic receivers was deployed at the end of the open-water period to continue monitoring movements during the first winter following impoundment.

Continued monitoring will determine if movements change during the initial years post-impoundment.

## 6.0 SUMMARY AND CONCLUSIONS

- Acoustic telemetry continues to be an effective method for monitoring adult Lake Sturgeon movement and habitat use. In the Keeyask Study Area, movement monitoring is generally more effective during the open-water period relative to the winter period. Lake Sturgeon were detected for 46% of the open-water period and 30% of the winter period upstream of the GS. Lake Sturgeon are detected more in the winter in Stephens Lake because the receiver array is more extensive. In 2020, fish were detected for more of the winter period (71%) than the open-water (58%).
- Upstream of the Keeyask GS, individual fish continue to remain in distinct portions of the study area: a) Clark Lake; b) the riverine portion of the Nelson River between Birthday Rapids and Gull Lake; and c) Gull Lake.
- Within Stephens Lake, Lake Sturgeon tend to remain in the main river channel, specifically the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Some fish tend to remain in the upper portion of Stephens Lake, while others use both the upper and lower portions.
- The key questions described in the AEMP for adult Lake Sturgeon movement monitoring during construction and commissioning of the Keeyask GS were as follows:

- *Will disturbances associated with construction alter coarse-scale movements upstream and/or downstream of the construction site?*

Quantitatively and qualitatively, there have been no changes in adult Lake Sturgeon movement patterns since the onset of Keeyask GS construction.

- *Are adult sturgeon using habitat in the immediate vicinity of the construction site?*

During the 2020 open-water period, adult Lake Sturgeon continued to use the areas upstream and immediately downstream of the Keeyask GS.

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

No adult Lake Sturgeon moved downstream through the Keeyask GS between October 2019 and September 2020. Since the inception of study in 2011, twelve movements through Gull Rapids have occurred: six upstream and six downstream. All upstream movements occurred before construction began. The Keeyask GS spillway was commissioned in August 2018, after which upstream movements were no longer possible. Downstream movements occurred both before (two) and during (four) construction. No adult Lake Sturgeon moved downstream through the Kettle GS between October 2019 and September 2020. Four fish have moved downstream



through the Kettle GS: three prior to construction and one during construction.

Data collected before construction began (2011–June 2014) suggest that the probability of moving through a barrier (either Gull Rapids or the Kettle GS) was 2.1%. Data collected after the onset of construction (July 2014–October 2019), suggest that the probability is slightly lower (1.0%). No fish moved through a barrier following impoundment in 2020.

- *Will there be a statistically significant 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)?*

Adult Lake Sturgeon tagged upstream of the GS continued to spend the greatest amount of time in the reservoir (previously Gull Lake) in the 19 days of monitoring after impoundment. Two fish displayed long distance movements, moving upstream out of the reservoir following impoundment. One moved as far upstream as Birthday Rapids and returned to the reservoir. One moved upstream into Clark Lake and likely continued to move upstream out of the study area. No fish moved downstream through the GS after impoundment.

Similar to the previous years of study, after reservoir impoundment, adult Lake Sturgeon in Stephens Lake continued to spend more time in the zone further from the GS than the zone closer to the GS. No Lake Sturgeon moved downstream through the Kettle GS.

- Movements of adult Lake Sturgeon were only monitored for 19 days after impoundment. An array of acoustic receivers were deployed at the end of the open-water period to continue monitoring movements during the first winter of GS operation. Continued monitoring will determine if movements change during the initial years post-impoundment.

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## **TABLES**



**Table 1: Number of acoustic transmitters applied, missing tags, immigrants and emigrants, and harvested adult Lake Sturgeon upstream of Gull Rapids and in Stephens Lake, indicating the number of fish remaining in the area at the end of each study period between June 2011 and September 2020.**

Year	Upstream of Gull Rapids <sup>1</sup>						Stephens Lake						
	Tags Applied	Missing Tags	In <sup>2</sup>	Out <sup>3</sup>	Harvest	# Active Tags	Tags Applied	Missing Tags	In <sup>4</sup>	Out (Gull Rapids) <sup>5</sup>	Out (Kettle GS) <sup>6</sup>	Harvest	# Active Tags
2011	30	-	1	-	-	31	19	-	-	1	-	-	18
2012	1	-	4	-	1	35	9	-	-	4	2	-	21
2013	0	-	1	-	-	36	1	-	-	1	-	-	21
2014	4	6	-	2	-	32	7	4	2	-	1	-	25
2015	0	6	-	1	-	31	0	4	1	-	-	-	26
2016	0	5	-	2	-	30	0	4	2	-	-	-	28
2017	0	5	-	1	-	29	0	4	1	-	-	-	29
2018	1	6	-	-	-	28	0	5	-	-	1	-	28
2019	26	6	-	-	-	54	25	5	-	-	-	-	52
2020	0	6	-	-	1	54	0	5	-	-	-	-	52

1. Referred to as the Keeyask GS after spillway commissioning in 2018.

2. Immigration from Stephens Lake.

3. Emigration to Stephens Lake.

4. Immigration from upstream of Gull Rapids.

5. Emigration to upstream of Gull Rapids.

6. Emigration to downstream of the Kettle GS.

**Table 2: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS between 2011 and 2020.**

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length(mm)	Total Length (mm)	Weight (g)
16026	19-Jun-12	17-Jun-22	100450	955	1070	7711
16036	5-Jun-11	2-Jun-21	74400	1313	1414	20185
16039	5-Jun-11	2-Jun-21	48596	1425	1530	27216
16042	5-Jun-11	2-Jun-21	74399	956	1060	8165
16045	10-Jun-11	7-Jun-21	77516	1379	1533	21773
16048	7-Jun-11	4-Jun-21	94396	967	1103	9299
16051	10-Jun-11	7-Jun-21	74394	1386	1510	24494
16054	6-Jun-11	3-Jun-21	74398	816	915	5023
16055	6-Jun-11	3-Jun-21	74396	872	974	6350
16056	10-Jun-11	7-Jun-21	77515	1020	1120	9526
16057	16-Jun-11	13-Jun-21	77509	900	1024	7711
16058	9-Jun-11	6-Jun-21	82631	867	953	6124
16059	16-Jun-11	13-Jun-21	64718	1260	1385	16783
16060	21-Jun-11	18-Jun-21	80188	1060	1170	10433
16061	21-Jun-11	18-Jun-21	77503	1305	1443	14515
16062	12-Jun-11	9-Jun-21	77510	1176	1284	12247
16063	11-Jun-11	8-Jun-21	77514	1124	1229	10660
16064	12-Jun-11	9-Jun-21	80370	1066	1148	9072
16065	12-Jun-11	9-Jun-21	77511	958	1058	7484
16066	20-Jun-11	17-Jun-21	77507	1310	1405	25855
16067	19-Jun-11	16-Jun-21	50826	1090	1210	11340
16068	19-Jun-11	16-Jun-21	80368	1140	1254	11794
16069	17-Jun-11	14-Jun-21	48909	1400	1570	32659
16070	16-Jun-11	13-Jun-21	77508	1072	1195	10886
16071	16-Jun-11	13-Jun-21	76484	1026	1133	7711
16072	21-Jun-11	18-Jun-21	77506	850	967	6350
16073	12-Jun-11	9-Jun-21	77512	1169	1284	15422
16074	13-Jun-11	10-Jun-21	94030	915	1016	6804
16075	10-Jun-11	7-Jun-21	50888	1610	1700	43092
16076	16-Jun-11	13-Jun-21	50808	1260	1375	19958
16077	10-Jun-11	7-Jun-21	80265	1143	1245	12247
32174	18-Jun-14	15-Jun-24	94117	1172	1296	17690
32175	18-Jun-14	15-Jun-24	105480	843	951	4082
32176	18-Jun-14	15-Jun-24	50853	1236	1370	22226
32177	18-Jun-14	15-Jun-24	105479	886	1001	5443
7017	08-Jun-19	05-Jun-29	114771	949	1160	7257
7018	05-Jun-19	02-Jun-29	114248	825	907	3629

**Table 2: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters upstream of the Keeyask GS between 2011 and 2020 (continued).**

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length(mm)	Total Length (mm)	Weight (g)
7019	05-Jun-19	02-Jun-29	76330	1172	1293	14061
7020	09-Jun-19	06-Jun-29	105417	1000	1112	5443
7021	06-Jun-19	03-Jun-29	91388	971	1080	7257
7022	07-Jun-19	04-Jun-29	114774	1020	1142	7257
7023	08-Jun-19	05-Jun-29	114770	955	1075	5897
7024	08-Jun-19	05-Jun-29	103456	953	1070	6350
7025	07-Jun-19	04-Jun-29	114773	902	1000	5443
7026	09-Jun-19	06-Jun-29	114769	1070	1173	8165
7027	09-Jun-19	06-Jun-29	50836	1280	1325	13154
7028	08-Jun-19	05-Jun-29	79711	1285	1413	17236
7029	09-Jun-19	06-Jun-29	114768	1135	1259	9525
7030	09-Jun-19	06-Jun-29	64705	1065	1167	9072
7031	08-Jun-19	05-Jun-29	114772	920	1040	6804
7032	09-Jun-19	06-Jun-29	101388	890	1000	4990
7033	05-Jun-19	02-Jun-29	114777	868	981	4990
7034	05-Jun-19	02-Jun-29	77504	968	1090	6577
7053	25-May-19	22-May-29	114648	866	994	4800
7056	25-May-19	22-May-29	64726	1217	1346	-
7059	25-May-19	22-May-29	86137	923	1042	6400
7061	05-Jun-19	02-Jun-29	114776	930	1058	5897
7064	29-May-19	26-May-29	114643	1016	1128	7938
7065	28-May-19	25-May-29	107113	1034	1145	8165
7066	29-May-19	26-May-29	91376	880	1010	5897
7067	29-May-19	26-May-29	46424	1317	1445	-

**Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters in Stephens Lake between 2011 and 2020.**

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length (mm)	Total Length (mm)	Weight (g)
16018	13-Jun-12	11-Jun-22	93923	1024	1145	8618
16019	13-Jun-12	11-Jun-22	93922	850	951	6577
16020	08-Jun-12	06-Jun-22	55557	992	1100	-
16021	28-Sept-11	25-Sept-21	91705	880	977	6804
16022	13-Jun-12	11-Jun-22	81628	810	900	5443
16024	13-Jun-12	11-Jun-22	74416	960	1081	8391
16025	15-Jun-12	13-Jun-22	80374	1120	2350	10433
16027	13-Jun-12	11-Jun-22	93921	894	991	6804
16028	13-Jun-12	11-Jun-22	93924	884	976	5216
16029	21-Jun-11	18-Jun-21	56202	1208	1316	16556
16030	21-Jun-11	18-Jun-21	56152	1004	1103	7711
16031	13-Jun-12	11-Jun-22	92925	906	1011	6804
16032	11-Jun-11	08-Jun-21	46892	1064	1159	11340
16033	18-Jun-11	15-Jun-21	74419	881	974	5443
16033b	16-Sept-13	14-Sept-23	103230	755	842	-
16034	18-Jun-11	15-Jun-21	74418	796	904	4082
16035	26-Sept-11	23-Sept-21	69868	941	1040	8165
16037	08-Jun-11	05-Jun-21	-9999	826	911	-
16038	12-Jun-11	09-Jun-21	74415	1116	1239	11793
16040	09-Jun-11	06-Jun-21	74411	1006	1105	8391
16041	26-Jun-11	23-Jun-21	74421	903	1001	7257
16043	10-Jun-11	07-Jun-21	88788	790	885	4536
16044	09-Jun-11	06-Jun-21	56208	1161	1296	14969
16046	11-Jun-11	08-Jun-21	74413	1085	1209	9979
16047	26-Jun-11	23-Jun-21	88789	920	1020	6577
16049	24-Sept-11	21-Sept-21	91174	1070	1182	10886
16050	13-Jun-11	10-Jun-21	74415	922	1041	6577
16052	26-Sept-11	23-Sept-21	69865	1190	1337	16329
16053	26-Sept-11	23-Sept-21	69867	919	1021	8618
32167	11-Jun-14	08-Jun-24	-9999	910	1015	4990
32168	11-Jun-14	08-Jun-24	94234	884	980	4990
32169	13-Jun-14	10-Jun-24	-9999	810	908	4082
32170	11-Jun-14	08-Jun-24	46844	1095	2000	9525
32171	13-Jun-14	10-Jun-24	-9999	880	976	4536
32172	13-Jun-14	10-Jun-24	86136	904	1050	5897
32173	13-Jun-14	10-Jun-24	-9999	842	936	4082

**Table 3: Tagging and biological information associated with adult Lake Sturgeon implanted with acoustic transmitters in Stephens Lake between 2011 and 2020 (continued).**

Tag ID	Date Tagged	Expiry Date	Floy Tag	Fork Length (mm)	Total Length (mm)	Weight (g)
7035	31-May-19	28-May-29	115802	1086	1206	9072
7036	31-May-19	28-May-29	100151	890	996	5897
7037	31-May-19	28-May-29	114626	896	994	5670
7038	31-May-19	28-May-29	114627	1032	1153	8618
7039	03-Jun-19	31-May-29	46844	1115	1230	11340
7040	03-Jun-19	31-May-29	114780	1050	1174	9072
7041	31-May-19	28-May-29	56152	1090	1211	10886
7042	03-Jun-19	31-May-29	114778	965	1074	6804
7043	15-Sept-19	12-Sept-29	116091	1060	1182	-
7044	31-May-19	28-May-29	88477	850	936	4536
7045	12-Sept-19	09-Sept-29	116010	830	921	4850
7046	14-Sept-19	11-Sept-29	91714	950	1100	-
7047	31-May-19	28-May-29	100162	830	917	4536
7048	03-Jun-19	31-May-29	69834	990	1114	9072
7049	03-Jun-19	31-May-29	114781	931	1035	6350
7050	01-Jun-19	29-May-29	114791	935	1043	6577
7051	03-Jun-19	31-May-29	50808	1371	1510	19504
7052	03-Jun-19	31-May-29	93921	980	1075	7938
7054	03-Jun-19	31-May-29	110710	1003	1123	8618
7055	01-Jun-19	29-May-29	114790	930	1040	5443
7057	03-Jun-19	31-May-29	115843	893	1021	5443
7058	03-Jun-19	31-May-29	115740	1135	1277	14515
7060	03-Jun-19	31-May-29	112911	820	910	3402
7062	03-Jun-19	31-May-29	110716	1065	1181	12020
7063	03-Jun-19	31-May-29	101041	830	951	4536



**Table 4: Average proportion of time spent in each river zone by adult Lake Sturgeon tagged upstream of the Keeyask GS and 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), and 2020 (July 3 to September 23) open-water periods. Data is divided into fish tagged in 2011, 2019, and all tagging years combined.**

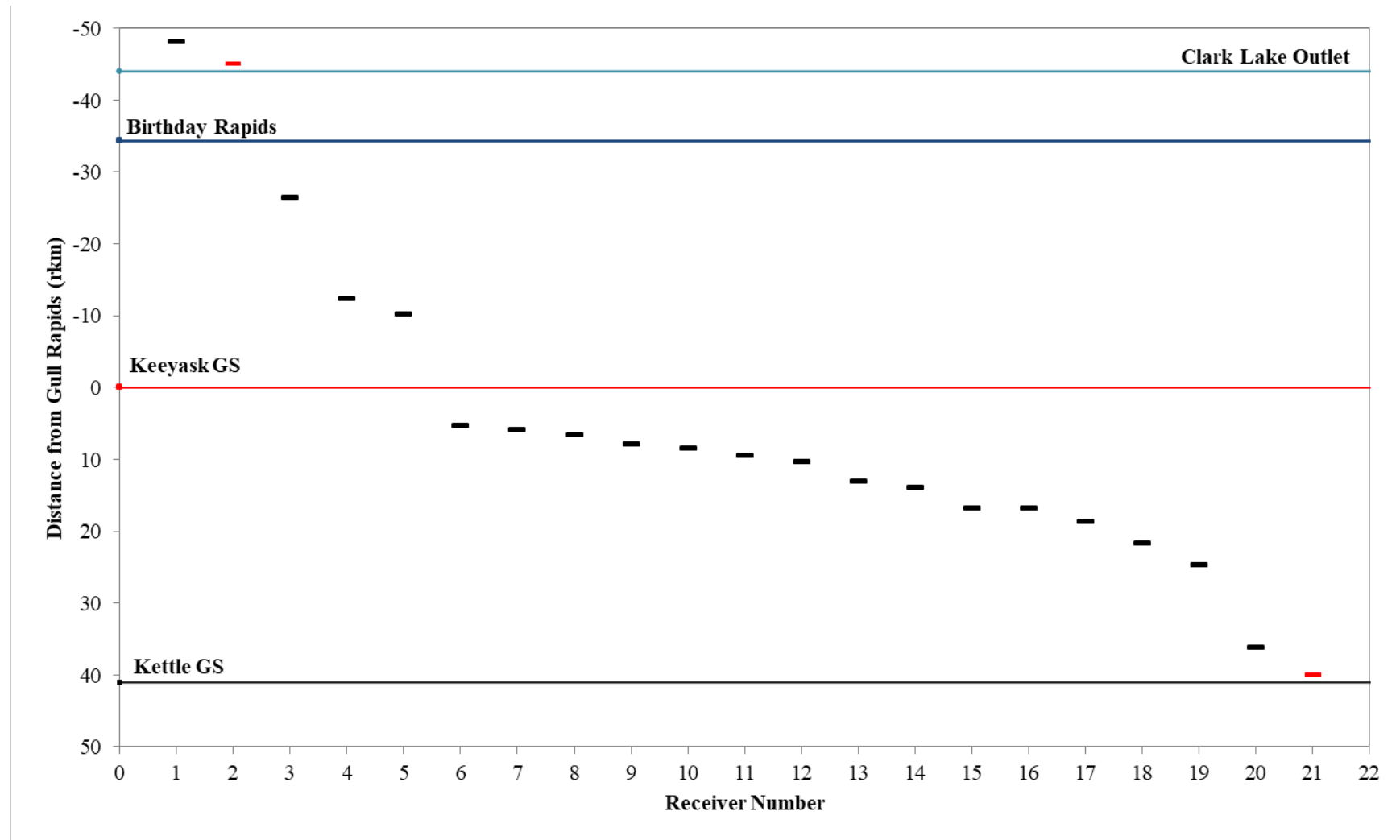
Tagging Year	Study Year	Upstream of Gull Rapids					Stephens Lake	
		1	2	3	4	5	6	7
2011	2013	6.4	0.1	12.4	72.5	8.6	45.0	55.0
	2014	9.0	0.1	10.8	52.3	27.7	38.2	61.8
	2015	4.7	0.1	9.9	43.6	41.7	55.6	44.9
	2016	7.3	0.1	12.1	56.5	24.1	41.8	59.2
	2017	5.3	0.0	10.7	62.6	21.4	47.6	52.9
	2018	7.4	0.1	14.8	48.5	29.2	47.4	53.3
	2019	15.2	0.0	10.0	50.2	24.6	48.5	51.9
	2020	0.5	0.0	10.3	59.7	29.5	42.7	59.5
2019	2019	0.4	0.2	12.3	73.8	13.3	53.6	46.4
	2020	3.3	0.2	9.5	72.0	15.0	48.1	51.9
All	2019	7.8	0.1	11.1	62.0	19.0	50.6	49.4
	2020	2.0	0.1	9.9	66.2	21.8	44.2	55.8

**Table 5: Number of Lake Sturgeon tagged with acoustic and radio tags that moved upstream or downstream through Gull Rapids during studies conducted in 2001–2004 and 2011–2020.**

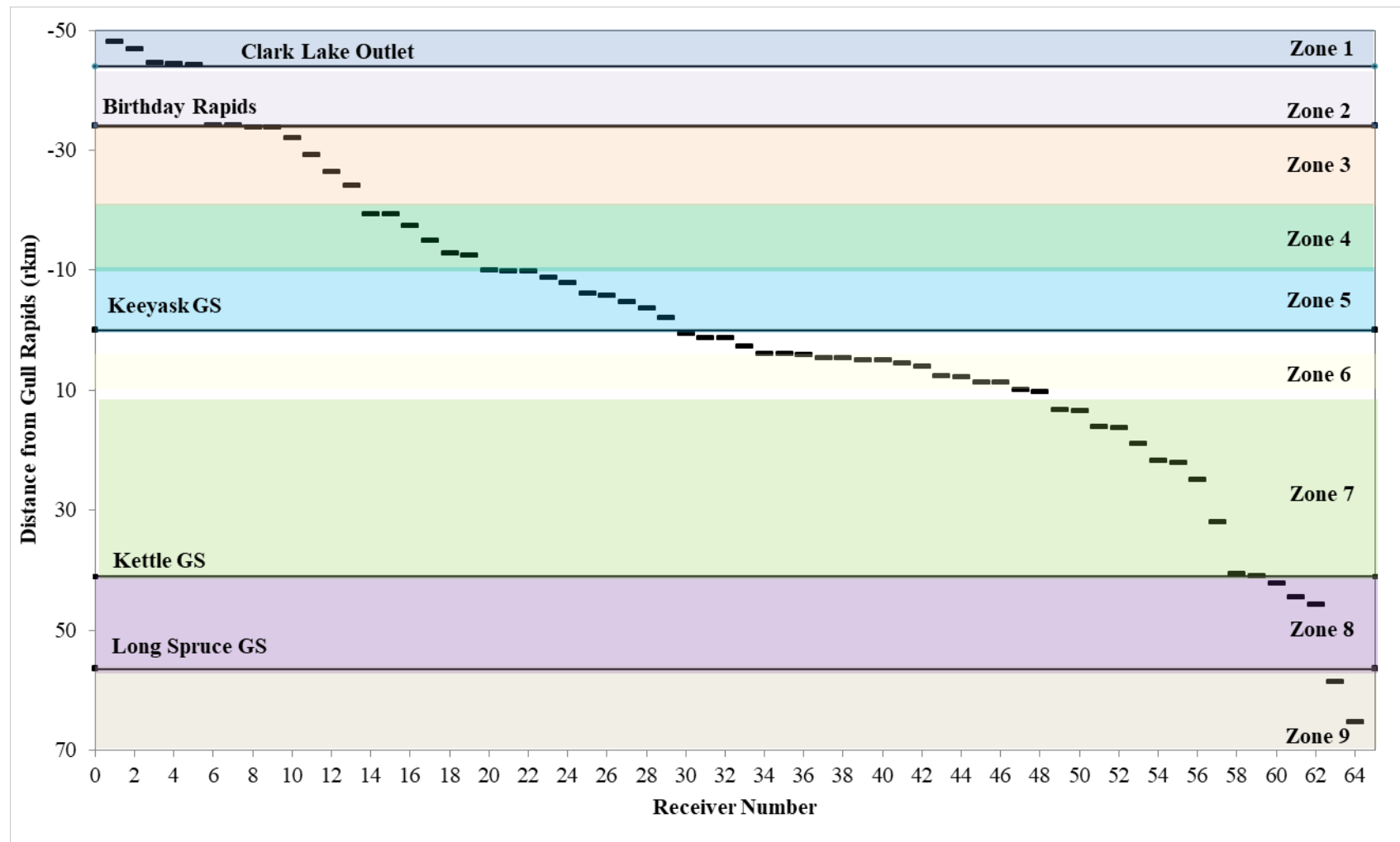
Life Stage	Year <sup>1</sup>	# Tagged Fish		# Fish Detected		Downstream Movements			Upstream Movements			Total # Move	% Tagged Fish Moved	% Detected Fish Moved
		U/S <sup>2</sup>	D/S <sup>3</sup>	U/S	D/S	#	% total	% detected	#	% total	% detected			
<b>Adult<sup>4</sup></b>	2001	21	11	21	11	1	4.8	4.8	0	0.0	0.0	1	3.1	3.1
	2002	19	12	19	10	0	0.0	0.0	3	25.0	30.0	3	9.7	10.3
	2003	21	9	20	4	1	4.8	5.0	0	0.0	0.0	1	3.3	4.2
	2004	19	9	16	4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2011	30	19	28	19	0	0.0	0.0	1	5.3	5.3	1	2.0	2.1
	2012	32	27	30	27	0	0.0	0.0	4	14.8	14.8	4	6.8	7.0
	2013	35	22	28	19	0	0.0	0.0	1	4.5	5.3	1	1.8	2.1
	2014	34	24	33	24	2	5.9	6.1	0	0.0	0.0	2	3.4	3.5
	2015	32	25	28	25	1	3.1	3.6	0	0.0	0.0	1	1.8	1.9
	2016	32	26	29	26	2	6.3	6.9	0	0.0	0.0	2	3.4	3.6
	2017	30	28	26	27	1	3.3	3.8	0	0.0	0.0	1	1.7	1.9
	2018	28	28	28	28	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2019	54	53	54	51	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2020	54	52	48	51	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
<b>Juvenile<sup>5</sup></b>	2013	20	20	18	20	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2014	20	20	20	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2015	20	20	19	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2016	20	20	19	19	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2017	20	18	18	13	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2018	20	19	20	14	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
	2019	20	14	17	13	1	0.0	0.0	0	0.0	0.0	1	0.03	0.03
	2020	19	13	17	12	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

1. Includes data from the current study (2011–2020), 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).
2. Upstream of Gull Rapids (between Clark Lake and Gull Rapids).
3. Downstream of Gull Rapids (in Stephens Lake between Gull Rapids and the Kettle GS).
4. Refers to fish greater than 800 mm fork length.
5. Refers to fish less than 800 mm fork length.

## FIGURES

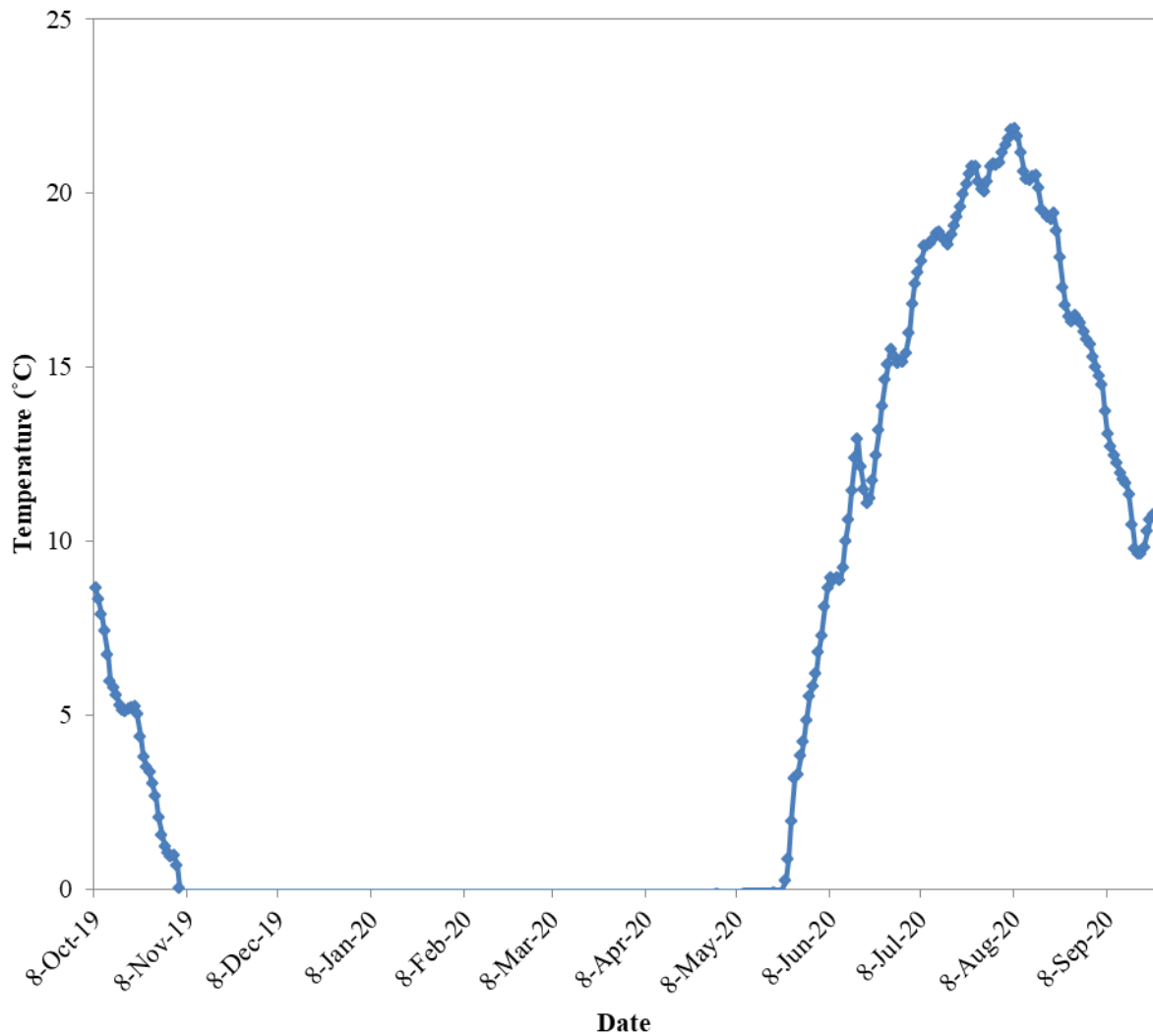


**Figure 1:** Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake and the Kettle GS between October, 2019 and June, 2020. A red dash indicates a receiver that was lost.

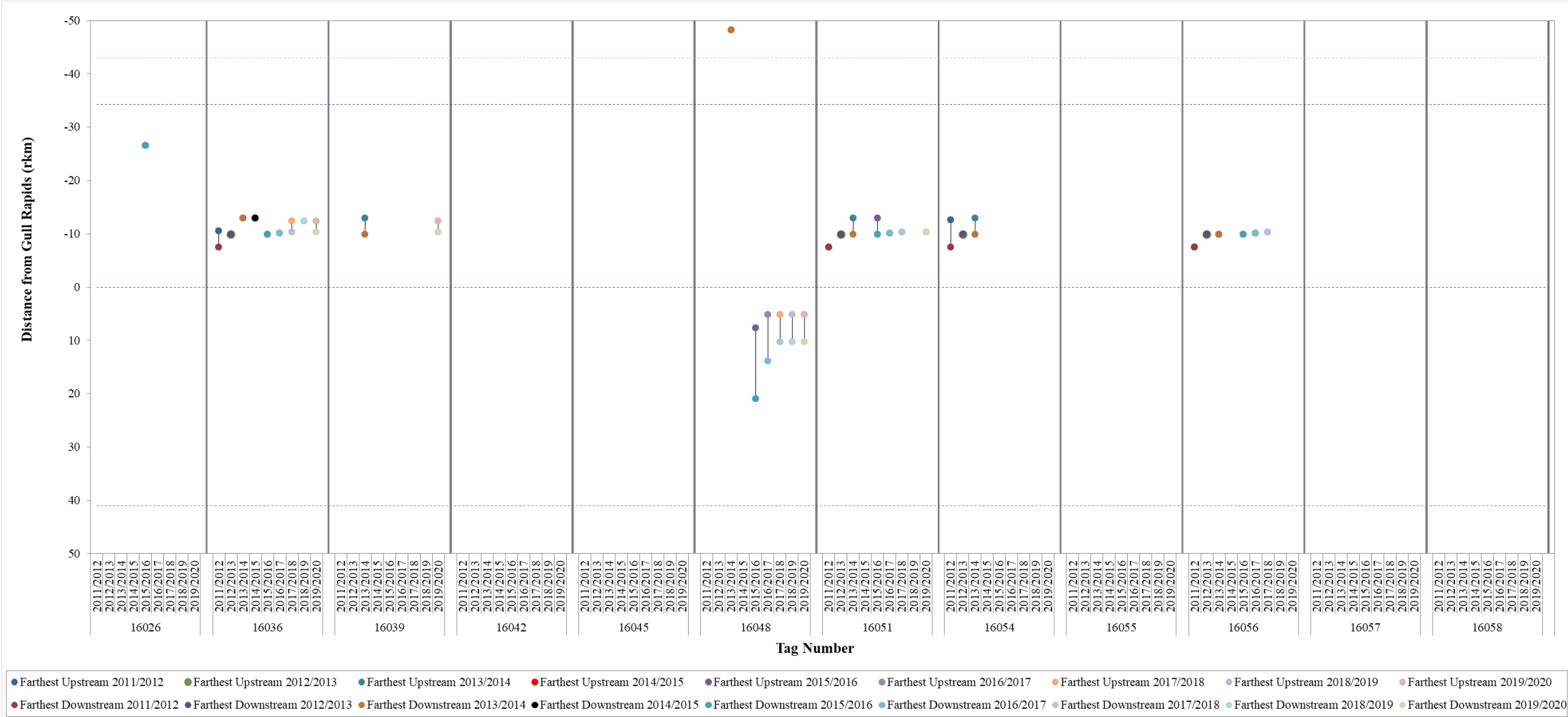


**Figure 2:** Locations of stationary acoustic receivers (dashes) in relation to the base of the Keeyask GS (rkm 0) and other major landmarks (lines) in the Nelson River between Clark Lake (zone 1) and the Limestone GS reservoir (Zone 9) between June and October, 2020. River zones upstream and downstream of Gull Rapids are indicated by shading.



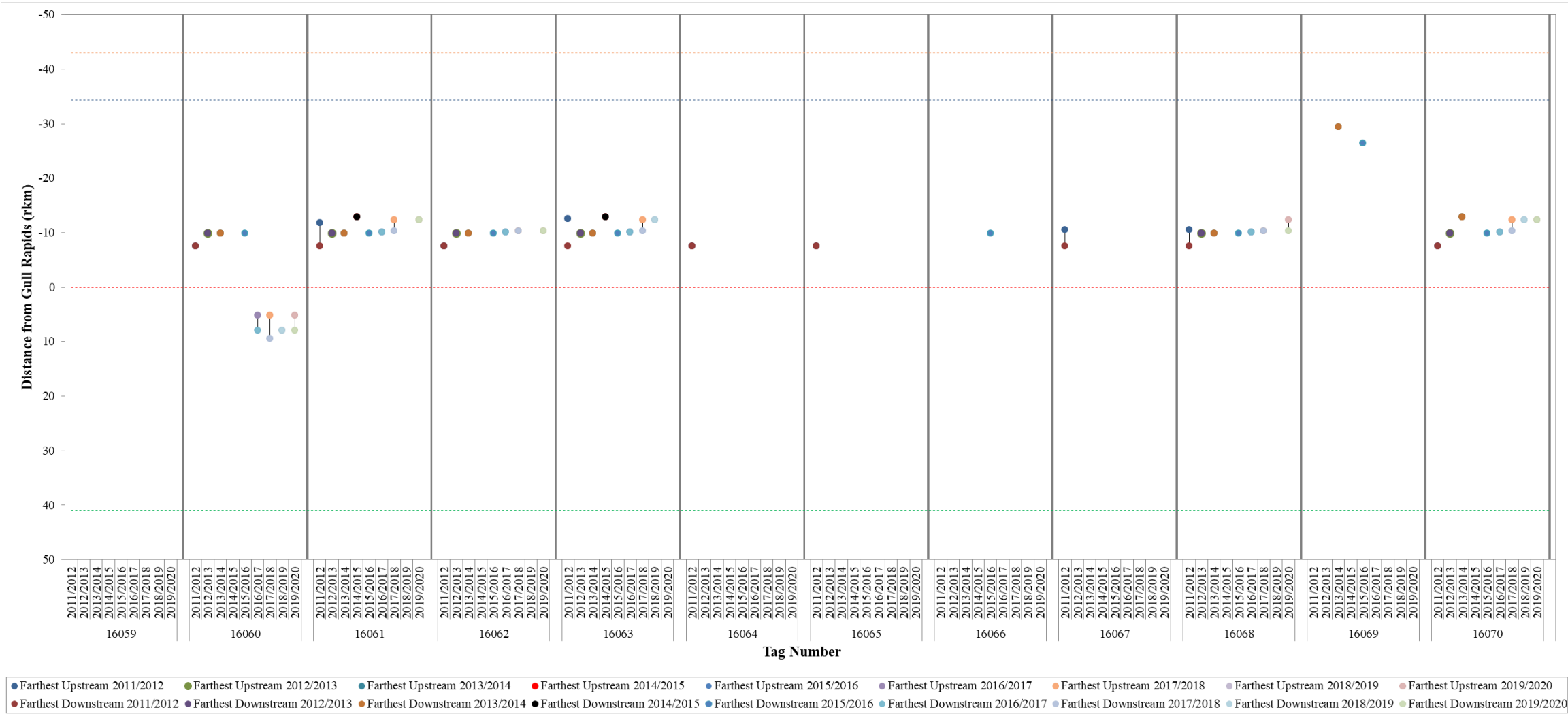


**Figure 3: Water temperature in the Nelson River mainstem from October 8, 2019, to September 23, 2020**

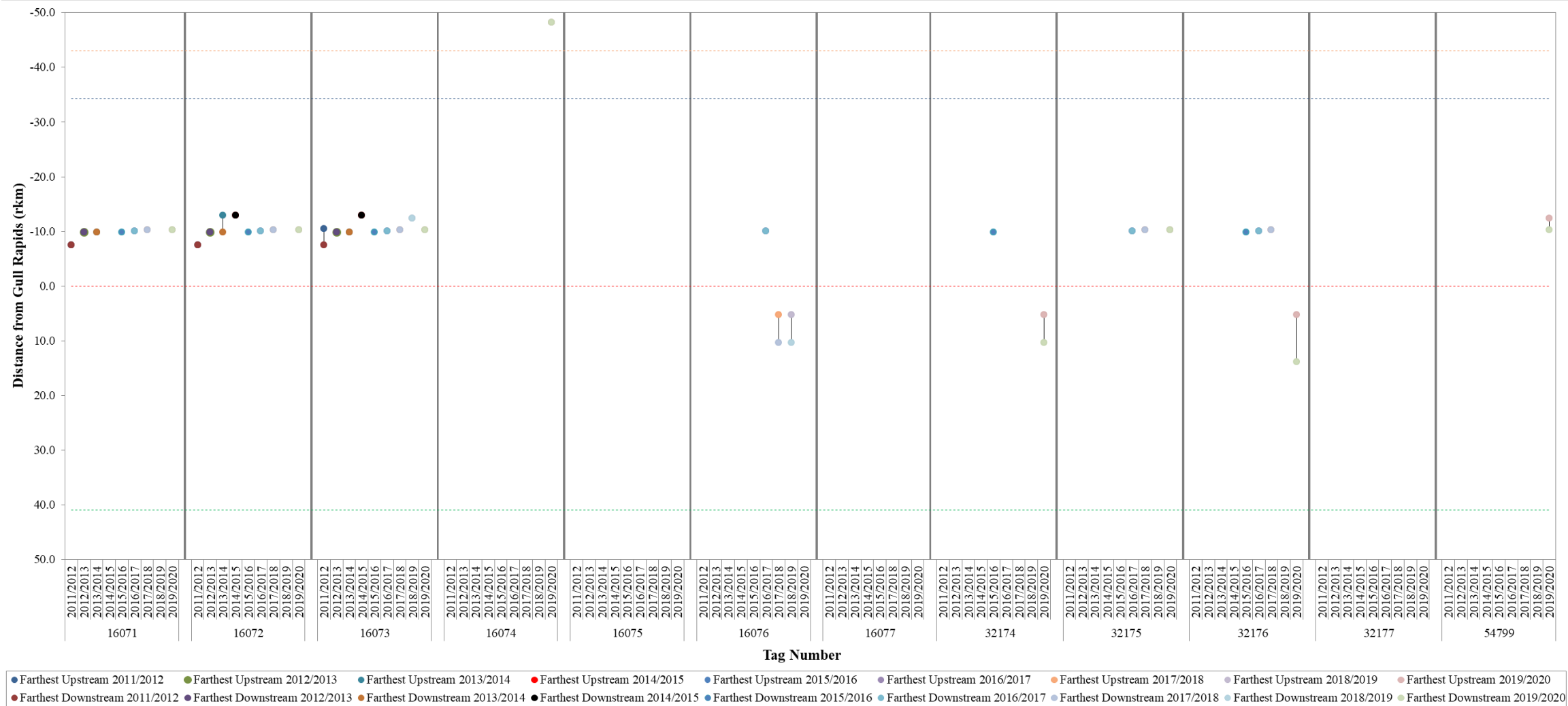


**Figure 4: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS).**



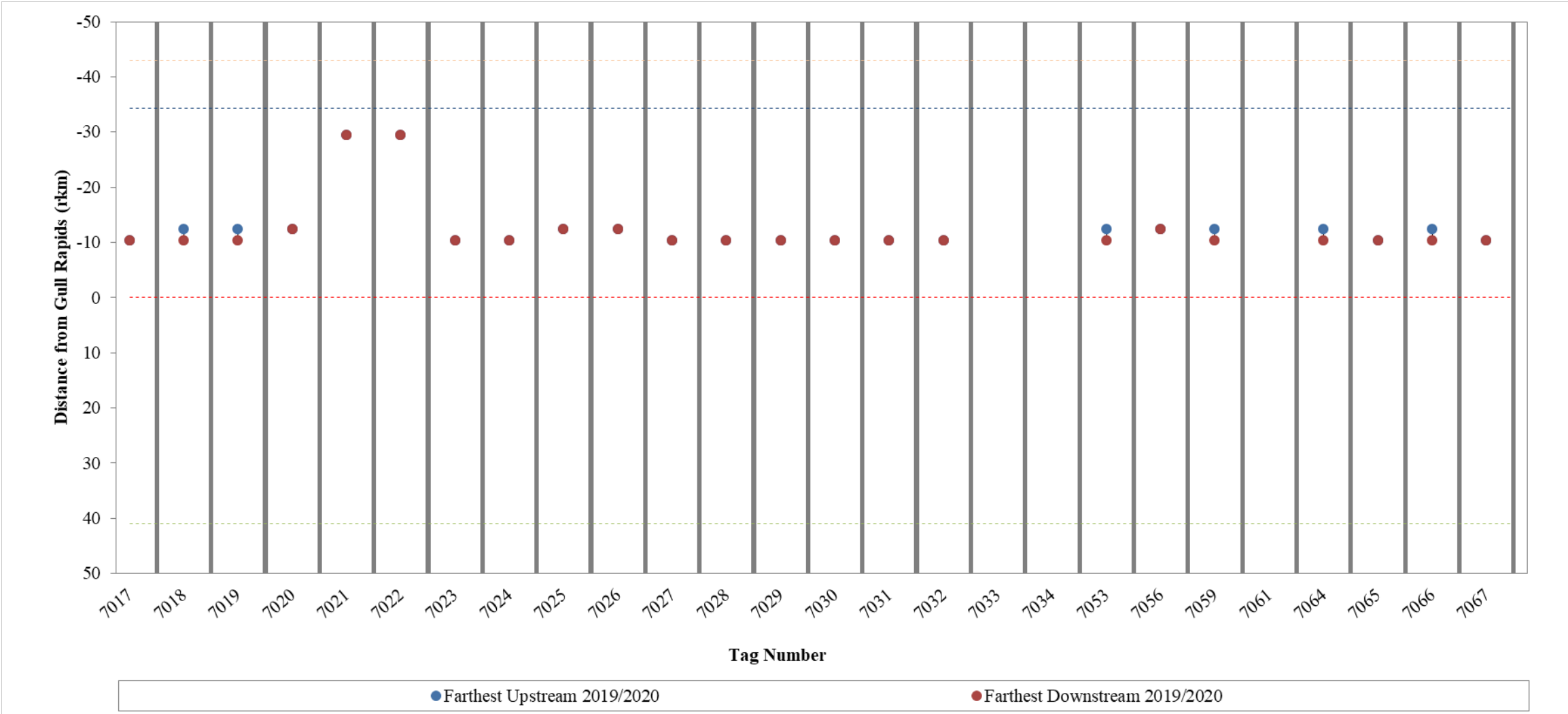


**Figure 4: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).**

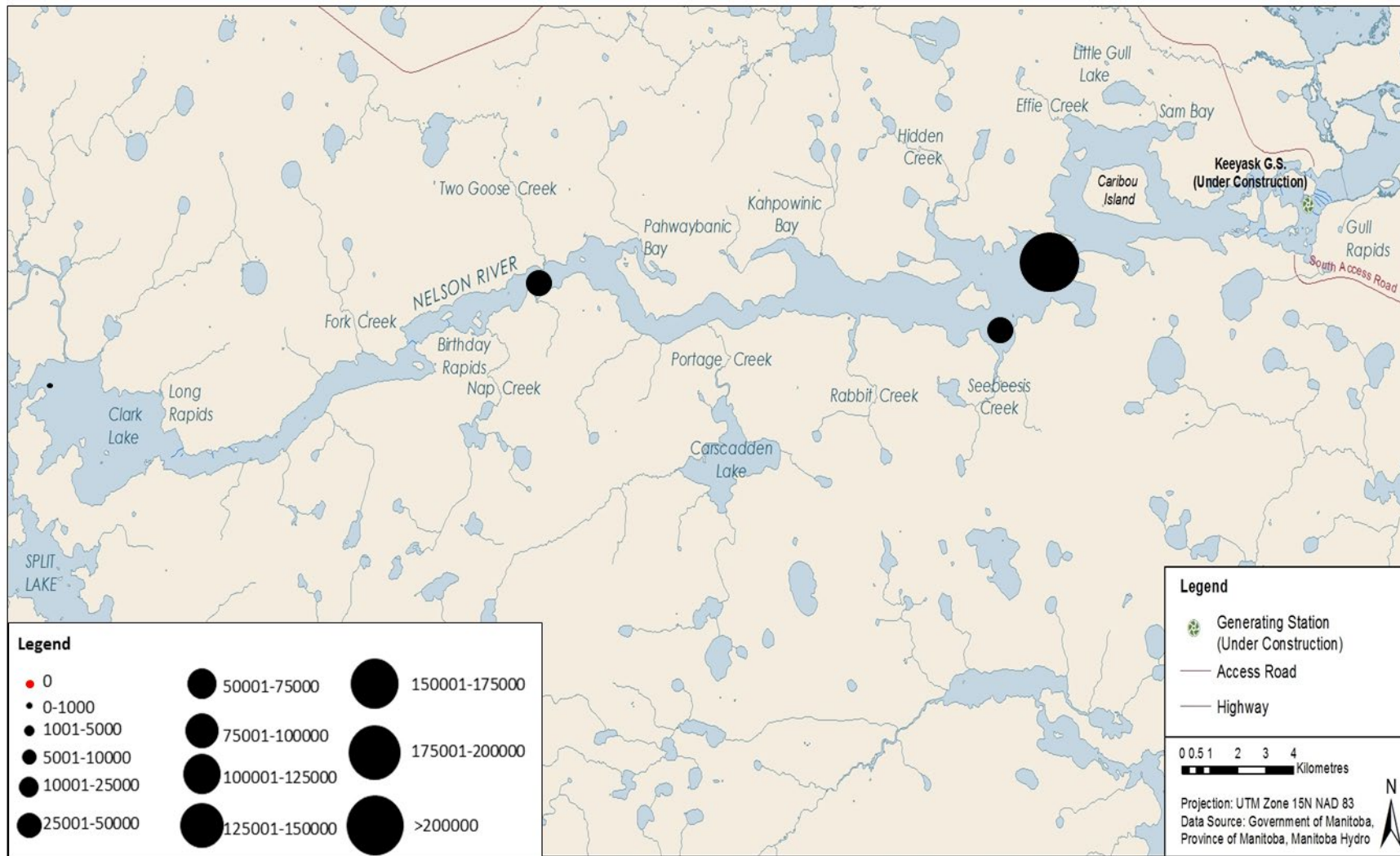


**Figure 4: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).**



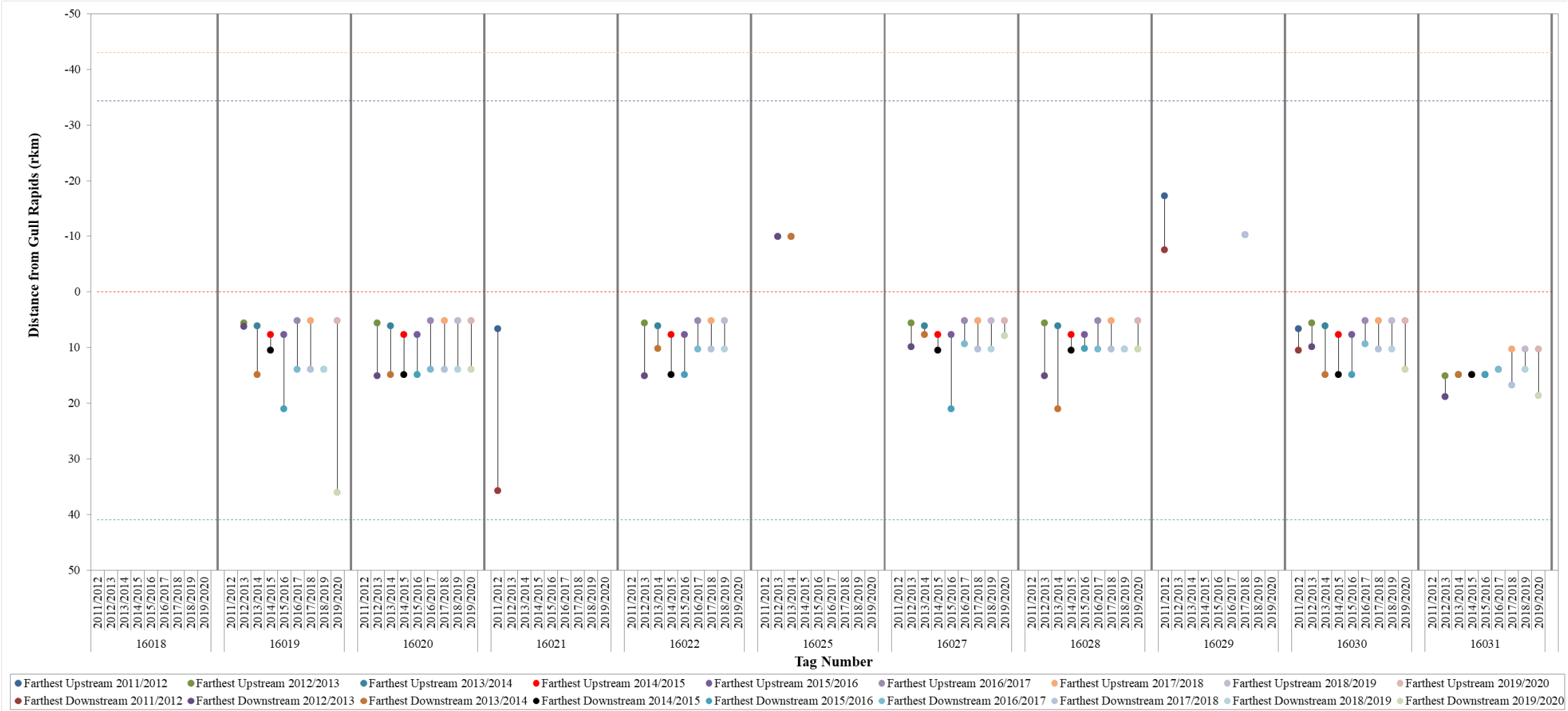


**Figure 4:** Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).

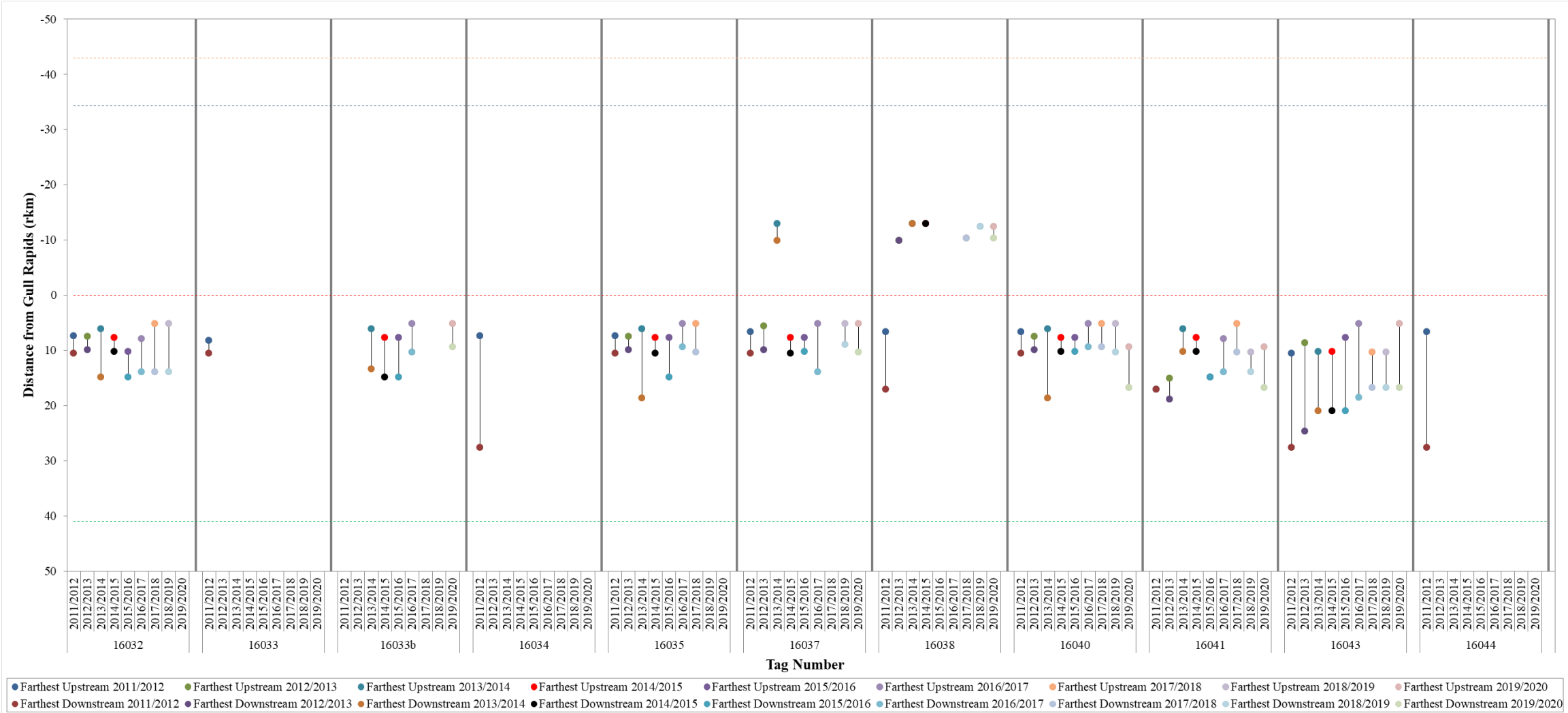


**Figure 5:** Relative number of detections at each acoustic receiver set between Clark Lake and the Keeyask GS during winter 2019/2020 (October 8, 2019, to April 30, 2020). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.



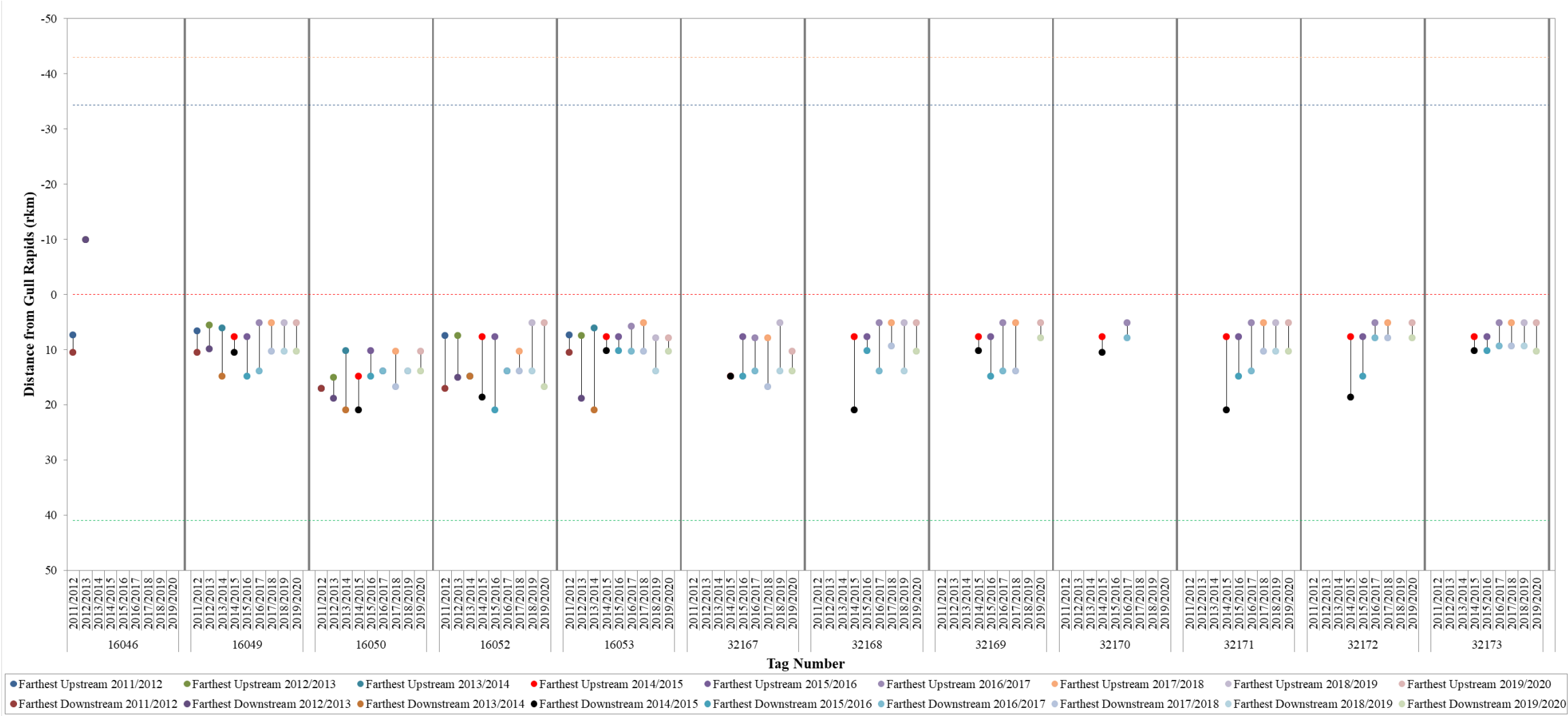


**Figure 6: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS).**



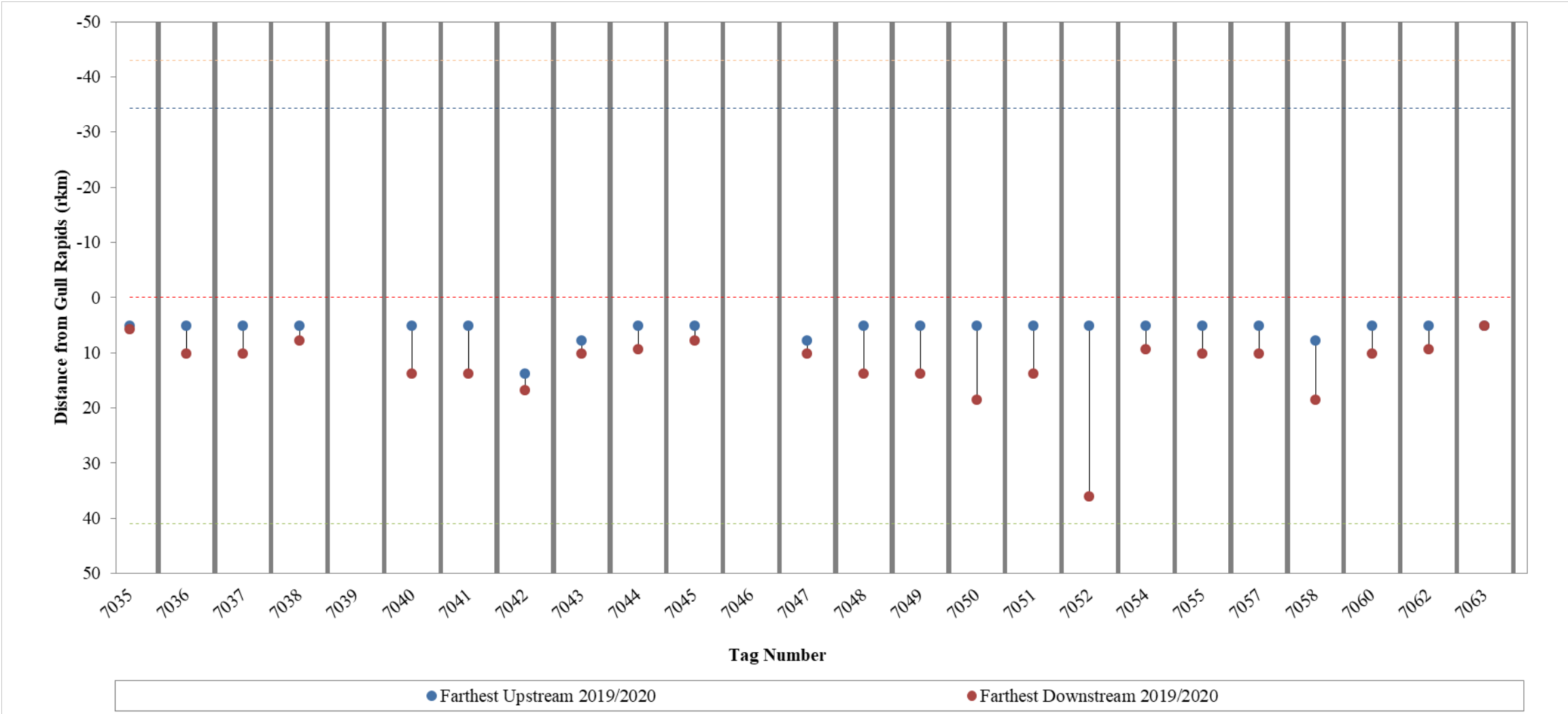
**Figure 6:** Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).



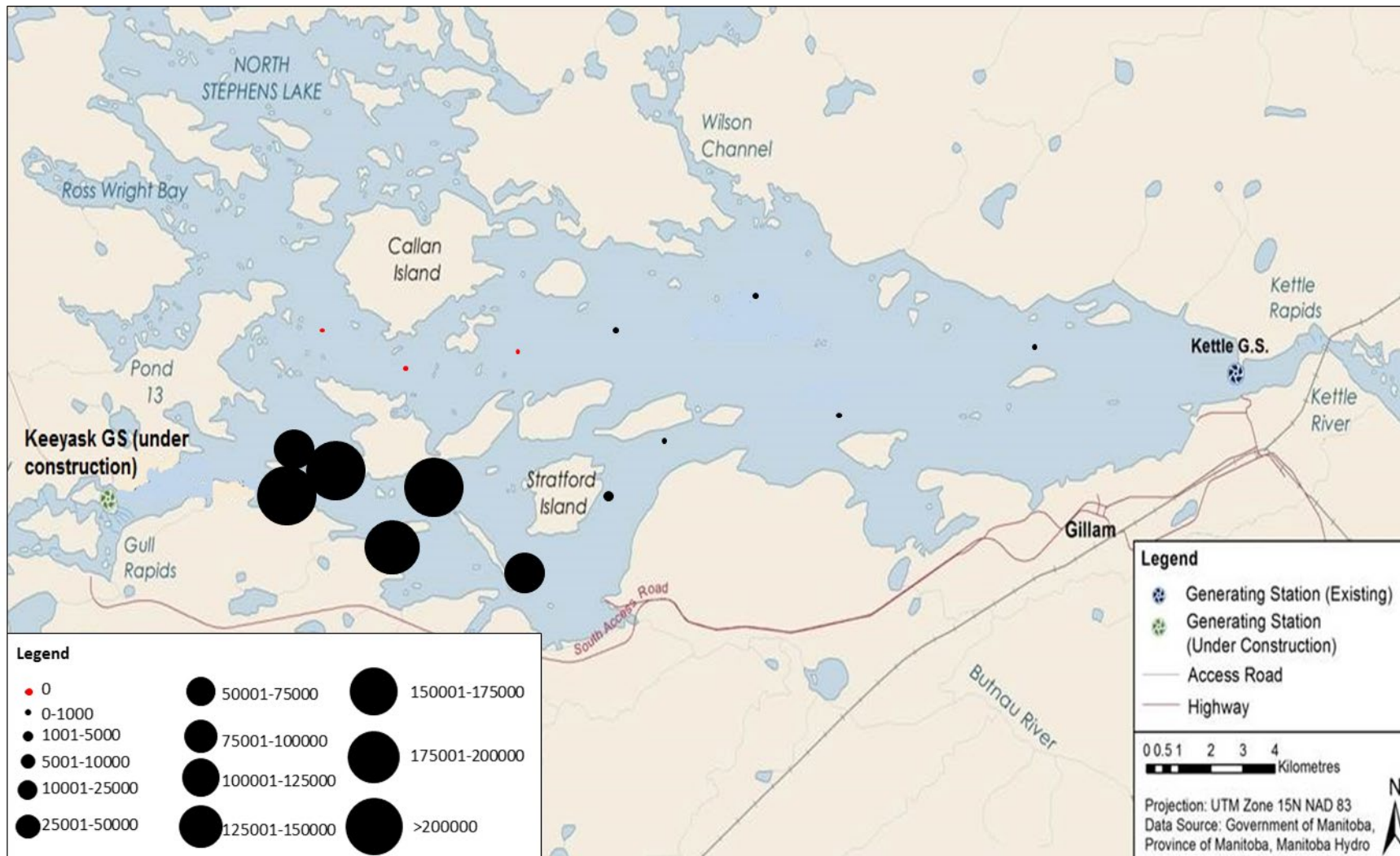


**Figure 6: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).**

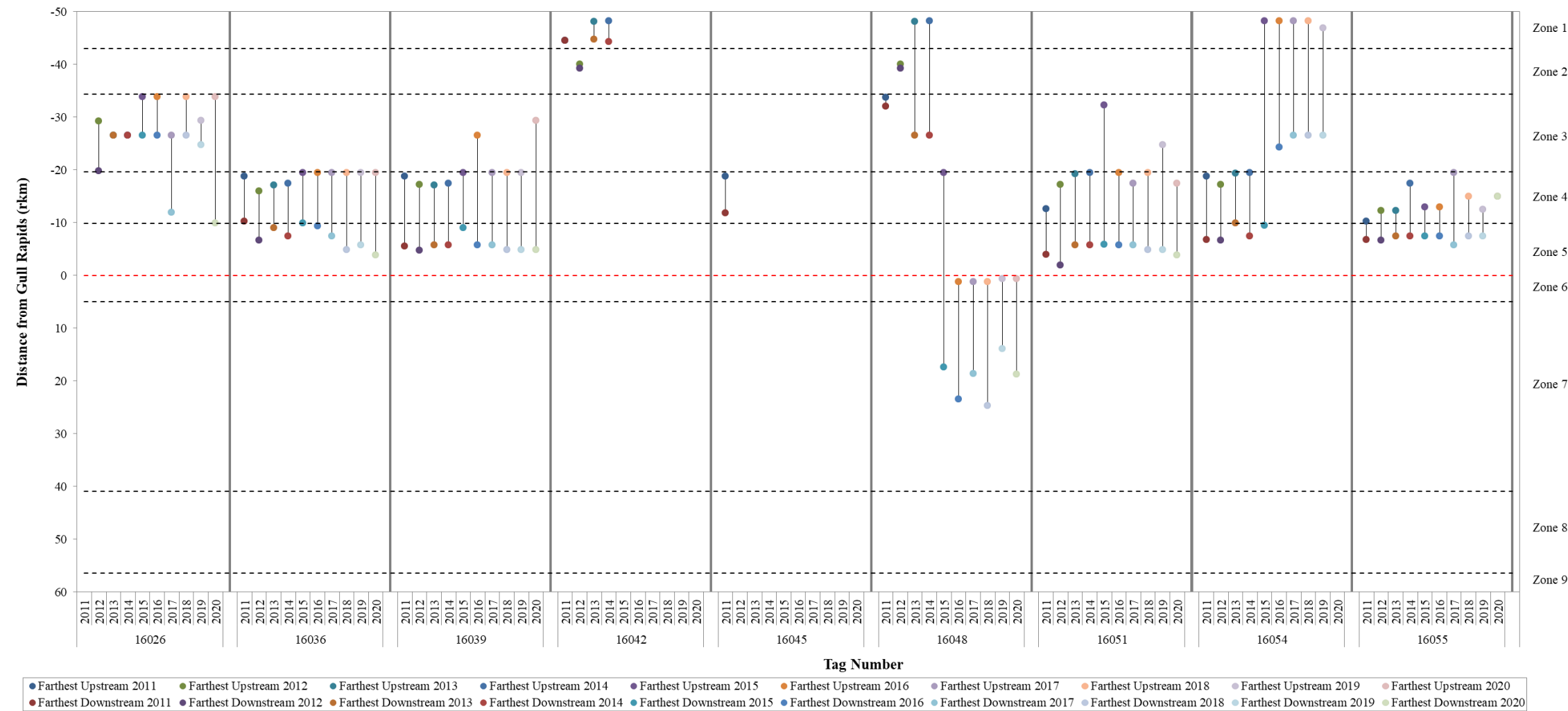




**Figure 6:** Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter period (2011–2020). Horizontal dotted lines indicate locations of landmarks (orange = Clark Lake outlet; blue = Birthday Rapids, red = Gull Rapids/the Keeyask GS; green = Kettle GS) (continued).

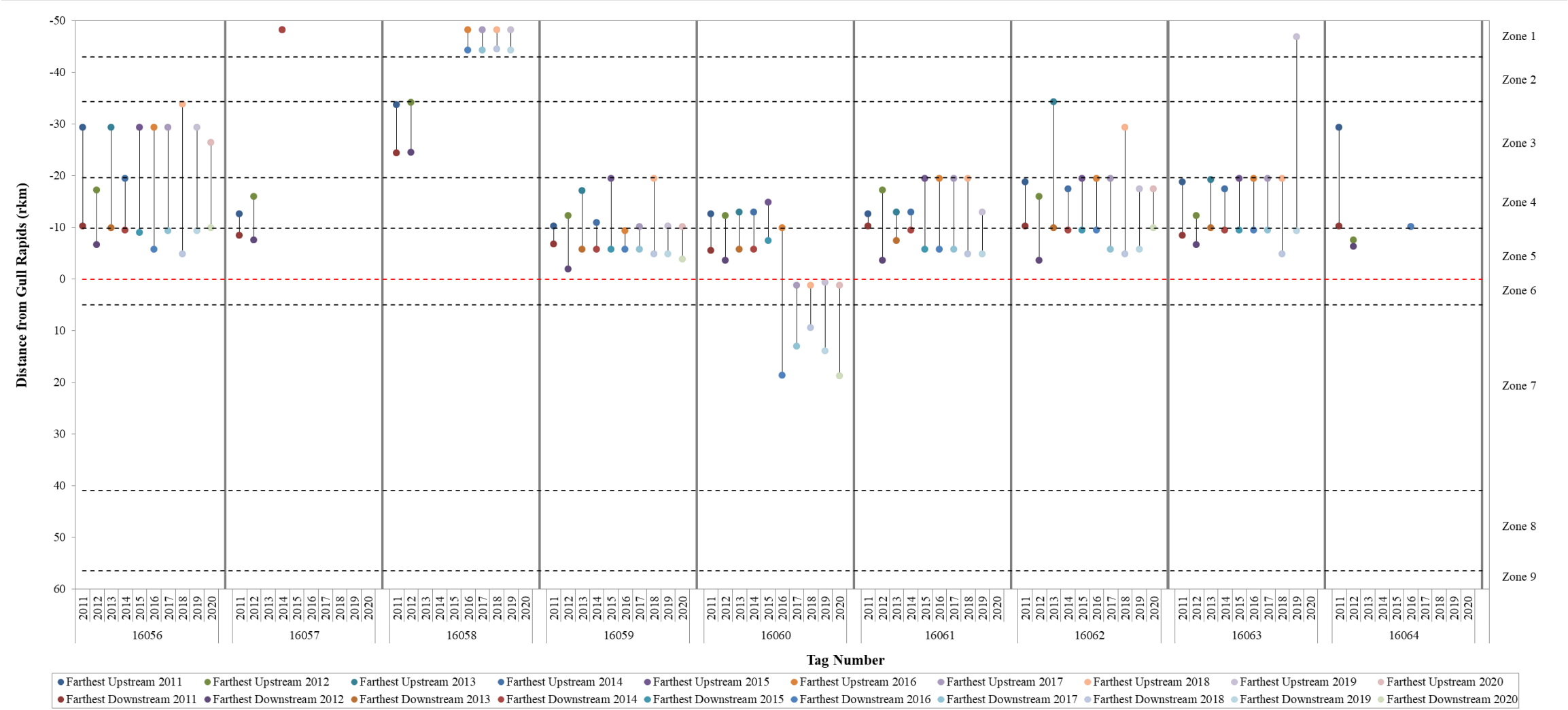


**Figure 7:** Relative number of detections at each acoustic receiver set in Stephens Lake during winter 2019/2020 (October 8, 2019, to September 23, 2020). Number of detections indicated by size of bubble (defined in legend). Receivers with no detections indicated with red dot.

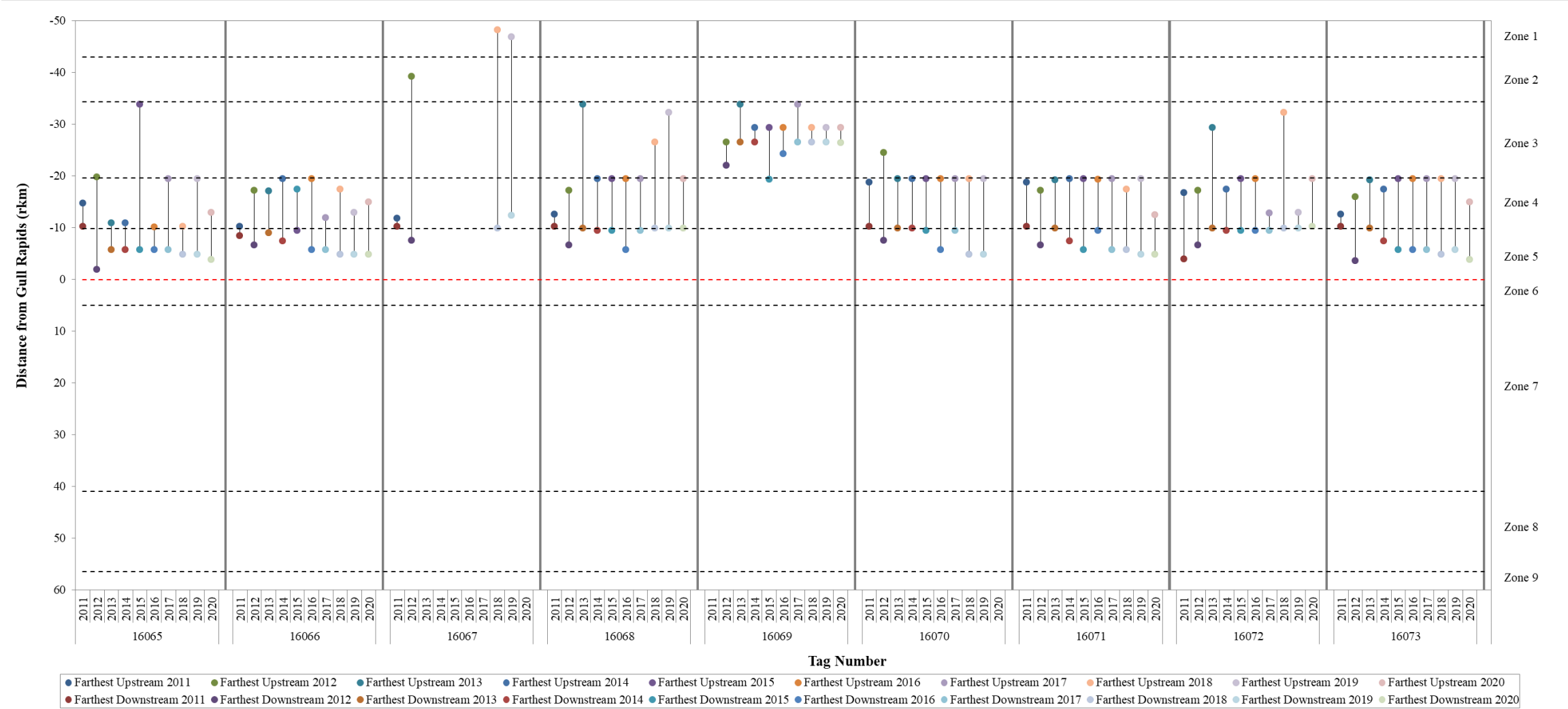


**Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.**

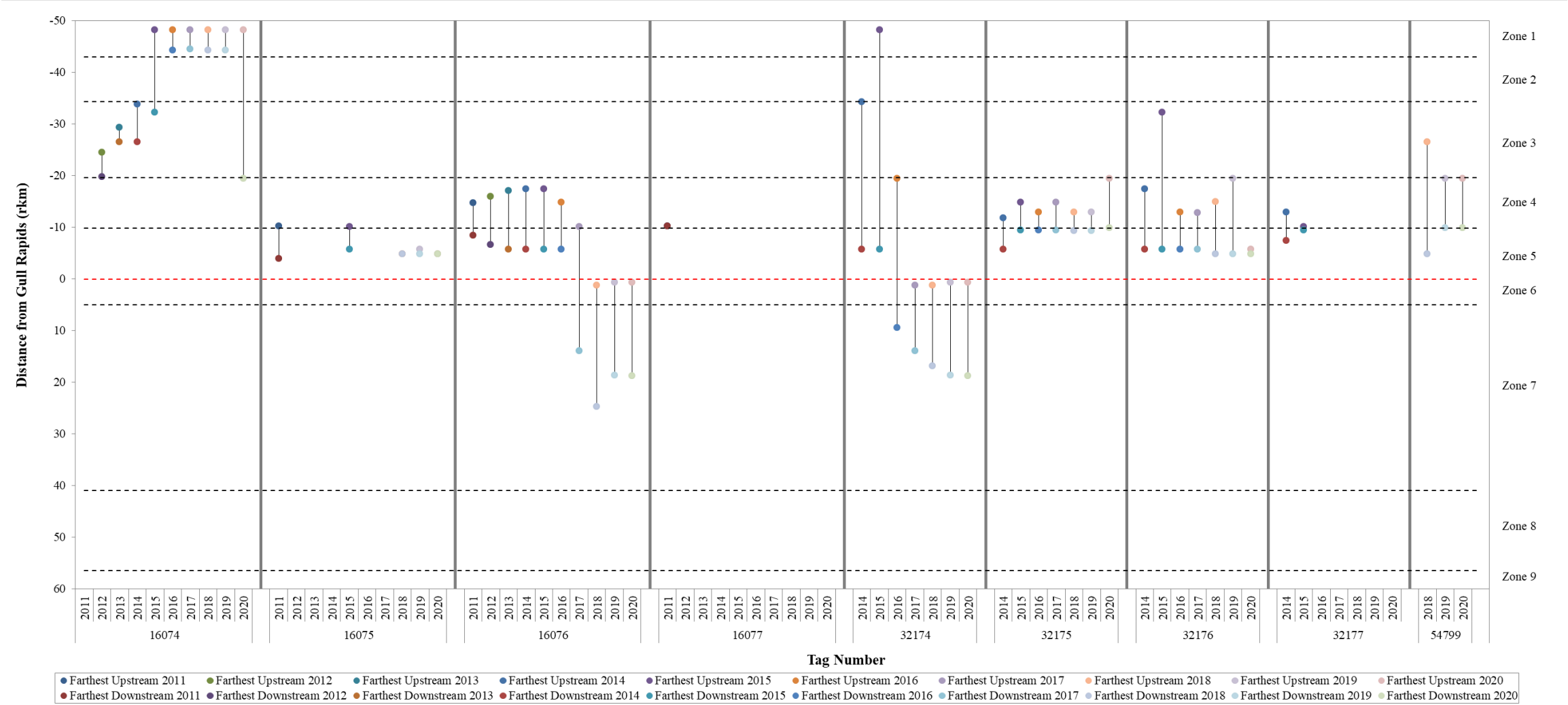




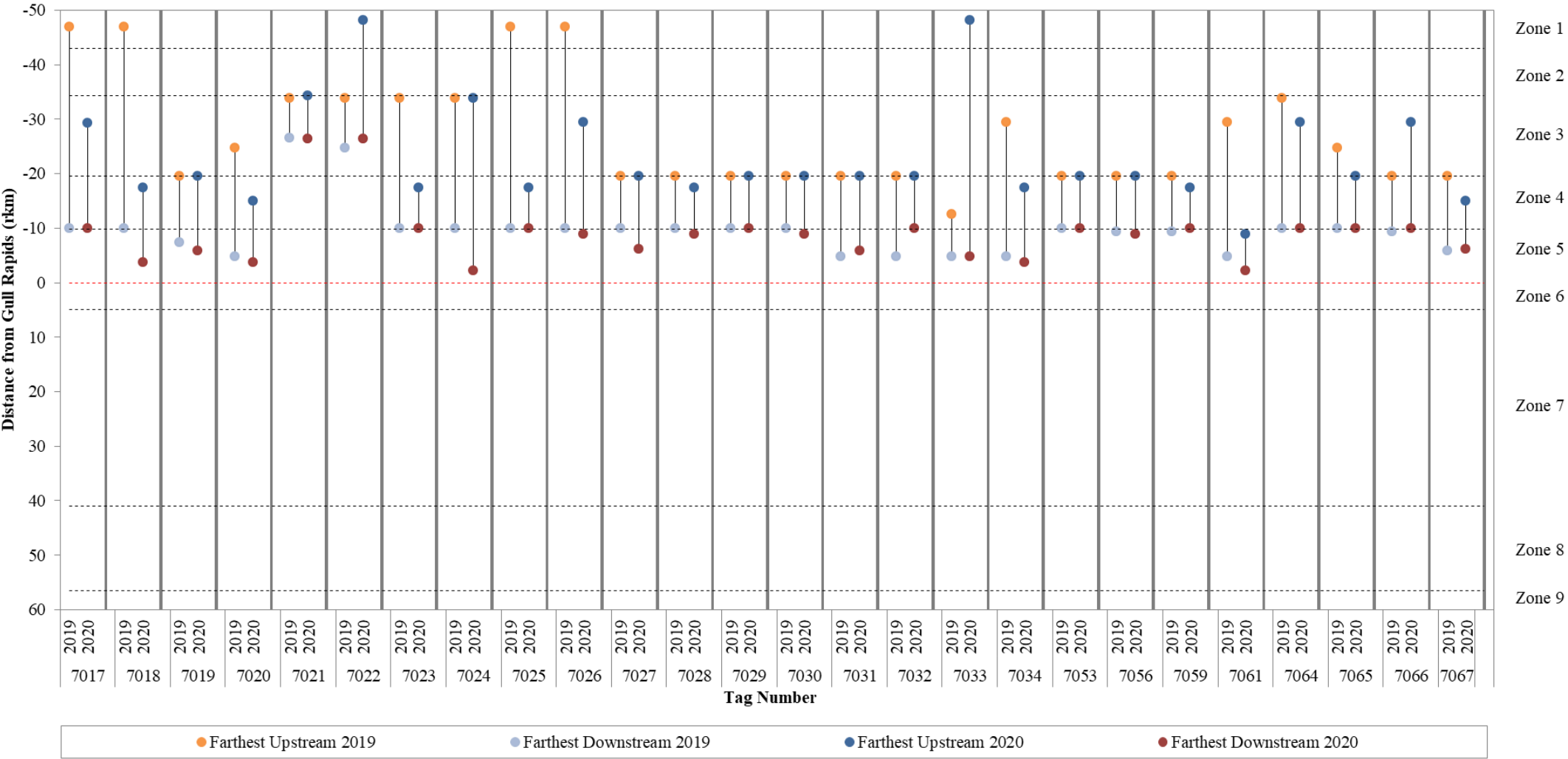
**Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**



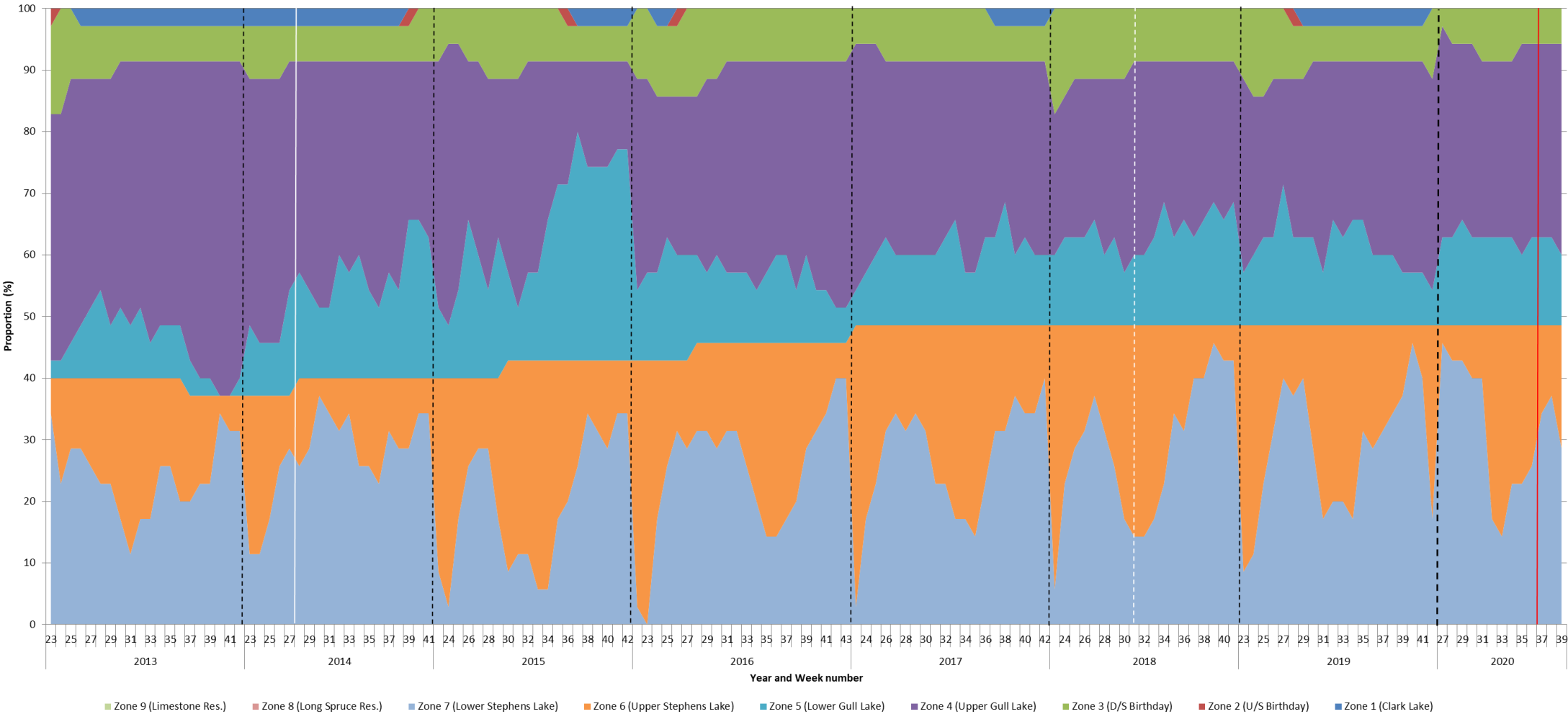
**Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**



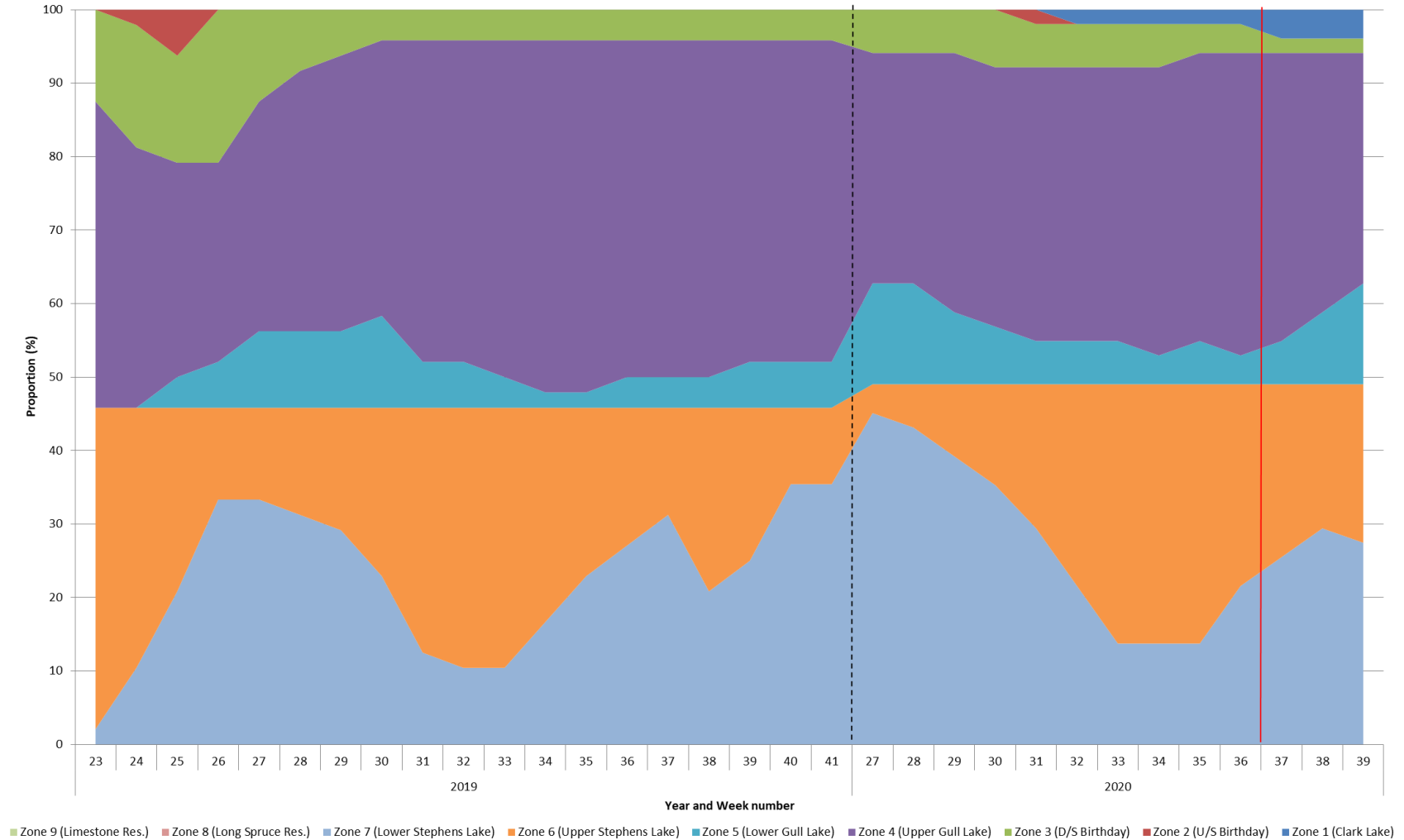
**Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**



**Figure 8: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of the Keeyask GS during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**

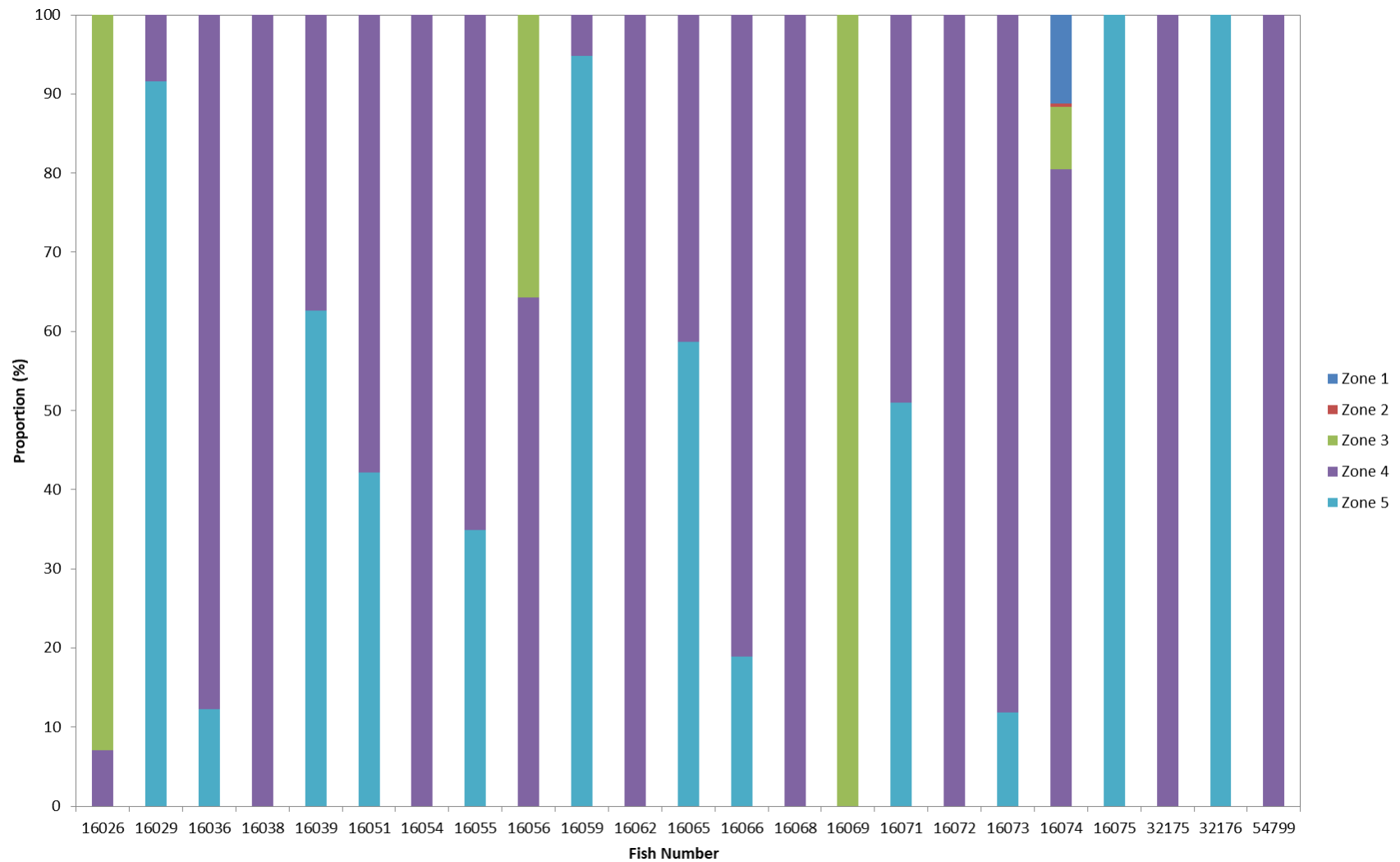


**Figure 9:** Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters in 2011 in the Keeyask GS Area during a portion of the 2013 (June 4 to October 15), 2014 (June 4 to October 3), 2015 (June 4 to October 11), 2016 (June 4 to October 19), 2017 (June 7 to October 16) 2018 (June 6 to October 10), 2019 (June 2 to October 7), and 2020 (July 3 to September 23) open-water periods. Black dashed lines indicate study years. Solid white line indicates start of Keeyask construction. Dashed white line indicates spillway commissioning. Solid red line indicates end of reservoir impoundment.

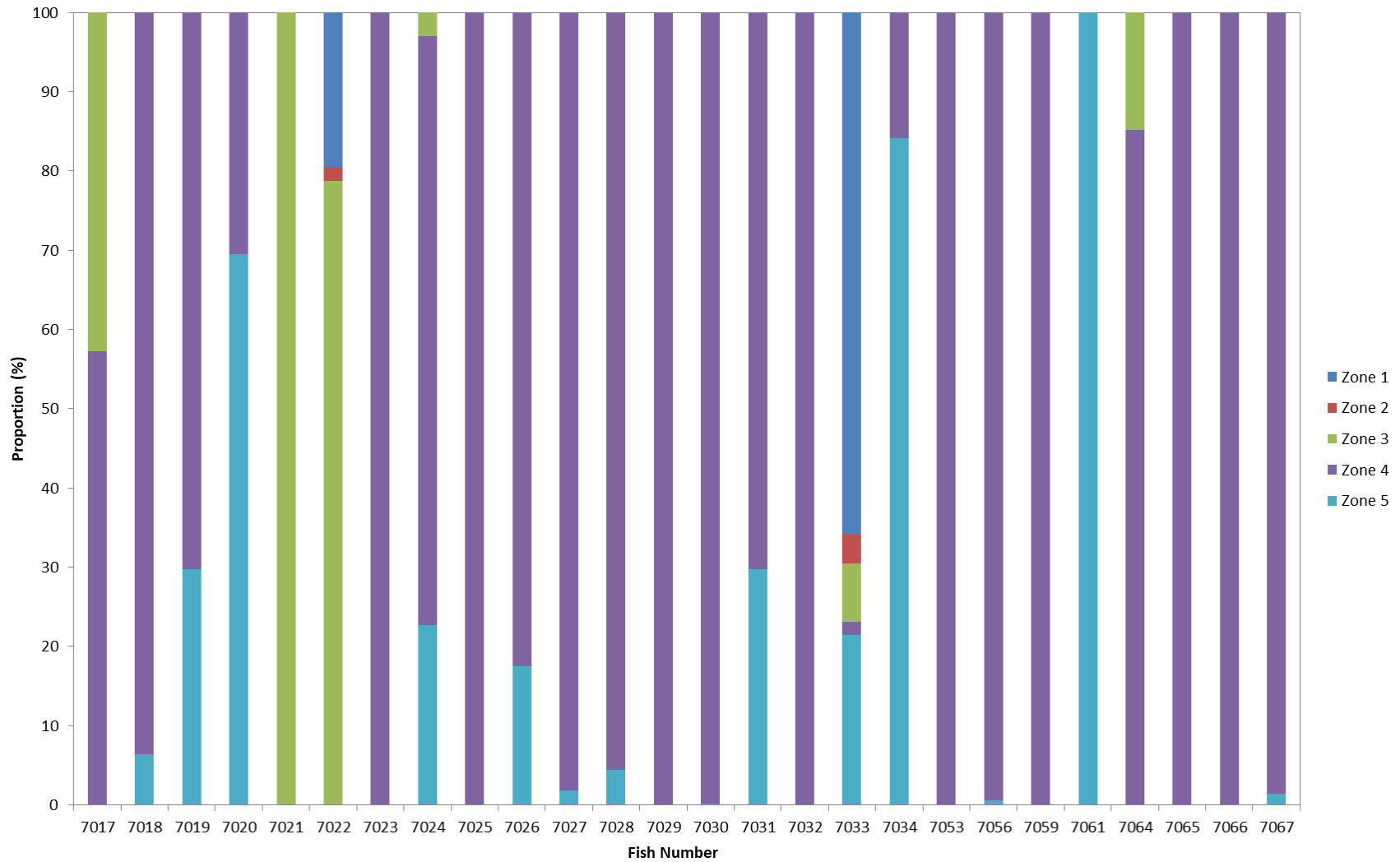


**Figure 10: Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters in 2019 in the Keeyask GS Area during a portion of the 2019 (June 2 to October 7) and 2020 (July 3 to September 23) open-water periods. Black dashed lines indicate study years. Solid red line indicates end of reservoir impoundment.**

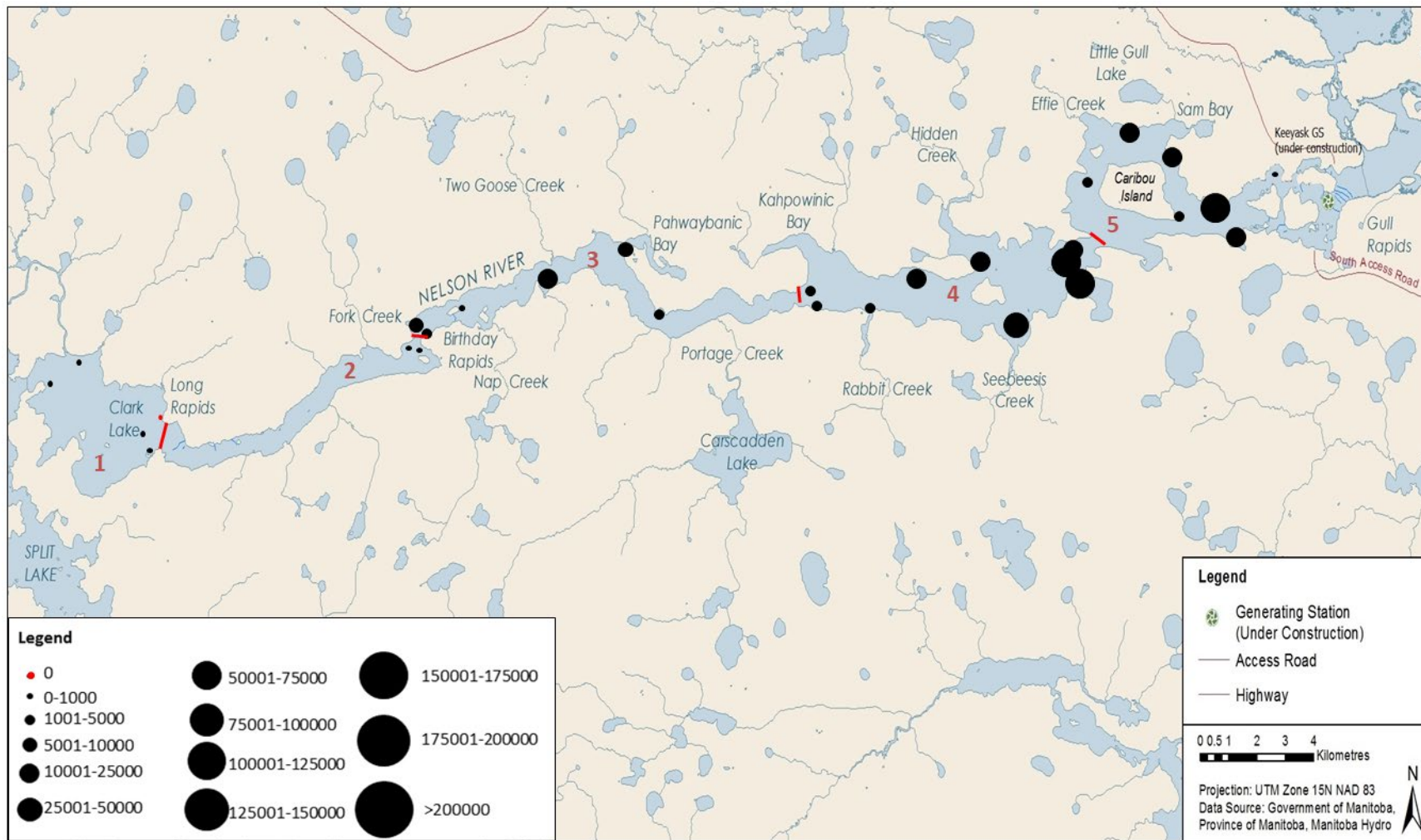




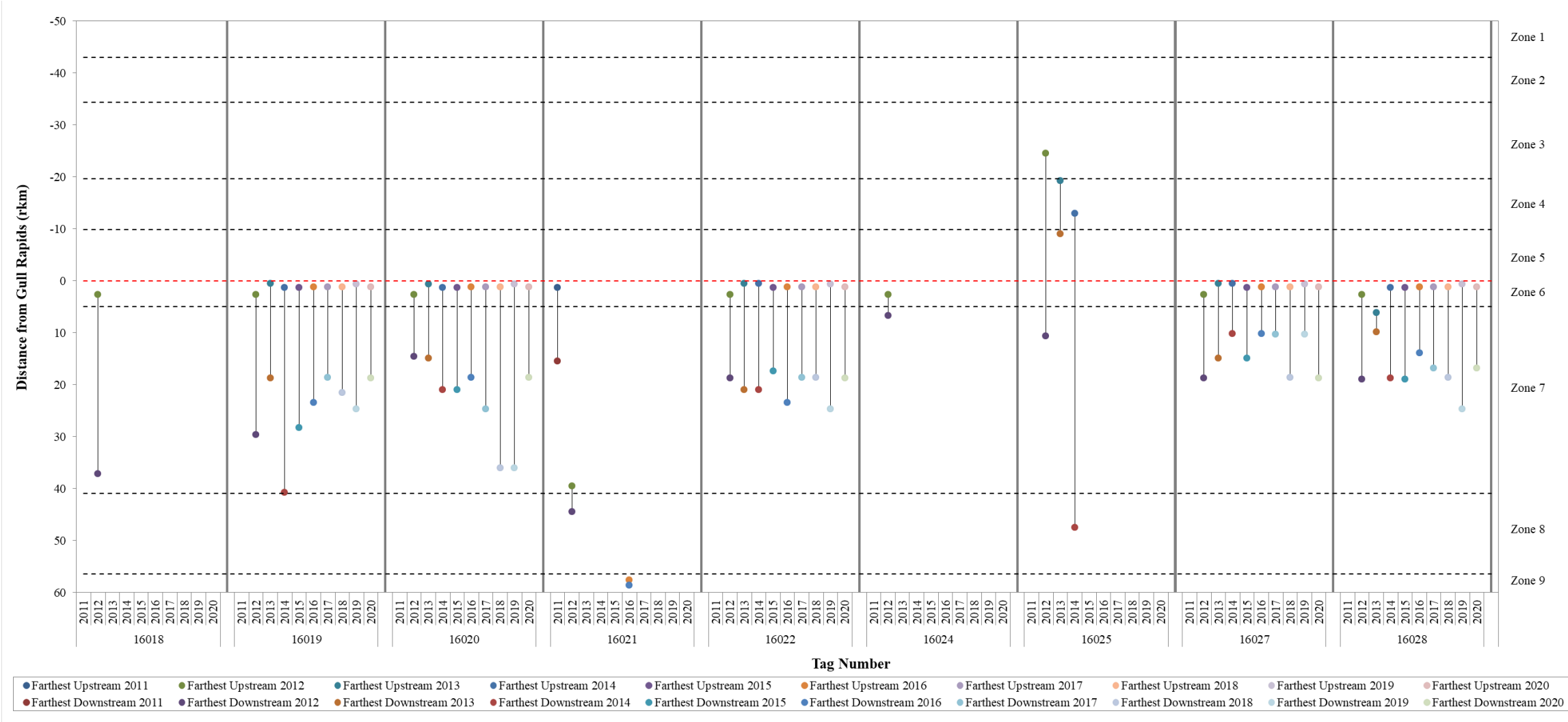
**Figure 11: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Keeyask GS during a portion of the 2020 open-water period (July 3 to September 23).**



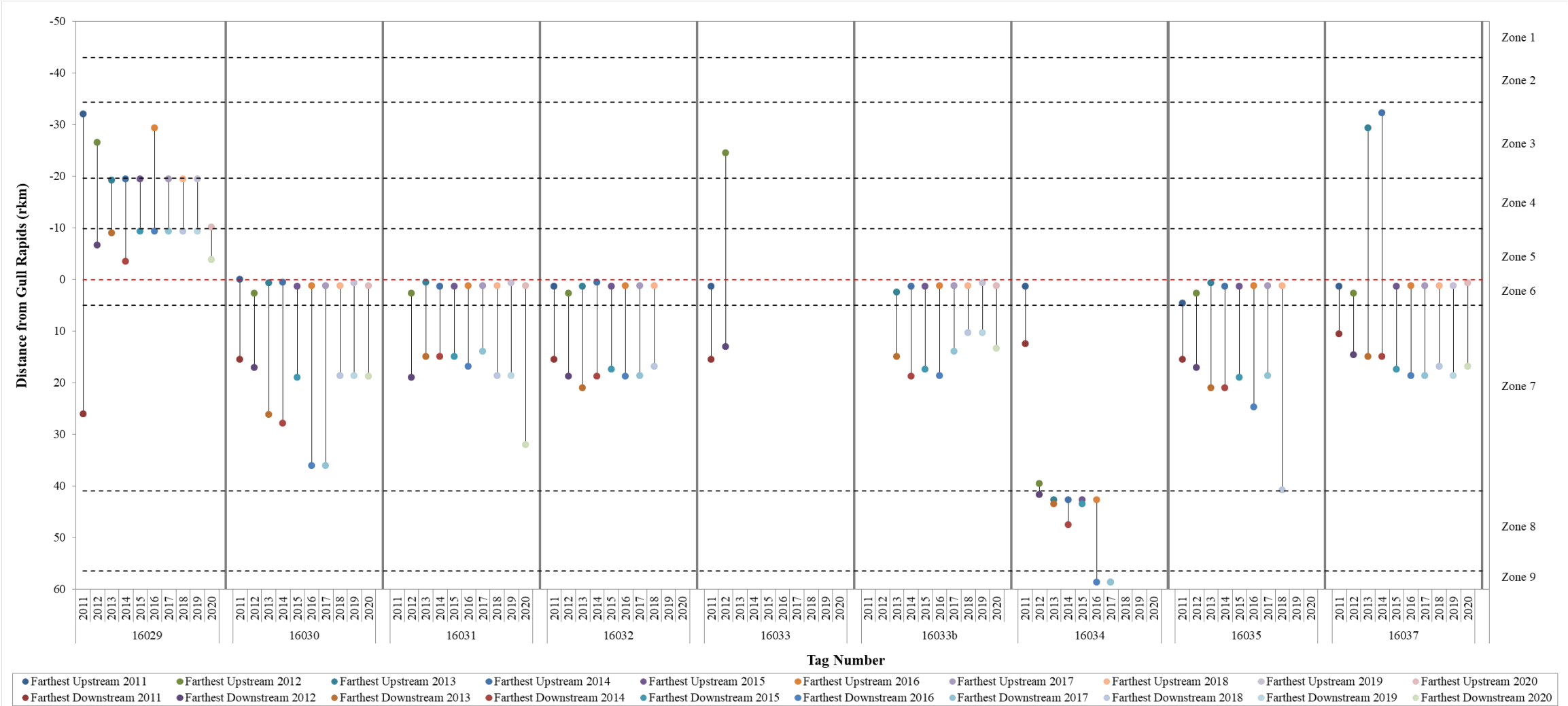
**Figure 11: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Keeyask GS during a portion of the 2020 open-water period (July 3 to September 23) (continued).**



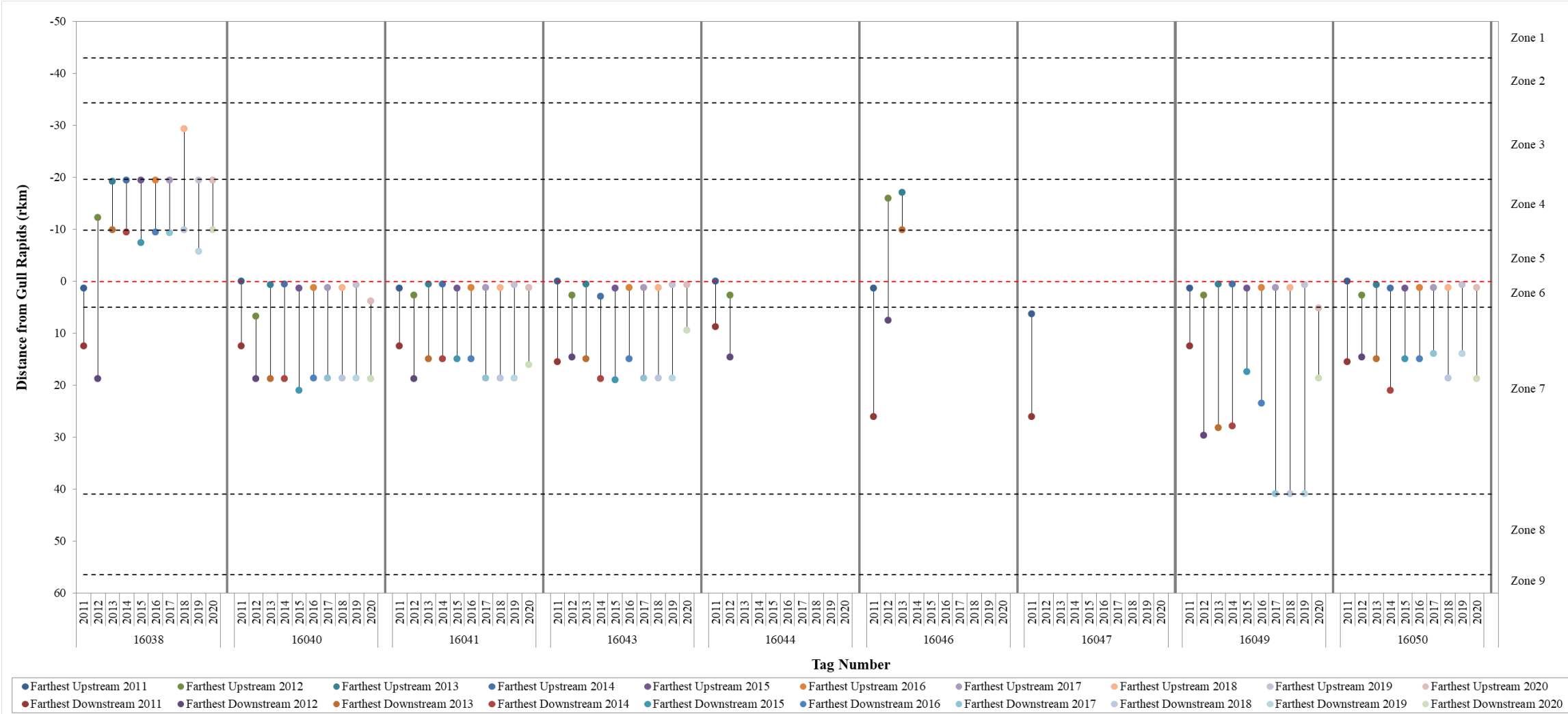
**Figure 12:** Relative number of detections at each acoustic receiver set in the Nelson River between Clark Lake and the Keyyask GS during the 2020 open-water period (May 1 to September 23). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into five "zones" based on placement of receiver "gates."



**Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS.**

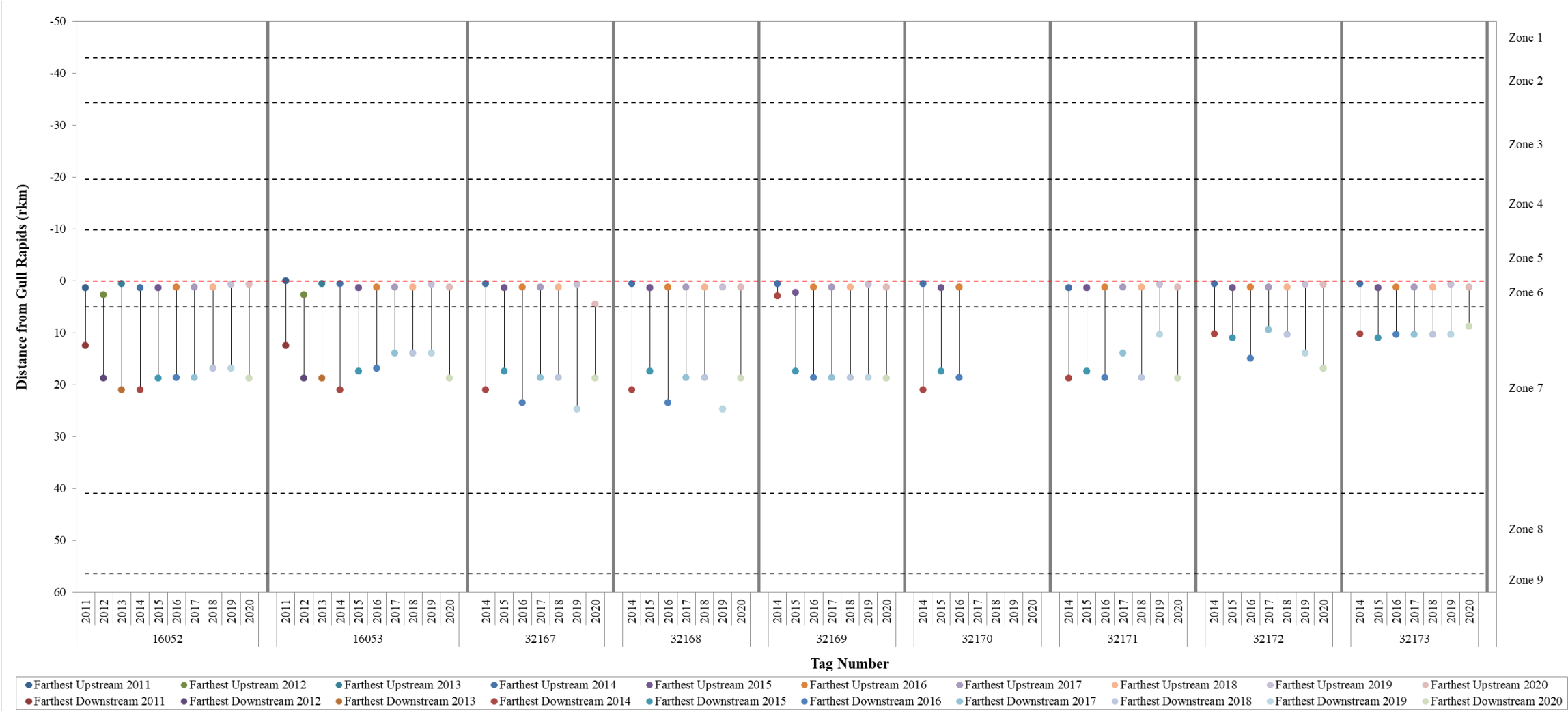


**Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**

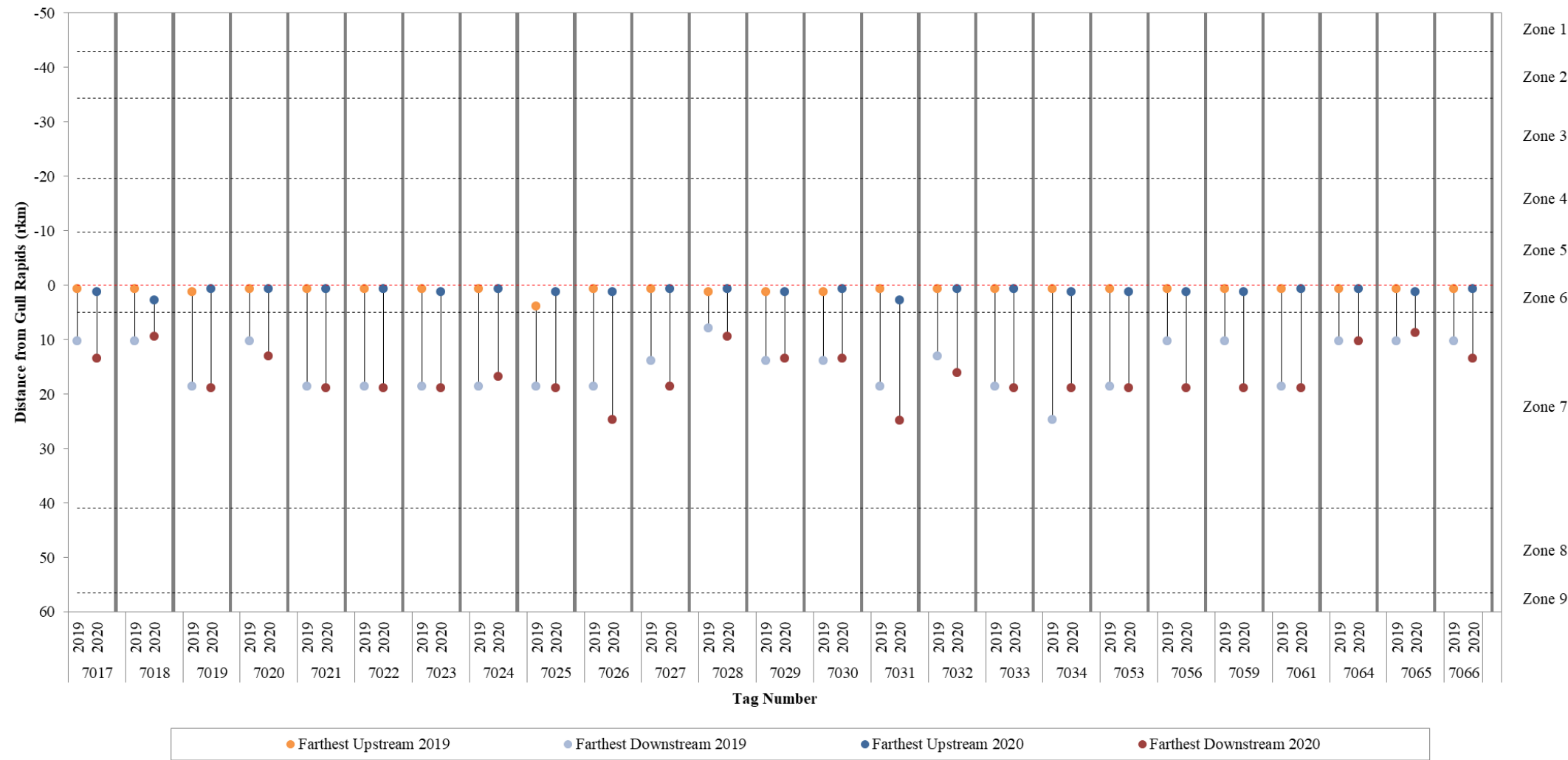


**Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**

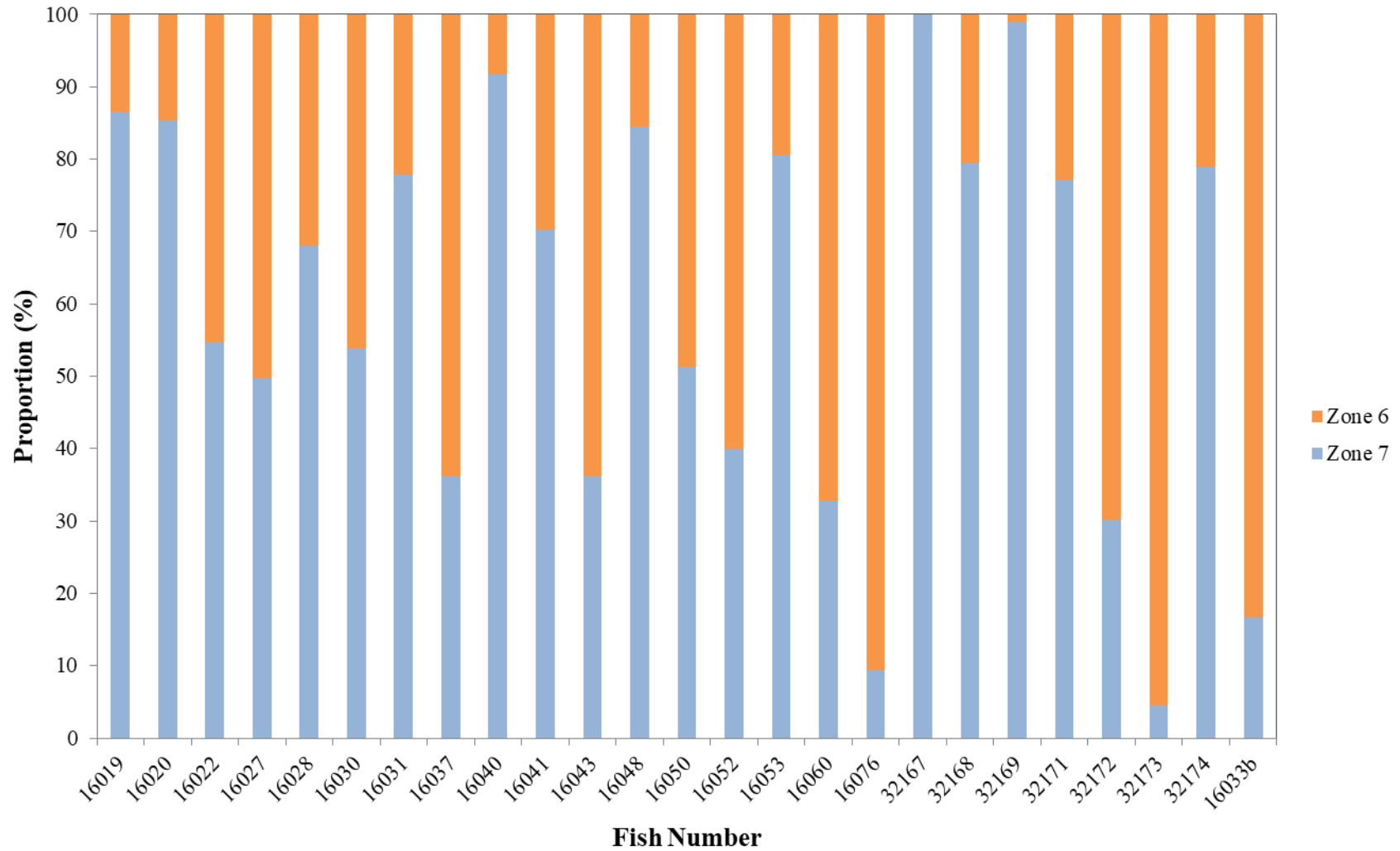




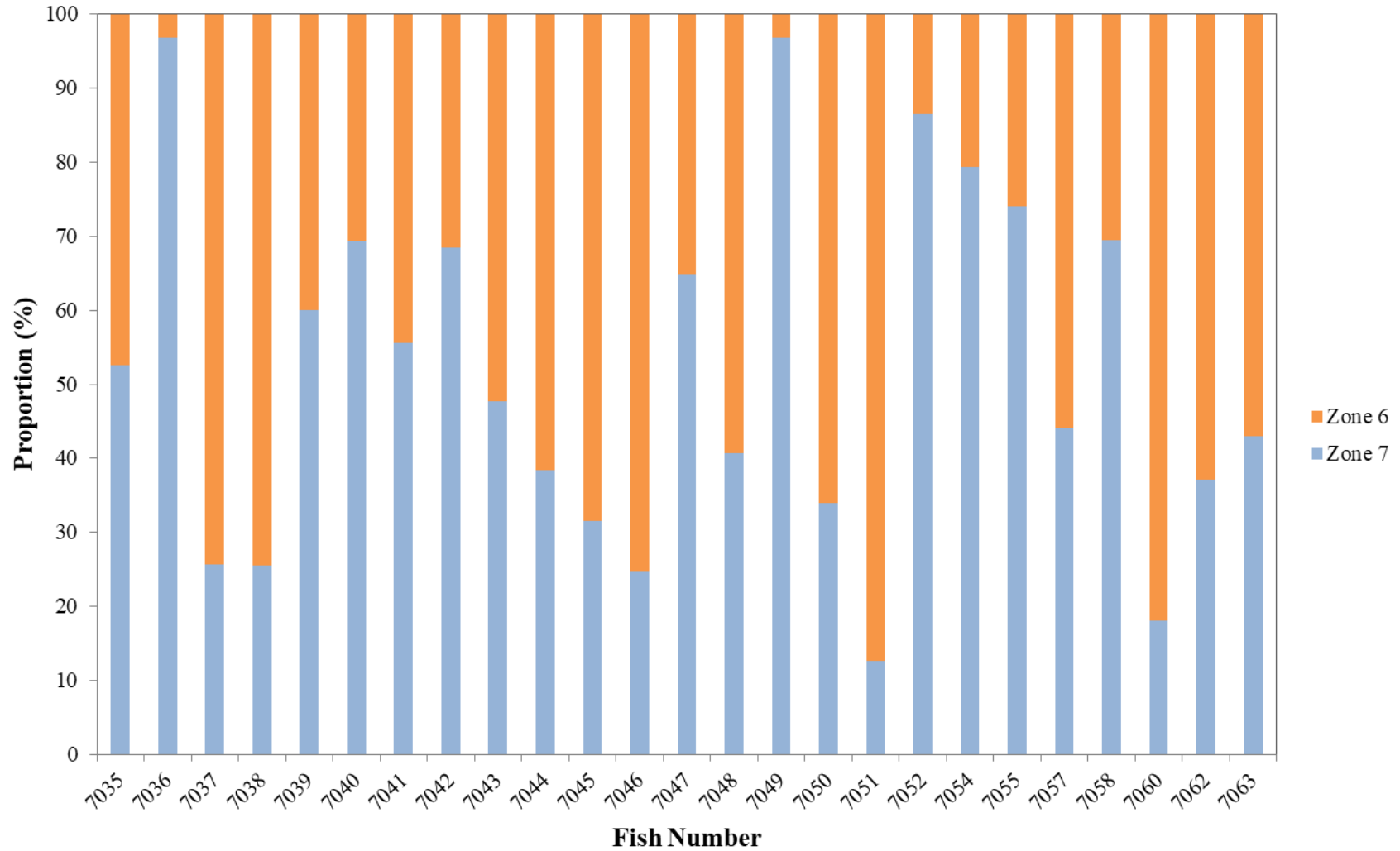
**Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**



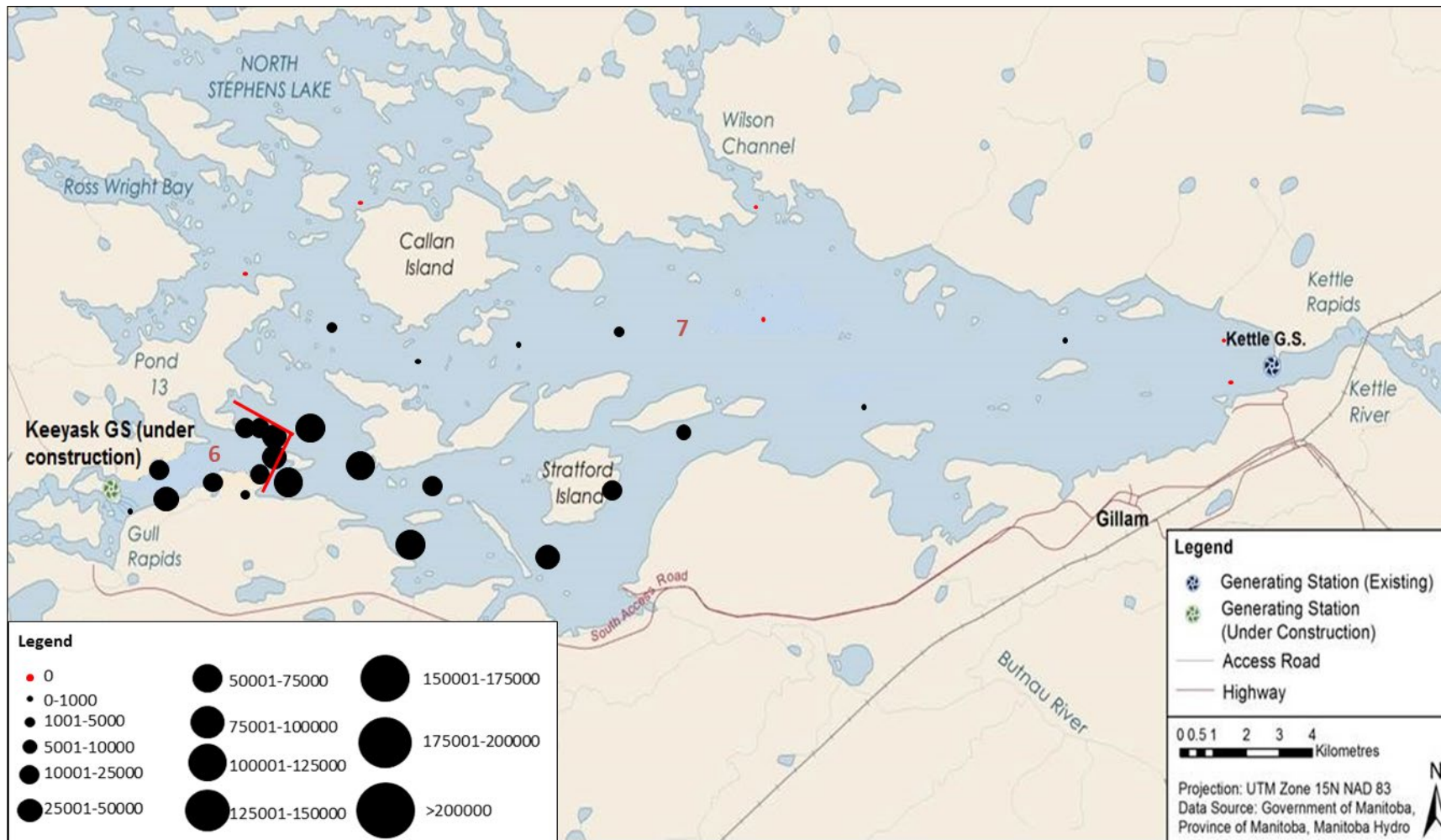
**Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the open-water period (2011–2020). Horizontal dotted lines demarcate zones with the red line representing the Keeyask GS (continued).**



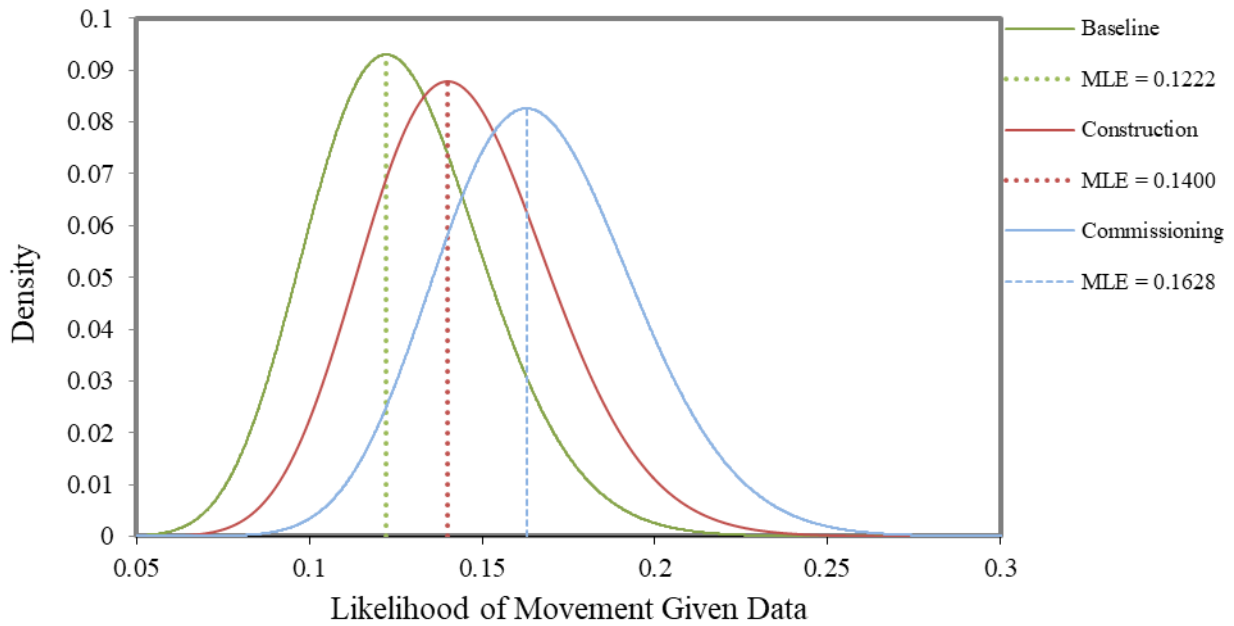
**Figure 14: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during a portion of the 2020 open-water period (July 3 to September 23).**



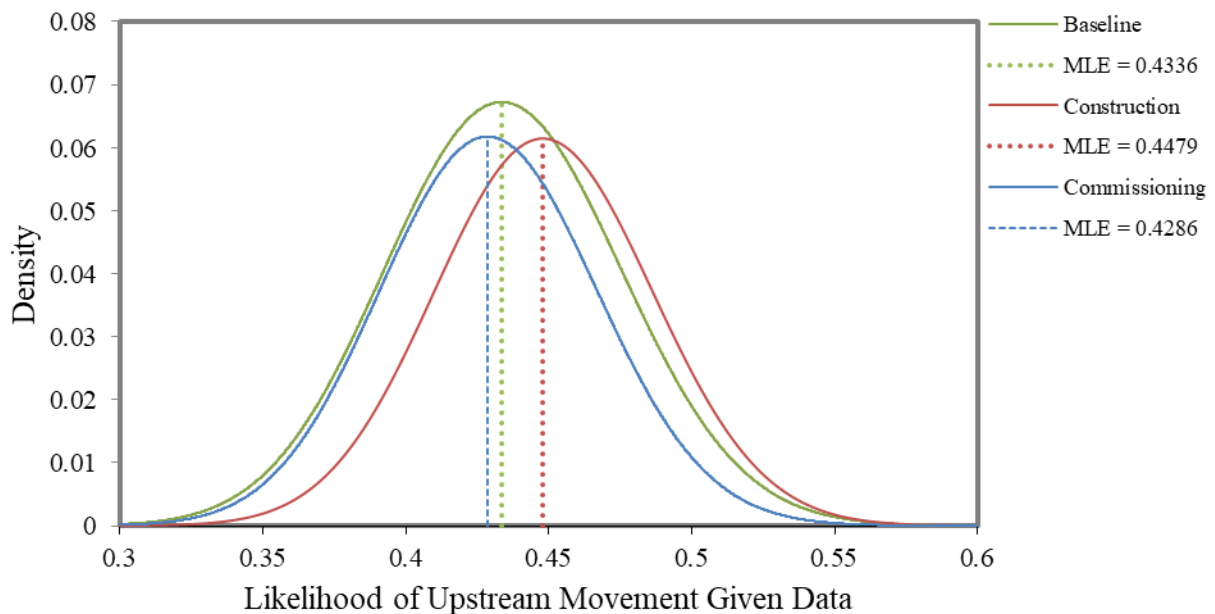
**Figure 14: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during a portion of the 2020 open-water period (July 3 to September 23).**



**Figure 15:** Relative number of detections at each acoustic receiver set in Stephens Lake during the 2020 open-water period (May 1 to September 23). Number of detections indicated by size of circle (defined in legend). Receivers with no detections indicated with red dot. The river is divided into two "zones" based on placement of receiver "gates."

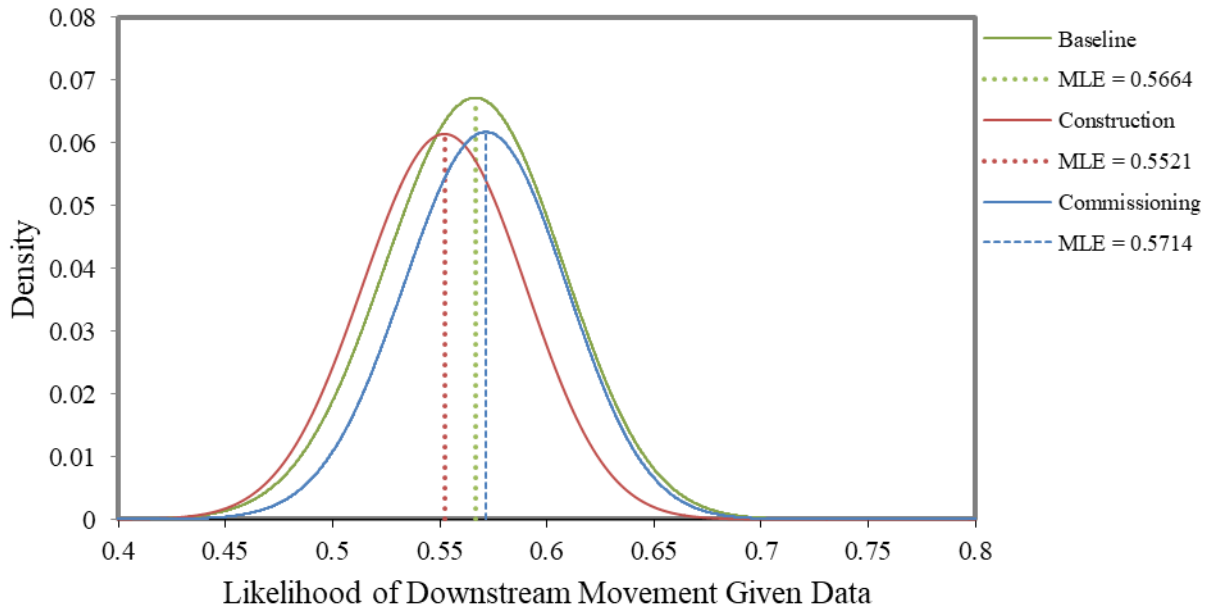


**Figure 16:** Likelihood of an adult Lake Sturgeon moving between river zones (either upstream or downstream) before construction, during construction, and after impoundment.

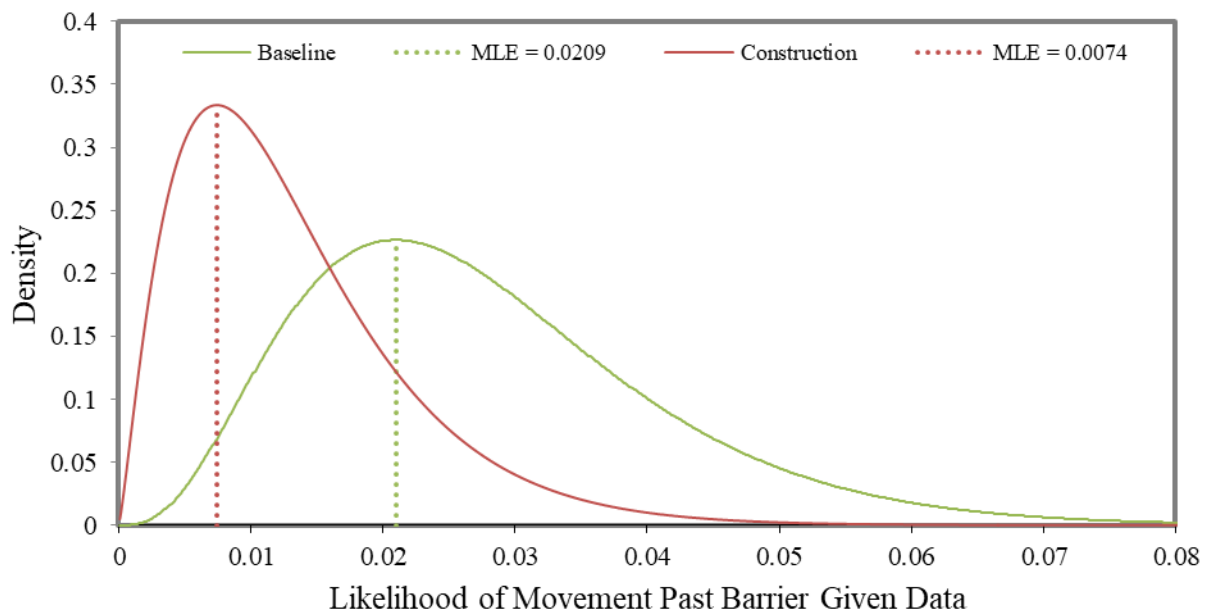


**Figure 17:** Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be upstream before construction, during construction, and after impoundment.

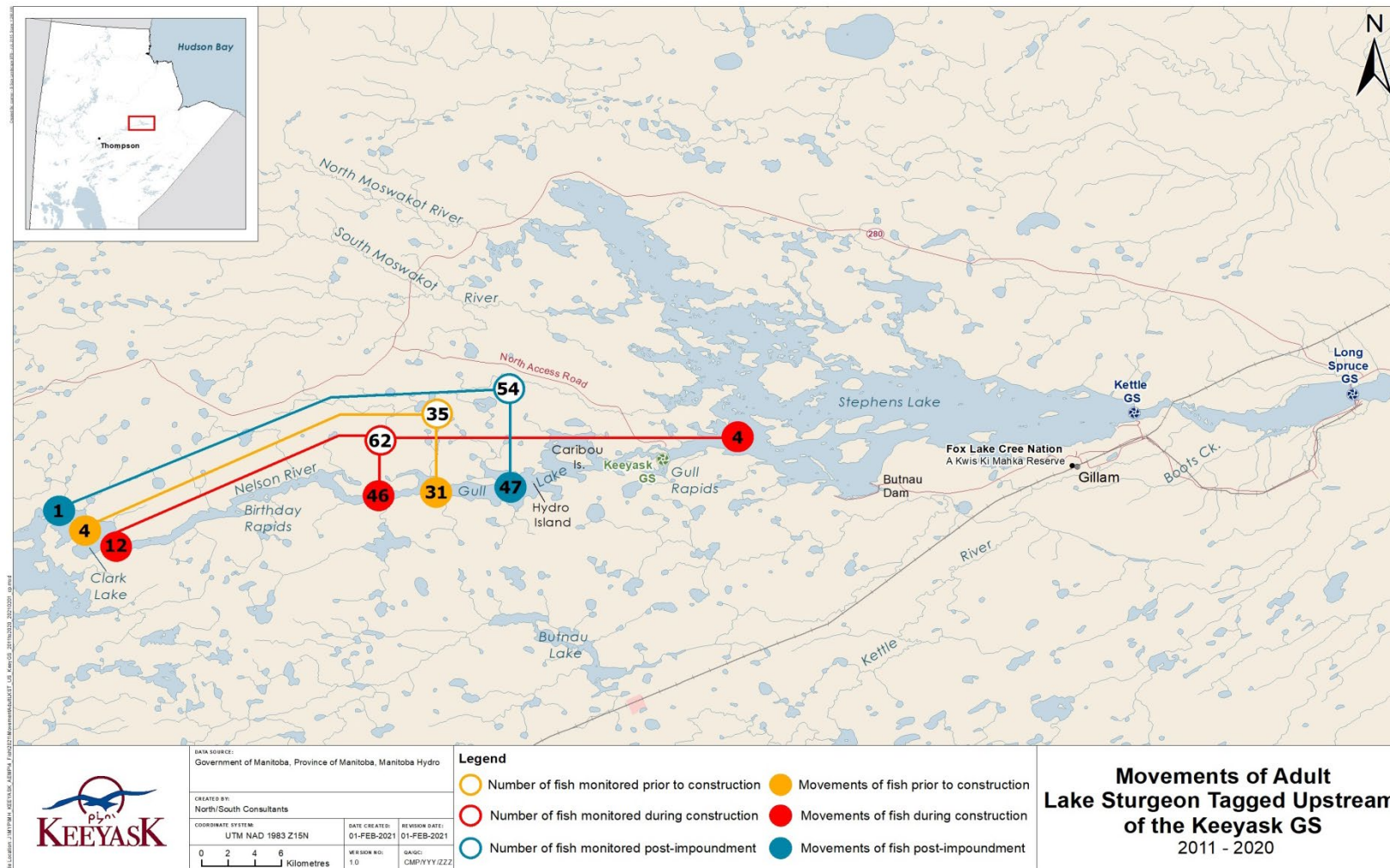




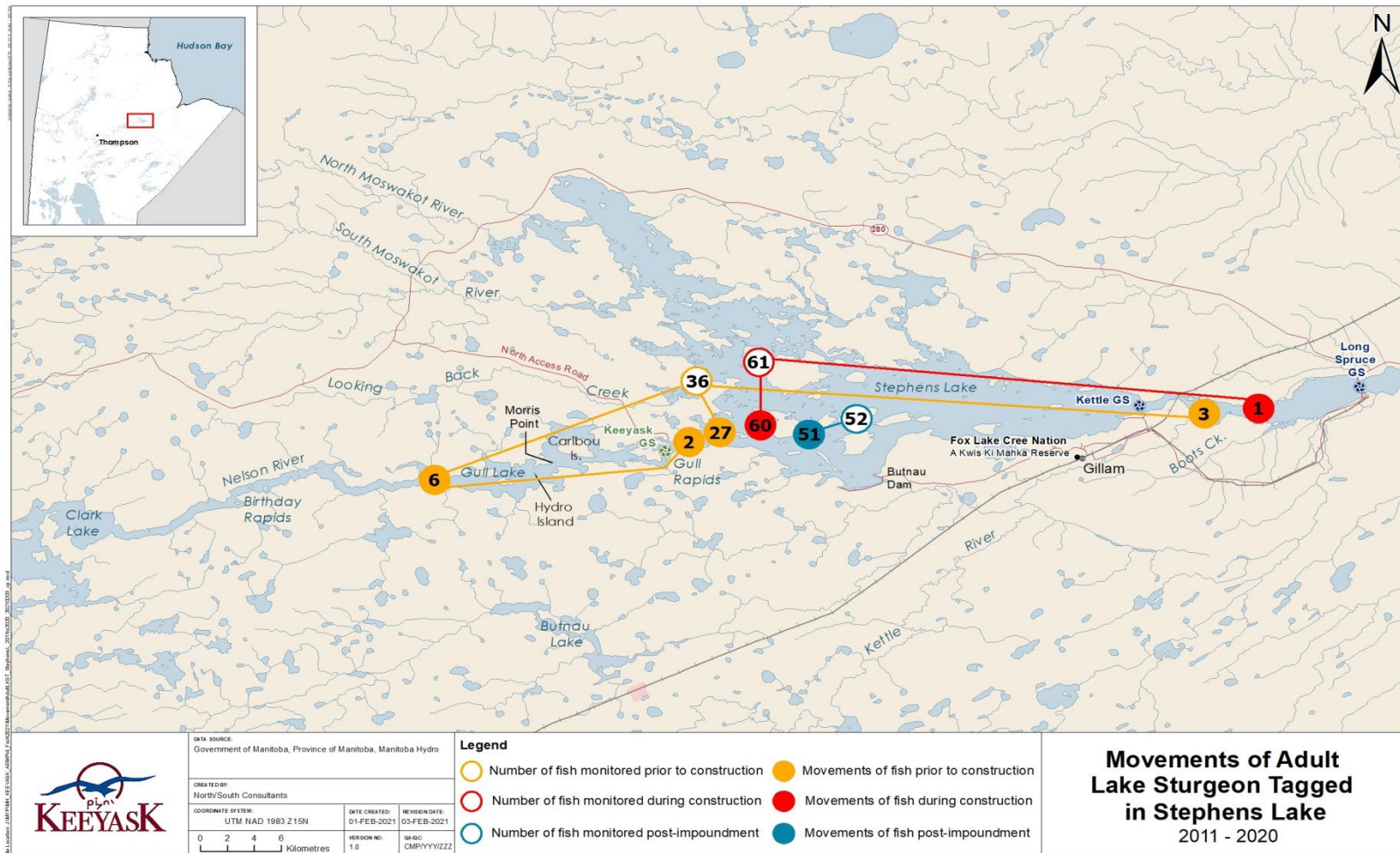
**Figure 18:** Likelihood that, if an adult Lake Sturgeon moves between river zones, the movement will be downstream before construction, during construction, and after impoundment.



**Figure 19:** 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.



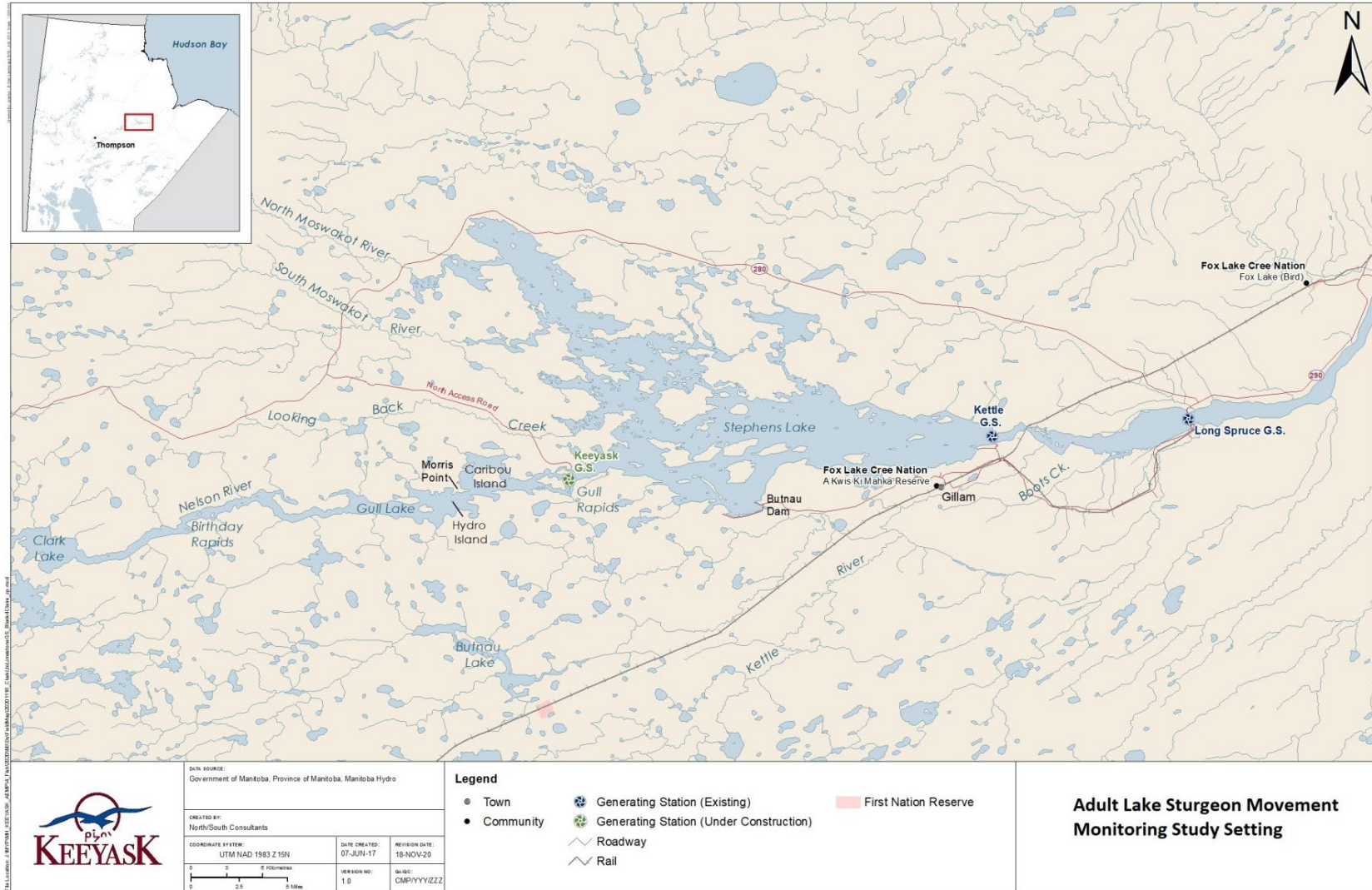
**Figure 20:** Map showing how many adult Lake Sturgeon moved upstream out of Gull Lake, stayed in Gull Lake, moved into Stephens Lake, and moved downstream through the Kettle GS before construction (yellow), during construction (red) and after reservoir impoundment (blue). Numbers of fish monitored (hollow circles) represent the number of fish tagged while the number of fish movements (solid circles) represent the number of fish detected.



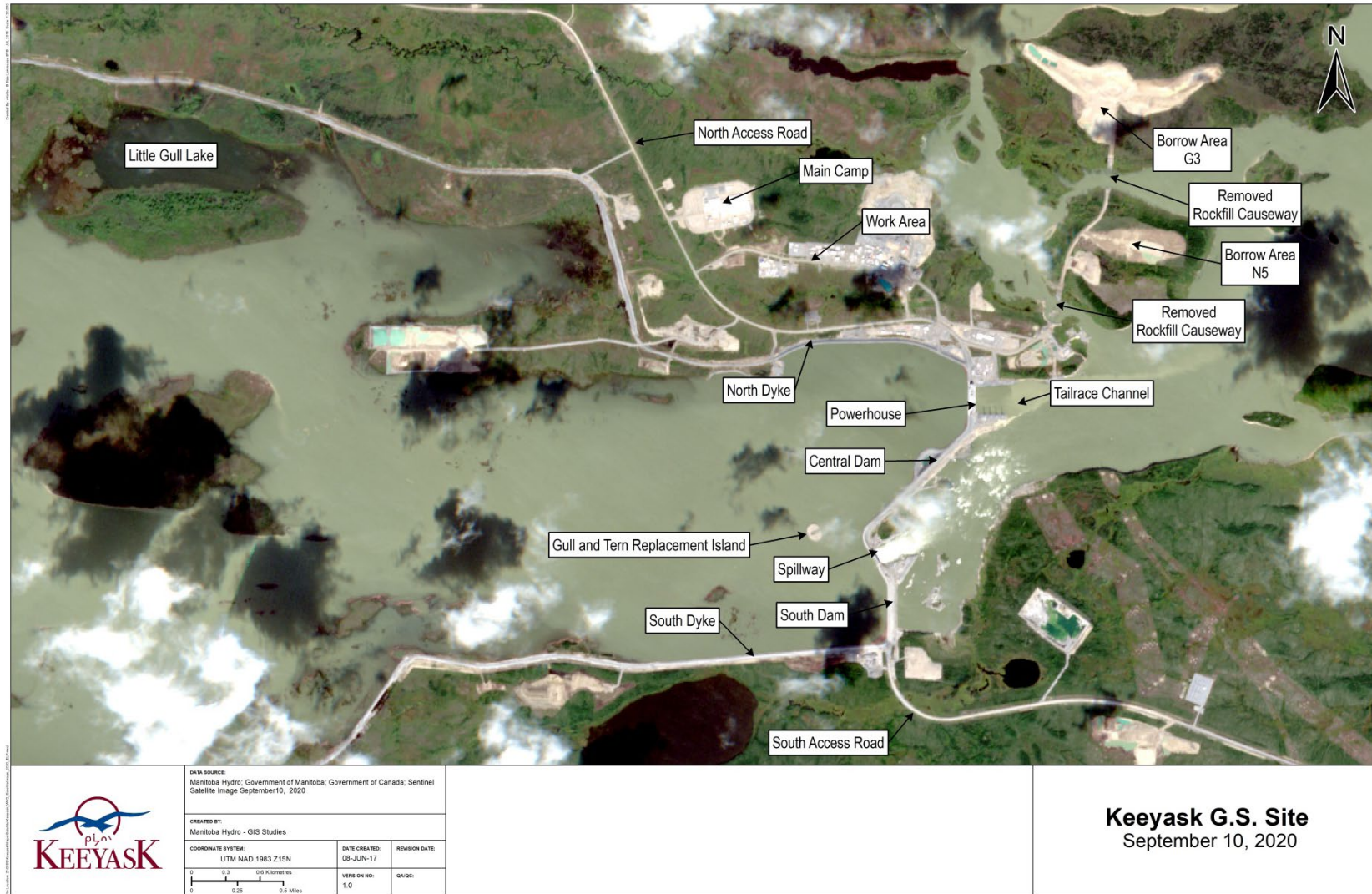
**Figure 21:** Map showing how many adult Lake Sturgeon moved stayed in Stephens Lake and moved downstream through the Kettle GS during before construction (yellow), during construction (red), and after reservoir impoundment (blue). Movements of fish due to tagging stress or mortality were not included. 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.

## MAPS



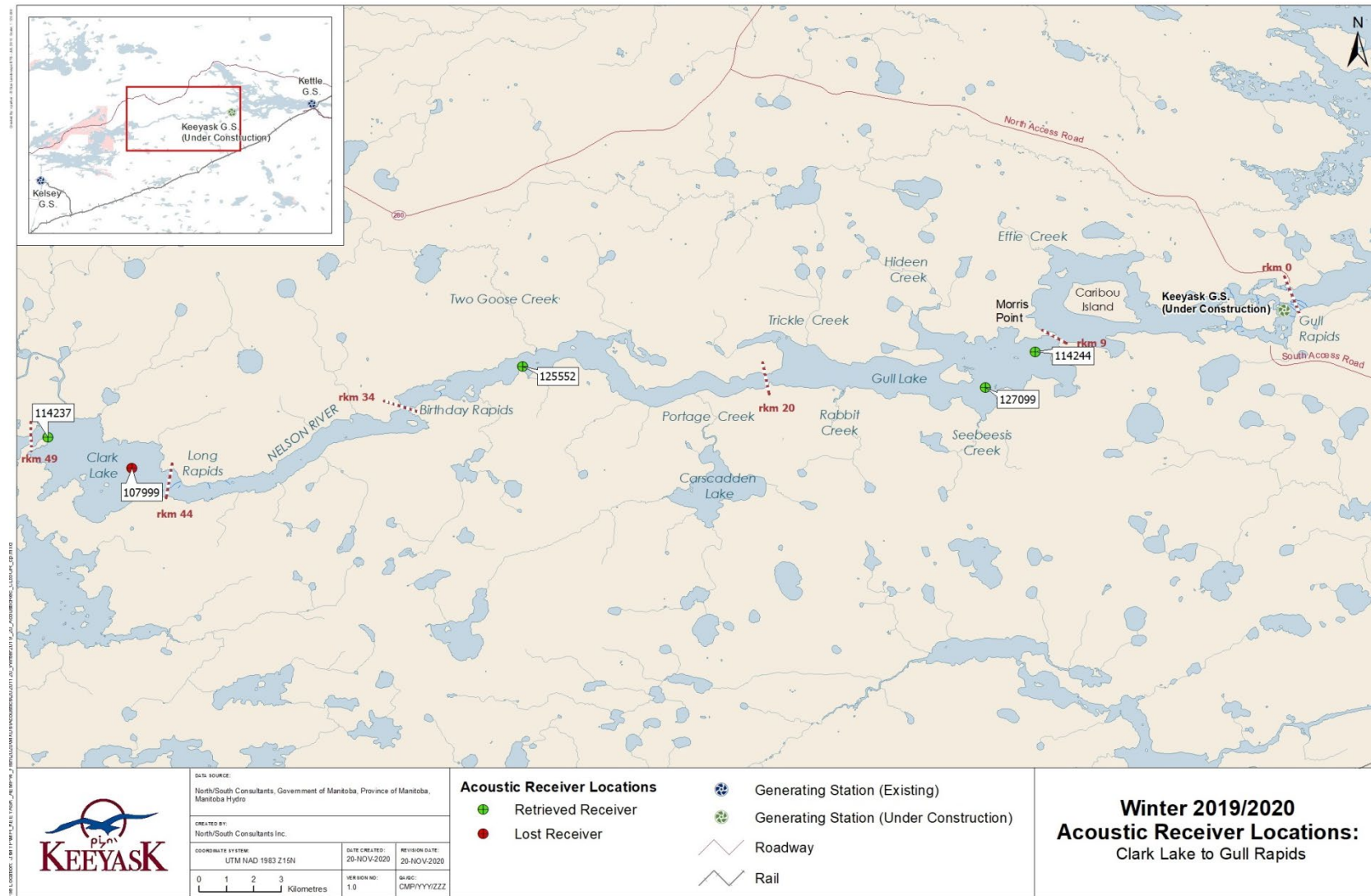


**Map 1: Map of the Nelson River showing the site of the Keeyask Generating Station and the adult Lake Sturgeon movement monitoring study setting.**

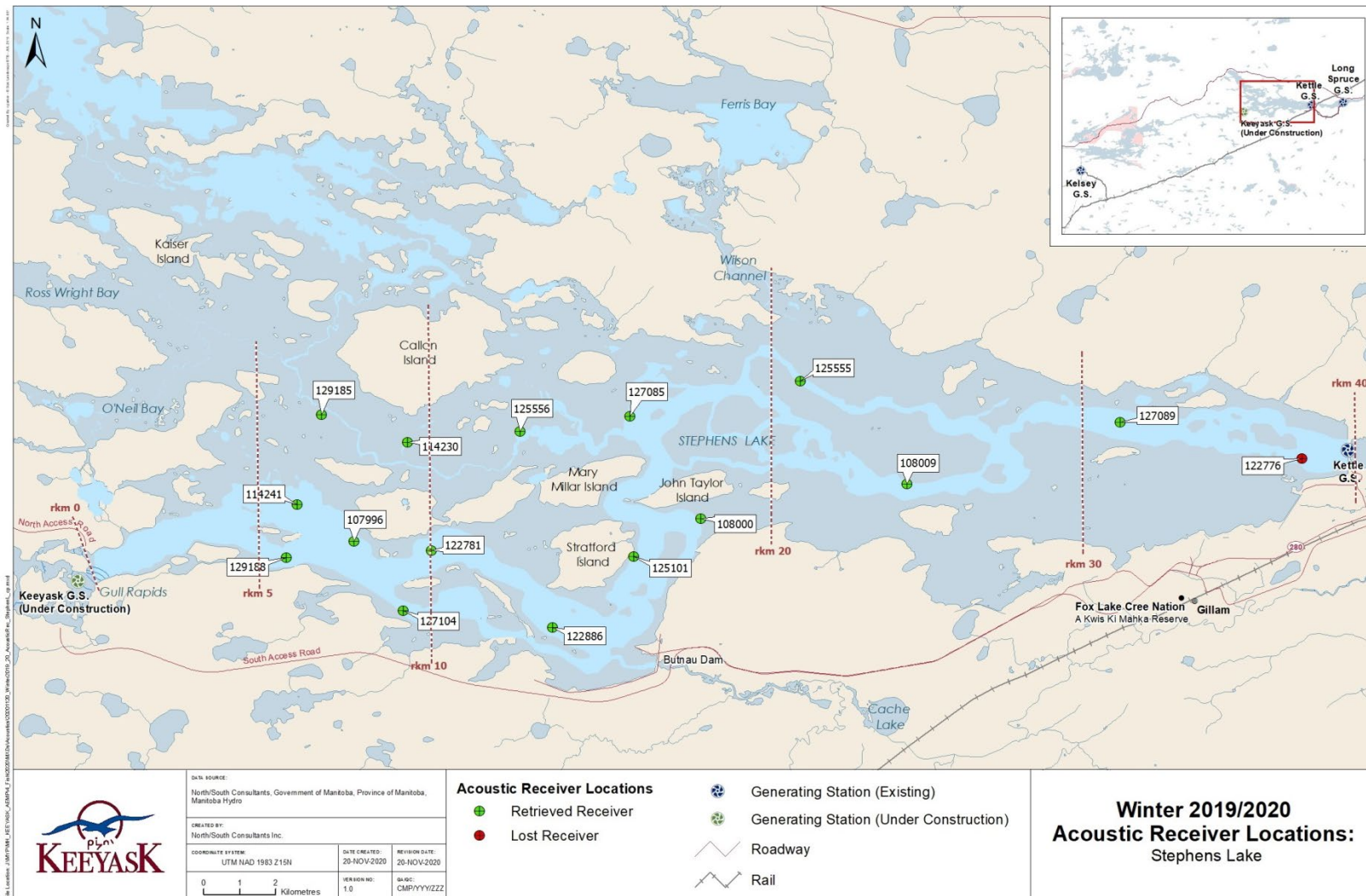


**Map 2: Map illustrating instream structures at the Keeyask Generating Station site after reservoir flooding, September 2020.**



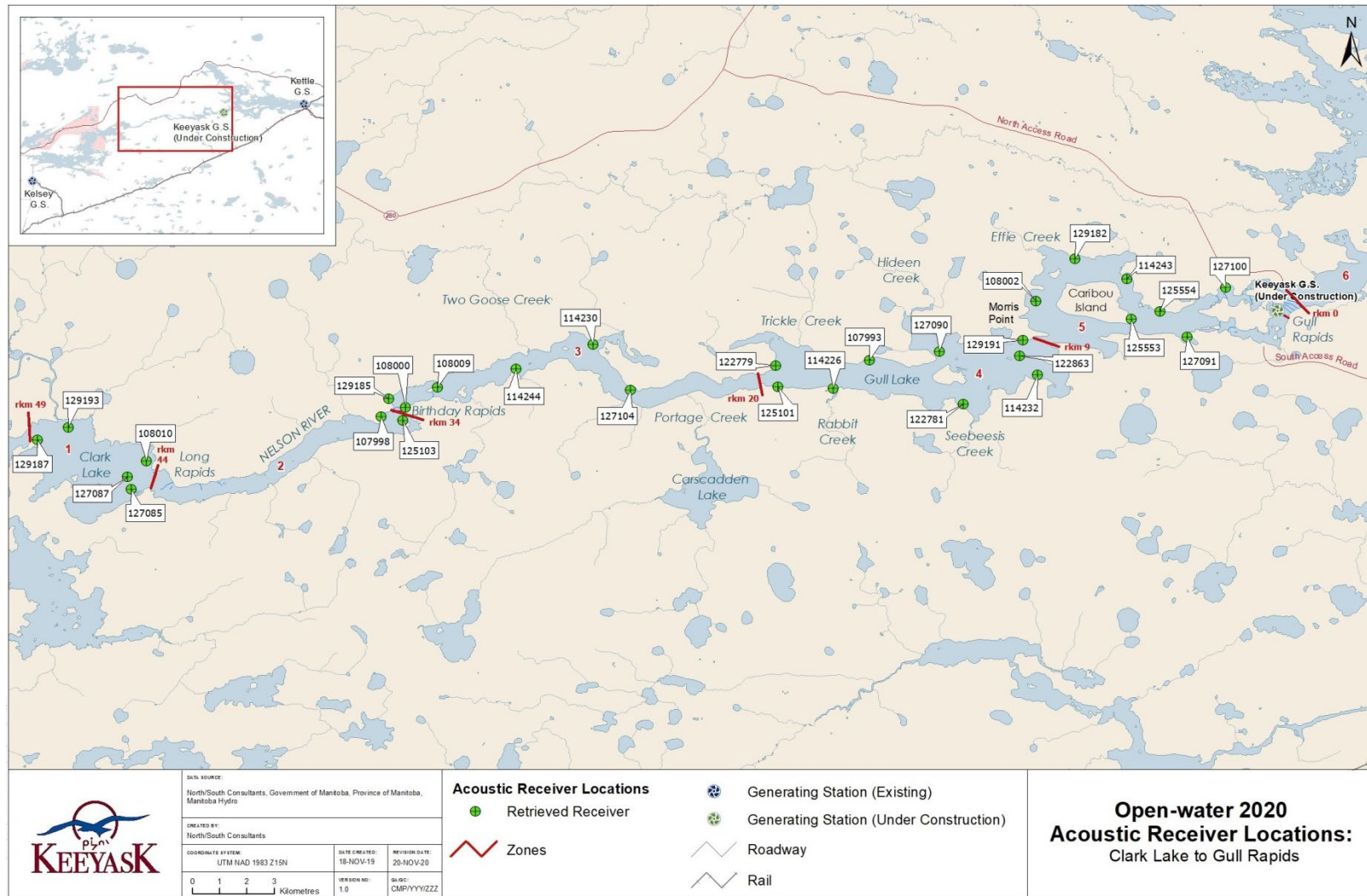


**Map 3: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between October 2019 and July 2020. River kilometer (rkm) distances are indicated with a red dotted line.**

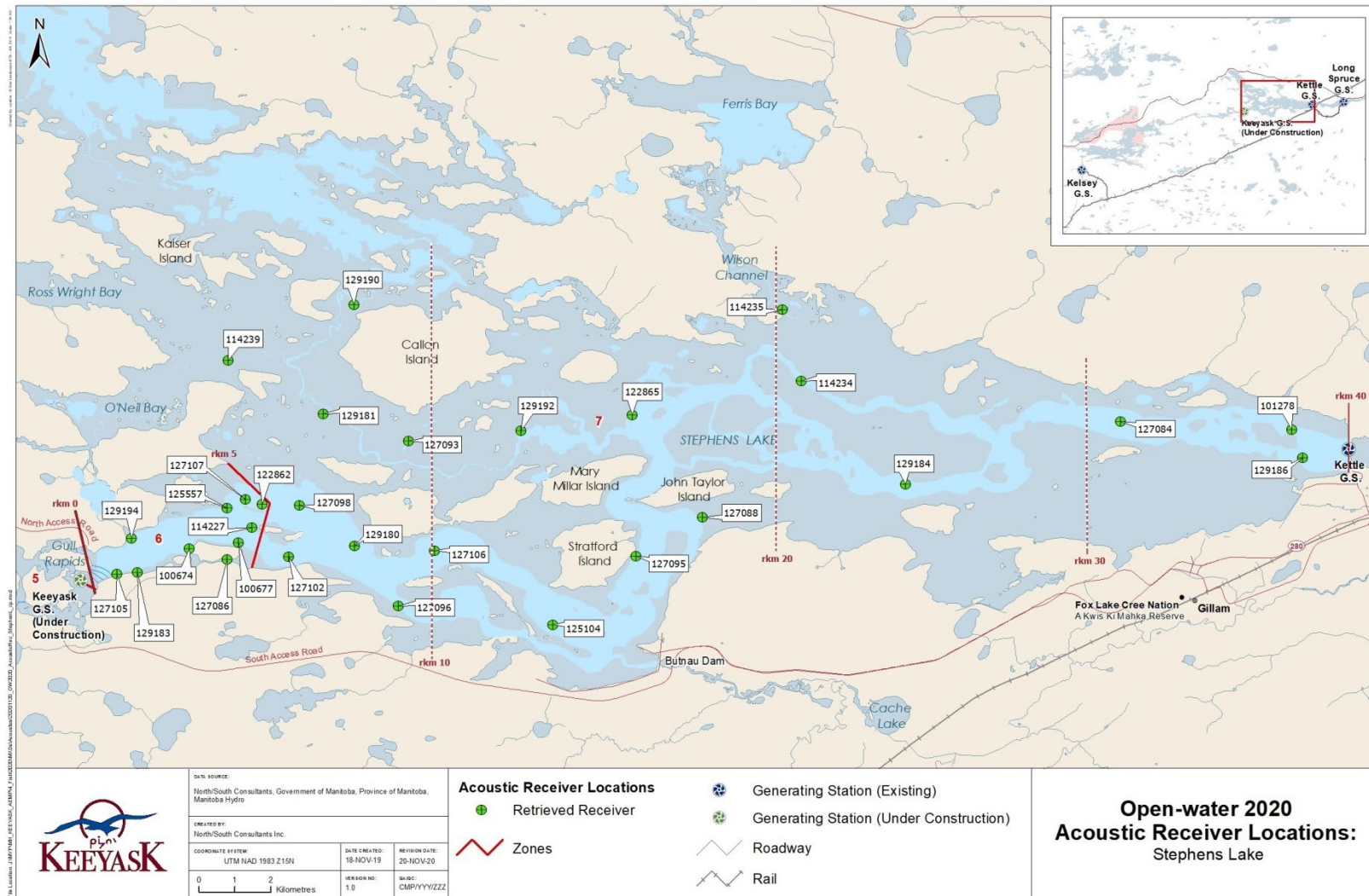


**Map 4: Locations of stationary receivers set in Stephens Lake from the Keeyask GS to Kettle GS between October 2019 and July 2020. The former (pre-impoundment) river channel is shown in light blue. River kilometer (rkm) distances are indicated with a dotted red line.**

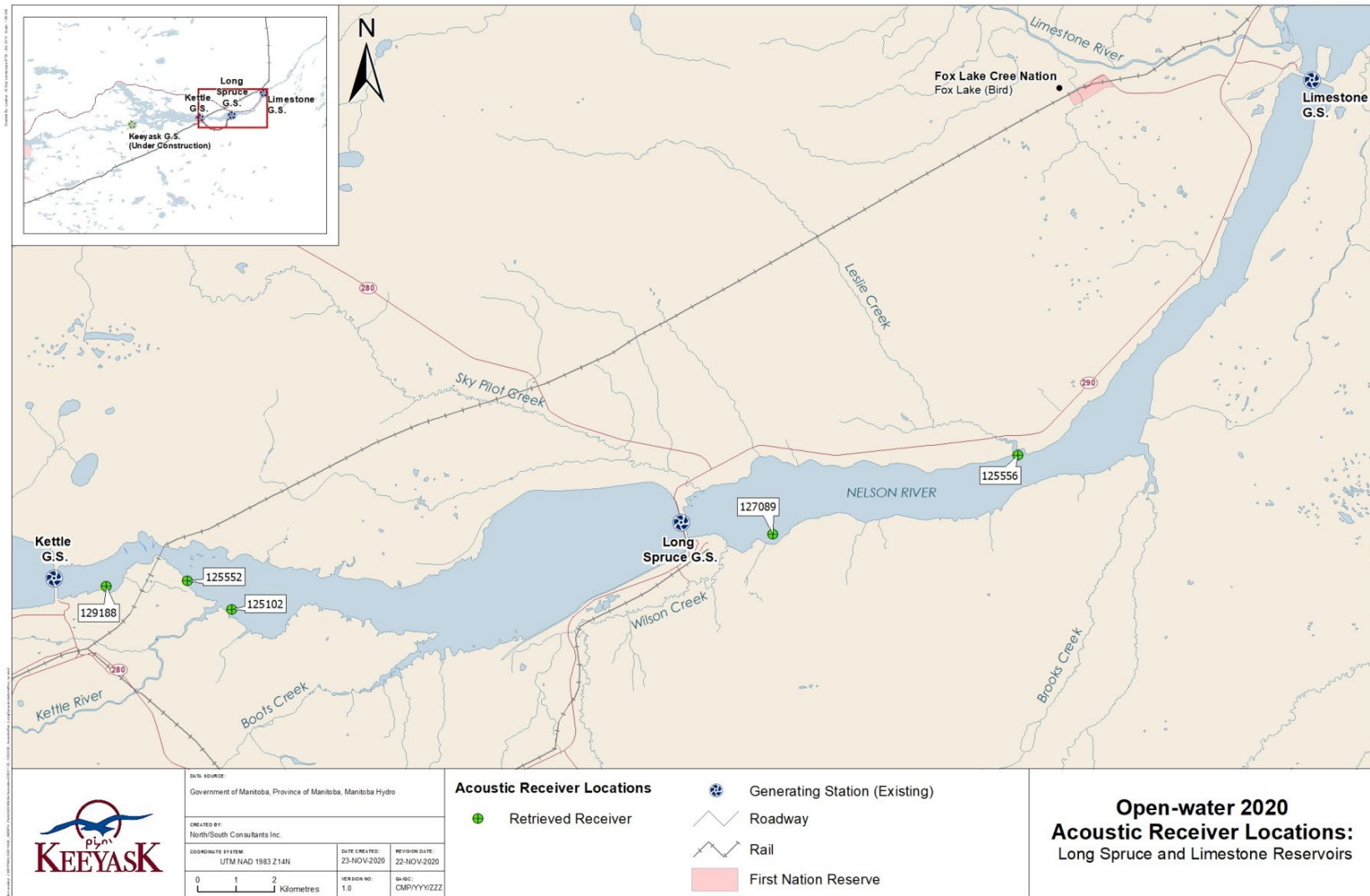




**Map 5: Locations of stationary receivers set in the Nelson River from Clark Lake to the Keeyask GS between July and September 2020. The river is divided into five "zones" based on placement of receiver "gates." River kilometer (rkm) distances at zone divisions are indicated in red.**



**Map 6: Locations of stationary receivers set in Stephens Lake between July and September 2020. The river is divided into two "zones" based on placement of receiver "gates." The pre-impoundment river channel is shown in light blue. River kilometer (rkm) distances are indicated with a dotted red line.**



**Map 7: Locations of stationary receivers set between the Kettle and Limestone Generating Stations, August to September 2020.**

# APPENDICES



# APPENDIX 1:

## DETECTION SUMMARIES FOR LAKE STURGEON TAGGED AND MONITORED BETWEEN 2011 AND 2020

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Table A1-1:	Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS 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), and 2019/2020 (October 8, 2019 to April 30, 2020) periods. ....	87
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	October 19), 2017 (May 1 to October 16), 2018 (May 1 to October 10), 2019 (May 1 to October 7), and 2020 (May 1 to September 23) periods.....	92
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**Table A1-1: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS 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), and 2019/2020 (October 8, 2019 to April 30, 2020) periods. Tag id highlighted yellow = lost tags. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS.**

Tag ID	2011/2012			2012/2013			2013/2014			2014/2015			2015/2016			2016/2017			2017/2018			2018/2019			2019/2020					
	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)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)	
16026	0	-	-	0	-	-	0	-	-	0	-	-	811	3	0.0	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16036	2537	118	3.0	43	12	0.0	2326	52	0.0	362	16	0.0	4663	44	0.0	19532	105	0.0	716	32	2.1	1515	19	0.0	10791	34	-12.4	-10.3	2.1	
16039	0	-	-	0	-	-	502	10	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	20	4	-12.4	-10.3	2.1	
16042	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16045	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16048	0	-	-	0	-	-	2932	66	0.0	0	-	-	11672	60	13.3	28566	172	8.7	43161	190	5.1	39113	195.0	5.1	36295	194.0	5.2	10.3	5.1	
16051	2475	51	0.0	7088	93	0.0	14618	92	3.0	0	-	-	13958	92	3.0	8873	101	0.0	18985	112	0.0	0	-	-	28439	134	-10.3	-10.3	0.0	
16054	2772	40	5.1	4027	66	0.0	10807	83	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16055	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16056	8711	176	0.0	1893	63	0.0	13493	87	0.0	0	-	-	12493	70	0.0	6661	102	0.0	16905	103	0.0	0	-	-	0	-	-	-	-	-
16057	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16058	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16059	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16060	11406	138	0.0	4354	75	0.0	25171	137	0.0	0	-	-	12623	76	0.0	8361	82	2.7	281	5	4.2	14080	125.0	2.7	36248	168.0	5.2	7.9	2.7	
16061	13225	94	4.3	1157	71	0.0	18018	115	0.0	140	11	0.0	16584	98	0.0	911	26	0.0	2403	34	2.1	0	-	-	273	11	-12.4	-12.4	0.0	
16062	5943	148	0.0	2495	48	0.0	9079	120	0.0	0	-	-	12485	88	0.0	12753	107	0.0	17968	107	0.0	0	-	-	10441	72	-10.3	-10.3	0.0	
16063	7905	134	5.1	3650	60	0.0	6098	84	0.0	739	10	0.0	17893	101	0.0	14630	106	0.0	12976	80	2.1	2127	21	0.0	0	-	-	-	-	-
16064	6717	139	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16065	3485	129	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16066	0	-	-	0	-	-	0	-	-	0	-	-	12928	84	0.0	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16067	4542	149	3.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16068	272	15	3.0	5623	73	0.0	22744	129	0.0	0	-	-	32671	142	0.0	17400	106	0.0	20418	116	0.0	0	-	-	123	10	-12.4	-10.3	2.1	
16069	0	-	-	0	-	-	678	4	0.0	0	-	-	20	2	0.0	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16070	12833	184	0.0	2	1	0.0	33086	118	0.0	0	-	-	2	1	0.0	23	6	0.0	144	14	2.1	2024	53	0.0	1868	25	-12.4	-12.4	0.0	
16071	7247	122	0.0	2351	38	0.0	11439	95	0.0	0	-	-	21854	118	0.0	7883	102	0.0	18505	100	0.0	0	-	-	1412	22	-10.3	-10.3	0.0	
16072	11220	174	0.0	11687	96	0.0	27653	142	3.0	958	5	0.0	10157	74	0.0	17250	108	0.0	22681	115	0.0	0	-	-	6828	100	-10.3	-10.3	0.0	
16073	2647	51	3.0	3284	66	0.0	1213	18	0.0	800	6	3.4	761	17	0.0	170	15	0.0	1629	83	0.0	4	2	0.0	7695	90	-10.3	-10.3	0.0	
16074	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	65	1	-48.2	-48.2	0.0	
16075	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
16076	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	11940	102	0	51871	187	5.1	53681	200	5.1	18313	119	5.2	13.9	8.7	
16077	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
32174	-	-	-	-	-	-	-	-	-	0	-	-	988	36	0.0	0	-	-	0	-	-	0	-	-	33639	165	5.2	10.3	5.1	
32175	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	6228	75	0	7739	101	0.0	0	-	-	12569	96	-10.3	-10.3	0.0	
32176	-	-	-	-	-	-	-	-	-	0	-	-	13046	87	0.0	13507	103	0.0	25715	118	0.0	0	-	-	0	-	-	-	-	-
32177	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-	-
54799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	40570	157	-12.4	-10.3	2.1	

**Table A1-2: 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), and 2019/2020 (October 8, 2019 to April 30, 2020) 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	2011/2012			2012/2013			2013/2014			2014/2015			2015/2016			2016/2017			2017/2018			2018/2019			2019/2020				
	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)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16018	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16019	0	-	-	887	39	0.6	2959	33	8.8	8761	79	2.8	14035	107	13.3	34307	144	8.7	49386	193	8.7	46504	201	0.0	46896	196	5.2	36.1	30.9
16020	0	-	-	3625	25	9.5	24335	102	8.8	6183	36	7.2	36598	188	7.2	40522	181	8.7	43215	188	8.7	42253	177	8.7	41964	199	5.2	13.9	8.7
16021	16475	79	29.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16022	0	-	-	1227	15	9.5	7508	83	4.1	10649	55	7.2	45870	197	7.2	21329	149	5.1	32696	193	5.1	51590	195	5.1	0	-	-	-	-
16024	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16025	0	-	-	1974	47	0.0	20670	114	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16027	0	-	-	3398	70	4.3	2111	24	1.6	23369	120	2.8	50070	189	13.3	17718	175	4.2	32484	177	5.1	35350	188	5.1	26437	164	5.2	7.9	2.7
16028	0	-	-	733	7	9.5	2123	8	14.9	21803	84	2.8	59177	199	2.5	5377	104	5.1	52456	184	5.1	79145	202	0.0	54606	167	5.2	10.3	5.1
16029	1937	39	9.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	16781	85	0.0	0	-	-	0	-	-	-	-
16030	12583	70	3.9	13733	89	4.3	2887	63	8.8	8872	97	7.2	24440	160	7.2	29177	156	4.2	49491	192	5.1	461	5	5.1	13133	85	5.2	13.9	8.7
16031	0	-	-	7414	26	3.8	45513	147	0.0	36654	117	0.0	58954	198	0.0	537	26	0.0	40104	140	6.5	14016	92	3.6	34404	129	10.3	18.6	8.3
16032	48676	67	3.1	2284	23	2.4	3780	48	8.8	4759	53	2.5	36289	190	4.7	39506	164	6.0	2367	21	8.7	7144	51	8.7	0	-	-	-	-
16033	125	3	2.3	-	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16033b	-	-	-	-	-	-	15689	104	7.3	3243	42	7.2	34665	149	7.2	17885	68	5.1	0	-	-	0	-	-	55567	204	5.2	9.4	4.2
16034	39927	61	20.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16035	7225	84	3.1	22099	113	2.4	29174	179	12.6	14317	83	2.8	60418	202	7.2	26922	190	4.2	43778	194	5.1	0	-	-	0	-	-	-	-
16037	36948	77	3.9	991	18	4.3	24601	133	3.0	10762	61	2.8	4277	21	2.5	1551	17	8.7	0	-	-	16566	107	2.7	28170	190	5.2	10.3	5.1
16038	14187	69	10.5	9	2	0.0	106	8	0.0	4	2	0.0	0	-	-	0	-	-	11575	61	0.0	26037	95	0.0	13692	71	-12.4	-10.3	2.1
16040	18814	85	3.9	23113	104	2.4	4436	21	12.6	5033	26	2.5	29413	189	2.5	39264	189	4.2	38059	189	4.2	30871	110	5.1	31853	92	9.4	16.8	7.4
16041	135	11	0.0	4328	25	3.8	16656	153	4.1	16912	74	2.5	30740	174	0.0	22473	119	6.0	48061	196	5.1	7027	121	3.6	31853	131	9.4	16.8	7.4
16043	6989	49	17.1	10520	95	16.0	16074	114	10.8	36372	188	10.8	17192	188	13.3	10142	166	13.4	18030	176	6.5	11163	81	6.5	40793	137	5.2	16.8	11.6
16044	9036	57	21.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16046	6972	85	3.1	248	25	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16047	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16049	20859	75	3.9	32364	157	4.3	24241	140	8.8	9993	101	2.8	18078	144	7.2	31523	176	8.7	16474	90	5.1	60739	199	5.1	52026	204	5.2	10.3	5.1
16050	345	3	0.0	18070	65	3.8	2920	50	10.8	8473	55	6.1	44567	169	4.7	23677	172	0.0	14296	93	6.5	37082	155	0.0	6670	84	10.3	13.9	3.6
16052	143	4	9.6	6505	78	7.6	34688	173	0.0	18189	165	11.0	49267	186	13.3	13313	124	0.0	4096	69	3.6	7370	89	8.7	3738	43	5.2	16.8	11.6
16053	2960	31	3.1	776	10	11.4	2209	20	14.9	7018	46	2.5	68422	200	2.5	26653	140	4.5	49211	184	5.1	26479	180	6.0	55416	199	7.9	10.3	2.4
32167	-	-	-	-	-	-	-	-	-	293	14	0.0	37839	187	7.2	30174	143	6.0	38220	144	8.9	27516	128	8.7	7289	64	10.3	13.9	3.6
32168	-	-	-	-	-	-	-	-	-	19931	142	13.3	47809	189	2.5	24622	74	8.7	22658	121	4.2	63772	194	8.7	45399	200	5.2	10.3	5.1
32169	-	-	-	-	-	-	-	-	-	444	6	2.5	51598	201	7.2	4141	22	8.7	42584	165	8.7	0	-	-	9080	123	5.2	7.9	2.7
32170	-	-	-	-	-	-	-	-	-	3328	69	2.8	0	-	-	47	2	2.7	0	-	-	0	-	-	0	-	-	-	-
32171	-	-	-	-	-	-	-	-	-	3275	24	13.3	53443	182	7.2	30627	156	5.1	65428	196	5.1	27162	176	5.1	55520	204	5.2	10.3	5.1
32172	-	-	-	-	-	-	-	-	-	8293	37	11.0	1455	13	7.2	9761	68	2.7	17548	93	2.7	0	-	-	3681	44	5.2	7.9	2.7
32173	-	-	-	-	-	-	-	-	-	3843	49	2.5	45871	157	2.5	46475	145	4.2	4357	69	4.2	15813	75	4.2	50454	196	5.2	10.3	5.1

**Table A1-3: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the 2019/2020 winter period (October 8, 2019 to April 30, 2020).**

Tag ID	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7017	24444	174	-10.3	-10.3	0.0
7018	1121	19	-12.4	-10.3	2.1
7019	2600	35	-12.4	-10.3	2.1
7020	607	21	-12.4	-12.4	0.0
7021	25206	79	-29.4	-29.4	0.0
7022	456	2	-29.4	-29.4	0.0
7023	8685	70	-10.3	-10.3	0.0
7024	27181	168	-10.3	-10.3	0.0
7025	3	1	-12.4	-12.4	0.0
7026	2214	41	-12.4	-12.4	0.0
7027	11820	105	-10.3	-10.3	0.0
7028	28985	177	-10.3	-10.3	0.0
7029	99	18	-10.3	-10.3	0.0
7030	8152	60	-10.3	-10.3	0.0
7031	27053	148	-10.3	-10.3	0.0
7032	8394	63	-10.3	-10.3	0.0
7033	0	-	-	-	-
7034	0	-	-	-	-
7053	219	13	-12.4	-10.3	2.1
7056	688	27	-12.4	-12.4	0.0
7059	852	14	-12.4	-10.3	2.1
7061	0	-	-	-	-
7064	696	37	-12.4	-10.3	2.1
7065	67	11	-10.3	-10.3	0.0
7066	959	39	-12.4	-10.3	2.1
7067	19911	124	-10.3	-10.3	0.0

**Table A1-4: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored in Stephens Lake during the 2019/2020 winter period (October 8, 2019 to April 30, 2020).**

Tag ID	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
7035	5505	54	5.2	5.8	0.6
7036	15525	114	5.2	10.3	5.1
7037	49403	202	5.2	10.3	5.1
7038	28537	127	5.2	7.9	2.7
7039	0	-	-	-	-
7040	40531	190	5.2	13.9	8.7
7041	14379	84	5.2	13.9	8.7
7042	22913	131	13.9	16.8	2.9
7043	34656	202	7.9	10.3	2.4
7044	31446	178	5.2	9.4	4.2
7045	24721	118	5.2	7.9	2.7
7046	0	-	-	-	-
7047	24191	165	7.9	10.3	2.4
7048	40541	160	5.2	13.9	8.7
7049	33043	177	5.2	13.9	8.7
7050	24998	152	5.2	18.6	13.4
7051	18711	120	5.2	13.9	8.7
7052	36882	196	5.2	36.1	30.9
7054	26409	175	5.2	9.4	4.2
7055	36130	192	5.2	10.3	5.1
7057	36308	203	5.2	10.3	5.1
7058	30636	159	7.9	18.6	10.7
7060	30137	184	5.2	10.3	5.1
7062	987	21	5.2	9.4	4.2
7063	4	1	5.2	5.2	0.0

**Table A1-5: Detection summary for adult Lake Sturgeon tagged prior to 2019 and monitored upstream of Keeyask GS 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), and 2020 (May 1 to September 23) periods. Tag id highlighted yellow = lost tags. Tag id highlighted purple = moved downstream through Gull Rapids/the Keeyask GS. Tag id highlighted green = moved downstream through the Kettle GS.**

Tag ID	2011			2012			2013			2014			2015			2016			2017			2018			2019			2020				
	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)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
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	29052	129	7.3	15615	107	4.7	5031	44	-33.8	-9.9	23.9
16036	2152	32	8.6	6980	86	9.4	5328	82	8.1	12362	112	10.0	20379	132	9.6	16678	140	10.2	11145	102	12.1	9722	90	14.7	13154	121	13.7	10082	90	-19.5	-3.8	15.7
16039	2260	42	13.3	5250	66	12.5	16487	107	11.3	12670	120	11.6	18372	119	10.5	15797	120	13.7	17882	110	13.7	23403	134	14.7	16641	116	14.7	16071	78	-29.4	-4.8	24.6
16042	1914	54	0.0	576	11	0.8	2626	30	3.4	6660	54	3.9	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16045	786	13	7.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16048	383	6	1.6	1773	37	0.8	10796	119	21.6	7527	93	21.7	20784	116	36.9	14738	108	22.3	15301	109	17.4	22386	128	23.5	27308	128	13.3	6739	83	0.6	18.8	18.2
16051	1935	76	8.7	5804	105	15.3	8015	115	13.4	10404	57	13.7	10706	126	26.5	8157	96	13.7	8451	85	11.6	15291	135	14.7	9992	112	19.9	60063	72	-17.4	-3.8	13.6
16054	2697	49	12.0	4278	101	10.6	11062	105	9.5	7102	93	12.1	17220	90	38.7	9099	114	23.9	5602	33	21.7	14850	85	21.7	4142	30	20.4	0	-	-	-	-
16055	1140	9	3.4	1384	27	5.7	8271	89	4.9	7657	86	10.0	5005	104	5.5	12401	92	5.5	8824	108	13.7	9709	88	7.6	15077	127	5.1	2544	48	-12.6	-6.2	0.0
16056	234	12	19.1	4665	87	10.6	12862	96	19.5	17163	115	10.0	18319	113	20.4	29142	135	23.6	16839	88	20.1	14370	110	29.0	8398	87	20.1	3647	50	-26.4	-9.9	16.5
16057	475	25	4.2	524	29	8.5	0	-	-	2	1	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16058	549	16	9.3	1071	4	9.7	0	-	-	0	-	-	0	-	-	418	13	3.9	1169	38	3.9	544	18	3.7	2030	90	3.9	0	-	-	-	-
16059	599	5	3.4	1696	32	10.4	13935	78	11.3	10991	57	5.1	4708	85	13.7	7570	59	3.5	6223	64	4.3	2903	91	14.7	14404	121	5.4	8370	64	-10.1	-3.8	6.3
16060	1759	43	7.1	4065	95	8.7	16366	124	7.1	13228	108	7.1	19911	115	7.4	8653	73	28.5	18575	115	11.8	12355	55	8.2	19060	132	13.3	2549	39	1.2	18.8	17.6
16061	711	37	2.4	4444	108	13.6	11503	114	5.5	7437	95	3.4	13771	111	13.7	15840	120	13.7	8642	79	13.7	11533	87	14.7	11202	107	8.1	0	-	-	-	-
16062	142	14	8.6	5624	86	12.4	16854	109	24.4	18336	129	7.9	19949	120	10.0	26029	145	10.0	18277	117	13.7	18684	137	24.6	15990	111	11.6	9066	76	-17.4	-9.9	7.5
16063	2617	59	10.4	9474	105	5.7	21588	126	9.3	23121	127	7.9	24981	137	10.0	28915	163	10.0	24788	121	10.0	14228	115	14.7	4478	36	37.6	0	-	-	-	-
16064	1910	27	19.1	573	26	1.2	0	-	-	0	-	-	0	-	-	5	2	0.0	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16065	931	36	4.5	6192	109	17.9	2581	38	5.1	3101	38	5.1	14349	104	28.0	7730	73	4.3	3061	62	13.7	4711	71	5.4	3448	90	14.7	3904	59	-12.9	-3.8	9.1
16066	772	39	1.8	4615	105	10.6	2322	36	8.1	8898	73	12.1	1884	20	7.9	6940	104	13.7	10910	94	6.1	10160	115	12.6	13197	127	8.1	5808	75	-15	-4.8	10.2
16067	1640	34	1.6	2516	39	31.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	19167	114	38.3	2314	23	34.5	0	-	-	-	-
16068	1046	27	2.4	5882	105	10.6	10402	111	23.9	13158	121	10.0	16490	123	10.0	20273	135	13.7	13842	118	10.0	12545	121	16.6	3126	89	22.4	6469	90	-19.5	-9.9	9.6
16069	0	-	-	17495	85	4.5	13288	100	7.3	14172	66	2.9	8287	80	10.0	24559	122	5.1	18718	92	7.3	19345	102	2.9	12791	93	2.9	1420	44	-29.4	-26.4	3.0
16070	1080	40	8.6	14691	106	17.0	7943	89	9.6	9967	83	9.6	12593	101	10.0	4083	80	13.7	3202	80	10.0	4014	78	14.7	5686	83	14.7	0	-	-	-	-
16071	1403	43	8.6	9124	89	10.6	11285	130	9.3	17413	102	12.1	39272	131	13.7	37521	151	9.9	31215	124	13.7	21205	139	11.6	16737	122	14.7	3957	67	-12.5	-4.8	7.7
16072	2839	58	12.9	4031	91	10.6	16638	129	19.5	19306	112	7.9	15866	127	10.0	6608	129	10.0	16299	127	3.3	10676	115	22.4	8895	114	3.0	281	16	-19.5	-10.3	9.2
16073	1025	35	2.4	4432	102	12.4	6885	94	9.3	13884	127	10.0	4500	73	13.7	25145	151	13.7	10316	113	13.7	14231	124	14.7	9649	114	13.7	8206	71	-15	-3.8	11.2
16074	0	-	-	13006	67	4.7	11803	78	2.9	3105	23	7.3	655	13	15.9	2889	25	3.9	2957	24	3.7	3174	20	3.9	7540	77	3.9	98	5	-48.2	-19.5	28.7
16075	462	10	6.3	0	-	-	0	-	-	0	-	-	865	35	4.3	0	-	-	0	-	-	61208	134	0.0	61112	137	1.0	34499	81	-4.8	-4.8	0.0
16076	1040	35	6.3	2225	56	9.4	9270	81	11.3	9075	84	11.6	12474	79	11.6	27013	118	9.0	16851	94	24.0	21817	127	23.5	18015	128	18.0	11704	68	0.6	18.8	18.2
16077	282	5	0.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
32174	-	-	-	-	-	-	-	-	-	9705	98	28.5	20042	118	42.4	15062	82	28.9	11336	60	12.7	1751	18	15.6	17944	90	18.0	8199	72	0.6	18.8	18.2
32175	-	-	-	-	-	-	-	-	-	9186	90	6.0	22601	114	5.3	48213	134	3.4	32547	133	5.3	11208	84	3.6	31761	117	3.6	15497	81	-19.5	-9.9	9.6
32176	-	-	-	-	-	-	-	-	-	22630	106	11.6	15054	109	26.5	23822	111	7.1	32410	125	7.0	23353	141	10.2	45707	134	14.7	23157	55	-5.7	-4.8	0.9
32177	-	-	-	-	-	-	-	-	-	20678	109	5.5	265	15	0.6	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
54799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16229	111	21.7	17416	132	9.6	7294	74	-19.5	-9.9	9.6

**Table A1-6: 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), and 2020 (May 1 to September 23) 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	2011			2012			2013			2014			2015			2016			2017			2018			2019			2020				
	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)	n	# Days	Range (rkm)	n	# Days	Range (rkm)	n	# Days	U/S (rkm)	D/S (rkm)	Range (rkm)
16018	0	-	-	341	5	34.5	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
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	19589	99	20.4	17756	128	24.1	9491	89	1.2	18.8	17.6
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	13674	104	34.9	8865	97	35.5	9754	105	1.2	18.6	17.4
16021	2770	21	14.2	4530	30	5.0	0	-	-	0	-	-	0	-	-	1331	18	1.0	0	-	-	0	-	-	0	-	-	0	-	-	-	-
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	19908	126	17.4	17340	141	24.1	12292	96	1.2	18.8	17.6
16024	0	-	-	398	9	4.0	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16025	0	-	-	2316	67	35.2	9668	119	10.2	1572	23	60.4	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
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	14092	119	17.4	16367	142	9.7	3342	42	1.2	18.8	17.6
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	22350	126	17.4	16146	125	24.1	7884	76	1.2	16.8	15.6
16029	3801	62	58.1	6087	102	19.9	4940	83	10.2	13325	102	16.0	8716	94	10.2	5821	101	20.1	12873	85	10.2	4030	80	10.2	3475	56	10.2	4059	37	-10.1	-3.8	
16030	7733	86	15.5	6414	86	14.4	13494	86	25.5	16498	104	27.4	15935	94	17.7	10843	118	34.9	16302	127	34.9	18034	120	17.4	21071	113	18.0	7288	78	1.2	18.8	17.6
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	19537	128	17.4	10698	123	18.0	5722	71	1.2	32	30.8
16032	5801	56	14.2	13833	120	16.0	17055	115	19.7	16765	118	18.2	11985	106	16.1	18322	116	17.5	29122	157	17.4	23612	107	15.6	0	-	-	0	-	-	-	-
16033	5144	44	14.2	3001	43	37.5	0	-	-	-	-	-	-	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16033b	-	-	-	-	-	-	3505	30	12.4	13578	101	17.4	28621	127	16.1	21058	118	17.4	27766	127	12.7	20613	108	9.1	26564	129	9.7	10265	65	1.2	13.4	12.2
16034	15378	75	11.2	15394	61	2.2	38582	117	0.8	25117	99	4.8	30925	119	0.8	10170	70	15.9	13	2	0.0	0	-	0.0	0	-	-	0	-	-	-	-
16035	1547	12	10.9	8767	91	14.4	19324	116	20.3	16298	121	19.7	23142	119	17.7	19523	133	23.5	27311	149	17.4	6244	35	39.6	0	-	-	0	-	-	-	-
16037	8375	50	7.4	13685	108	11.9	21481	125	44.3	13636	91	47.2	17230	113	16.1	13411	89	17.4	15203	109	17.4	19431	114	15.6	18611	126	17.4	9668	91	0.6	16.8	
16038	5777	45	11.2	3402	87	31.0	7973	124	9.3	3975	76	10.0	10827	75	12.1	15190	103	10.0	13109	131	10.2	12193	97	19.5	10310	99	13.7	7297	78	-19.5	-9.9	
16040	9602	70	12.5	8598	109	12.0	21959	128	18.0	4833	62	18.2	15041	122	19.7	15740	117	17.4	12642	92	17.4	16018	114	17.4	13386	90	18.0	6521	52	3.8	18.8	15.0
16041	15169	88	11.2	9437	81	40.7	8915	81	14.4	13556	111	14.4	15807	101	16.1	14398	113	13.7	20805	136	17.4	19091	126	17.4	12752	115	18.0	12102	106	1.2	16.1	14.9
16043	20429	92	15.5	13049	98	11.9	12476	115	14.4	13303	118	15.8	20525	131	17.7	22234	122	13.7	18103	135	17.4	13235	102	17.4	23678	143	18.0	41	12	0.6	9.4	8.8
16044	1582	36	8.7	3932	53	11.9	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16046	8350	72	24.7	199	68	23.5	360	10	7.2	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16047	131	2	19.7	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-	-	-
16049	1919	12	11.2	11705	102	26.9	24320	123	27.7	11319	83	27.4	20752	132	16.1	16056	127	22.3	22073	140	39.7	23304	115	39.7	21421	149	40.3	4135	31	5.2	18.6	13.4
16050	6519	57	15.5	7755	85	11.9	14411	88	14.2	7019	69	19.7	13783	98	13.6	17742	93	13.7	18778	72	12.7	12123	103	17.4	14718	124	13.3	6917	61	1.2	18.8	17.6
16052	1920	17	11.2	4785	80	16.0	9791	65	20.5	8323	68	19.7	10937	96	17.4	13008	113	17.4	19047	127	17.4	14140	110	15.6	11608	122	16.2	6330	63	0.6	18.8	18.2
16053	2740	18	12.5	13416	114	16.0	17049	126	18.2	13586	95	20.5	26058	130	16.1	29704	139	15.6	27363	150	12.7	29144	145	12.7	16622	138	13.3	11491	90	1.2	18.8	17.6
32167	-	-	-	-	-	-	-	-	-	10421	91	20.5	33420	126	16.1	26260	130	22.3	27586	142	17.4	24579	138	17.4	12795	107	24.1	2460	49	4.5	18.8	14.3
32168	-	-	-	-	-	-	-	-	-	18169	100	20.5	34961	140	16.1	27764	134	22.3	35684	132	17.4	26784	129	17.4	28311	138	23.5	18990	85	1.2	18.8	17.6
32169	-	-	-	-	-	-	-	-	-	614	20	2.4	24873	131	15.2	26025	131	17.4	24410	124	17.4	16832	100	17.4	22173	118	18.0	5085	65	1.2	18.8	17.6
32170	-	-	-	-	-	-	-	-	-	5151	77	20.5	17310	127	16.1	13320	103	17.4	0	-	-	0	-	-	0	-	-	0	-	-	-	-
32171	-	-	-	-	-	-	-	-	-	36691	103	17.4	22567	111	16.1	27226	134	17.4	26214	120	12.7	34797	129	17.4	28597	138	9.7	10449	68	1.2	18.8	17.6
32172	-	-	-	-	-	-	-	-	-	19105	86	9.7	17221	108	9.7	19907	110	13.7	23914	93	8.2	18285	92	9.1	23516	110	13.3	8565	73	0.6	16.8	16.2
32173	-	-	-	-	-	-	-	-	-	24278	103	9.7	28920	117	9.7	26056	107	9.1	32014	127	9.1	36522	119	9.1	33008	128	9.7	11175	76	1.2	8.7	7.5



**Table A1-7: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored upstream of the Keeyask GS during the 2019 (June 1 to October 7) and 2020 (May 1 to September 23) open-water periods.**

Tag ID	2019					2020				
	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
7018	8505	88	-46.9	-9.9	37.0	6403	72	-17.4	-3.8	13.6
7019	9944	102	-19.5	-7.4	12.1	6530	72	-19.5	-5.8	13.7
7020	11960	94	-24.7	-4.8	19.9	3797	59	-15	-3.8	11.2
7021	7937	51	-33.8	-26.5	7.3	10778	71	-34.3	-26.4	7.9
7022	22714	105	-33.8	-24.7	9.1	7286	46	-48.2	-26.4	21.8
7023	7212	82	-33.8	-9.9	23.9	3849	84	-17.4	-9.9	7.5
7024	6599	80	-33.8	-9.9	23.9	5966	84	-33.8	-2.2	31.6
7025	17574	114	-46.9	-9.9	37.0	10765	90	-17.4	-9.9	7.5
7026	6780	46	-46.9	-9.9	37.0	3840	52	-29.4	-8.9	20.5
7027	10611	112	-19.5	-9.9	9.6	12281	69	-19.5	-6.2	13.3
7028	18216	108	-19.5	-9.9	9.6	10967	96	-17.4	-8.9	8.5
7029	7705	94	-19.5	-9.9	9.6	7584	67	-19.5	-9.9	9.6
7030	6345	100	-19.5	-9.9	9.6	5911	72	-19.5	-8.9	10.6
7031	18594	117	-19.5	-4.8	14.7	9560	92	-19.5	-5.8	13.7
7032	9883	114	-19.5	-4.8	14.7	3024	55	-19.5	-9.9	9.6
7033	18839	116	-12.5	-4.8	7.7	1428	16	-48.2	-4.8	43.4
7034	13573	98	-29.4	-4.8	24.6	10215	69	-17.4	-3.8	13.6
7053	8500	106	-19.5	-9.9	9.6	5183	70	-19.5	-9.9	9.6
7056	4253	89	-19.5	-9.3	10.2	3597	71	-19.5	-8.9	10.6
7059	9639	97	-19.5	-9.3	10.2	18696	102	-17.4	-9.9	7.5
7061	12007	93	-29.4	-4.8	24.6	11986	71	-8.9	-2.2	6.7
7064	13665	104	-33.8	-9.9	23.9	5783	62	-29.4	-9.9	19.5
7065	7891	107	-24.7	-9.9	14.8	6776	60	-19.5	-9.9	9.6
7066	12321	108	-19.5	-9.3	10.2	8428	81	-29.4	-9.9	19.5
7067	8705	109	-19.5	-5.8	13.7	10238	78	-15	-6.2	8.8

**Table A1-8: Detection summary for adult Lake Sturgeon tagged in 2019 and monitored in Stephens Lake during the 2019 (June 1 to October 7) and 2020 (June 1 to September 23) open-water periods.**

Tag ID	2019					2020				
	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
7036	19903	109	0.6	10.3	9.7	12401	102	2.7	9.4	6.7
7037	21304	127	1.2	18.6	17.4	8027	68	0.6	18.8	18.2
7038	12726	78	0.6	10.3	9.7	12491	75	0.6	13.0	12.4
7039	10752	109	0.6	18.6	18.0	4523	69	0.6	18.8	18.2
7040	5823	89	0.6	18.6	18.0	7485	78	0.6	18.8	18.2
7041	20381	108	0.6	18.6	18.0	7261	77	1.2	18.8	17.6
7042	18735	119	0.6	18.6	18.0	10964	98	0.6	16.8	16.2
7043	3795	22	3.9	18.6	14.7	12258	100	1.2	18.8	17.6
7044	10107	94	0.6	18.6	18.0	8483	73	1.2	24.7	23.5
7045	5079	23	0.6	13.9	13.3	8293	87	0.6	18.6	18.0
7046	4188	22	1.2	7.9	6.7	10581	86	0.6	9.4	8.8
7047	11770	101	1.2	13.9	12.7	12139	92	1.2	13.4	12.2
7048	19411	107	1.2	13.9	12.7	21325	110	0.6	13.4	12.8
7049	17017	113	0.6	18.6	18.0	7696	100	2.7	24.9	22.2
7050	20573	116	0.6	13	12.4	10323	80	0.6	16.1	15.5
7051	13163	108	0.6	18.6	18.0	12468	75	0.6	18.8	18.2
7052	16243	106	0.6	24.7	24.1	8029	92	1.2	18.8	17.6
7054	30588	96	0.6	18.6	18.0	22518	109	1.2	18.8	17.6
7055	18411	112	0.6	10.3	9.7	11888	97	1.2	18.8	17.6
7057	27099	110	0.6	10.3	9.7	15469	92	1.2	18.8	17.6
7058	13394	113	0.6	18.6	18.0	6453	101	0.6	18.8	18.2
7060	16679	120	0.6	10.3	9.7	17039	85	0.6	10.3	9.7
7062	27646	122	0.6	10.3	9.7	10919	90	1.2	8.7	7.5
7063	27802	111	0.6	10.3	9.7	9448	85	0.6	13.4	12.8

## APPENDIX 2:

# LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF THE KEEYASKGS, JUNE 2011 TO SEPTEMBER 2020

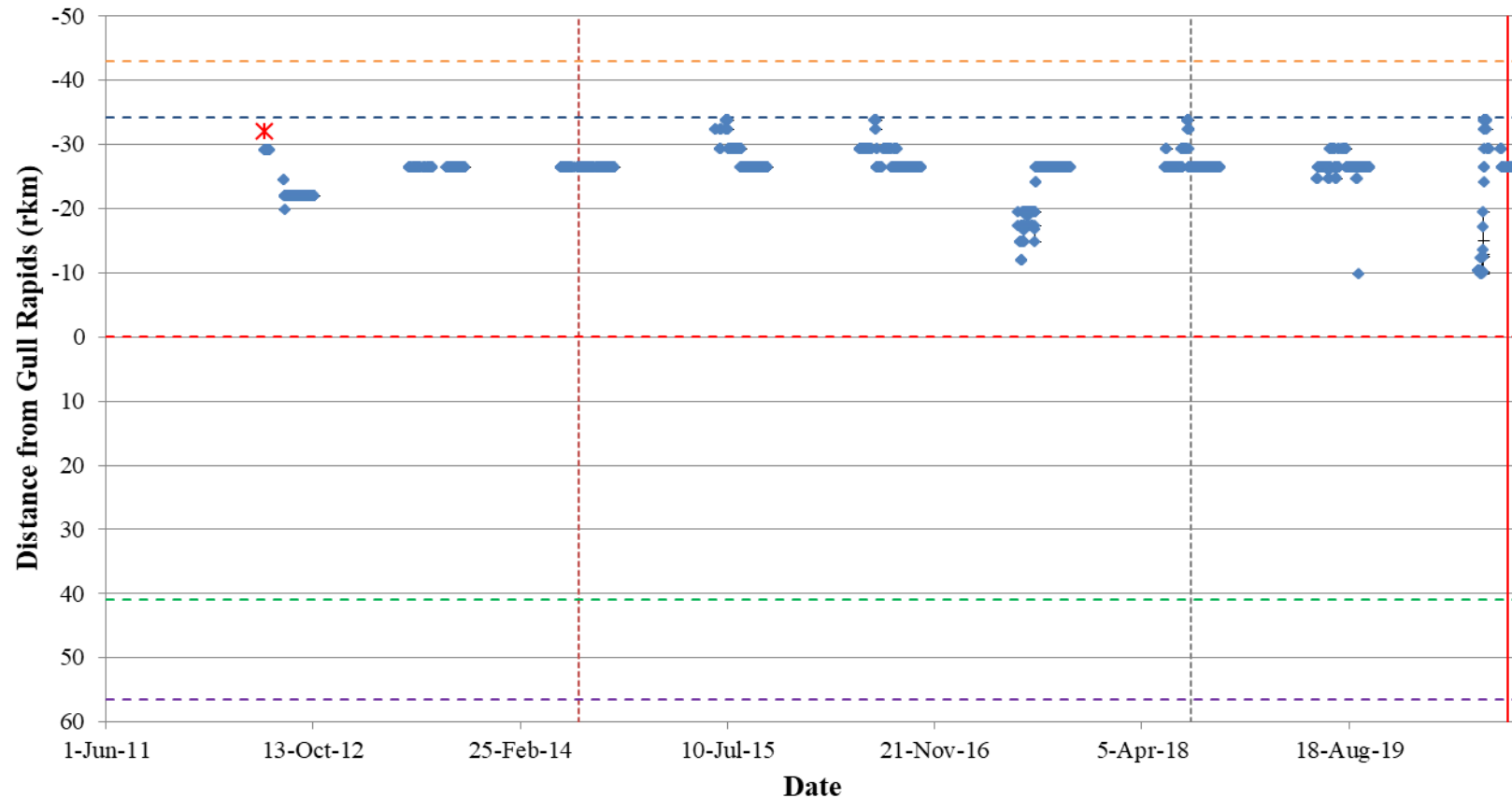
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Figure A2-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020.....	99
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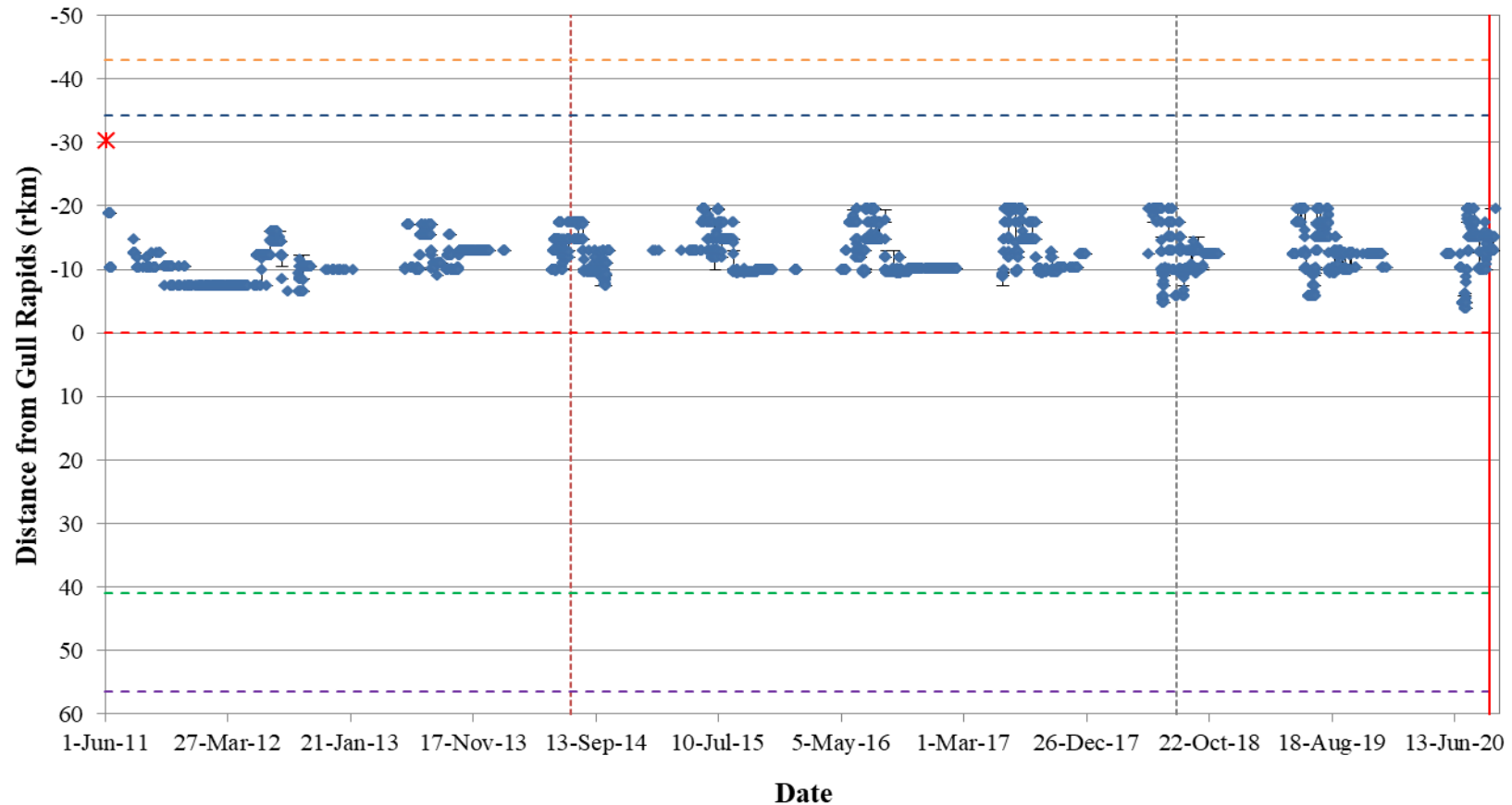
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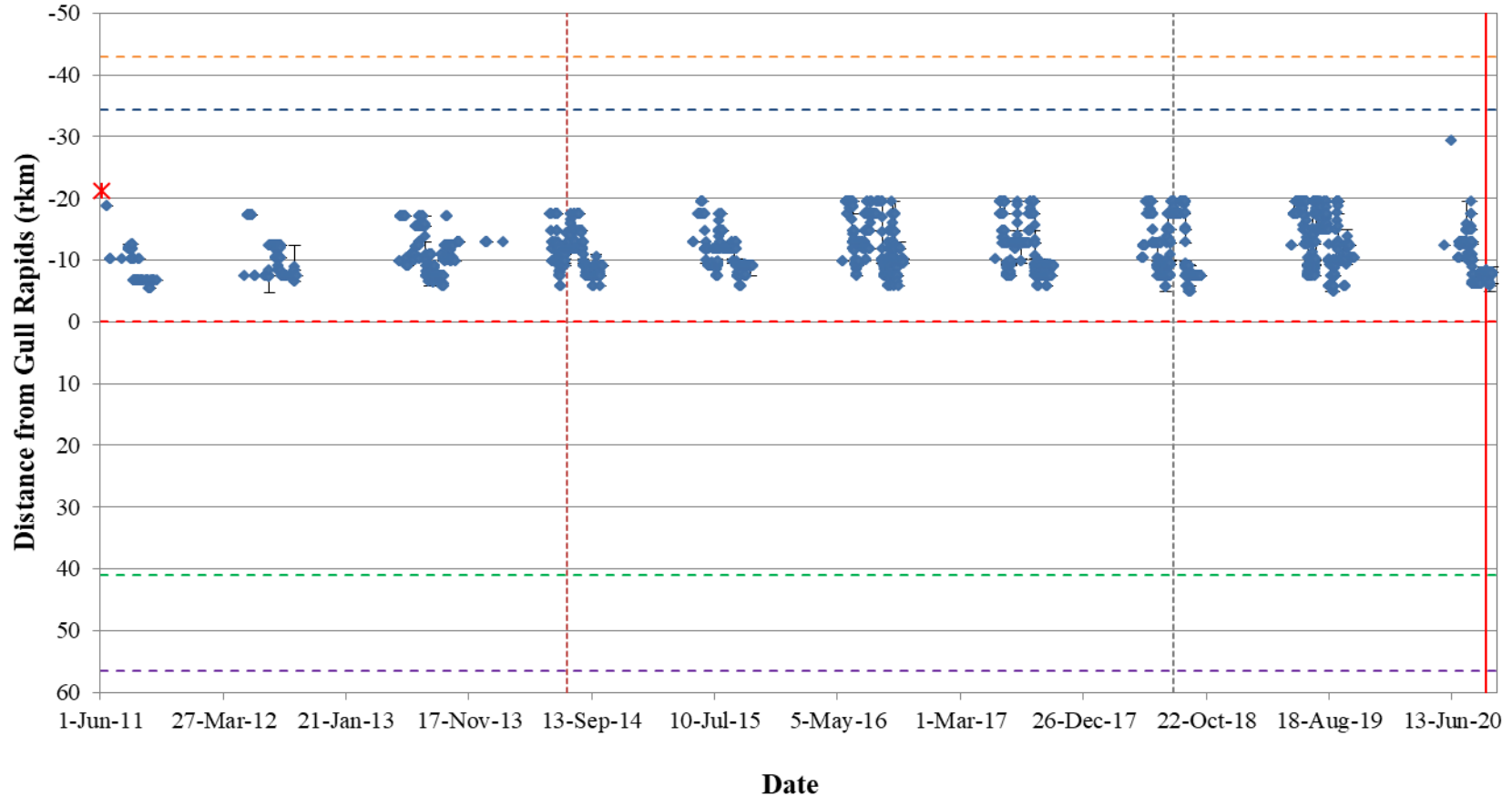


**Figure A2-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

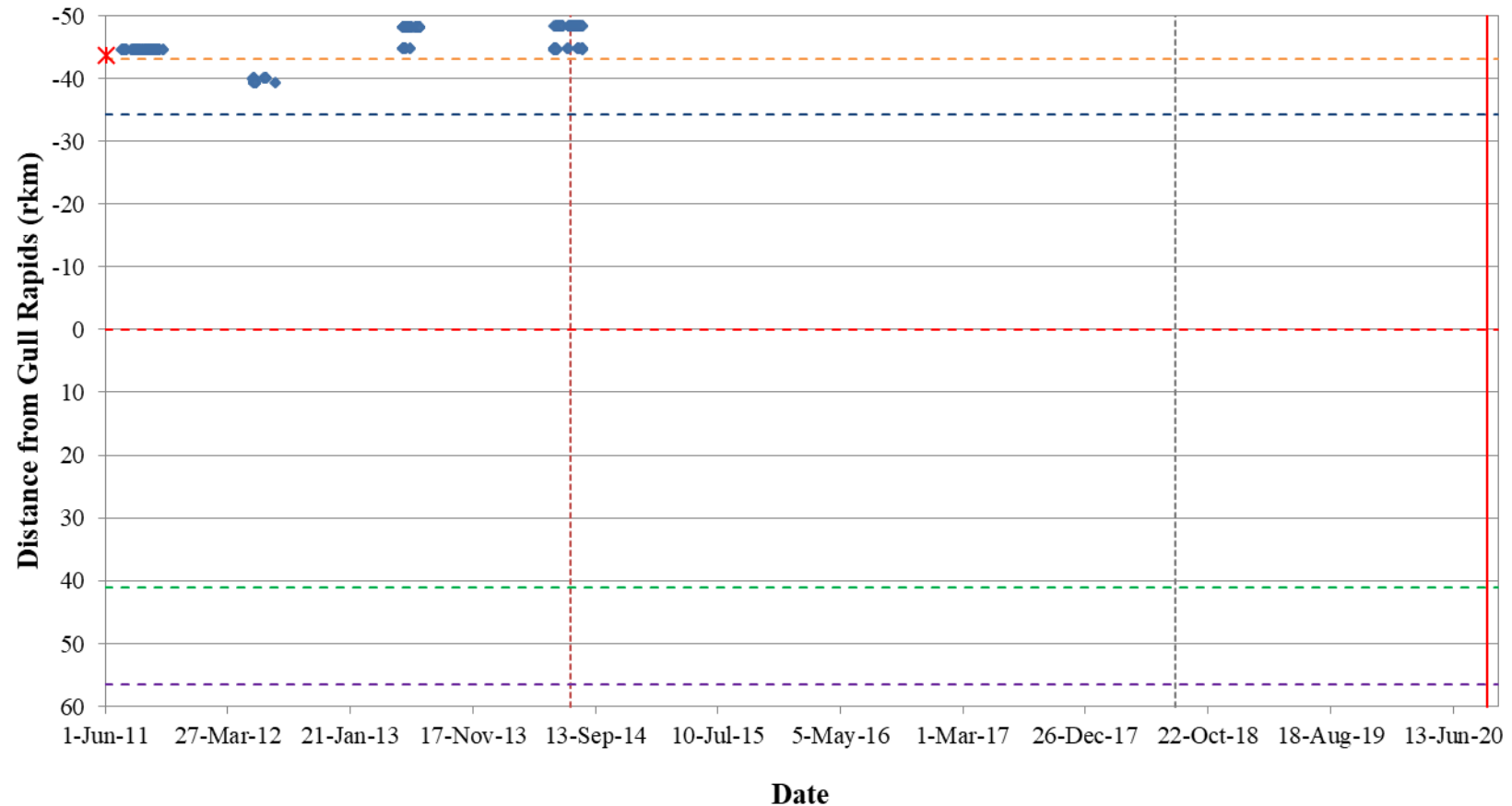




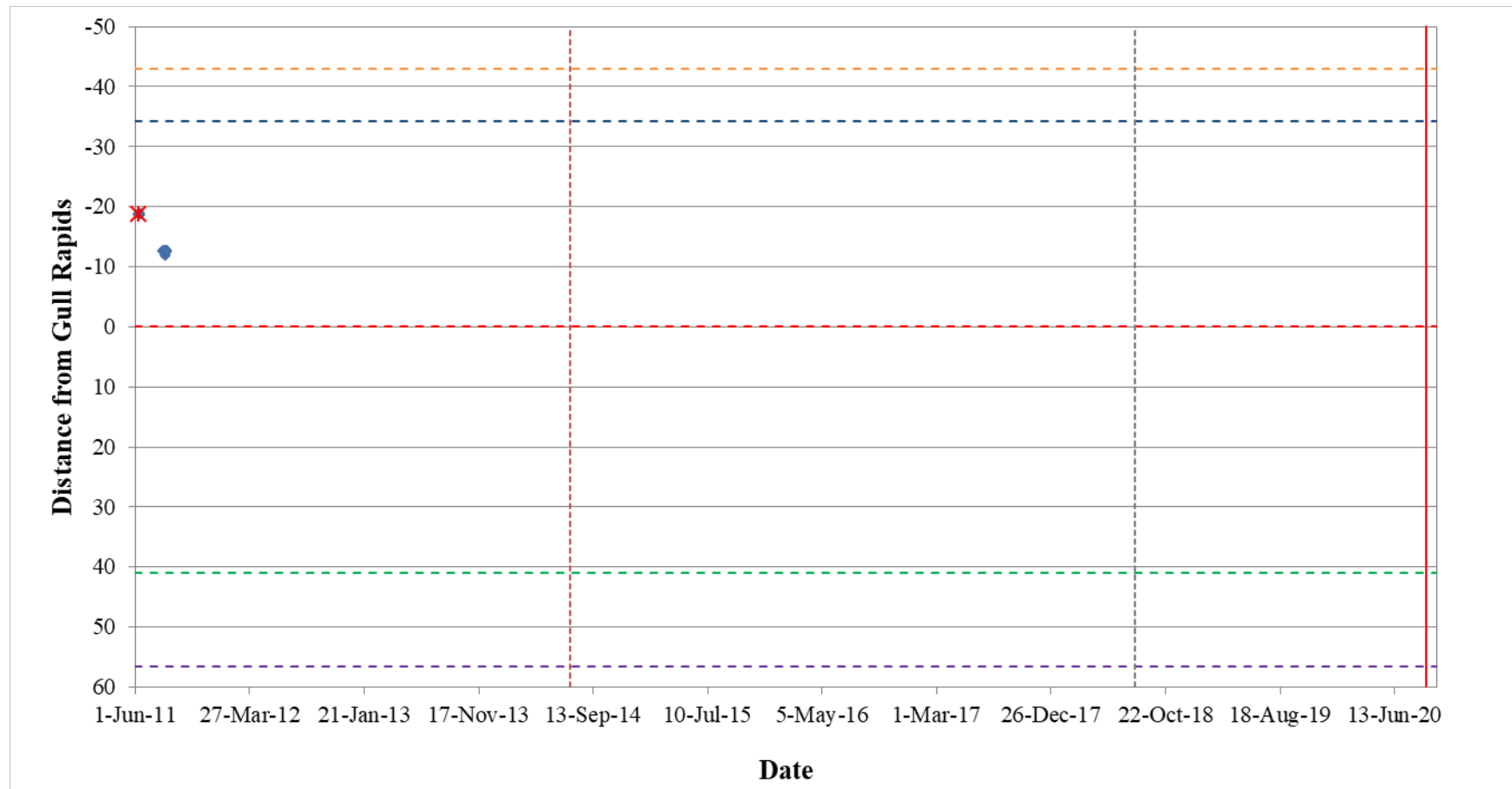
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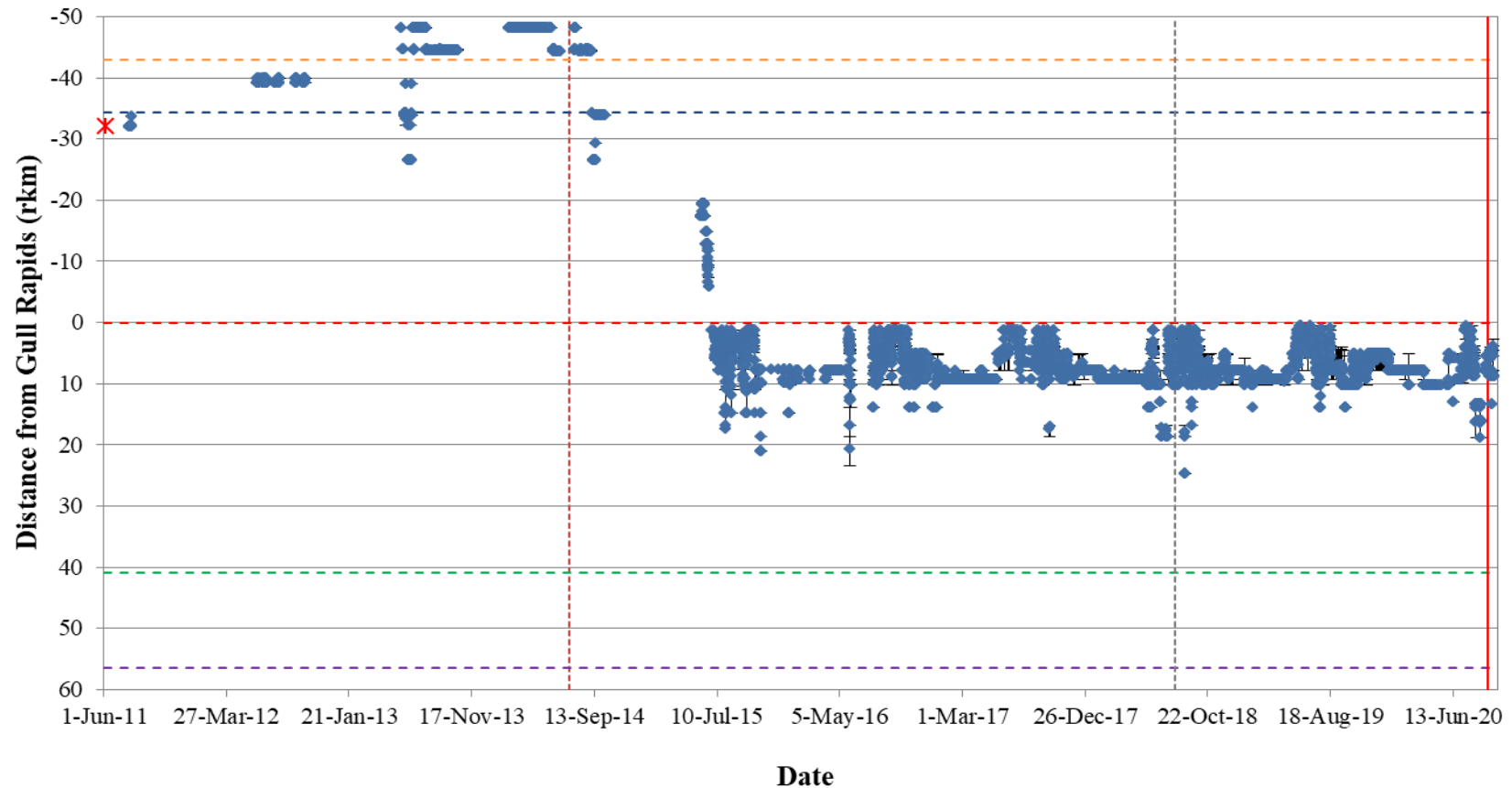
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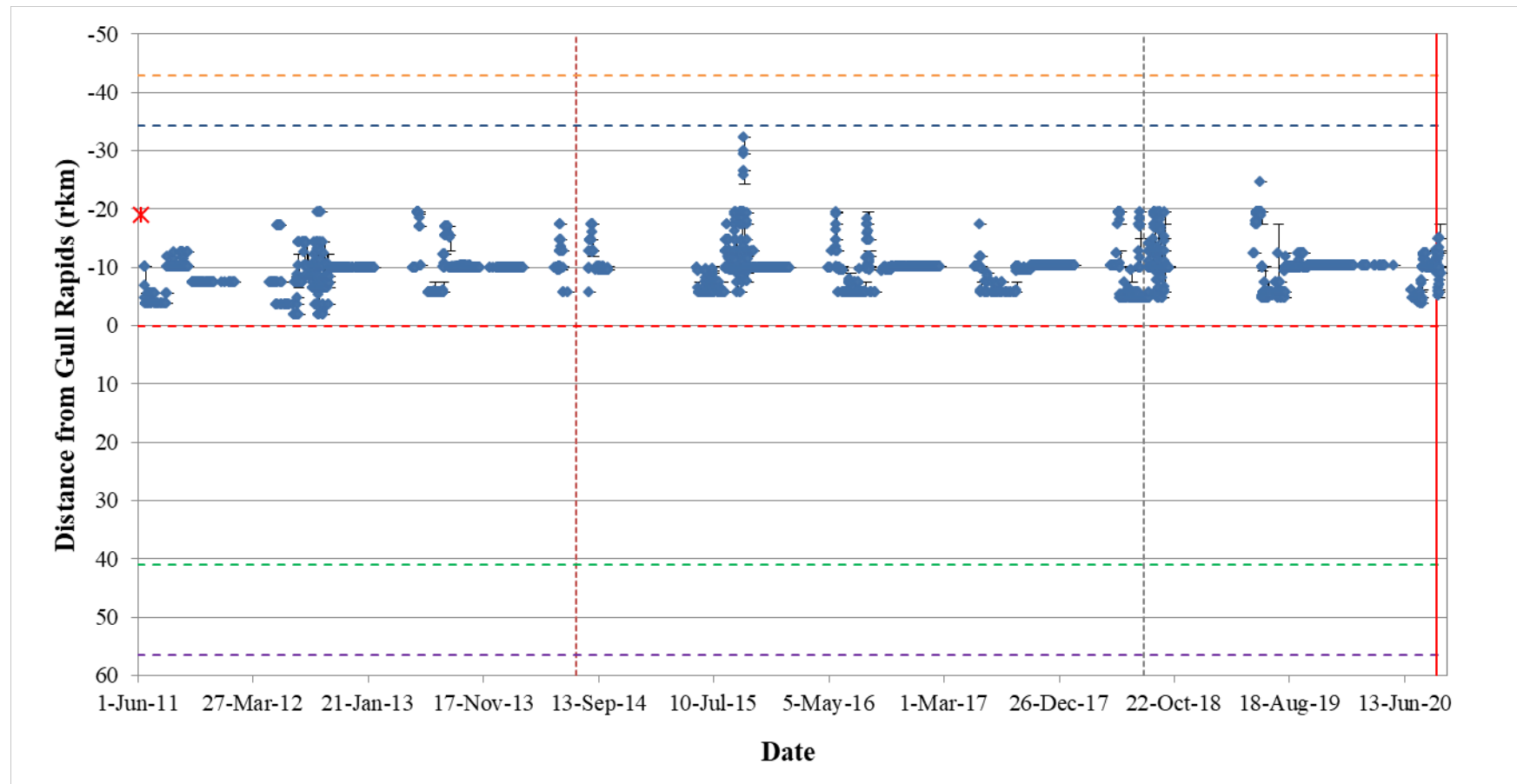
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**Figure A2-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16045) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location 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).**

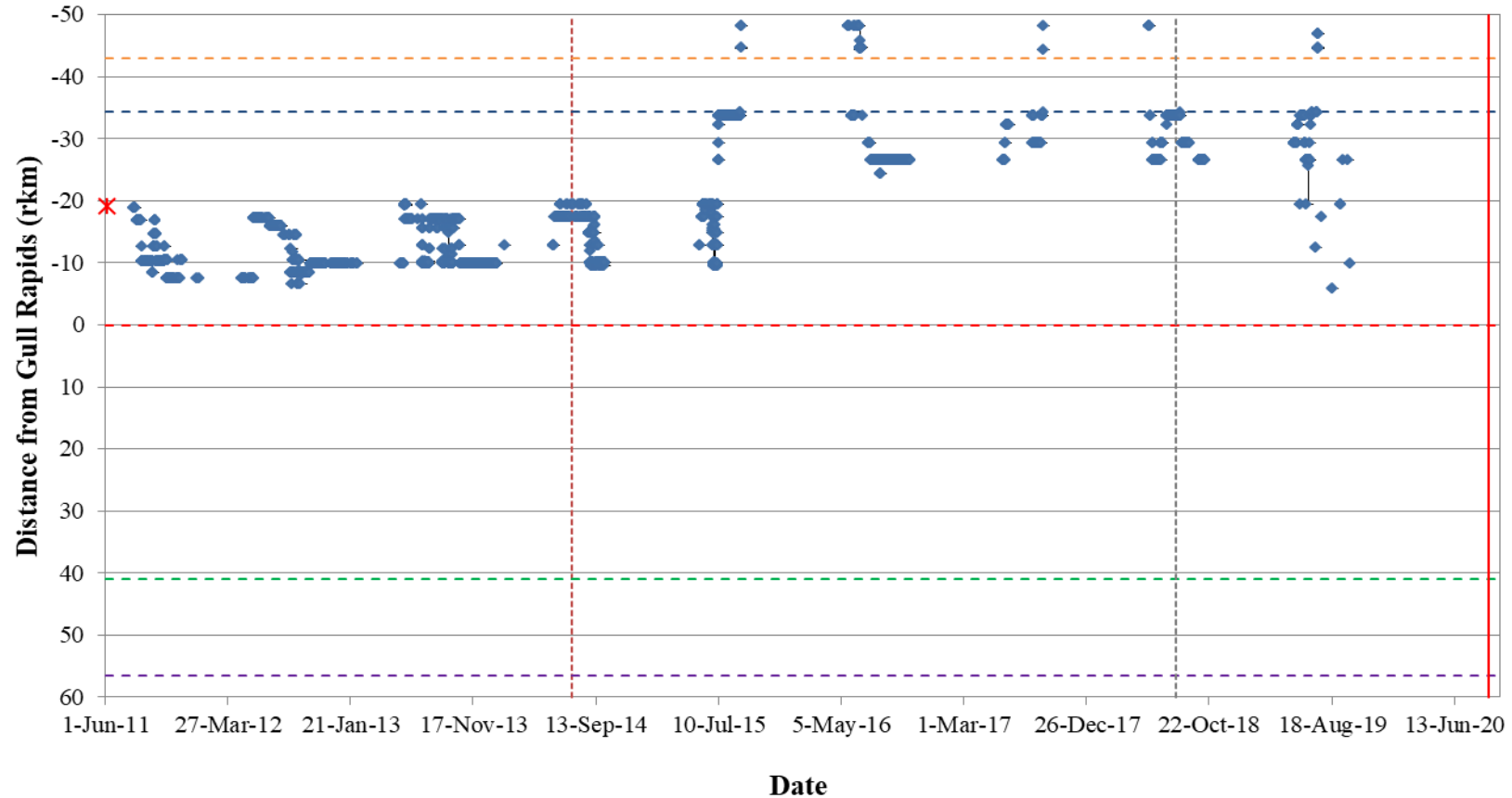


**Figure A2-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16048) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

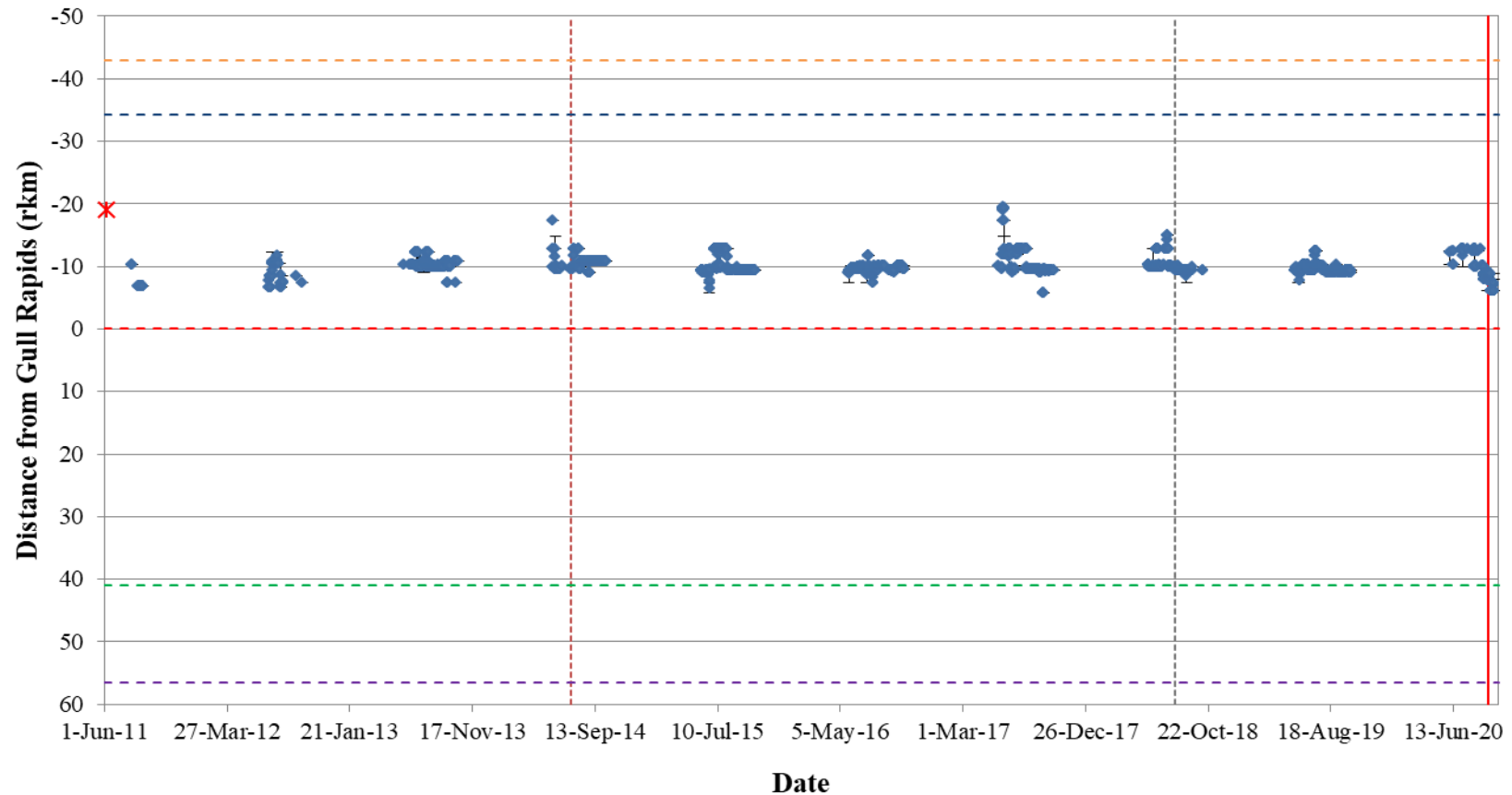


**Figure A2-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16051) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

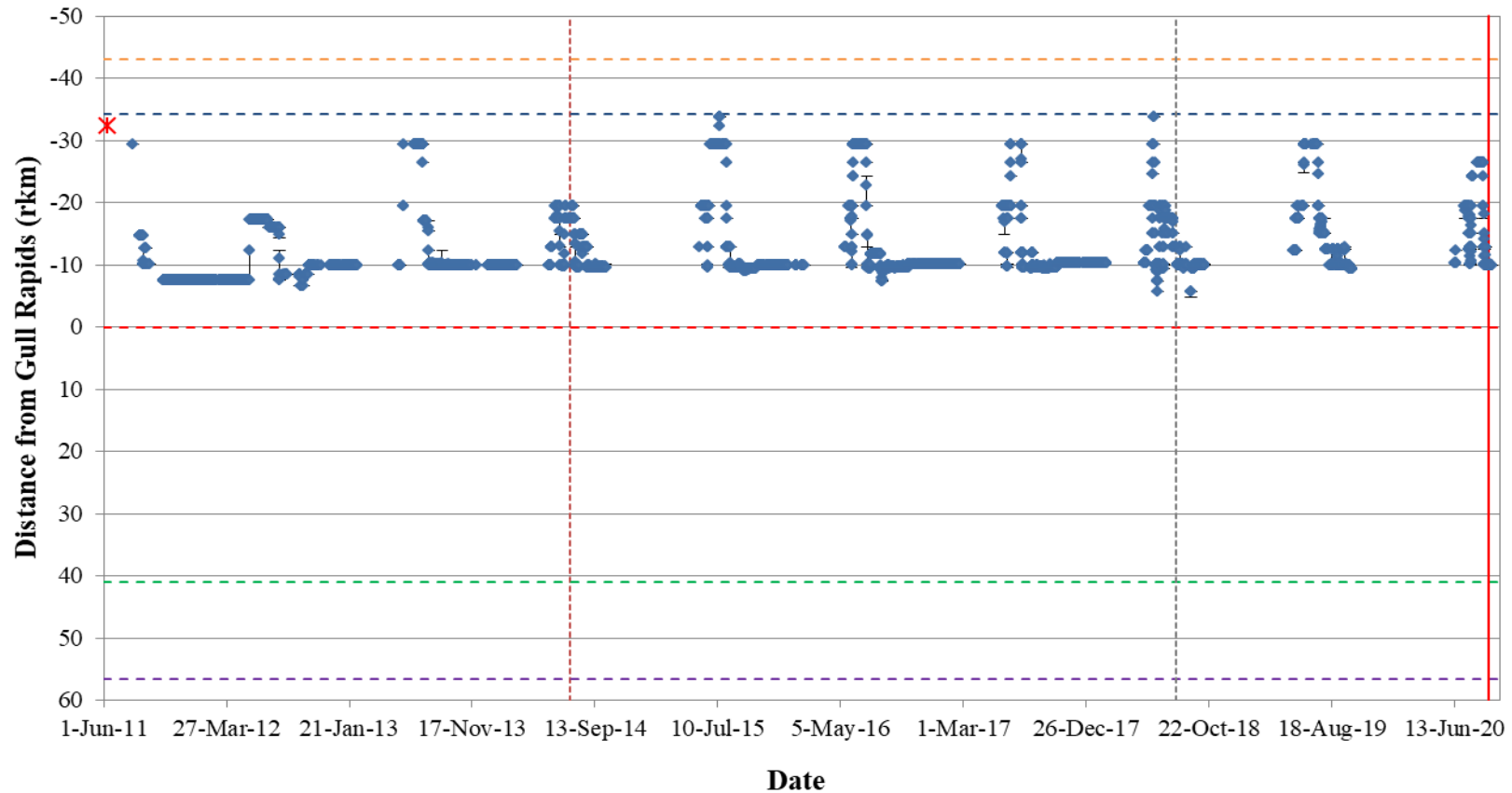




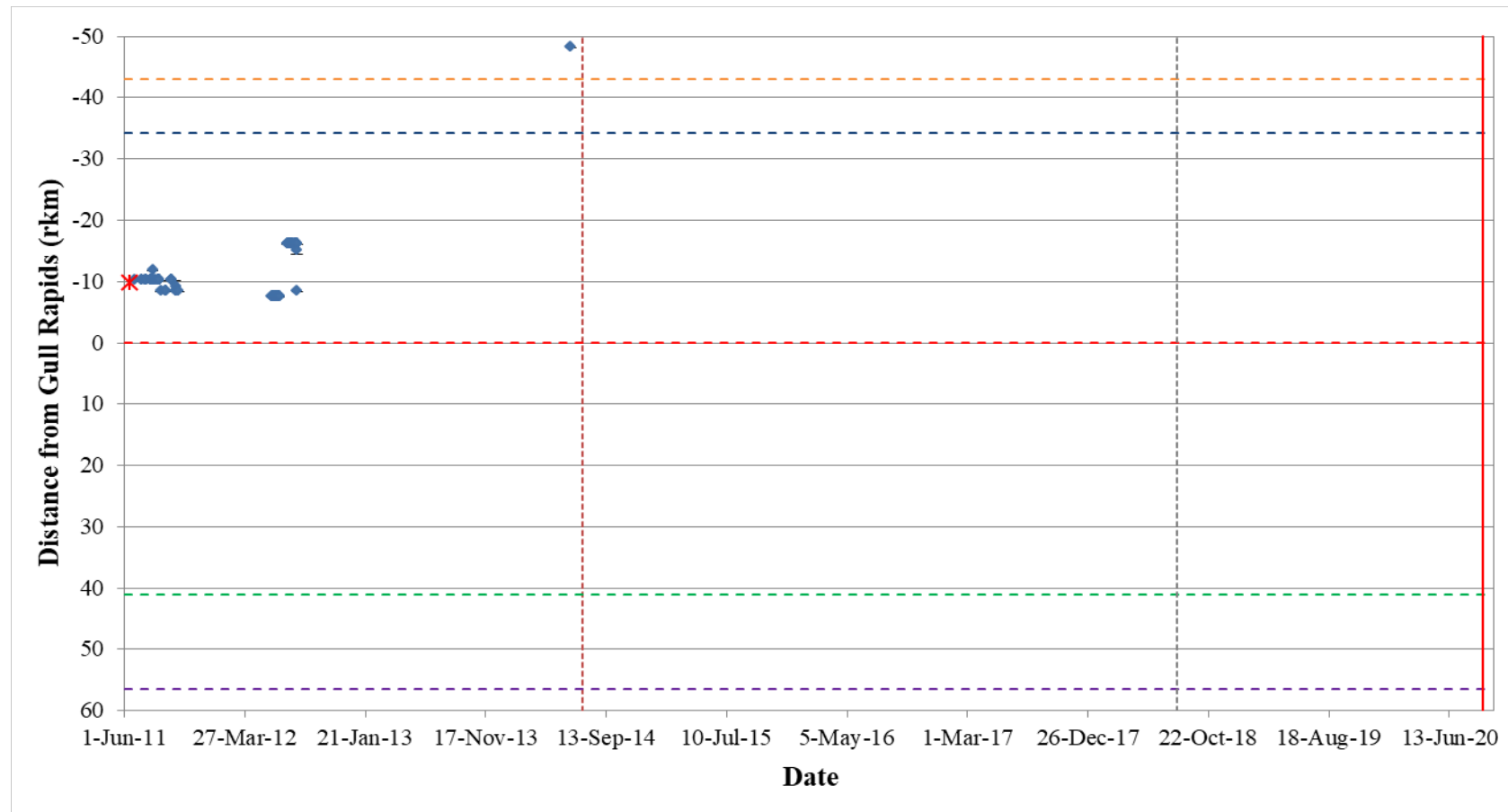
**Figure A2-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16054) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



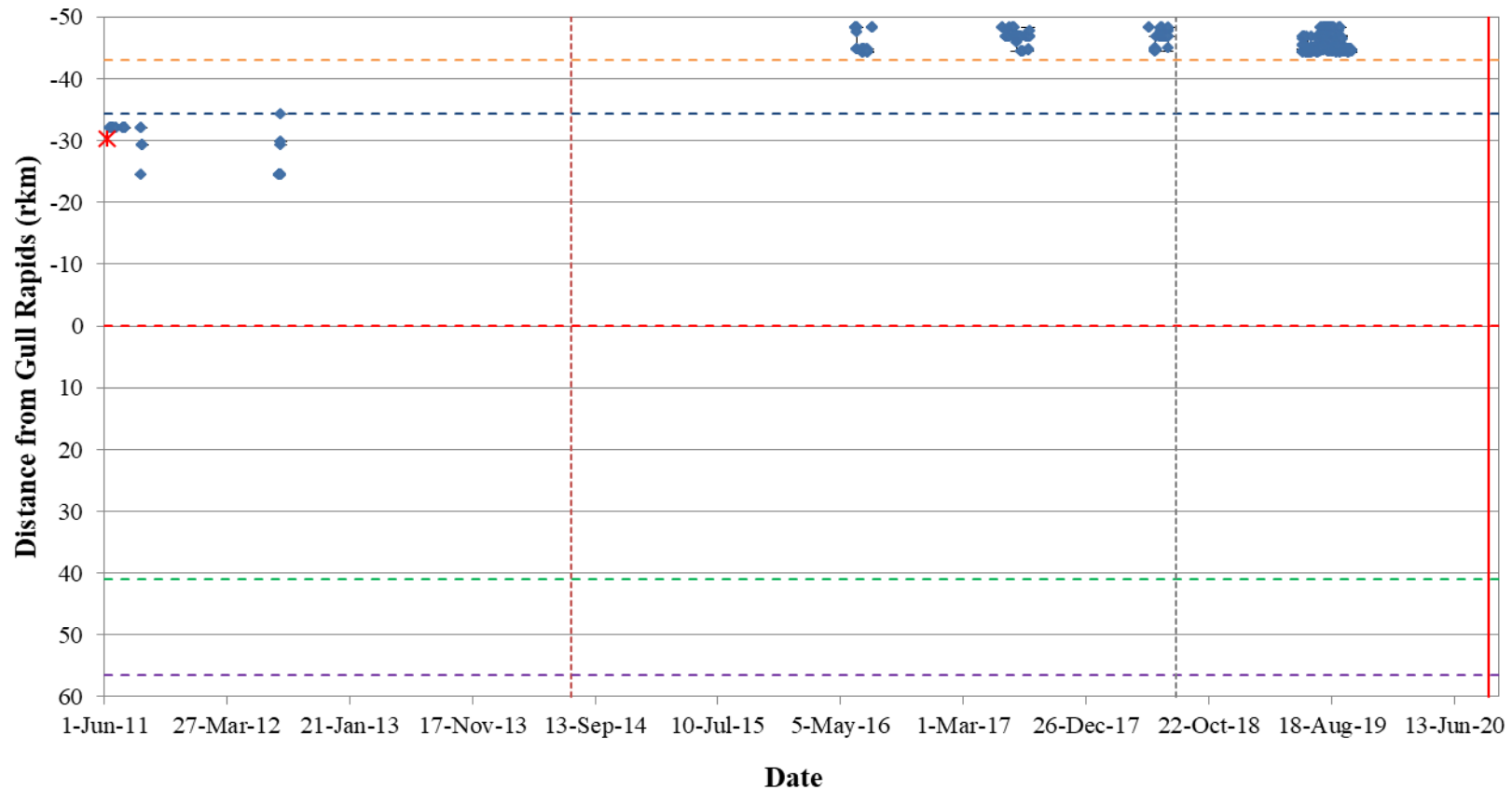
**Figure A2-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16055) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



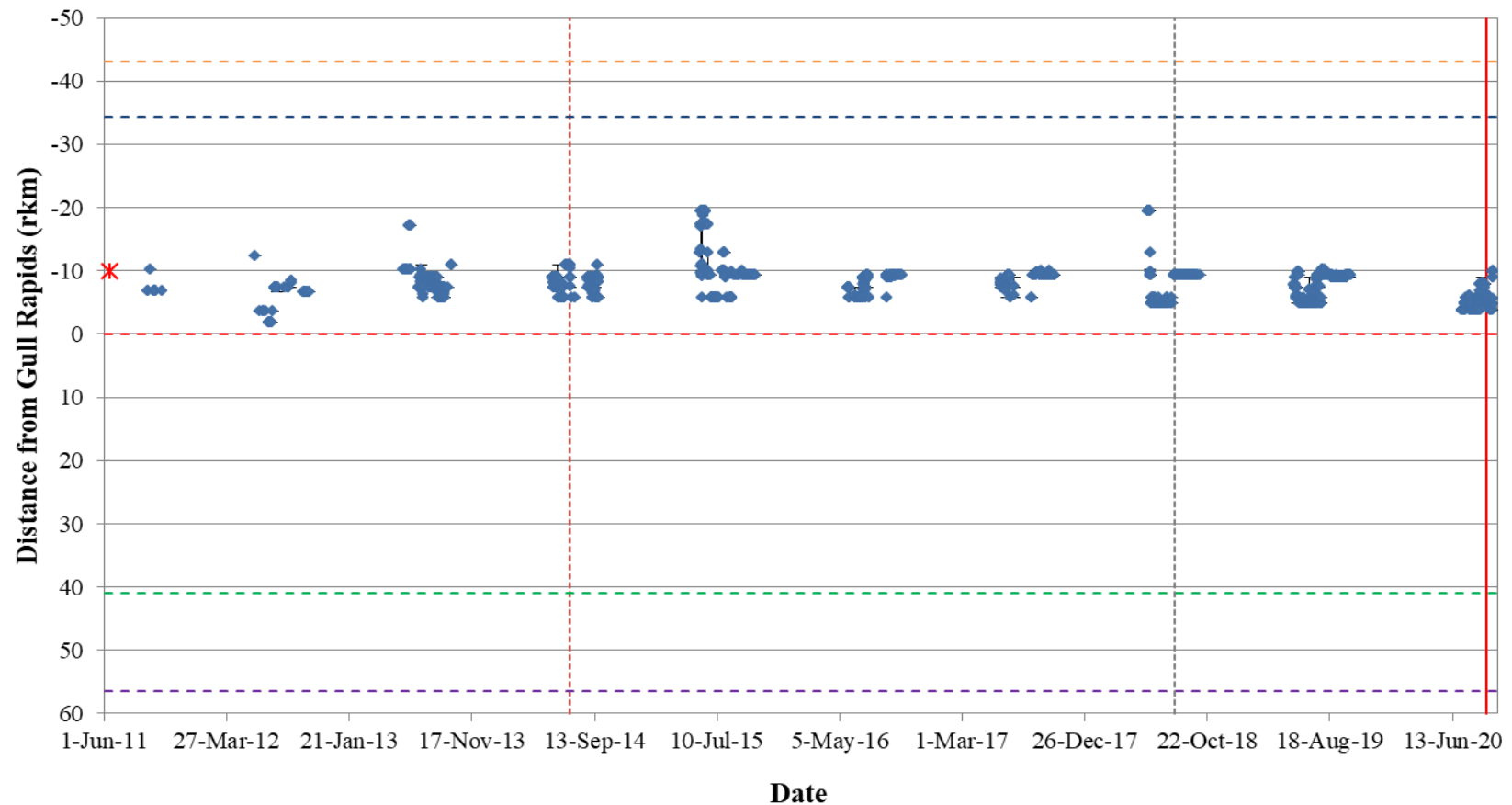
**Figure A2-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16056) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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 A2-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16057) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

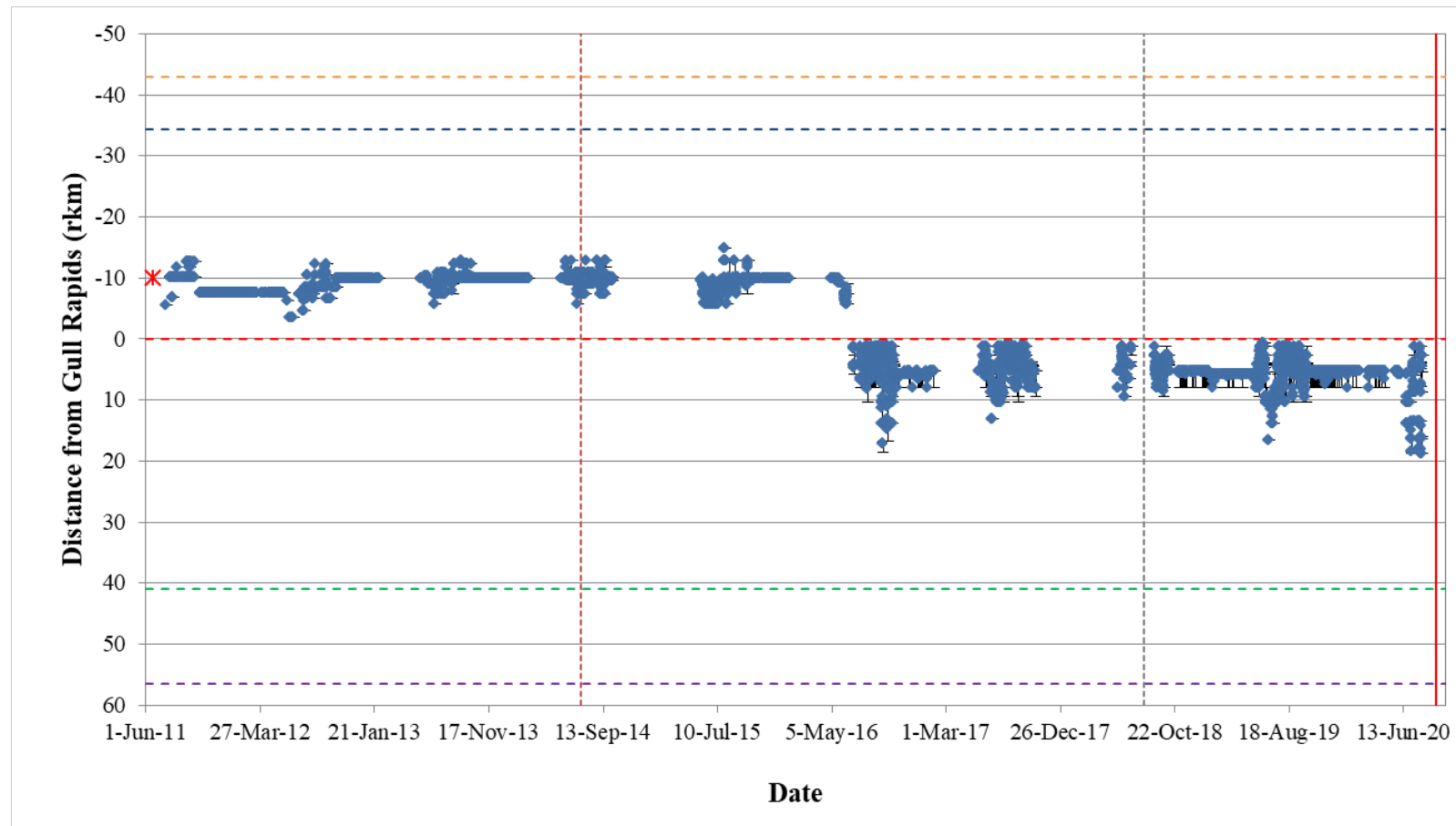


**Figure A2-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16058) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

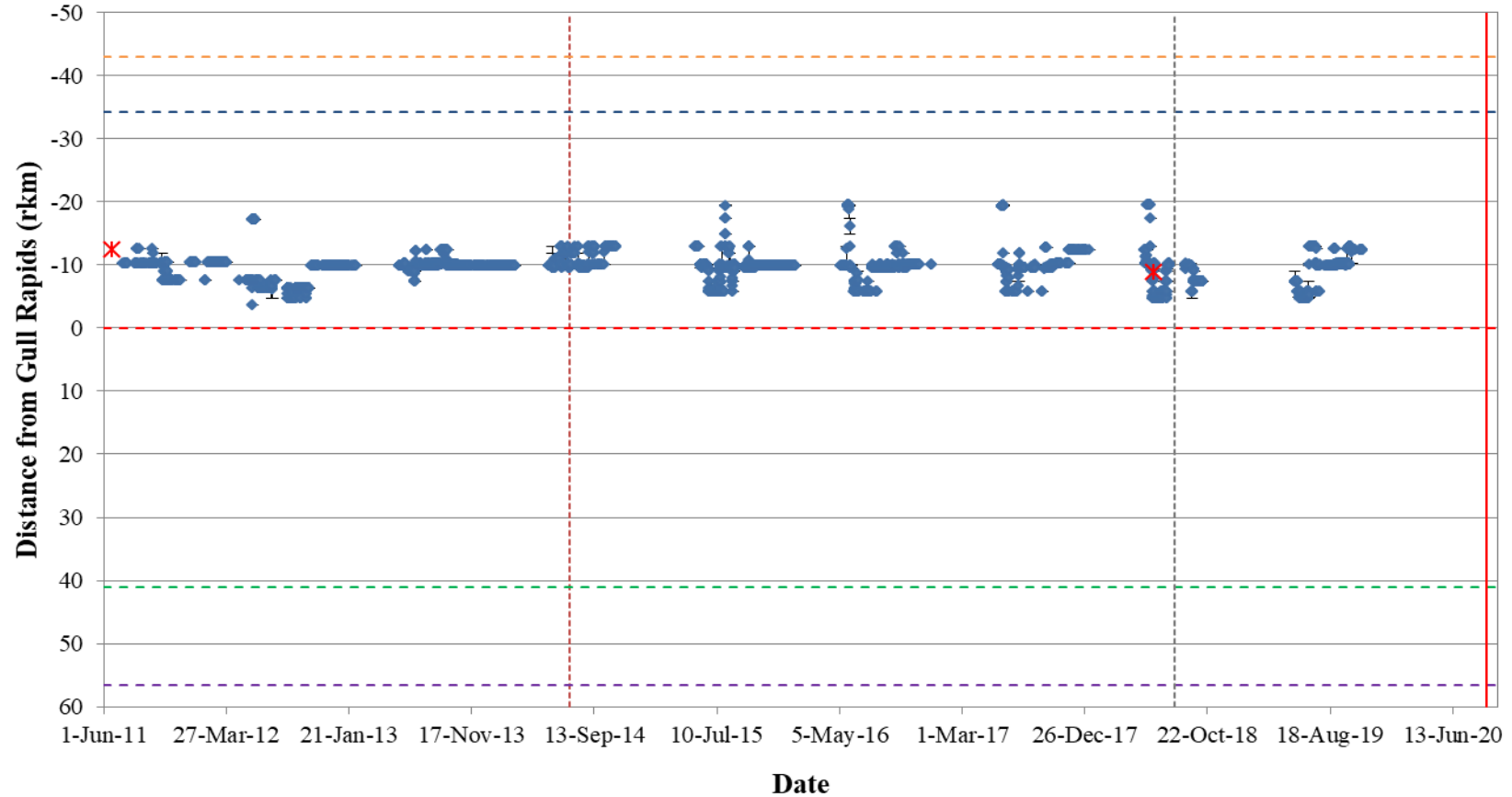


**Figure A2-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16059) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

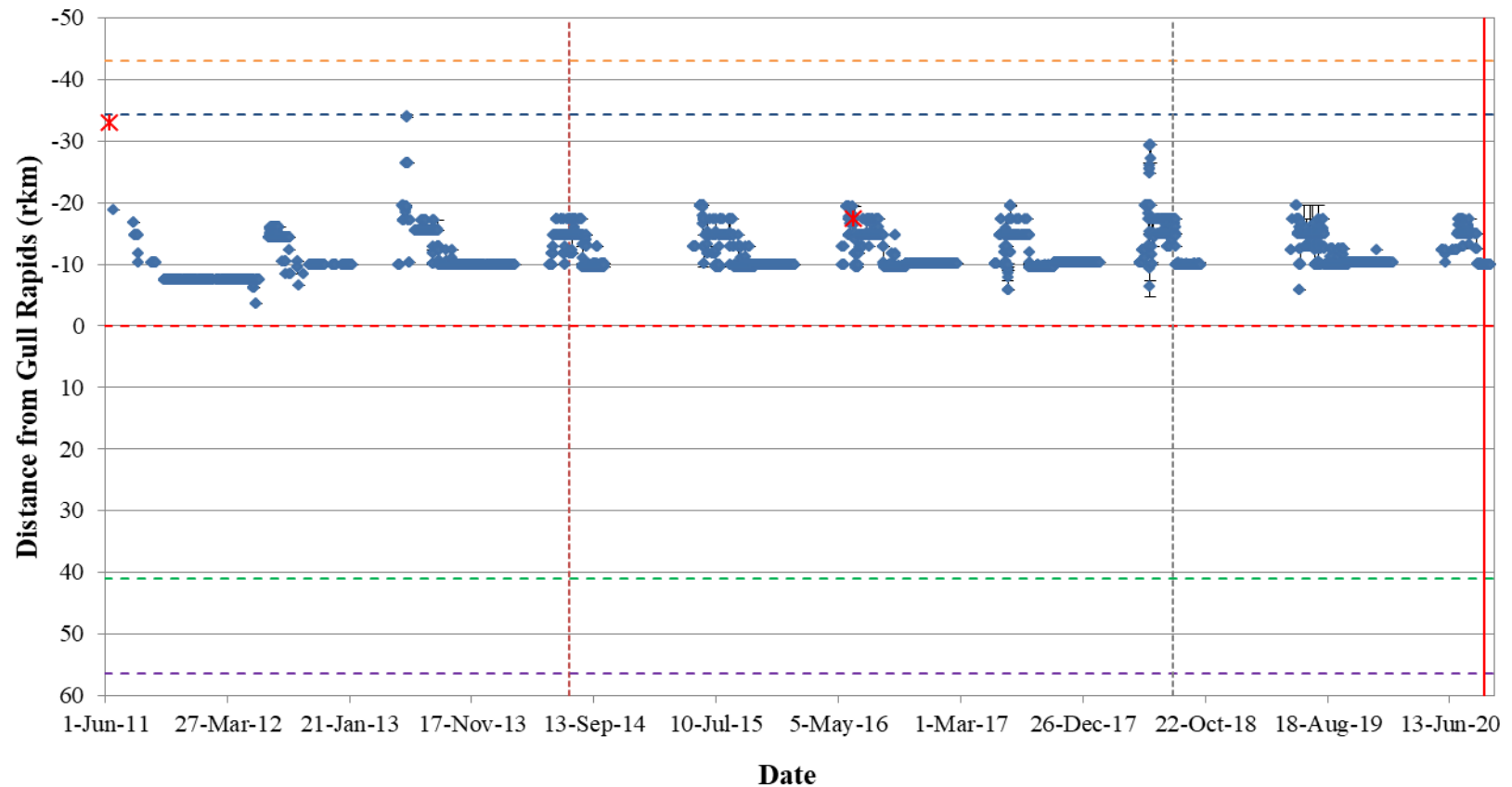




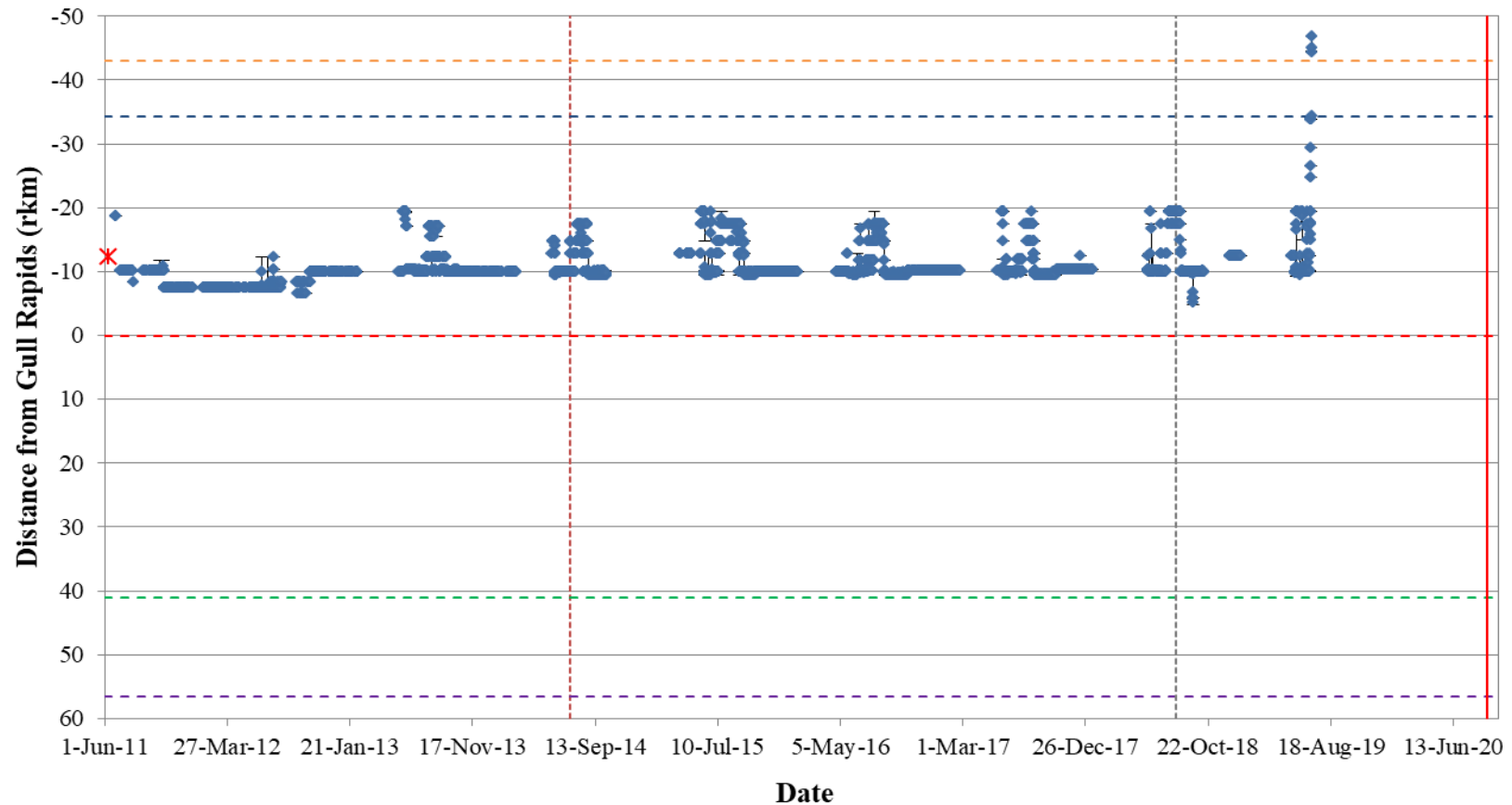
**Figure A2-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16060) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



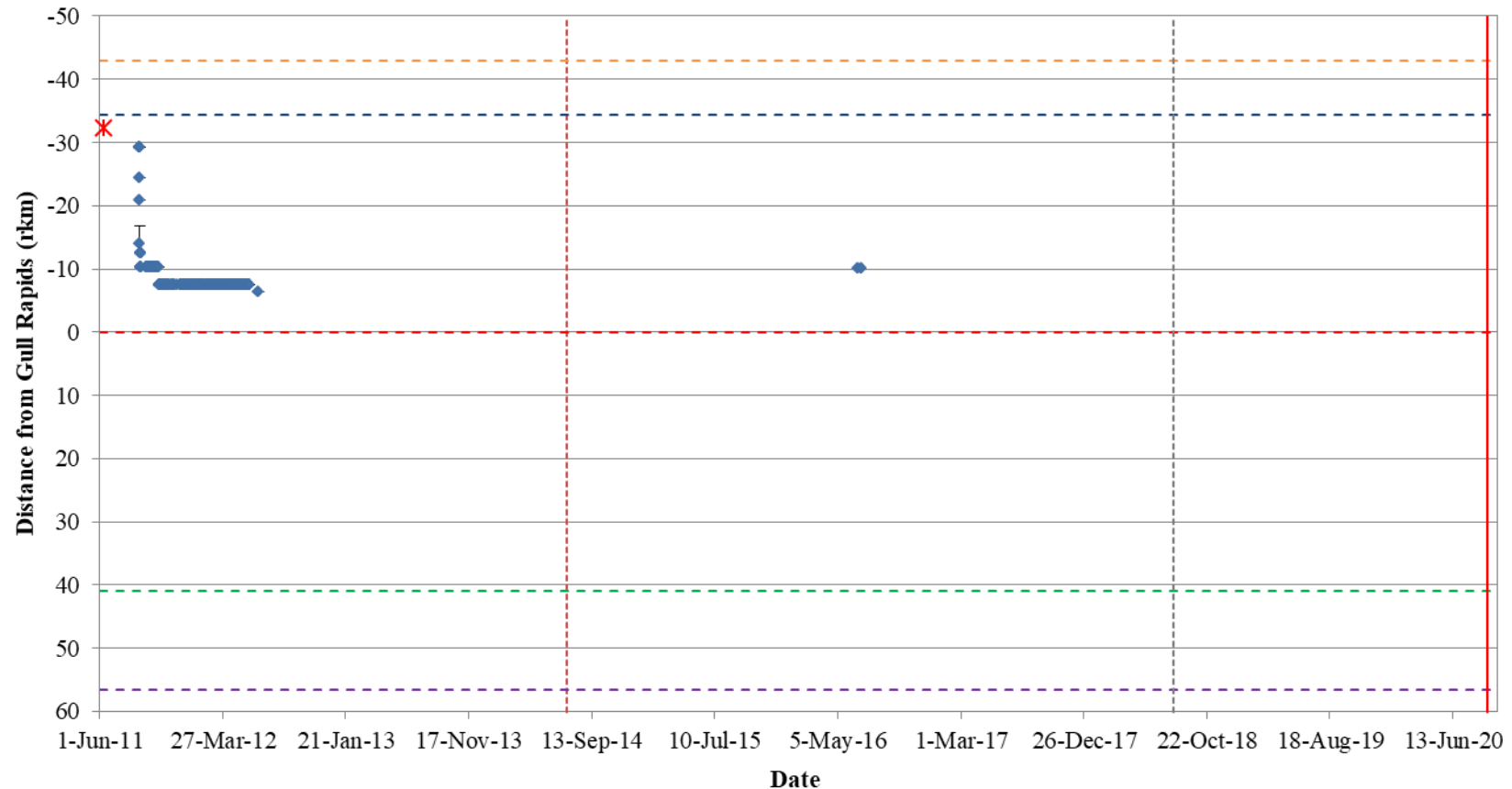
**Figure A2-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16061) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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).**



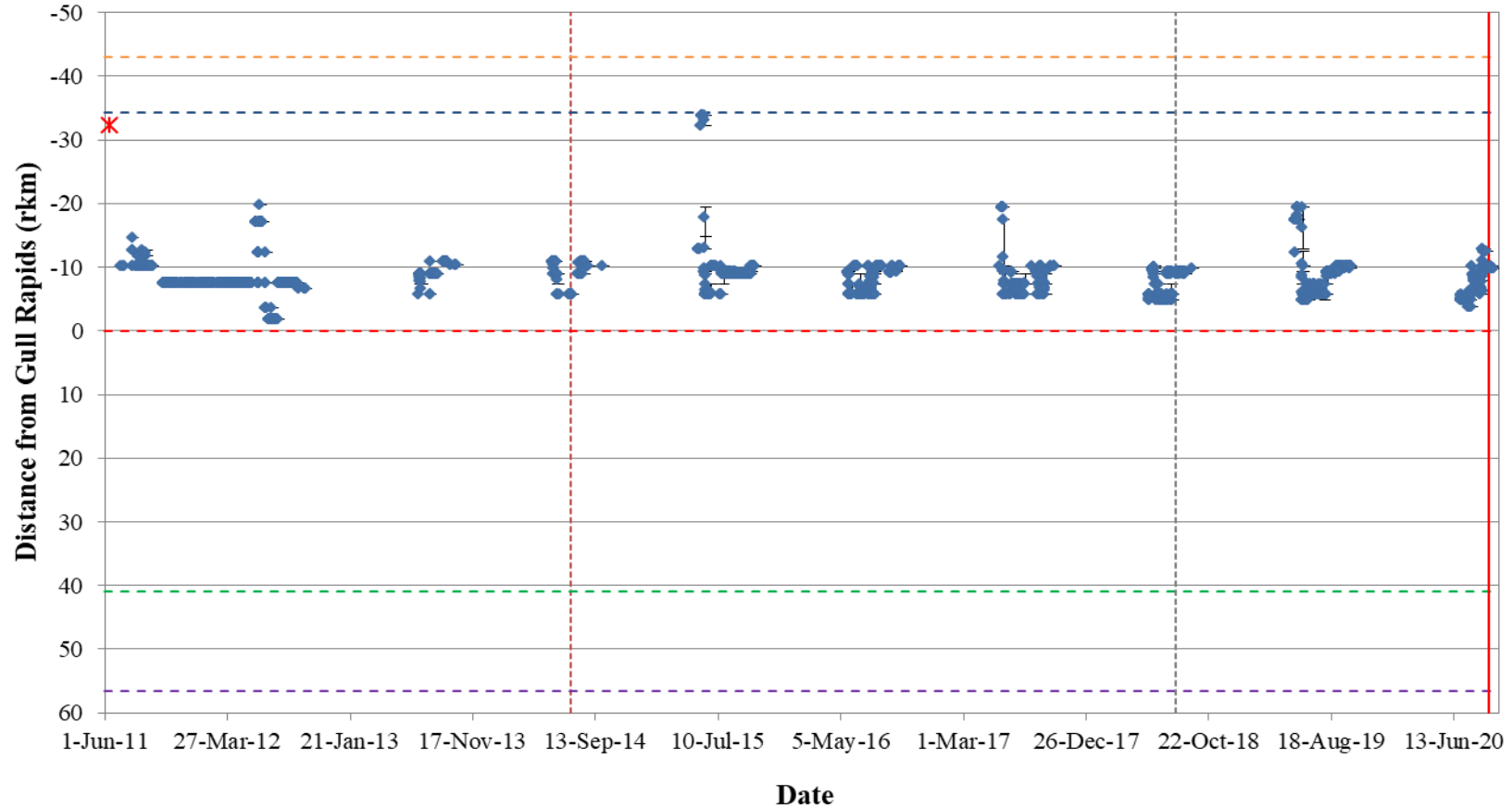
**Figure A2-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16062) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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 A2-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16063) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

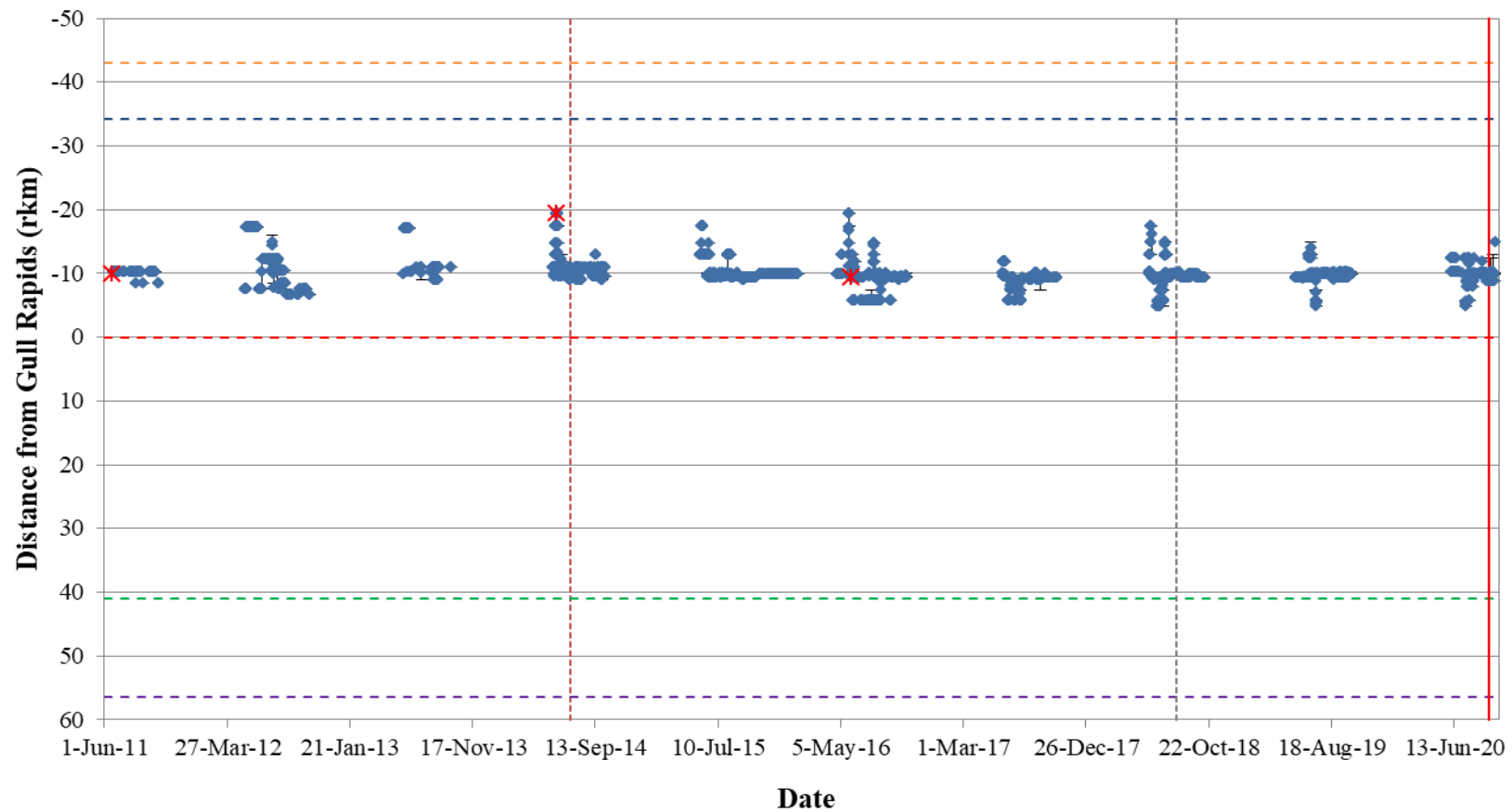


**Figure A2-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16064) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

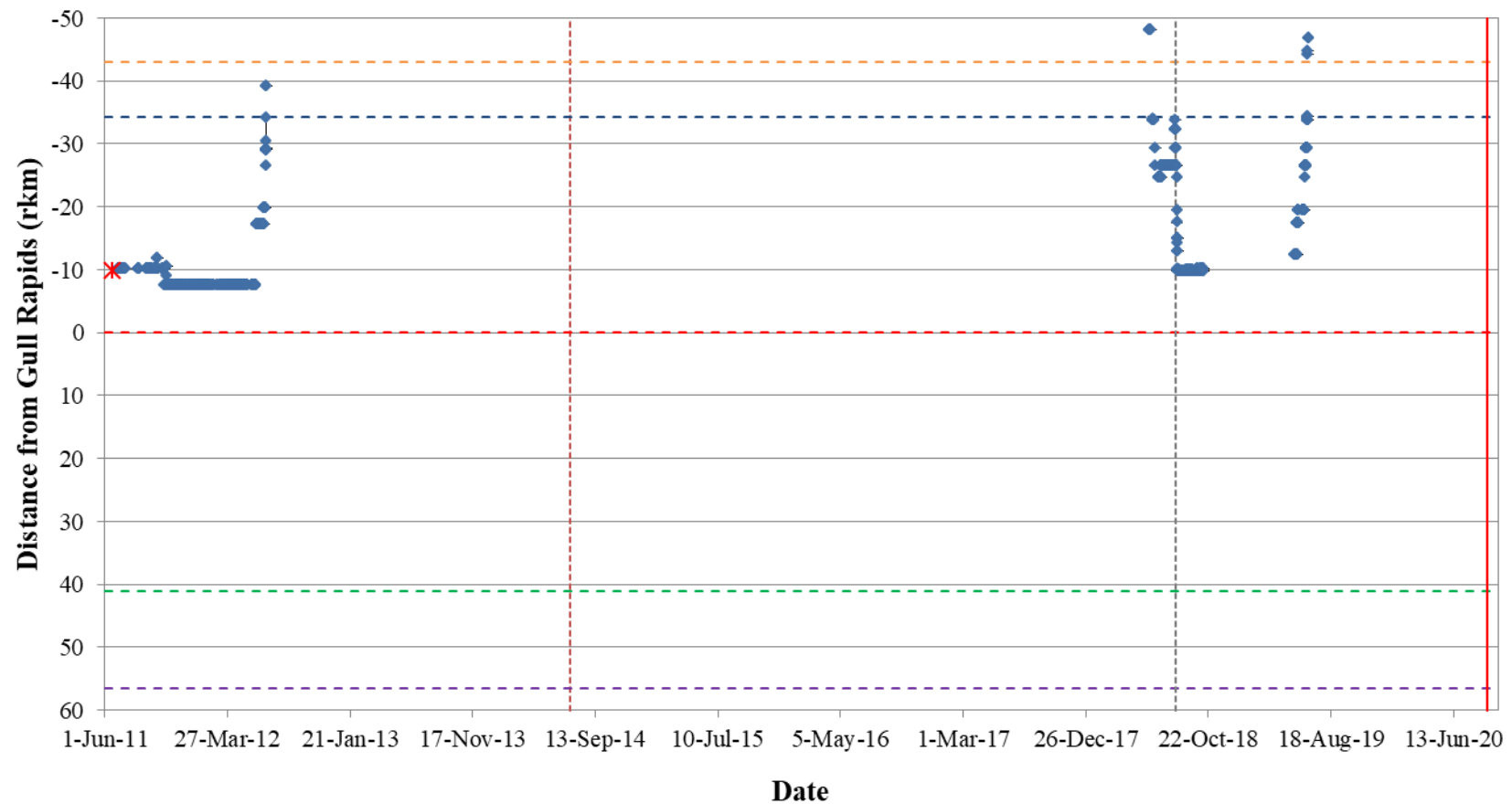


**Figure A2-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16065) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

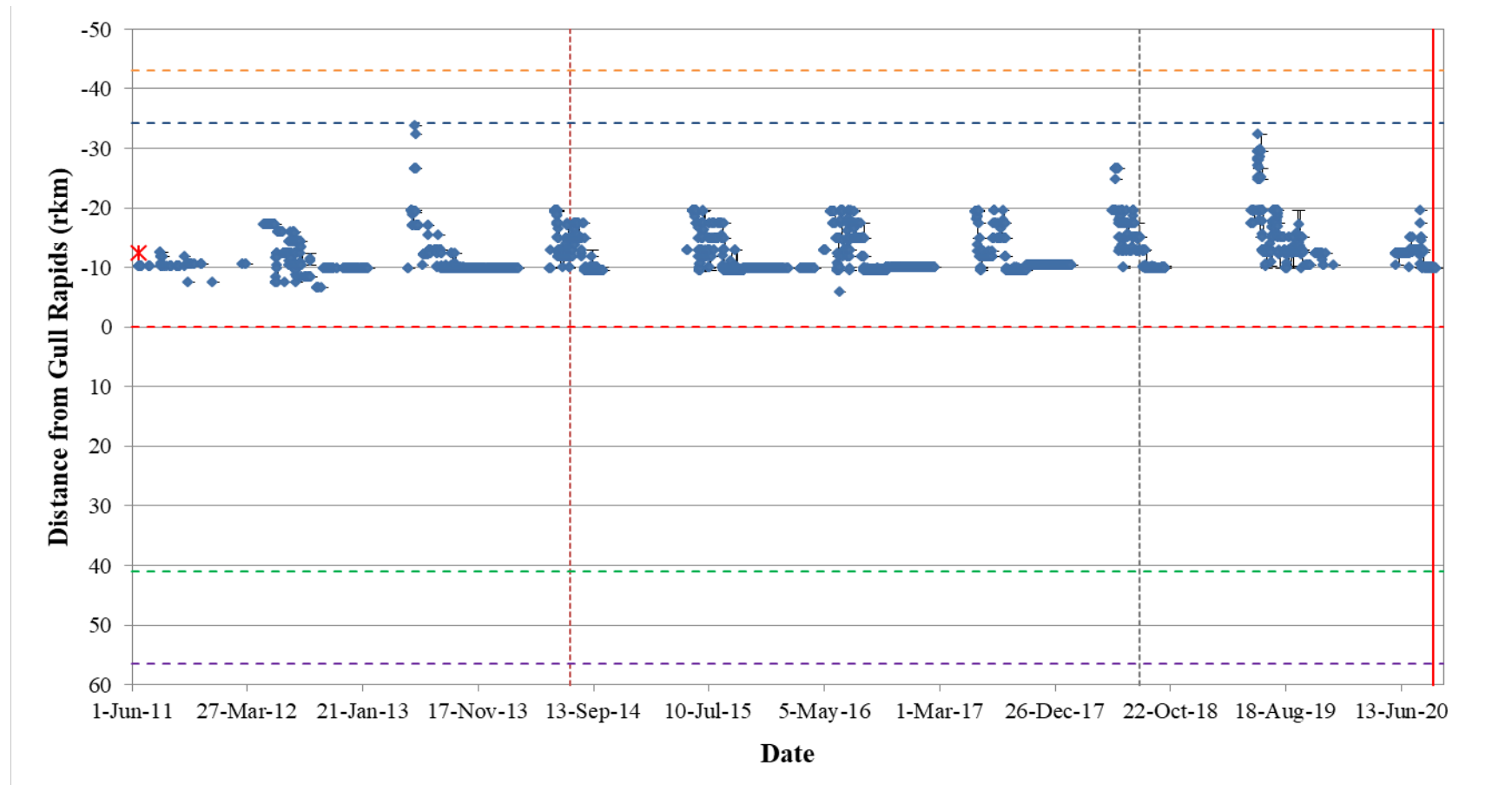




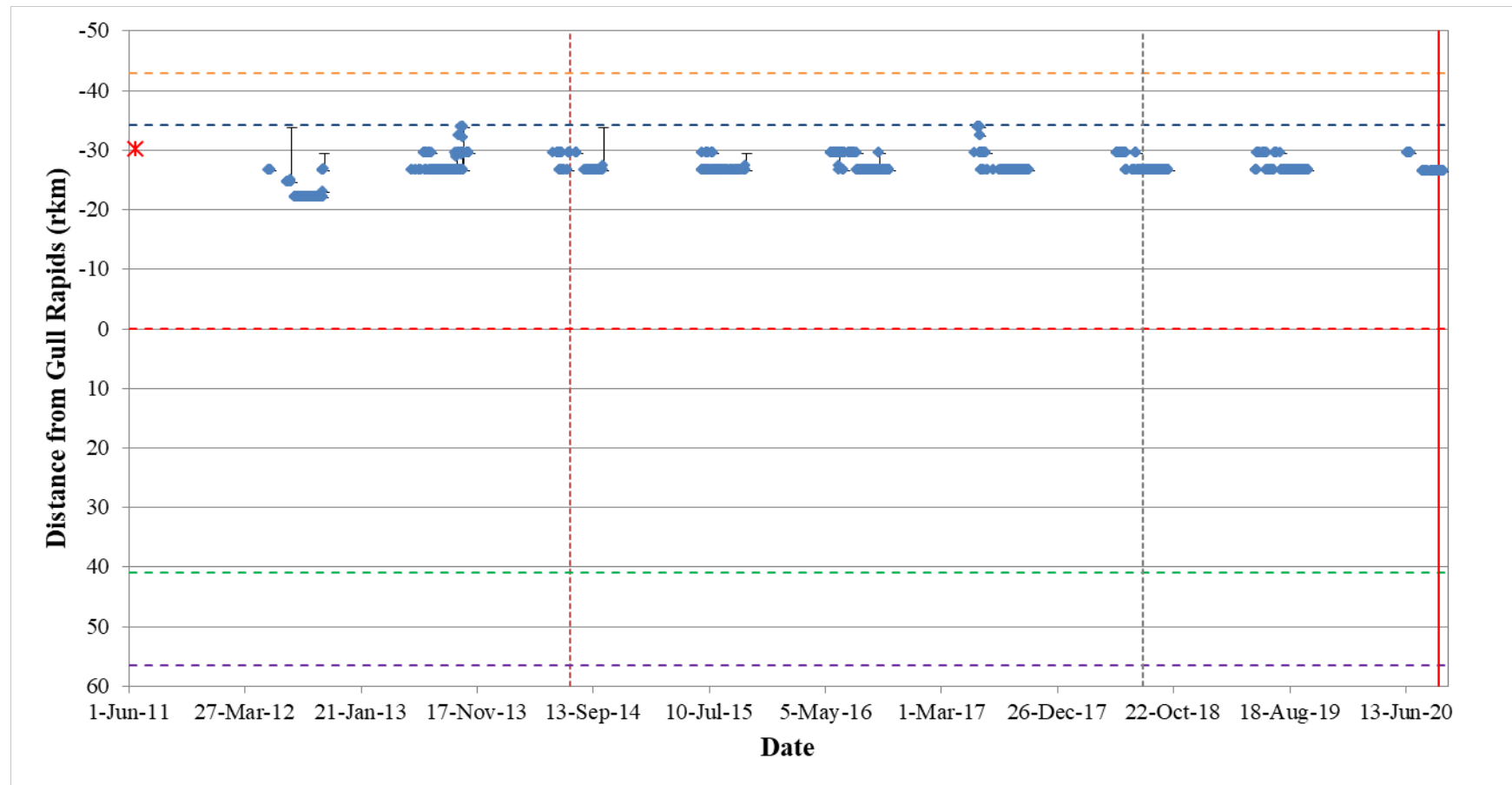
**Figure A2-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16066) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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).**



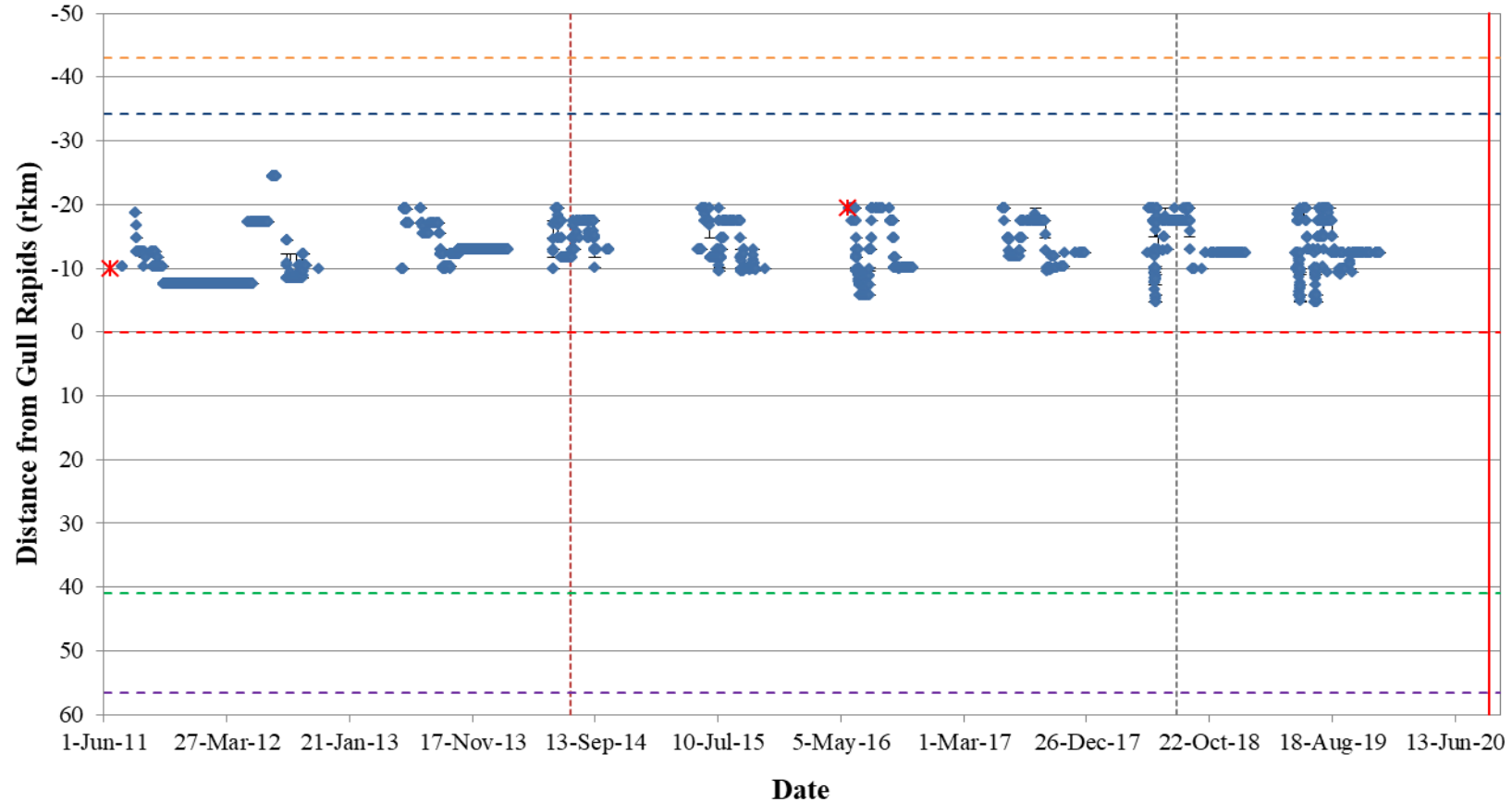
**Figure A2-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16067) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



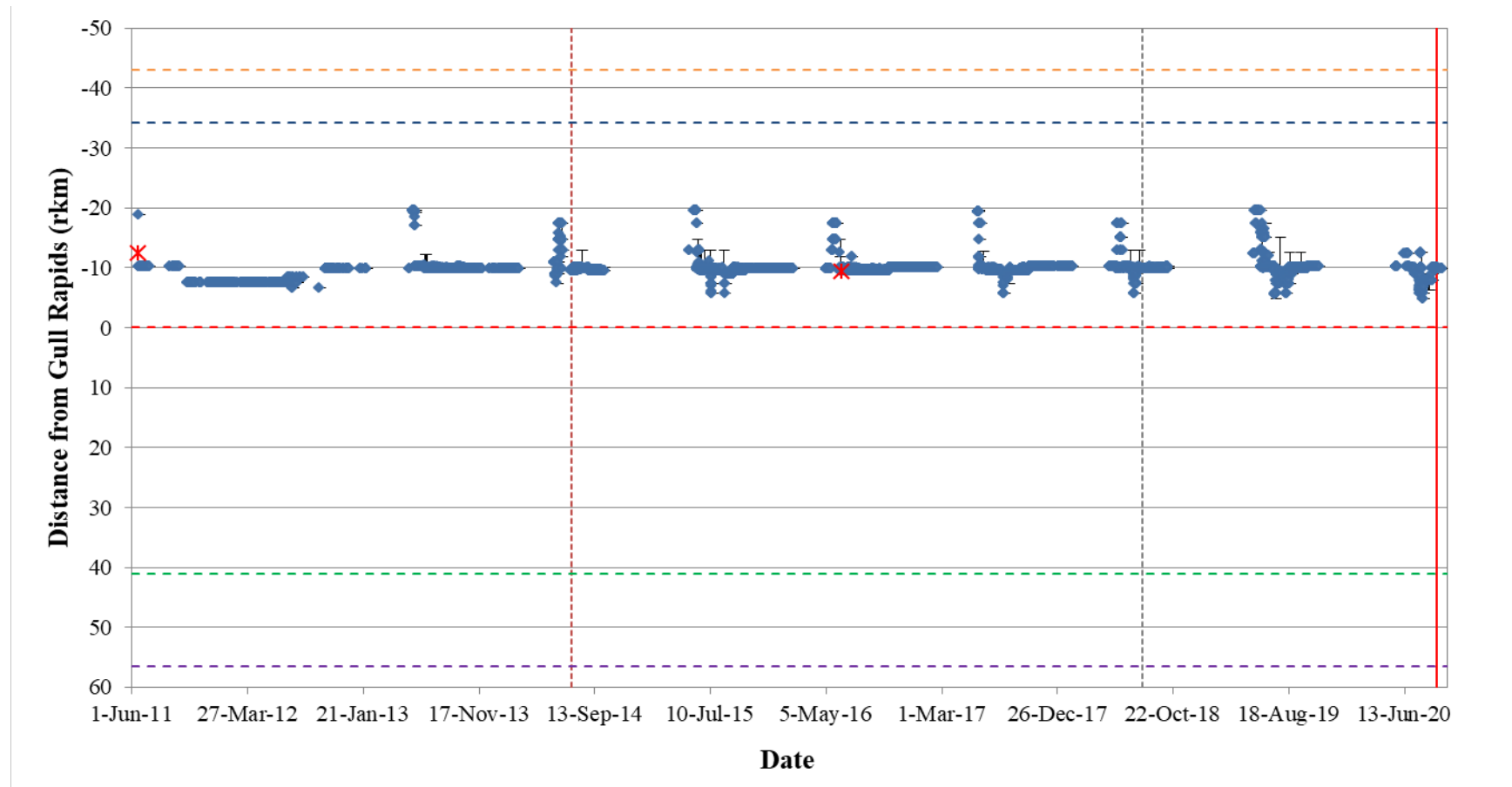
**Figure A2-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16068) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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 A2-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16069) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

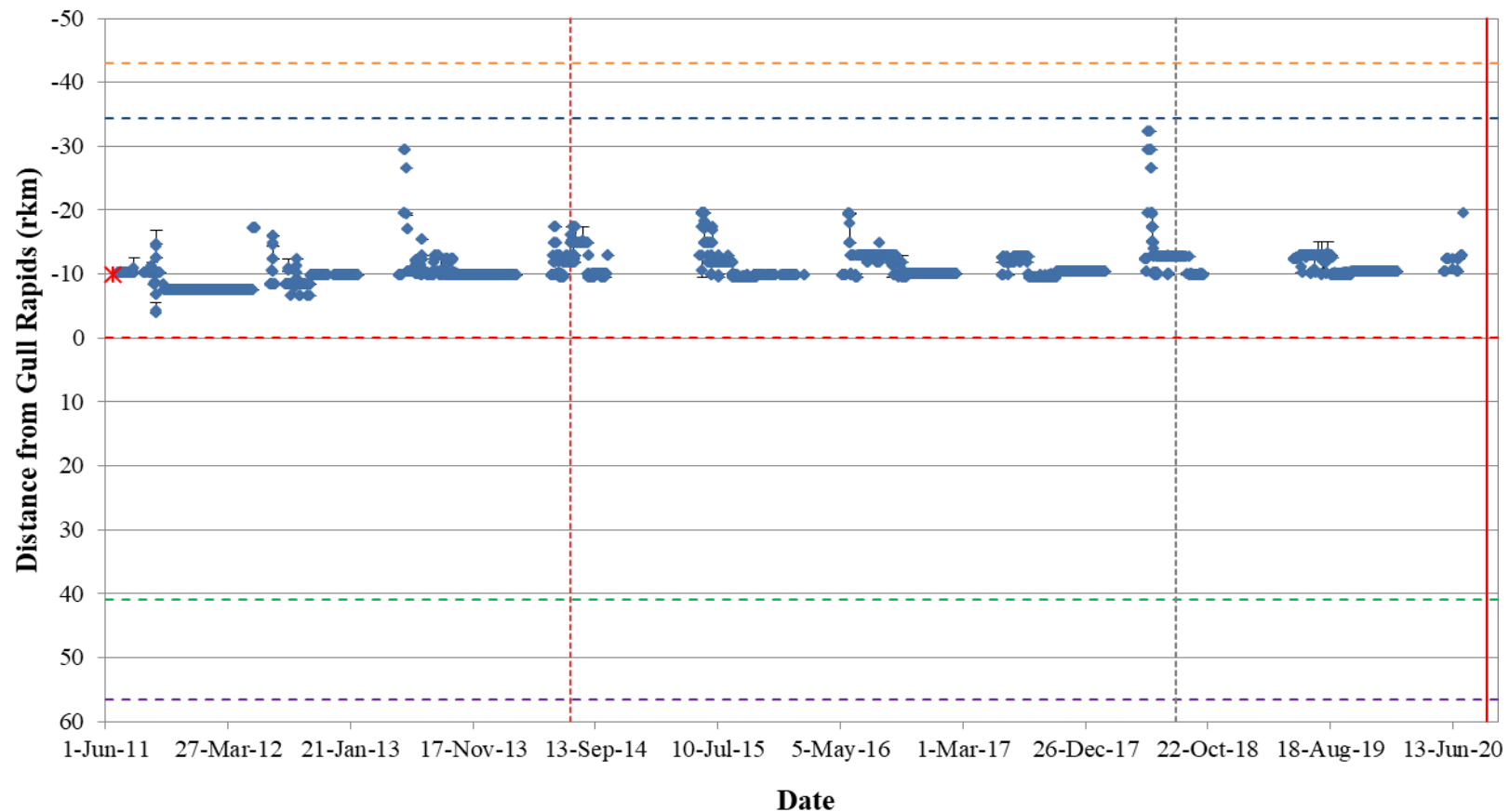


**Figure A2-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16070) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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).**

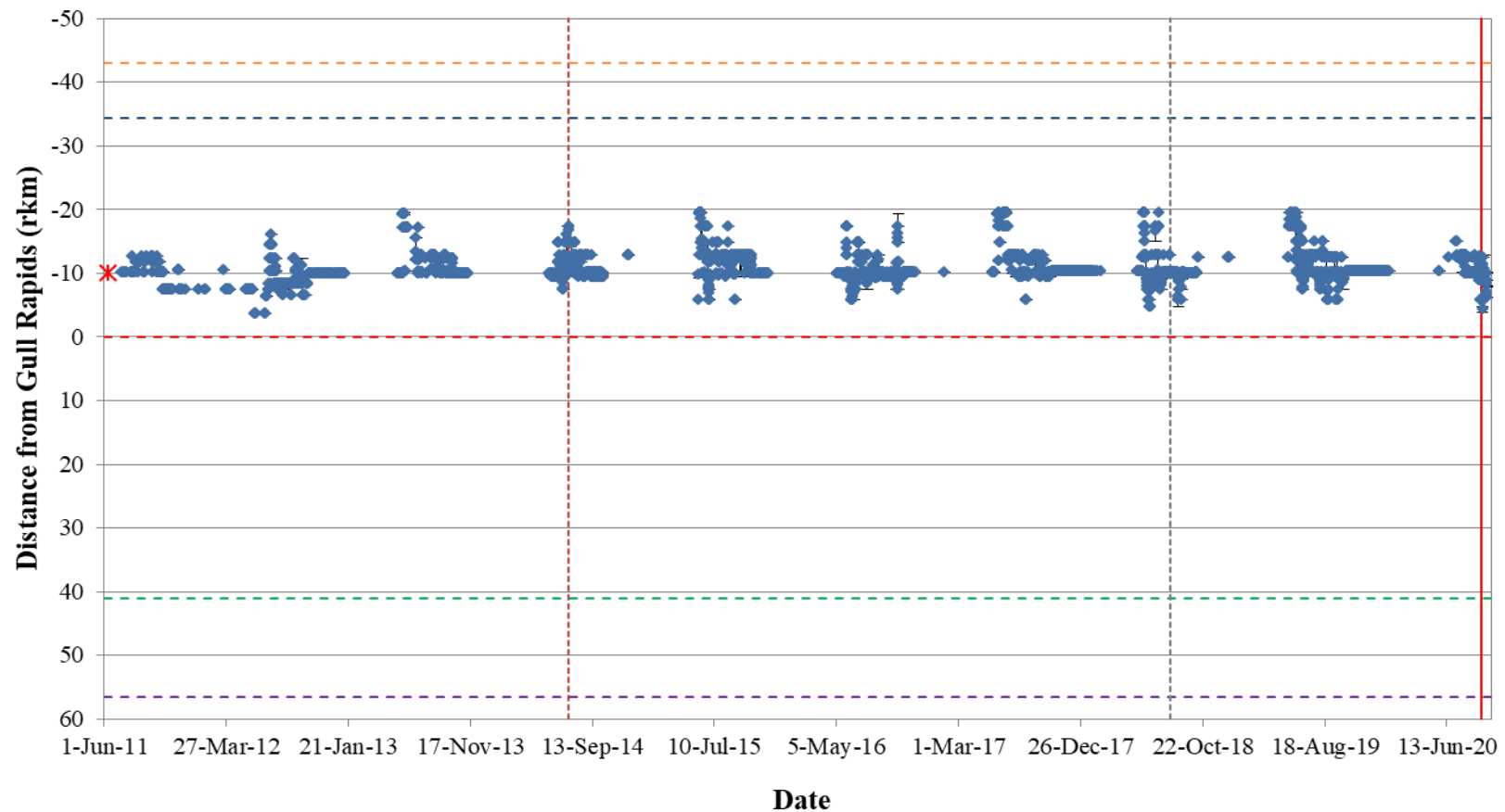


**Figure A2-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16071) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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).**

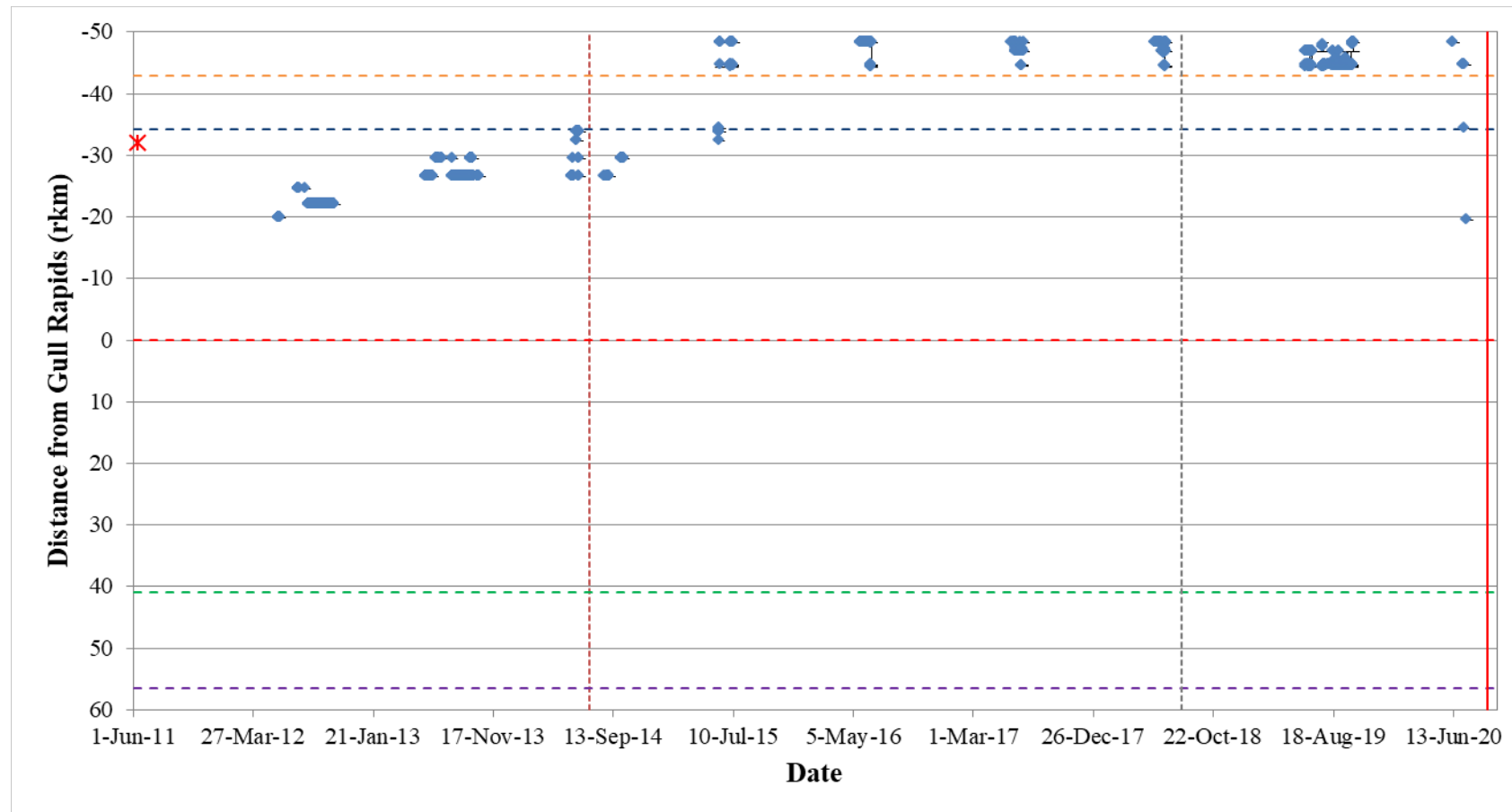




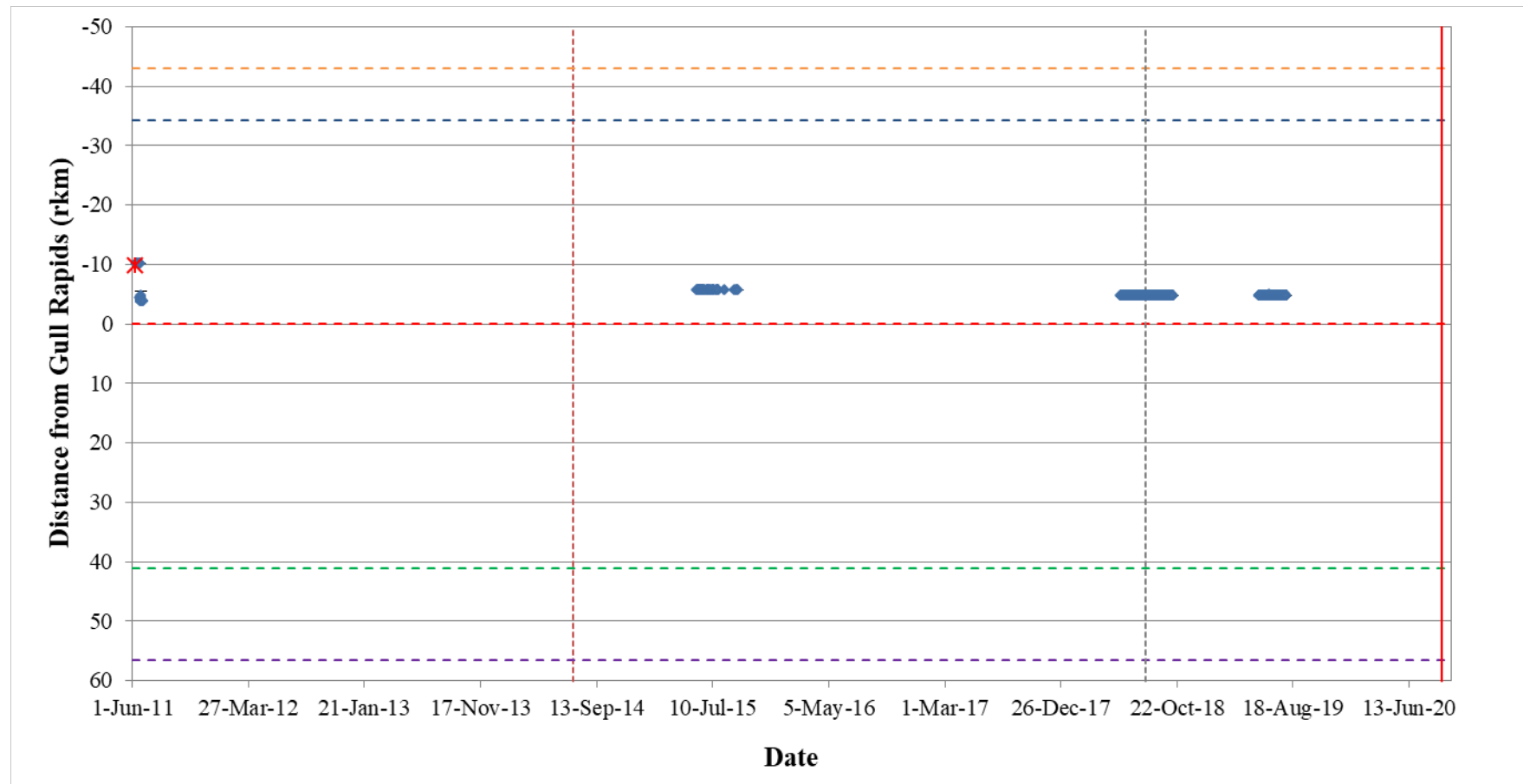
**Figure A2-26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16072) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



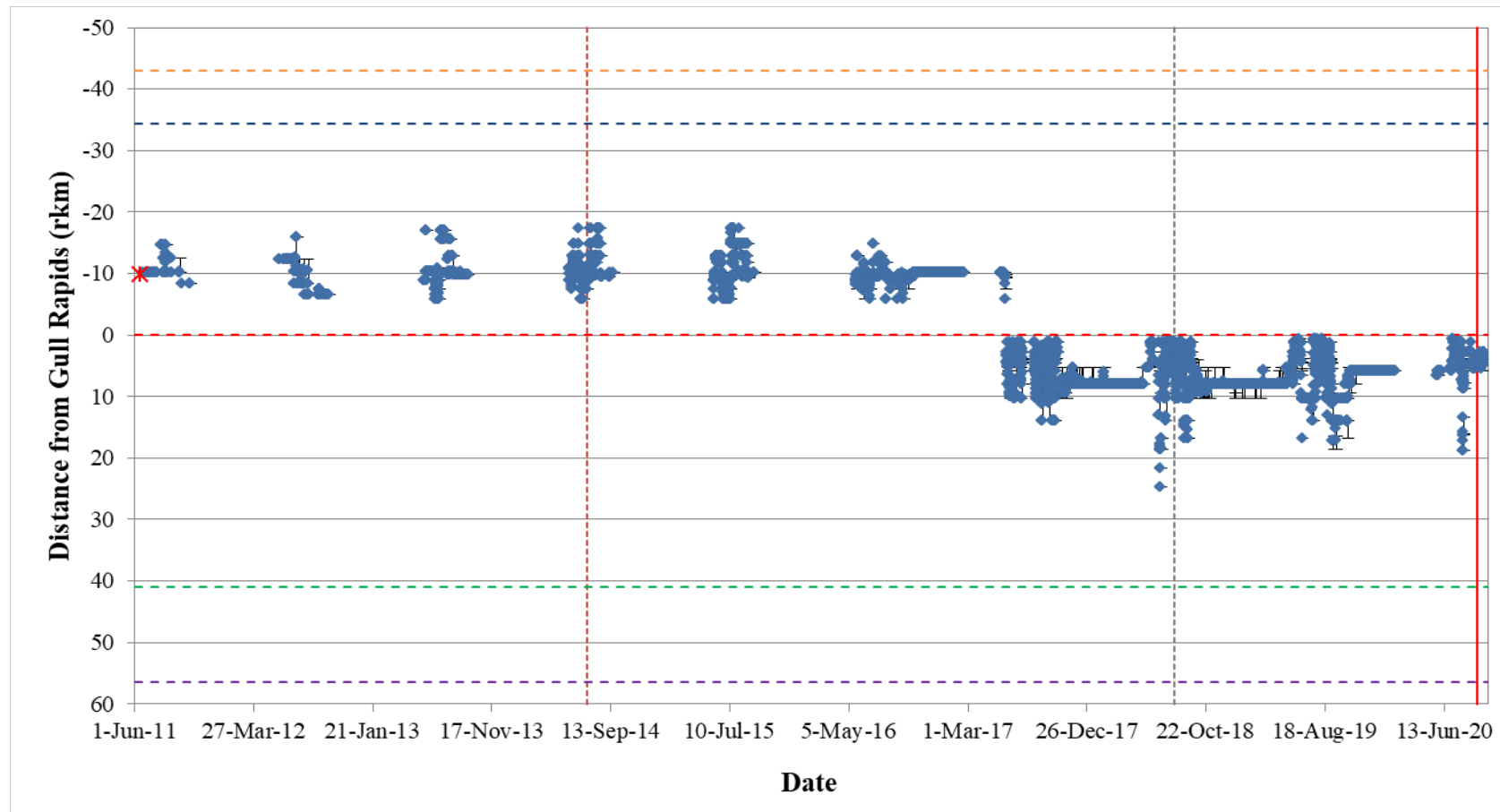
**Figure A2-27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16073) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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 A2-28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16074) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 A2-29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16075) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

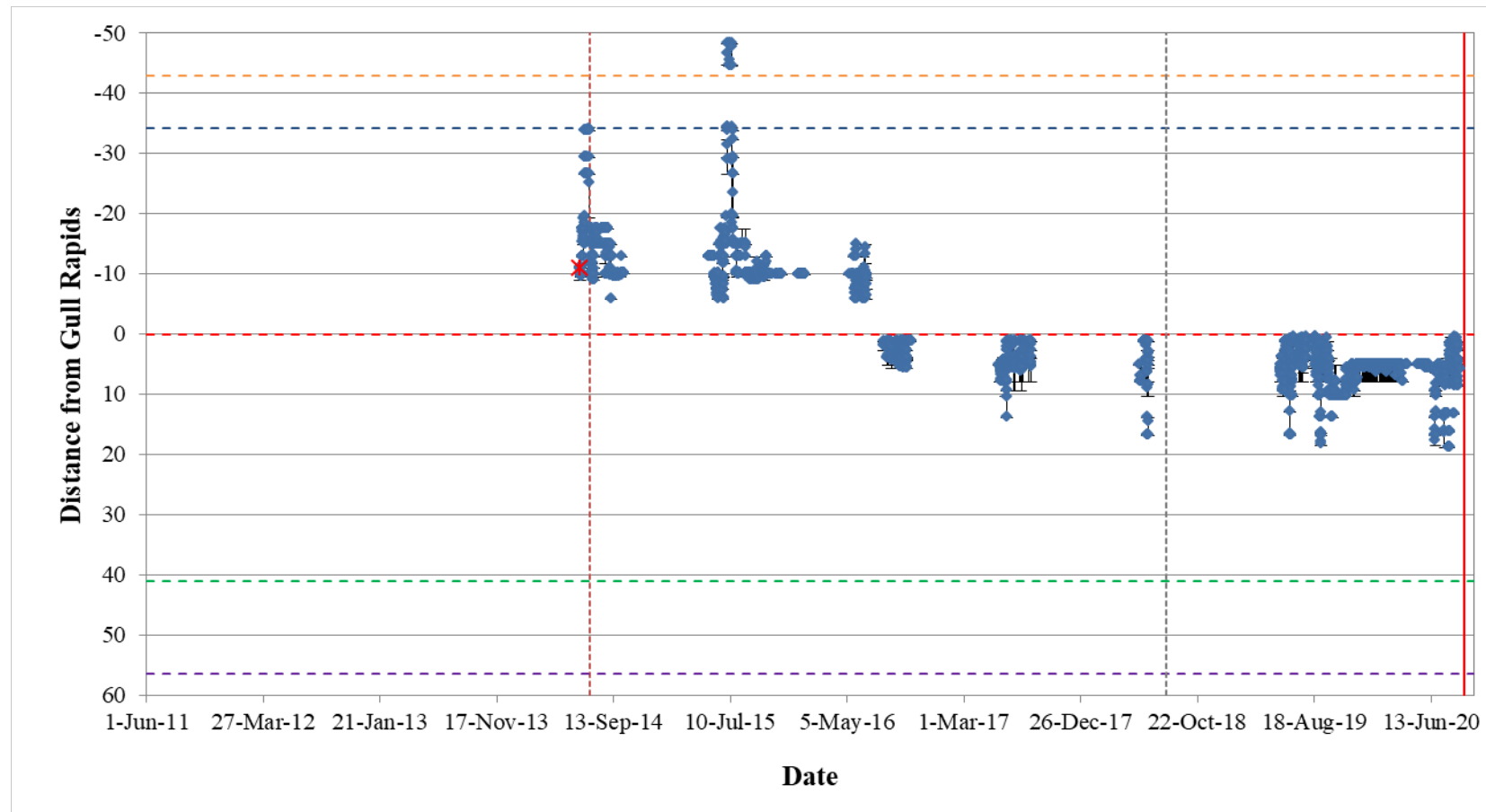


**Figure A2-30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16076) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

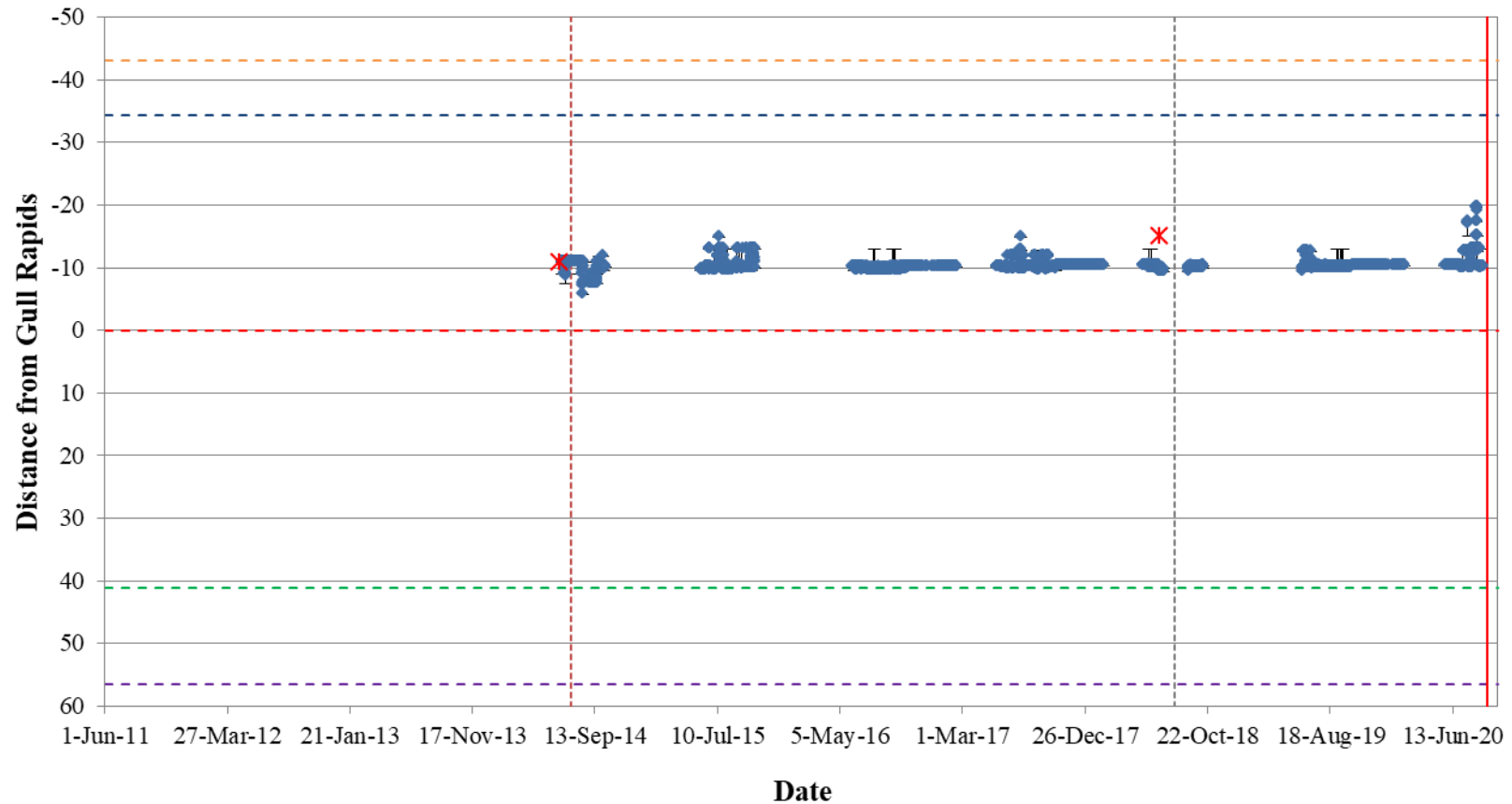


**Figure A2-31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16077) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**

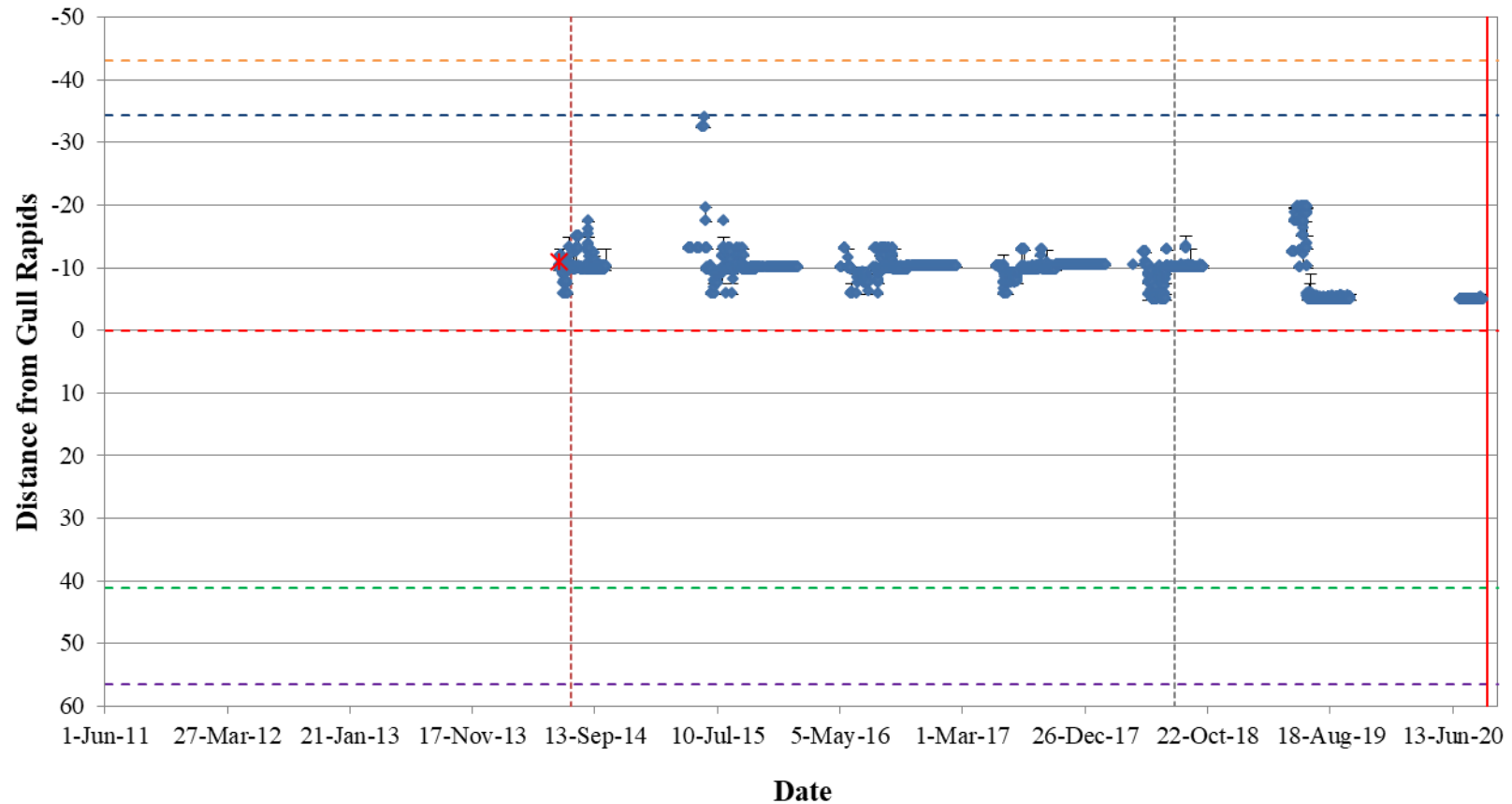




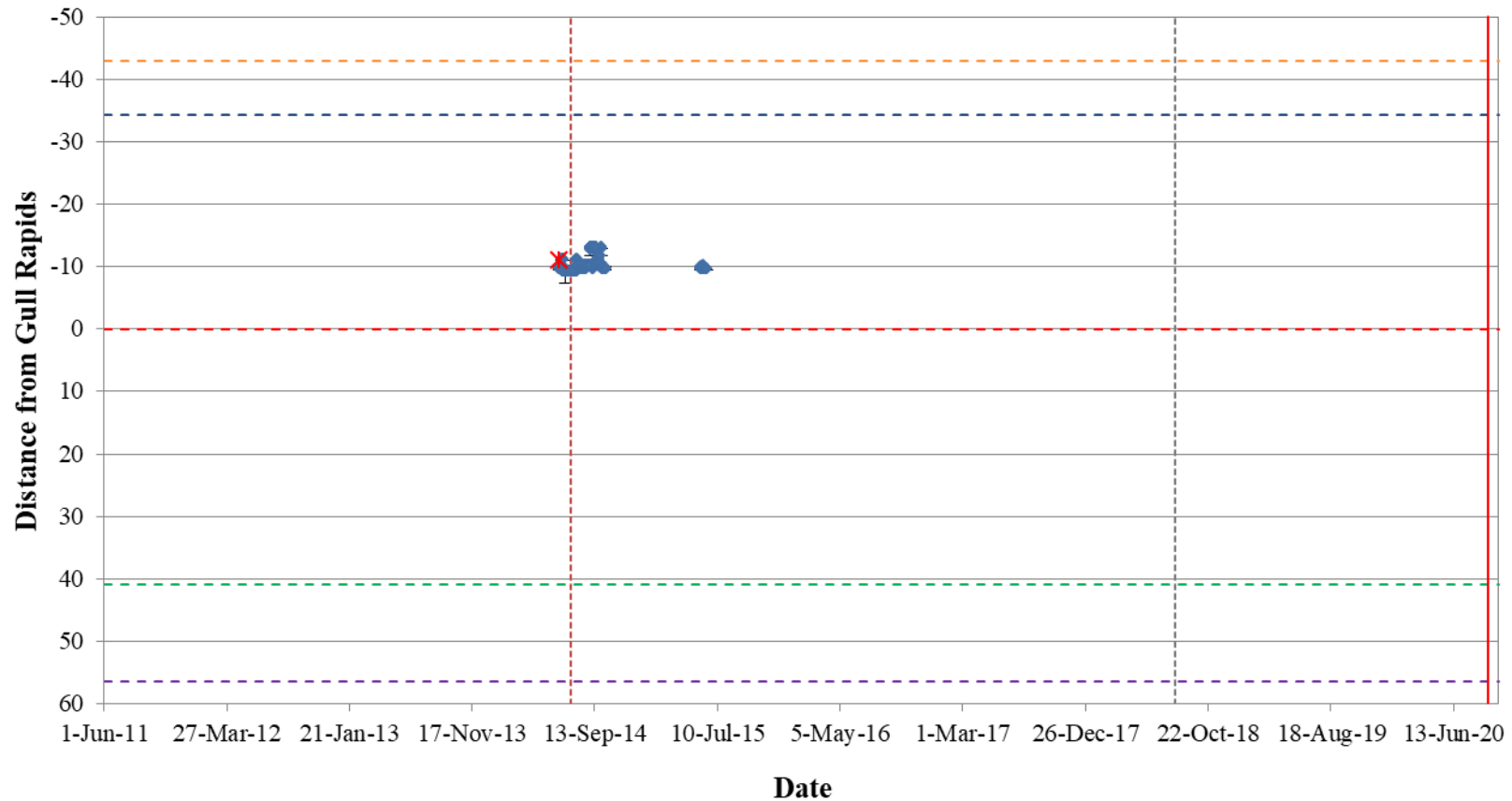
**Figure A2-32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32174) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask 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).**



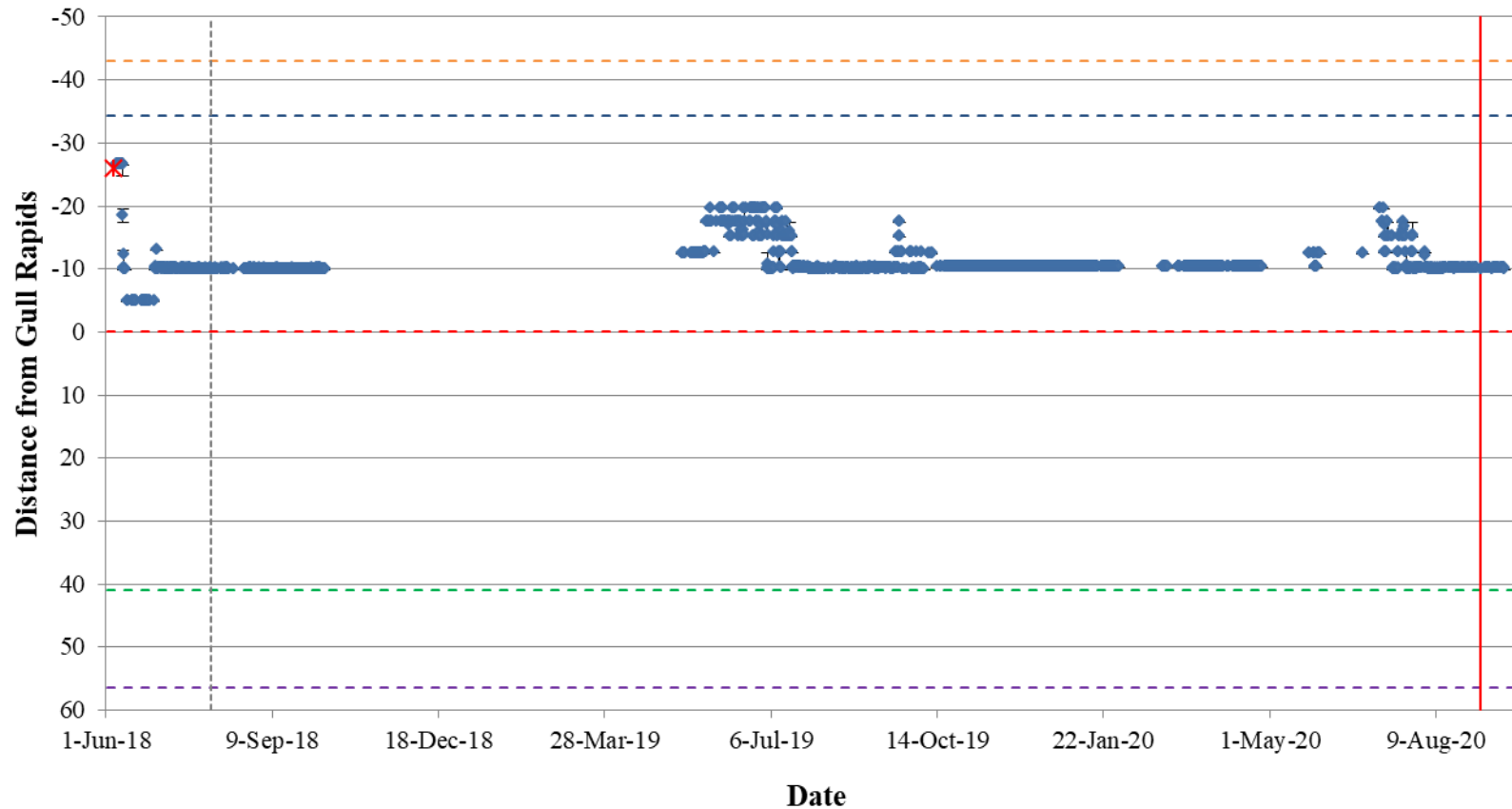
**Figure A2-33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32175) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. 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 A2-34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32176) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 A2-35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32177) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 A2-36: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #54799) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from June 1, 2018 to September 23, 2020. 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, STEPHENS LAKE, JUNE 2011 TO SEPTEMBER 2020**

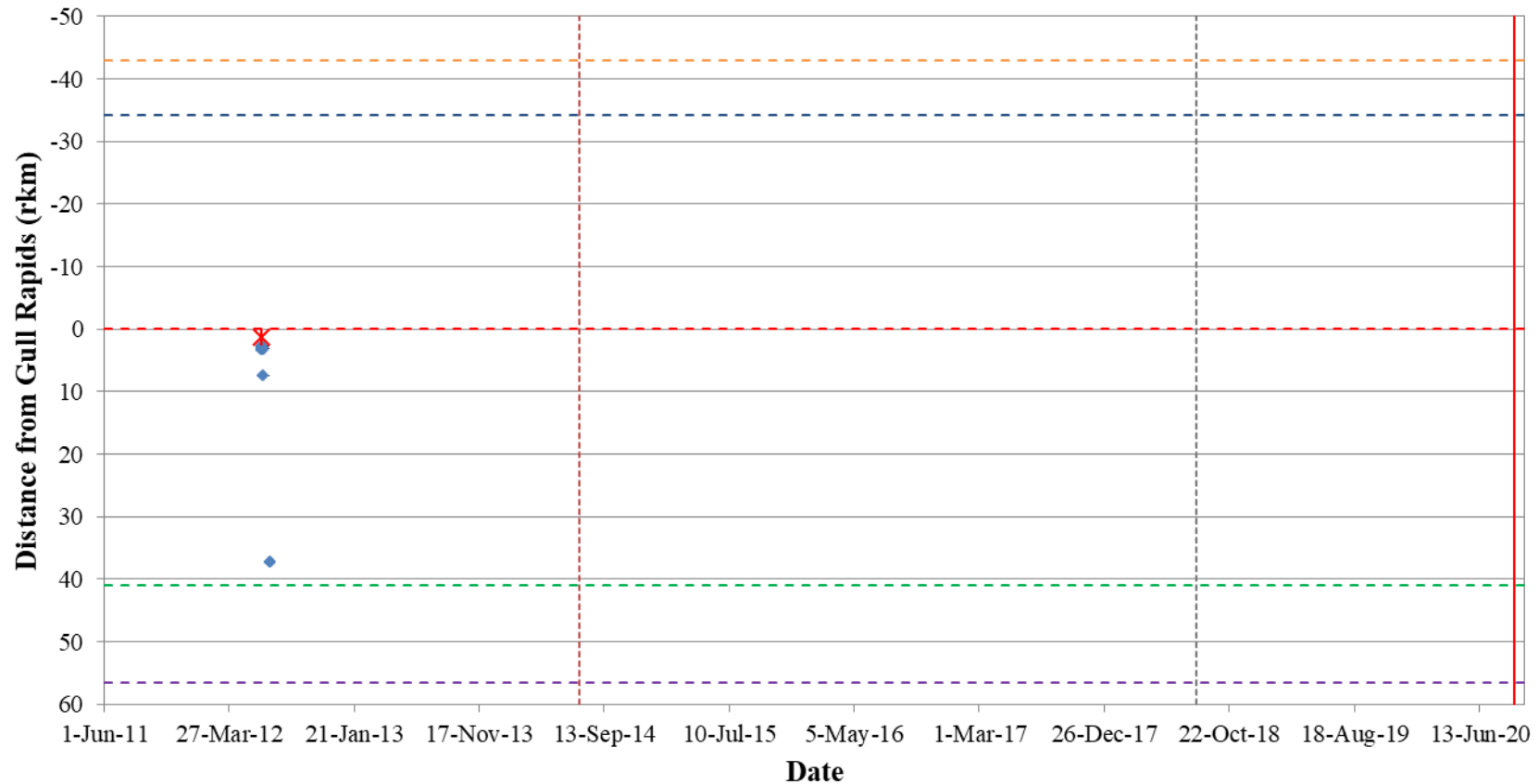
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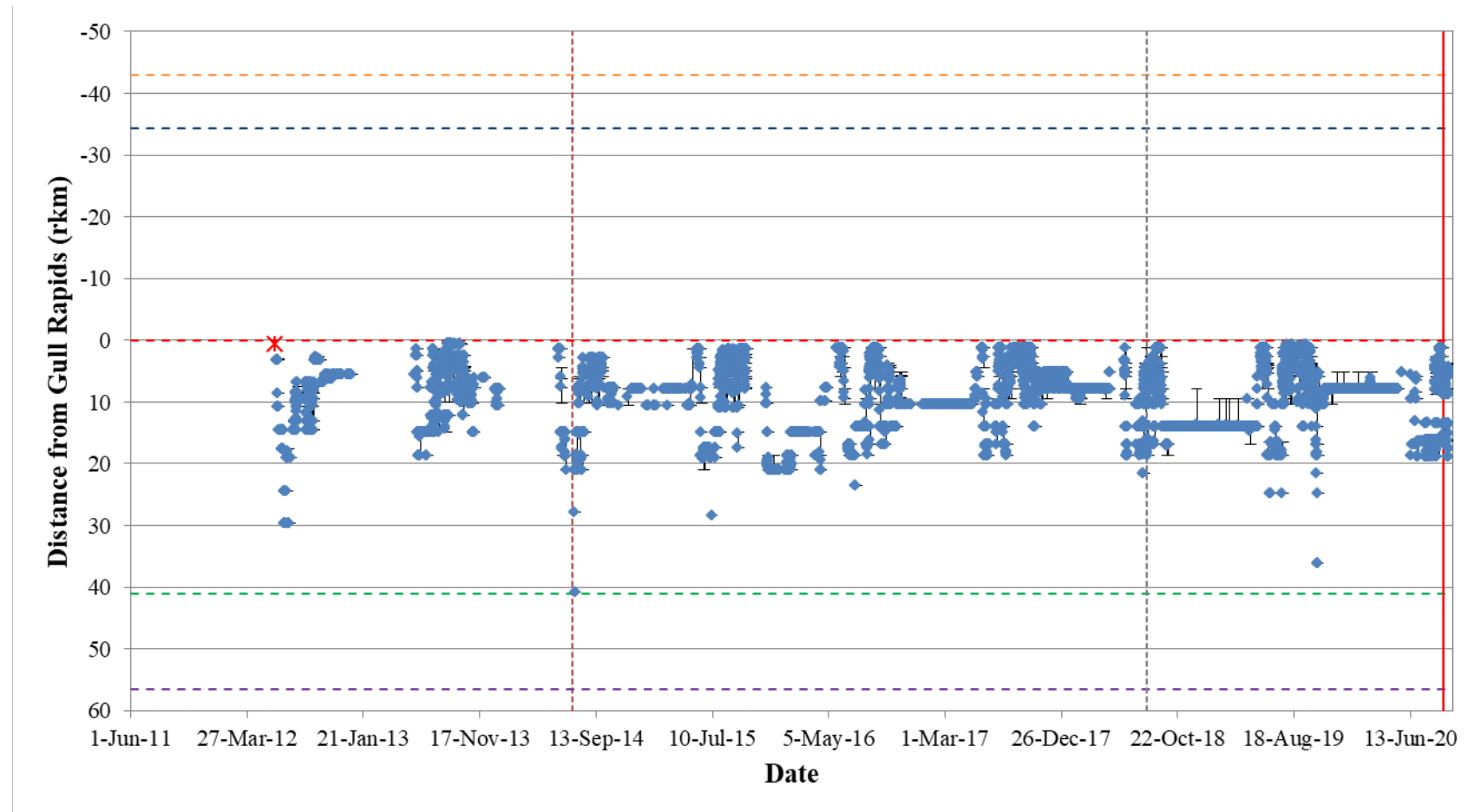


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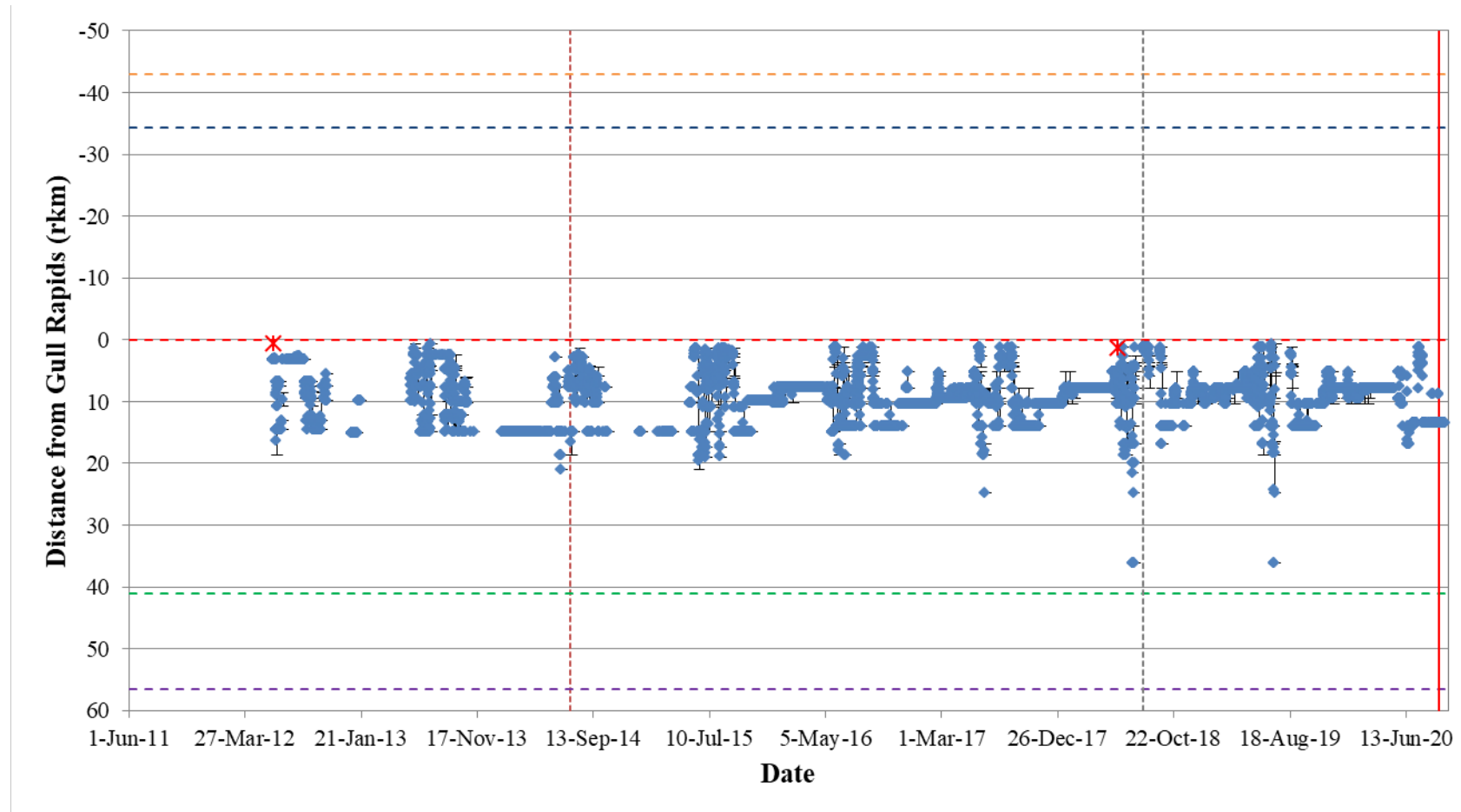
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**Figure A3-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16018) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning 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).**



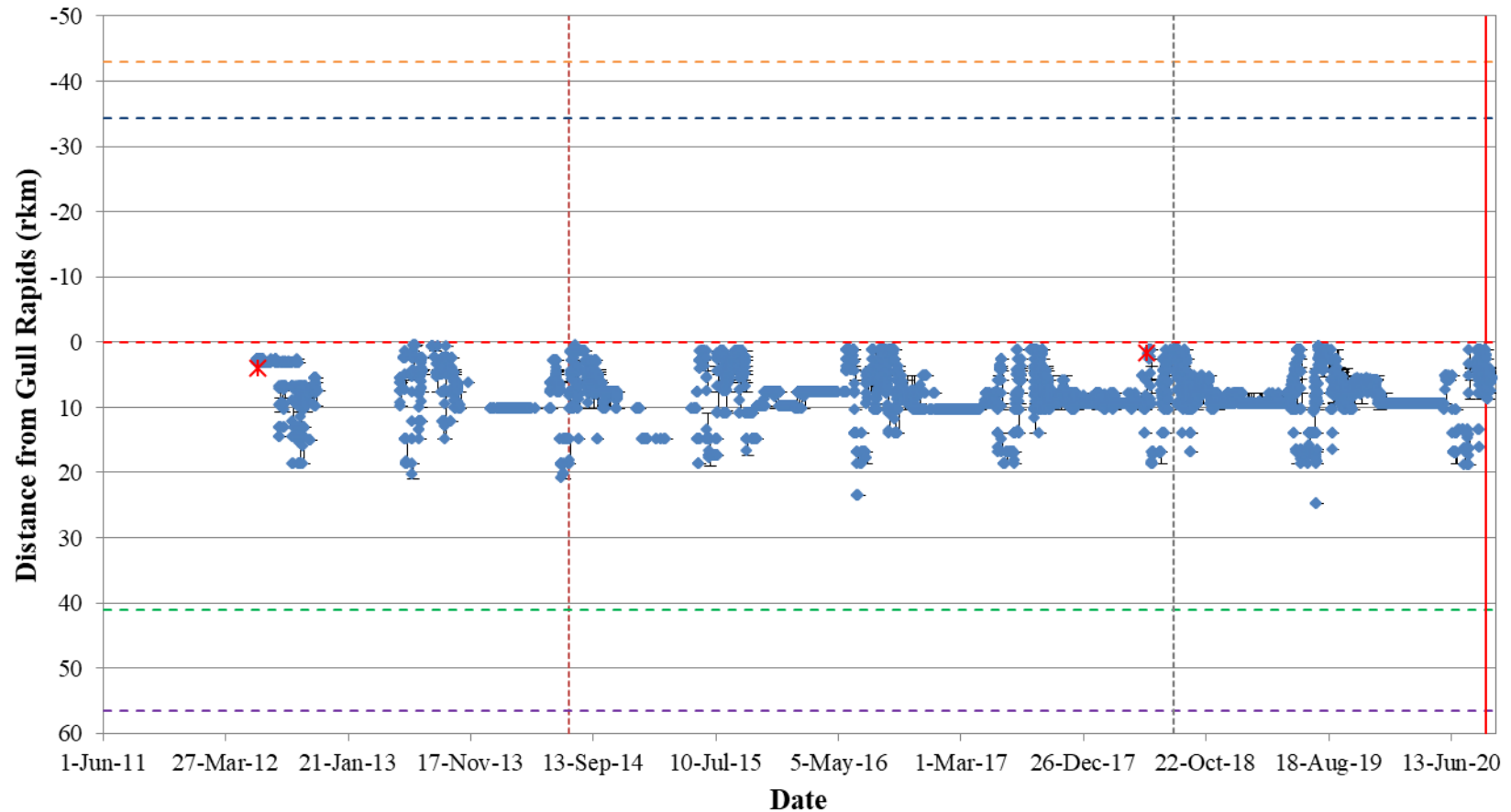
**Figure A3-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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 A3-3: 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 September 23, 2020. 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).**

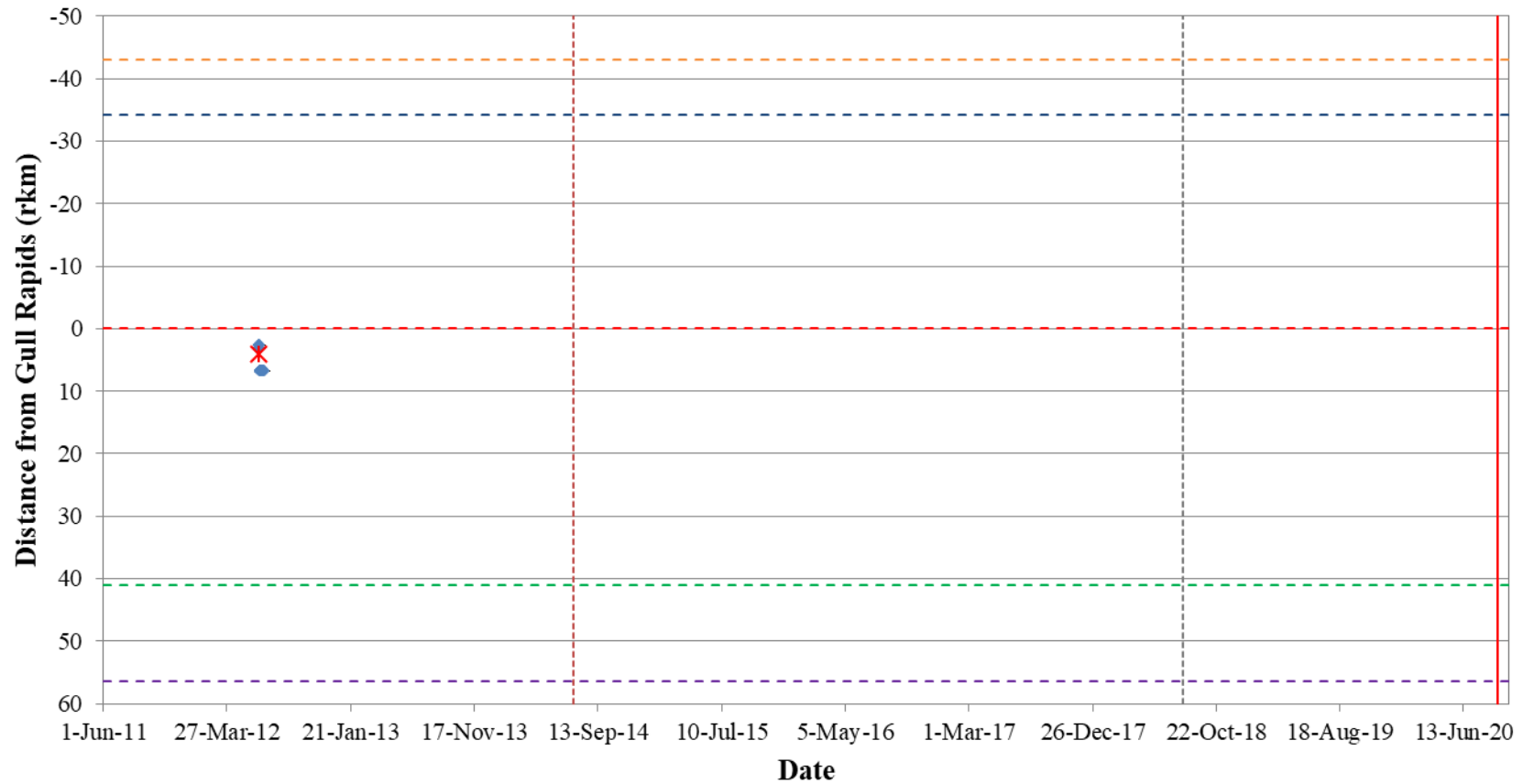


**Figure A3-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16021) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**

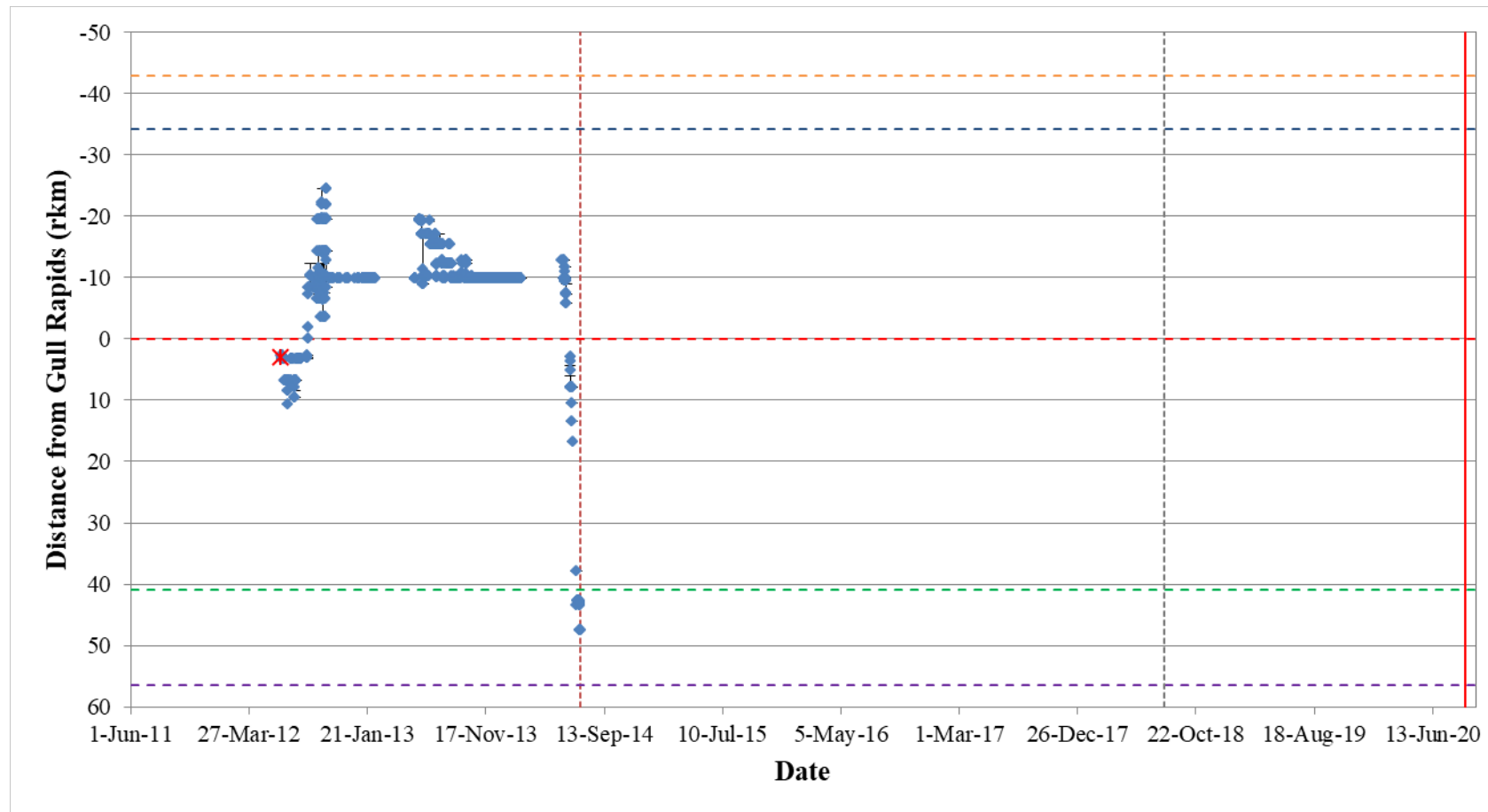


**Figure A3-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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).**

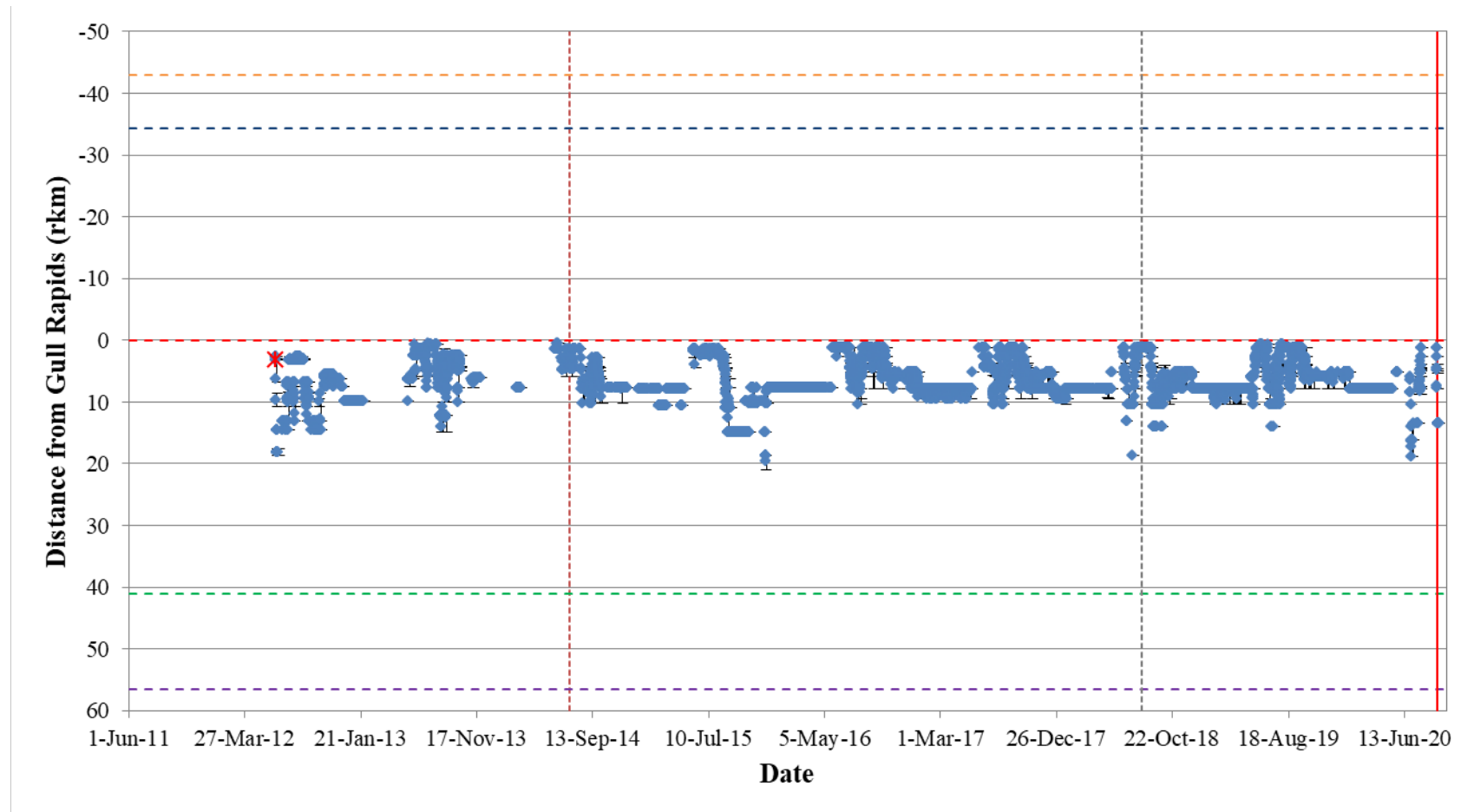




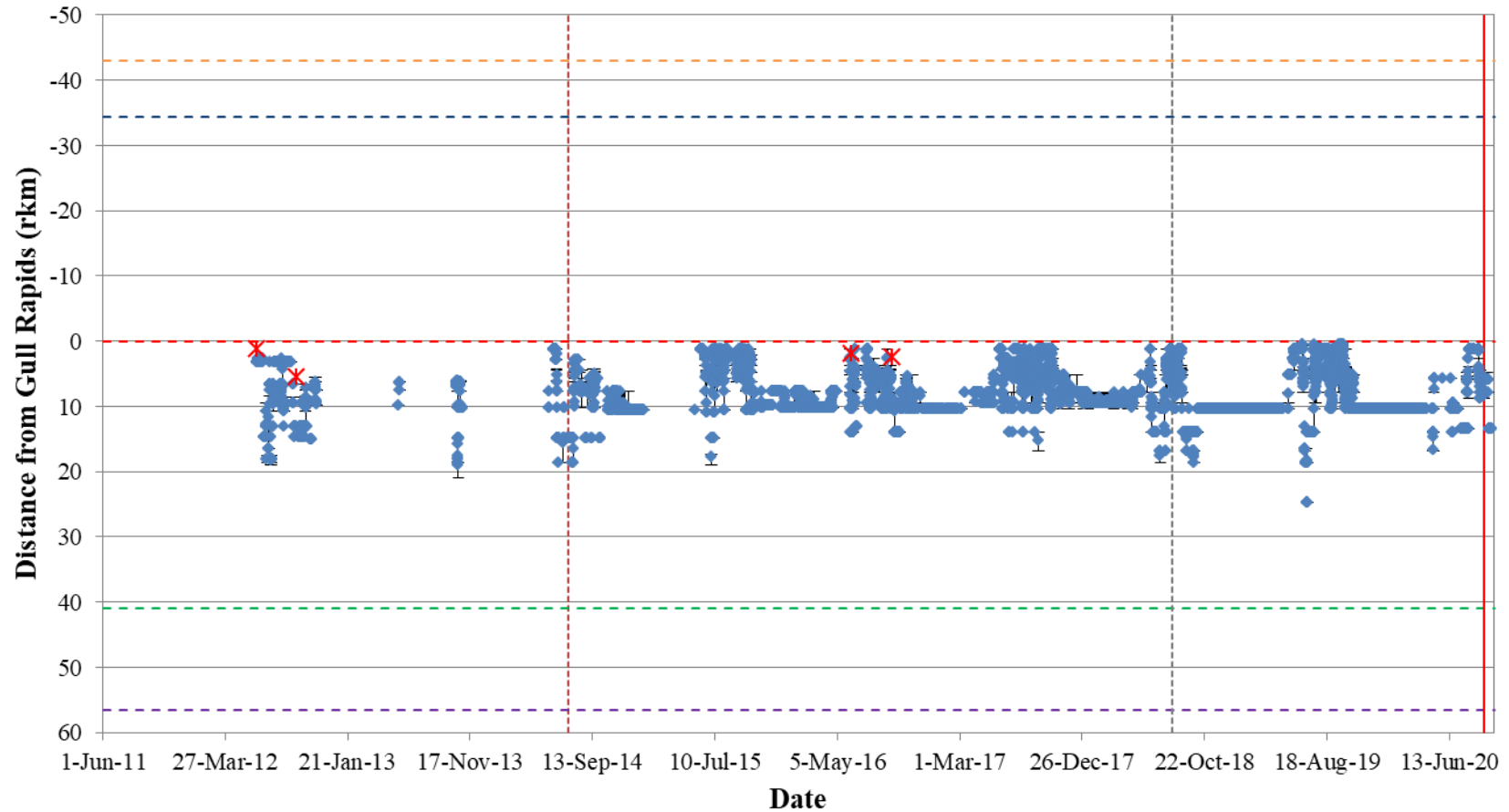
**Figure A 3-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16024) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



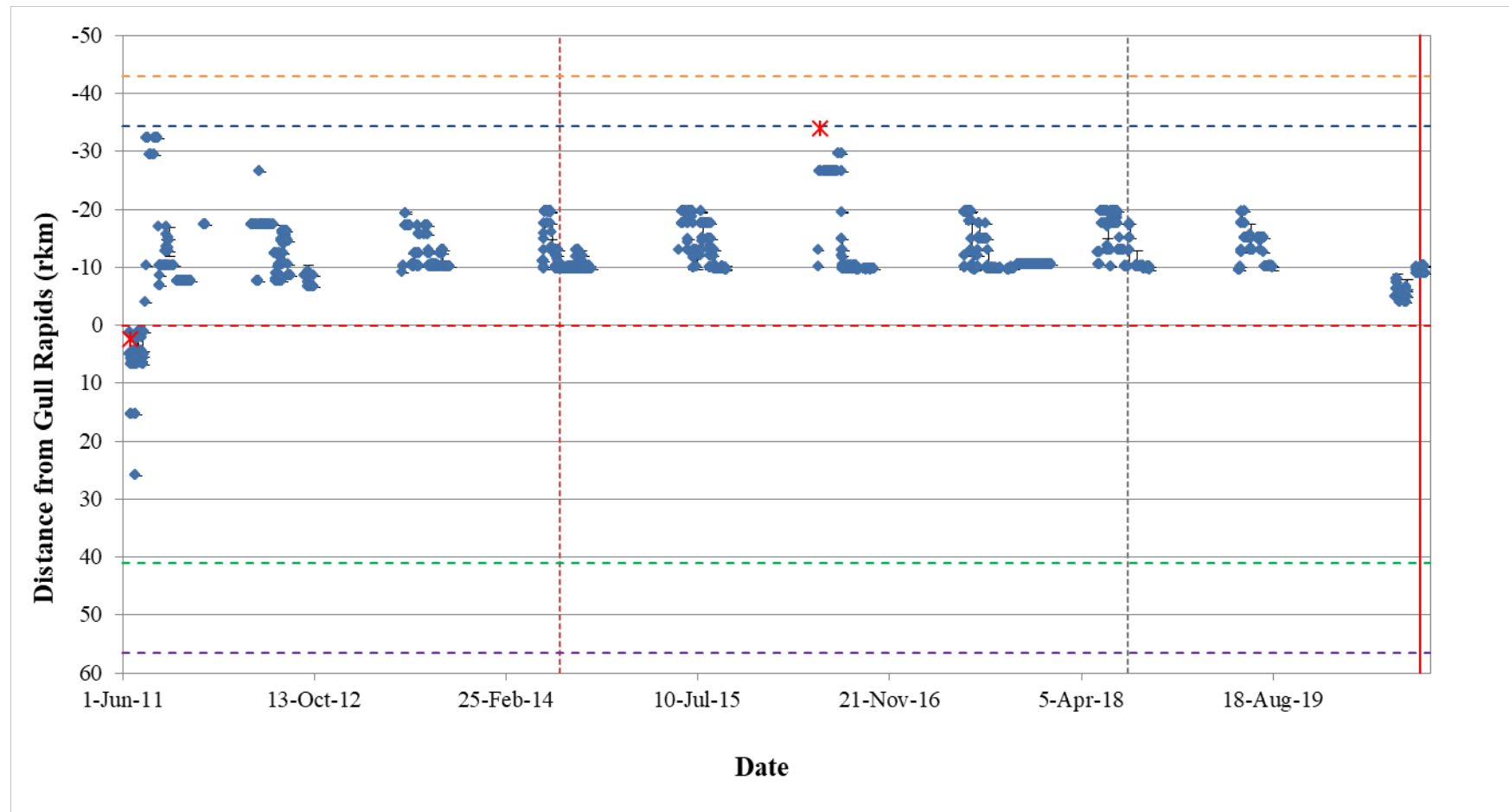
**Figure A3-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16025) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



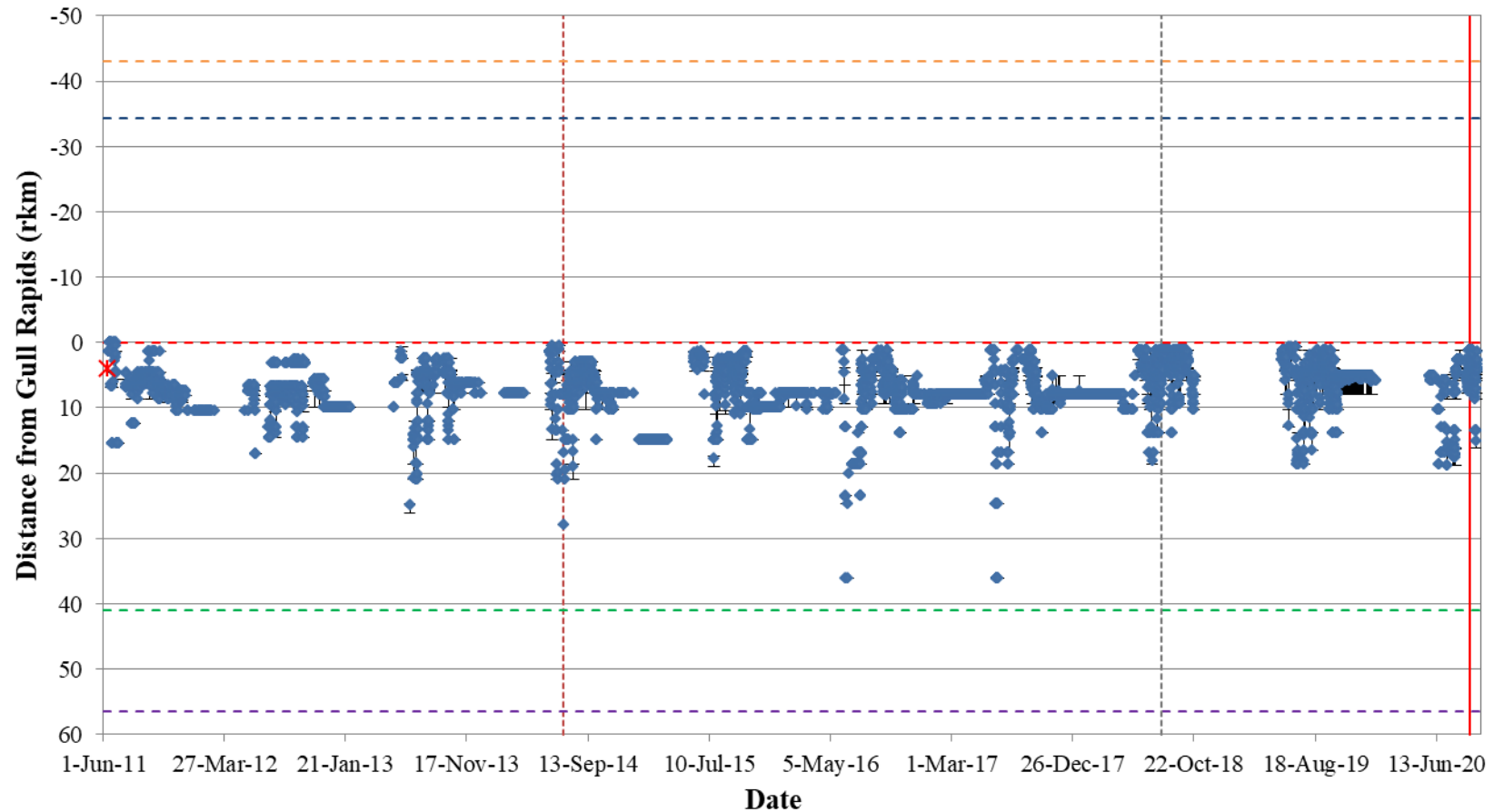
**Figure A3-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16027) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



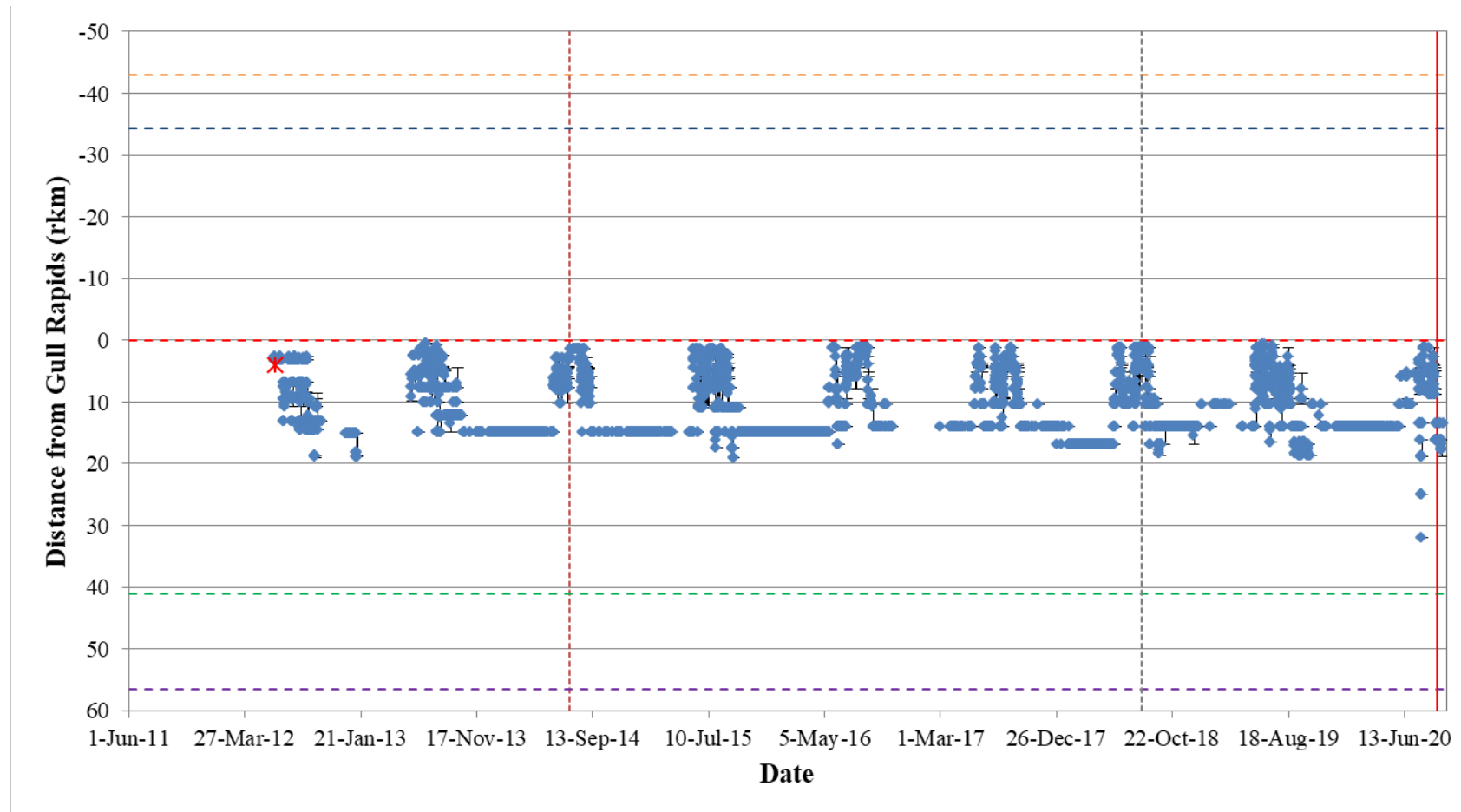
**Figure A3-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16028) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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 A3-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16029) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

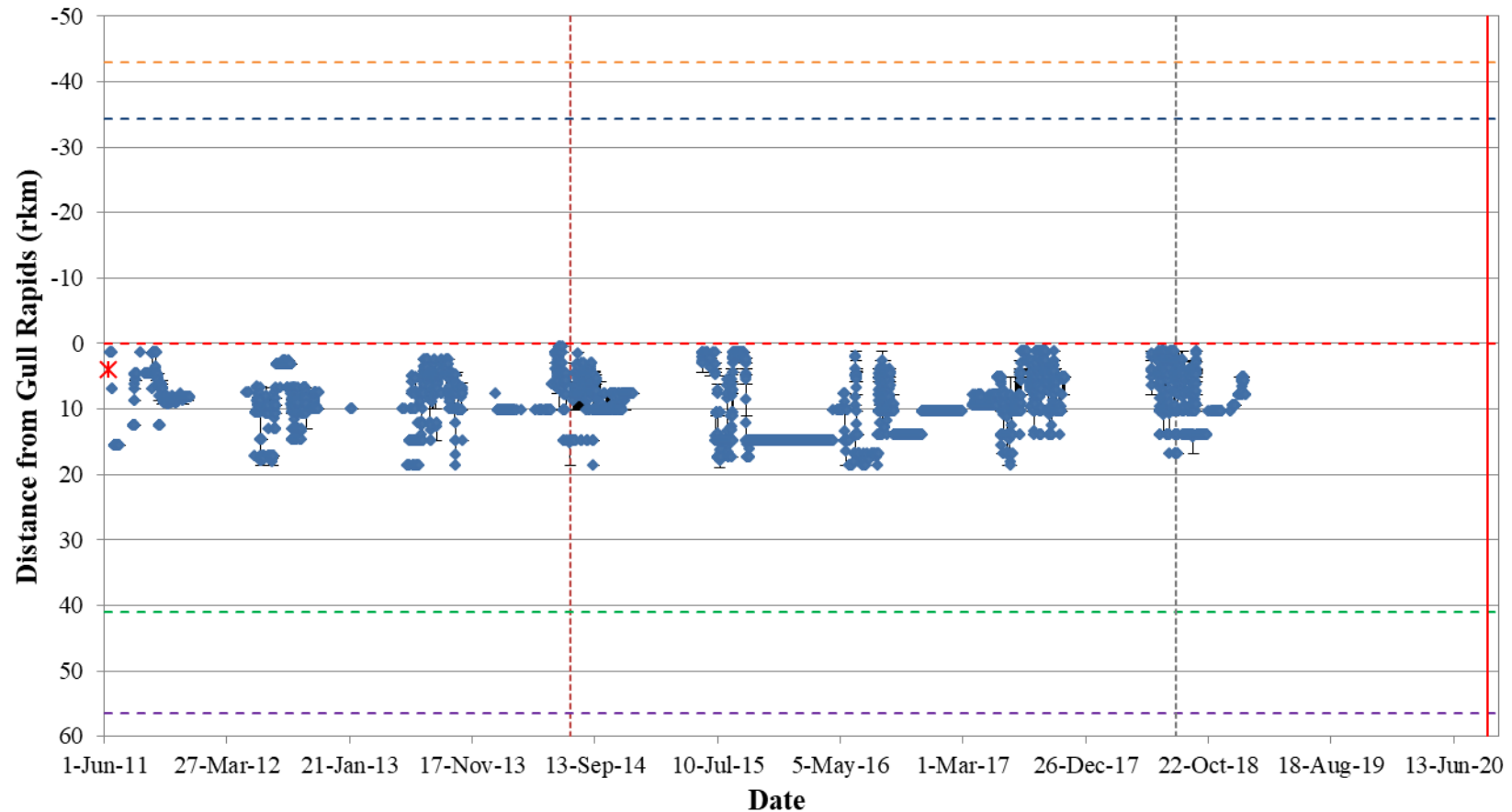


**Figure A3-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16030) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**

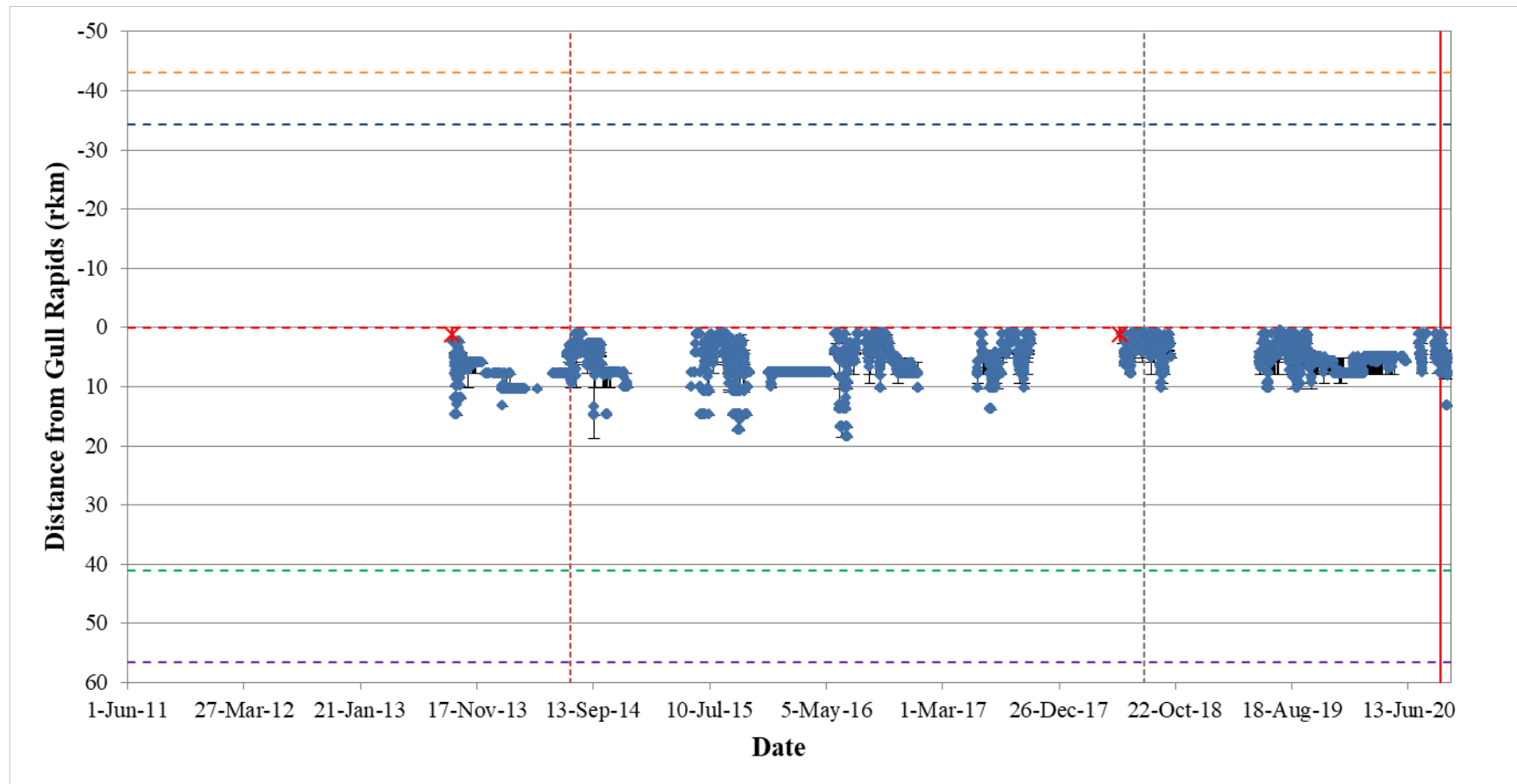


**Figure A3-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16031) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**

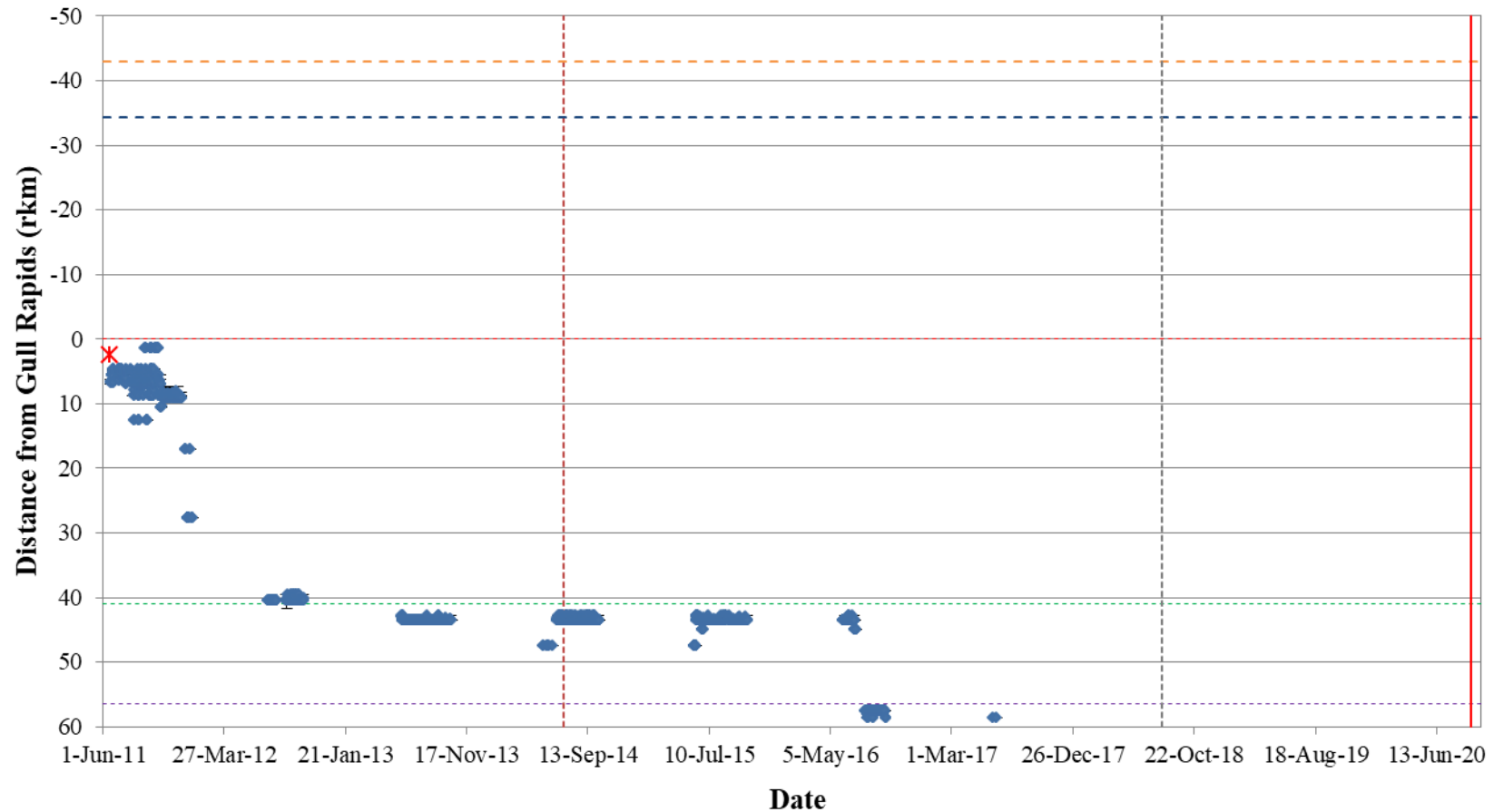




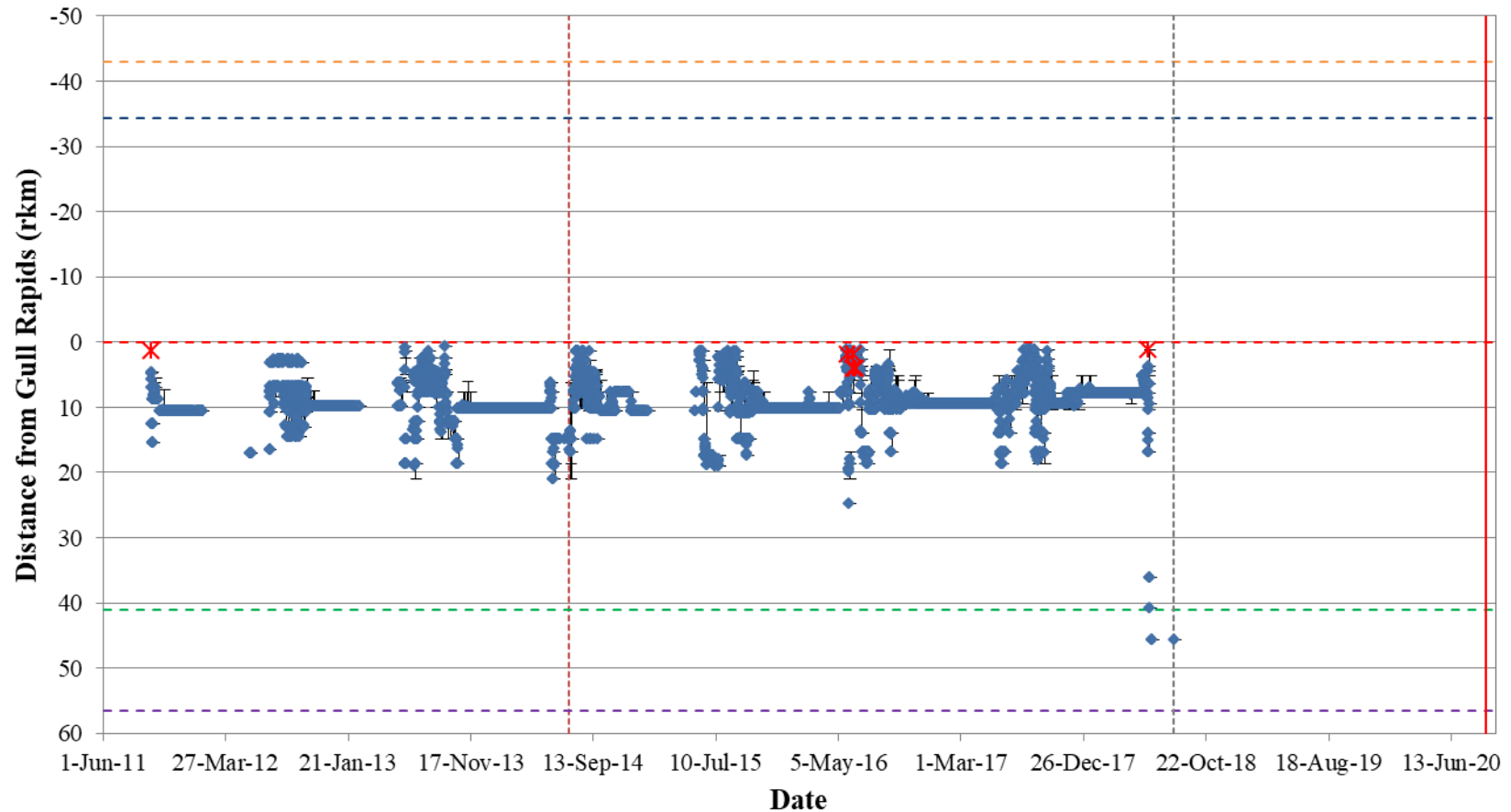
**Figure A3-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16032) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



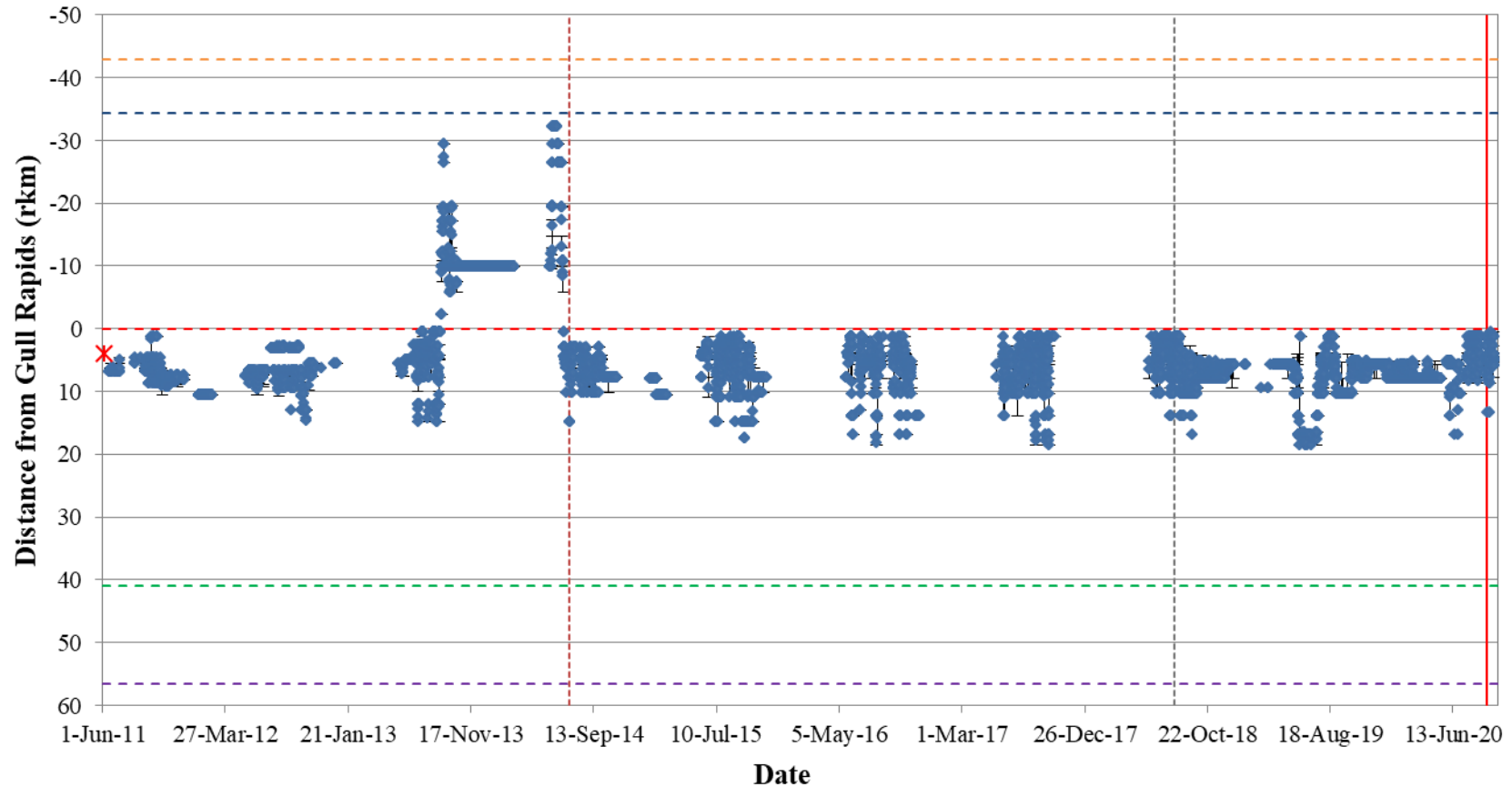
**Figure A3-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16033b) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recapture is indicated by a star. Beginning of Keeyask construction is indicated 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).**



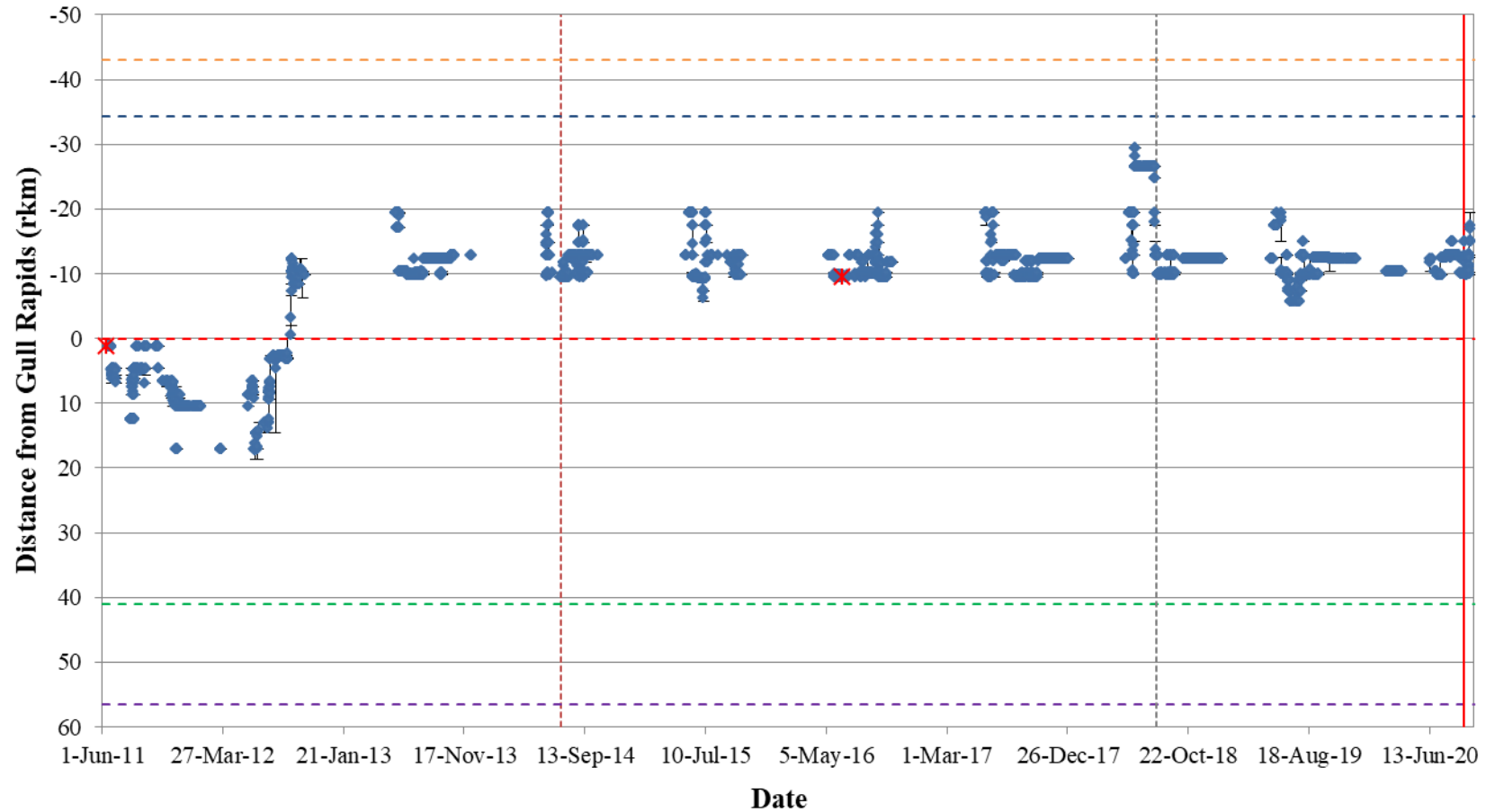
**Figure A3-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16034) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



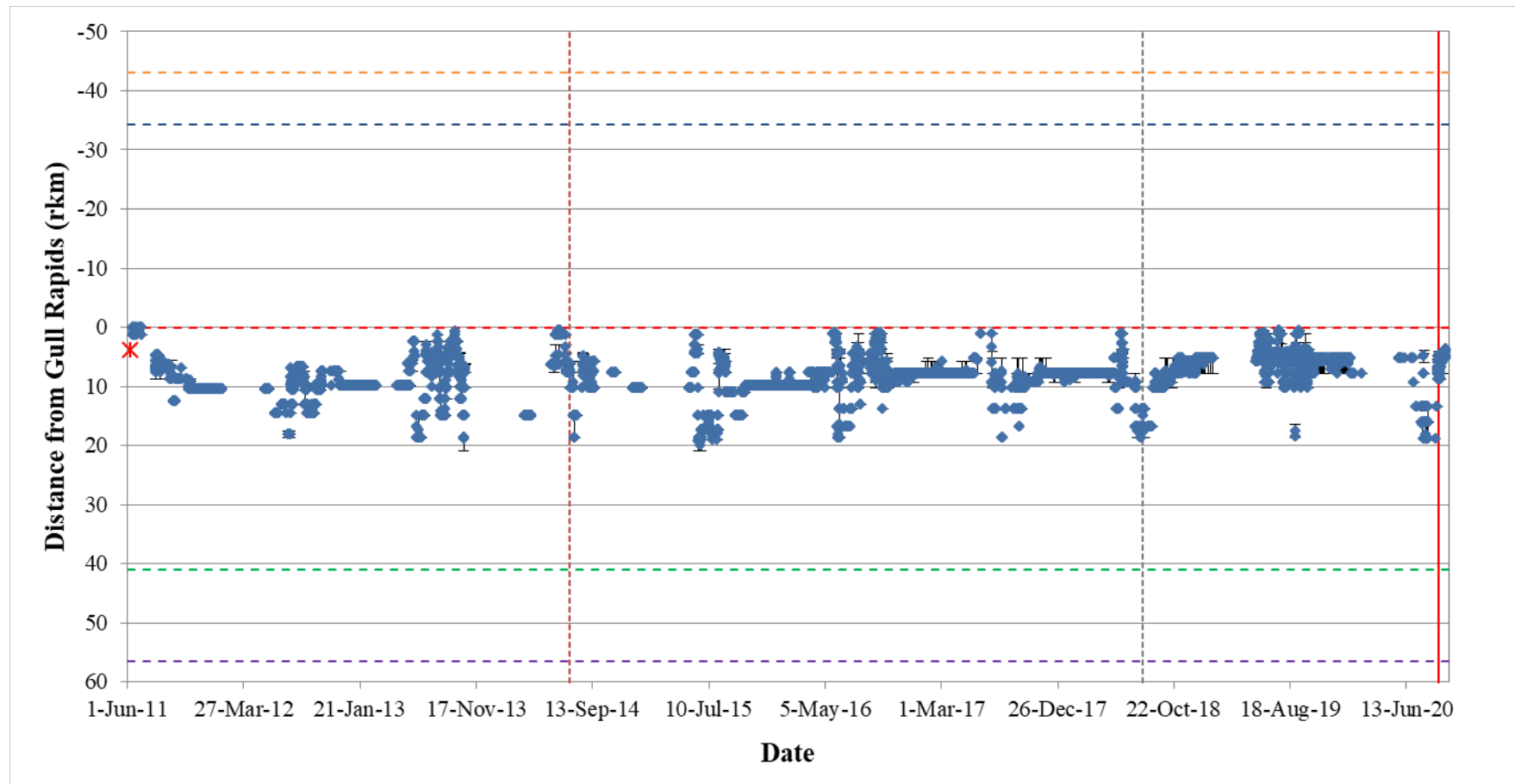
**Figure A3-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16035) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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 A3-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16037) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

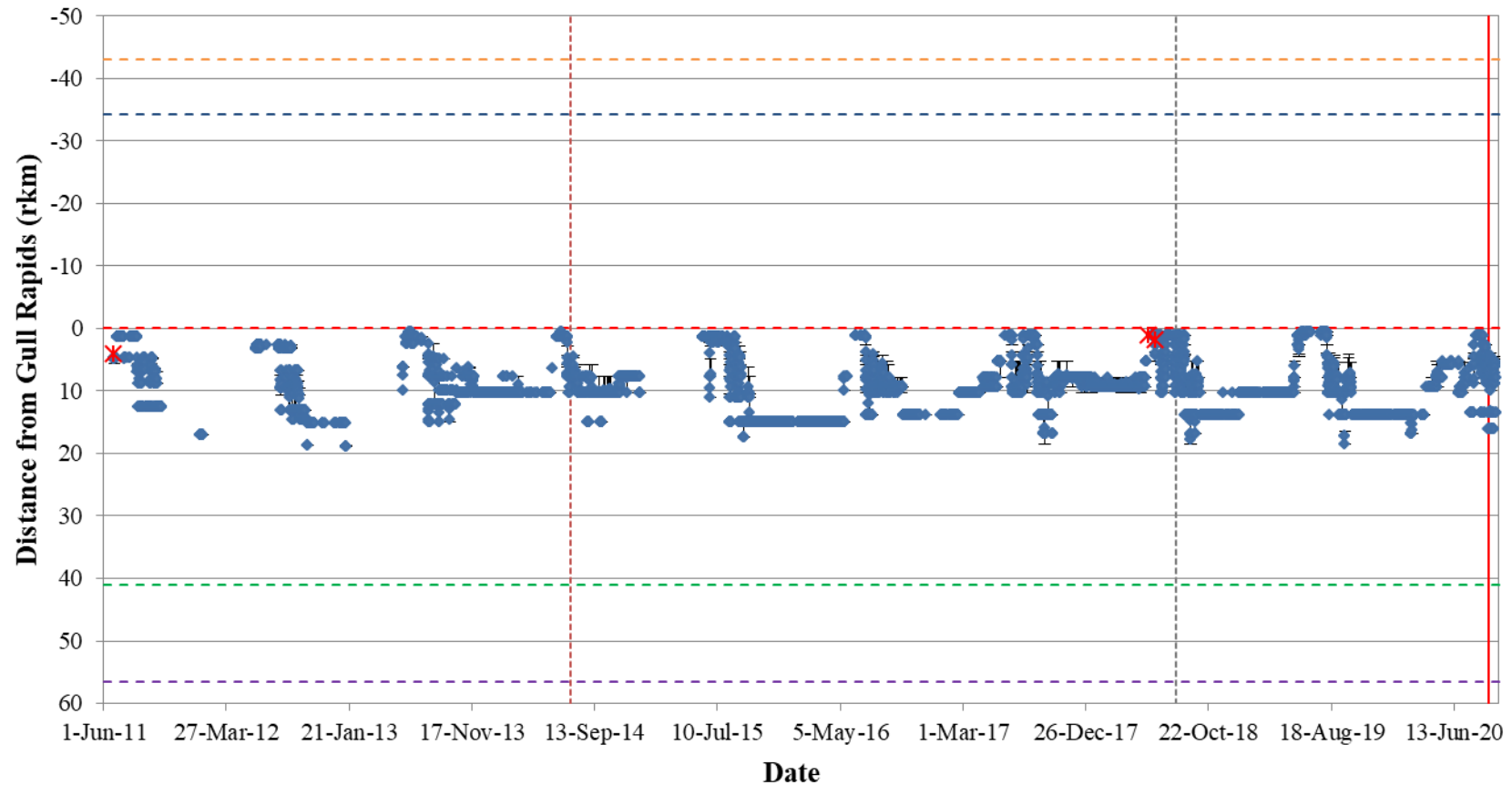


**Figure A3-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16038) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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).**

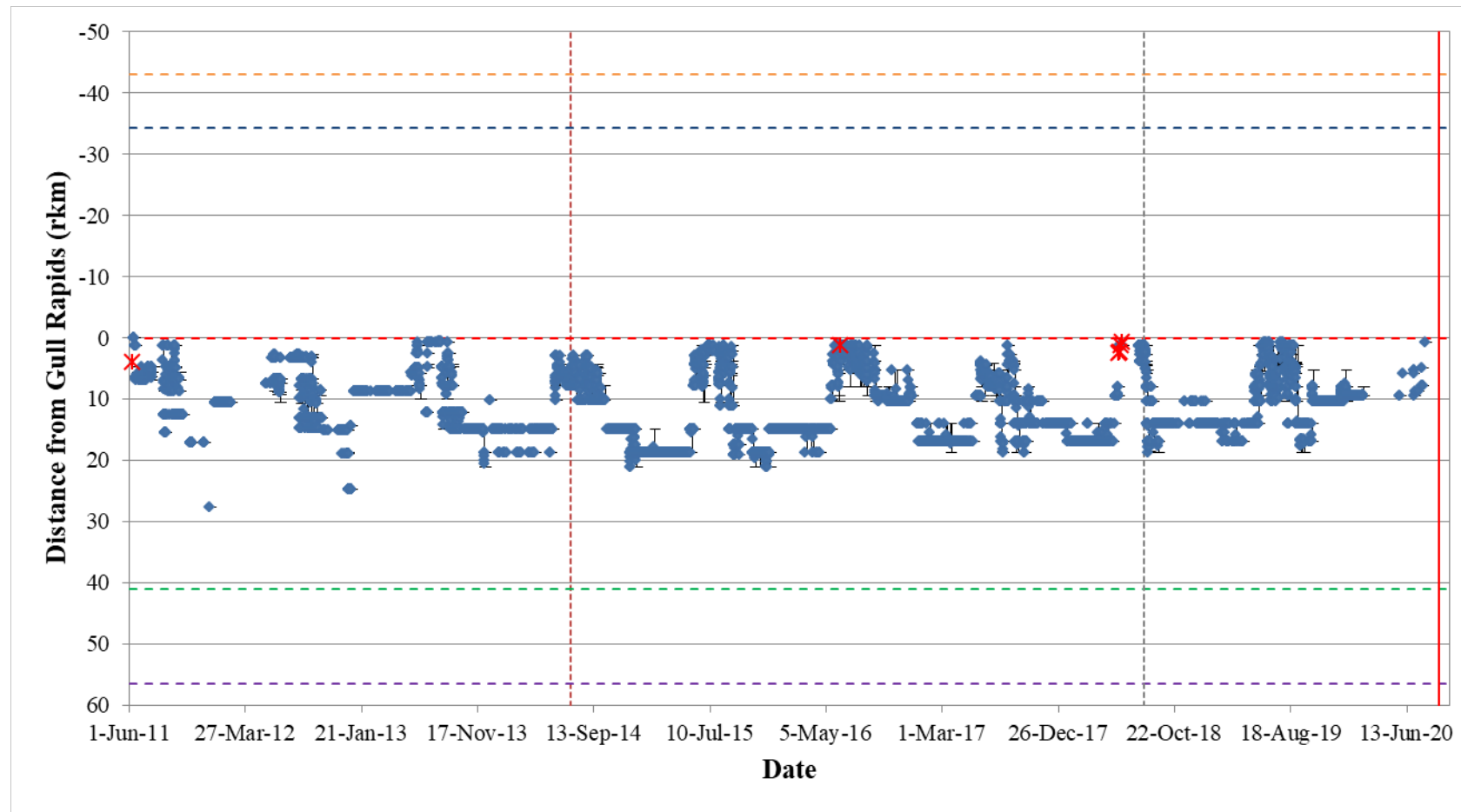


**Figure A3-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16040) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**

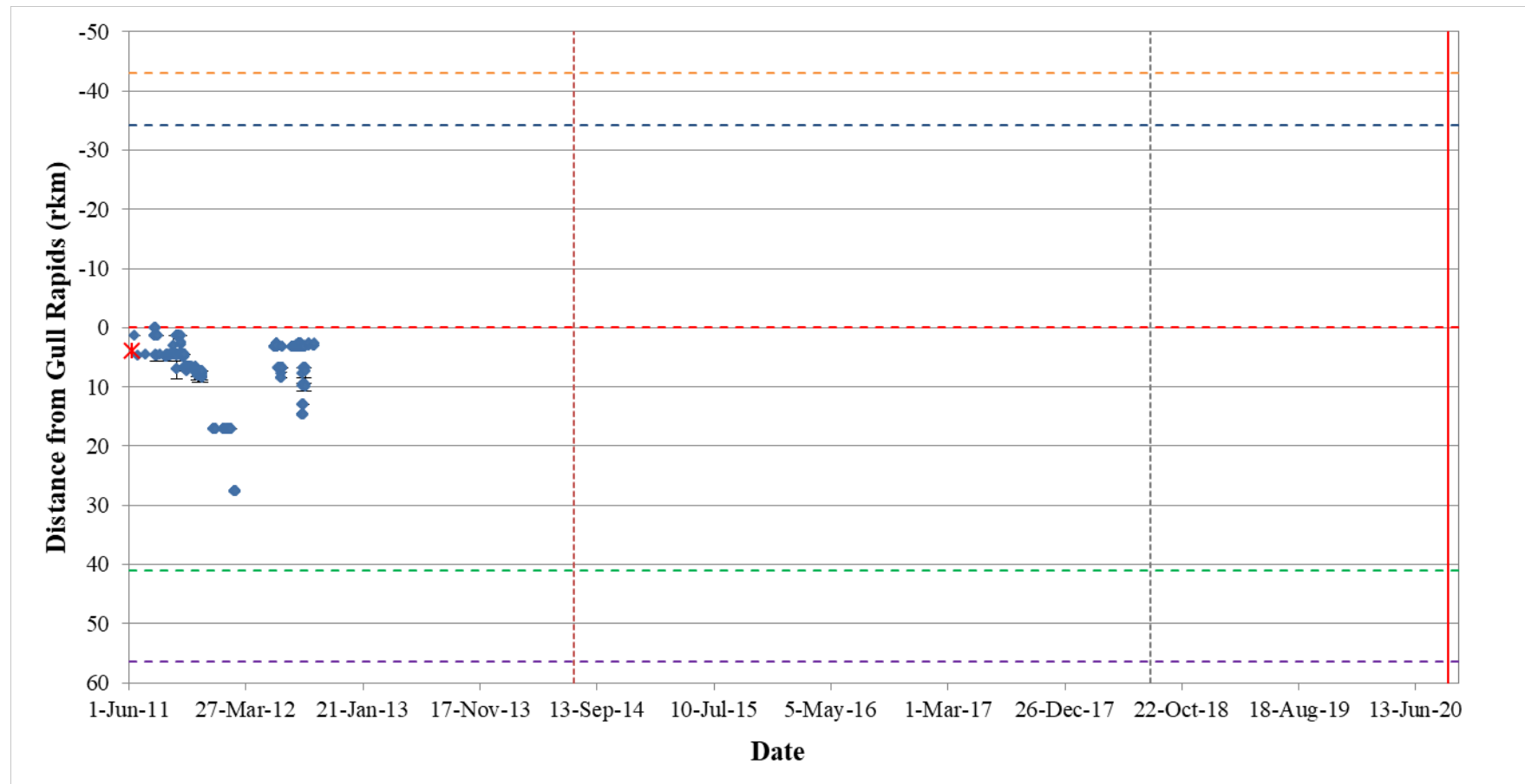




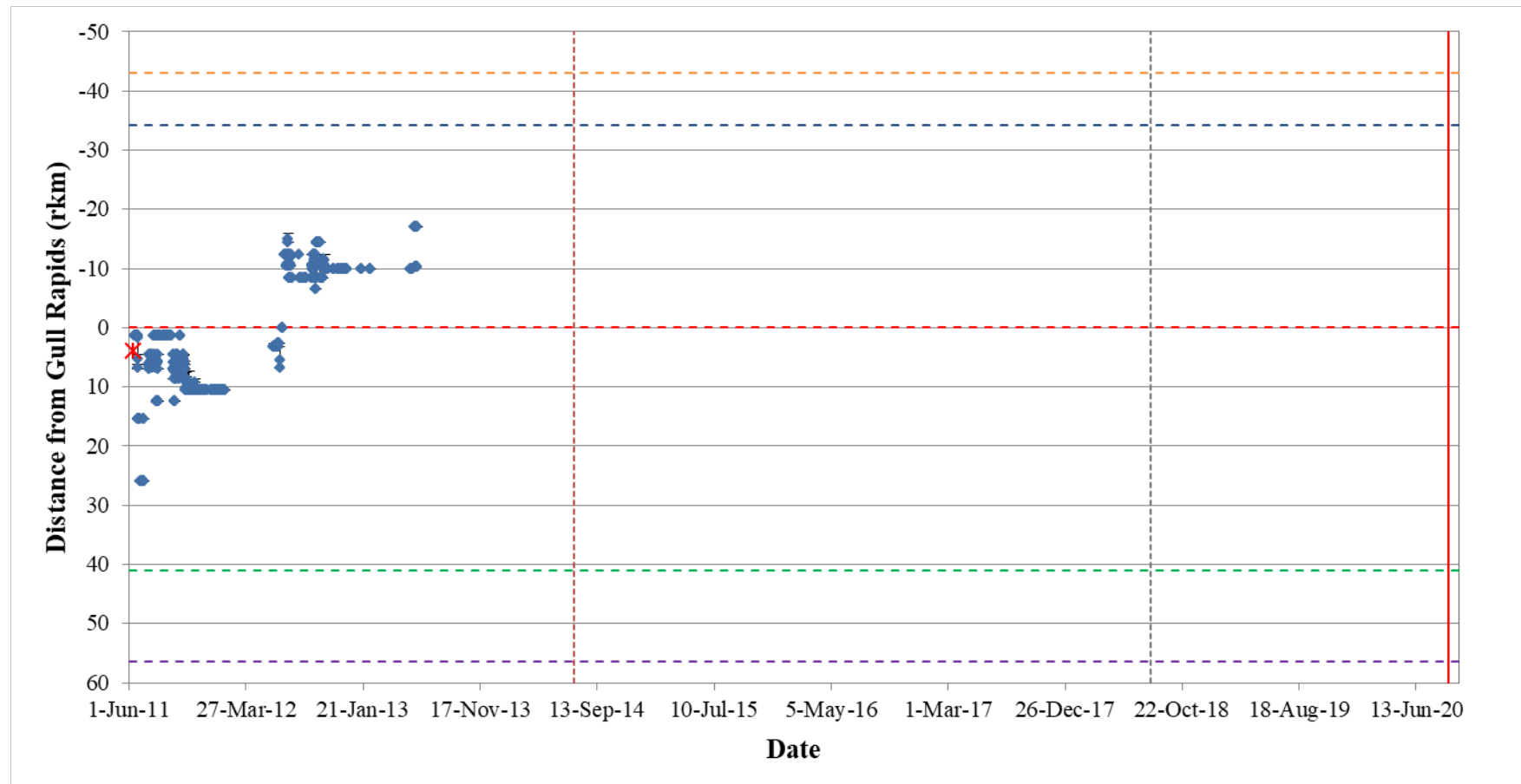
**Figure A3-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16041) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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).**



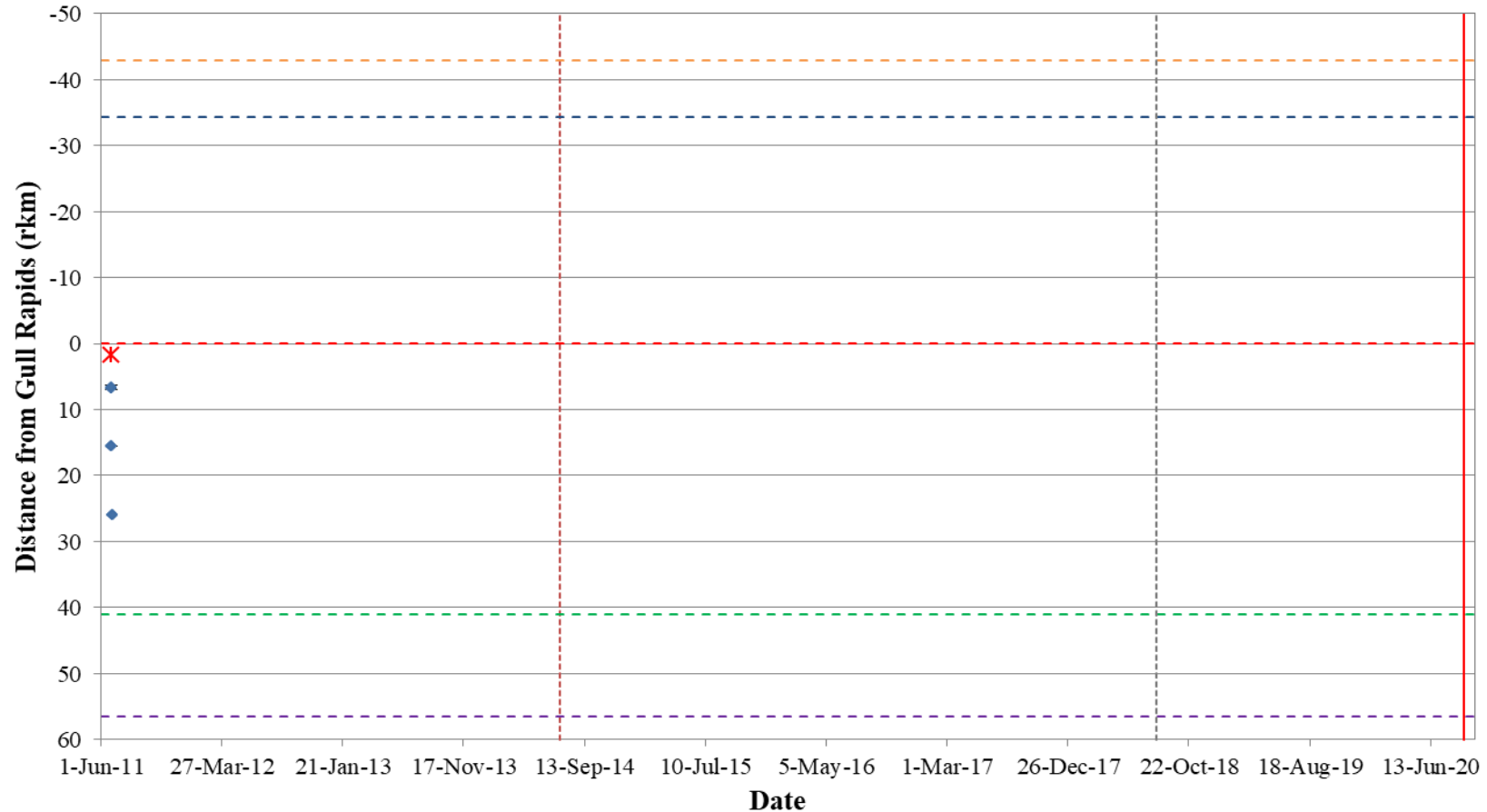
**Figure A3-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16043) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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).**



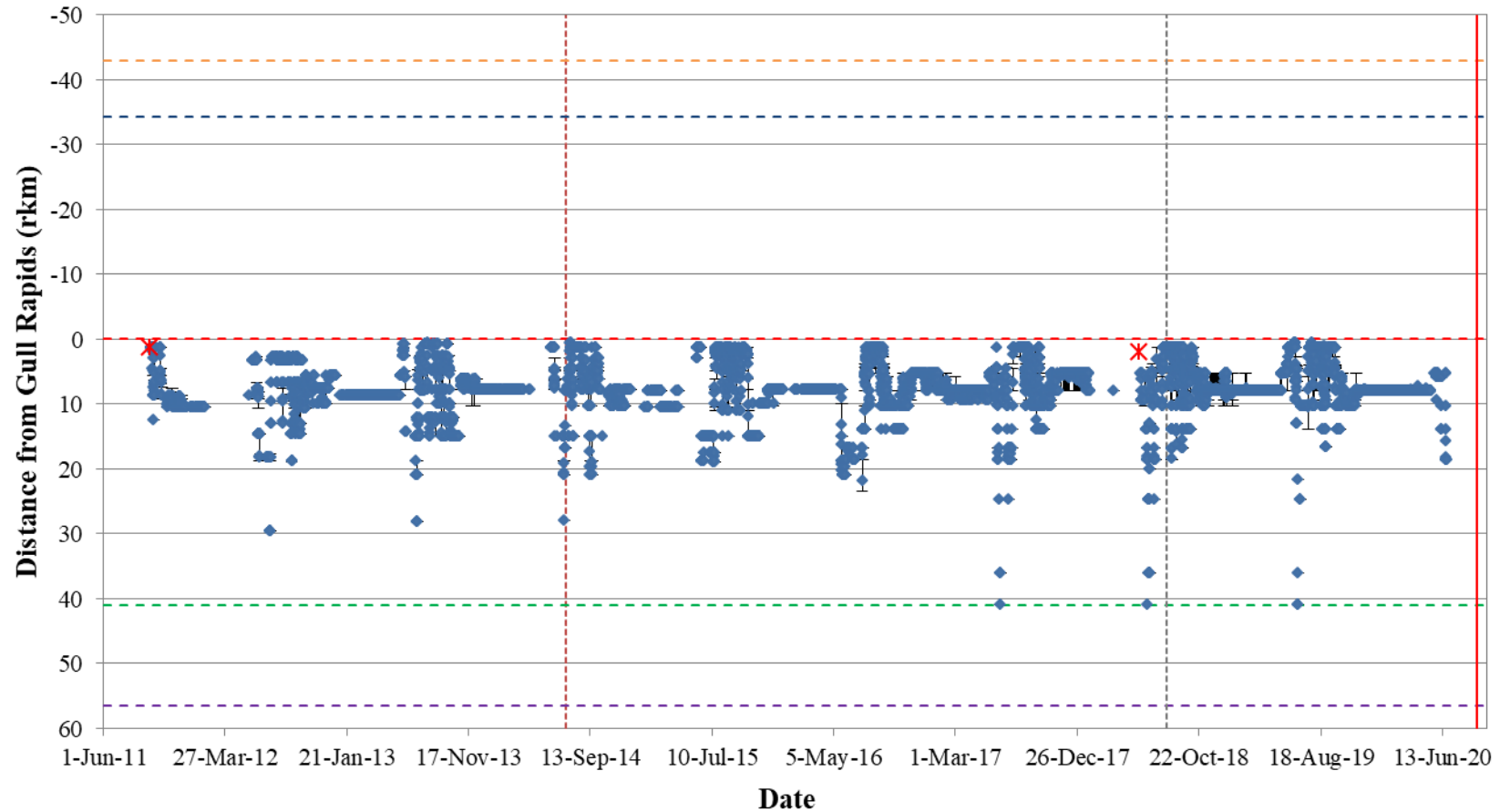
**Figure A3-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16044) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



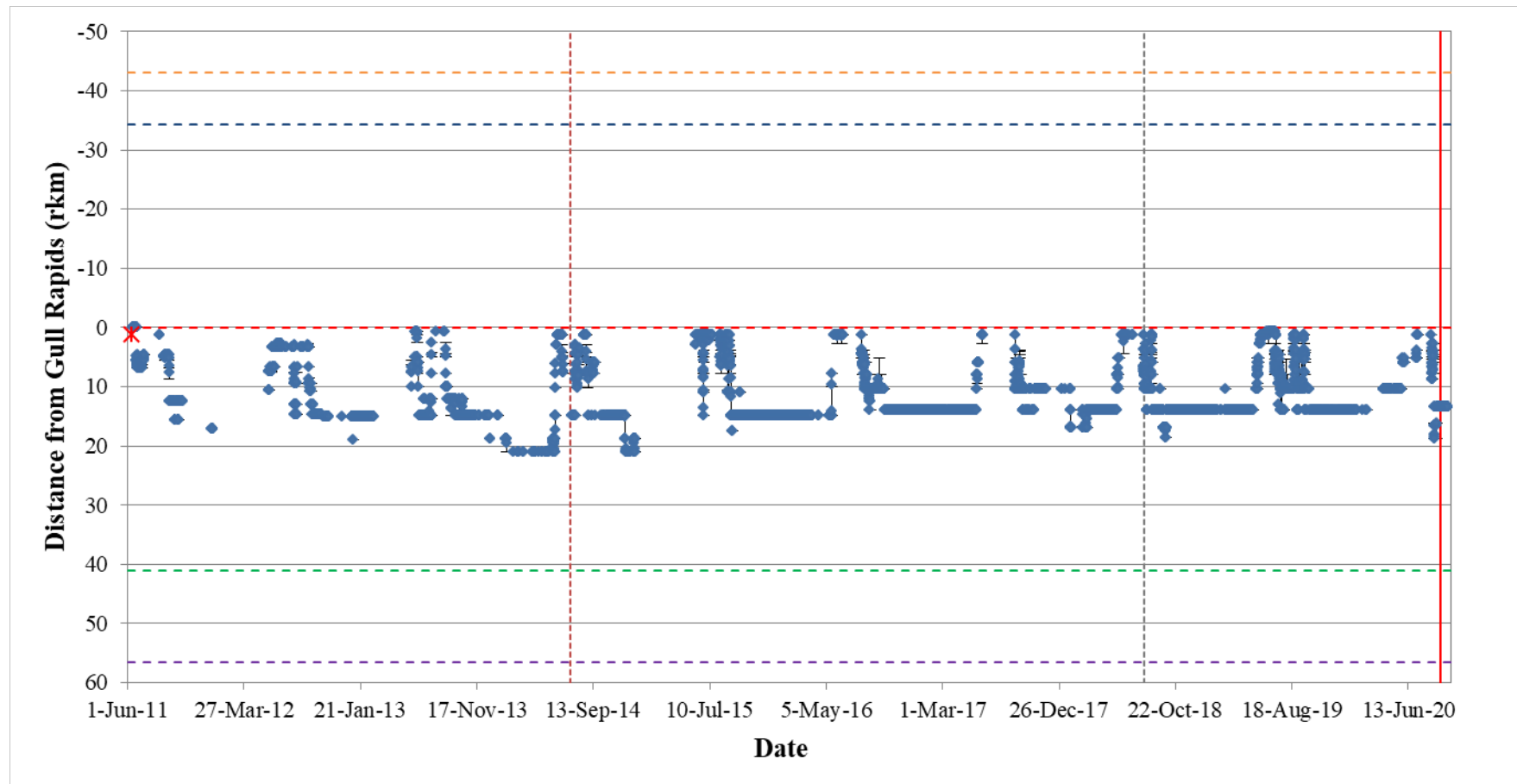
**Figure A3-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16046) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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 A3-24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16047) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

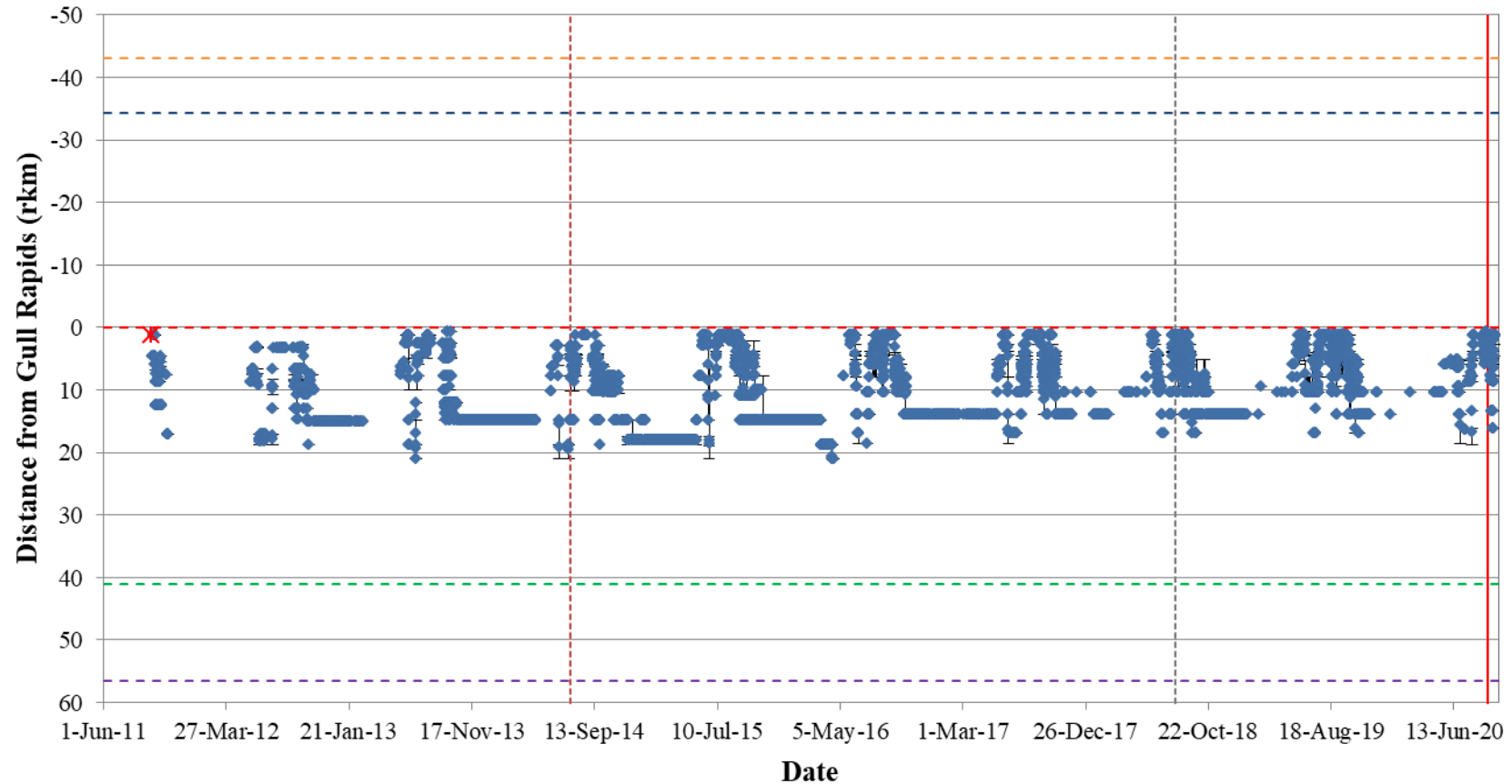


**Figure A3-25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16049) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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).**

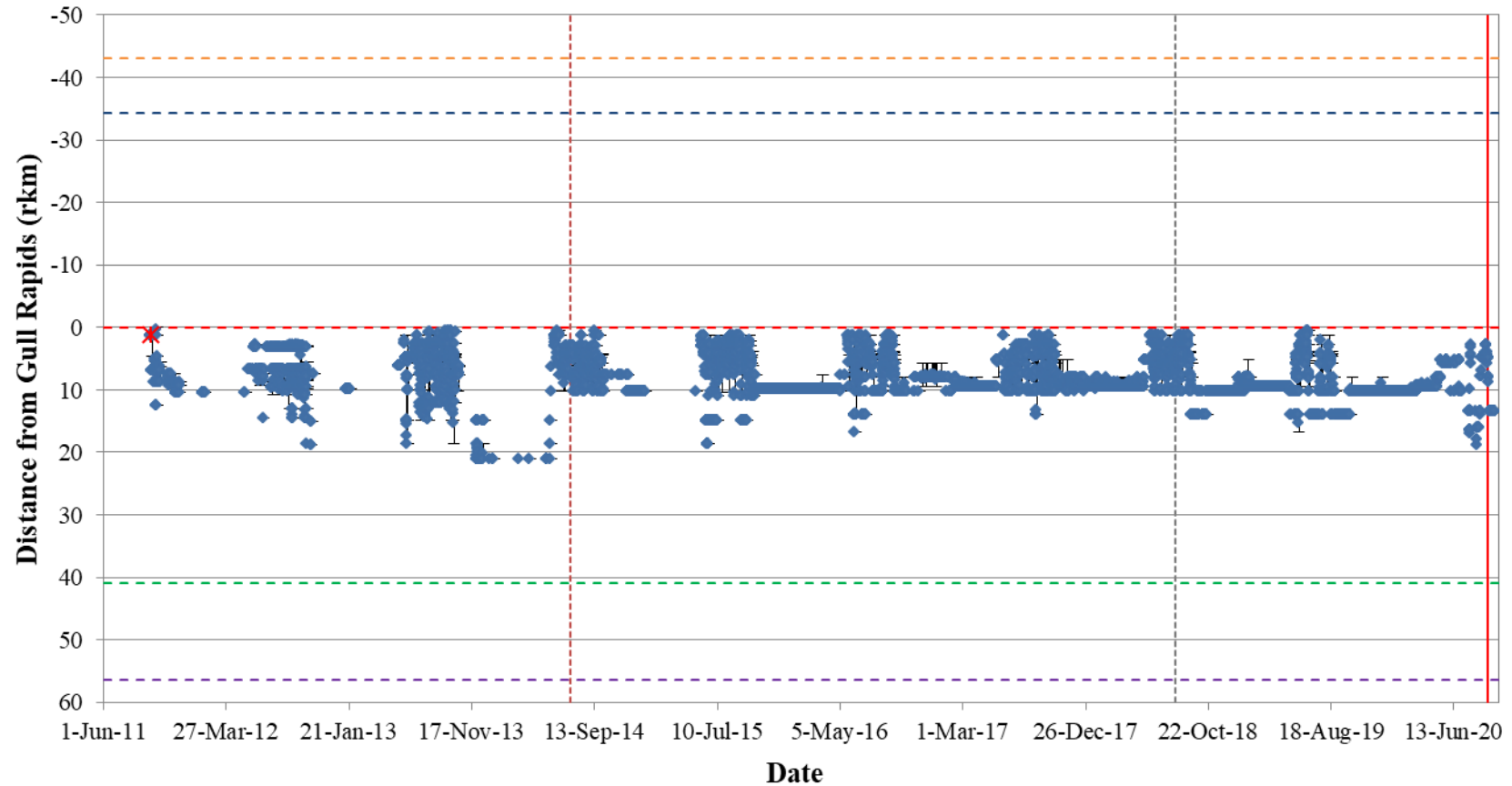


**Figure A3-26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16050) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**

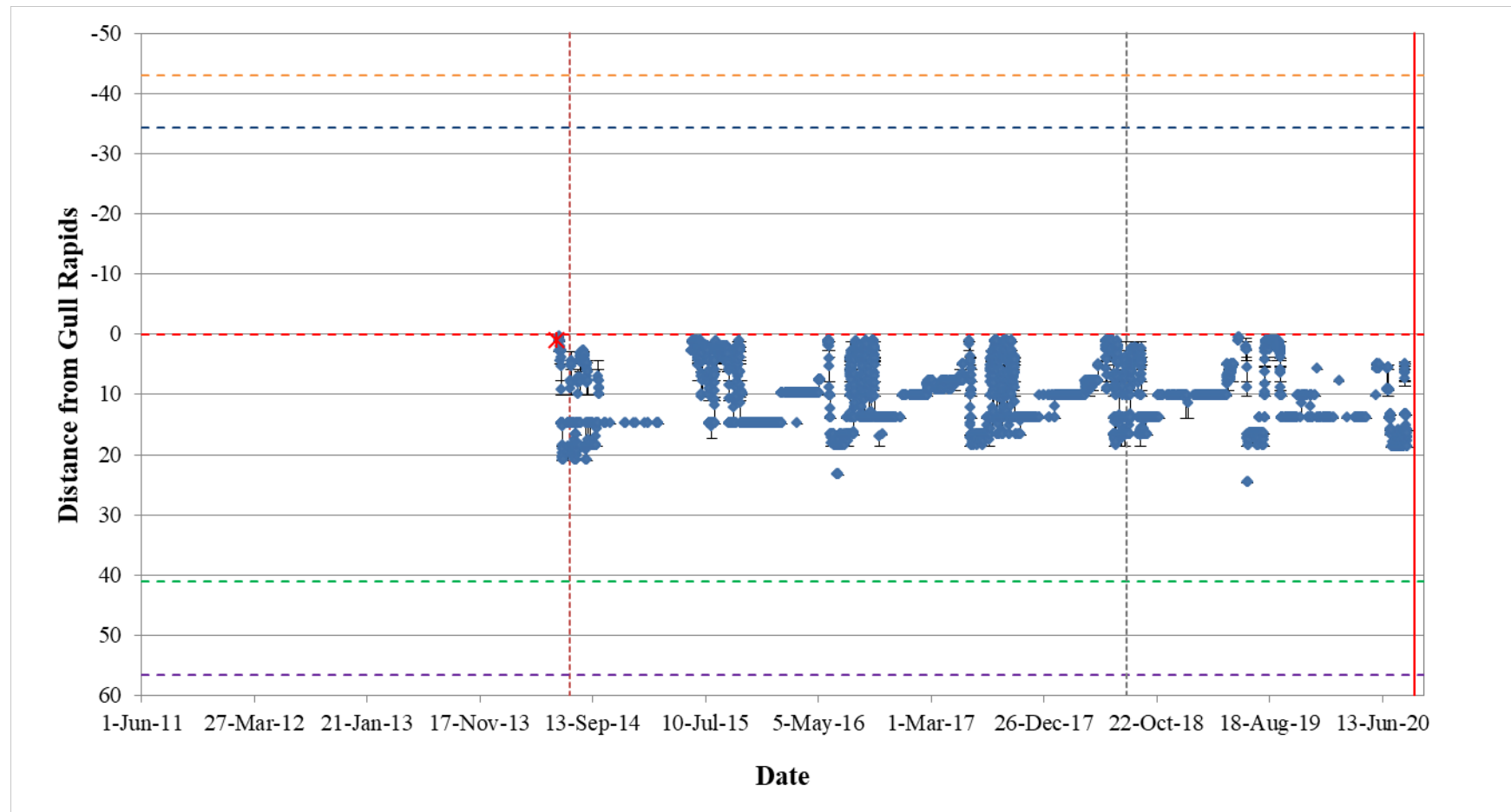




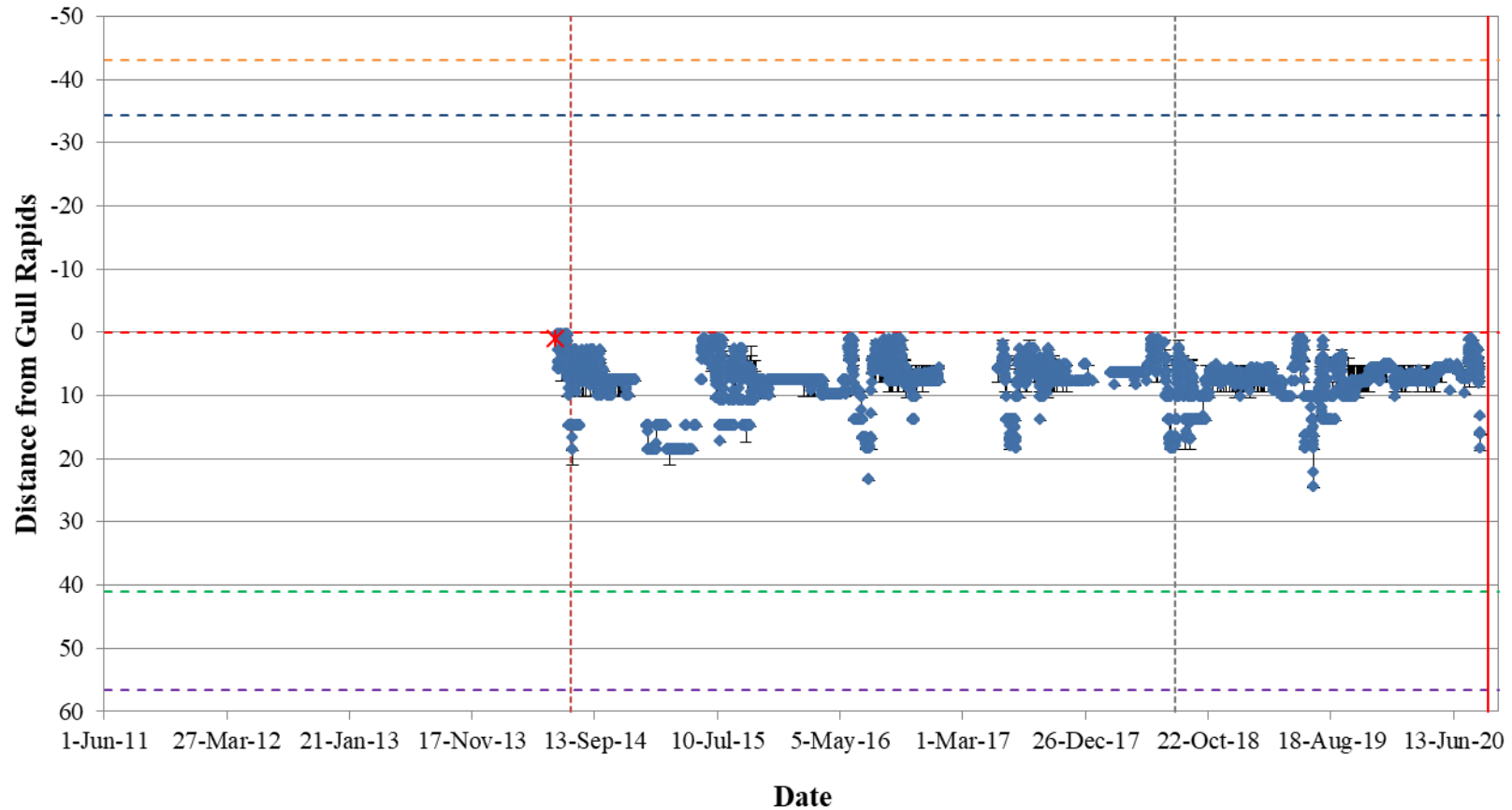
**Figure A3-27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16052) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



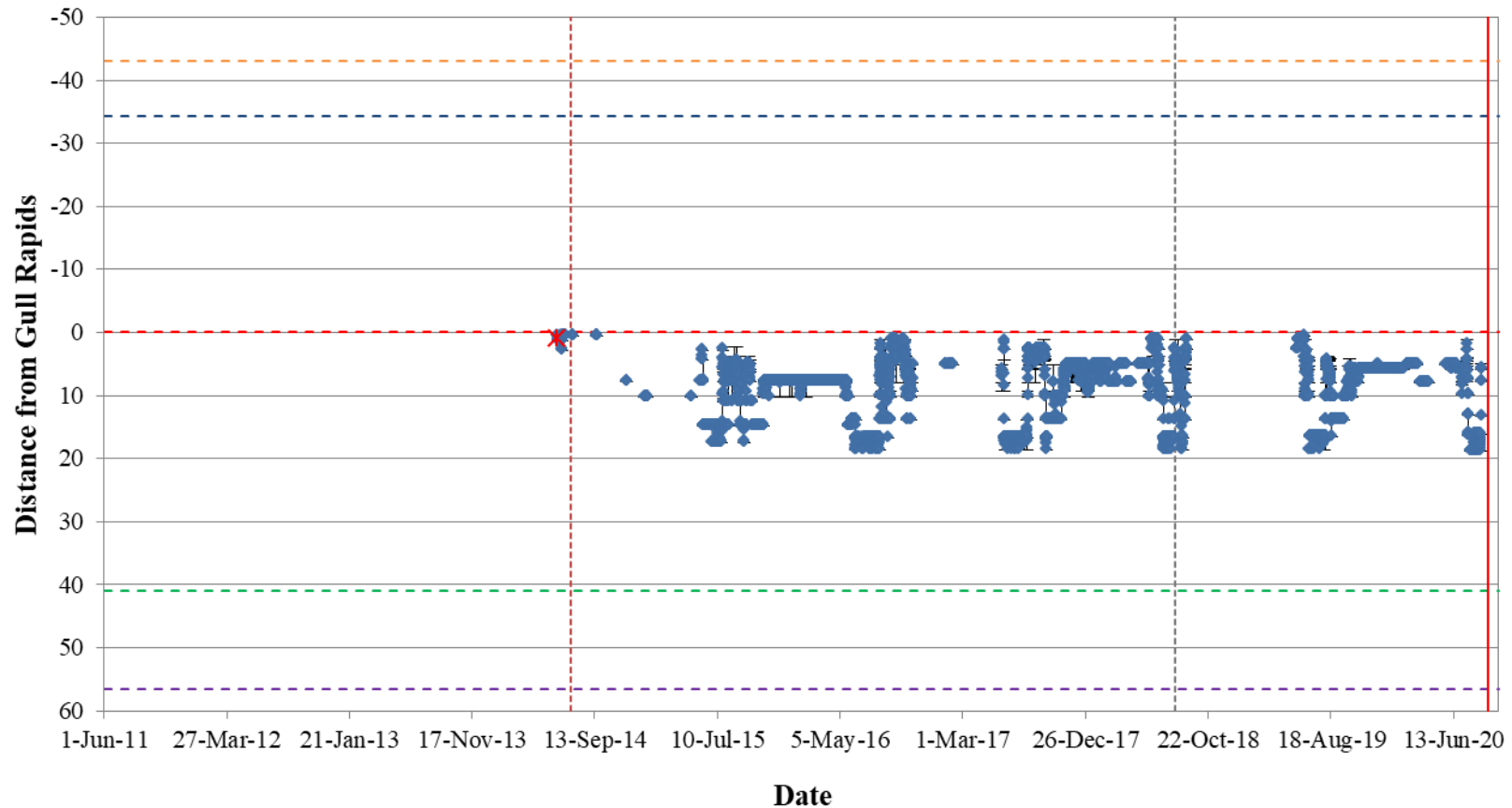
**Figure A3-28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16053) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



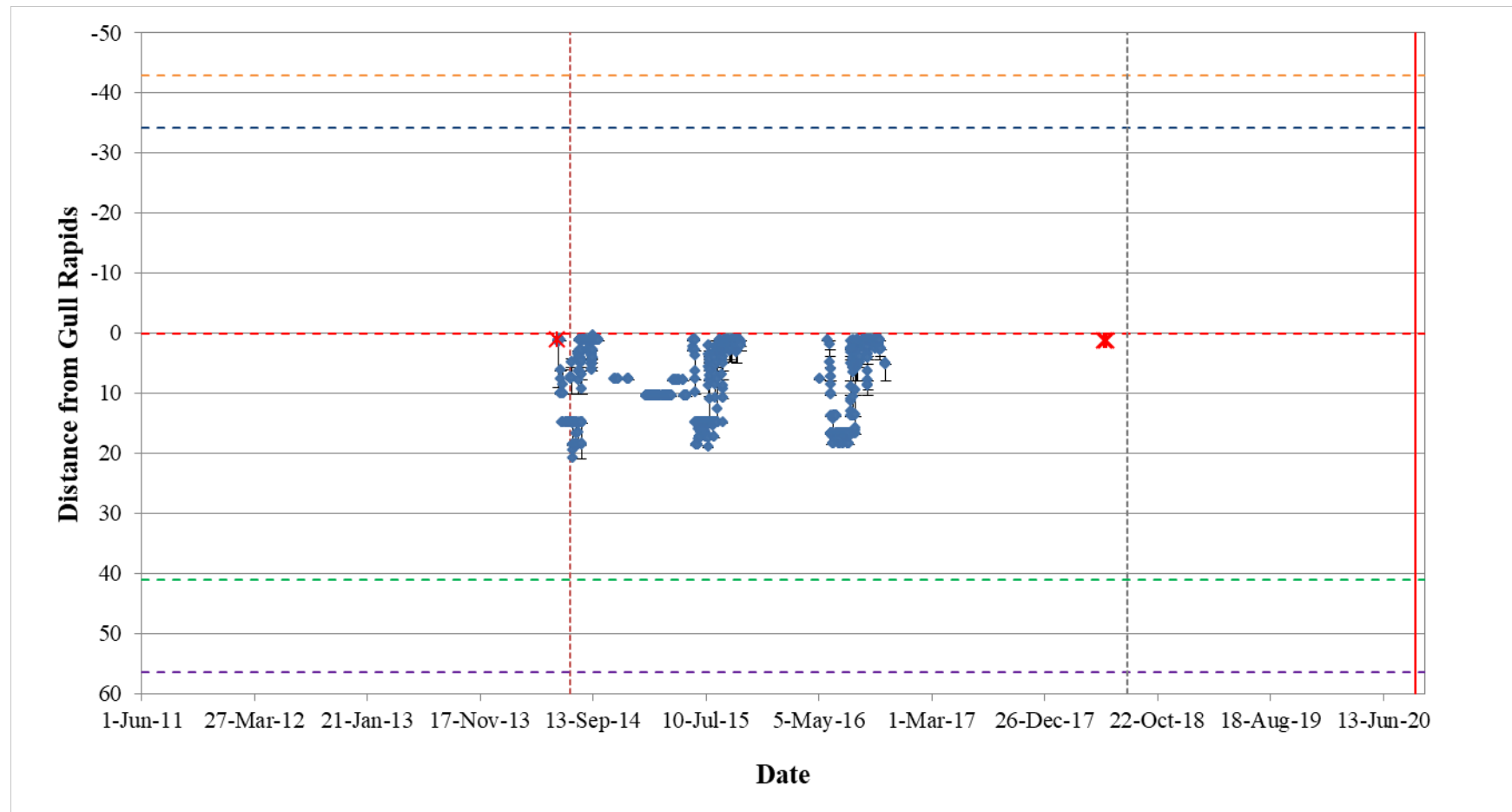
**Figure A3-29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32167) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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).**



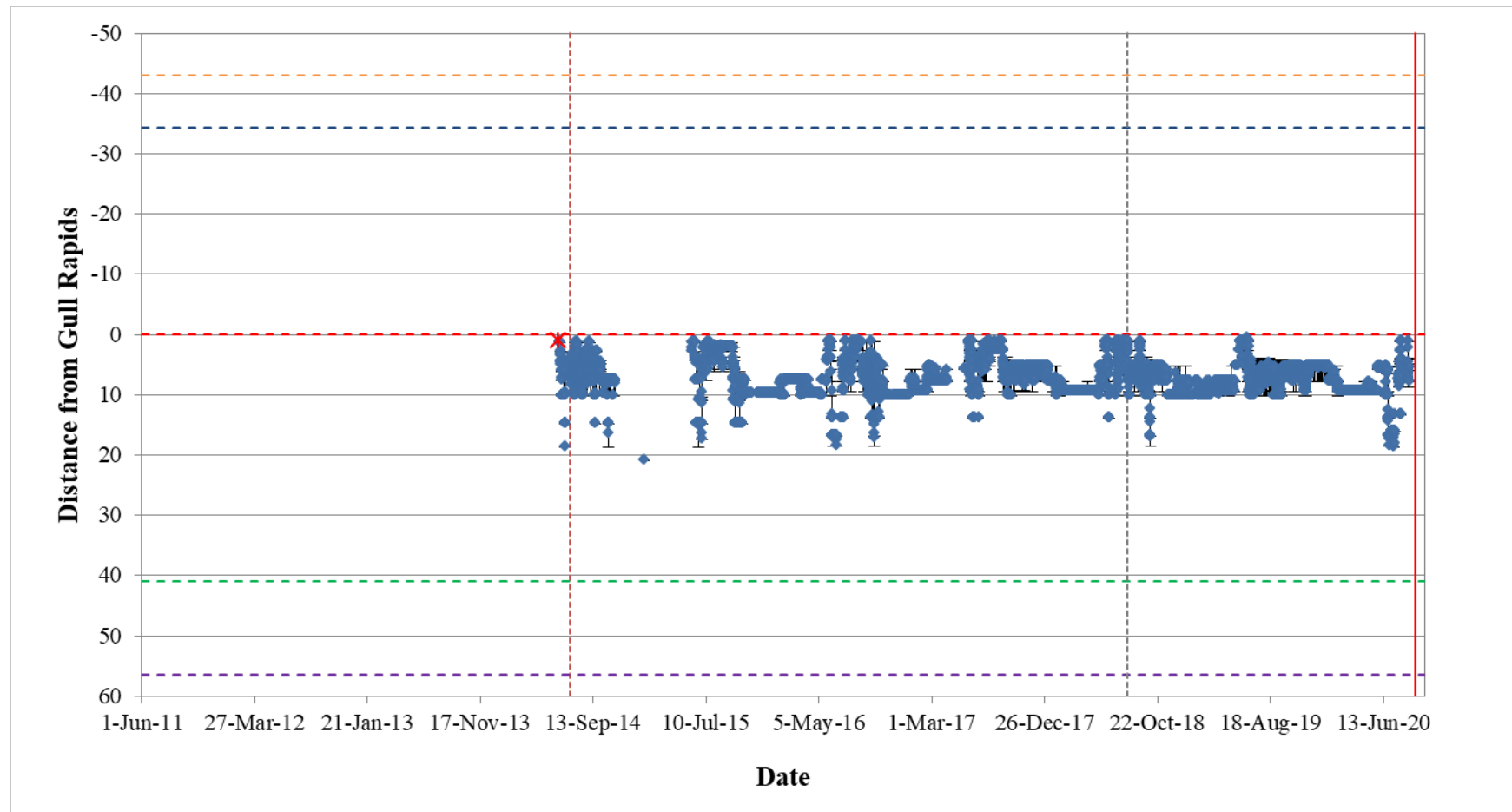
**Figure A3-30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32168) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a vertical 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 A3-31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32169) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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).**

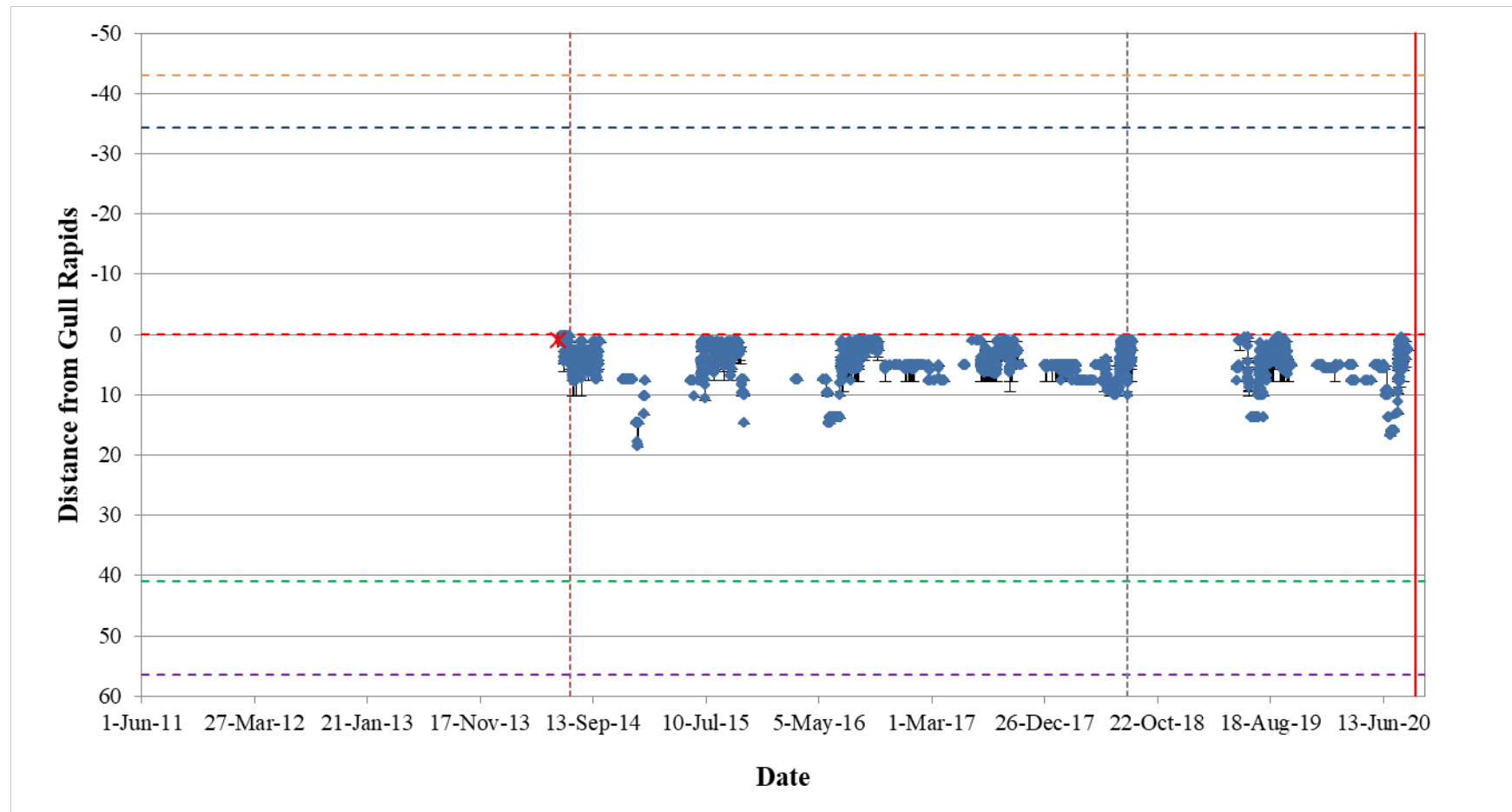


**Figure A3-32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32170) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. Date and location of tagging and recaptures are indicated by a star. Beginning of Keeyask construction is indicated 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 A3-33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32171) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 A3-34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32172) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 A3-35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32173) in Stephens Lake in relation to the Keeyask GS (rkm 0), from June 1, 2011 to September 23, 2020. 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 4:**

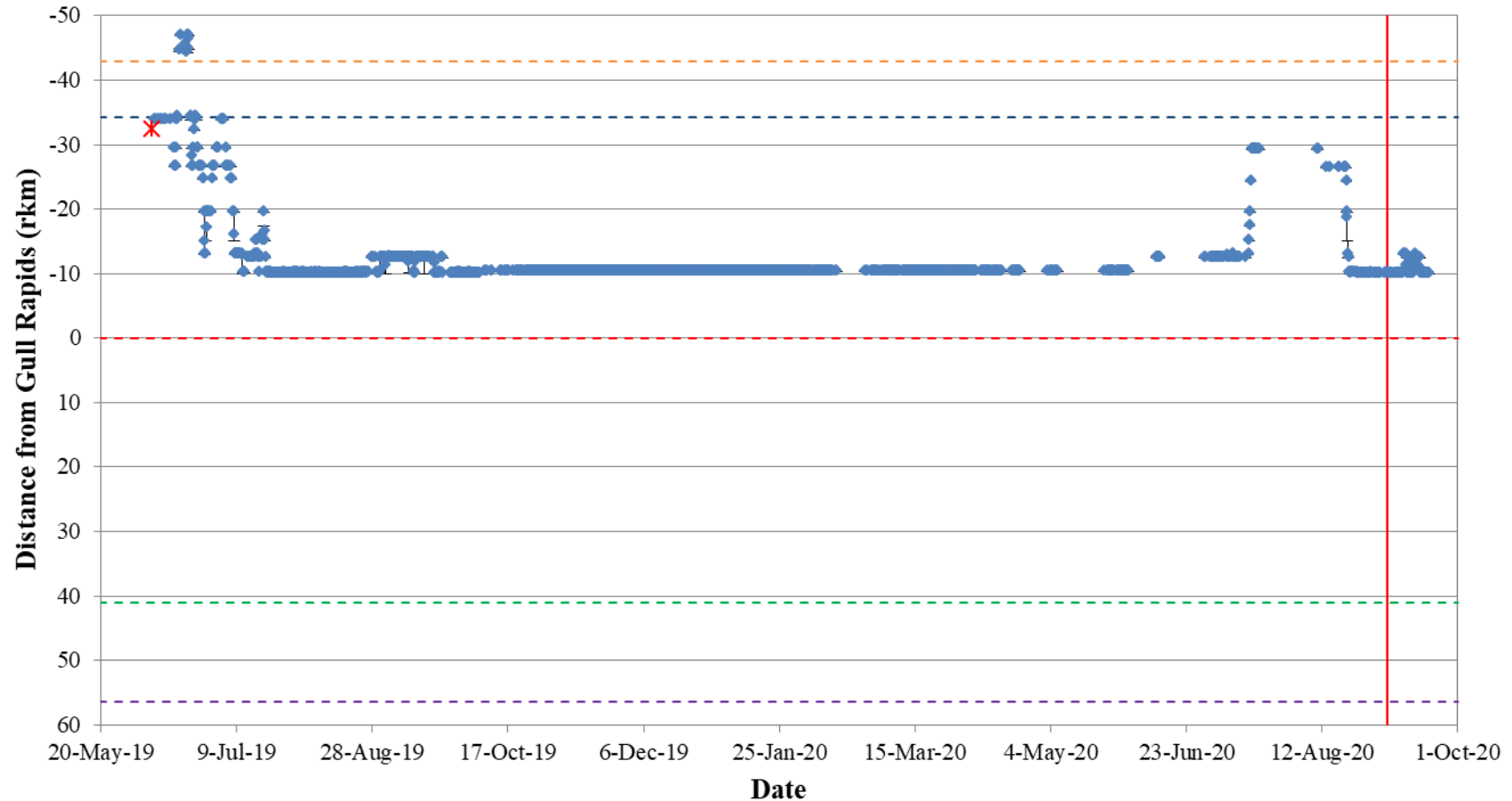
# **LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF THE KEEYASK GS, MAY TO SEPTEMBER 2020**

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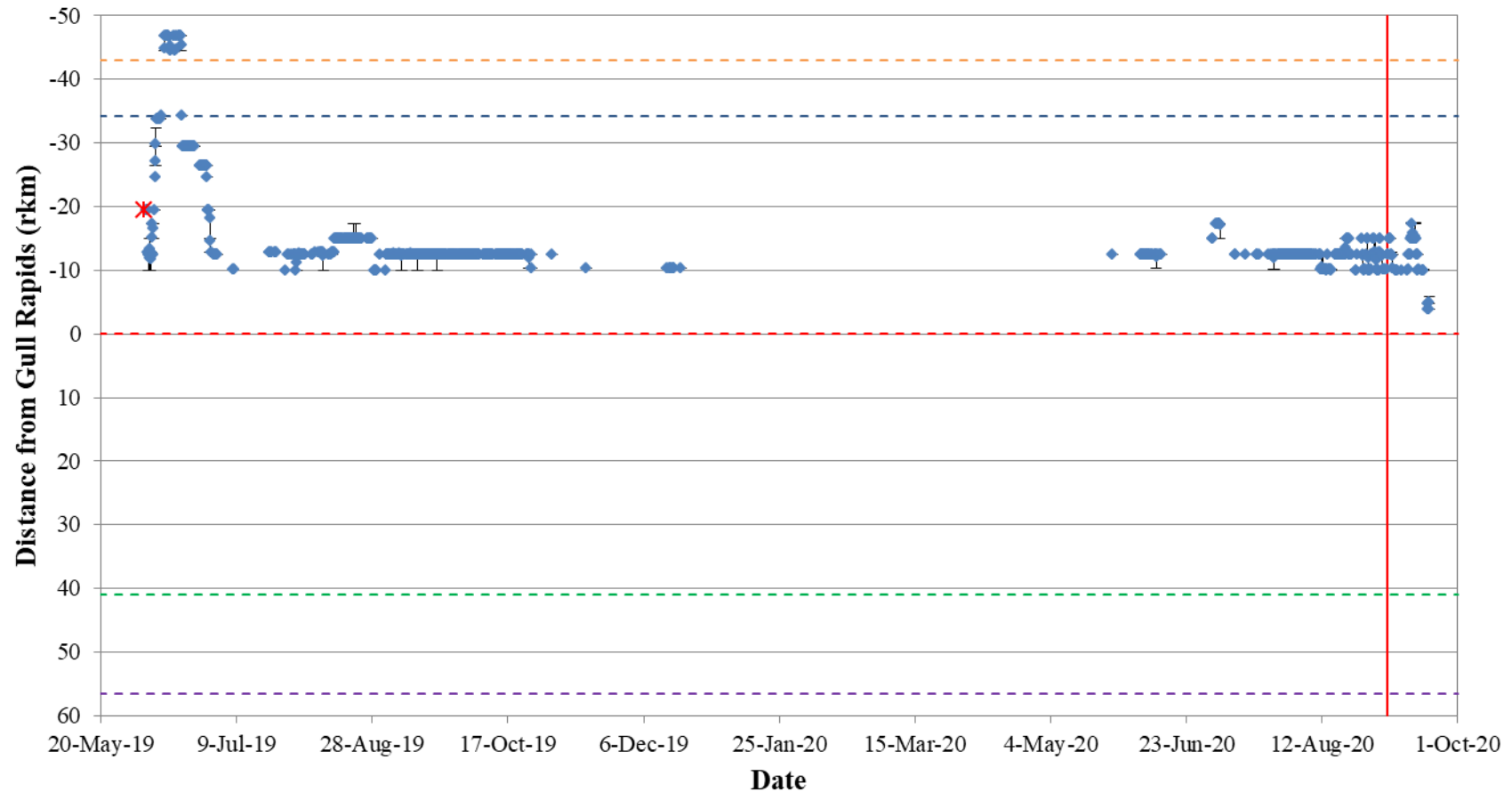
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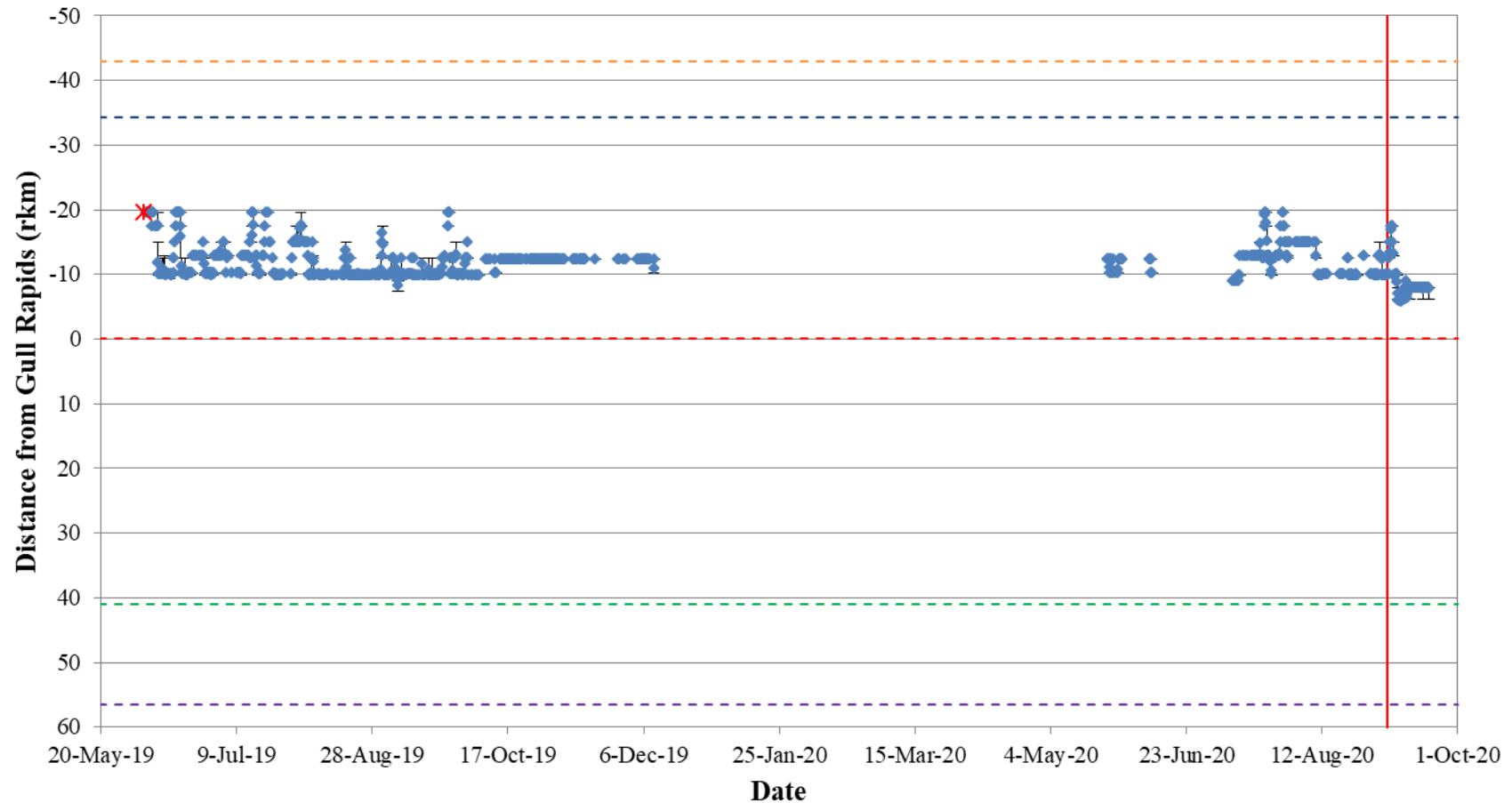


**Figure A4-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7017) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

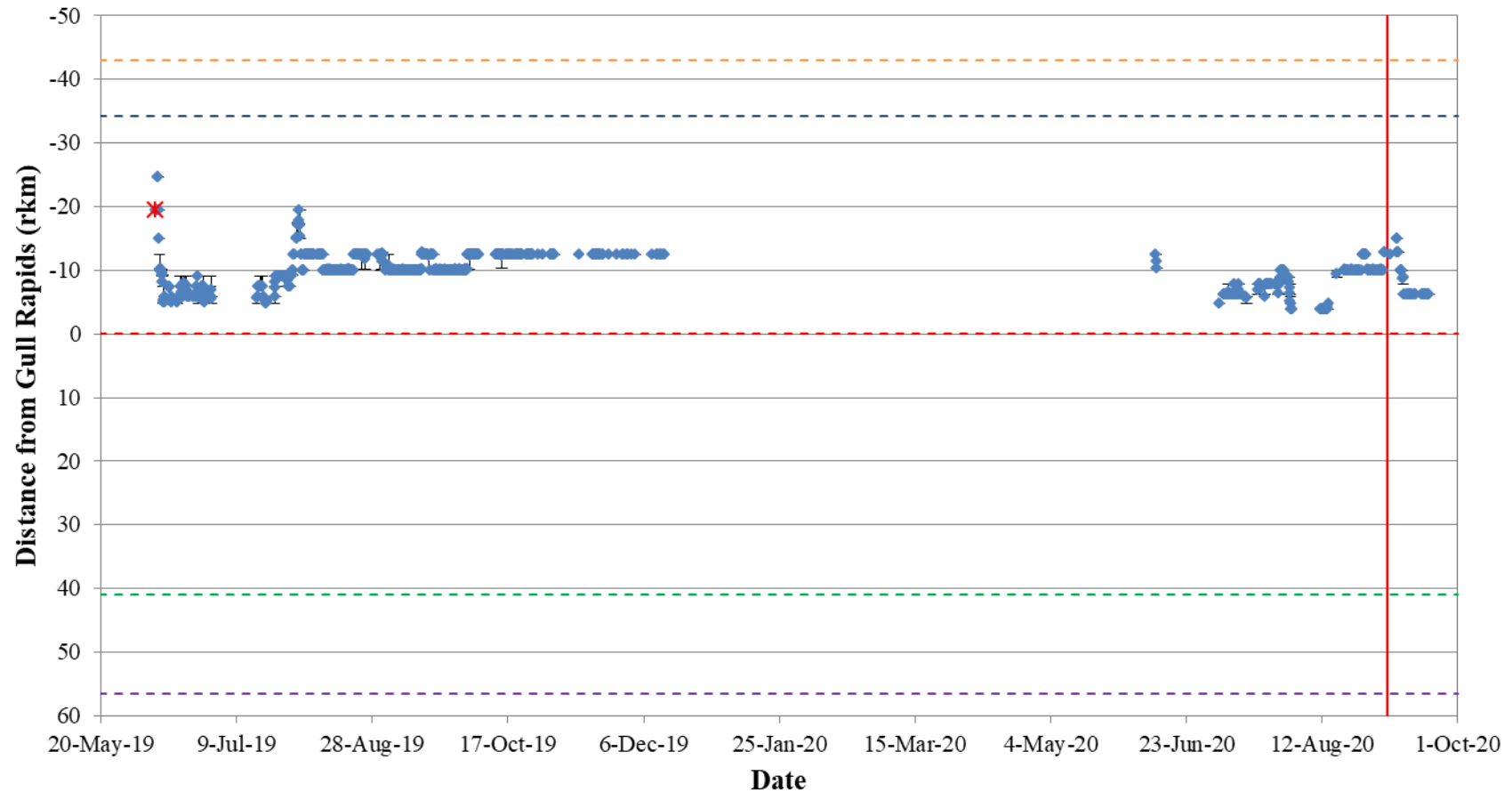


**Figure A4-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7018) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

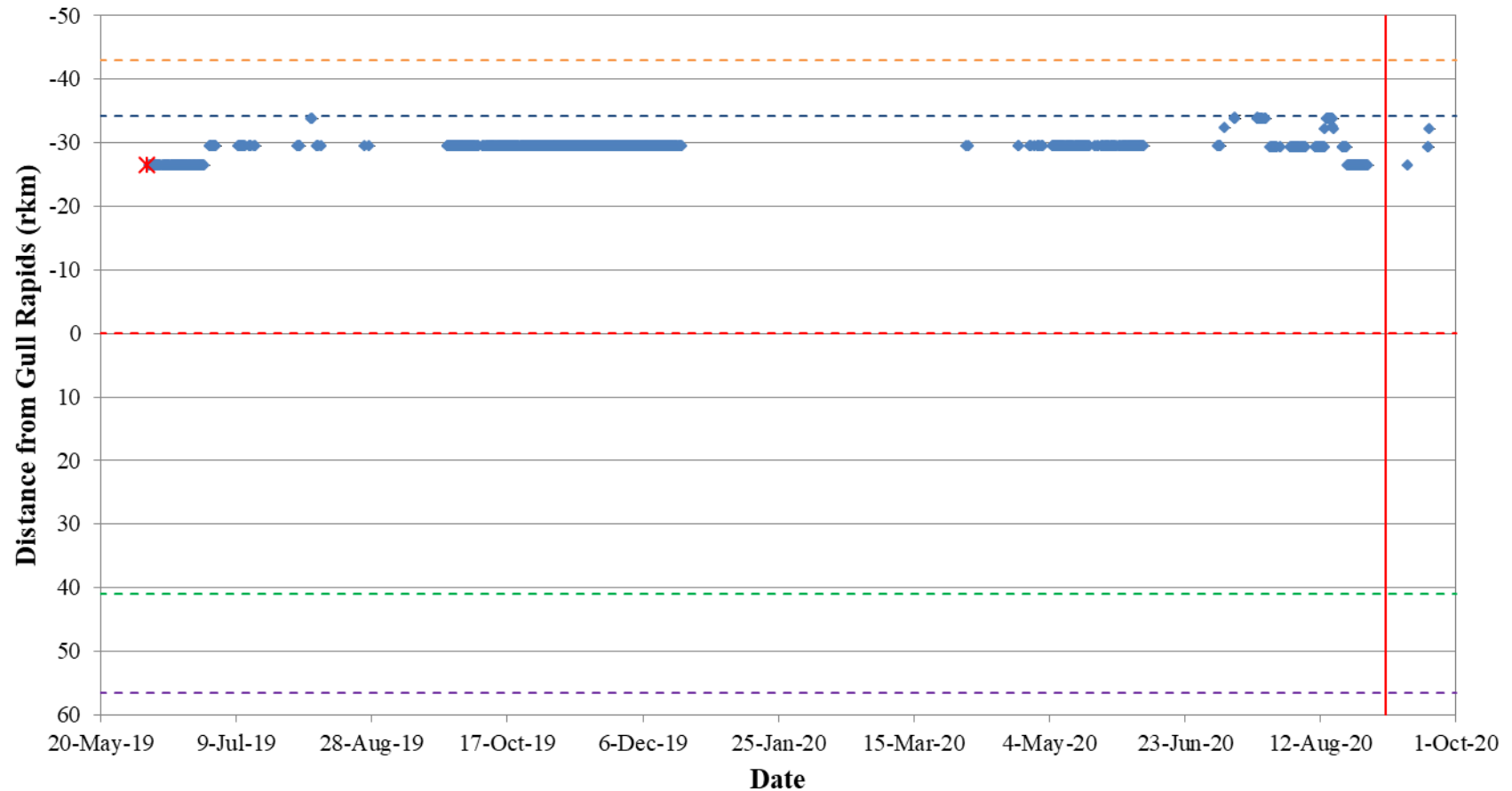




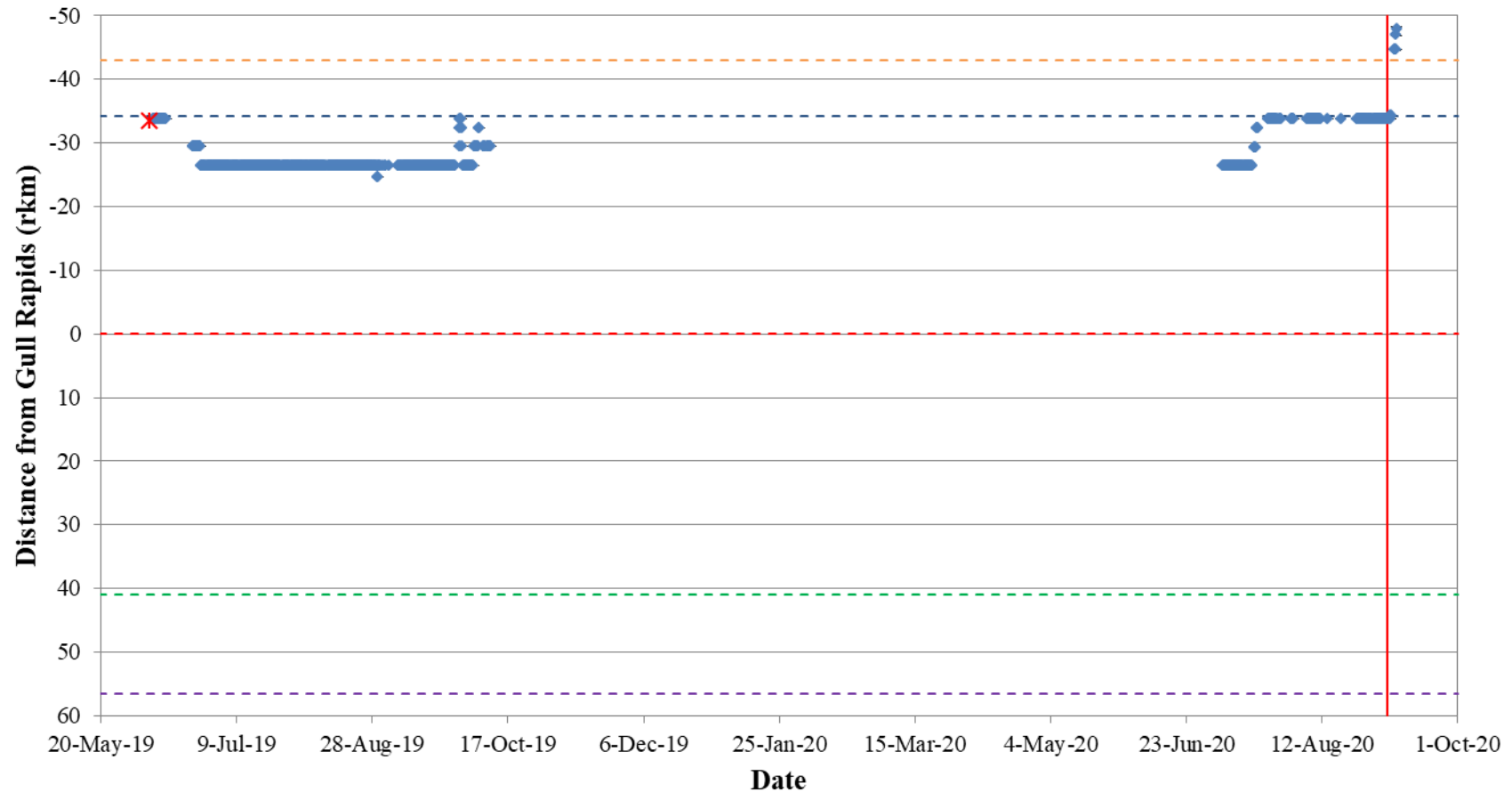
**Figure A4-3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7019) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



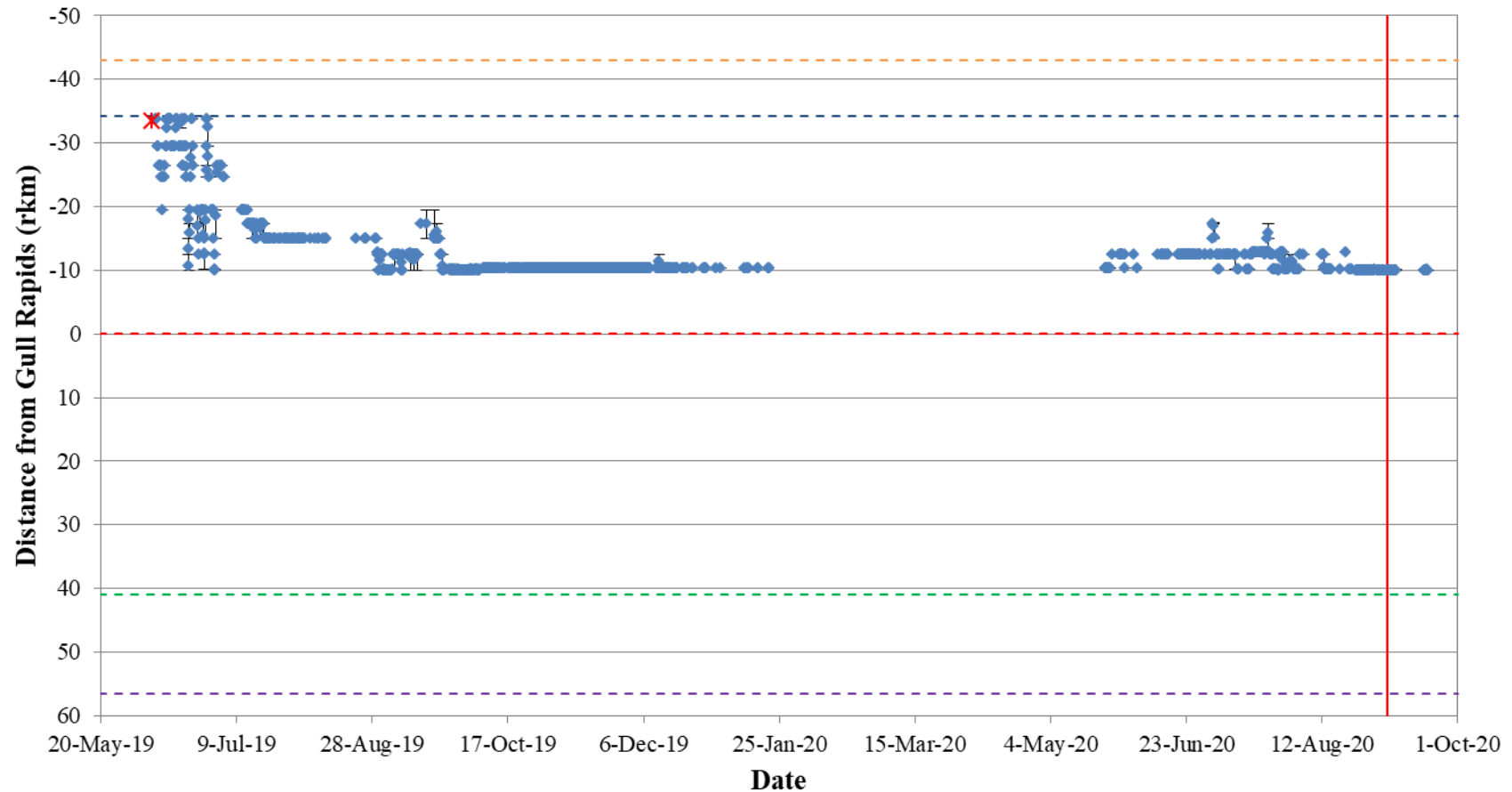
**Figure A4-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7020) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



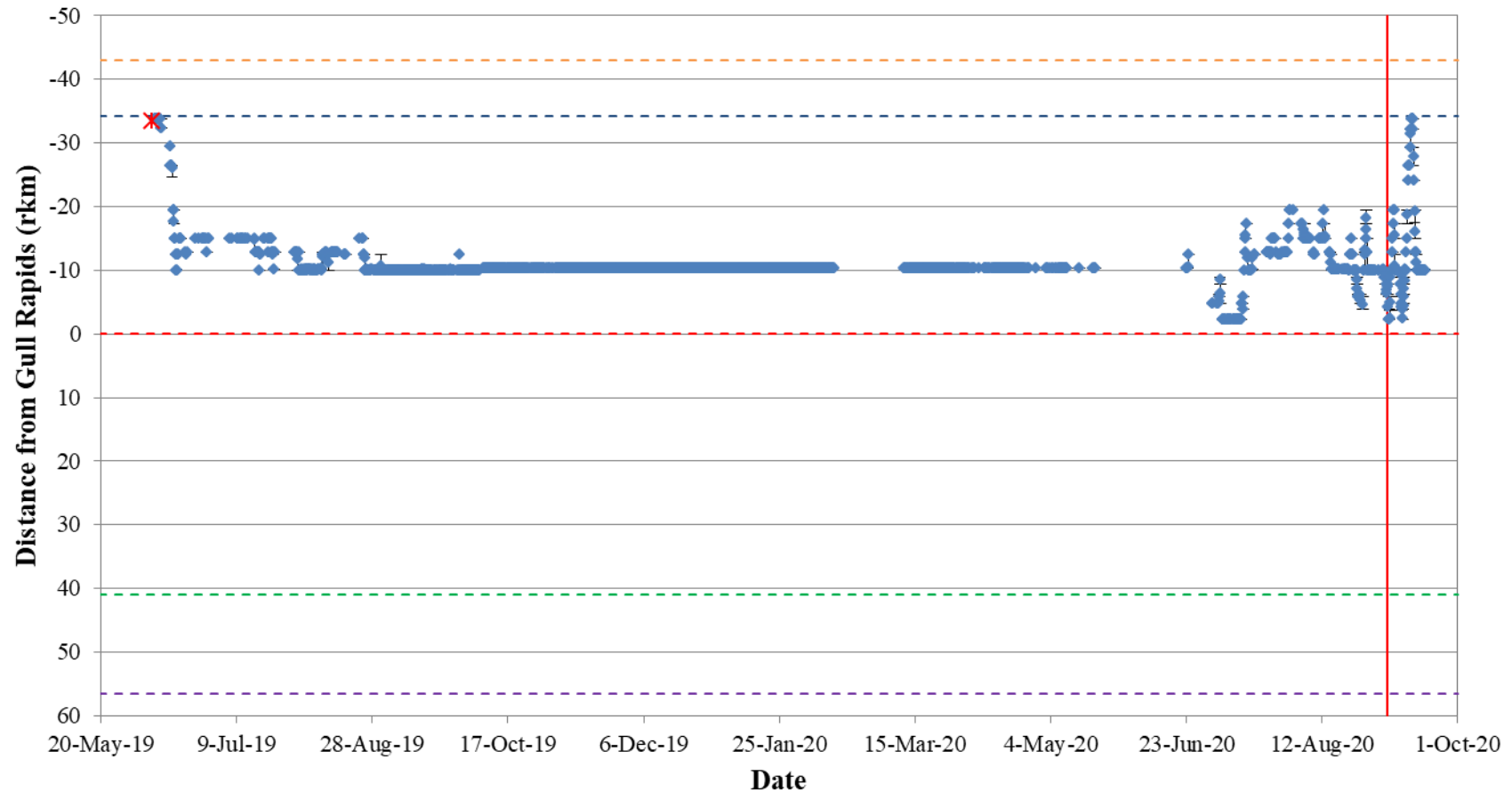
**Figure A4-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7021) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



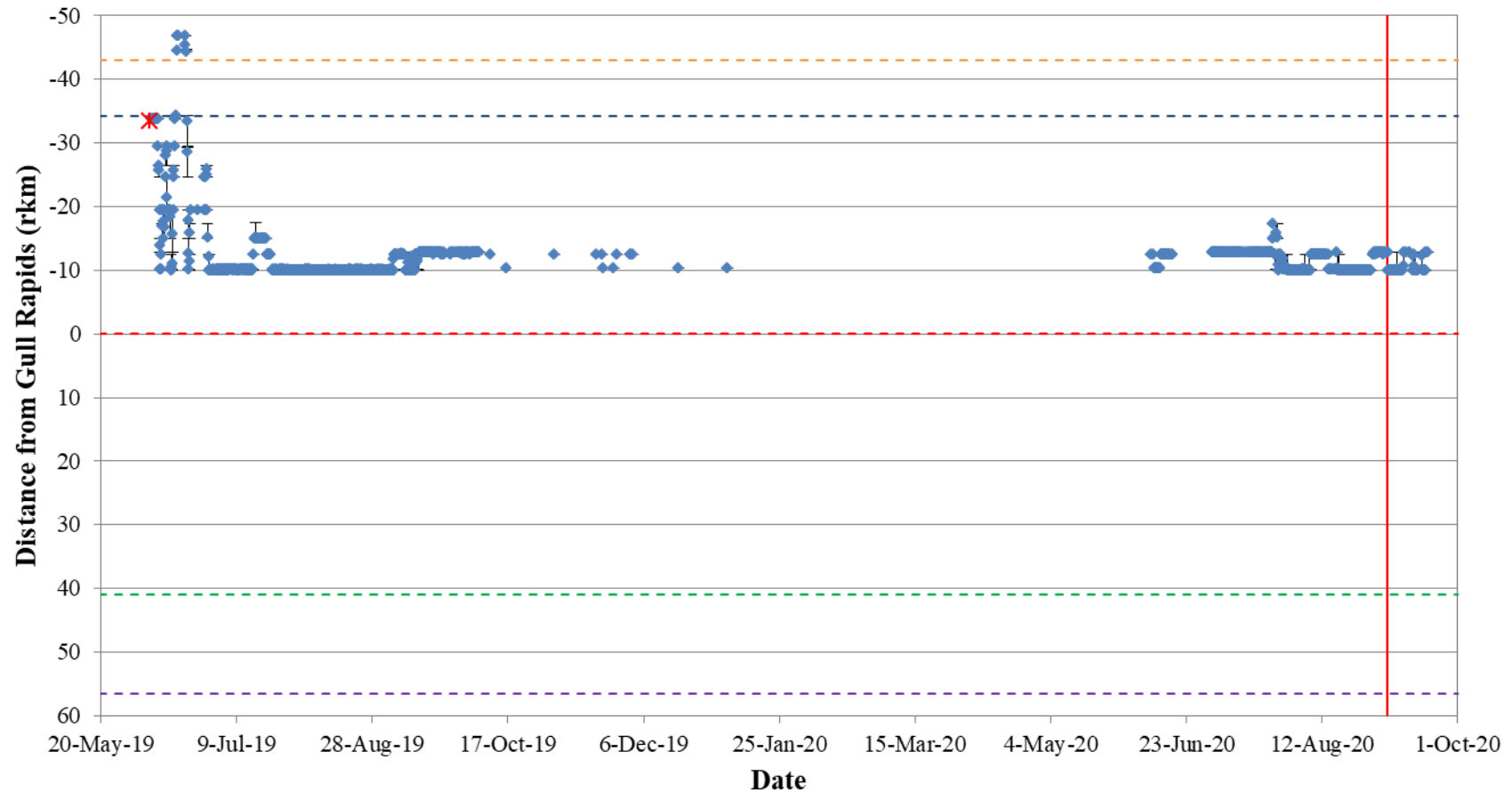
**Figure A4-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7022) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



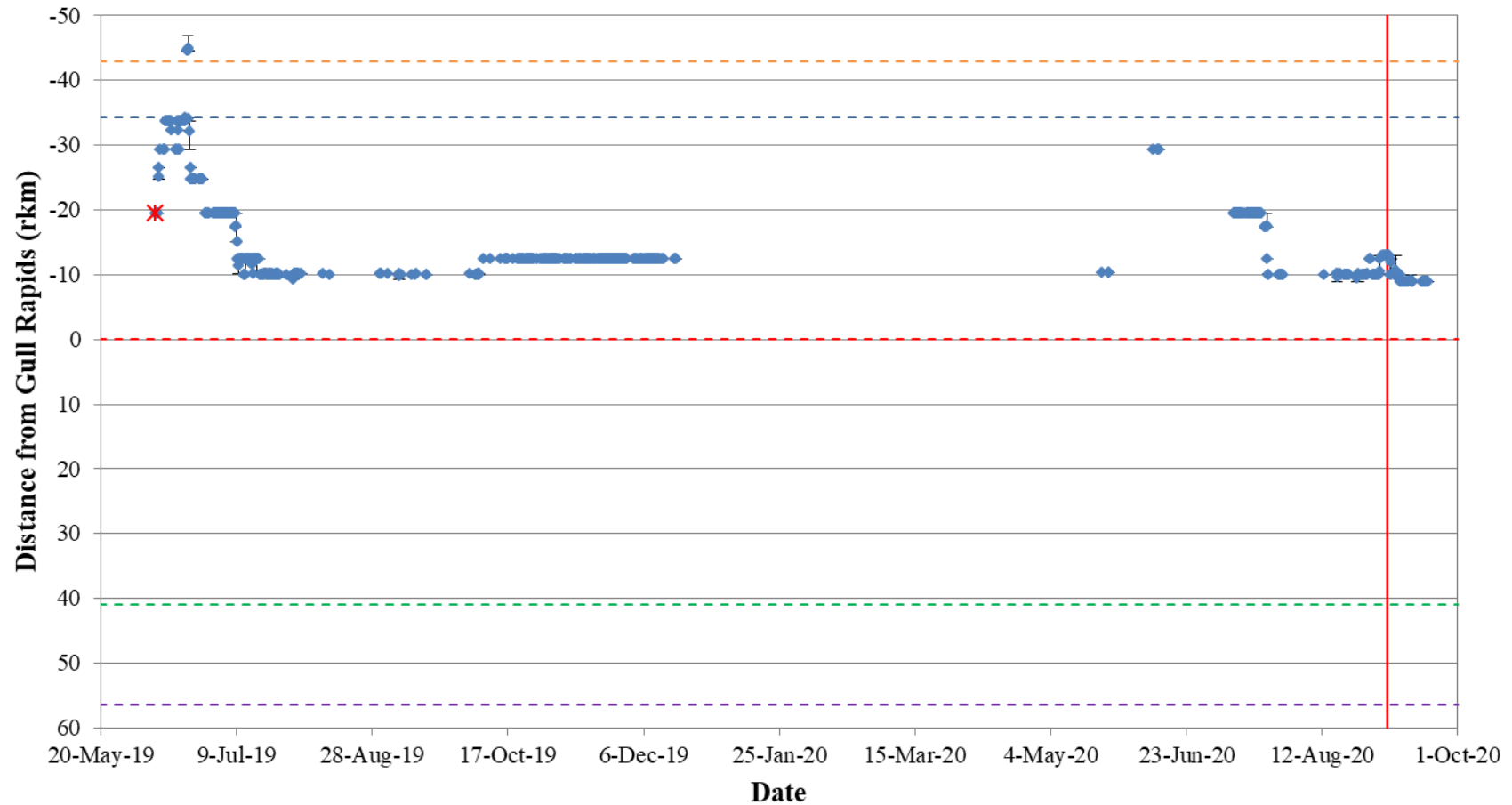
**Figure A4-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7023) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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 #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 September 23, 2020. 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).**

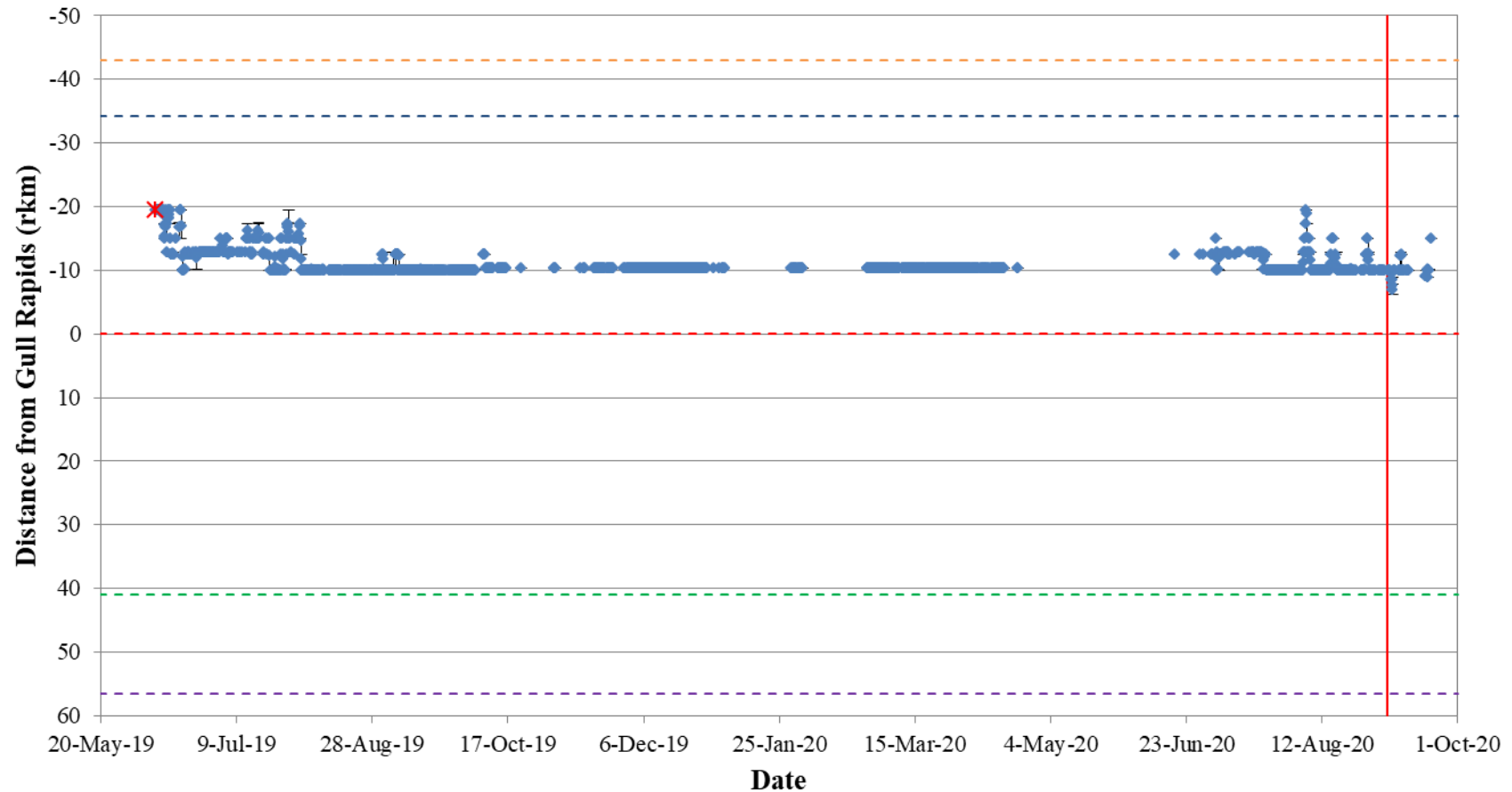


**Figure A4-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7025) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

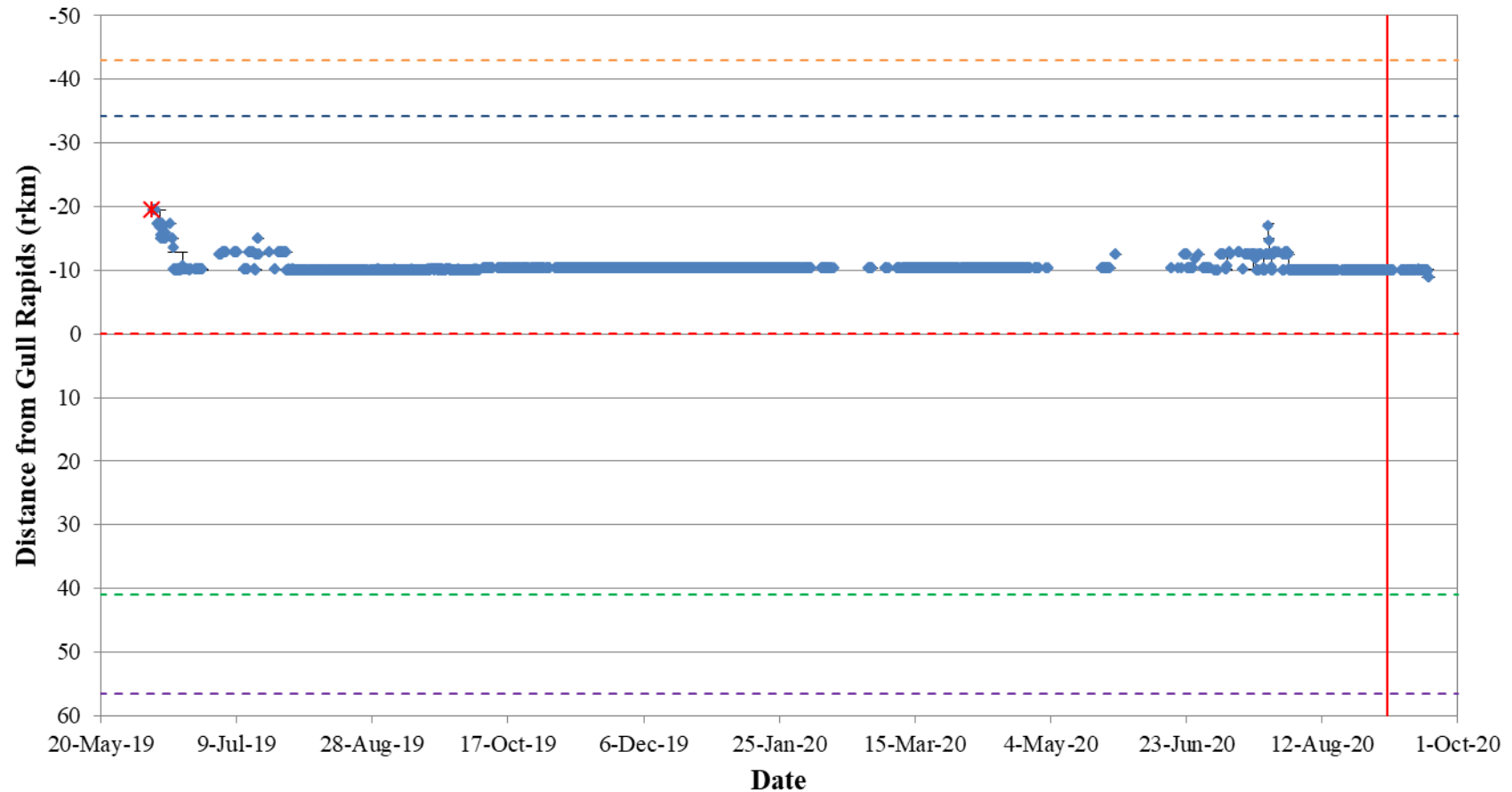


**Figure A4-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7026) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

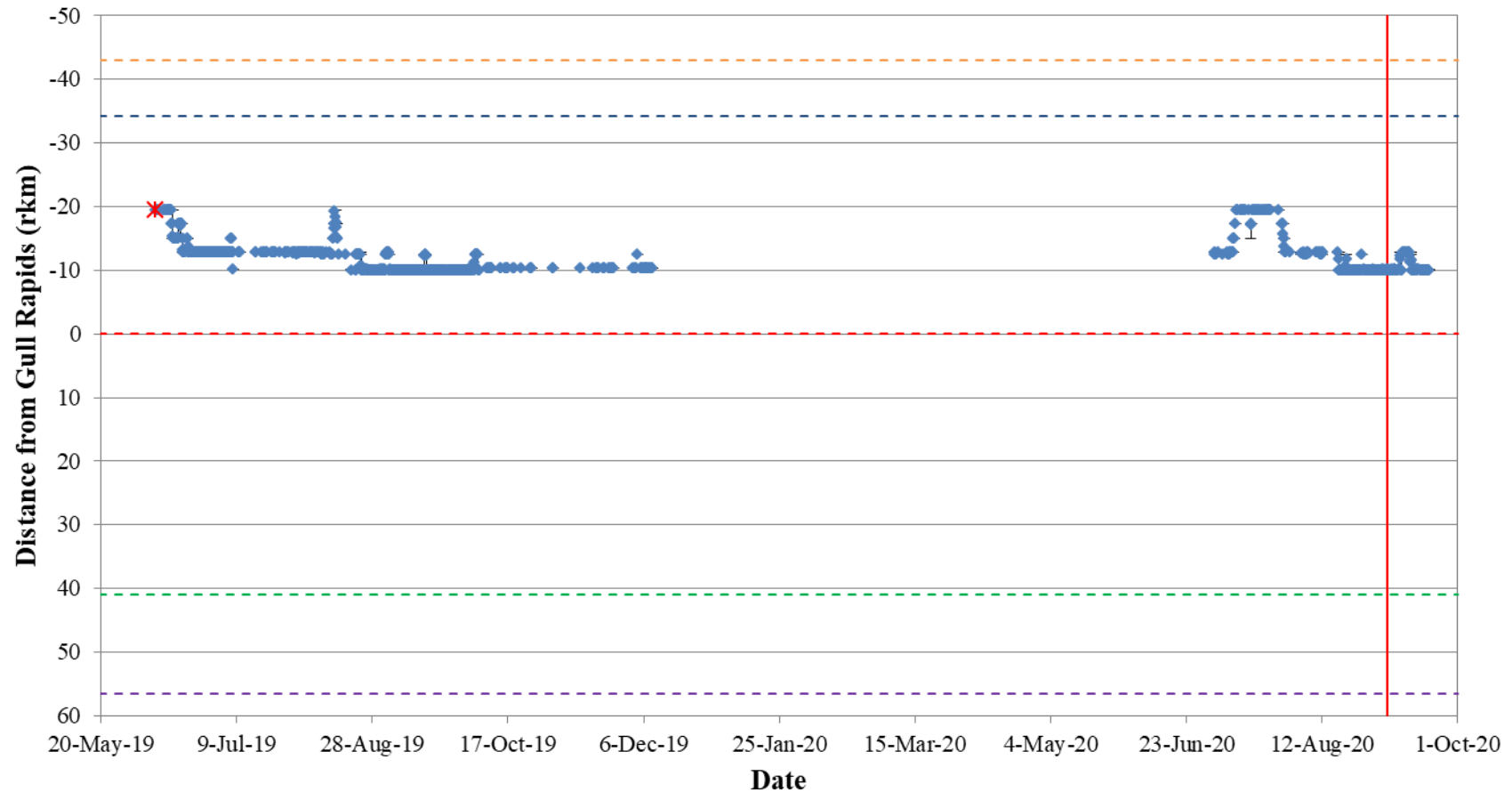




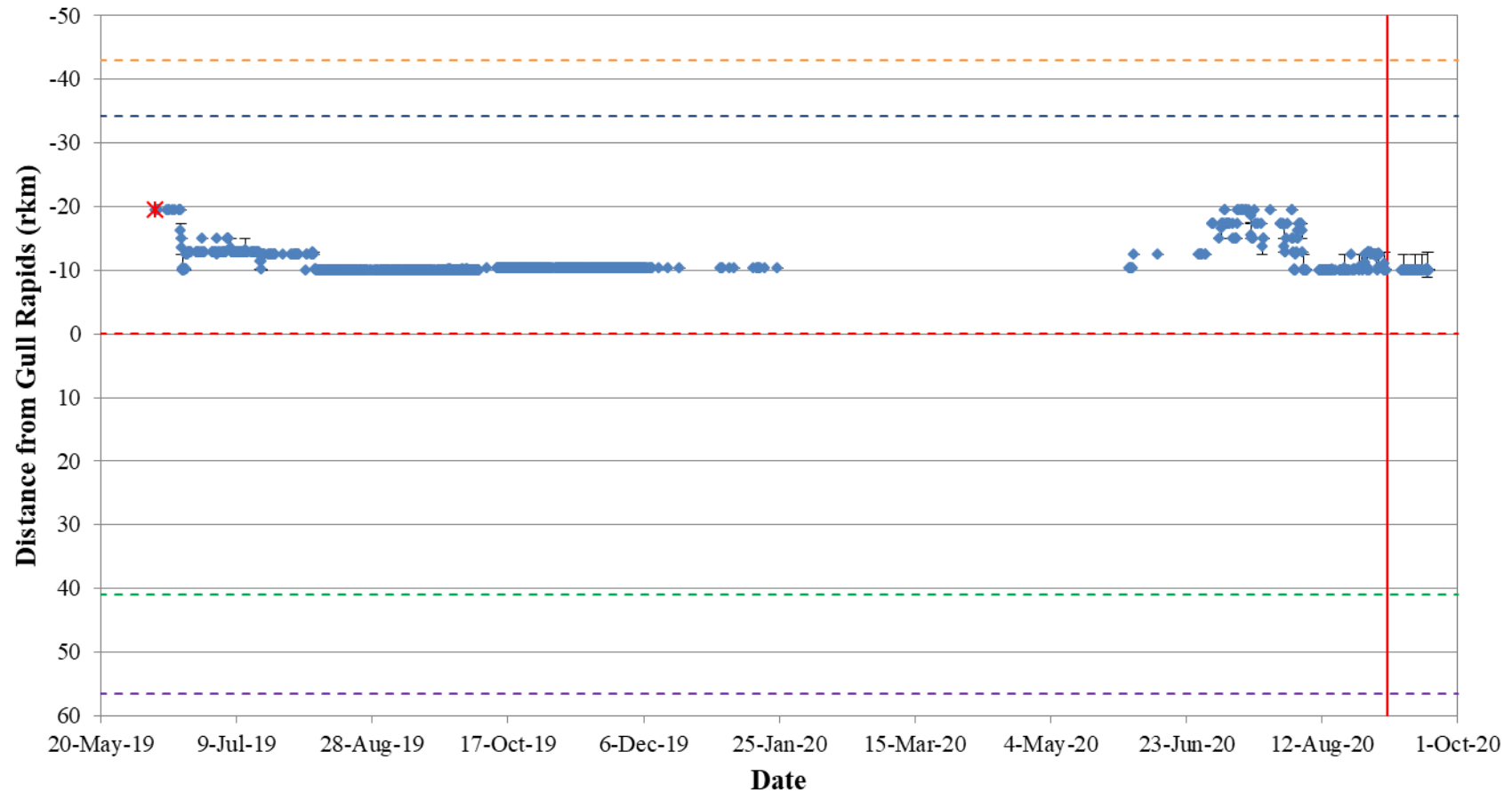
**Figure A4-11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7027) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



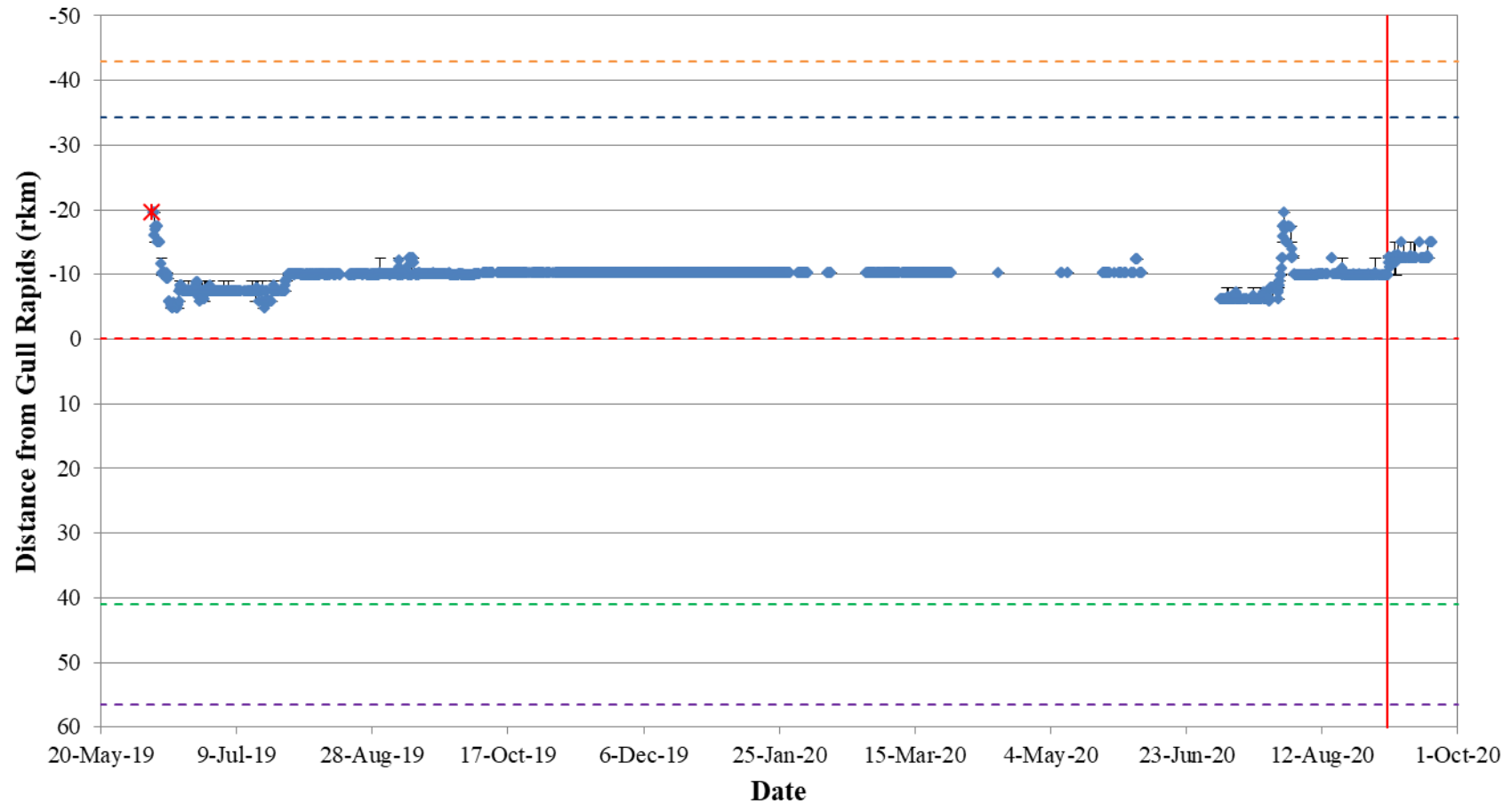
**Figure A4-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7028) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



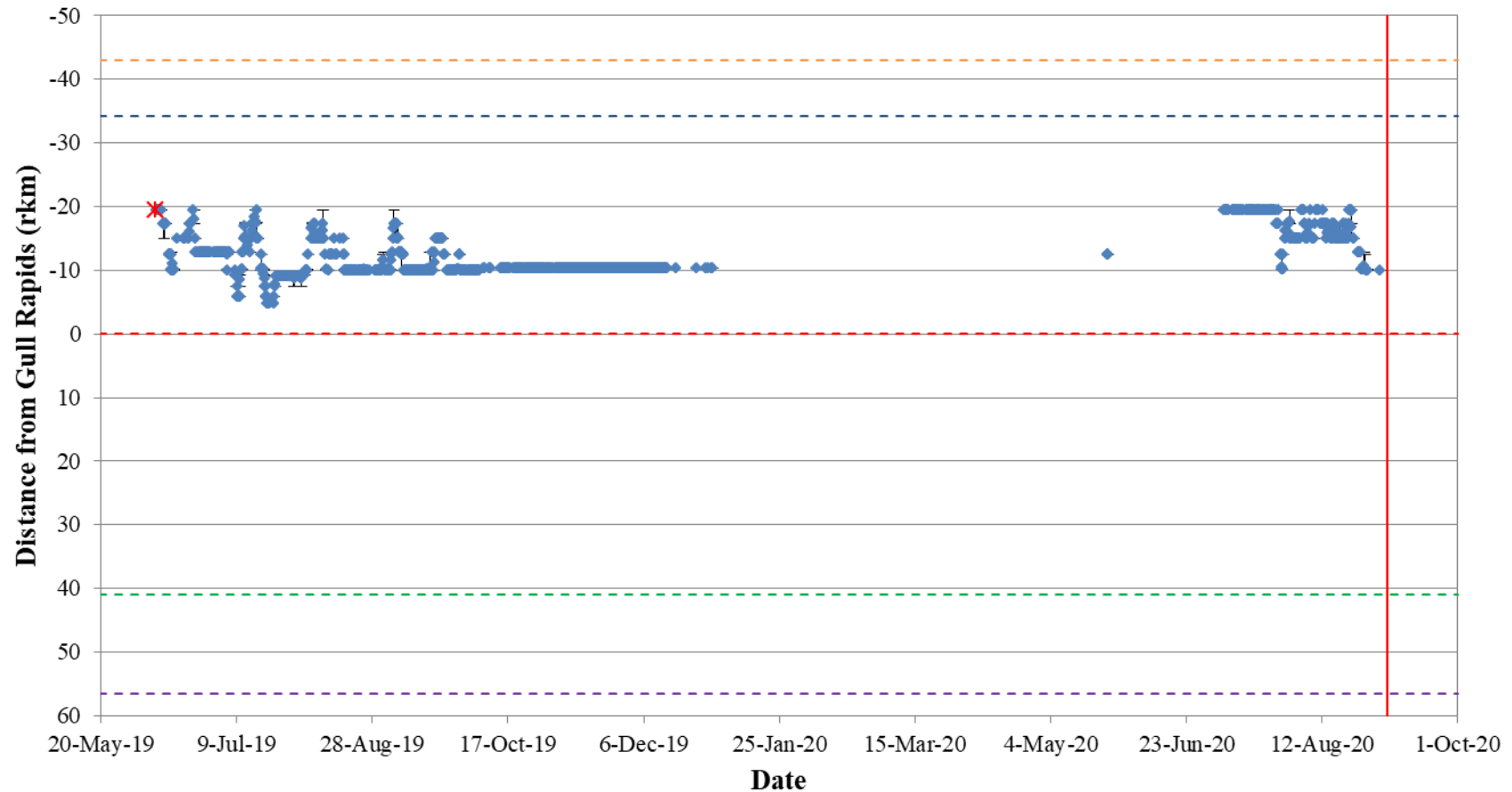
**Figure A4-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7029) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



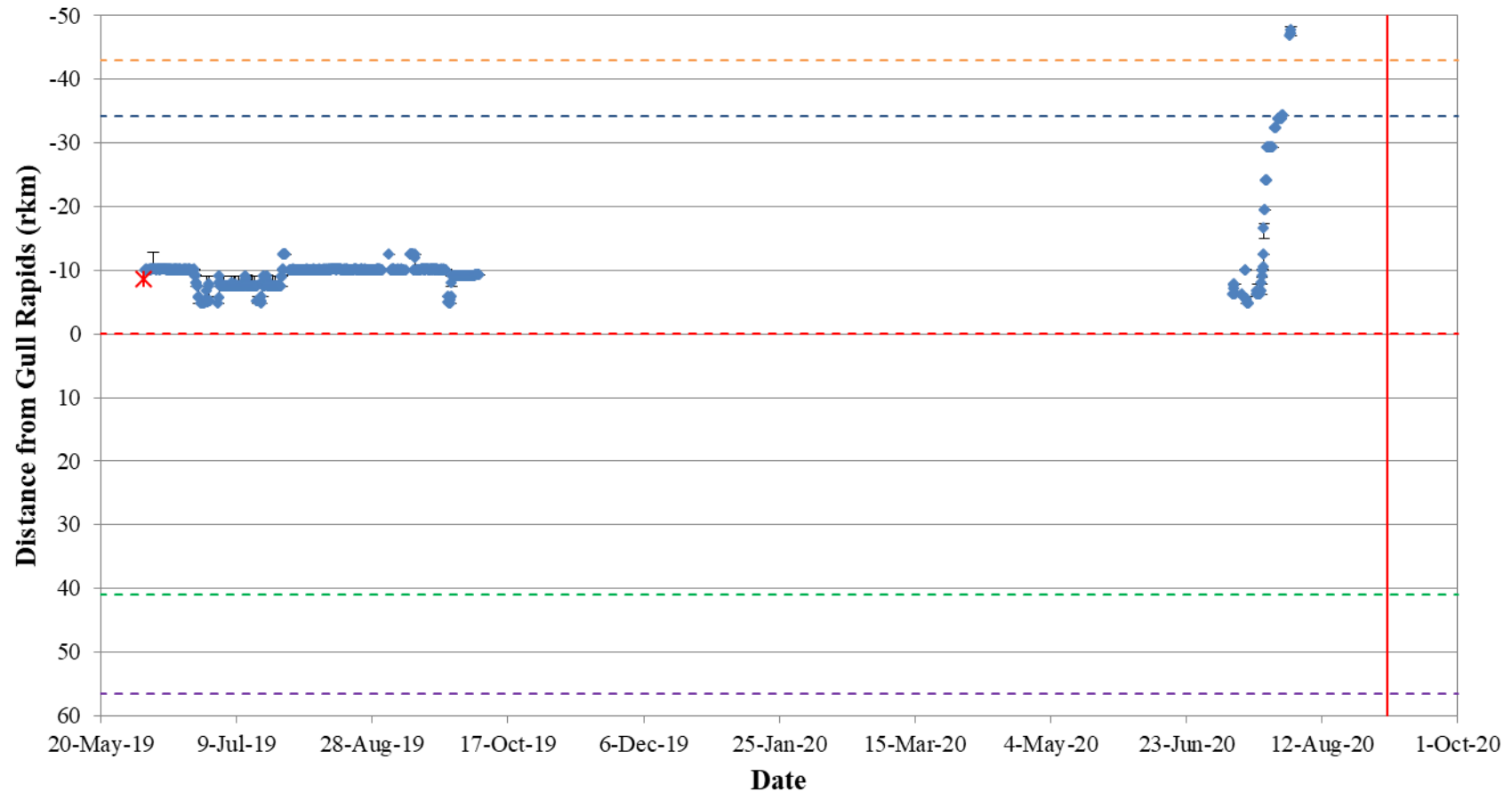
**Figure A4-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7030) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



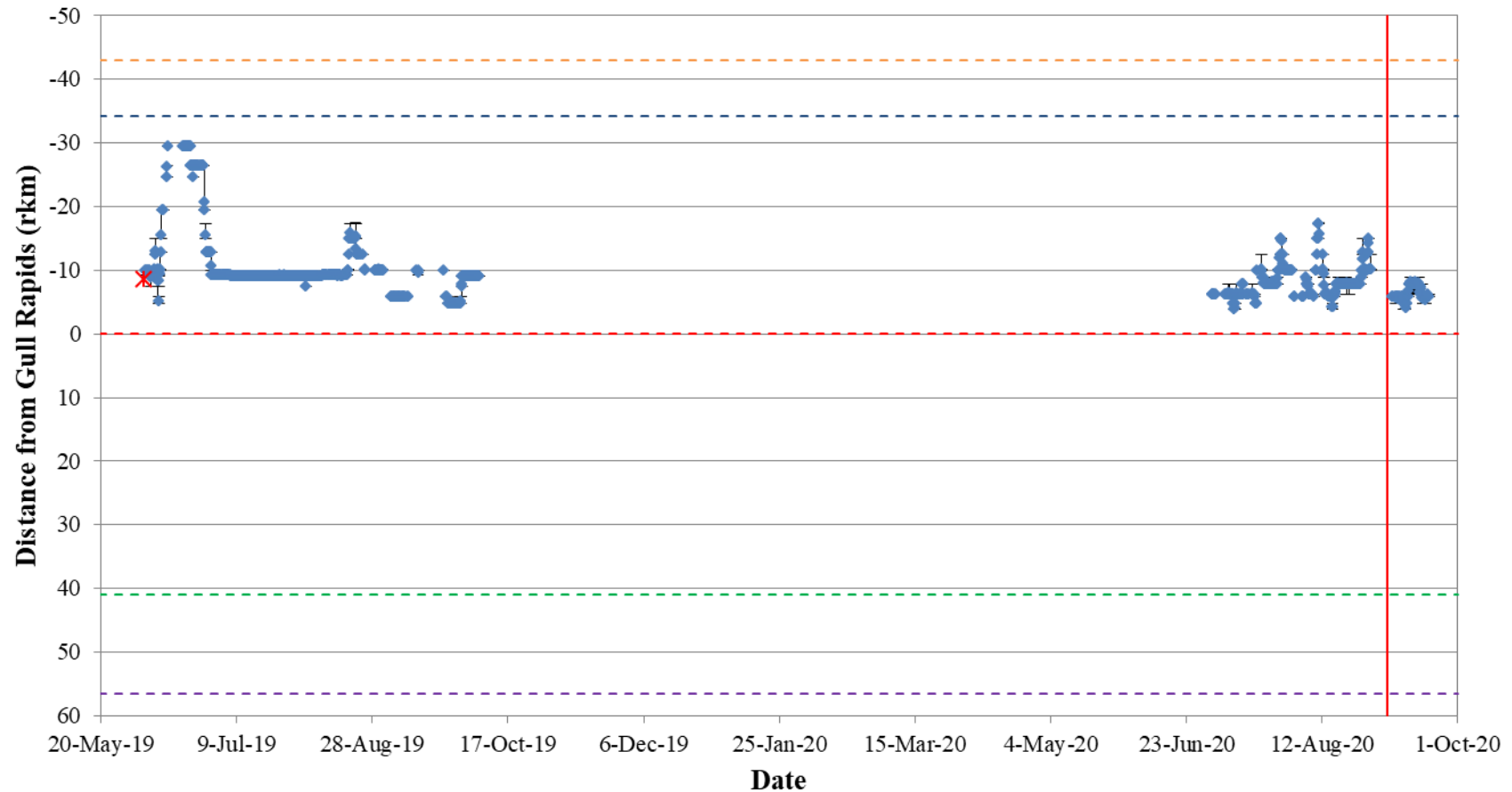
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**Figure A4-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7032) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location 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).**

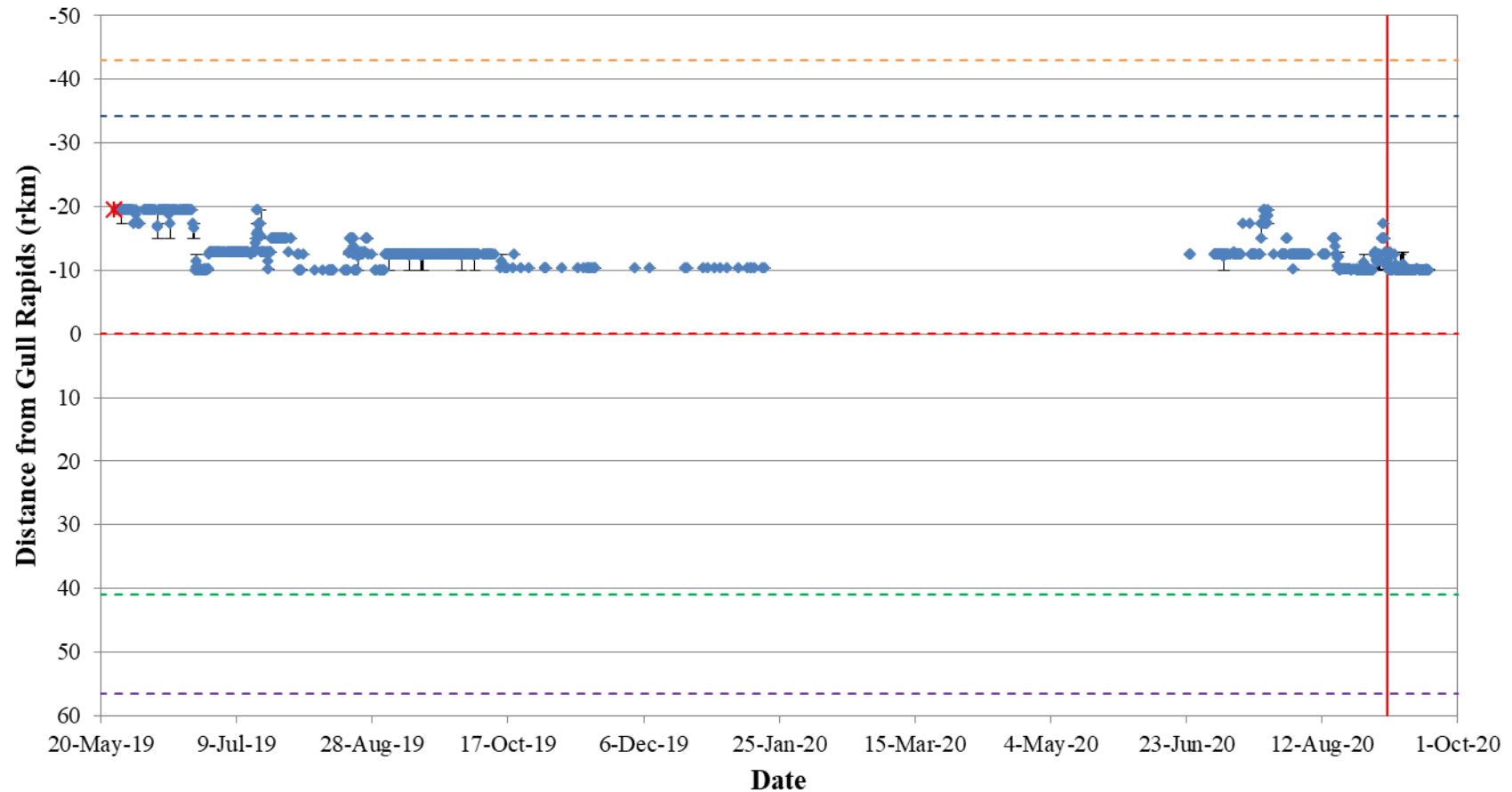


**Figure A4-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7033) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

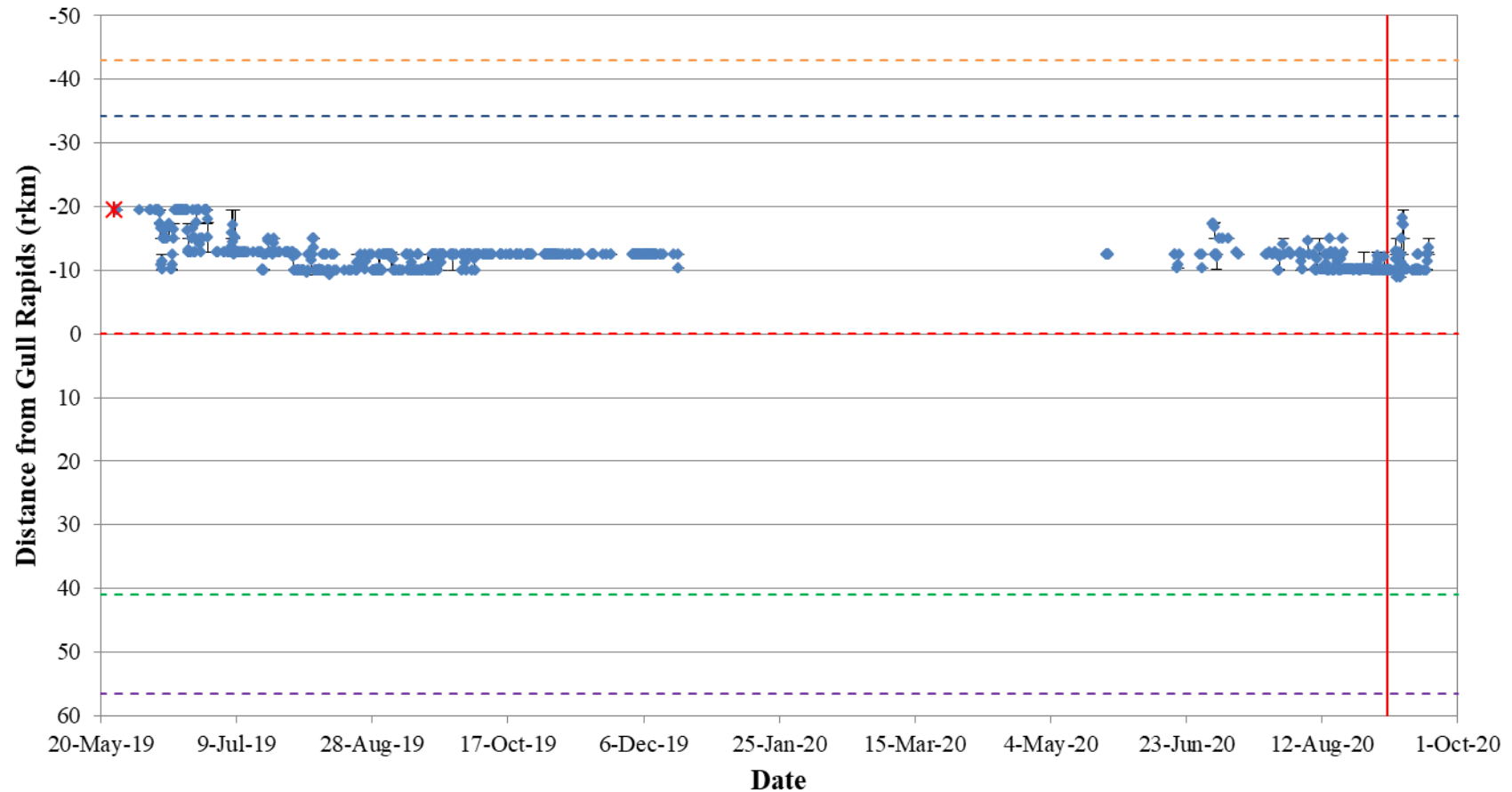


**Figure A4-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7034) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**

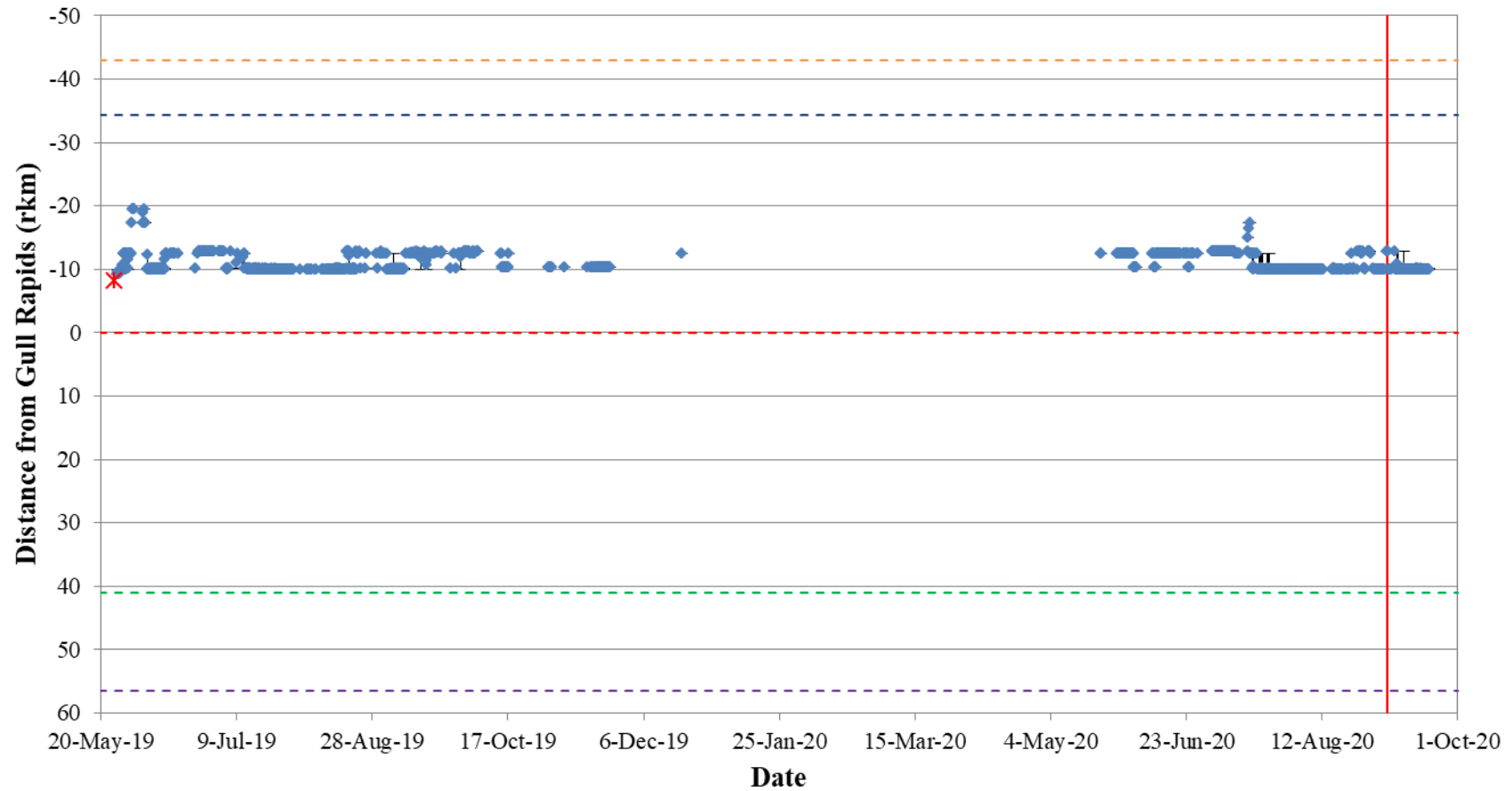




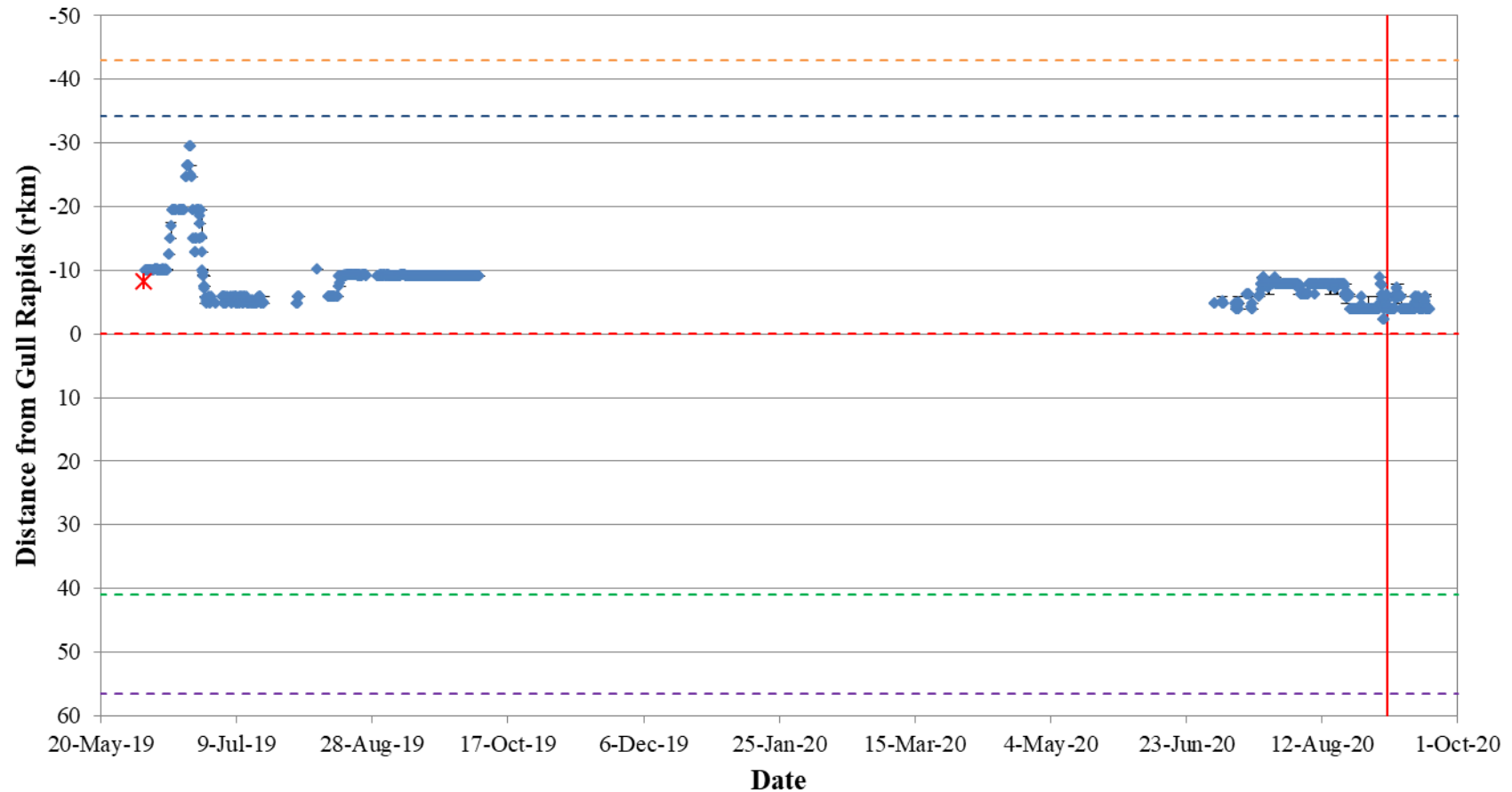
**Figure A4-19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7053) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



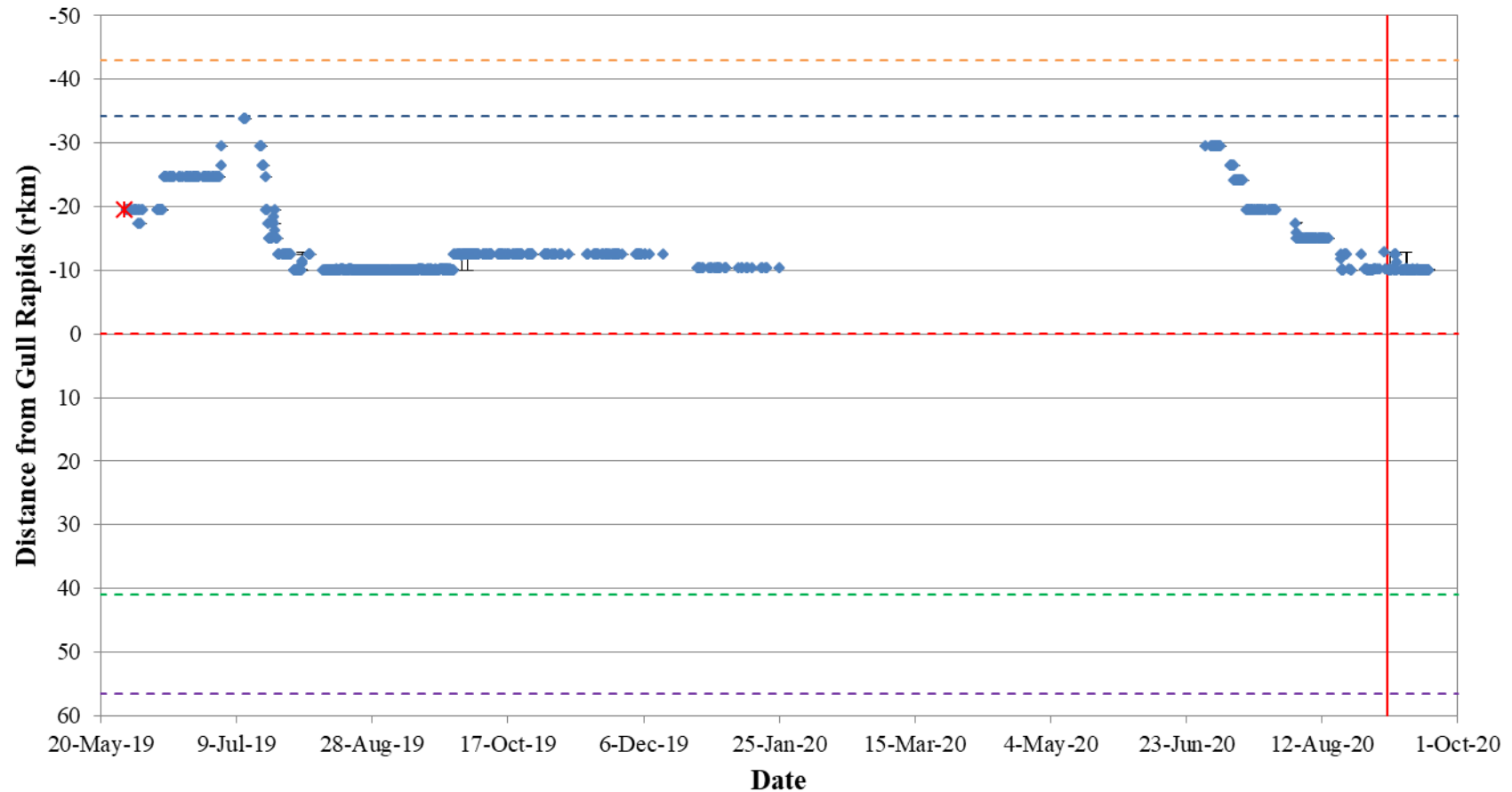
**Figure A4-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7056) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



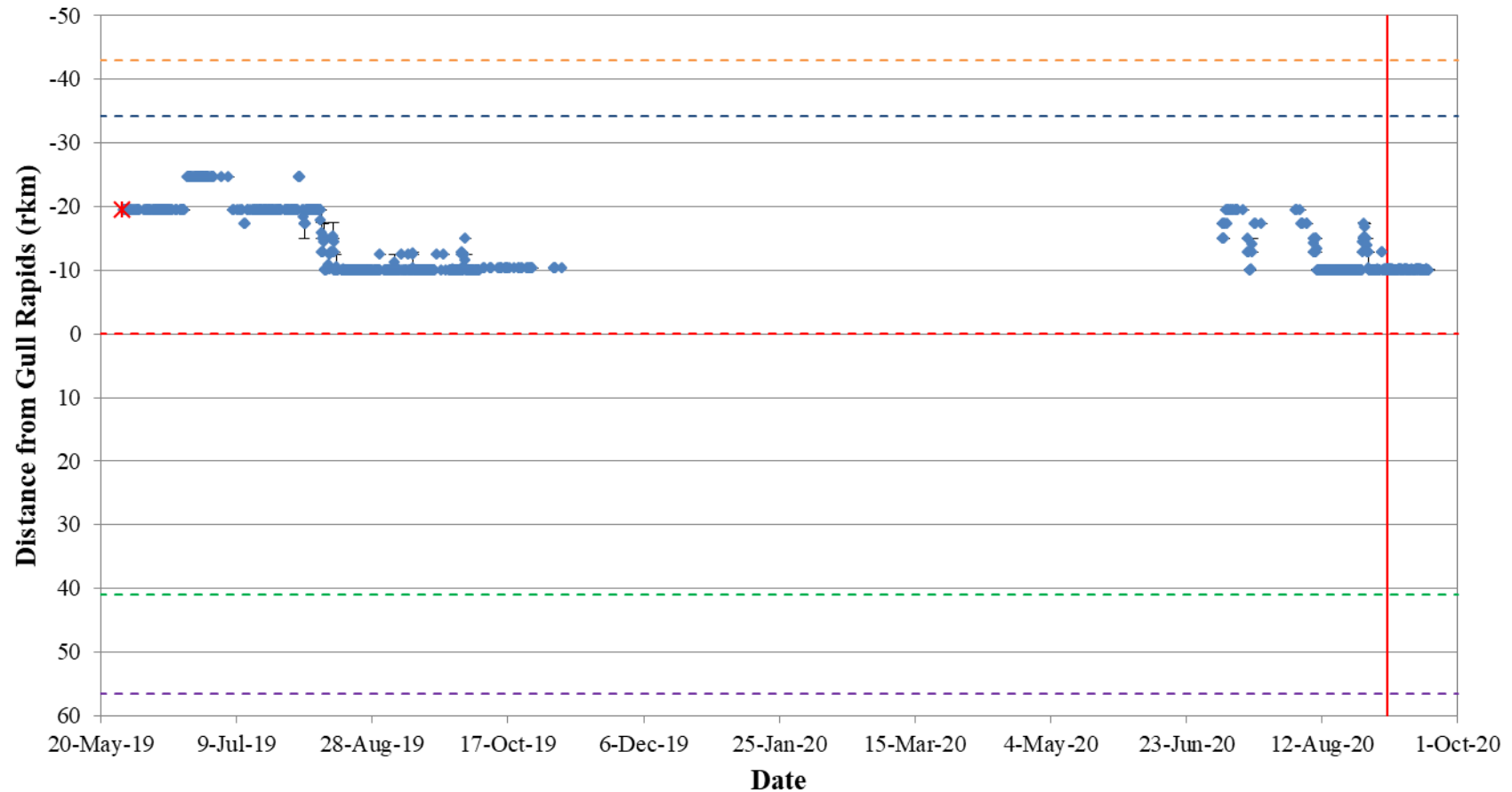
**Figure A4-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7059) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



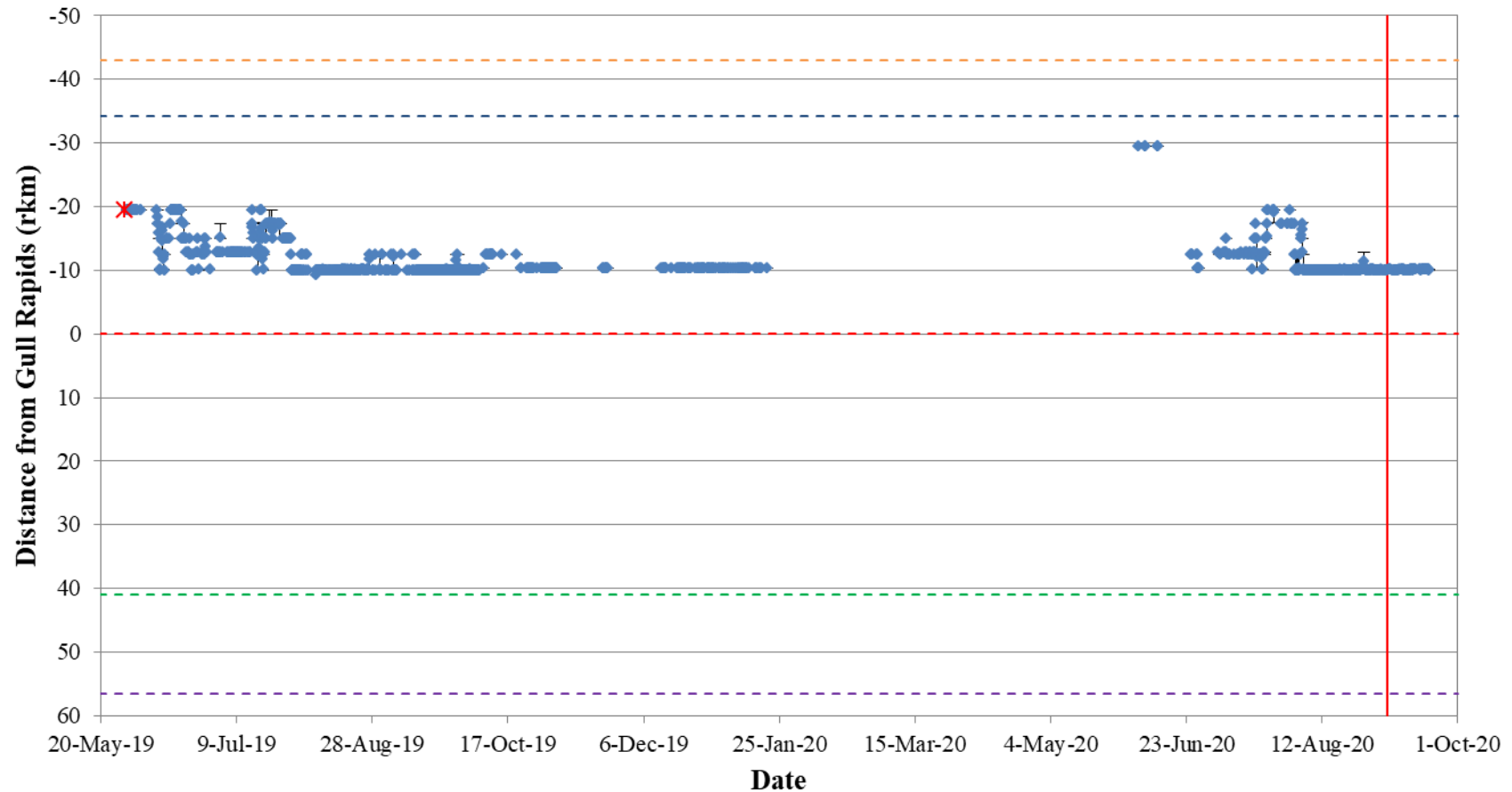
**Figure A4-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7061) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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).**



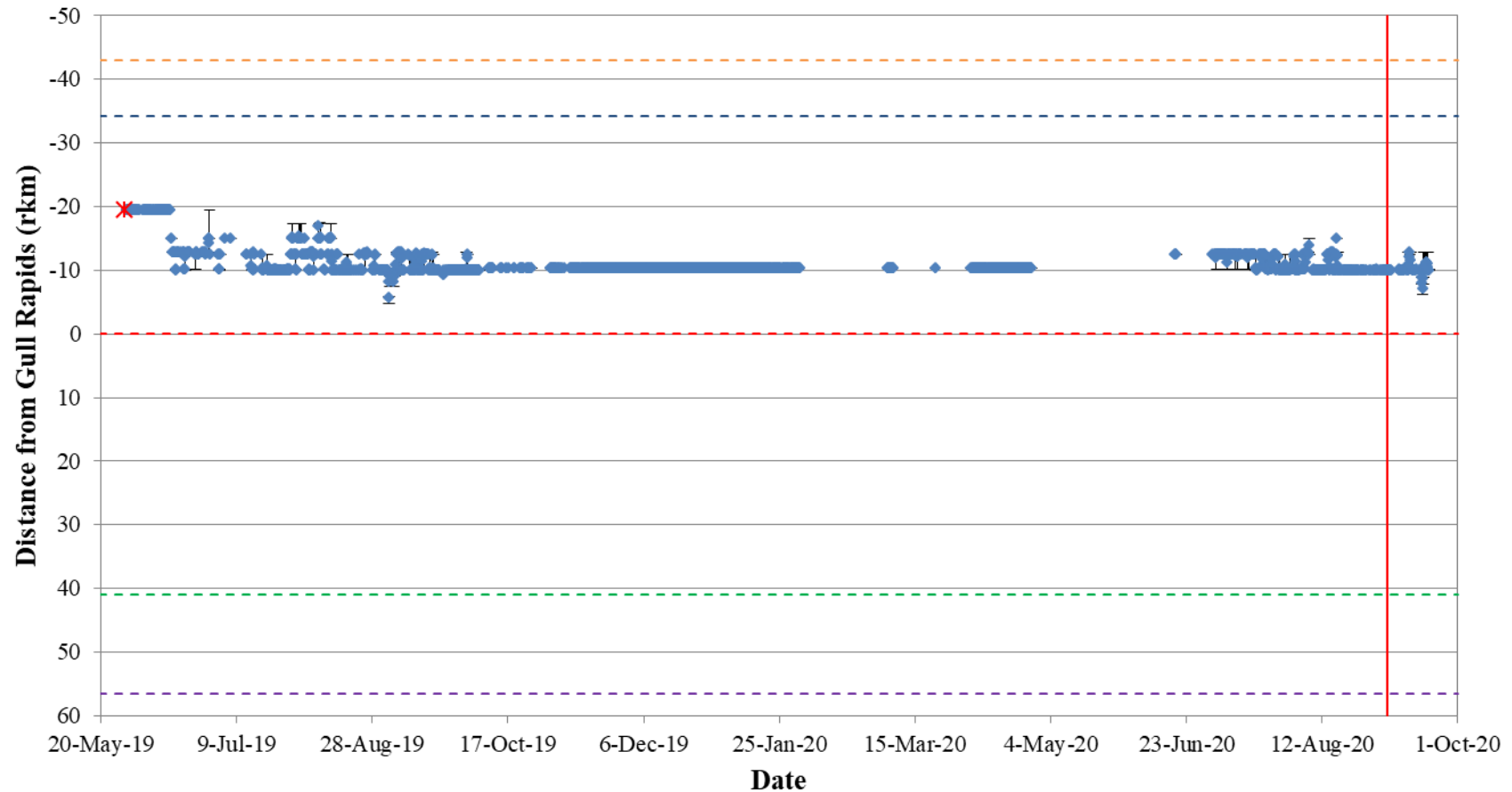
**Figure A4-23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7064) in the Nelson River between Clark Lake and the Keeyask GS in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir 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 #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 September 23, 2020. 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 #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 September 23, 2020. 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 A4-26: 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 September 23, 2020. 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:**

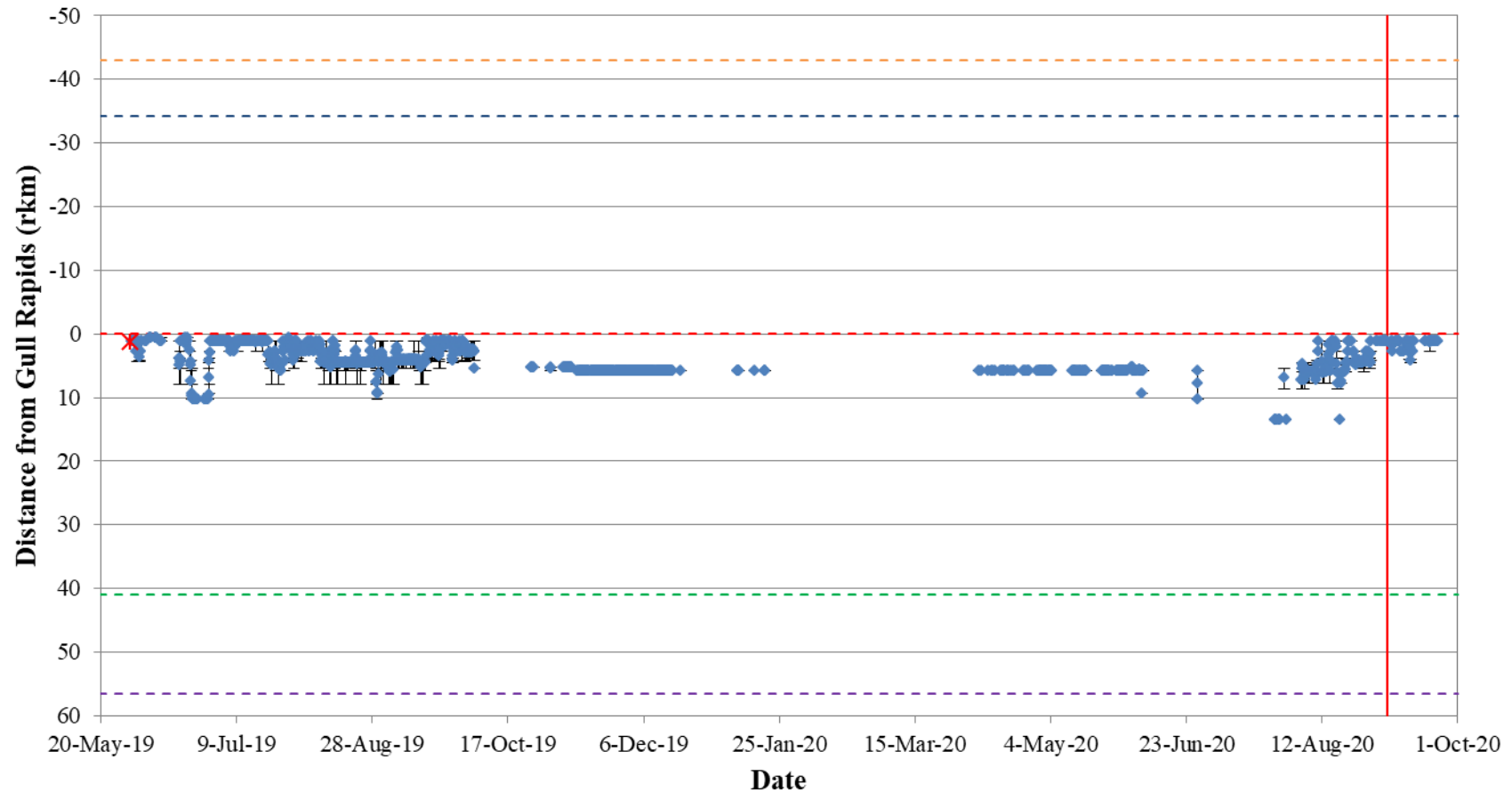
### **LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, STEPHENS LAKE, MAY TO SEPTEMBER 2020**

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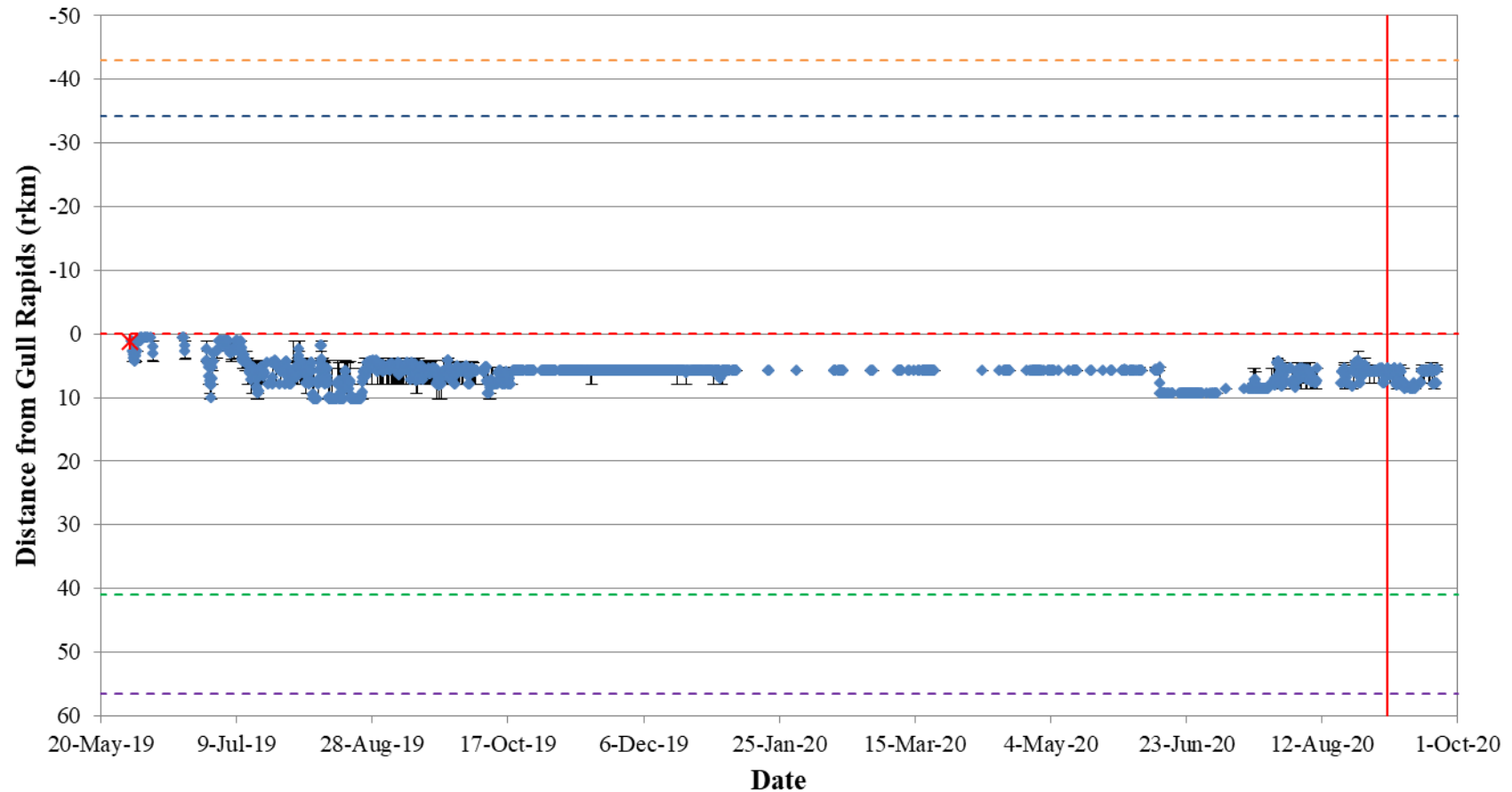
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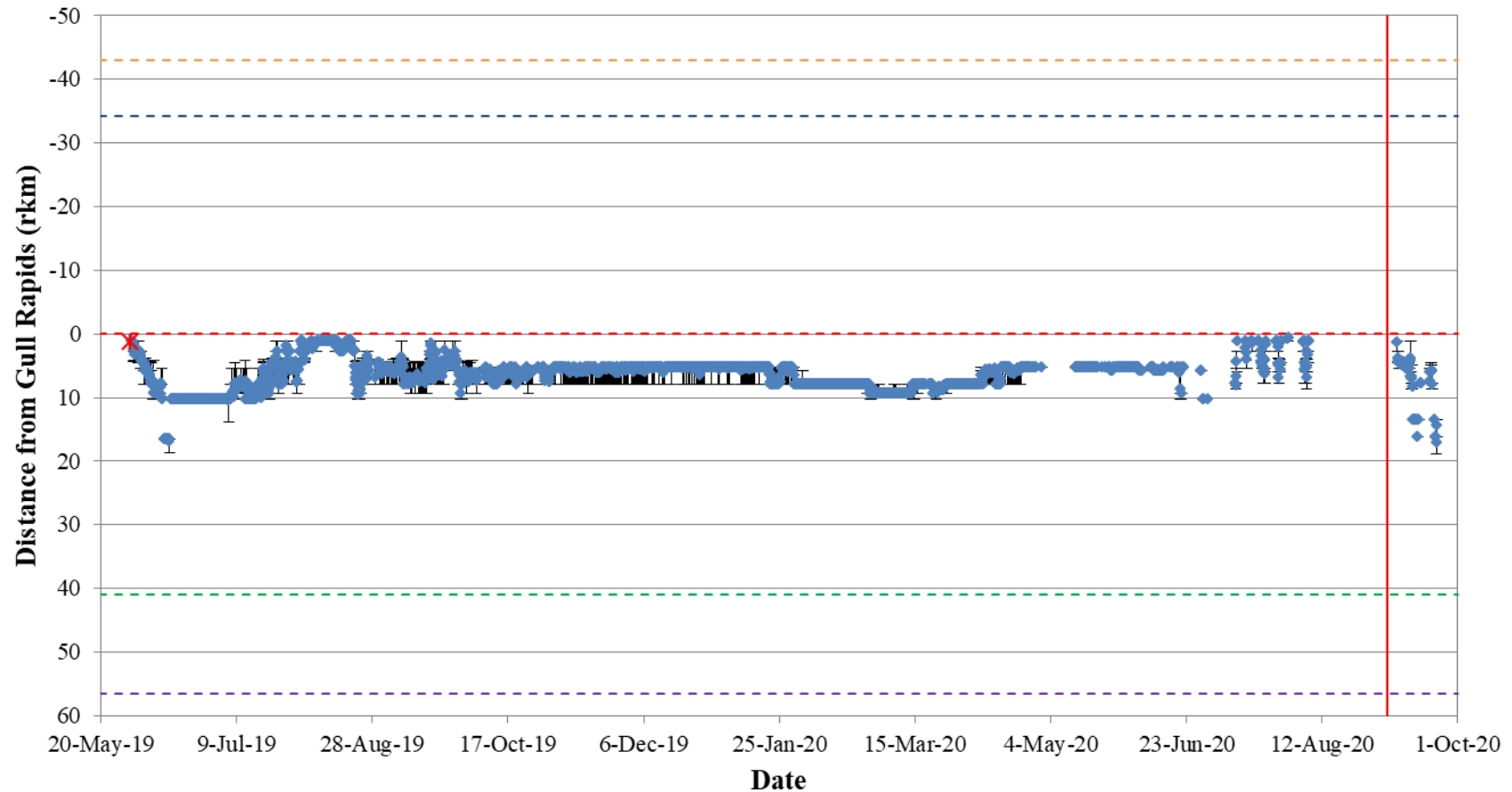
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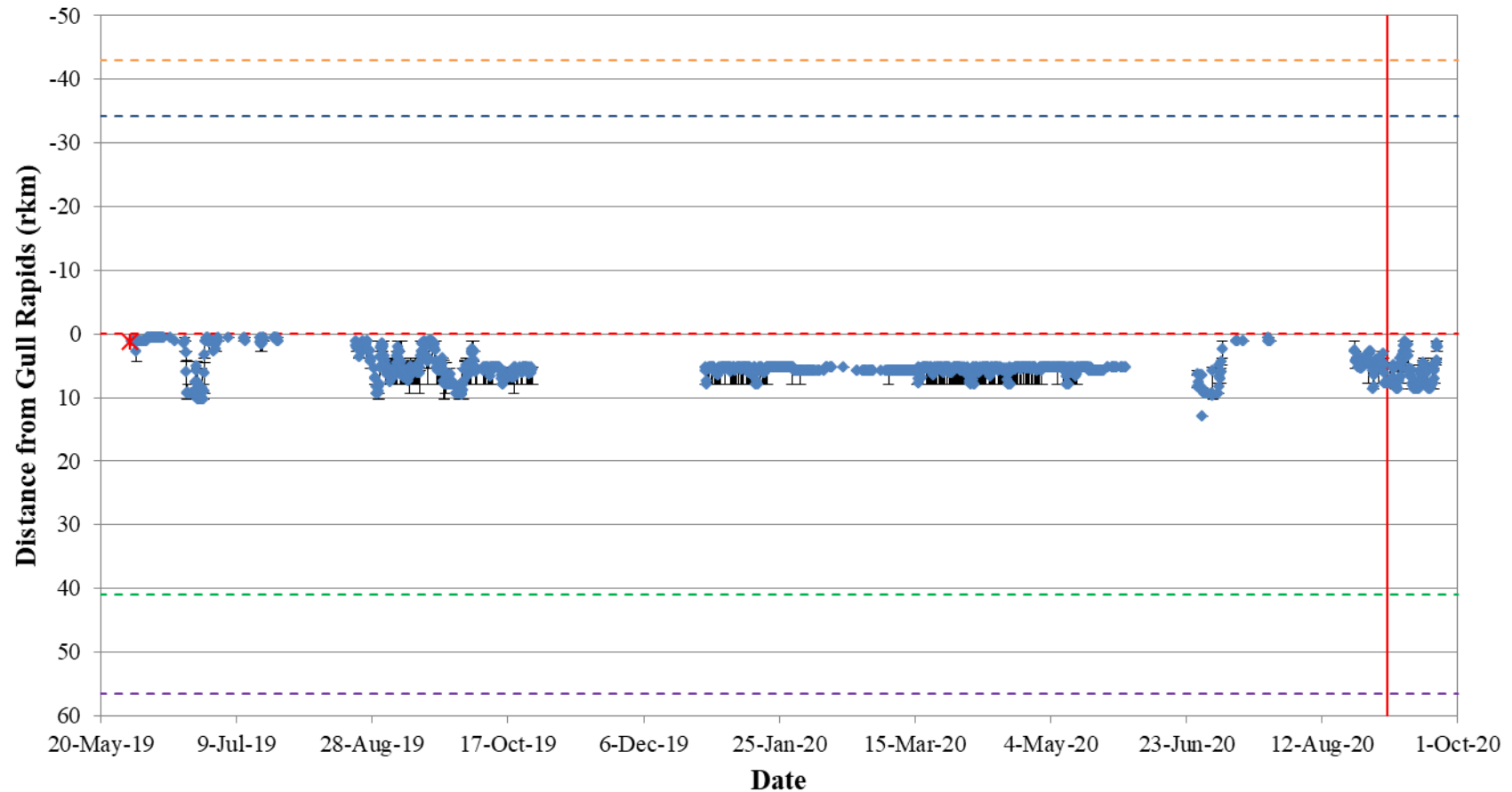
**Figure A5-1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7035) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



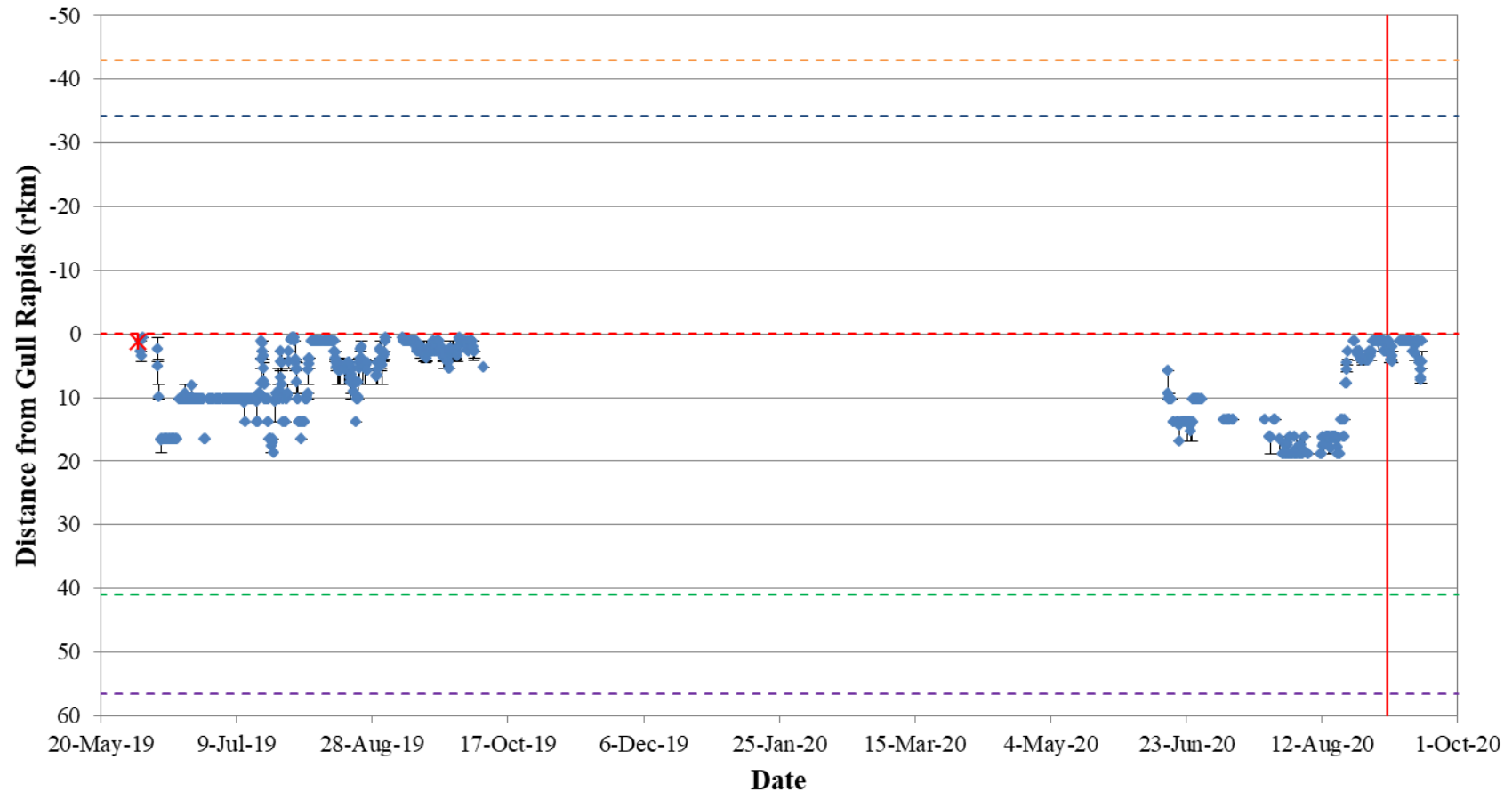
**Figure A5-2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7036) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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 A5-3: 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 September 23, 2020. 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).**

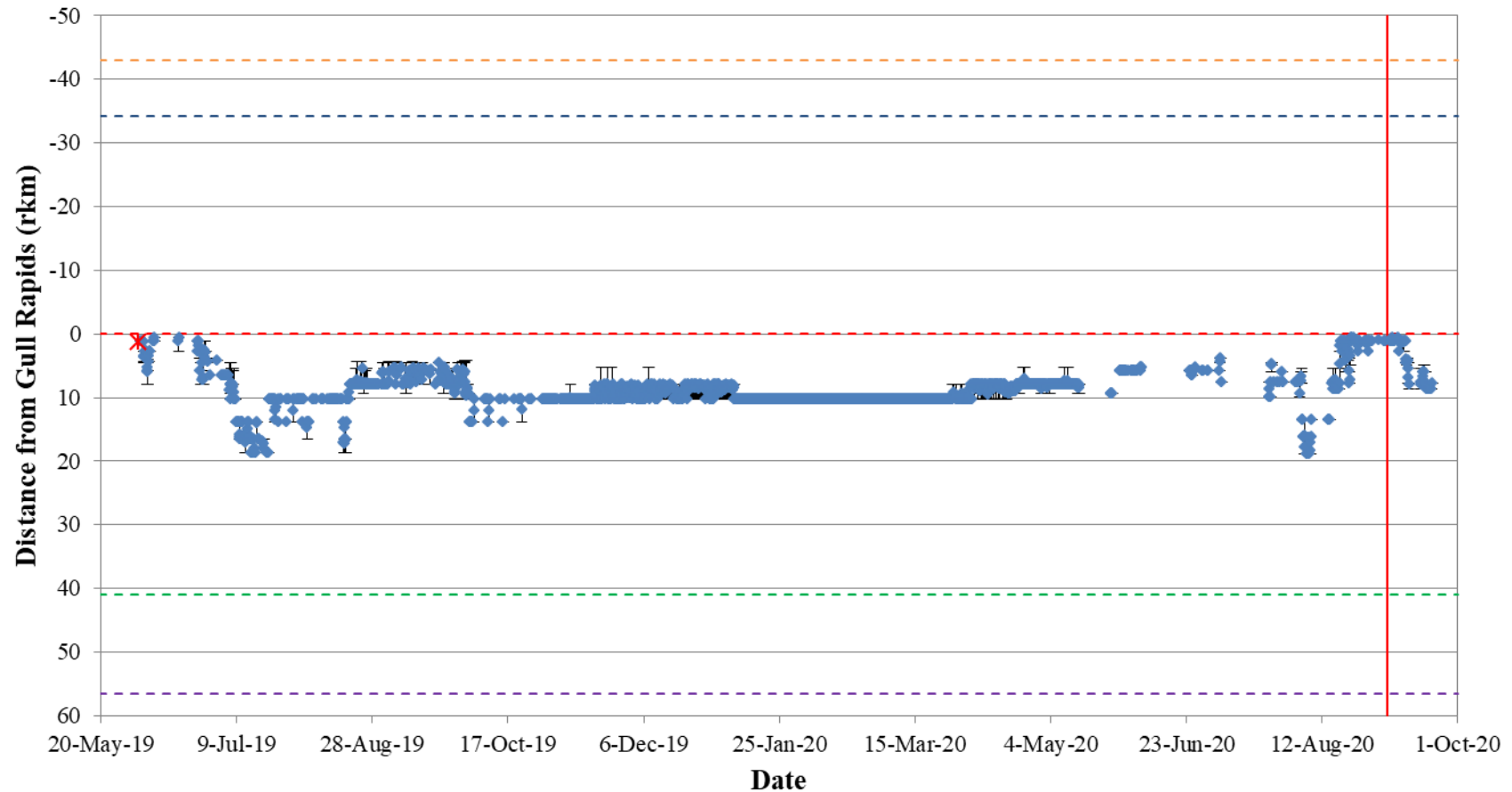


**Figure A5-4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7038) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

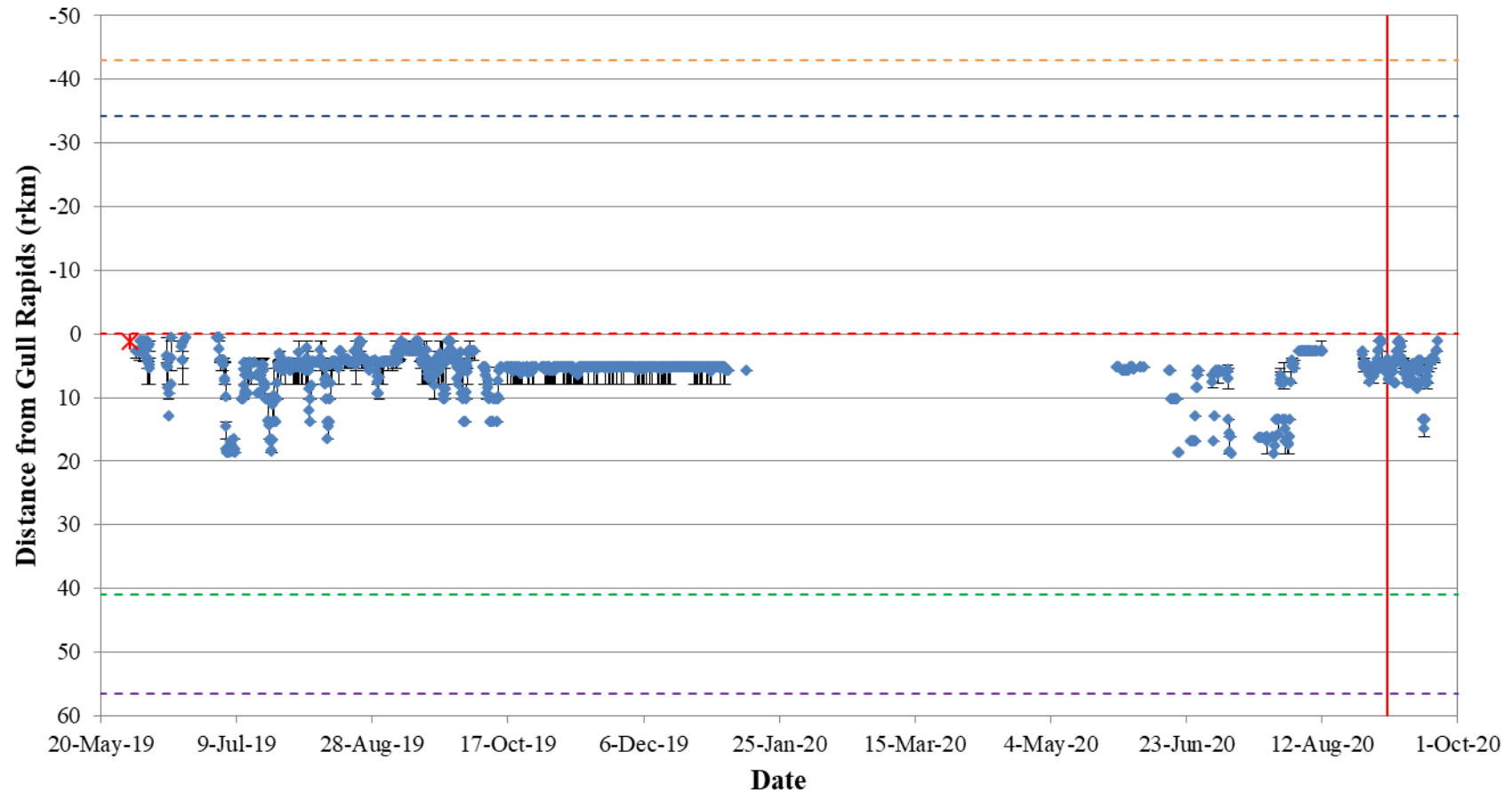


**Figure A5-5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7039) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

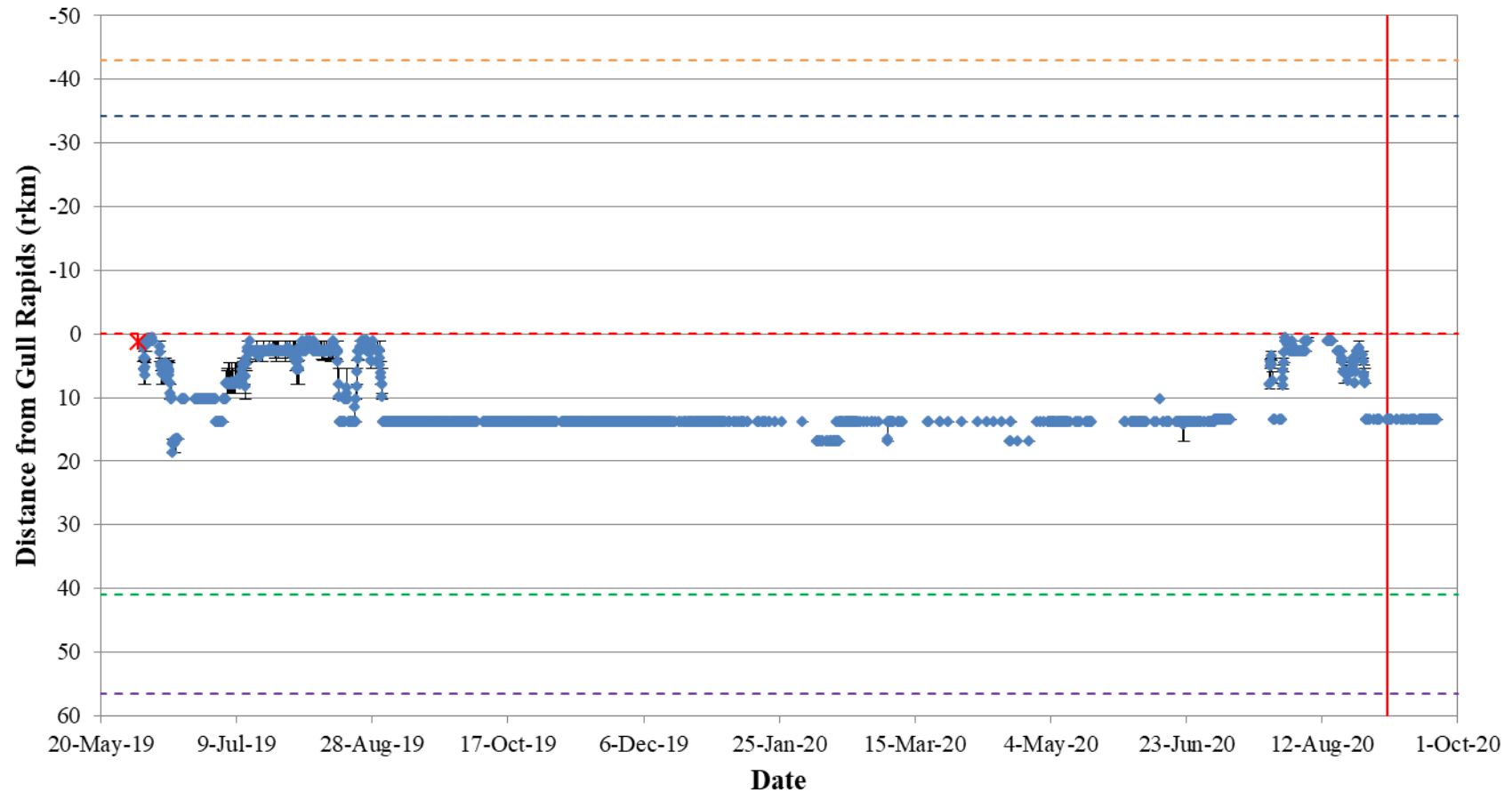




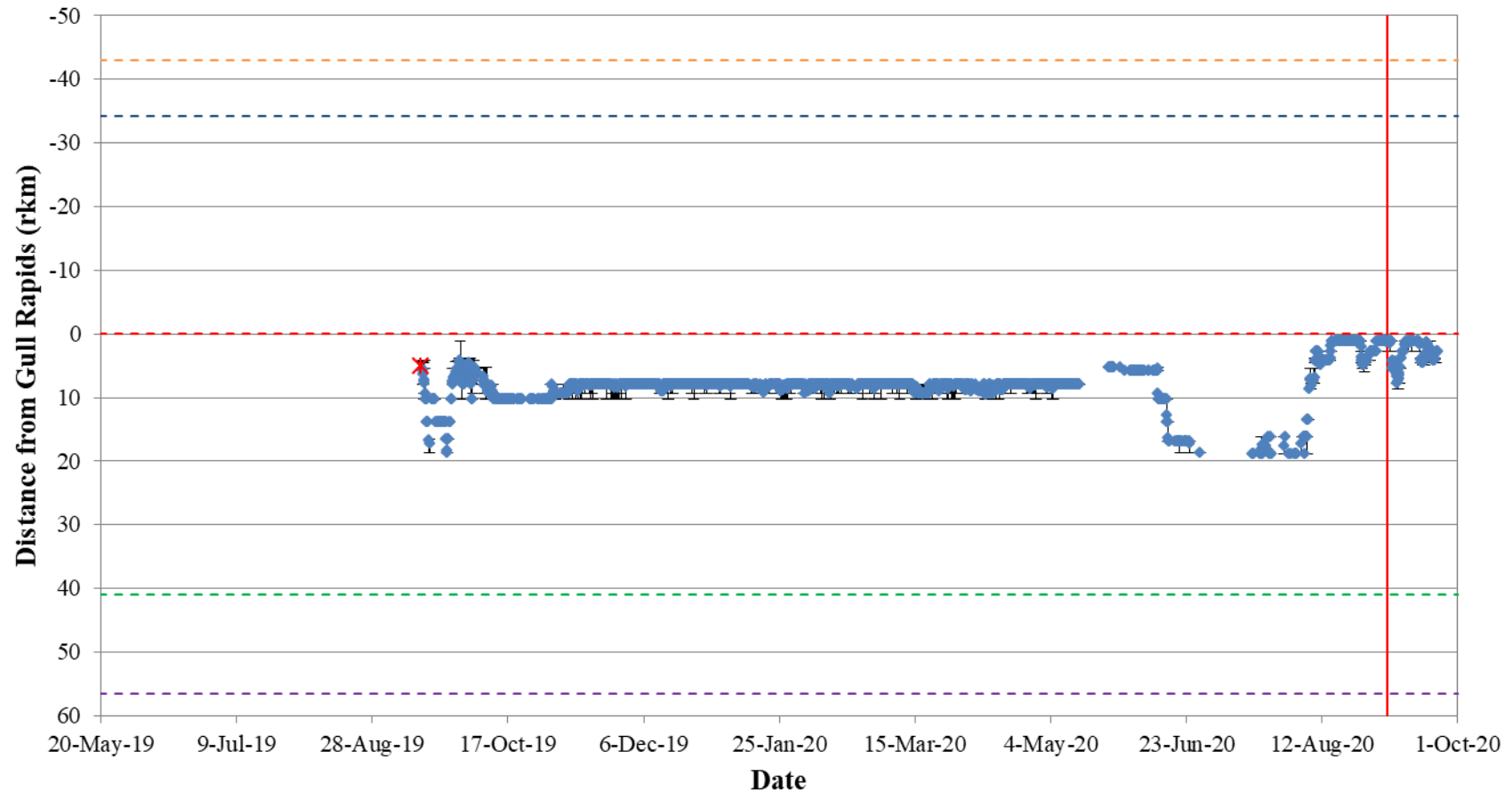
**Figure A5-6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7040) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



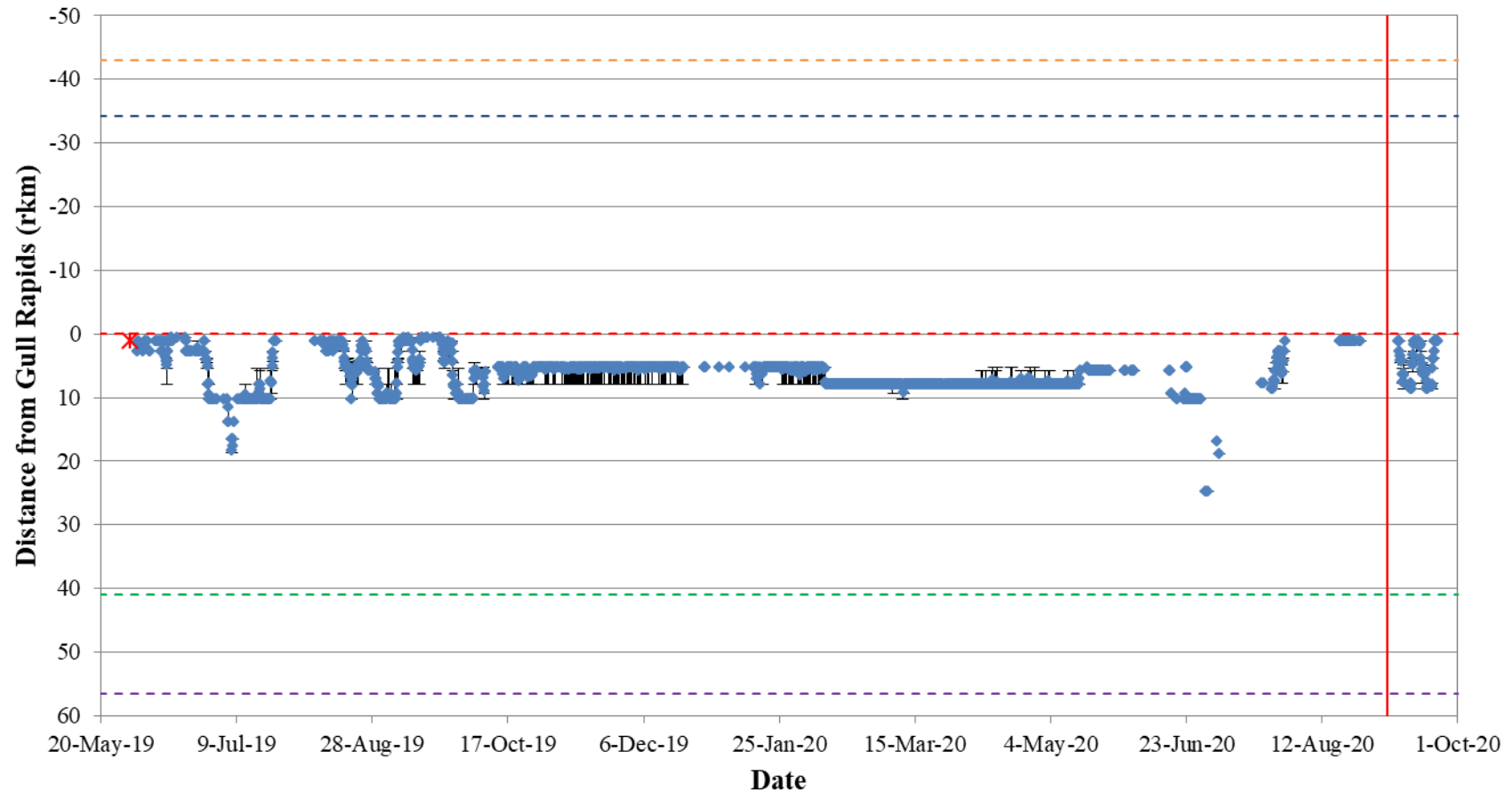
**Figure A5-7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7041) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



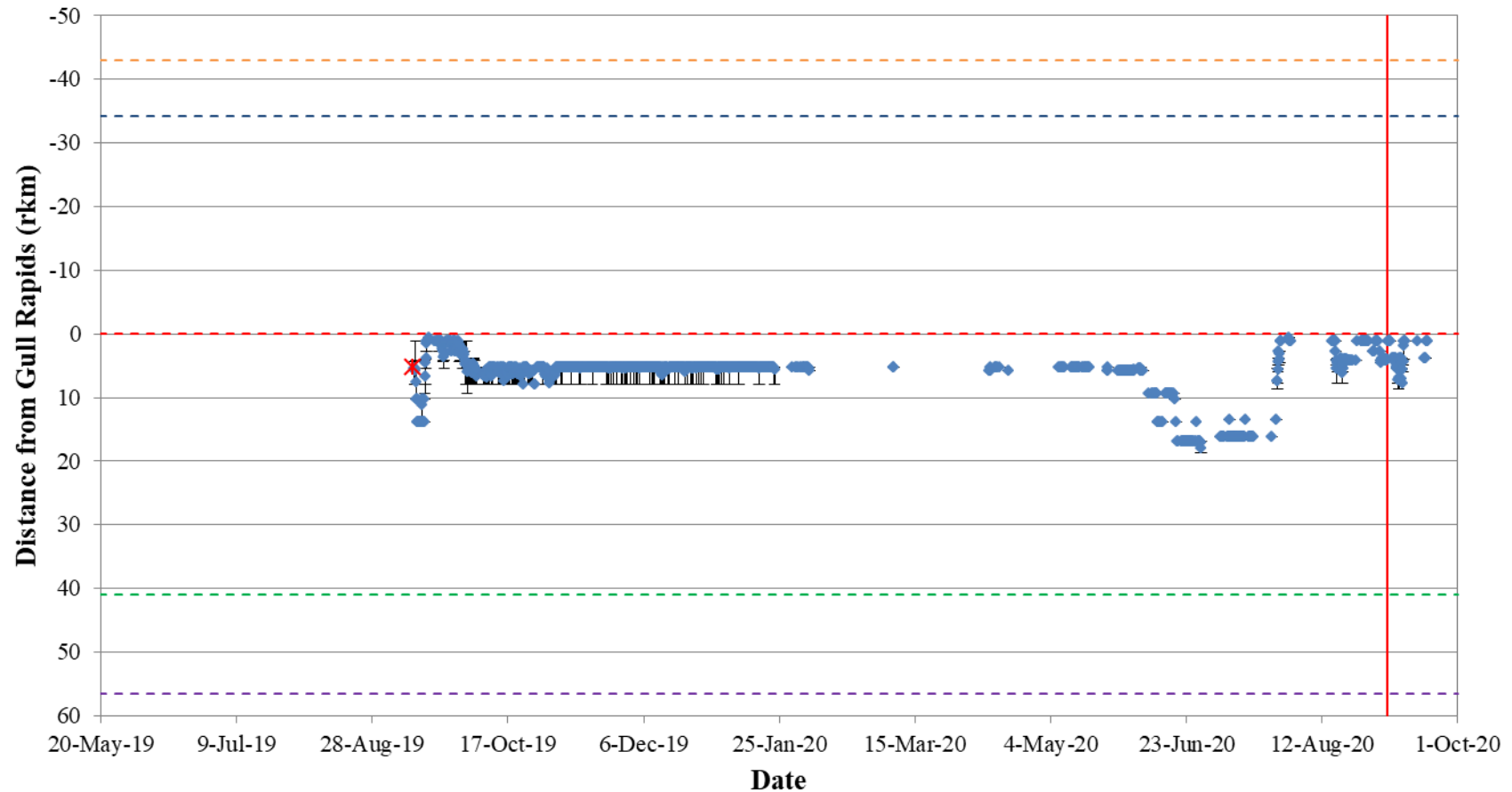
**Figure A5-8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7042) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



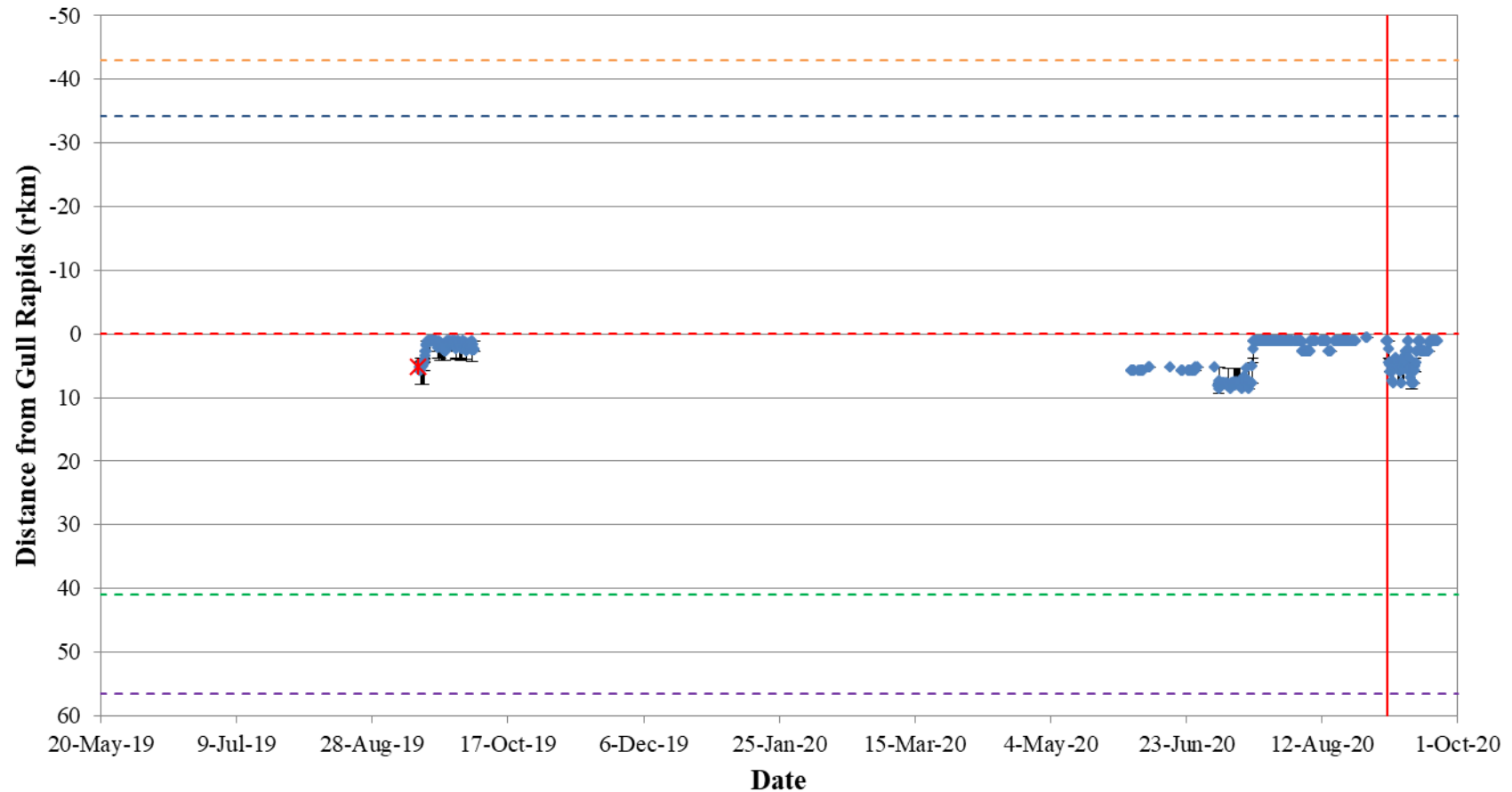
**Figure A5-9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7043) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



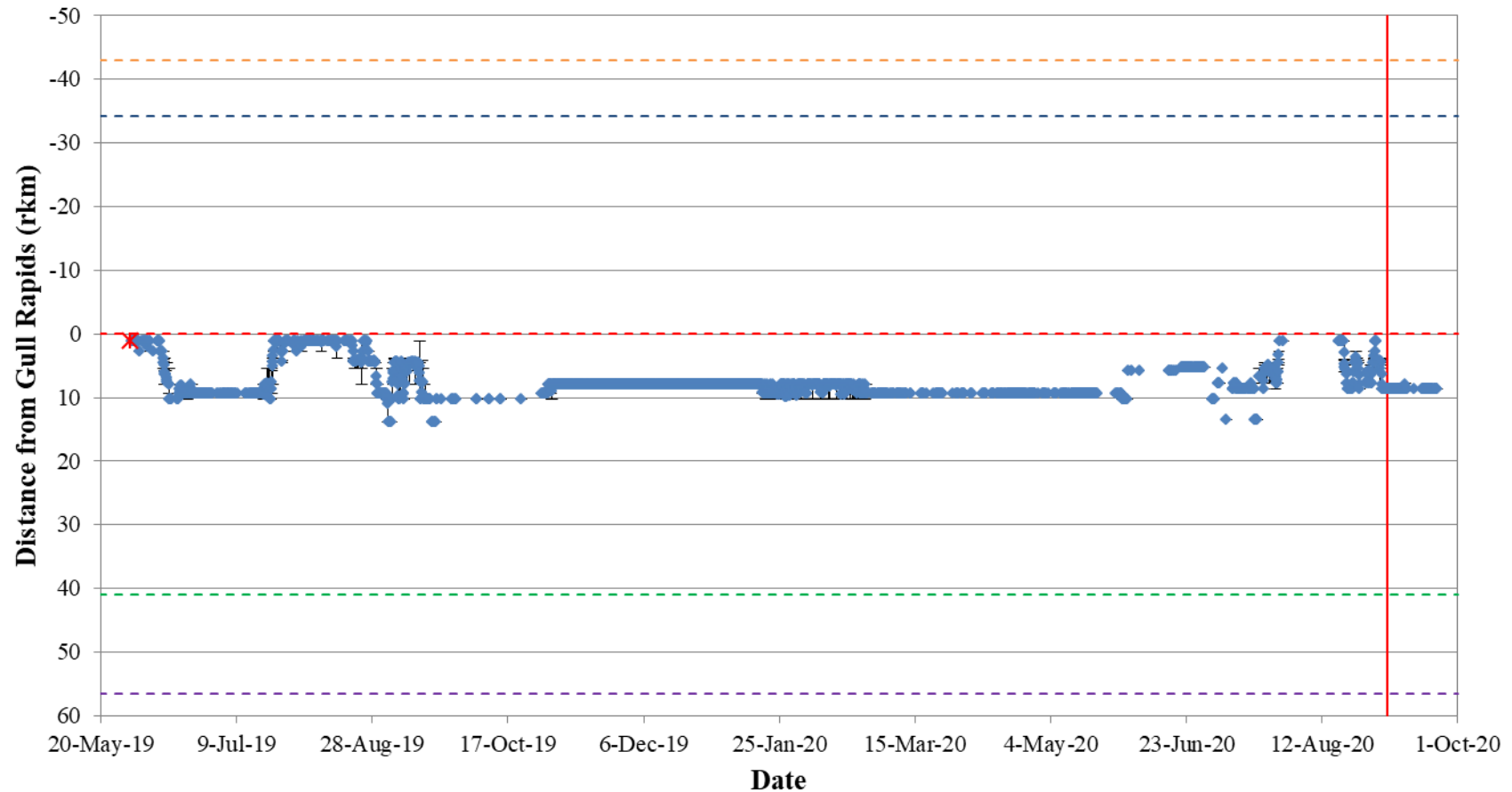
**Figure A5-10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7044) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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 A5-11: 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 September 23, 2020. 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).**

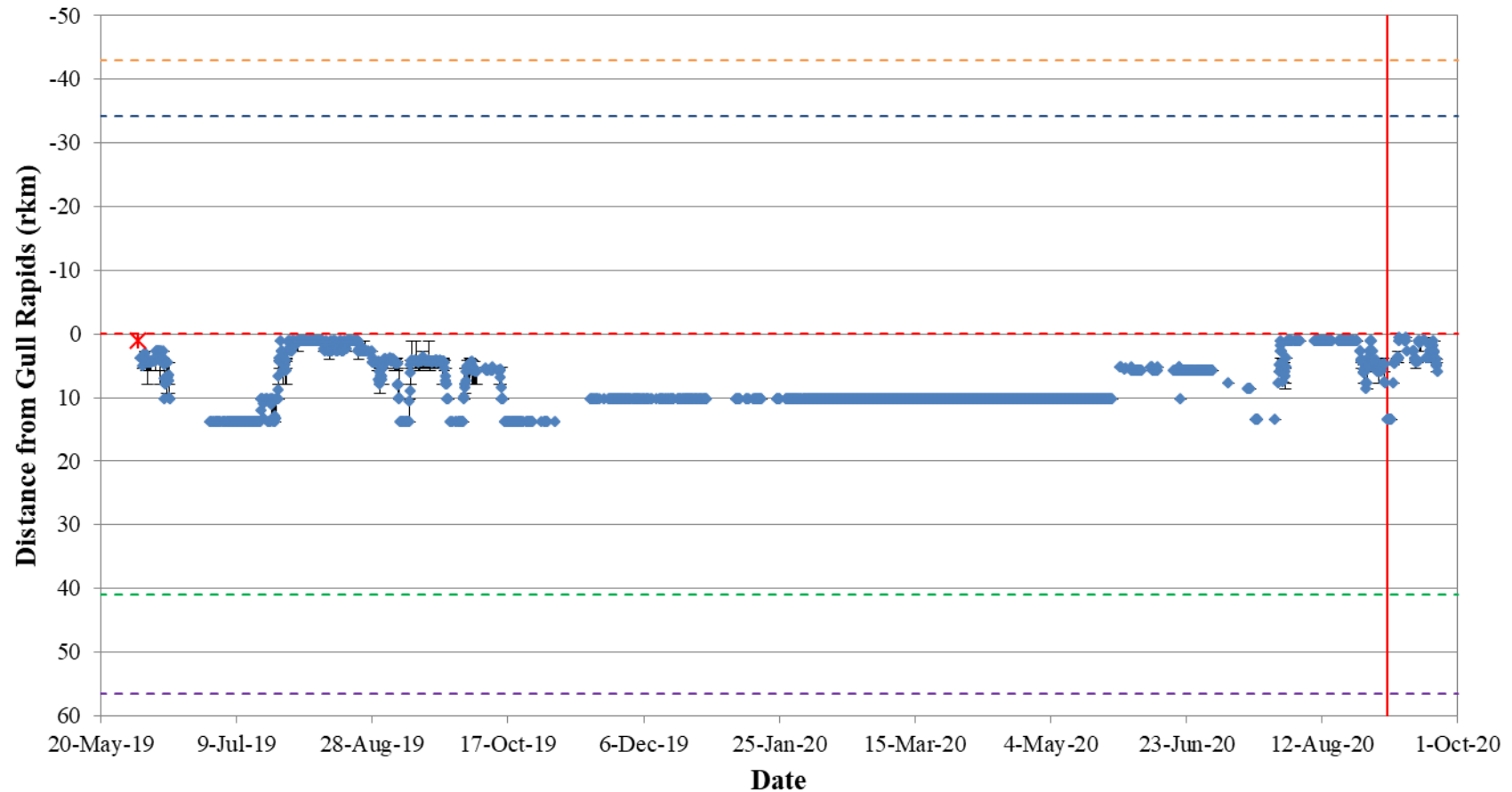


**Figure A5-12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7046) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

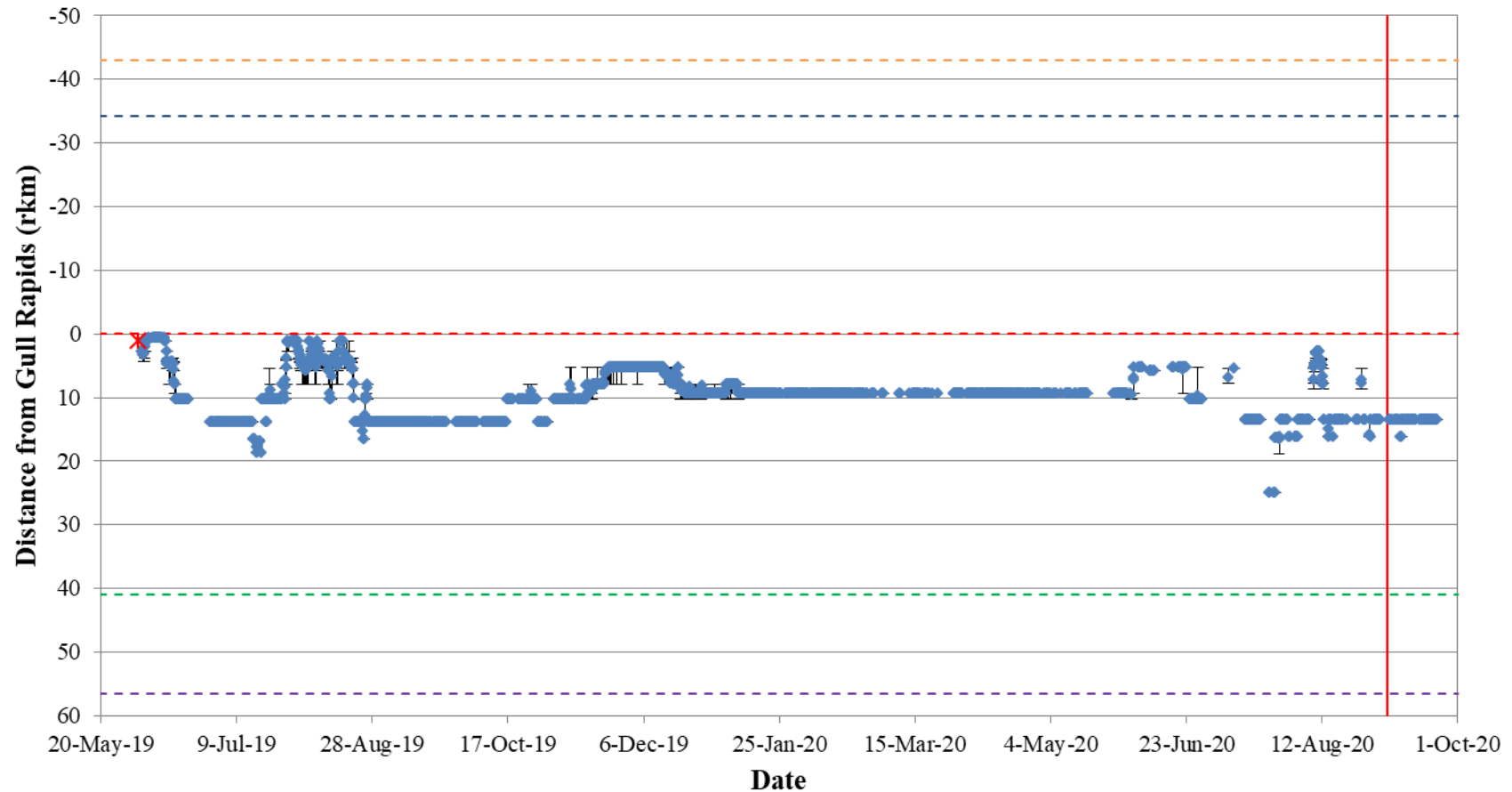


**Figure A5-13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7047) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

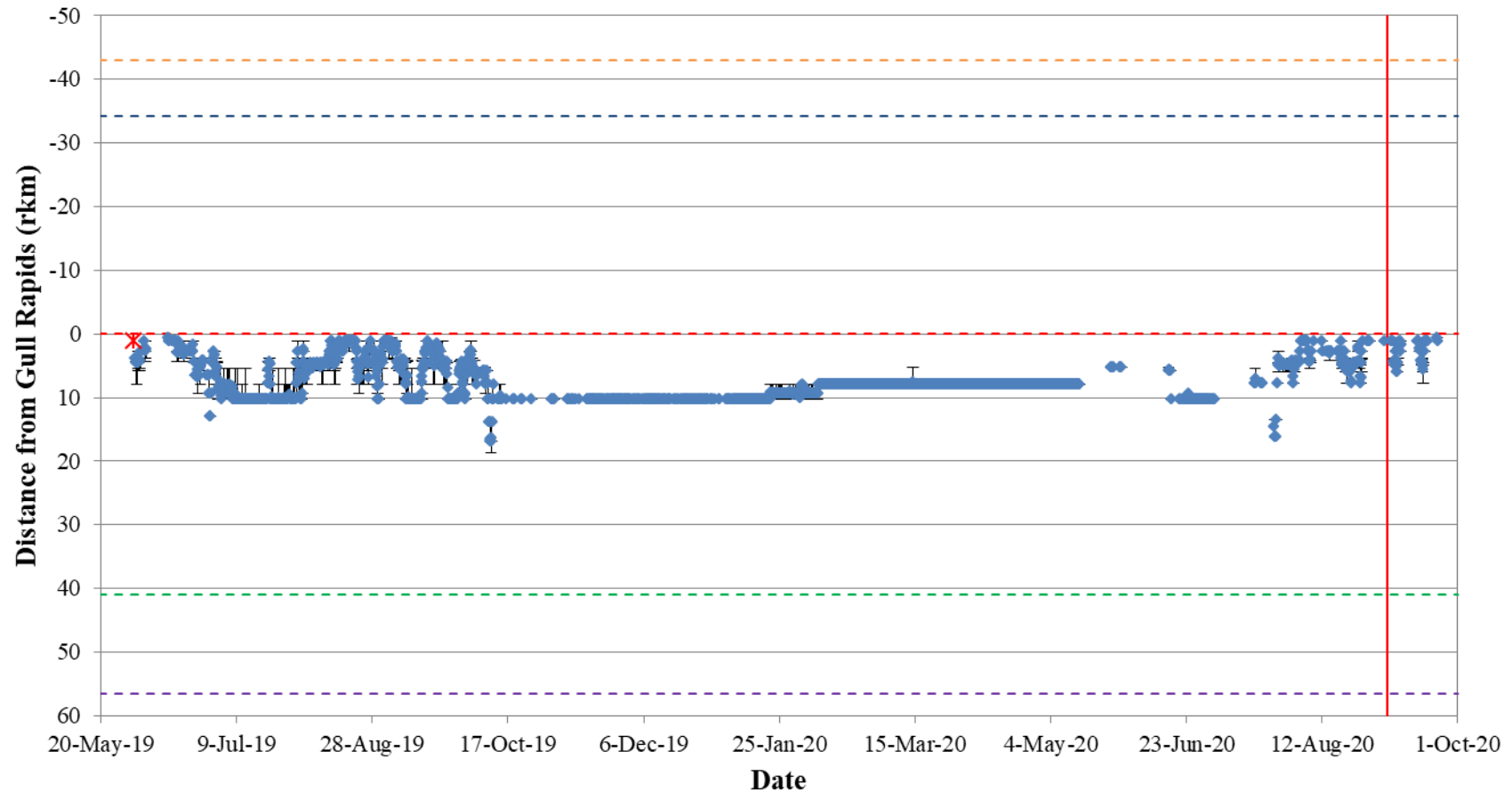




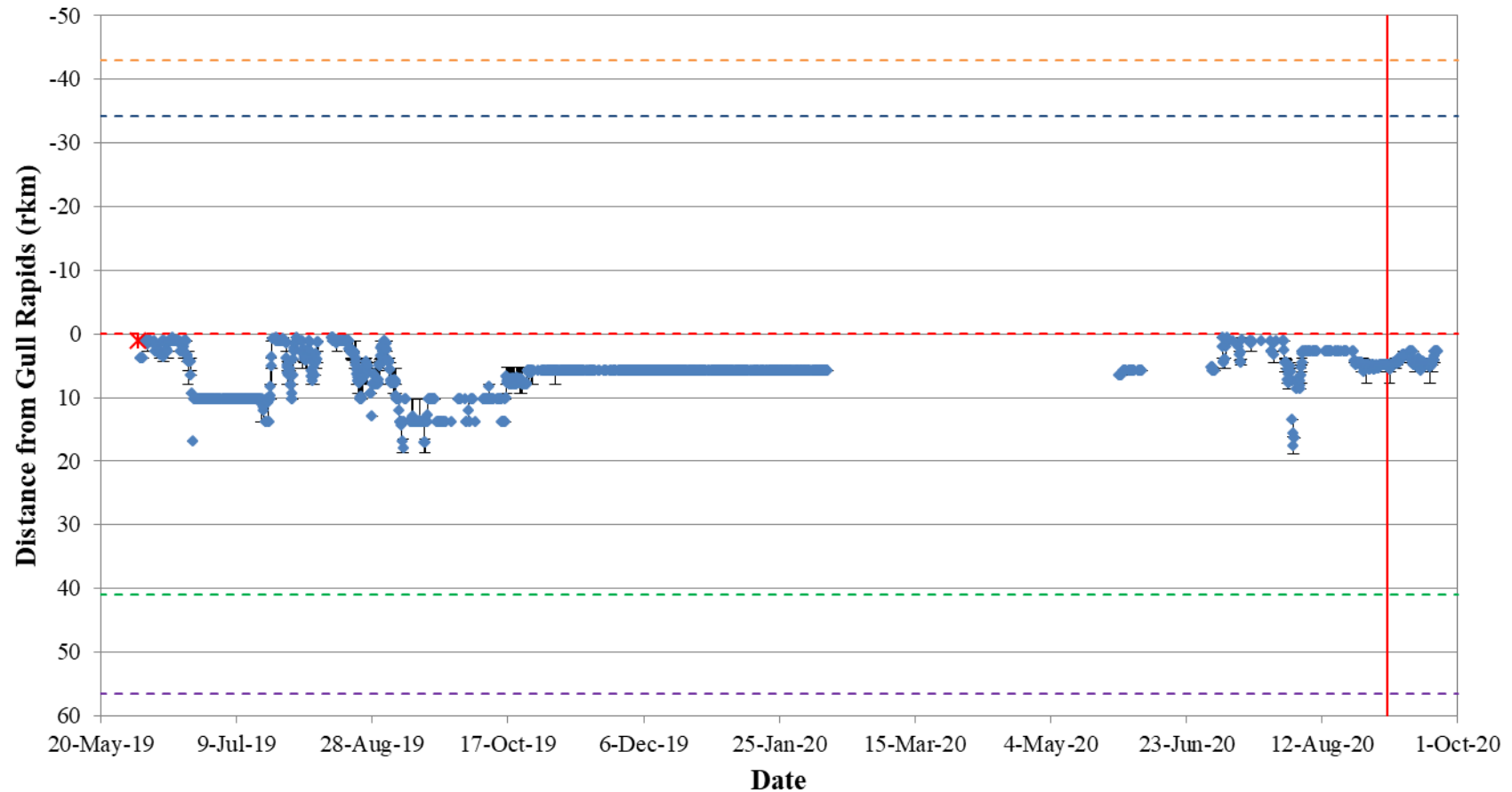
**Figure A5-14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7048) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



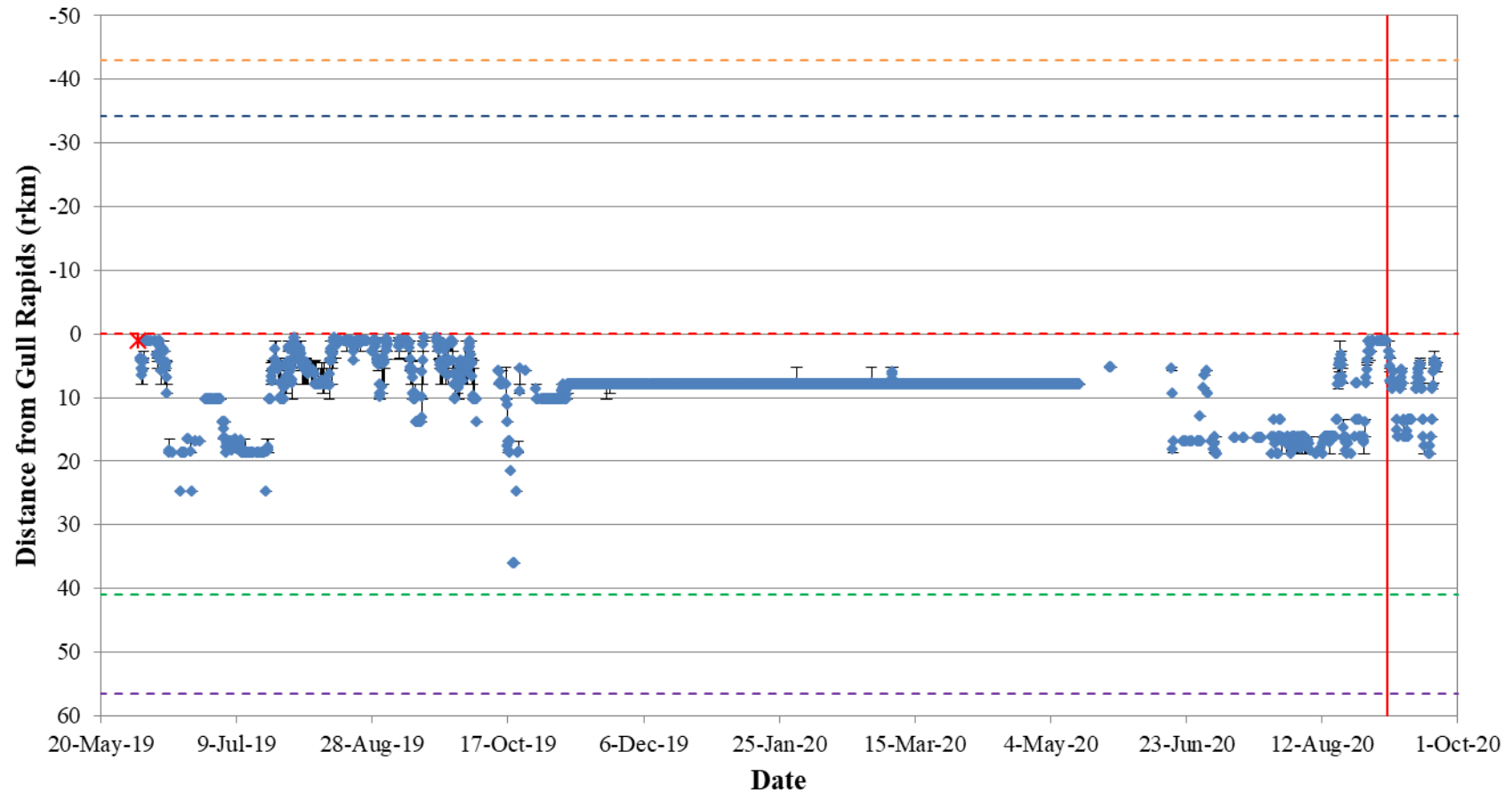
**Figure A5-15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7049) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



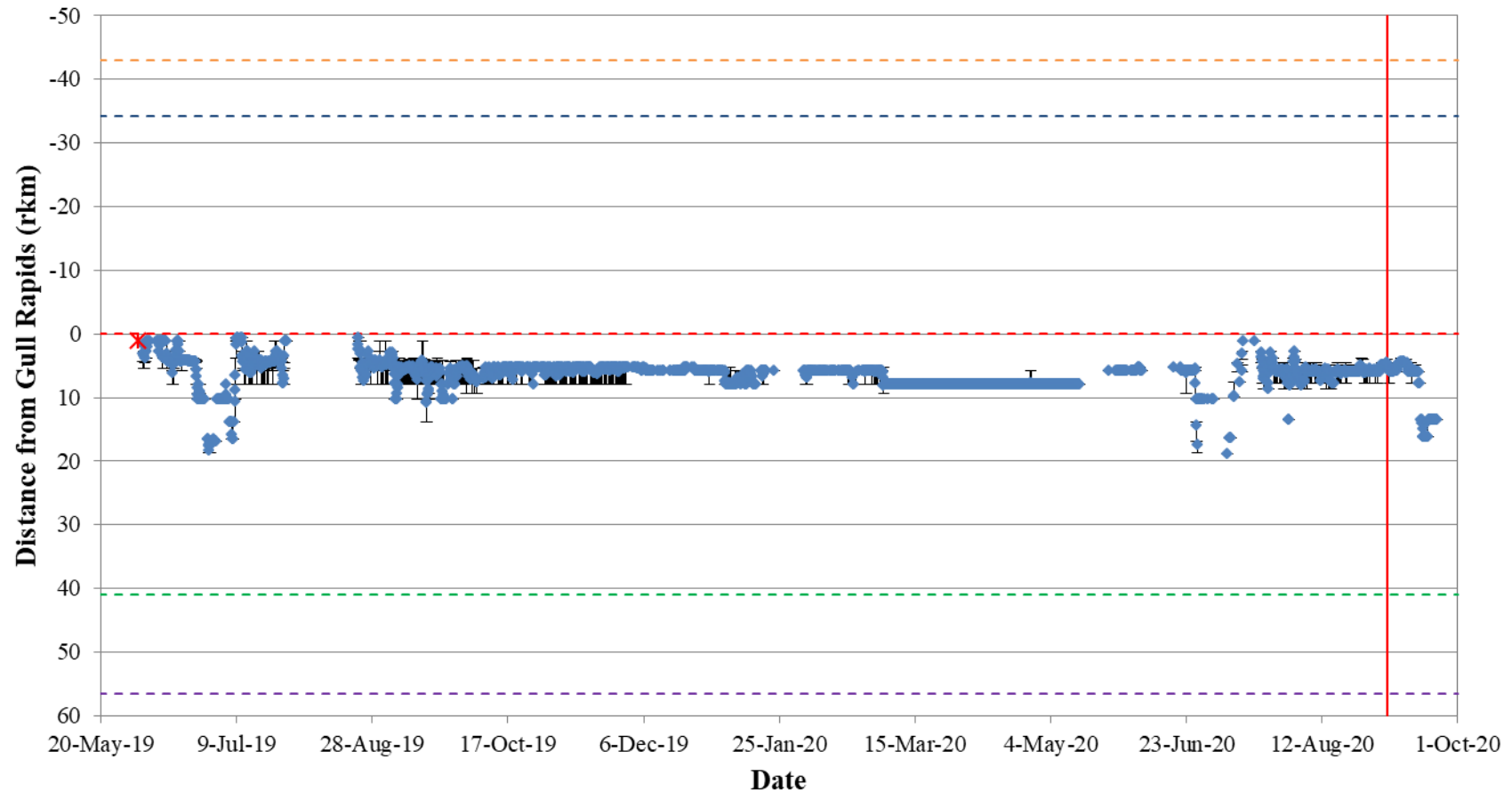
**Figure A5-16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7050) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



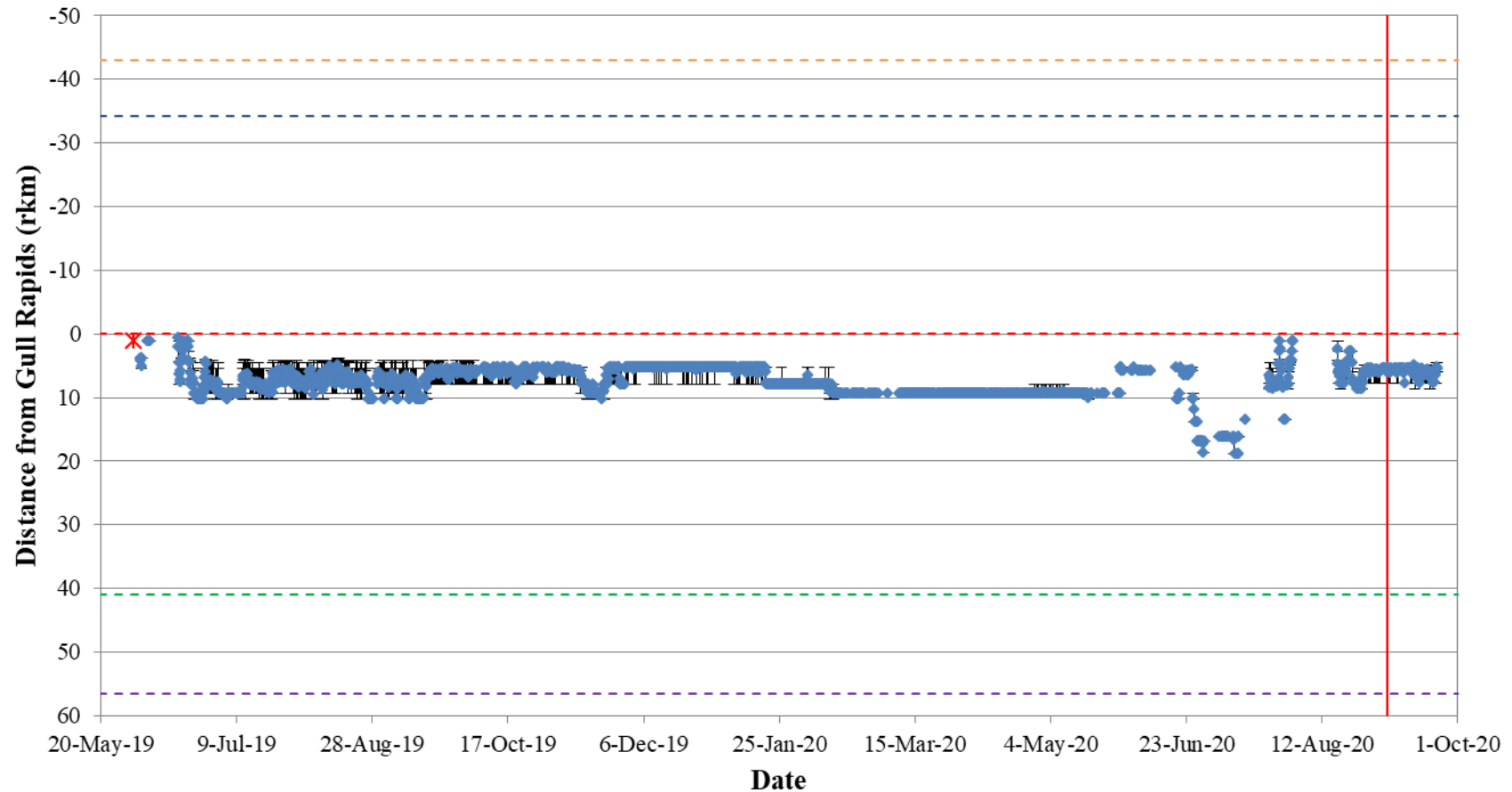
**Figure A5-17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7051) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**



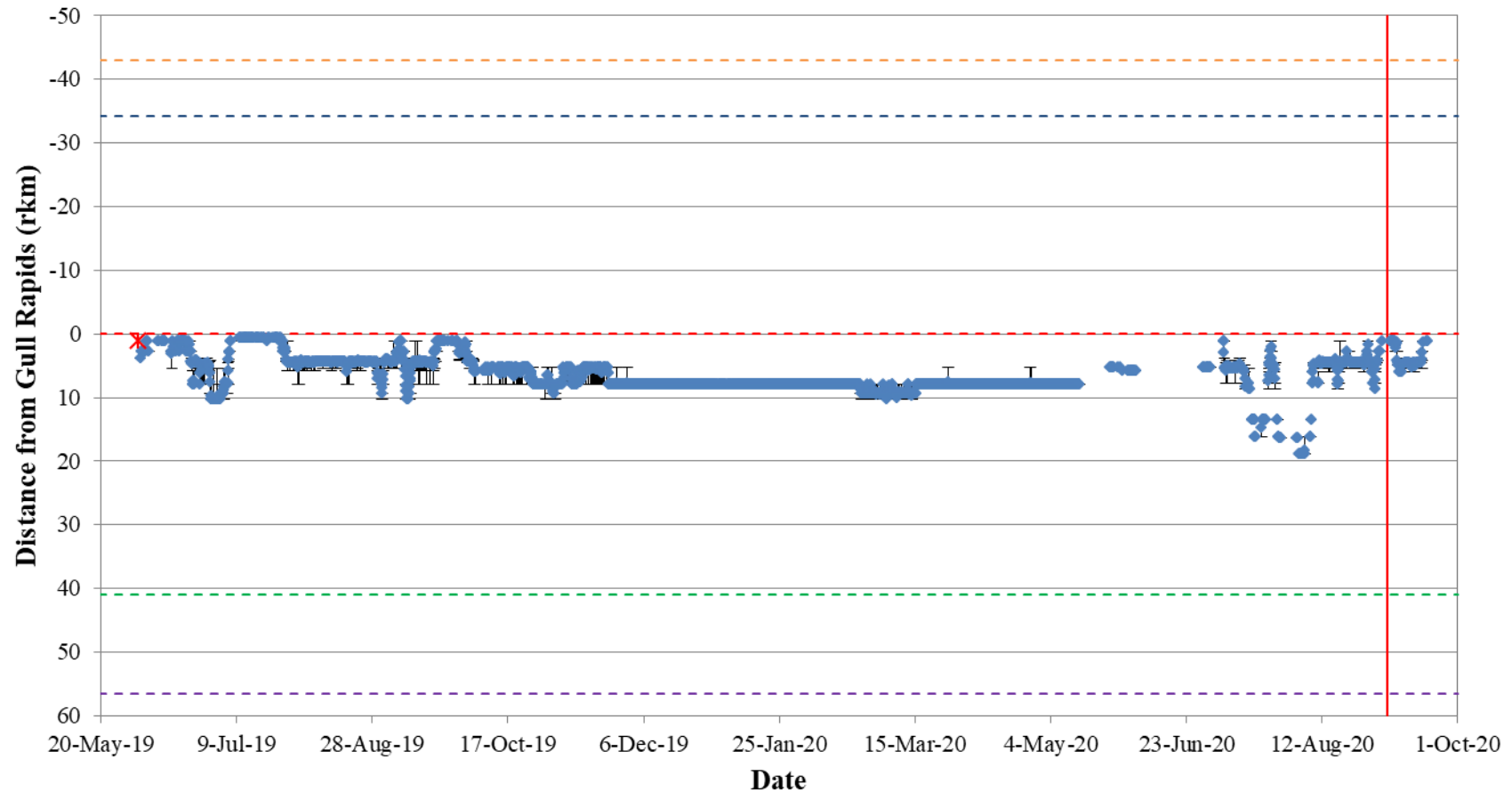
**Figure A5-18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7052) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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 A5-19: 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 September 23, 2020. 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).**

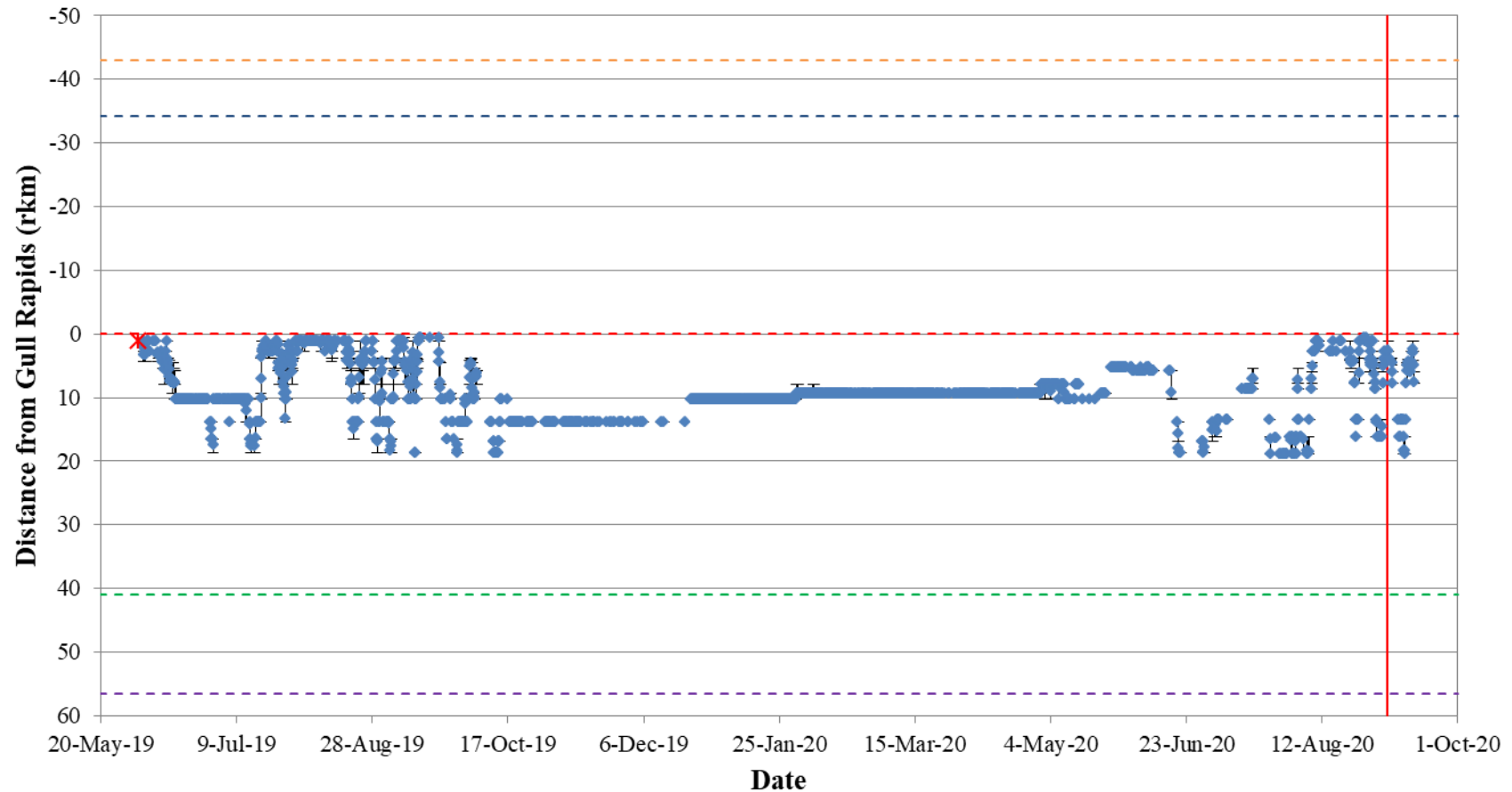


**Figure A5-20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7055) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

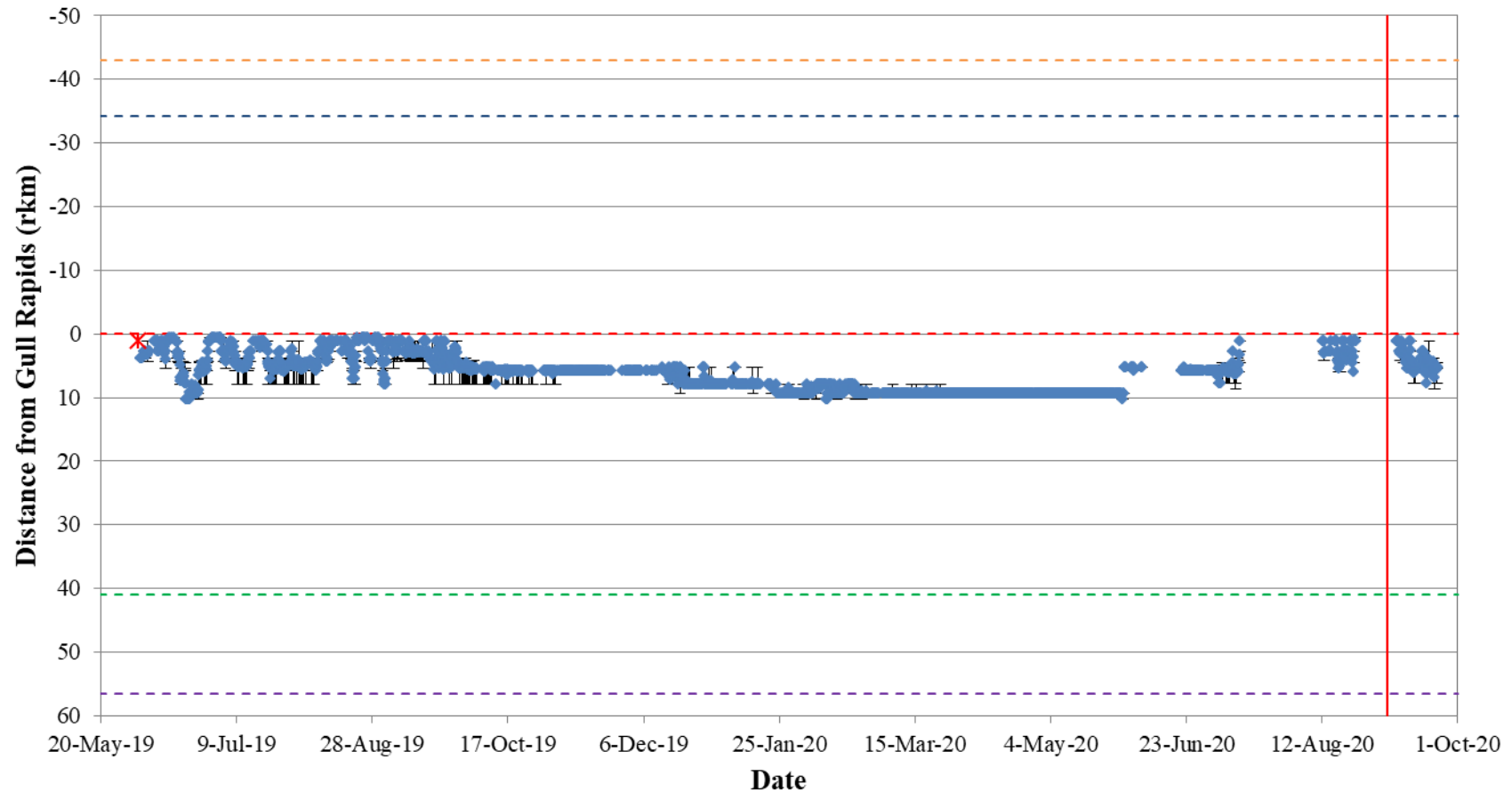


**Figure A5-21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7057) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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).**

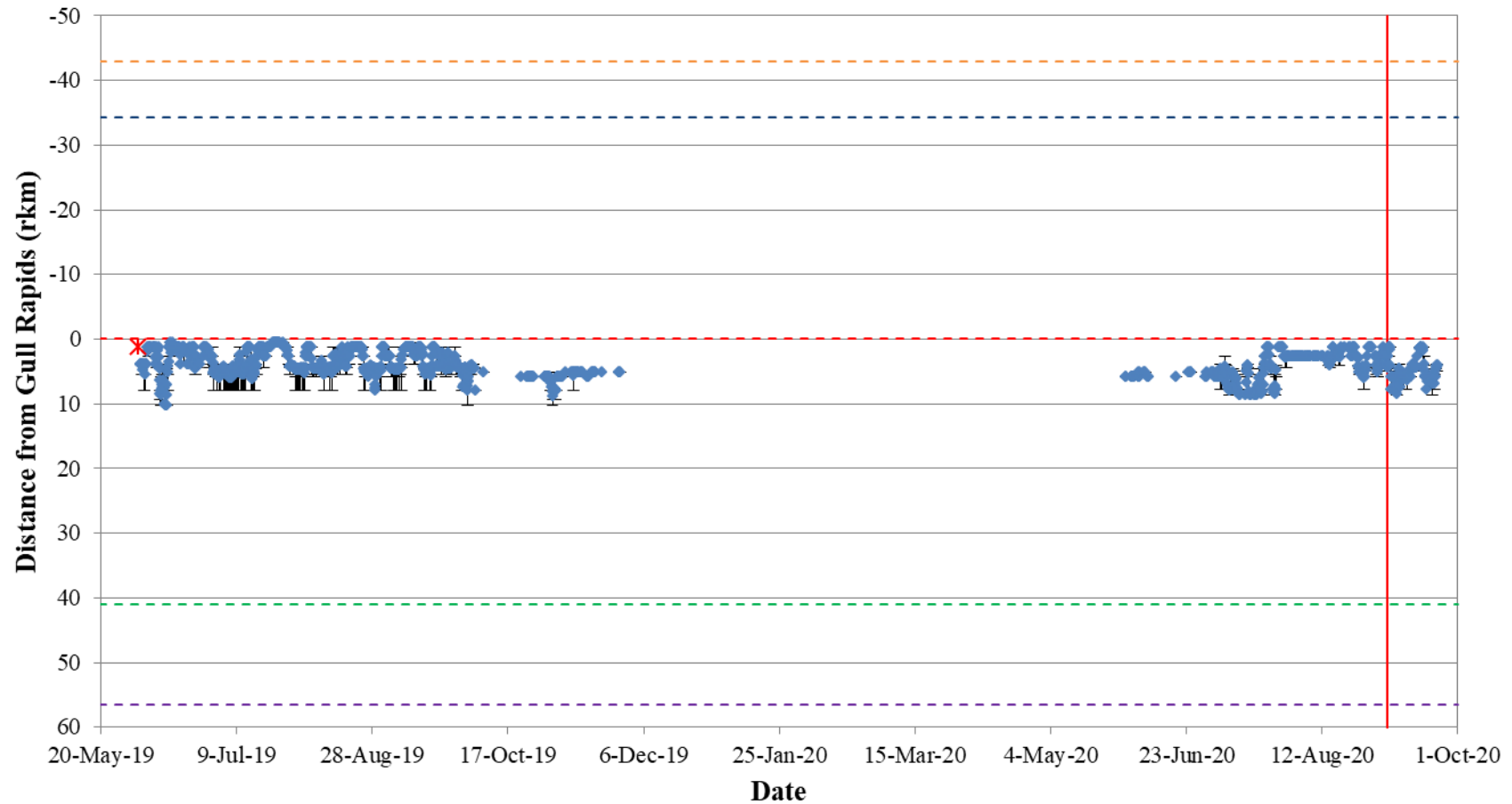




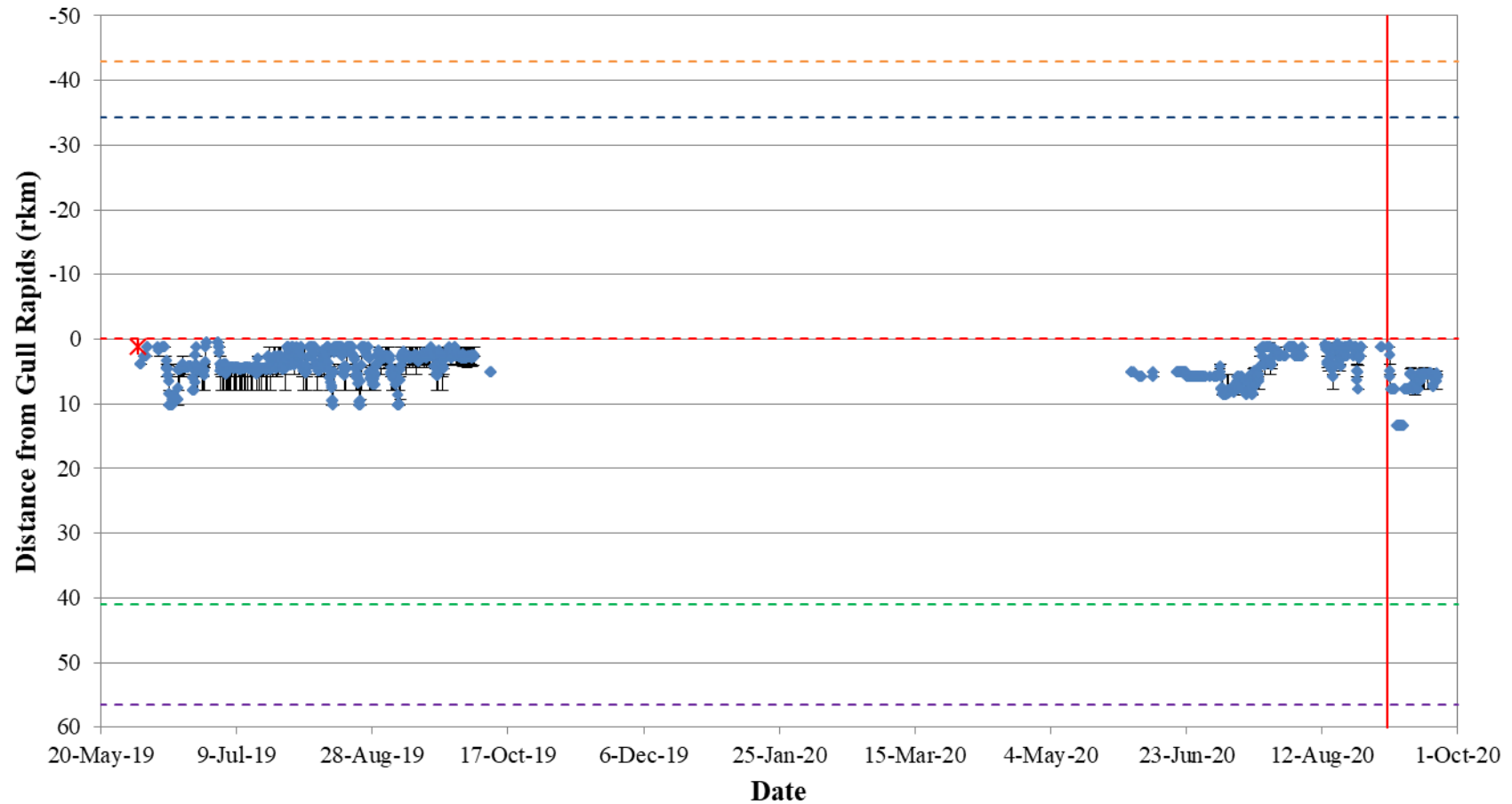
**Figure A5-22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #7058) in Stephens Lake in relation to the Keeyask GS (rkm 0), from May 1, 2019 to September 23, 2020. Date and location of tagging is indicated by a star. Completion of reservoir impoundment is indicated by a vertical 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 A5-23: 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 September 23, 2020. 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 A5-24: 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 September 23, 2020. 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 A5-25: 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 September 23, 2020. 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).**