



Keeyask Generation Project Aquatic Effects Monitoring Plan

Adult Lake Sturgeon Movement Monitoring Report AEMP-2015-01



KEEYASK GENERATION PROJECT

AQUATIC EFFECTS MONITORING REPORT

Report #AEMP-2015-01

Adult Lake Sturgeon Movement Monitoring in the Nelson River between
Clark Lake and the Long Spruce Generating Station, October 2013 to
October 2014: Year 1 Construction

Prepared for
Manitoba Hydro

By
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SUMMARY

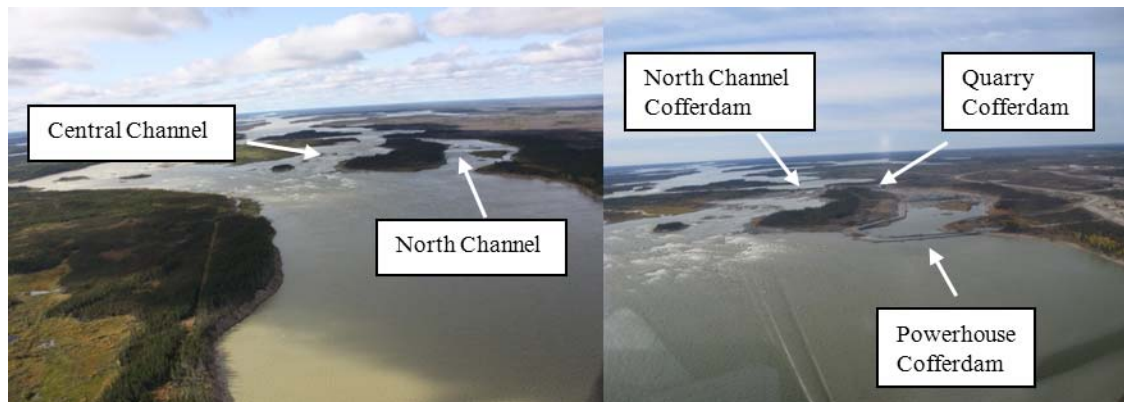
BACKGROUND

Construction of the Keeyask Generation Project (Project) at Gull Rapids began in July 2014. The Project includes a hydroelectric generating station (GS), roads, work areas, borrow pits (to get gravel/clay/sand used to build the Project), concrete manufacturing, waste material disposal areas, a 2000 person construction camp, and water and sewage treatment plants. Before the government issued a licence to construct the Project, the owner, who is the Keeyask Hydropower Limited Partnership (KHLP), needed to prepare a plan to monitor the effects of the Project on the aquatic environment, including fish and water quality. This monitoring work will take place over many years to make sure it is clear if the Project does or does not have an effect on the aquatic environment. The results will help the KHLP, government regulators, members of local First Nation communities, and the general public understand how construction and operation of the generating station will affect the environment. It will also tell us whether more needs to be done to reduce harmful effects.

Lake Sturgeon is one of the key species for monitoring because they are important to local people, the population is already not doing well, and the generating station will change or destroy important habitat. The plan to monitor sturgeon includes several types of studies:

- Measurement of the number of adults;
- Measurement of the number and growth of juveniles (in particular fish up to ten years old);
- Recording of spawning (egg-laying); and
- Studies of movement to record use of different habitats and longer migrations.

This report describes results of adult sturgeon movement monitoring from October 2013 to October 2014. The study was initiated in June 2011 when 59 adult Lake Sturgeon were tagged with acoustic transmitters with a 10-year battery life. Movements of these fish have now been monitored for three years before any changes to the river occurred, and the first three and a half months since the start of construction. During mid-July to October 2014, flow in the north and central channels of Gull Rapids was blocked by the construction of cofferdams. Cofferdams are temporary dams that create dry conditions for building the powerhouse and permanent dams.



Gull Rapids before (left) and after (right) construction of cofferdams blocked the north and central channels.

WHY IS THE STUDY BEING DONE?

The study is being done to answer two questions:

Do sturgeon move away from the construction area and, if so, how far? This question is important because if sturgeon stay 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. If they move far away, they may permanently leave this sturgeon population.

Do sturgeon move up and down over Gull Rapids to reach habitat that they need to complete their life cycle? This question is important because, after the permanent dam is built, sturgeon will no longer be able to move from Stephens Lake to Gull Lake unless a special fish passage structure is built that makes this movement possible. Studying the movement of sturgeon will help regulators and the KHLPP decide if sturgeon living in Stephens Lake must be able to move upstream past the GS to Gull Lake for the sturgeon population to survive. Sturgeon moving downstream after the GS is built would need to go either over the spillway or through the powerhouse and by the turbines (see photo), both of which may injure or kill them. Movement studies are also important to help decide if too many sturgeon will be injured or killed moving downstream and if additional ways to reduce effects on sturgeon are required.



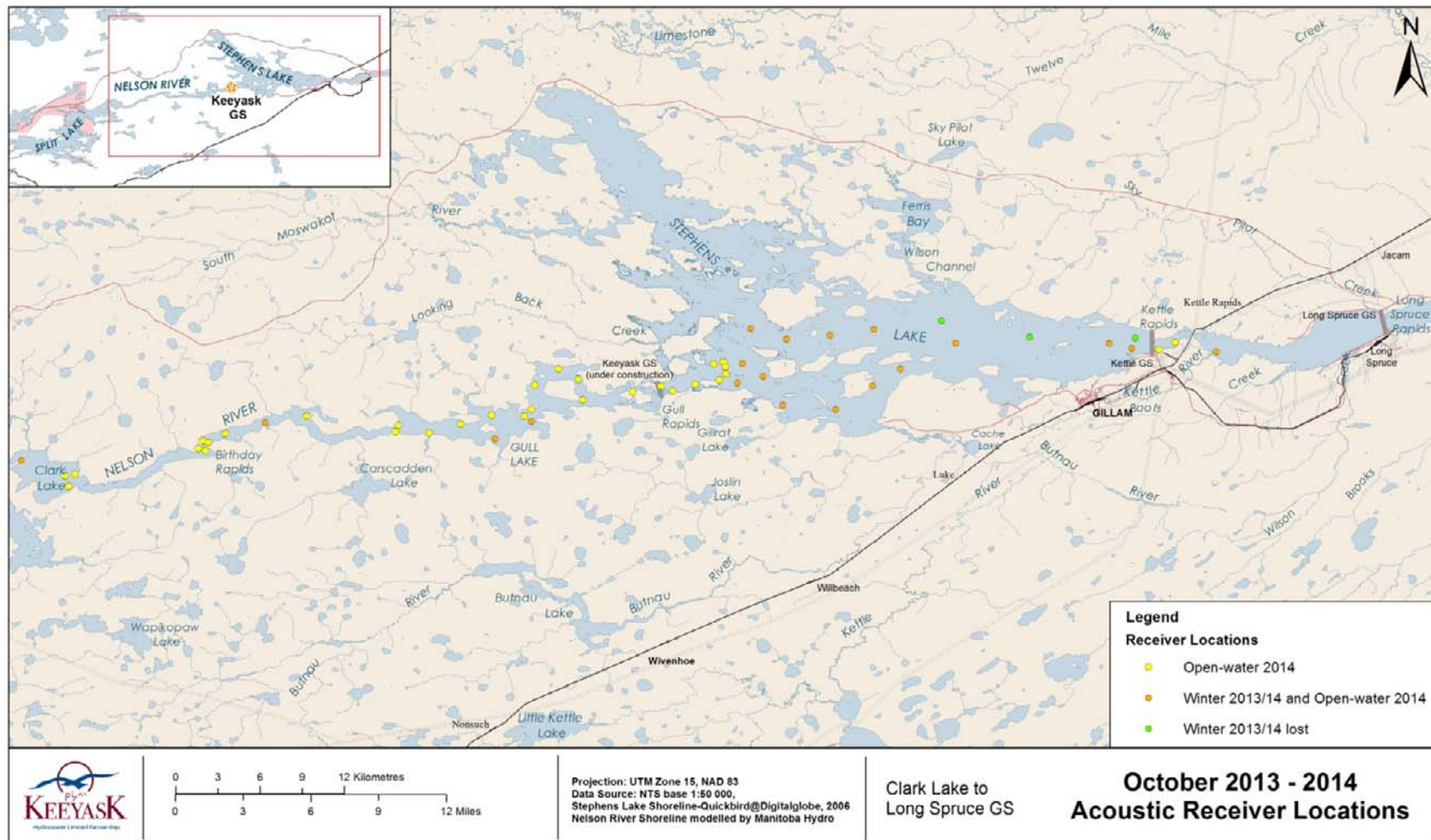
Generating station showing powerhouse and spillway. Water passing through the powerhouse turns turbines (example turbine on right).

WHAT WAS DONE?

The movements of adult sturgeon were tracked using acoustic telemetry. Acoustic tags were implanted inside fish (see photo below). Each tag sends out a sound (called a “ping”) that is heard and recorded by receivers placed in the Nelson River between Clark Lake and Gull Rapids, and in Stephens Lake (see Map). Each fish is given a tag that sends out a unique ping, and the pings can be heard by receivers that are up to 1 km away. By looking at the pings that were recorded by receivers in different places, the movement of each fish can be followed. The transmitters are powered by batteries that will last for 10 years



An acoustic tag is implanted into a sturgeon through an incision.



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

WHAT WAS FOUND?

How far and where sturgeon moved depended on the individual fish, whether it lived in Gull Lake or Stephens Lake, and the season. 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 3 to 5 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 (photo), and spend the rest of the ice free season feeding in areas of rivers or lakes. During the winter they move to areas where they are protected from ice and fast water.



Adult sturgeon caught in rapids (left). Sturgeon spawning in rapids (right).

The sturgeon that were tagged in Gull Lake were divided into two groups: those that usually stayed in a lake (either Clark Lake (3 fish) or Gull Lake (25 fish)); and those that usually stayed in the channel of the Nelson River (3 fish). Throughout the study, most of the fish stayed in the same general area for most of the time. In spring of each year, some of the sturgeon from Gull Lake moved to Birthday Rapids, which is a known spawning area.



Birthday Rapids (both photos) is 10 km upstream of Gull Lake.

Fish in Stephens Lake generally stayed in the river channel, even in the part of Stephens Lake where the river channel was flooded when the Kettle GS was built. Fish tagged in Stephens Lake were divided into two groups: fish that remained within 15 km of Gull Rapids; and those that moved throughout the former river channel in Stephens Lake (a distance of 40 km).



Stephens Lake

Monitoring movements in winter is challenging because of ice conditions that can damage receivers. For this reason, receivers are left in only a few locations over winter, making it less likely that sturgeon locations will be recorded. However, in both Stephens and Gull lakes, sturgeon have been recorded in deeper areas with little water flow. Many of these sturgeon seem to move very little.

In each year of the study, at least one sturgeon moved through Gull Rapids. Six fish moved upstream through Gull Rapids (one in 2011, four in 2012, one in 2013, and none in 2014) and two moved downstream (both in 2014). Most of these movements occurred in fall and were not directly associated with spawning movements. One fish moved upstream in fall as far upstream as Birthday Rapids, before returning to Gull Lake for the winter. This fish then returned to Birthday Rapids the following spring, and may have spawned. Sturgeon living in Stephens Lake have spawning habitat at Gull Rapids, so it is not known why they would move upstream past Gull Rapids to spawn. One possible explanation is that they are seeking a location with more adult sturgeon. There are almost no adult sturgeon in Stephens Lake so very few would be spawning each year, but there are more sturgeon in Gull Lake.



Gull Rapids

During 2011, 2012, 2013, and the first half of 2014, a group of sturgeon spent much of the time from May to September along the north shore of the Nelson River just downstream of the north channel of Gull Rapids. Construction of the Quarry Cofferdam began in July 2014 gradually cut off flow in the north channel. In fall, this area was enclosed in the Powerhouse Cofferdam (see photo). The sturgeon remained at this location close to construction, until fall, when they moved further downstream, as they have in previous years. One of five fish present in the area where the Powerhouse Cofferdam was constructed was no longer recorded after mid-September. However, it was not found within the Powerhouse Cofferdam when the area was searched with a handheld receiver before it was drained. This fish may have moved to a location where it cannot be recorded by the receivers, the tag may have failed, or it may have been harvested.



Powerhouse Cofferdam in fall 2014

WHAT DOES IT MEAN?

For the most part, this study has shown that each sturgeon has a place that it likes to live. At times, each fish may move to a different habitat, particularly if it is spawning. It is not known why some sturgeon moved from Stephens Lake upstream into Gull Lake nor why two sturgeon moved down to Stephens Lake. As the study continues, we may see that from time to time sturgeon go to live in another lake or river environment for a while.

The information collected to date does not give a clear answer about whether a fish passage structure will be needed to allow fish to move upstream, or whether many sturgeon will move downstream past the GS after it is built. So far we have seen that sturgeon usually do not move great distances and that most prefer to live in similar locations year after year. Habitat may affect how far sturgeon move; for example, sturgeon may move further when they are living in a long stretch of deep river channel. For this reason, the movements of sturgeon may change after the GS is built and Gull Lake becomes part of a deep reservoir.

WHAT WILL BE DONE NEXT?

The tags that were implanted in 2011 will last to the end of construction in 2021. 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. It will also show us when they are spawning and when they are resting (growing). This information will help government regulators and the KHLP decide if fish passage structures or additional fish mitigation measures are needed after the generating station is built. Following the locations and movements of fish will also help us understand whether fish may be exposed to harm at the construction site.

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 # 18-14.

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1.0 INTRODUCTION

Construction of the Keeyask Generation Project (the Project), a 695-megawatt hydroelectric generating station (GS) and associated facilities, began in July 2014. The Project is located at Gull Rapids on the lower Nelson River in northern Manitoba where Gull Lake flows into Stephens Lake, 35 km upstream of the existing Kettle GS (Figure 1).

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 licencing 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, fish community, specifically adult Lake Sturgeon movement, for the construction and operation phases of the Project.

The study area included in the sturgeon components of the AEMP is the reach of the Nelson River from the Kelsey GS to the Kettle GS, as well as waterbodies immediately adjacent to the Nelson River (Figure 1).

The Lake Sturgeon component includes four monitoring activities:

- Adult population monitoring;
- Juvenile population monitoring;
- Spawn monitoring; and
- Movement monitoring.

This report provides results of movement monitoring studies, specifically for adult Lake Sturgeon, conducted between 2011 and 2014 (results of juvenile Lake Sturgeon movement monitoring are reported in Lacho et al. 2015). Movement monitoring during the construction phase is being conducted to determine if disturbances associated with construction alter habitat use and coarse-scale movement patterns upstream and/or downstream of the Project. Results will 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 stranding during dewatering); and
- the potential for increased emigration or avoidance of the construction site due to disturbance (*i.e.*, blasting, suspended sediment inputs, etc.).

Movement data collected during the construction period, in conjunction with baseline data collected prior to construction, will also contribute to the assessment of the need for: (i) upstream fish passage; and (ii) additional mitigation for fish moving downstream after the GS is completed.

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

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

The adult movement study was initiated in 2011, when 59 fish (measuring > 755 mm fork length) were tagged with acoustic transmitters with a ten-year battery lifespan. Thirty-one fish captured upstream of Gull Rapids, and 28 fish captured downstream of Gull Rapids were tagged. 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. Data collected prior to the start of construction (from June 2011 to mid-July 2014) are considered preconstruction and are provided in three separate reports (Hrenchuk and McDougall 2012; Hrenchuk and Barth 2013; and Hrenchuk et al. 2014).

Construction of the Keeyask GS began in mid-July 2014, and resulted in altered flows in the north and central channels of Gull Rapids, diverting them into the south channel (Figure 2). Between 22 July and 4 August 2014, flow in the north channel was cut off by construction of the Quarry Cofferdam. Movements of tagged sturgeon in the immediate vicinity of construction activities were monitored by a receiver placed at the base of the north channel of Gull Rapids. As construction continued, flow in the central channel of Gull Rapids was gradually cut off (construction of the North Channel Cofferdam began on 10 September and dewatering continued to the end of October, 2014). The Powerhouse Cofferdam was constructed at the base of the north channel of Gull Rapids, and dewatered the remainder of the north channel between 2 and 26 October, 2014. During this time, the receiver at the base of the north channel was removed. Blasting occurred in quarries situated in the north channel intermittently during July to October, 2014.

2.0 THE KEYYASK STUDY SETTING

The study area encompasses an approximately 95 km long reach of the Nelson River from Clark Lake to the upstream end of the Long Spruce GS forebay. This section of river offers a diversity of physical habitat conditions, including a variety of substrate types, and variable water depths (ranging from 0 to 30 m) and velocities.

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

Birthday Rapids is located approximately 10 km downstream of Clark Lake and 30 km upstream of Gull Rapids (Figures 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 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 17 km upstream of Gull Rapids and 14 km downstream of Birthday Rapids, where the river widens to the north into a bay around a large point of land (Figures 1 and 4), and extending to the downstream end of Caribou Island, approximately 3 km upstream of Gull Rapids. 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 (Figure 4).

Gull Rapids is located approximately 3 km downstream of Caribou Island on the Nelson River (Figure 1). Two large islands and several small islands occur within the rapids, prior to the river narrowing. The rapids are approximately 2 km in length, and the river elevation drops approximately 11 m along its 2 km length.

Just below Gull Rapids, the Nelson River enters Stephens Lake. Stephens Lake was formed in 1971 by construction of the Kettle GS. Between Gull Rapids and Stephens Lake there is an approximately 6 km long reach of the Nelson River that, although affected by water regulation at the Kettle GS, remains riverine habitat with moderate velocity. Construction of the Kettle GS flooded Moose Nose Lake (north arm) and several other small lakes that previously drained into the Nelson River, as well as the old channels of the Nelson River that now lie within the southern portion of the lake. Major tributaries of Stephens Lake include the North and South Moswakot rivers that enter the north arm of the lake. Looking Back Creek is a second order

stream that drains into the north arm of Stephens Lake (Figure 1). Kettle GS is located approximately 40 km downstream of Gull Rapids.

Long Spruce Forebay 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 Forebay, with both tributaries entering the Forebay on the south shore (Figure 1).

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 range (generally 500 m to 1 km, depending on conditions), the transmitter code number, as well as the date and time is stored in the receiver.

3.1.1 ACOUSTIC TRANSMITTER APPLICATION

Acoustic transmitters (VEMCO V16-4x, estimated 3650-day battery life) were first applied to 59 fish in 2011 and 2012; 31 upstream, and 28 downstream of Gull Rapids (Table 1). Since then, it is suspected that 11 fish have either shed their tags, suffered mortality, or have been captured by local resource users and the tags have not been returned. 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 the GS ($n = 4$) and in Stephens Lake ($n = 7$).

At both locations, Lake Sturgeon were captured in June 2014, using gill nets. Gillnet gangs were 50 yds (45.8 m) long, each composed of two panels of 8, 9, 10, or 12 inch (203, 229, 254, and 305 mm) twisted nylon stretched mesh. Individual gill net panels measured 25 yds (22.9 m) long and 2.7 yds (2.5 m) deep. Following capture, Lake Sturgeon were placed in a 76 L nesting fish tub fitted with an aquarium aerator for transport. All tagging was conducted on shore near the site of capture. Prior to transmitter implantation, Lake Sturgeon were anaesthetized in a solution of clove oil and ethanol, adapted from Anderson et al. (1997). When the Lake Sturgeon became immobile, they were placed in a surgery cradle ventral side up. Because the anaesthetic renders a fish unable to ventilate on its own, freshwater was continuously pumped over the gills. A small incision, approximately 3 cm in length, was made through the ventral body wall using a sterilized scalpel. An acoustic transmitter was inserted into the body cavity and the incision was closed. Lake Sturgeon were monitored in a large (~400 L) recovery tank until they were able to maintain equilibrium and had regained their strength. They were released in off-current areas near the original capture site (Figure 3).

3.1.2 ACOUSTIC RECEIVERS AND DEPLOYMENT

During the open-water season, receivers were deployed in calm water with a flat bottom free of large debris to maximize detection range, and were 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 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 pass by.

The retrieval of receivers deployed during winter has proven challenging and several were lost in 2011/2012 that were believed to have been moved by ice (Hrenchuk and Barth 2013). Because it appears that receivers will only remain safe from ice if deployed at depths > 10 m, the number of possible receiver locations during winter, especially in Gull Lake, is limited.

3.1.2.1 WINTER 2013/2014

Twenty-two stationary acoustic receivers (VEMCO model VR2 and VR2W, Shad Bay, Nova Scotia) were placed between Clark Lake and the Long Spruce GS during the winter 2013/2014 period (16 October 2013, to 30 April 2014). Four were set upstream of Gull Rapids, 16 throughout Stephens Lake, and two in the Long Spruce Forebay (Figures 4, 5, and 6). Two receivers were deployed at new sites in 2013/2014, one in Gull Lake (#122862; river kilometer [rkm] -12.9), and one in Stephens Lake (#114233; rkm 32) (Figures 4 and 5).

3.1.2.2 OPEN-WATER 2014

An array of 50 receivers were used during the 2014 open-water period (1 May to 12 October 2014). Twenty-four were set between Clark Lake and Gull Rapids, one in Gull Rapids proper, and 22 in Stephens Lake (Figures 7 and 8). Three additional receivers were placed in the Long Spruce Reservoir (Figure 9). No receivers were set at new deployment locations.

Receiver “gates” were deployed in several key areas: four between Clark Lake and Gull Rapids (44, 34, 19, and 10 rkms upstream of Gull Rapids), and two in Stephens Lake (4.5 and 40 rkms downstream of Gull Rapids) (Figures 7 and 8). Receiver “gates” consisted of two or more acoustic receivers set parallel to flow to provide complete signal coverage¹ of a river cross-section. Areas between the “gates” were referred to as river zones. The area upstream of Gull Rapids was divided into five zones (Figure 7), while Stephens Lake was divided into two zones (Figure 8). Gate locations were consistent with the 2013 open-water study period, and divided the river into the same zones. On 12 October 2014, the majority of receivers were removed and a subset (n = 22) were redeployed to monitor movements during winter 2014/2015.

¹Coverage refers to relocation coverage, in that all tagged fish passing through receivers are detected.

3.1.3 DATA ANALYSIS

To filter out false relocations, a Lake Sturgeon was required to be detected at least two times within a 30-minute interval at a given stationary receiver for the detections to be deemed valid. Single detections were filtered and not used in the analyses.

Movements were analysed in terms of rkm distance, with the base of Gull Rapids representing a distance of 0 rkm. The area located downstream of Gull Rapids (*i.e.*, Stephens Lake and the Long Spruce Forebay) was considered positive (+), while the area located upstream (*i.e.*, Gull and Clark lakes) was considered negative (-) (Figures 10 and 11). The average rkm distance from Gull Rapids was calculated over a 4-hour interval and plotted versus time for each fish. Total relocation ranges were calculated by subtracting the furthest downstream detection location from the location of the furthest upstream detection. Proportion of time all fish spent within each river zone was calculated and plotted.

4.0 RESULTS

Tables 1 through 3 provide acoustic tagging and biological information associated with each tagged fish. Figures 1 to 20 provide maps of release locations, movement range, and proportional distribution of tagged fish both upstream and downstream of the construction site by season. Appendix A1 provides detection summaries, while appendices A2 through A4 provide movement summaries, by rkm, for each tagged sturgeon since the study began in June 2011.

4.1 WINTER 2013/2014

4.1.1 UPSTREAM OF GULL RAPIDS

Thirty-one fish were tagged upstream of Gull Rapids in 2011 and 2012 (Table 1), but, since that time, several tags are considered missing:

- #16045 has not been relocated since 18 August, 2011. It moved downstream immediately after tagging and displayed few upstream movements (Appendix A2-5).
- #16058 was tagged downstream of Birthday Rapids (rkm -30.2) in 2011. It was last detected in the riverine portion of the Nelson River near Birthday Rapids on 5 August, 2012 (Appendix A2-12).
- #16064 was regularly detected in Gull Lake from the date it was tagged (12 June, 2011) to 21 June, 2012 (Appendix A2-18) and has not been detected since that time.
- #16067 was tagged in Gull Lake on 19 June, 2011. It remained in this area until 27 May, 2012, when it moved upstream through Birthday Rapids into Clark Lake. It was last detected in Clark Lake on 29 June, 2012. It is likely this fish continued to move upstream past the receiver array (Appendix A2-21).
- #16075 moved downstream immediately after tagging on 10 June, 2011. It was last detected on 27 June, 2011 (Appendix A2-29).
- #16077 moved downstream immediately after tagging on 10 June, 2011. It was last detected on 21 June, 2011, (Appendix A2-31).

These six missing fish are not discussed in the remainder of this report. Potential reasons that these transmitters are missing include tagging mortality, harvest, natural mortality, or tag shedding. Tagging mortality has been observed in other acoustic telemetry studies (also referenced in Adams et al. 2006 and McDougall et al. 2013).

Prior to winter 2013/2014, six fish had moved upstream through Gull Rapids from Stephens Lake:

- #16025 was tagged in Stephens Lake on 16 June, 2012, and moved upstream through Gull Rapids on 22 August, 2012 (Appendix A3-6).
- #16029 was tagged in Stephens Lake on 21 June, 2011, and moved upstream through Gull Rapids between 29 July and 2 August, 2011 (Appendix A3-9).
- #16033 was tagged in Stephens Lake on 18 June, 2011, and moved upstream through Gull Rapids on 28 July, 2012. However, shortly after, it was captured by a local resource user and the tag was returned and later reapplied in Stephens Lake (Appendix A3-13 and highlighted green in Appendix A1-2).
- #16037 was tagged in Stephens Lake on 8 June, 2011, and moved upstream through Gull Rapids between 3 and 6 September, 2013 (Appendix A3-16).
- #16038 was tagged in Stephens Lake on 12 June, 2011, and moved upstream through Gull Rapids on 12 September, 2013 (Appendix A3-17).
- #16046 was tagged in Stephens Lake on 11 June, 2011, and moved upstream through Gull Rapids between 27 June and 4 July, 2012 (Appendix A3-22).

Therefore, accounting for the 31 originally tagged, the six missing tags (highlighted yellow in Appendix A1-1), the six sturgeon that moved upstream through Gull Rapids from Stephens Lake (highlighted blue and green in Appendix A1-2), subtracting the one that was confirmed harvested (highlighted green in Appendix A1-2), a total of 30 sturgeon were available to be detected upstream of Gull Rapids during winter 2013/2014.

All four stationary acoustic receivers deployed upstream of Gull Rapids over winter 2013/2014 were retrieved (Figure 4). Of the 30 sturgeon available to be detected, 245,234 detections from 19 fish were logged, ranging from 502 to 33,086 detections per individual (Appendix A1-1). Fish were relocated on 4 to 142 days of the 196 day winter period (2 to 72% of the time; Appendix A1-1). Median movement range was 0.0 rkm (range: 0.0-3.0 rkm) (Figure 12; Appendix A1-1 and A1-2). Eleven of the available 30 fish were not detected.

Sturgeon were detected by one or two receivers as follows (Appendix A1-1):

- One (#16048) was relocated only at the upstream end of Clark Lake (rkm -48.2) for 66 days;
- One (#16069) was relocated only at rkm -29.4 for four days;
- Three (#16036, and #16038, and #16070) were relocated only in Gull Lake at rkm -12.9 for 52, eight, and 118 days, respectively;
- Nine (#16025, #16056, #16060, #16061, #16062, #16063, #16068, #16071, and #16073) were relocated only in Gull Lake at rkm -9.9 for between 18 and 137 days; and
- Five (#16037, #16039, #16051, #16054, and #16072) were relocated at both receivers in Gull Lake (rkms -12.9 and -9.9).

Individual Lake Sturgeon movements are summarized graphically in Appendix 2.

4.1.2 STEPHENS LAKE

Twenty-eight fish were originally tagged downstream of Gull Rapids in 2011 and 2012 (Table 1), however, since that time, six fish have moved upstream through Gull Rapids (section 4.1.1). As previously discussed, one of these fish (#16033) was captured by a local resource user, and the tag was re-applied in Stephens Lake. In addition, two fish have moved downstream through the Kettle GS into the Long Spruce Reservoir (highlighted in red in A1-2):

- #16021 was tagged in Stephens Lake on 28 September, 2011, and moved downstream through the Kettle GS on 16 September, 2012 (Appendix A4-1).
- #16034 was tagged in Stephens Lake on 18 June, 2011, and moved downstream through the Kettle GS between 9 October, 2012, and 10 June, 2013 (Appendix A4-2).

Four fish are considered missing (highlighted in yellow in A1-2):

- #16018 moved downstream immediately after tagging on 13 June, 2012. It was last detected on 2 July, 2012, immediately upstream of Kettle GS (Appendix A3-1) (See the discussion for further details on this fish).
- #16024 moved downstream immediately being tagged on 13 June, 2012. It was last detected on 25 June, 2012 (Appendix A3-5).
- #16044 moved downstream immediately after being tagged on 9 June, 2011. It was last detected on 17 September, 2012 (Appendix A3-21).
- #16047 moved downstream immediately after tagging on 26 June, 2011. It was last detected on 28 June, 2011 (Appendix A3-23).

Thus 17 fish were available to be detected in Stephens Lake during winter 2013/2014.

Thirteen of 16 receivers deployed in Stephens Lake during winter 2013/2014 were retrieved. Three receivers, located at rkms 26.0, 32.0, and 40.8 could not be retrieved due to the buildup of large woody debris around the receiver (Figure 5). In total, 241,235 detections from all 17 fish were logged, ranging from 2,111 – 45,513 detections per individual (Appendix A1-2). Thirteen (76%) were detected at least once in upper Stephens Lake (rkms 6.1 to 7.9), and four (24%) were detected as far downstream as rkm 21.0 (Figure 13). Median movement range was 8.8 rkm (range: 0.0 – 14.9) (Figure 13; Appendix A1-2).

Fish displayed four distinct patterns of movement, illustrated in Figure 14:

- Five (#16022, #16027, #16030, #16032, and #16041) were detected exclusively in the upper portion of Stephens Lake (no further downstream than rkm 10.2) (Appendix A1-2).
 - Three (#16027, #16030, and #16032) were detected sporadically (between 24 and 63 days):
 - #16027 was relocated between rkm 6.1 and 7.7 from 6 to 27 November, 2013, and again from 3 and 10 March, 2014 (Appendix A3-7).

- #16030 was detected as far downstream as rkm 14.9 on 17 October, 2013, but moved upstream to rkm 7.7 on 18 October, 2013. It was relocated between rkms 6.1 and 10.2 sporadically for the remainder of the winter (Appendix A3-10).
- #16032 was relocated between rkm 6.1 and 10.2 for the month of October, 2013. It was next relocated at rkm 10.2 on 12 January, 2014. It remained in this location until the end of February, 2014 (Appendix A3-12).
- The two remaining fish were detected for the majority (between 83 and 153 days) of the winter 2013/2014 period.
 - #16022 was relocated between rkm 6.1 and 7.7 from 16 to 19 October, 2013. It was then relocated at rkm 10.2 for the remainder of the study period (Appendix A3-4).
 - #16041 moved between rkms 7.7 and 10.2 for the entire winter period (Appendix A3-19).
- Four Lake Sturgeon (#16031, #16043, #16050, and #16052) were detected exclusively by receivers located downstream of rkm 10.2:
 - Two fish (#16031 and #16052) were relocated exclusively at rkm 14.9 for 147 and 173 days, respectively; and
 - Two fish (#16043 and #16050) were relocated between rkms 10.2 and 21.0 for 114 and 50 days, respectively.
- Seven Lake Sturgeon exhibited some degree of movement between upper and lower Stephens Lake (rkms 6.1 and 21.0):
 - Two (#16020 and #16053) were mainly relocated within lower Stephens Lake:
 - #16020 was detected between rkm 6.1 and 10.2 from 19 to 24 October, 2013. It was then relocated at rkm 14.9 on 2 November, 2014, and remained at this location for the rest of the study period (Appendix A3-3). Overall, it was relocated on 102 days of the 196 day study period.
 - #16053 was detected between rkm 6.1 and 7.7 between 16 and 19 October, 2013. It moved into lower Stephens Lake on 30 November, 2013, and was relocated at rkm 21 on 12 December, 2013. It was relocated for 20 days of the study period (Appendix A3-27).
 - Two (#16035 and #16049) were mainly relocated within upper Stephens Lake:
 - #16035 moved as far downstream as rkm 18.7 on 19 October, 2013, but was relocated no further downstream than rkm 10.2 for the remainder of the study period (Appendix A3-15). It was relocated for a total of 179 days of the 196 day period.
 - #16049 was detected at rkm 14.9 until 25 October, 2013, after which it was relocated no further downstream than rkm 10.2 (Appendix A3-24).
 - Three (#16019, #16028, and #16040) were detected sporadically (8 to 33 days) during the study period :

- #16019 was detected between rkms 6.1 and 14.9 sporadically from 16 October, 2013, to 4 January, 2014 (Appendix A3-2).
- #16028 moved between rkms 6.1 and 21 from 16 to 28 October, 2014 (Appendix A3-8).
- #16040 was detected between rkm 6.1 and 10.2 from 16 to 19 October, 2013. It was relocated at rkm 14.9 on 22 March, 2014. It remained in this location until 7 April, 2014 (Appendix A3-18).
- A single fish (#16033b) moved into the former channel of the Moosenose River in the upper reaches of Stephens Lake from 16 October to 26 November, 2013. It was then relocated in the upper portion of Stephens Lake (rkms 7.9 to 13.4) for the remainder of the winter period (Appendix A3-14).

Given the frequency of detections, it does not appear that any Lake Sturgeon left the southern riverine portion of Stephens Lake and moved into the north arm. Individual Lake Sturgeon movements are summarized graphically in Appendix 3.

4.1.3 LONG SPRUCE RESERVOIR

The single receiver set in the Long Spruce Reservoir was retrieved (Figure 6). However, neither of the two Lake Sturgeon (#16021 and #16034) last detected in this area were relocated during winter 2013/2014 (Appendix 4).

4.2 OPEN-WATER 2014

4.2.1 ACOUSTIC TAGGING

As previously discussed, 11 adult Lake Sturgeon were implanted with acoustic transmitters in spring 2014, $n = 4$ upstream of the GS construction site and $n = 7$ in Stephens Lake. Transmitters were applied upstream of the GS on 18 June, 2014. Fish had a mean fork length of 1,034 mm (range: 843 – 1,236 mm) and a mean weight of 12,360 g (range: 4,082 – 22,226 g) (Table 2). Fish were released along the north shore of Gull Lake (at rkm -10.9; Figure 3).

Transmitters were applied to seven adult Lake Sturgeon in Stephens Lake between 11 and 13 June, 2014. Fish had a mean fork length of 904 mm (range: 810 – 1,095 mm) and a mean weight of 5,443 g (range: 4,082 – 9,526 g) (Table 3). Fish were released near the north shore approximately 1 rkm downstream of Gull Rapids (Figure 3).

4.2.2 ACOUSTIC RECEIVER RETRIEVAL

All stationary acoustic receivers were successfully retrieved from upstream of the GS construction site (24), Stephens Lake (22), and the Long Spruce Reservoir (3) at the end of the open-water study period (Figures 7, 8, and 9). The receiver set within Gull Rapids was lost (Figure 8).

4.2.3 ADULT LAKE STURGEON MOVEMENTS

4.2.3.1 UPSTREAM OF GULL RAPIDS

With the addition of four tags (section 4.1.1), 34 fish were available to be detected upstream of Gull Rapids during the 2014 open-water period. Thirty-three of these were detected 2 – 23,121 times for 1 – 129 days of the 167 day study period (1 – 77% of the time; Appendix A1-3). The mean total movement range was 12.1 rkm (StDev = 12.2 rkm; range: 0.0 – 60.4 rkm) (Figure 15; Appendix A1-3). Three (9%) were detected as far upstream as the inlet to Clark Lake (rkm - 48.1), while nine (27%) were relocated as far downstream in Gull Lake as rkm -5.8 (Figure 15; Appendix A1-3). Two fish moved downstream through Gull Rapids. One moved as far downstream as rkm 14.9 in Stephens Lake, while the other moved downstream through the Kettle GS as far downstream as rkm 47.5 in the Long Spruce Reservoir.

A single fish (#16046) last detected in 2013 was not relocated in 2014. This fish moved upstream from Stephens Lake in 2012. It was relocated in Gull Lake until 7 June, 2013. It was likely harvested by a local resource user.

Individual Lake Sturgeon used Zone 4 (central basin of Gull Lake) most frequently, spending an average of 52% of time (StDev = 32%; range: 0 – 100%) in this area (Figures 16 and 17). Zone 5 (lower basin of Gull Lake) was also frequently used (28% of the time) (StDev = 23%; range: 0 – 83%). Zones 1 (Clark Lake) and 3 (river reach Birthday Rapids to Gull Lake) were used nearly equally, while Zone 2 (river reach Clark Lake to Birthday Rapids) was rarely used: Zone 1 (9%) (StDev = 28%; range: 0 – 100%), Zone 2 (0.1%) (StDev = 0.6%; range: 0 – 3%), and Zone 3 (11%) (StDev = 30%; range: 0 – 100%) (Figures 16 and 17). Qualitatively, there was no detectable change in distribution among zones after the beginning of Keeyask construction on 15 July, 2014.

Habitual movements were displayed by three groups of fish, illustrated in Figure 18:

- Three fish remained within the riverine area between Clark Lake and Gull Lake and have been relocated exclusively within this area since the study began in 2011:
 - #16026 was relocated exclusively at rkm -26.5 for 103 days (Appendix A2-1);
 - #16062 moved between rkms -29.4 and -26.5. It was relocated for 129 days during the study period (Appendix A2-16); and

- #16074 moved as far upstream as rkm -33.8 (immediately downstream of Birthday Rapids), and as far downstream as rkm -26.5 over 23 days (Appendix A2-28).
- Three fish remained within Clark Lake:
 - #16042 moved between the inlet (rkm -48.1) and the outlet (rkm -44.5) of the lake. It was relocated for 54 days of the open-water period (Appendix A2-4);
 - #16048 was relocated within Clark Lake from 5 May to 6 September, 2014, after which it moved downstream through Birthday Rapids. Overall, it was relocated for 98 days (Appendix A2-6); and
 - #16057 was detected briefly (1 day) at the lake's inlet (rkm -48.2), suggesting that it likely moved upstream out of the receiver array into Split Lake (Appendix A2-11).
- Twenty-five fish were relocated only within Gull Lake:
 - Six (#16059, #16060, #16061, #16065, #32175, and #32177) remained within lower Gull Lake and were detected only between rkms -5.8 and -12.9 for 39 – 109 days (Appendix 2).
 - Eighteen were detected throughout Gull Lake as far upstream as rkm -19.4 and as far downstream as rkm -5.8.
 - Sixteen made multiple upstream and downstream movements throughout Gull Lake.
 - Two (#16029 and #16066) made single, distinct upstream movements during spring:
 - #16029 moved upstream to rkm -19.4 from lower Gull Lake on 9 June, 2014. It remained in this area until 24 June, 2014 (Appendix A3-9).
 - #16066 moved to the same area on 10 June and remained until 12 June, 2014 (Appendix A2-20).
 - After returning to Gull Lake, both fish remained between rkms -12.9 and -9.0 until the end of the study period.
 - One fish (#32174) was relocated throughout Gull Lake, but moved upstream to Birthday Rapids (rkm -33.8) on 7 July, 2014. It moved downstream to Gull Lake on 12 July, 2014, and was relocated throughout the lake until the end of the study period (Appendix A2-32).

Two sturgeon (#16025 and #16037) that were tagged in Stephens Lake and previously moved upstream through Gull Rapids into Gull Lake moved back downstream through Gull Rapids in 2014.

- #16025 was tagged in Stephens Lake in June, 2012, and moved upstream into Gull Lake in August, 2012. At the time of tagging it measured 1,176 mm fork length and weighed 14,969 g (Table 3). Through the remainder of 2012 and 2013 it remained in Gull Lake being relocated as far upstream as rkm -19.4 (the inlet to Gull Lake) and as far downstream as rkm -5.8. It was first relocated in Stephens Lake on 18 June, 2014. It then displayed rapid downstream movement, moved downstream through the Kettle GS and was first relocated in

the Long Spruce Reservoir on 5 July, 2014. Upstream movements were observed within the Long Spruce Reservoir between rkms 42.7 and 43.5 indicating that the fish survived passage through the GS. This fish was not relocated after 14 July, 2014 (Appendix A3-6).

- #16037 was tagged in Stephens Lake on 8 June, 2011 (Table 3). It moved upstream into Gull Lake on 7 September, 2013, moving as far upstream as (rkm -29.4). It was relocated within Gull Lake at the beginning of the open-water 2014 study period, and moved upstream to Birthday Rapids (rkm -32.3) remaining in the area from 5 to 14 June, 2014. It then moved downstream and was relocated in Stephens Lake on 1 July, 2014. It remained largely within upper Stephens Lake for the remainder of the study period (Appendix A3-16).

These two fish represent the first downstream movements through Gull Rapids observed since the inception of this study in 2011. A summary of all observed movement through Gull Rapids by adult Lake Sturgeon tagged with radio or acoustic tags since 2001 is provided in Table 4. This summary includes data from the current study (2011 – 2014), 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).

Individual Lake Sturgeon movements are summarized graphically in Appendix 2.

4.2.3.2 STEPHENS LAKE

Seven fish were tagged in Stephens Lake in 2014, adding to the 17 fish remaining in this area (section 4.1.2) at the onset of the open-water 2014 period. Thus 24 fish were available to be detected in Stephens Lake during open-water 2014. All twenty-four fish were relocated in Stephens Lake between 614 and 36,691 times, over 20 – 121 days of the 167 day study period (12 – 72% of the time) (Appendix A1-4). Mean movement range was 18.3 rkm (StDev = 7.1 rkm; range: 2.4 – 39.5 rkm) (Figure 19; Appendix 1-4). Fourteen fish (58%) were detected as far upstream as the base of Gull Rapids at rkm 0.5, and a single fish (#16049) was detected as far downstream as rkm 27.9 (Appendix A1-4).

Lake Sturgeon used zone 2 more frequently than zone 1, spending 62% (StDev = 24%; range: 0 – 89%), and 38% (StDev = 24%; range: 11 – 100%) of the study period in each zone, respectively (Figures 20 and 21). However, utilization of the zones changed throughout the course of the open-water period. As in 2013, a greater proportion of fish were detected close to Gull Rapids during the middle of the study period than at the beginning or the end:

- Zone 1 was used an average of 41% of the time (StDev = 12%; range: 17-67%) between 20 June and 30 August, 2014;
- 26% (StDev = 15%; range: 11 – 78%) of the time from 14 June and 19 July, 2014; and
- 36% of the time (StDev = 8%; range: 11 – 44%) between 1 September and 3 October, 2014 (Figure 20).

After the beginning of Keeyask construction on 15 July, 2014, five fish (#16022, #16049, #16053, #32169, and #32170) were relocated by the receiver immediately downstream of Gull Rapids (#125104; rkm 0.5) for 1 – 5 days (Appendix 1-4).

Two general movement patterns were displayed, illustrated in Figure 22:

- Eight fish remained exclusively within the upper portions of Stephens Lake, moving only as far downstream as rkm 14.9:
 - Two (#16027 and #16041) were detected for short periods of time within the upper reaches of Stephens Lake in the former channel of the Moosenose River. Both fish were relocated briefly at receiver #114227 (Figure 8).
 - #16027 was detected four times on 8 August, 2014 (Appendix A3-7).
 - #16041 was detected 228 times between 21 and 27 July (Appendix A3-19).
 - Six (#16031, #16043, #16050, #32169, #32172, and #32173) remained within the southern portion of Stephens Lake and were relocated between 20 and 118 days (Appendix A1-4).
 - Sixteen fish moved throughout Stephens Lake:
 - Nine made regular upstream and downstream movements throughout the southern portion of Stephens Lake.
 - Three (#16028, #16040, and #32171) moved as far downstream as rkm 18.7.
 - Six (#16020, #16022, #16052, #16053, #32168, and #32170) moved as far downstream as rkm 21.0.
 - There were no observable patterns of movements among these fish.
 - Seven were detected for short periods of time within the former channel of the Moosenose River in the upper reaches of Stephens Lake.
 - #16032 and #16033b were detected by receiver #114227 (Figure 8) 671 and 1553 times, respectively, between 2 June and 8 July, 2014 (Appendix A1-4).
 - #16019 and #16035 were detected further downstream at receiver #7778 (Figure 8).
 - #32167 was relocated at receiver #4079 (Figure 8).
 - #16030 and #16049 were relocated by all four acoustic receivers within the upper reaches of Stephens Lake.

Individual Lake Sturgeon movements are summarized graphically in Appendix 3.

4.2.3.3 LONG SPRUCE RESERVOIR

One of two² fish last detected in the Long Spruce Reservoir was relocated. Lake Sturgeon #16034 was detected by all three acoustic receivers. This fish remained at the furthest

² Both fish were originally tagged in Stephens Lake and move downstream through Kettle GS in 2012.

downstream receiver (rkm 47.5) between 26 May and 18 June 2014. It was then relocated at the two upstream acoustic receivers, logging 25,093 detections between 29 June and 10 October 2014 (for 99 days) (appendices A1-4 and A4-2).

Lake Sturgeon #16021 was last detected in the Long Spruce Reservoir on 18 September 2012 (Appendix A4-1).

5.0 DISCUSSION

The main objective of this long-term (10 year) movement study was to monitor movements of adult Lake Sturgeon prior to, during, and following construction of the Keeyask GS to assess their response to construction and operation of the GS. More specifically, the study aims to monitor the potential effects associated with the construction and operation of the GS that may include increased emigration of adults from the population (through either an avoidance response to disturbances such as noise and blasting at the construction site; or as a response to altered water levels and flows associated with impoundment), increased mortality at the GS structure through either entrainment or impingement, and annexation and/or obstruction of critical habitats needed to complete their lifecycle. Movements of individual fish have now been monitored for approximately three and a half years, three years prior to construction and for three months following the start of construction in mid-July 2014. 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 on Lake Sturgeon and their movements.

Overall, acoustic telemetry has proven effective at monitoring movements of adult Lake Sturgeon in this study area. Despite difficulties in monitoring during winter (*i.e.*, deploying receivers and signal reception) the size and extent of the study area which prevents complete coverage, and the habitat characteristics associated with the Nelson River (*i.e.*, high water velocities and turbulent flows) which limit the detection range of each receiver, a considerable quantity of data has been collected on most fish. In terms of monitoring long distance movements and movements through rapids or generating stations, the system has performed extremely well.

Although the three and a half years of movement monitoring that have been completed to date might represent a substantial portion of the life history of many species, it represents a small fraction of a sturgeon's lifespan (60+ years) and may not include spawning by all adult fish. Seasonally, winter movements are limited in terms of extent and frequency, and although not directly comparable (due to the number of receivers deployed), the extent and frequency of sturgeon movement in Stephens Lake is greater relative to Gull Lake. This may be due to the greater extent of contiguous deep-water habitat, which has been suggested as a factor influencing movement extent of juvenile Lake Sturgeon from this area (McDougall et al. 2013). Limited winter movements have been observed from a large number of populations (Harkness and Dymond 1961; Hay-Chmielewski 1987; Rusak and Mosindy 1997; Labadie 2011). During the open-water period, sturgeon appear to be habitual in their movement patterns, with individual fish occupying similar areas year after year. For example, two distinct groups of sturgeon have been observed: those that consistently use riverine habitats in the reach between Birthday Rapids and Gull Lake, and those that prefer lacustrine habitats in either Clark or Gull lakes. Outside of spring, when the fish may be spawning, these fish have rarely moved outside of their "preferred" area. In Lake of the Woods, Rusak and Mosindy (1997) also observed a

similar pattern in individual Lake Sturgeon that were habitual in their use of either lacustrine or riverine habitat types.

Long distance movements that perhaps do not fit a habitual pattern have also been observed. However, with continued monitoring these movements might also be classified as habitual. Six fish have moved from Stephens to Gull Lake and, of these, two returned to Stephens Lake. Four fish moved upstream into Clark Lake, where three remain. A single fish appears to have moved upstream past Clark Lake outside the receiver array. Three fish are confirmed to have moved downstream past the Kettle GS and survived passage (fork lengths ranged from 796 to 1,176 mm), including a single fish that moved upstream from Stephens Lake into Gull Lake, and subsequently downstream through Gull Rapids into Stephens Lake, continuing downstream through the Kettle GS. A fourth fish (#16018), measuring 851 mm FL, is considered missing (Section 4.1.2), but is suspected to have passed or attempted passage through the Kettle GS. This fish was last detected by receivers immediately upstream of the Kettle GS in July 2012, and because it has not been detected since, it is possible that fish attempted passage and did not survive. However, it is also possible that the fish moved downstream past the receivers in the Long Spruce Reservoir undetected. In 2015, attempts will be made to locate this fish by manual tracking in the Long Spruce Reservoir and, if unsuccessful, further attempts will be made in the Limestone Reservoir.

Understanding the frequency of adult Lake Sturgeon movement through Gull Rapids has been the impetus for several initiatives aimed at studying Lake Sturgeon movement since 2001 (Barth and Mochnacz 2004; Barth 2005; Barth and Murray 2005; Barth and Ambrose 2006; Hrenchuk and McDougall 2012; Hrenchuk and Barth 2013; Hrenchuk and Barth 2014). Results of acoustic/radio telemetry suggest that upstream movement through Gull Rapids may be more frequent relative to downstream movement. Over eight years of monitoring, nine fish moved upstream from Stephens Lake (0 – 30% of fish monitored each year) while four have moved downstream (0 – 6% of fish monitored each year). Based on these data, it can be concluded that the current downstream dispersal rate of adult Lake Sturgeon is ~2%. Conversely, juvenile Lake Sturgeon do not appear to move through Gull Rapids. The smallest Lake Sturgeon that has passed through the rapids in this study measured 826 mm FL, while no juveniles (450 – 668 mm FL) currently tracked in the Keeyask area ($n = 40$) have moved through. In the Winnipeg River, juvenile Lake Sturgeon rarely move through natural river constrictions or small sets of rapids, even in the downstream direction, and this behaviour appears to be consistent with juveniles in this area (Barth et al. 2011; McDougall et al. 2013). As a large set of rapids, Gull Rapids likely represents an energetic barrier to juvenile Lake Sturgeon movements.

In the Population Viability Assessment model for the Lake Sturgeon population upstream of Gull Rapids with the Keeyask GS in place, a downstream dispersal rate through the GS of 4.5% was specified for all life stages. Based on the data described above, this estimate would appear higher, especially for juveniles, than the pre-project data would suggest. However, once Keeyask is built, it is possible that the frequency of movement may change and downstream movement could potentially increase.

Construction of the Keeyask GS began in July 2014, with cofferdams being constructed in the north and central channels of Gull Rapids from July to October. The key questions, as described in the AEMP, for adult movement monitoring during construction are as follows:

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

Baseline data suggests that few Lake Sturgeon in Gull Lake use habitat within 5 km of the upstream end of Gull Rapids. Therefore, disturbances associated with construction are minimal for sturgeon in this area. It is expected that effects of GS construction on sturgeon upstream of the GS may not occur until the reservoir is developed.

Downstream of the GS, baseline data (*i.e.*, prior to construction 2011 – 2013) suggest that Lake Sturgeon frequent the base of Gull Rapids throughout the open-water period, typically moving further downstream in fall. For this reason, sturgeon in this area could be directly impacted by increased TSS levels, blasting, or noise associated with construction of the GS. In 2014, sturgeon continued to frequent the base of Gull Rapids. Five were relocated in the north channel of the rapids, in the immediate vicinity of the Powerhouse Cofferdam, until fall, when they moved further downstream, as they have in previous years. One of five fish present in the area where the Powerhouse Cofferdam was constructed was no longer recorded after mid-September. However, it was not found within the Powerhouse Cofferdam when the area was searched with a handheld receiver before it was drained. This fish may have moved to a location where it cannot be recorded by the receivers, the tag may have failed, or it may have been harvested. Data collection in 2015 will confirm whether or not this fish is missing.

Given that only three months of movement data have been collected since construction at Keeyask began, an assessment of the impacts of construction on sturgeon habitat use and movement of adult Lake Sturgeon is premature. Qualitatively, there was not an obvious change in Lake Sturgeon movement, the frequency of long-distance movements or the use of habitat immediately downstream of Gull Rapids.

6.0 REFERENCES

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TABLES

Table 1: Number of acoustic transmitters applied to adult Lake Sturgeon in the Keeyask Study Area (upstream of Gull Rapids (GR) and in Stephens Lake) between June 2011 and October 2014.

Year	Upstream GR	Stephens Lake	Total
2011	30	19	49
2012	1	9	10
2013	-	1	1
2014	4	7	11

Table 2: Tagging and biological information associated with Lake Sturgeon implanted with acoustic transmitters upstream of Gull Rapids between 2011 and 2014.

Tag ID	Date Tagged	Tag Life (days)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex
16026	19-Jun-12	3650	955	1070	7711	-
16036	05-Jun-11	3650	1313	1414	20185	-
16039	05-Jun-11	3650	1425	1530	27216	F
16042	05-Jun-11	3650	956	1060	8165	M
16045	10-Jun-11	3650	1379	1533	21773	M
16048	07-Jun-11	3650	967	1103	9299	-
16051	10-Jun-11	3650	1386	1510	24494	-
16054	06-Jun-11	3650	816	915	5023	-
16055	06-Jun-11	3650	872	974	6350	M
16056	10-Jun-11	3650	1020	1120	9526	M
16057	16-Jun-11	3650	900	1024	7711	-
16058	09-Jun-11	3650	867	953	6124	-
16059	16-Jun-11	3650	1260	1385	16783	F
16060	21-Jun-11	3650	1060	1170	10433	-
16061	21-Jun-11	3650	805	901	3175	-
16062	12-Jun-11	3650	1176	1284	12247	-
16063	11-Jun-11	3650	1124	1229	10660	M
16064	12-Jun-11	3650	1066	1148	9072	M
16065	12-Jun-11	3650	958	1058	7484	-
16066	20-Jun-11	3650	1310	1405	25855	F
16067	19-Jun-11	3650	1090	1210	11340	-
16068	19-Jun-11	3650	1140	1254	11794	-
16069	17-Jun-11	3650	1400	1570	32659	-
16070	16-Jun-11	3650	1072	1195	10886	M
16071	16-Jun-11	3650	1026	1133	7711	M
16072	21-Jun-11	3650	850	967	6350	-
16073	12-Jun-11	3650	1169	1284	15422	M
16074	13-Jun-11	3650	915	1016	6804	M
16075	10-Jun-11	3650	1610	1700	43092	F
16076	16-Jun-11	3650	1260	1375	19958	-
16077	10-Jun-11	3650	1143	1245	12247	M
32174	18-Jun-14	3650	1172	1296	17690	-
32175	18-Jun-14	3650	843	951	4082	-
32176	18-Jun-14	3650	1236	1370	22226	-
32177	18-Jun-14	3650	886	1001	5443	-

Table 3: Tagging and biological information for Lake Sturgeon implanted with acoustic transmitters in Stephens Lake between 2011 and 2014.

Tag ID	Date Tagged	Tag Life (days)	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex
16018	13-Jun-12	3650	850	951	6577	M
16019	13-Jun-12	3650	894	991	6804	-
16020	08-Jun-12	3650	992	1100	-	M
16021	28-Sep-11	3650	880	977	6804	-
16022	13-Jun-12	3650	884	976	5216	M
16024	13-Jun-12	3650	906	1011	6804	-
16025	16-Jun-12	3650	1176	2956	14969	M
16027	15-Jun-12	3650	1120	2350	10433	M
16028	13-Jun-12	3650	1024	1145	8618	M
16029	21-Jun-11	3650	1208	1316	16556	F
16030	12-Jun-11	3650	1004	1103	7711	-
16031	13-Jun-12	3650	810	900	5443	-
16032	11-Jun-11	3650	1064	1159	11340	M
16033	18-Jun-11	3650	881	974	5443	-
16033b	16-Sep-13	3650	755	842	-	-
16034	18-Jun-11	3650	796	904	4082	-
16035	26-Sep-11	3650	941	1040	8165	-
16037	08-Jun-11	3650	826	911	-	-
16038	12-Jun-11	3650	1116	1239	11793	-
16040	09-Jun-11	3650	1006	1105	8391	M
16041	26-Jun-11	3650	903	1001	7257	-
16043	10-Jun-11	3650	790	885	4536	-
16044	09-Jun-11	3650	1161	1296	14969	M
16046	11-Jun-11	3650	1085	1209	9979	M
16047	26-Jun-11	3650	920	1020	6577	-
16049	24-Sep-11	3650	1070	1182	10886	-
16050	13-Jun-11	3650	922	1041	6577	-
16052	26-Sep-11	3650	1190	1337	16329	-
16053	26-Sep-11	3650	919	1021	8218	-
32167	11-Jun-14	3650	910	1015	4990	-
32168	11-Jun-14	3650	884	980	4990	-
32169	13-Jun-14	3650	810	908	4082	-
32170	11-Jun-14	3650	1095	2000	9526	M
32171	13-Jun-14	3650	880	976	4536	M
32172	13-Jun-14	3650	904	1050	5897	-
32173	13-Jun-14	3650	842	936	4082	-

Table 4: Number of Lake Sturgeon tagged with acoustic and radio tags that moved upstream or downstream through Gull Rapids during studies conducted in the Keeyask Study Ares in 2001-2004 and 2011-2014.

Life Stage	Year	# Tagged Fish		# Fish Detected		Downstream Movements			Upstream Movements			Total # Movements	% Tagged Fish Moved	% Detected Fish Moved
		U/S ¹	D/S ²	U/S	D/S	#	% of total	% of detected	#	% of total	% of detected			
Adult ³	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
Juvenile ⁴	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

1 – Upstream of Gull Rapids (between Clark Lake and Gull Rapids)

2 – Downstream of Gull Rapids (in Stephens Lake between Gull Rapids and the Kettle GS)

3 – Refers to fish >834 mm FL.

4 – Refers to fish <834 mm FL.

FIGURES

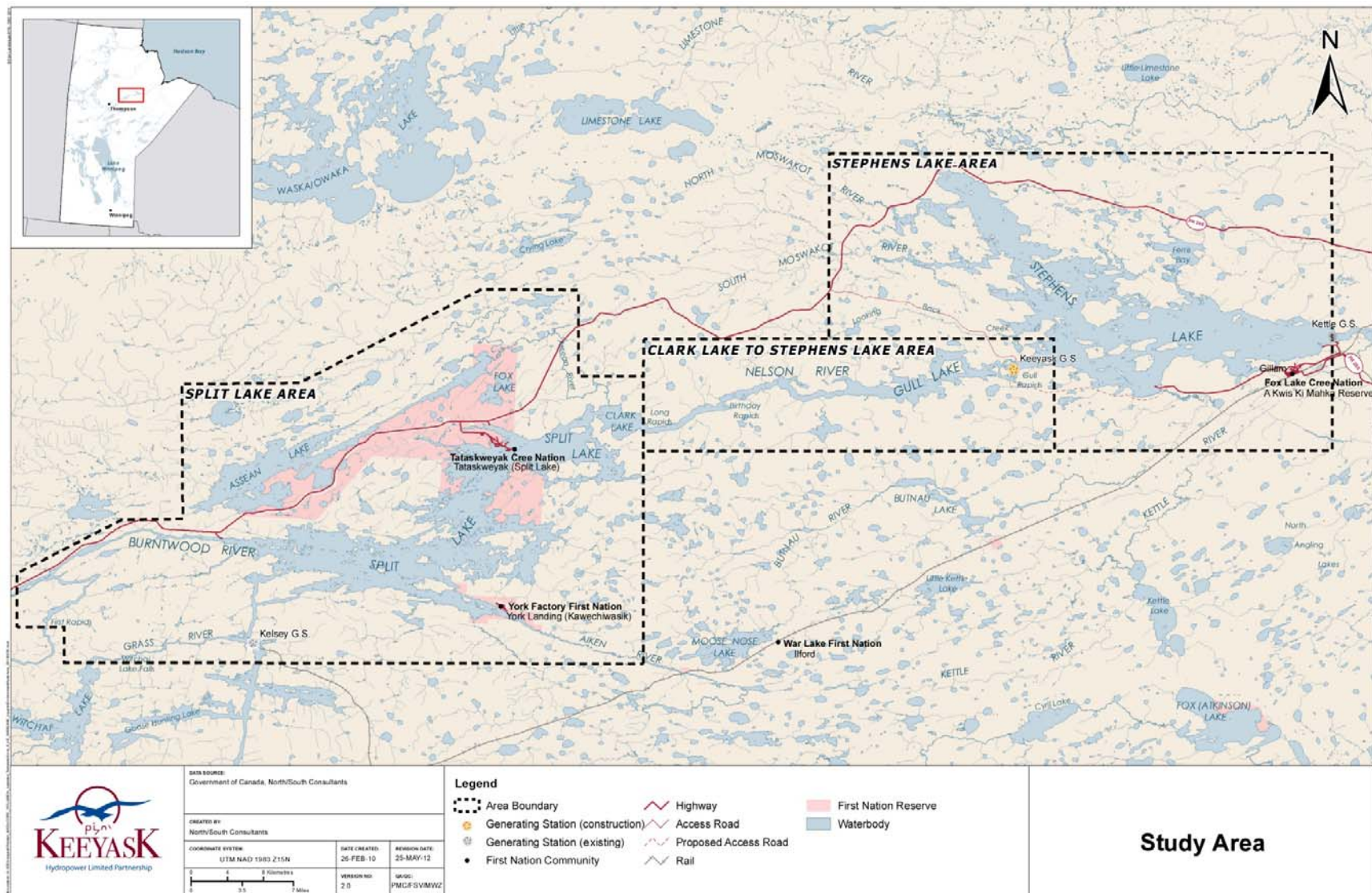


Figure 1: Map of the Keeyask Study Area showing hydroelectric development

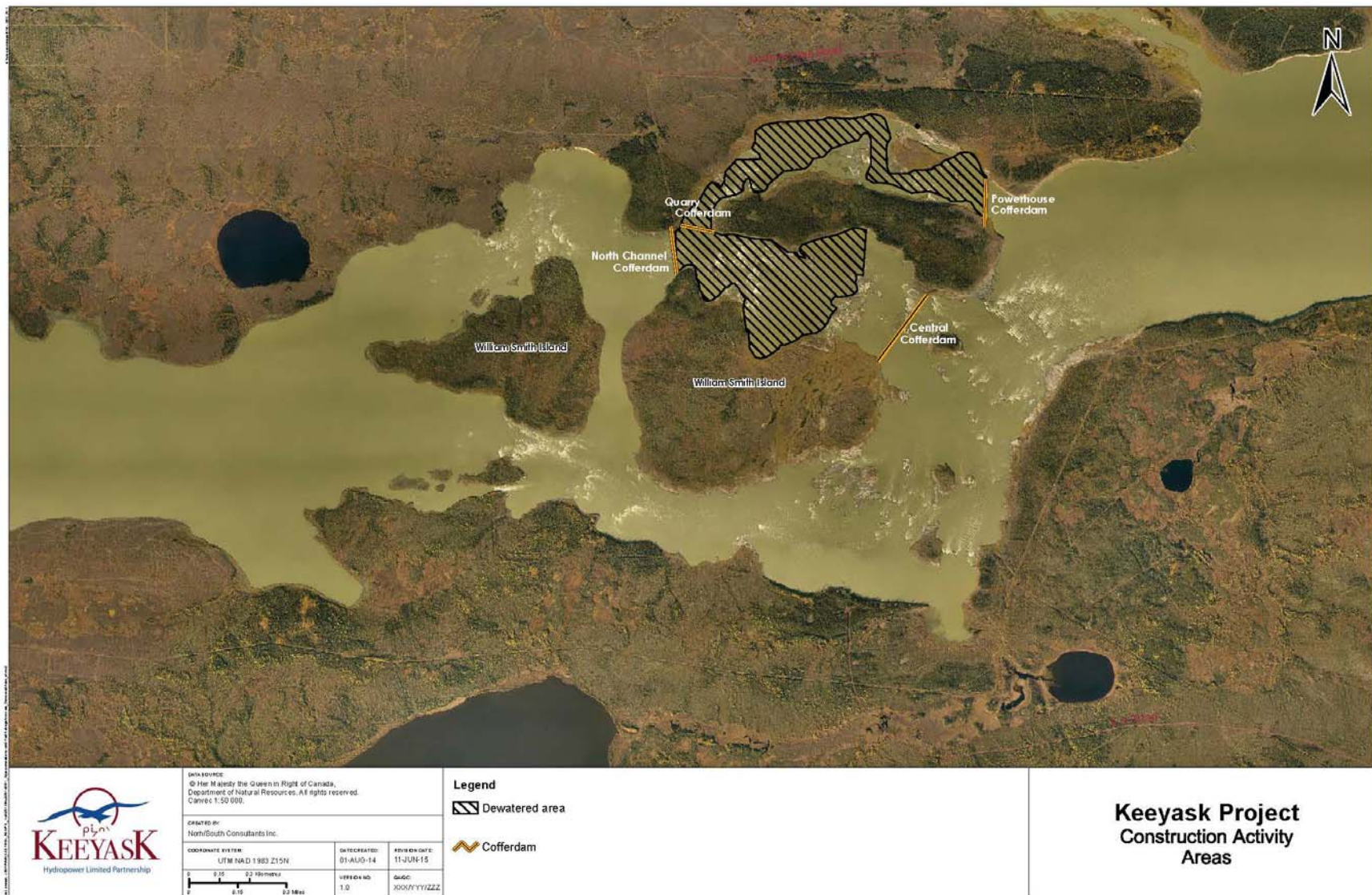


Figure 2: Locations of construction activities within the north and central channels of Gull Lake, July to October, 2014

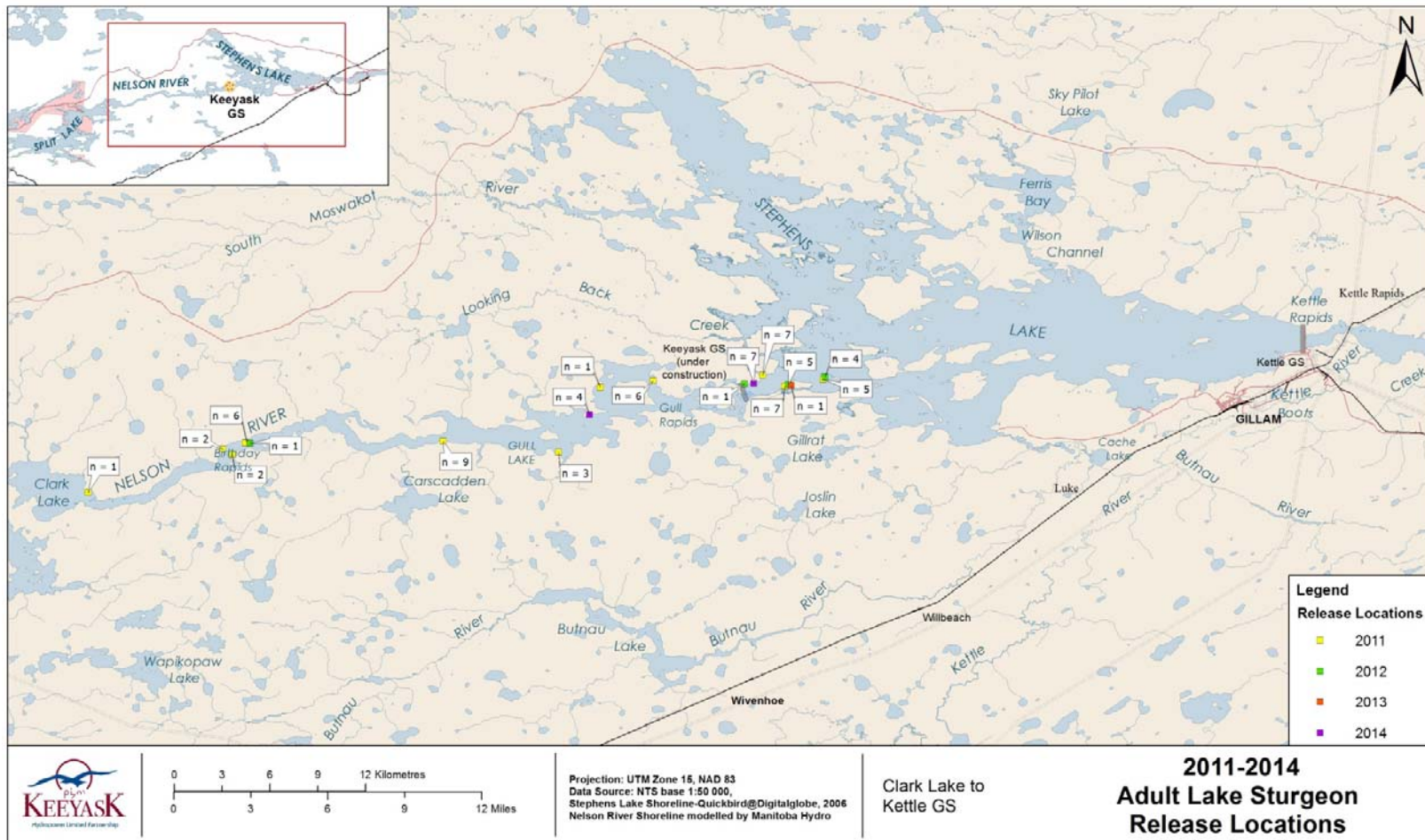


Figure 3: Release locations of Lake Sturgeon following acoustic transmitter application, 2011-2014

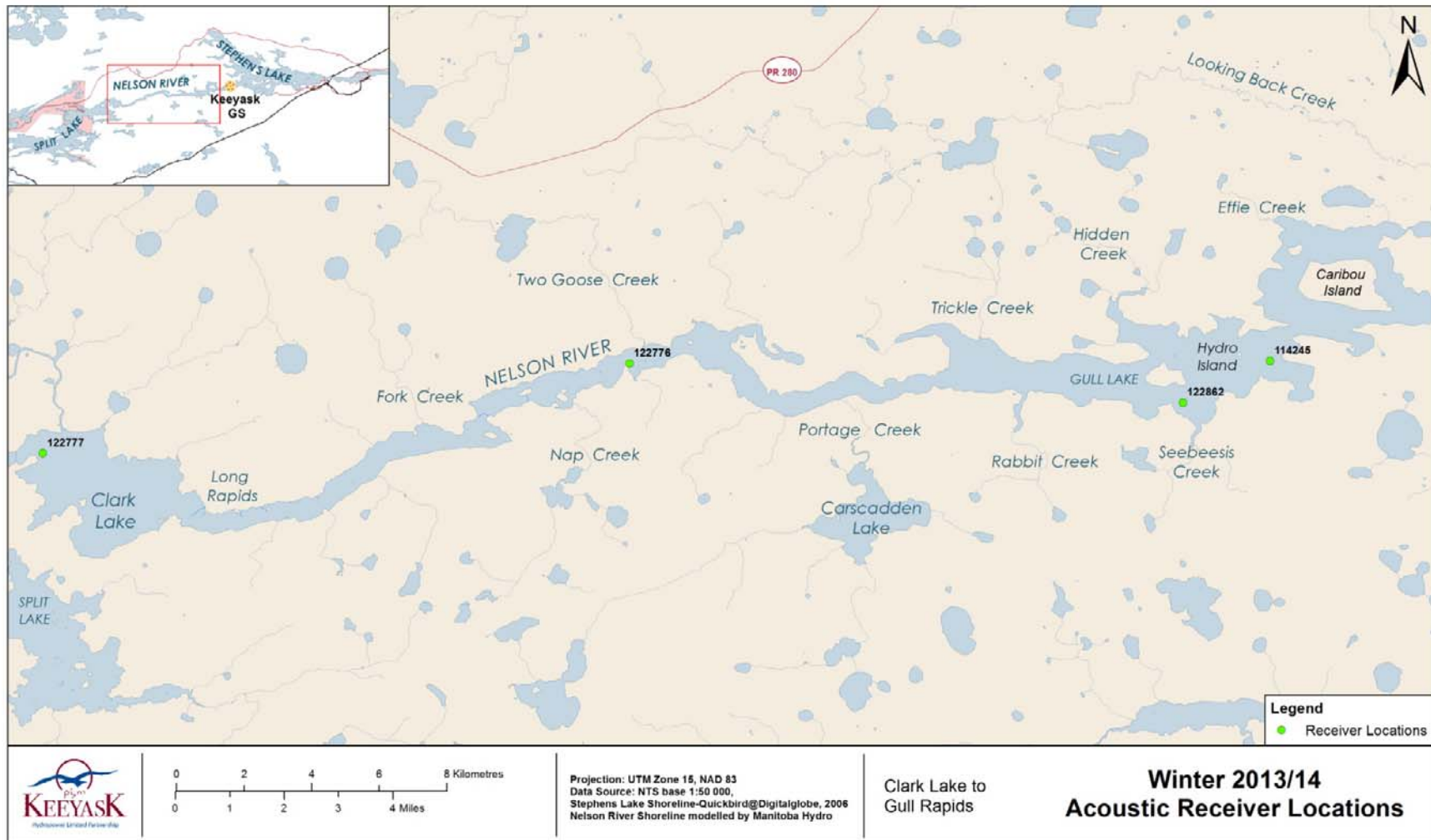


Figure 4: Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between October, 2013, and June, 2014

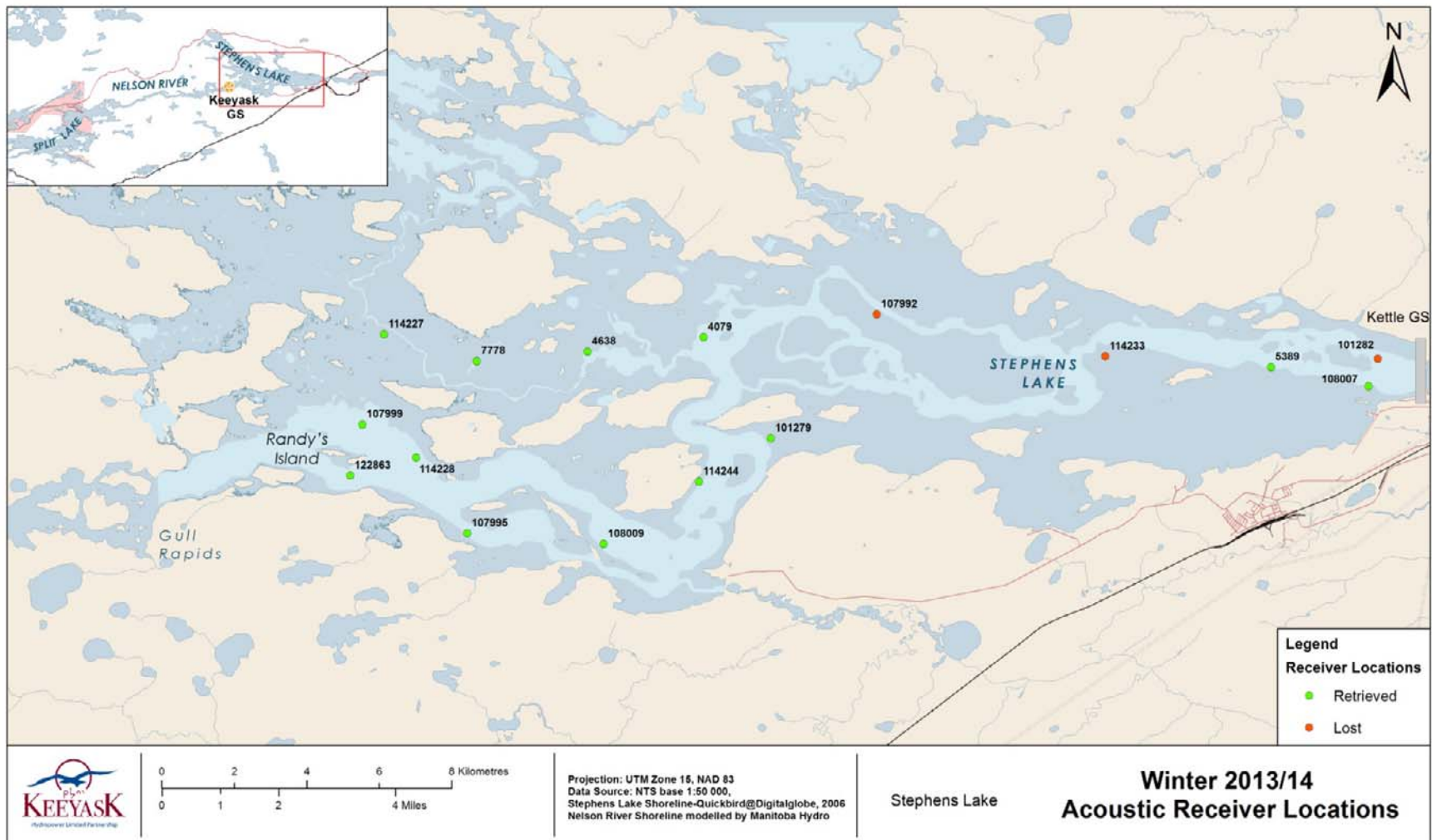


Figure 5: Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between October, 2013, and June, 2014. The former (pre-impoundment) river channel is shown in light blue

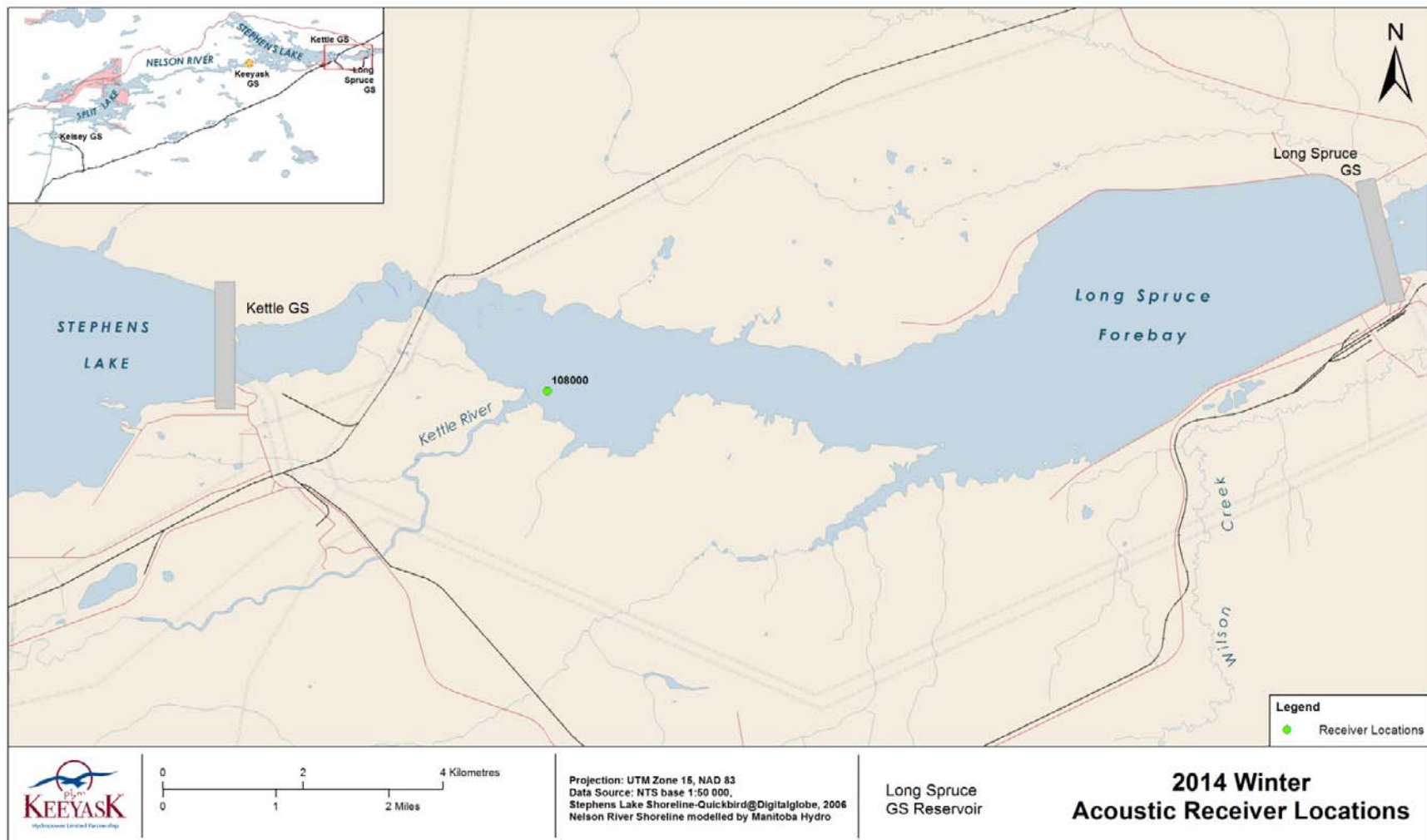


Figure 6: Locations of stationary receivers set in the Long Spruce Forebay between October, 2013, and June, 2014

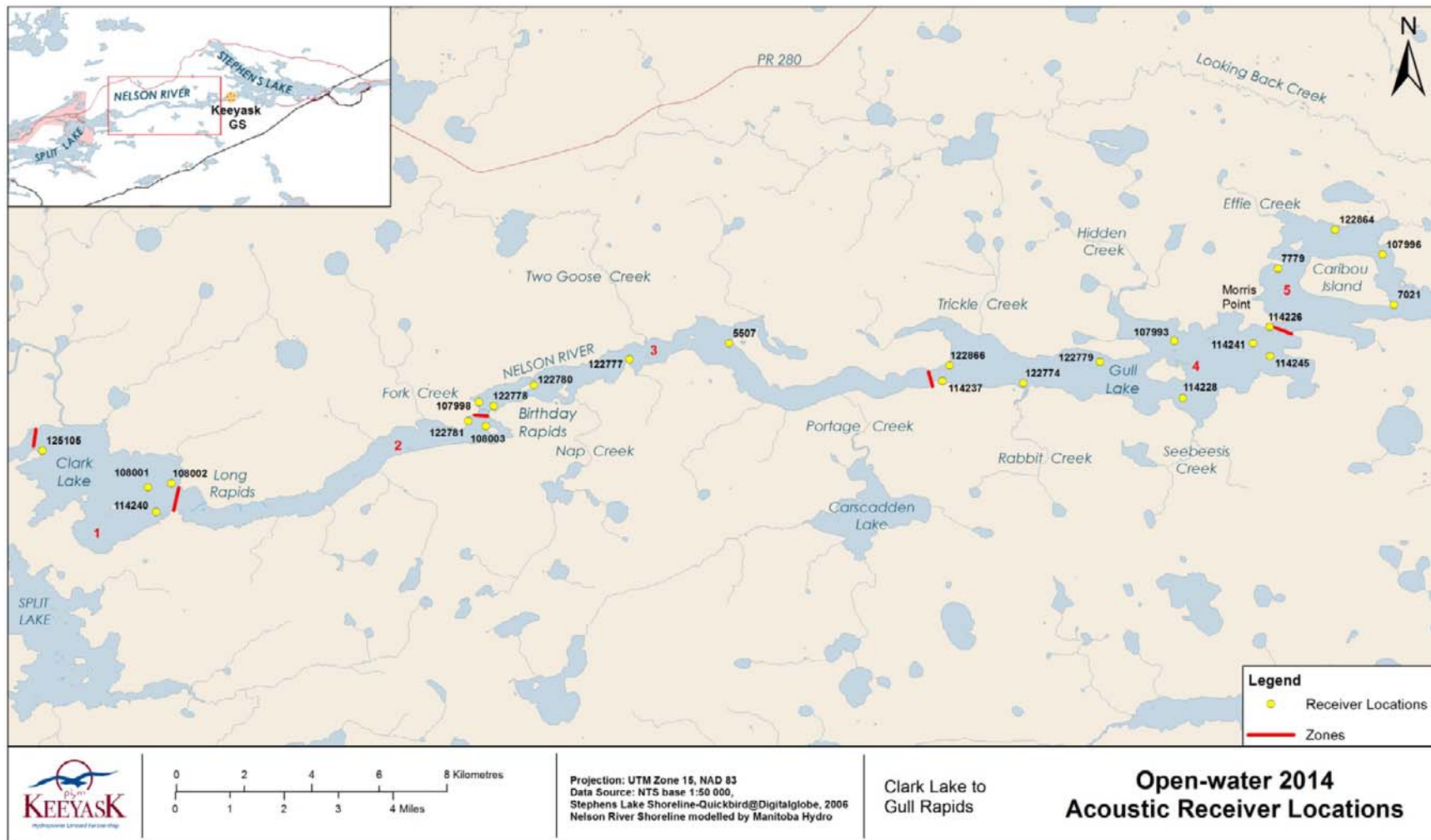


Figure 7: Locations of stationary receivers set in the Nelson River from Clark Lake to Gull Rapids between June and October, 2014. The river is divided into five “zones” based on placement of receiver “gates”

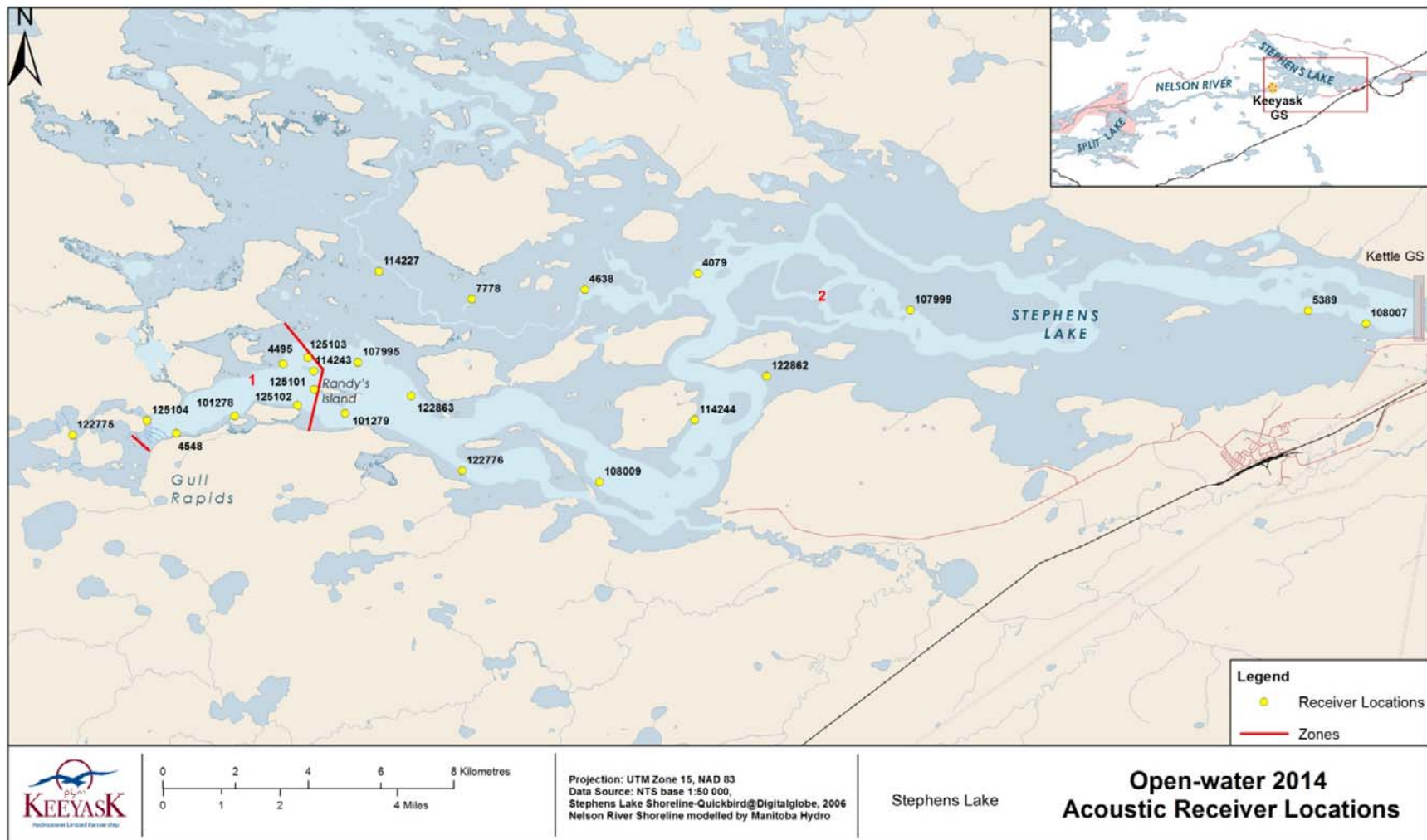


Figure 8: Locations of stationary receivers set in Stephens Lake from Gull Rapids to Kettle GS between June and October, 2014. The river is divided into two “zones” based on placement of receiver “gates”. The pre-impoundment river channel is shown in light blue

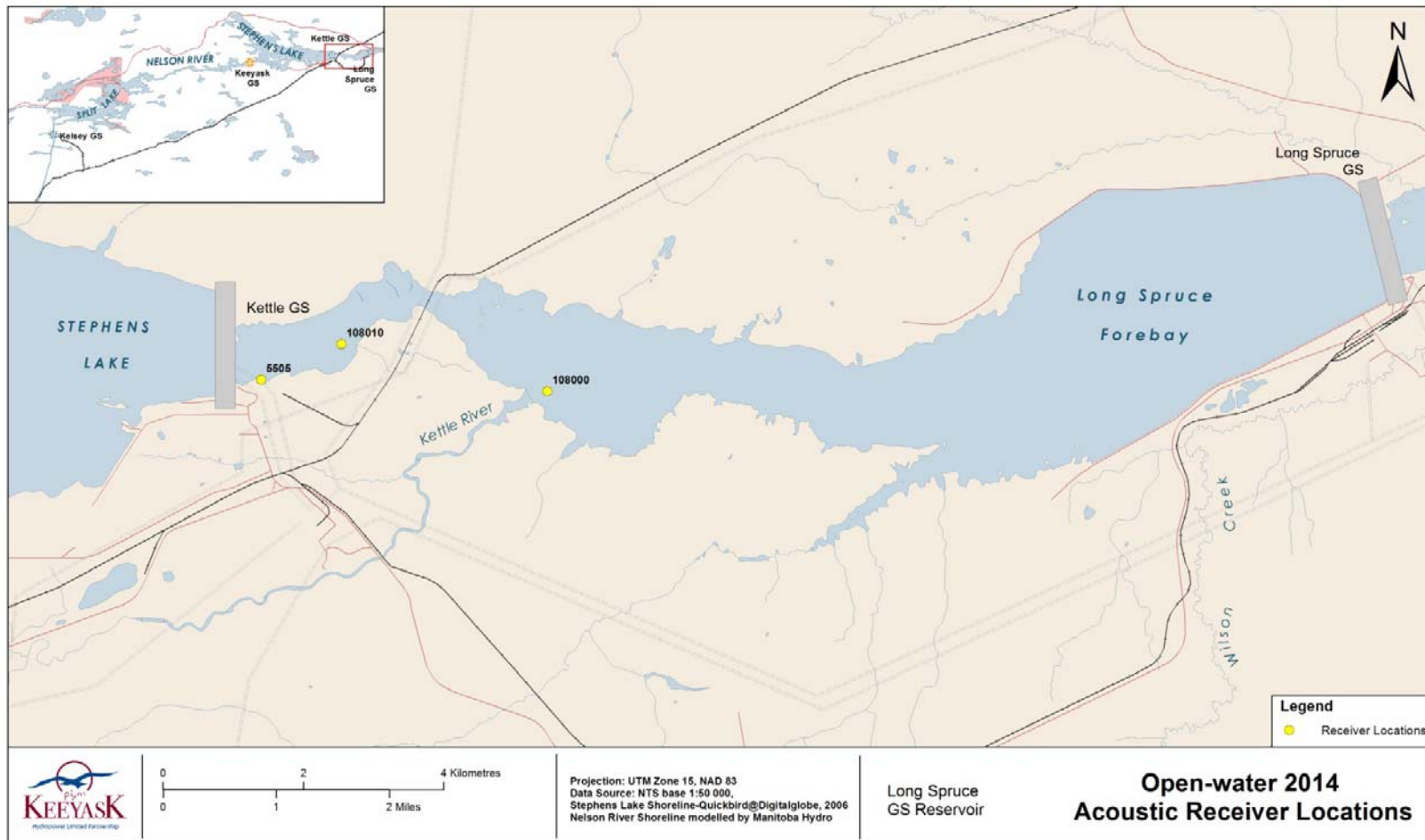


Figure 9: Locations of stationary receivers set in the Long Spruce Forebay between June and October, 2014.

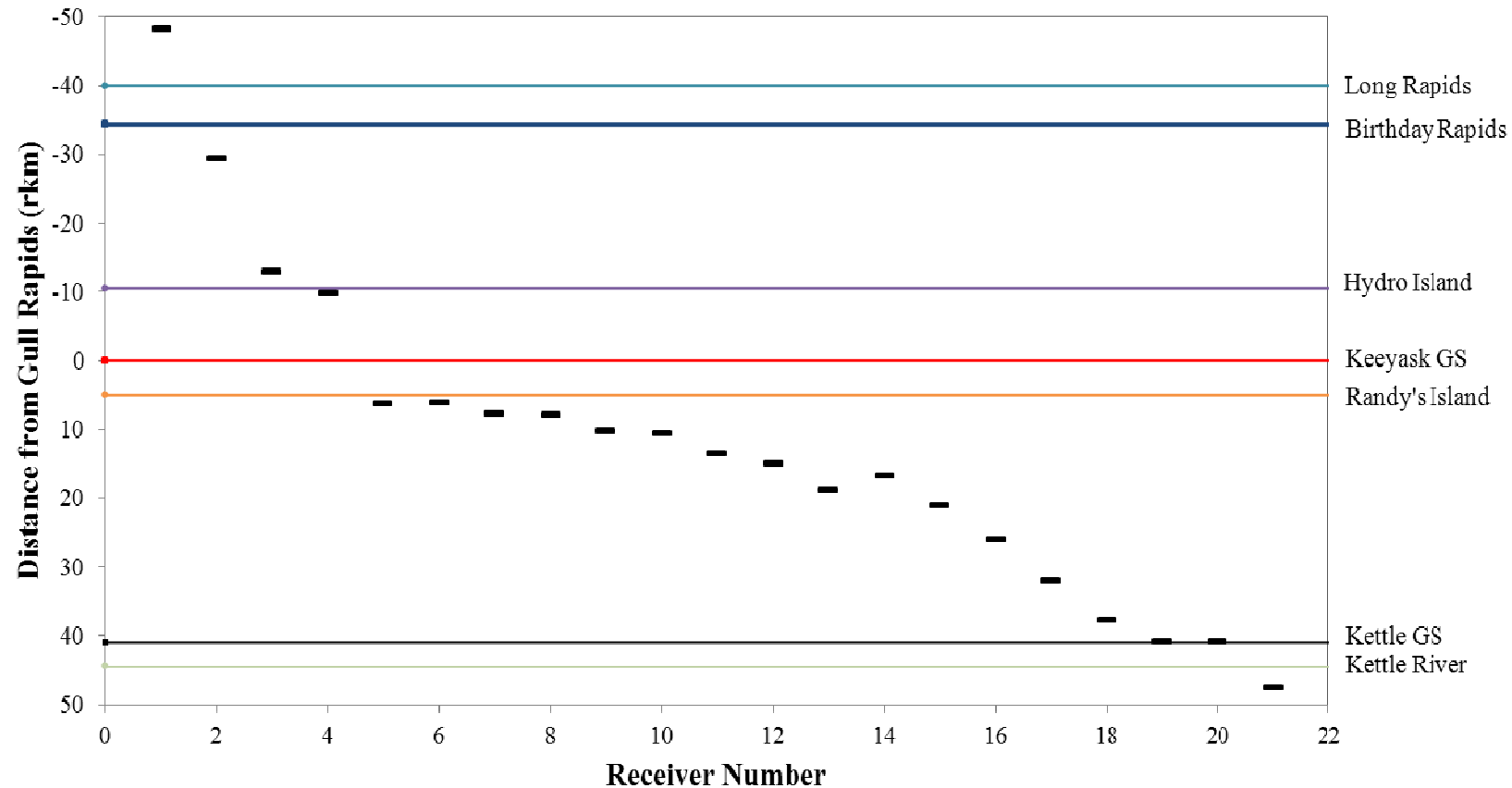


Figure 10: Locations of stationary acoustic receivers in relation to the base of Gull Rapids (rkm 0) and other major landmarks in the Nelson River between Clark Lake and the Long Spruce GS between October, 2013 and June, 2014.

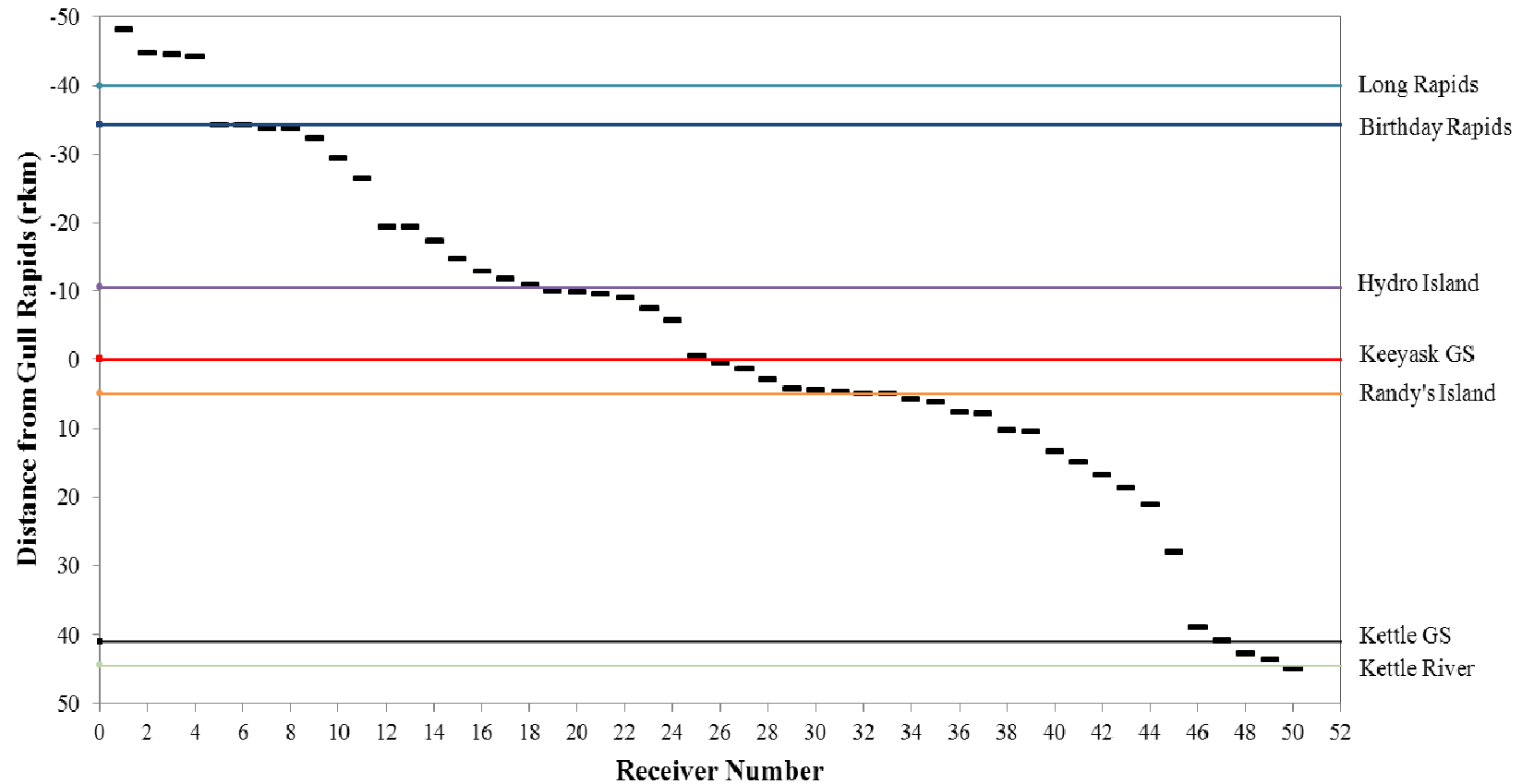


Figure 11: Locations of stationary acoustic receivers in relation to the base of Gull Rapids (rkm 0) and other major landmarks in the Nelson River between Clark Lake and the Long Spruce GS between June and October, 2014.

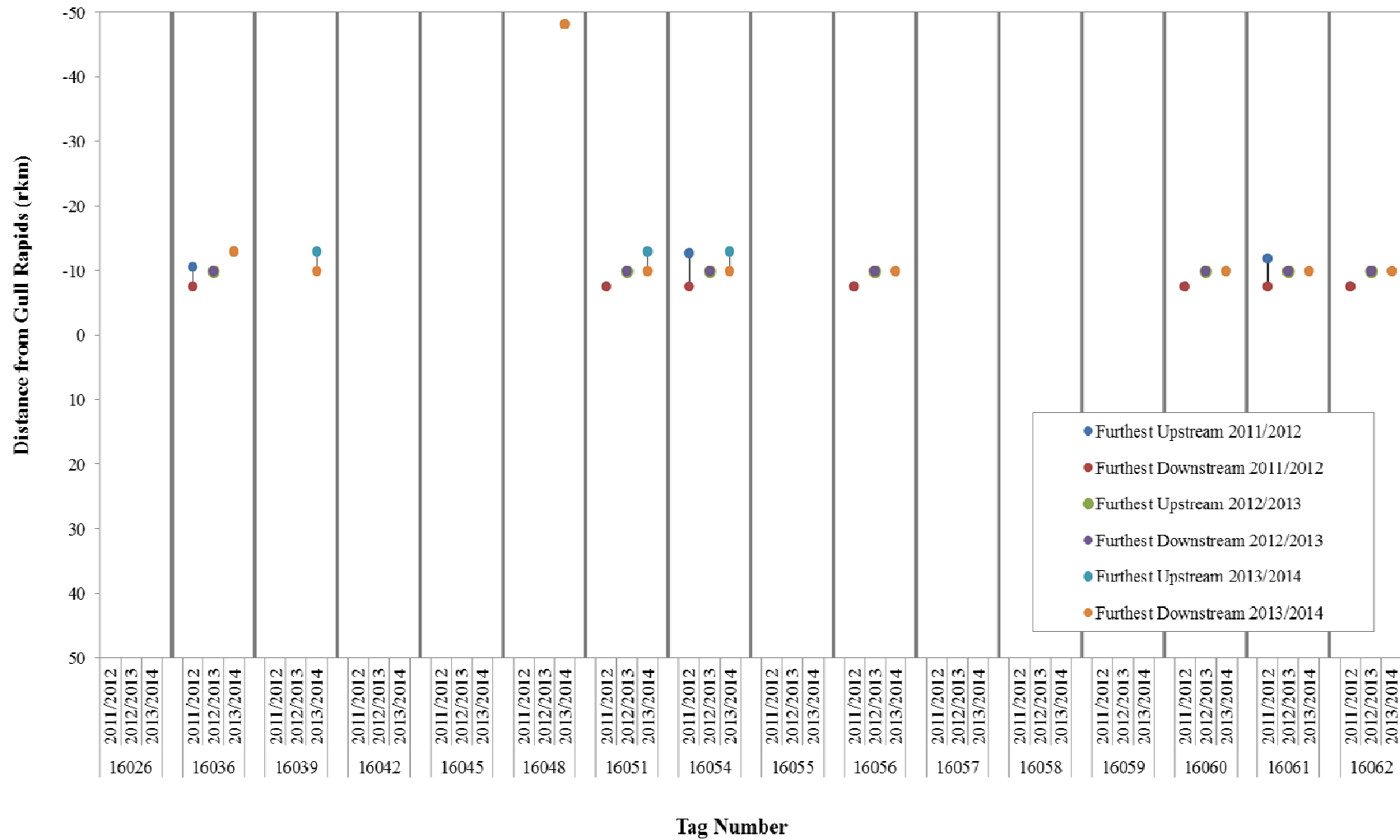


Figure 12: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Gull Rapids during the winter 2013/2014 period (16 October, 2013 to 30 April, 2014).

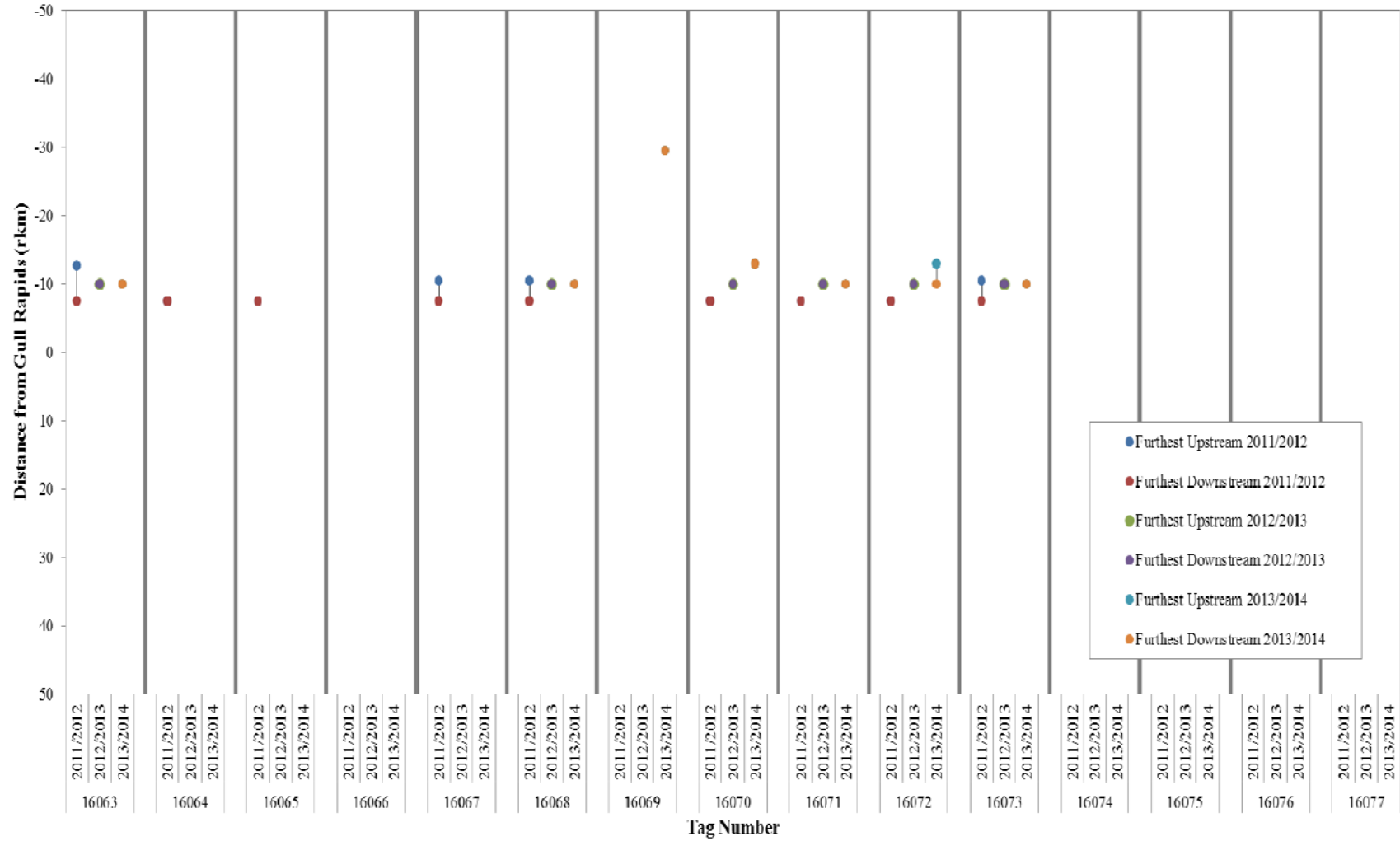


Figure 12: Continued.

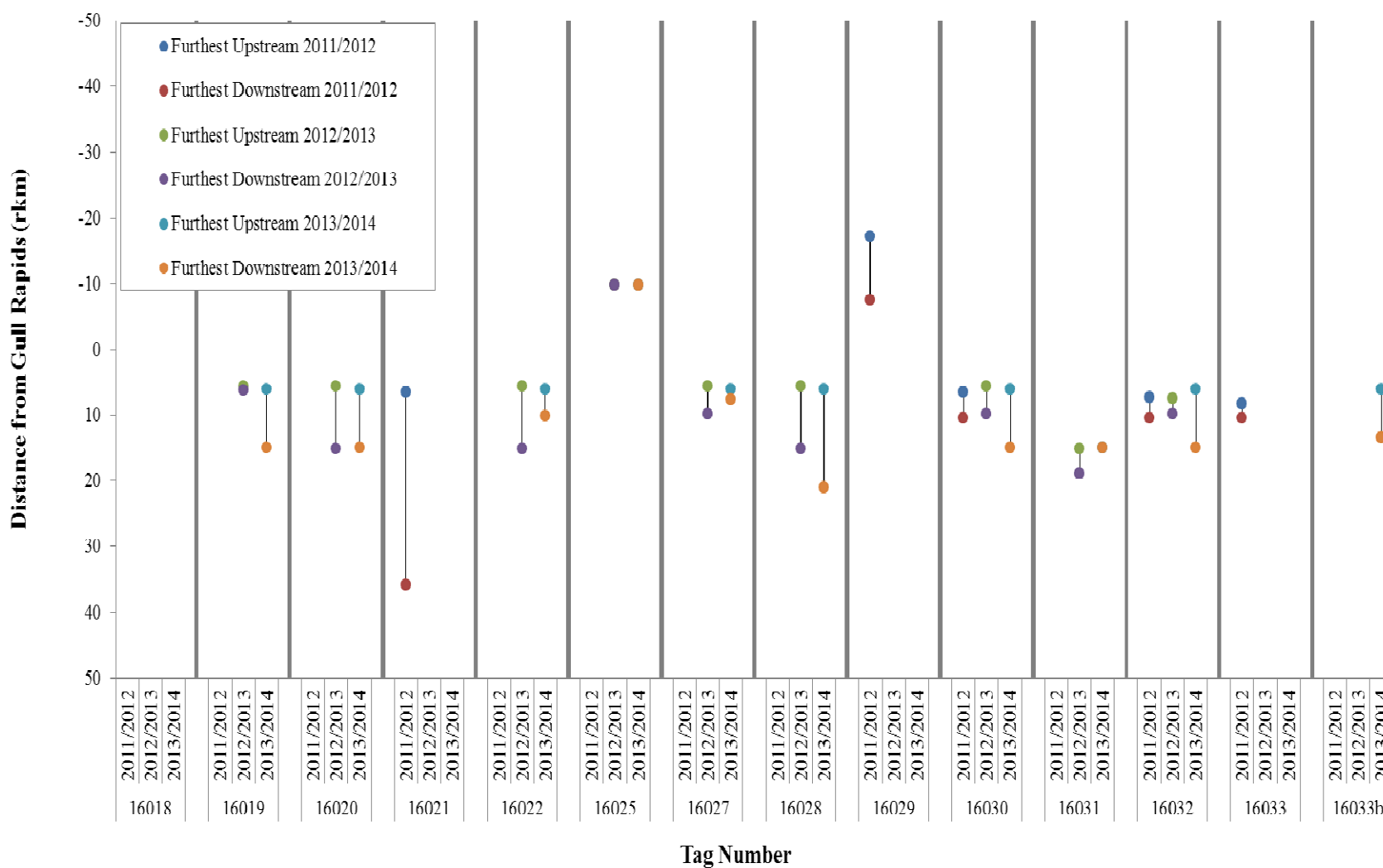


Figure 13: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the winter 2013/2014 period (16 October, 2013 to 30 April, 2014).

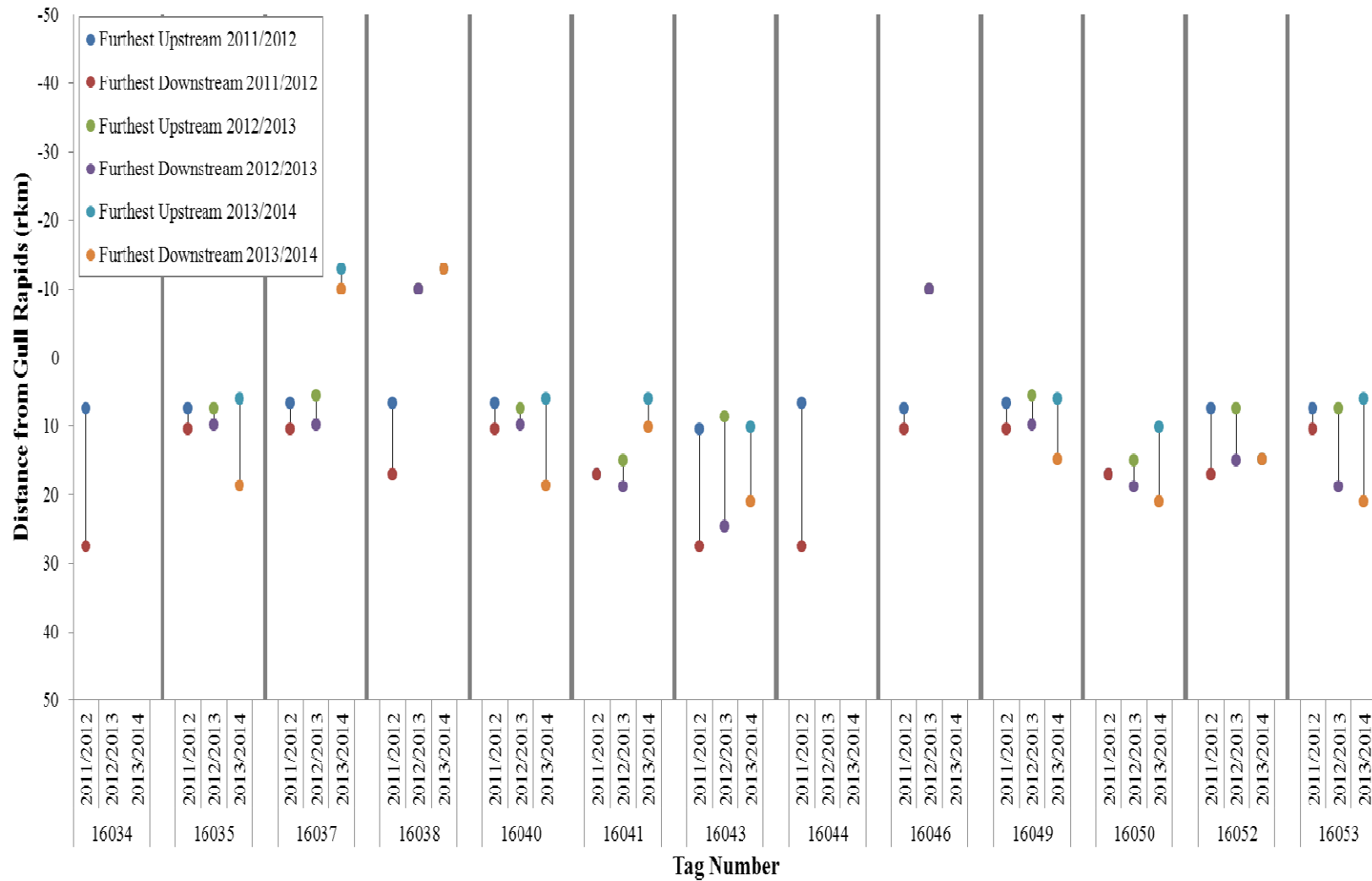


Figure 13: Continued.

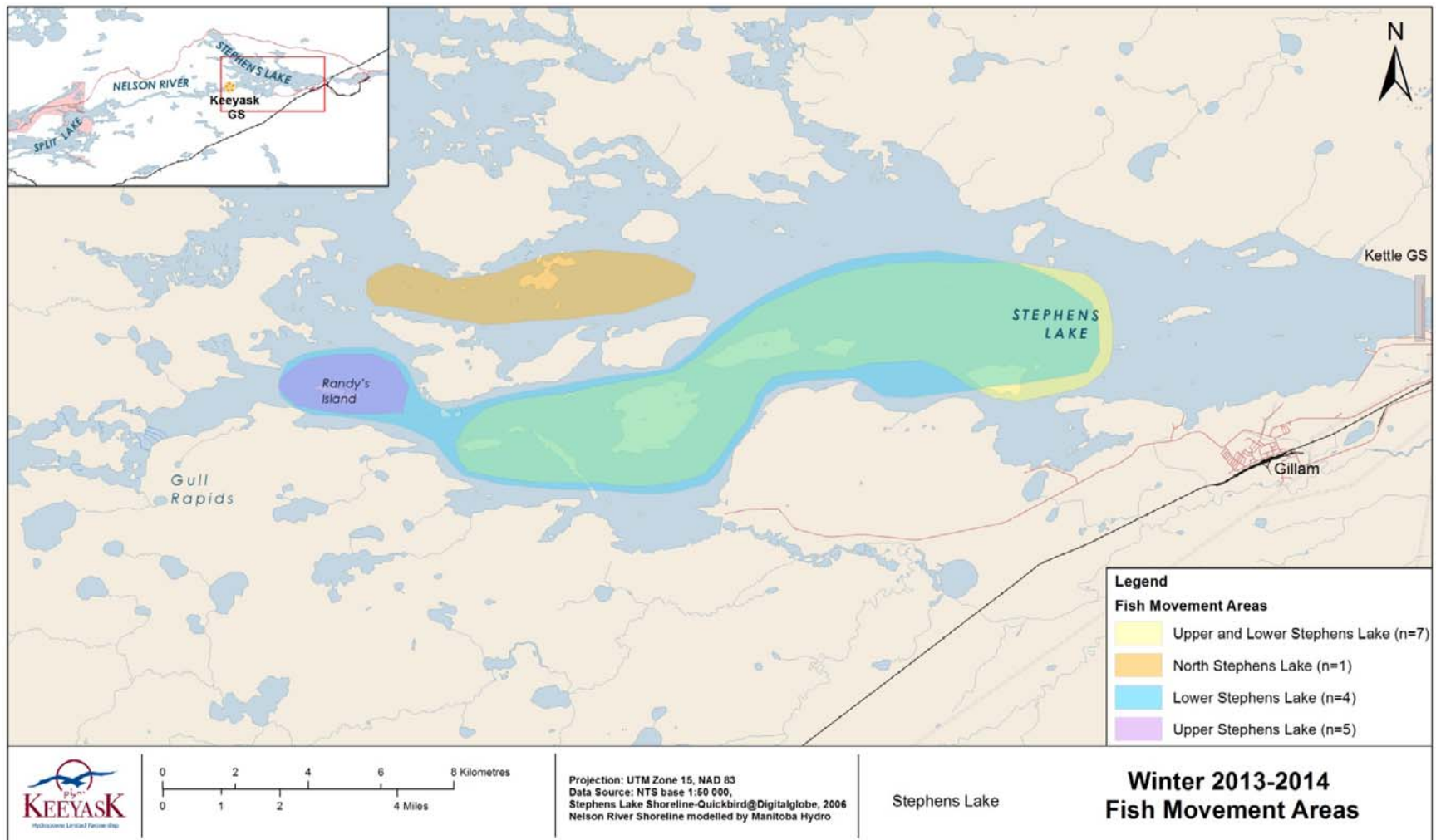


Figure 14: Illustration of movement patterns for 17 fish relocated in Stephens Lake during the winter 2013/2014 period (16 October, 2013 to 30 April, 2014).

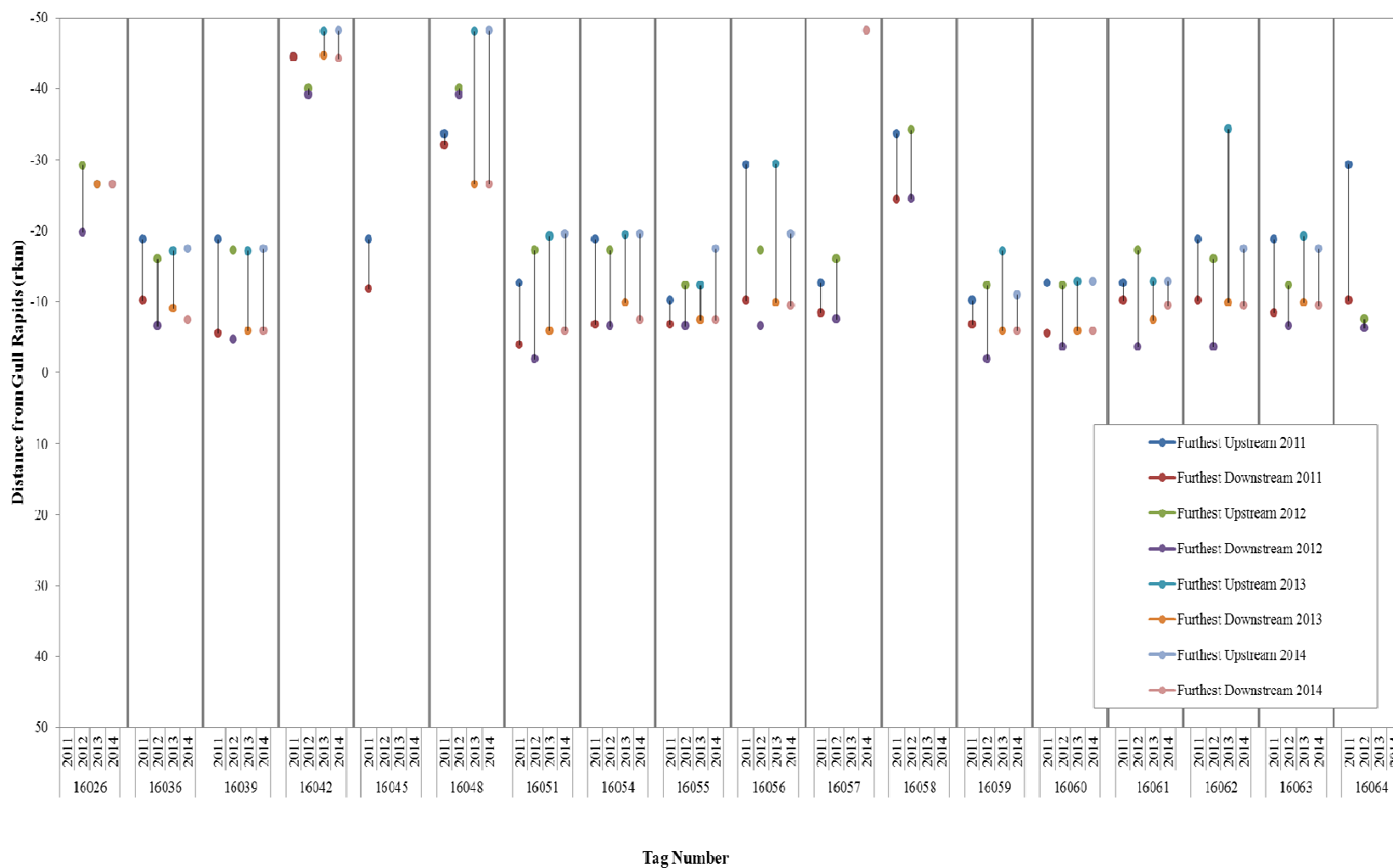


Figure 15: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Gull Rapids during the 2013 open-water period (1 May, 2013 to 15 October, 2013).

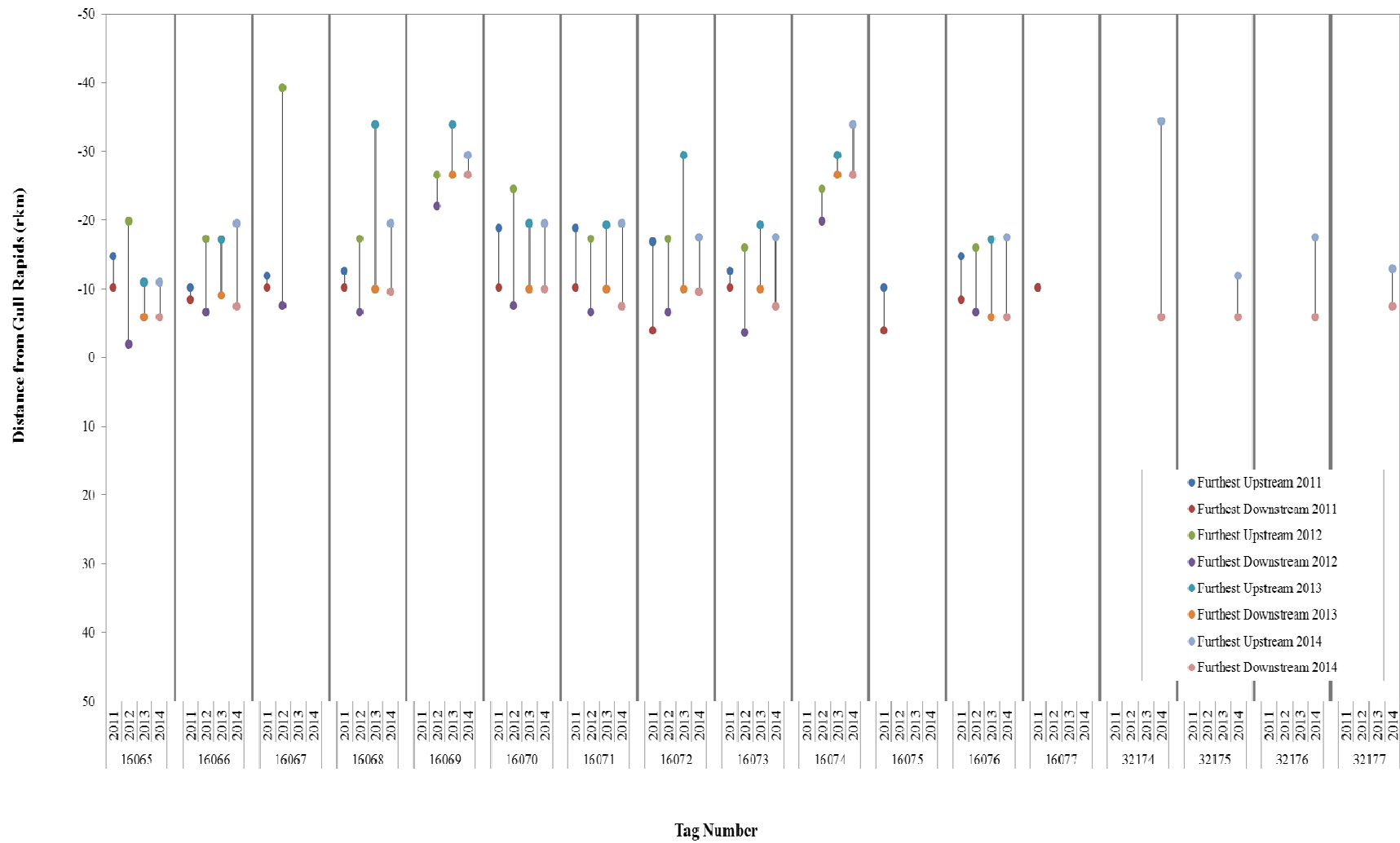


Figure 15: Continued.

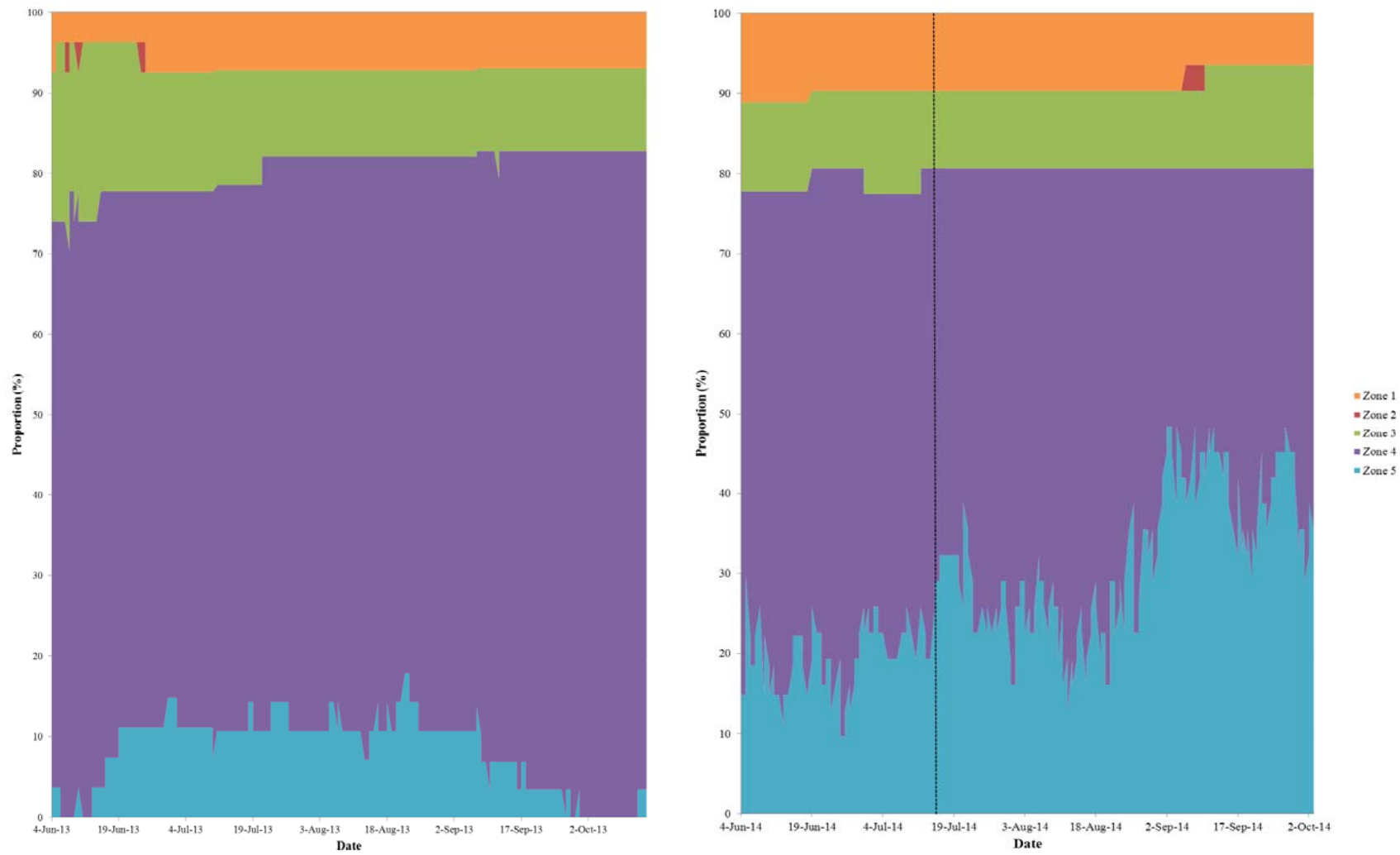


Figure 16: Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters upstream of the GS during a portion of the 2013 (4 June to 15 October, 2013) and 2014 open-water periods (4 June to 3 October, 2014). Dotted line indicates start of Keeyask construction.

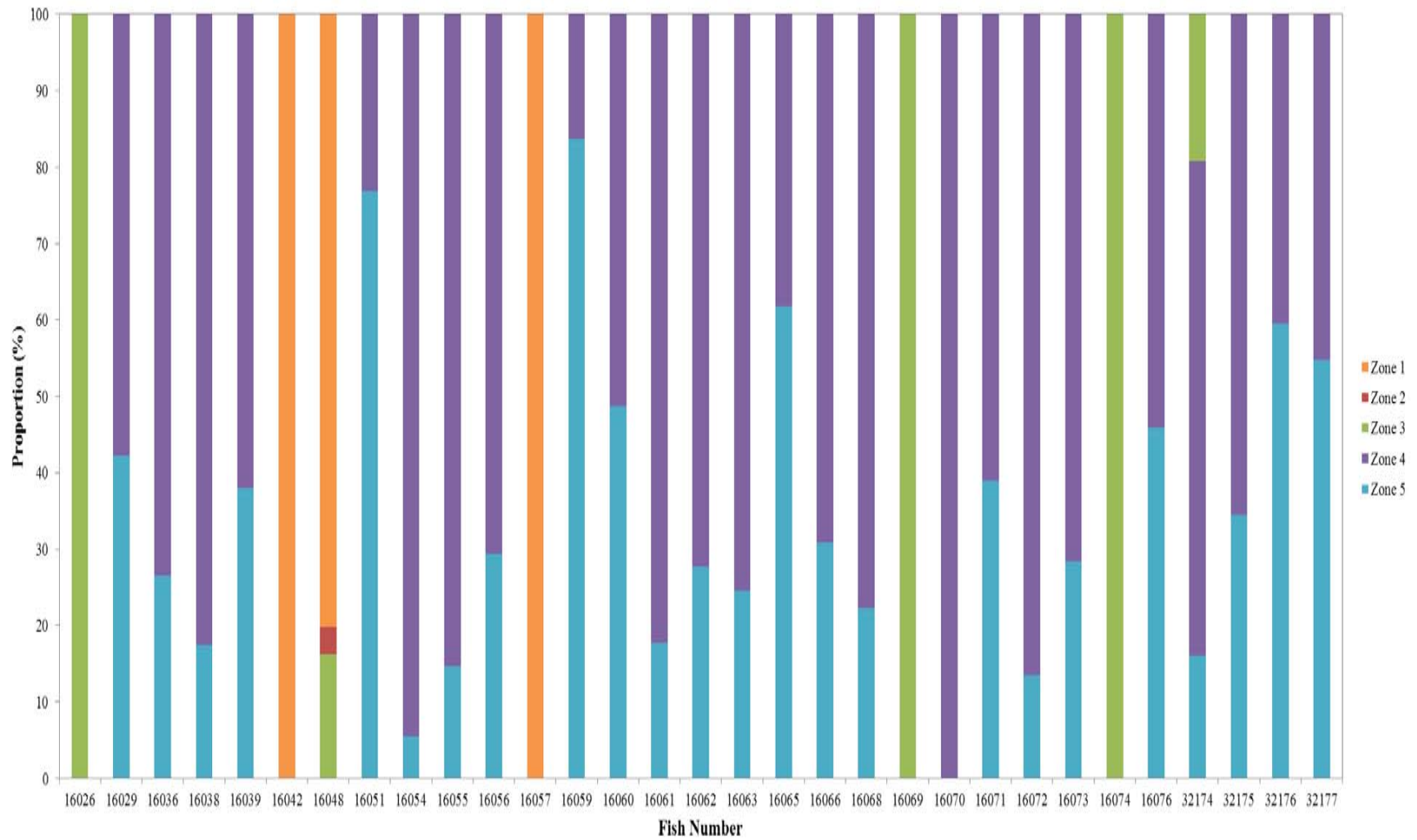


Figure 17: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters upstream of Keeyask GS during a portion of the 2014 open-water period (4 June to 3 October, 2014).

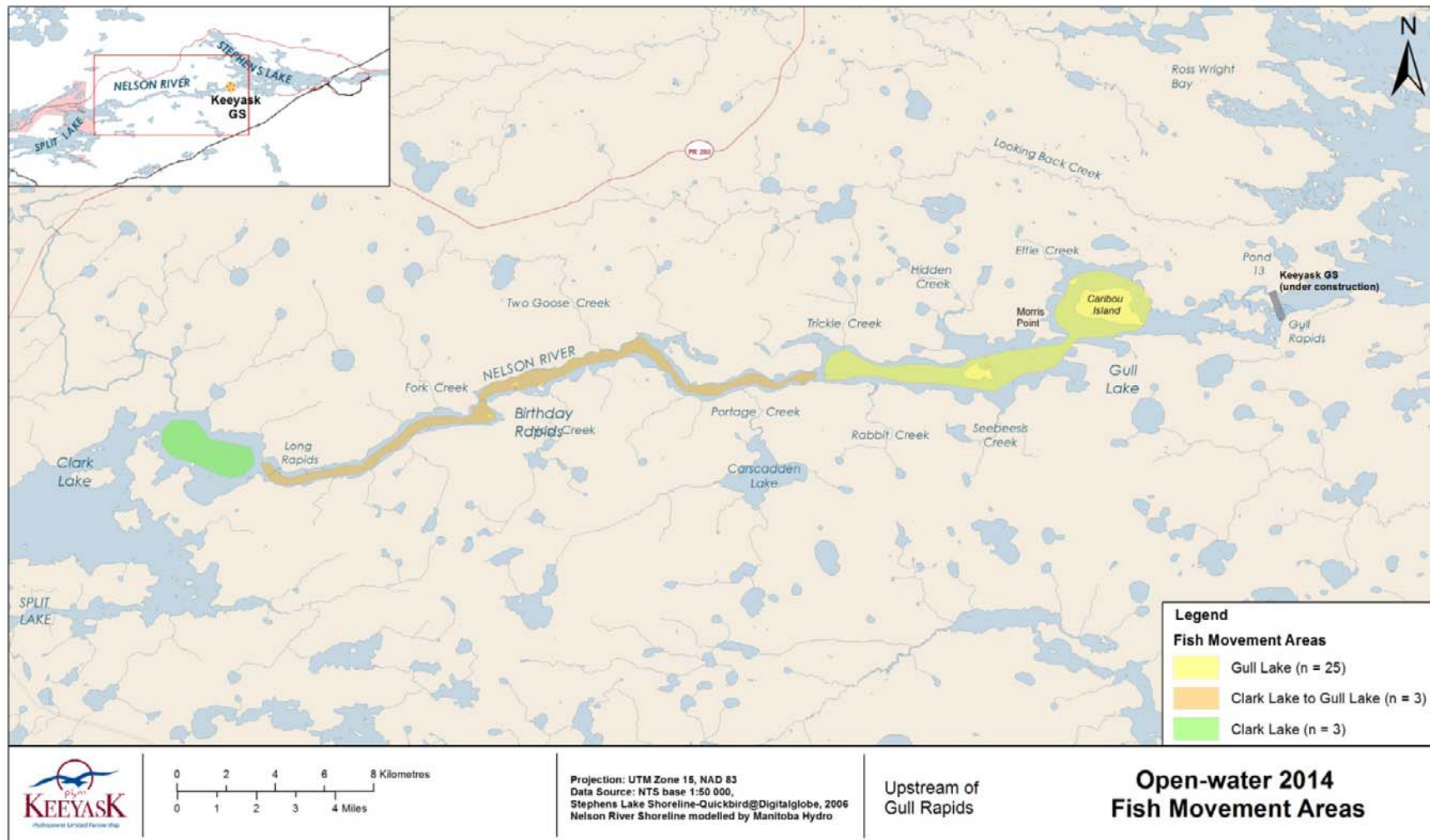


Figure 18: Illustration of movement patterns for 31 fish relocated upstream of Keeyask GS during the 2014 open-water period (4 June to 3 October, 2014).

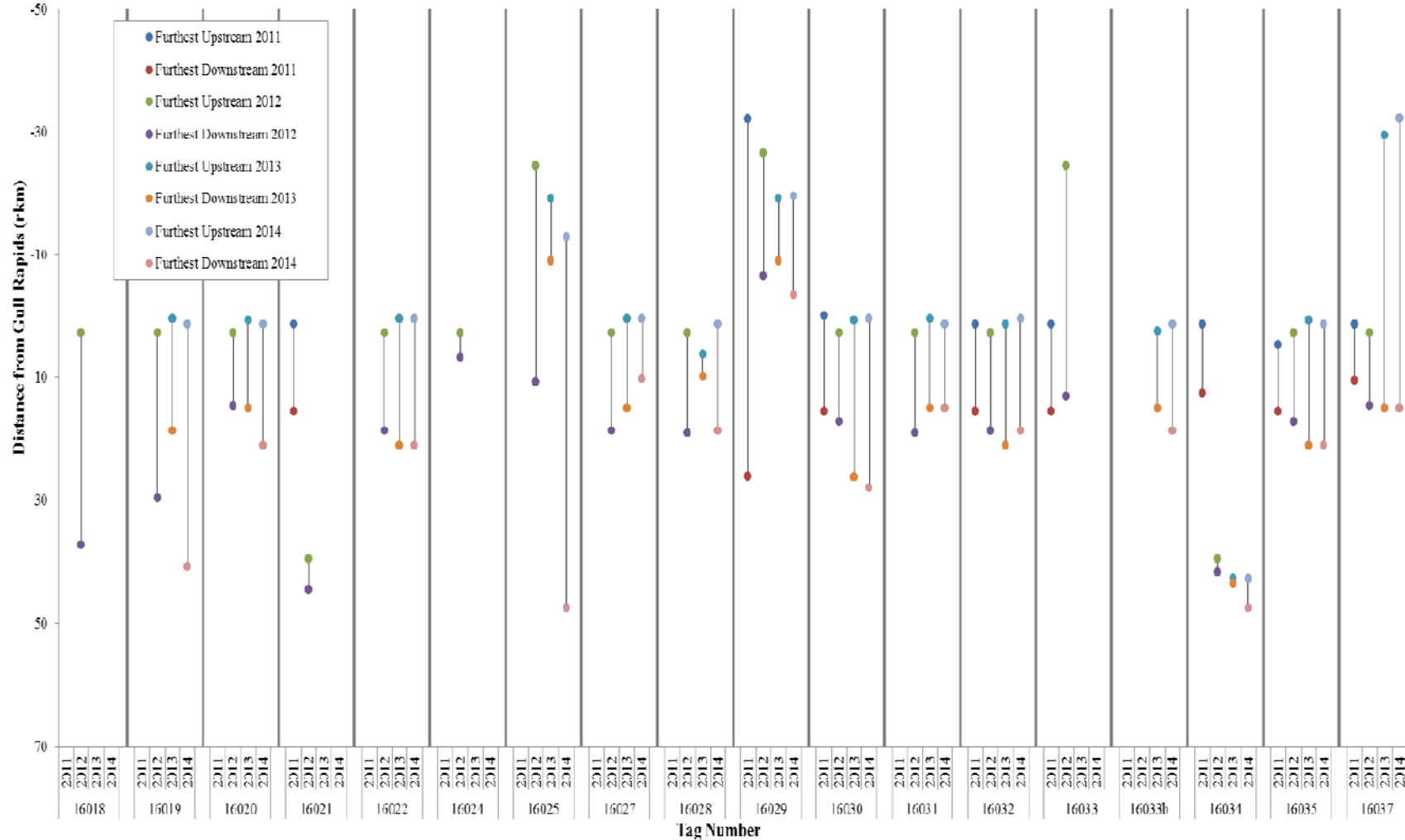


Figure 19: Detection ranges for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during the 2014 open-water period (1 May, 2014 to 16 October, 2014).

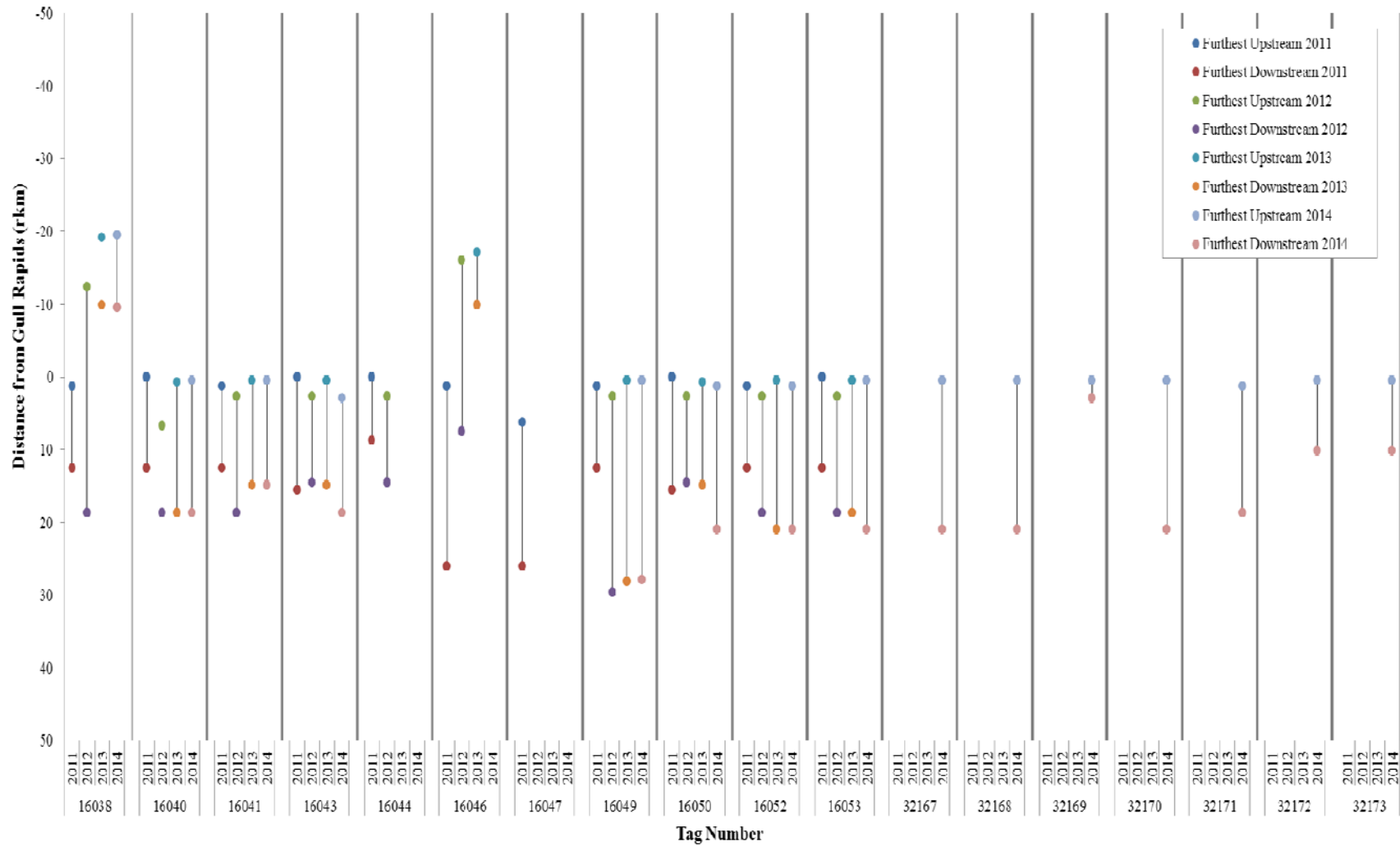


Figure 19: Continued.

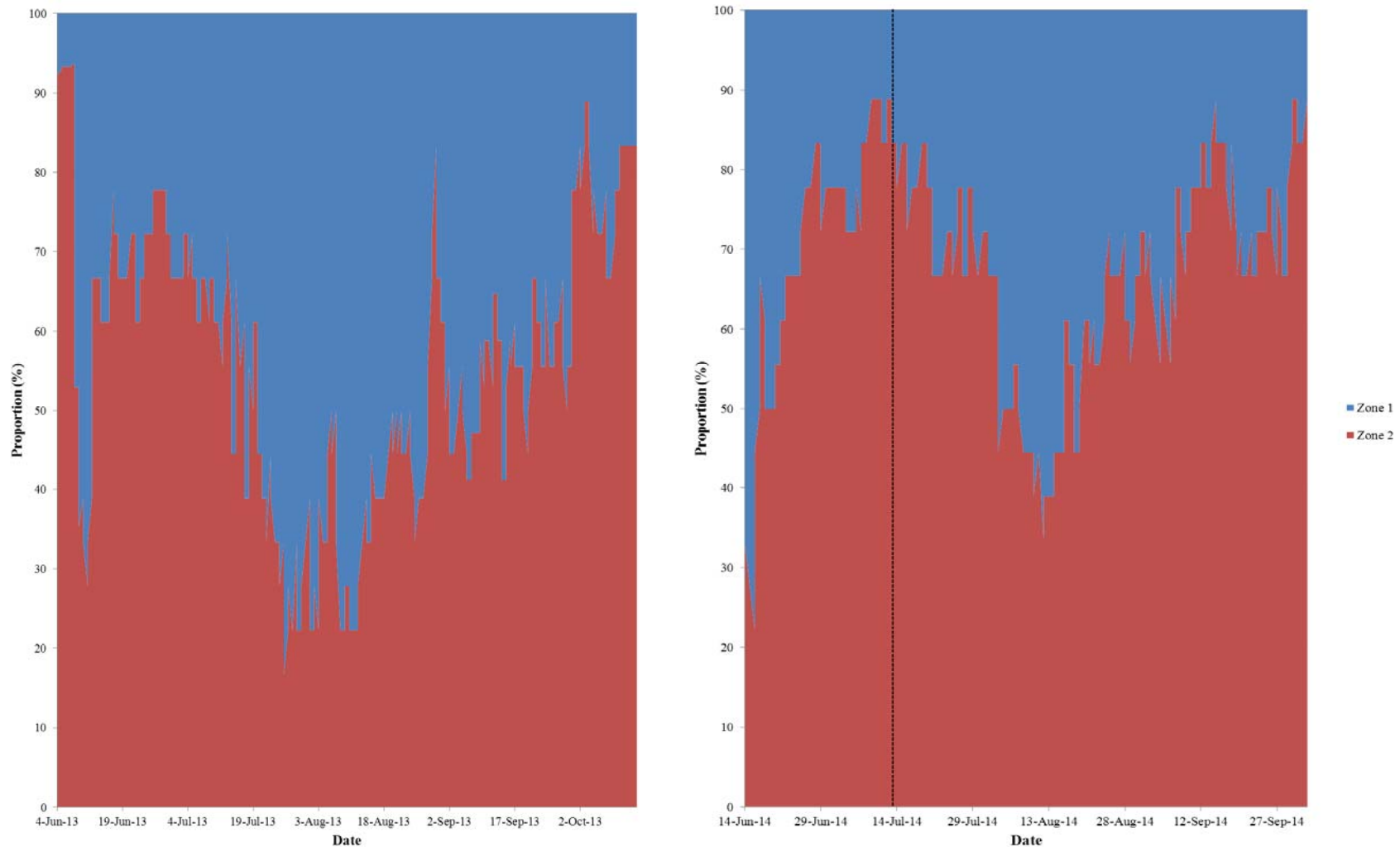


Figure 20: Proportional distribution by zone, for adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during a portion of the 2013 (4 June to 15 October, 2013) and 2014 open-water periods (14 June to 3 October, 2014). Dotted line indicates start of Keeyask construction.

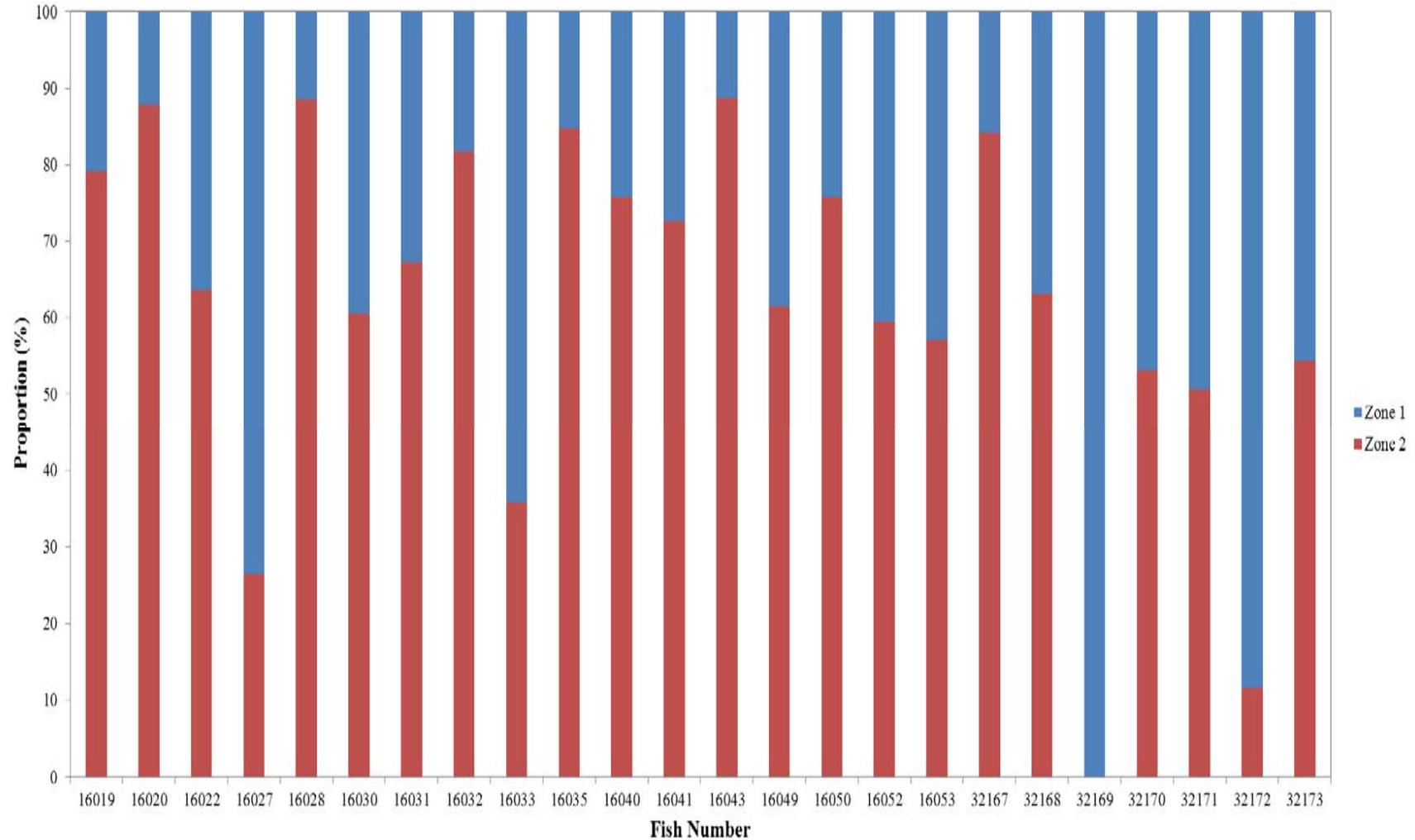


Figure 21: Proportional distributions by zone, for individual adult Lake Sturgeon tagged with acoustic transmitters in Stephens Lake during a portion of the 2014 open-water period (14 June to 3 October, 2014).

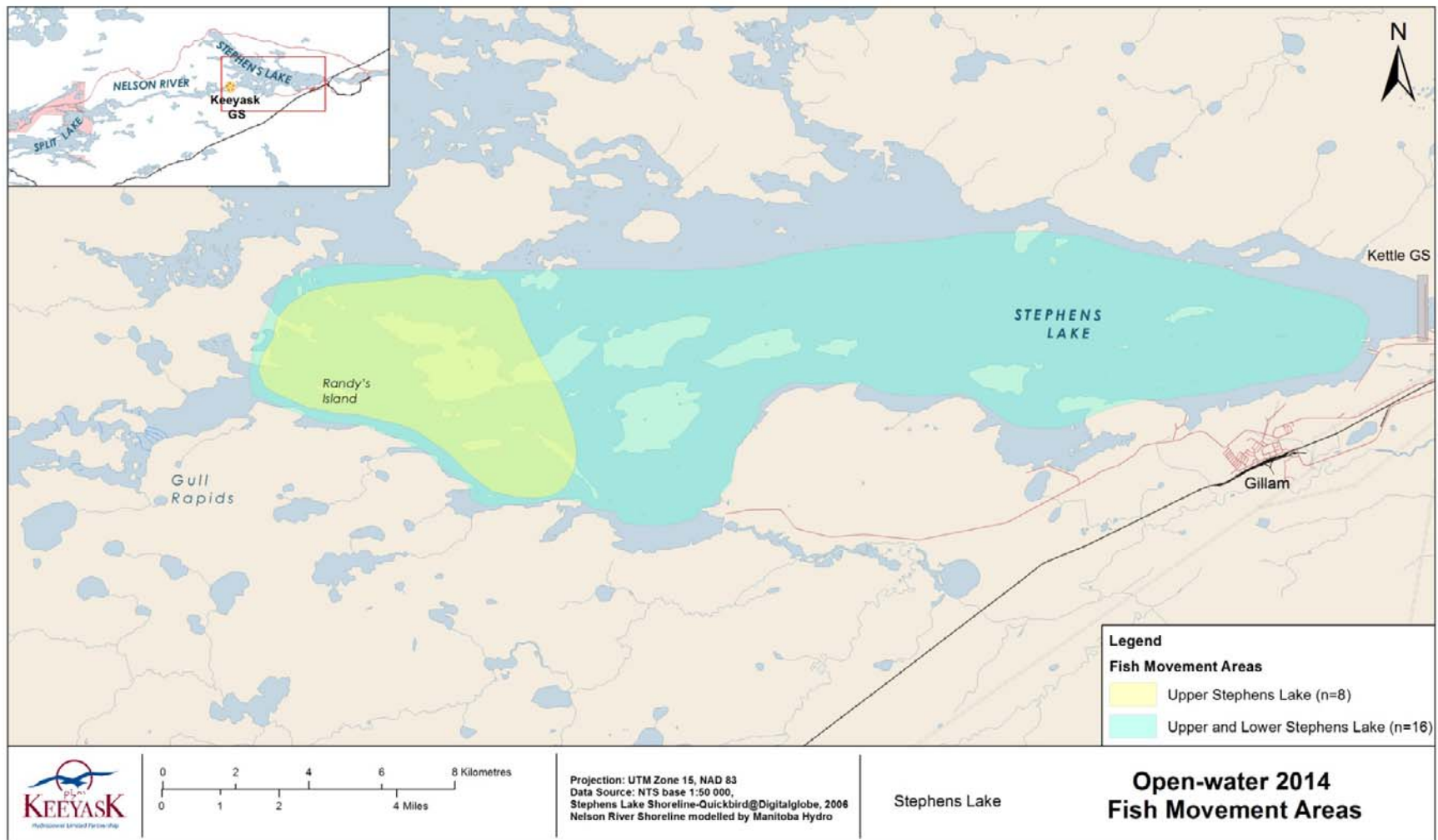


Figure 22: Illustration of movement patterns for 24 fish relocated in Stephens Lake during the 2014 open-water period (4 June to 3 October, 2014).

APPENDICES

APPENDIX 1:

DETECTION SUMMARIES FOR LAKE STURGEON TAGGED AND MONITORED IN THE KEEYASK STUDY AREA BETWEEN 2011 AND 2014

Table A1- 1:	Detection summary for each of 31 Lake Sturgeon tagged and monitored upstream of the GS during the winter 2011/2012 (20 October, 2011 to 30 April, 2012), 2012/2013 (16 October, 2012 to 30 April, 2013), and 2013/2014 (16 October, 2013 to 30 April, 2014) periods. Tag id highlighted yellow = lost tags.....	57
Table A1- 2:	Detection summary for each of 29 Lake Sturgeon tagged and monitored in Stephens Lake during the winter 2011/2012 (20 October, 2011 to 30 April, 2012), 2012/2013 (16 October, 2012 to 30 April, 2013), and 2013/2014 (16 October, 2013 to 30 April, 2014) 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.	58
Table A1- 3:	Detection summary for each of 35 Lake Sturgeon tagged and monitored upstream of the GS during the open-water 2011 (1 June to 20 October), 2012 (1 May to 16 October), 2013 (1 May to 16 October), and 2014 (1 May to 12 October) periods. Tag id highlighted yellow = lost tags.	59
Table A1- 4:	Detection summary for each of 36 Lake Sturgeon tagged and monitored in Stephens Lake during the open-water 2011 (1 June to 20 October), 2012 (1 May to 16 October), 2013 (1 May to 16 October), and 2014 (1 May to 12 October) 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.....	60

Table A1- 1: Detection summary for each of 31 Lake Sturgeon tagged and monitored upstream of the GS during the winter 2011/2012 (20 October, 2011 to 30 April, 2012), 2012/2013 (16 October, 2012 to 30 April, 2013), and 2013/2014 (16 October, 2013 to 30 April, 2014) periods. Tag id highlighted yellow = lost tags.

2011/2012						2012/2013					2013/2014				
Tag ID	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)
16026	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16036	2537	118	-10.5	-7.5	3.0	43	12	-9.9	-9.9	0.0	2326	52	-12.9	-12.9	0.0
16039	0	-	-	-	-	0	-	-	-	-	502	10	-12.9	-9.9	3.0
16042	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16045	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16048	0	-	-	-	-	0	-	-	-	-	2932	66	-48.2	-48.2	0.0
16051	2475	51	-7.5	-7.5	0.0	7088	93	-9.9	-9.9	0.0	14618	92	-12.9	-9.9	3.0
16054	2772	40	-12.6	-7.5	5.1	4027	66	-9.9	-9.9	0.0	10807	83	-12.9	-9.9	3.0
16055	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16056	8711	176	-7.5	-7.5	0.0	1893	63	-9.9	-9.9	0.0	13493	87	-9.9	-9.9	0.0
16057	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16058	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16059	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16060	11406	138	-7.5	-7.5	0.0	4354	75	-9.9	-9.9	0.0	25171	137	-9.9	-9.9	0.0
16061	13225	94	-11.8	-7.5	4.3	1157	71	-9.9	-9.9	0.0	18018	115	-9.9	-9.9	0.0
16062	5943	148	-7.5	-7.5	0.0	2495	48	-9.9	-9.9	0.0	9079	120	-9.9	-9.9	0.0
16063	7905	134	-12.6	-7.5	5.1	3650	60	-9.9	-9.9	0.0	6098	84	-9.9	-9.9	0.0
16064	6717	139	-7.5	-7.5	0.0	0	-	-	-	-	0	-	-	-	-
16065	3485	129	-7.5	-7.5	0.0	0	-	-	-	-	0	-	-	-	-
16066	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16067	4542	149	-10.5	-7.5	3.0	0	-	-	-	-	0	-	-	-	-
16068	272	15	-10.5	-7.5	3.0	5623	73	-9.9	-9.9	0.0	22744	129	-9.9	-9.9	0.0
16069	0	-	-	-	-	0	-	-	-	-	678	4	-29.4	-29.4	0.0
16070	12833	184	-7.5	-7.5	0.0	2	1	-9.9	-9.9	0.0	33086	118	-12.9	-12.9	0.0
16071	7247	122	-7.5	-7.5	0.0	2351	38	-9.9	-9.9	0.0	11439	95	-9.9	-9.9	0.0
16072	11220	174	-7.5	-7.5	0.0	11687	96	-9.9	-9.9	0.0	27653	142	-12.9	-9.9	3.0
16073	2647	51	-10.5	-7.5	3.0	3284	66	-9.9	-9.9	0.0	1213	18	-9.9	-9.9	0.0
16074	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16075	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16076	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16077	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-

Table A1- 2: Detection summary for each of 29 Lake Sturgeon tagged and monitored in Stephens Lake during the winter 2011/2012 (20 October, 2011 to 30 April, 2012), 2012/2013 (16 October, 2012 to 30 April, 2013), and 2013/2014 (16 October, 2013 to 30 April, 2014) 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.

2011/2012						2012/2013					2013/2014				
Tag ID	#	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	#	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	#	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)
16018	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16019	0	-	-	-	-	887	39	5.6	6.2	0.6	2959	33	6.1	14.9	8.8
16020	0	-	-	-	-	3625	25	5.6	15.1	9.5	24335	102	6.1	14.9	8.8
16021	16475	79	6.6	35.8	29.2	0	-	-	-	-	0	-	-	-	-
16022	0	-	-	-	-	1227	15	5.6	15.1	9.5	7508	83	6.1	10.2	4.1
16024	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16025	0	-	-	-	-	1974	47	-9.9	-9.9	0.0	20670	114	-9.9	-9.9	0.0
16027	0	-	-	-	-	3398	70	5.6	9.9	4.3	2111	24	6.1	7.7	1.6
16028	0	-	-	-	-	733	7	5.6	15.1	9.5	2123	8	6.1	21.0	14.9
16029	1937	39	-17.2	-7.5	9.7	0	-	-	-	-	0	-	-	-	-
16030	12583	70	6.6	10.5	3.9	13733	89	5.6	9.9	4.3	2887	63	6.1	14.9	8.8
16031	0	-	-	-	-	7414	26	15.1	18.9	3.8	45513	147	14.9	14.9	0.0
16032	48676	67	7.4	10.5	3.1	2284	23	7.5	9.9	2.4	3780	48	6.1	14.9	8.8
16033	125	3	8.2	10.5	2.3	0	-	-	-	-	0	-	-	-	-
16033b	-	-	-	-	-	-	-	-	-	-	15689	104	6.1	13.4	7.3
16034	39927	61	7.4	27.6	20.2	0	-	-	-	-	0	-	-	-	-
16035	7225	84	7.4	10.5	3.1	22099	113	7.5	9.9	2.4	29174	179	6.1	18.7	12.6
16037	36948	77	6.6	10.5	3.9	991	18	5.6	9.9	4.3	24601	133	-12.9	-9.9	3.0
16038	14187	69	6.6	17.1	10.5	9	2	-9.9	-9.9	0.0	106	8	-12.9	-12.9	0.0
16040	18814	85	6.6	10.5	3.9	23113	104	7.5	9.9	2.4	4436	21	6.1	18.7	12.6
16041	135	11	17.1	17.1	0.0	4328	25	15.1	18.9	3.8	16656	153	6.1	10.2	4.1
16043	6989	49	10.5	27.6	17.1	10520	95	8.7	24.7	16.0	16074	114	10.2	21.0	10.8
16044	9036	57	6.6	27.6	21.0	0	-	-	-	-	0	-	-	-	-
16046	6972	85	7.4	10.5	3.1	248	25	-9.9	-9.9	0.0	0	-	-	-	-
16047	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16049	20859	75	6.6	10.5	3.9	32364	157	5.6	9.9	4.3	24241	140	6.1	14.9	8.8
16050	345	3	17.1	17.1	0.0	18070	65	15.1	18.9	3.8	2920	50	10.2	21.0	10.8
16052	143	4	7.5	17.1	9.6	6505	78	7.5	15.1	7.6	34688	173	14.9	14.9	0.0
16053	2960	31	7.4	10.5	3.1	776	10	7.5	18.9	11.4	2209	20	6.1	21.0	14.9

Table A1- 3: Detection summary for each of 35 Lake Sturgeon tagged and monitored upstream of the GS during the open-water 2011 (1 June to 20 October), 2012 (1 May to 16 October), 2013 (1 May to 16 October), and 2014 (1 May to 12 October) periods. Tag id highlighted yellow = lost tags.

Tag ID	2011					2012					2013					2014				
	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)
16026	-	-	-	-	-	23195	83	-29.2	-19.8	9.4	12588	83	-26.5	-26.5	0.0	13090	103	-26.5	-26.5	0.0
16036	2152	32	-18.8	-10.2	8.6	6980	86	-16.0	-6.6	9.4	5328	82	-17.1	-9.0	8.1	12362	112	-17.4	-7.4	10.0
16039	2260	42	-18.8	-5.5	13.3	5250	66	-17.2	-4.7	12.5	16487	107	-17.1	-5.8	11.3	12670	120	-17.4	-5.8	11.6
16042	1914	54	-44.5	-44.5	0.0	576	11	-40.0	-39.2	0.8	2626	30	-48.1	-44.7	3.4	6660	54	-48.2	-44.3	3.9
16045	786	13	-18.8	-11.8	7.0	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16048	383	6	-33.7	-32.1	1.6	1773	37	-40.0	-39.2	0.8	10796	119	-48.1	-26.5	21.6	7527	93	-48.2	-26.5	21.7
16051	1935	76	-12.6	-3.9	8.7	5804	105	-17.2	-1.9	15.3	8015	115	-19.2	-5.8	13.4	10404	57	-19.5	-5.8	13.7
16054	2697	49	-18.8	-6.8	12.0	4278	101	-17.2	-6.6	10.6	11062	105	-19.4	-9.9	9.5	7102	93	-19.5	-7.4	12.1
16055	1140	9	-10.2	-6.8	3.4	1384	27	-12.3	-6.6	5.7	8271	89	-12.3	-7.4	4.9	7657	86	-17.4	-7.4	10.0
16056	234	12	-29.3	-10.2	19.1	4665	87	-17.2	-6.6	10.6	12862	96	-29.4	-9.9	19.5	17163	115	-19.5	-9.5	10.0
16057	475	25	-12.6	-8.4	4.2	524	29	-16.0	-7.5	8.5	0	-	-	-	-	2	1	-48.2	-48.2	0.0
16058	549	16	-33.7	-24.4	9.3	1071	4	-34.2	-24.5	9.7	0	-	-	-	-	0	-	-	-	-
16059	599	5	-10.2	-6.8	3.4	1696	32	-12.3	-1.9	10.4	13935	78	-17.1	-5.8	11.3	10991	57	-10.9	-5.8	5.1
16060	1759	43	-12.6	-5.5	7.1	4065	95	-12.3	-3.6	8.7	16366	124	-12.9	-5.8	7.1	13228	108	-12.9	-5.8	7.1
16061	711	37	-12.6	-10.2	2.4	4444	108	-17.2	-3.6	13.6	11503	114	-12.9	-7.4	5.5	7437	95	-12.9	-9.5	3.4
16062	142	14	-18.8	-10.2	8.6	5624	86	-16.0	-3.6	12.4	16854	109	-34.3	-9.9	24.4	18336	129	-17.4	-9.5	7.9
16063	2617	59	-18.8	-8.4	10.4	9474	105	-12.3	-6.6	5.7	21588	126	-19.2	-9.9	9.3	23121	127	-17.4	-9.5	7.9
16064	1910	27	-29.3	-10.2	19.1	573	26	-7.5	-6.3	1.2	0	-	-	-	-	0	-	-	-	-
16065	931	36	-14.7	-10.2	4.5	6192	109	-19.8	-1.9	17.9	2581	38	-10.9	-5.8	5.1	3101	38	-10.9	-5.8	5.1
16066	772	39	-10.2	-8.4	1.8	4615	105	-17.2	-6.6	10.6	2322	36	-17.1	-9.0	8.1	8898	73	-19.5	-7.4	12.1
16067	1640	34	-11.8	-10.2	1.6	2516	39	-39.2	-7.5	31.7	0	-	-	-	-	0	-	-	-	-
16068	1046	27	-12.6	-10.2	2.4	5882	105	-17.2	-6.6	10.6	10402	111	-33.8	-9.9	23.9	13158	121	-19.5	-9.5	10.0
16069	0	-	-	-	-	17495	85	-26.5	-22.0	4.5	13288	100	-33.8	-26.5	7.3	14172	66	-29.4	-26.5	2.9
16070	1080	40	-18.8	-10.2	8.6	14691	106	-24.5	-7.5	17.0	7943	89	-19.5	-9.9	9.6	9967	83	-19.5	-9.9	9.6
16071	1403	43	-18.8	-10.2	8.6	9124	89	-17.2	-6.6	10.6	11285	130	-19.2	-9.9	9.3	17413	102	-19.5	-7.4	12.1
16072	2839	58	-16.8	-3.9	12.9	4031	91	-17.2	-6.6	10.6	16638	129	-29.4	-9.9	19.5	19306	112	-17.4	-9.5	7.9
16073	1025	35	-12.6	-10.2	2.4	4432	102	-16.0	-3.6	12.4	6885	94	-19.2	-9.9	9.3	13884	127	-17.4	-7.4	10.0
16074	0	-	-	-	-	13006	67	-24.5	-19.8	4.7	11803	78	-29.4	-26.5	2.9	3105	23	-33.8	-26.5	7.3
16075	462	10	-10.2	-3.9	6.3	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
16076	1040	35	-14.7	-8.4	6.3	2225	56	-16.0	-6.6	9.4	9270	81	-17.1	-5.8	11.3	9075	84	-17.4	-5.8	11.6
16077	282	5	-10.2	-10.2	0.0	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-
32174	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9705	98	-34.3	-5.8	28.5
32175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9186	90	-11.8	-5.8	6.0
32176	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22630	106	-17.4	-5.8	11.6
32177	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20678	109	-12.9	-7.4	5.5

Table A1- 4: Detection summary for each of 36 Lake Sturgeon tagged and monitored in Stephens Lake during the open-water 2011 (1 June to 20 October), 2012 (1 May to 16 October), 2013 (1 May to 16 October), and 2014 (1 May to 12 October) 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.

Tag ID	2011					2012					2013					2014				
	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)	# Detections	# Detection Days	Furthest U/S (rkm)	Furthest D/S (rkm)	Total Movement Range (rkm)
16018						341	5	2.7	37.2	34.5	0					0				
16019	-	-	-	-	-	9272	70	2.7	29.6	26.9	15039	116	0.5	18.7	18.2	13297	76	1.3	40.8	39.5
16020	-	-	-	-	-	7450	101	2.7	14.6	11.9	13664	99	0.7	14.9	14.2	8592	111	1.3	21.0	19.7
16021	2770	21	1.3	15.5	14.2	4530	30	39.5	44.5	5.0	0					0				
16022	-	-	-	-	-	9845	100	2.7	18.7	16.0	7248	71	0.5	21.0	20.5	10957	101	0.5	21.0	20.5
16024						398	9	2.7	6.7	4.0	0					0				
16025						2316	67	-24.5	10.7	35.2	9668	119	-19.2	-9.0	10.2	1572	23	-12.9	47.5	60.4
16027	-	-	-	-	-	8249	87	2.7	18.7	16.0	15717	109	0.5	14.9	14.4	10960	72	0.5	10.2	9.7
16028	-	-	-	-	-	9063	92	2.7	19.0	16.3	98	8	6.2	9.9	3.7	6174	58	1.3	18.7	17.4
16029	3801	62	-32.1	26.0	58.1	6087	102	-26.5	-6.6	19.9	4940	83	-19.2	-9.0	10.2	13325	102	-19.5	-3.5	16.0
16030	7733	86	0.0	15.5	15.5	6414	86	2.7	17.1	14.4	13494	86	0.7	26.2	25.5	16498	104	0.5	27.9	27.4
16031	-	-	-	-	-	12814	104	2.7	19.0	16.3	10315	106	0.5	14.9	14.4	12775	99	1.3	14.9	13.6
16032	5801	56	1.3	15.5	14.2	13833	120	2.7	18.7	16.0	17055	115	1.3	21.0	19.7	16765	118	0.5	18.7	18.2
16033	5144	44	1.3	15.5	14.2	3001	43	-24.5	13.0	37.5	0					0				
16033b	-	-	-	-	-	-	-	-	-	-	3505	30	2.5	14.9	12.4	13578	101	1.3	18.7	17.4
16034	15378	75	1.3	12.5	11.2	15394	61	39.5	41.7	2.2	38582	117	42.7	43.5	0.8	25117	99	42.7	47.5	4.8
16035	1547	12	4.6	15.5	10.9	8767	91	2.7	17.1	14.4	19324	116	0.7	21.0	20.3	16298	121	1.3	21.0	19.7
16037	8375	50	1.3	10.5	7.4	13685	108	2.7	14.6	11.9	21481	125	-29.4	14.9	44.3	13636	91	-32.3	14.9	47.2
16038	5777	45	1.3	12.5	11.2	3402	87	-12.3	18.7	31.0	7973	124	-19.2	-9.9	9.3	3975	76	-19.5	-9.5	10.0
16040	9602	70	0.0	12.5	12.5	8598	109	6.7	18.7	12.0	21959	128	0.7	18.7	18.0	4833	62	0.5	18.7	18.2
16041	15169	88	1.3	12.5	11.2	9437	81	2.7	18.7	40.7	8915	81	0.5	14.9	14.4	13556	111	0.5	14.9	14.4
16043	20429	92	0.0	15.5	15.5	13049	98	2.7	14.6	11.9	12476	115	0.5	14.9	14.4	13303	118	2.9	18.7	15.8
16044	1582	36	0.0	8.7	8.7	3932	53	2.7	14.6	11.9	0					0				
16046	8350	72	1.3	26.0	24.7	199	68	-16.0	7.5	23.5	360	10	-17.1	-9.9	7.2	0				
16047	131	2	6.3	26.0	19.7	0					0					0				
16049	1919	12	1.3	12.5	11.2	11705	102	2.7	29.6	26.9	24320	123	0.5	28.2	27.7	11319	83	0.5	27.9	27.4
16050	6519	57	0.0	15.5	15.5	7755	85	2.7	14.6	11.9	14411	88	0.7	14.9	14.2	7019	69	1.3	21.0	19.7
16052	1920	17	1.3	12.5	11.2	4785	80	2.7	18.7	16.0	9791	65	0.5	21.0	20.5	8323	68	1.3	21.0	19.7
16053	2740	18	0.0	12.5	12.5	13416	114	2.7	18.7	16.0	17049	126	0.5	18.7	18.2	13586	95	0.5	21.0	20.5
32167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10421	91	0.5	21.0	20.5
32168	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18169	100	0.5	21.0	20.5
32169	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	614	20	0.5	2.9	2.4
32170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5151	77	0.5	21.0	20.5
32171	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36691	103	1.3	18.7	17.4
32172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19105	86	0.5	10.2	9.7
32173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24278	103	0.5	10.2	9.7

APPENDIX 2:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON, UPSTREAM OF GULL RAPIDS, JUNE 2011 TO OCTOBER 2014

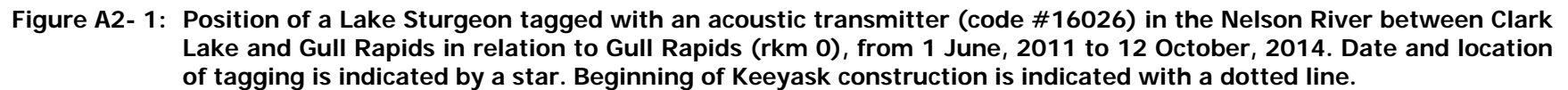
Figure A2- 1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16026) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	66
Figure A2- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16036) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	67
Figure A2- 3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16039) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	68
Figure A2- 4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16042) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	69
Figure A2- 5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16045) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	70
Figure A2- 6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16048) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.	71

- Figure A2- 7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16051) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 72
- Figure A2- 8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16054) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 73
- Figure A2- 9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16055) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 74
- Figure A2- 10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16056) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 75
- Figure A2- 11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16057) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 76
- Figure A2- 12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16058) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2013. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 77
- Figure A2- 13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16059) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 78
- Figure A2- 14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16060) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 79

- Figure A2- 15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16061) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 80
- Figure A2- 16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16062) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 81
- Figure A2- 17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16063) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 82
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- Figure A2- 22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16068) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 87

- Figure A2- 23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16069) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 88
- Figure A2- 24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16070) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 89
- Figure A2- 25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16071) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 90
- Figure A2- 26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16072) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 91
- Figure A2- 27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16073) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 92
- Figure A2- 28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16074) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 93
- Figure A2- 29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16075) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 94
- Figure A2- 30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16076) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 95

- Figure A2- 31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16077) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 96
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- Figure A2- 35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32177) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 100



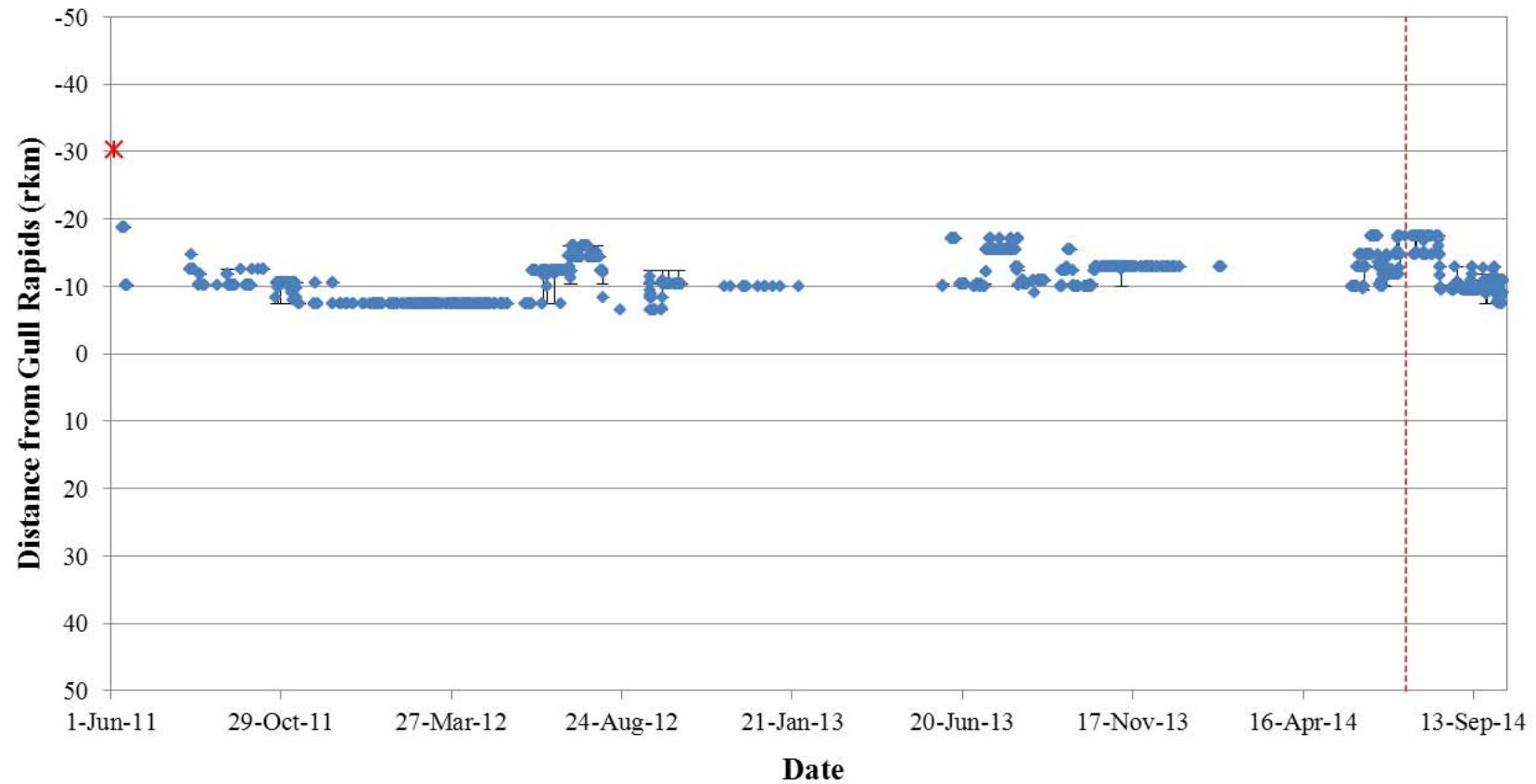


Figure A2- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16036) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

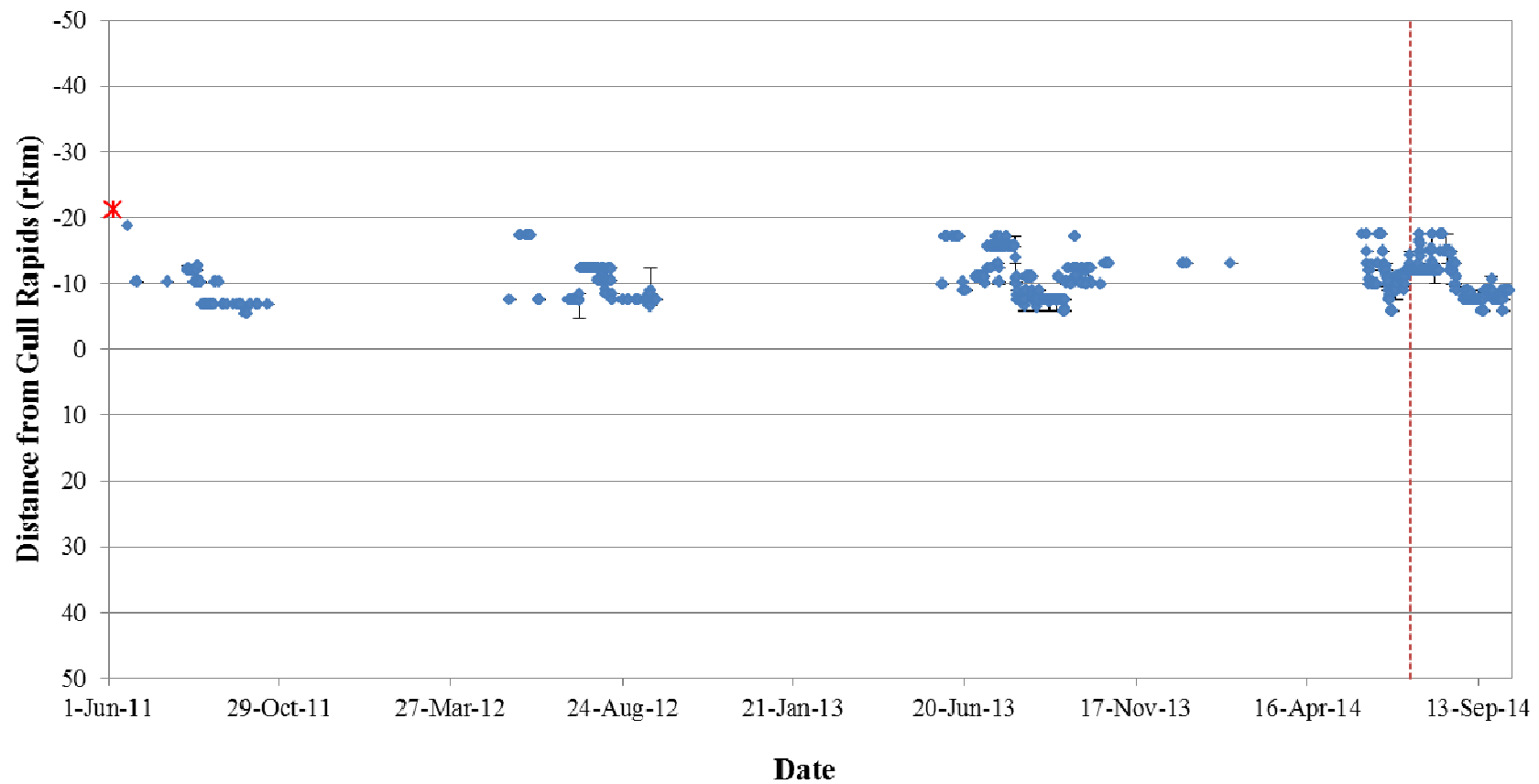


Figure A2- 3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16039) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

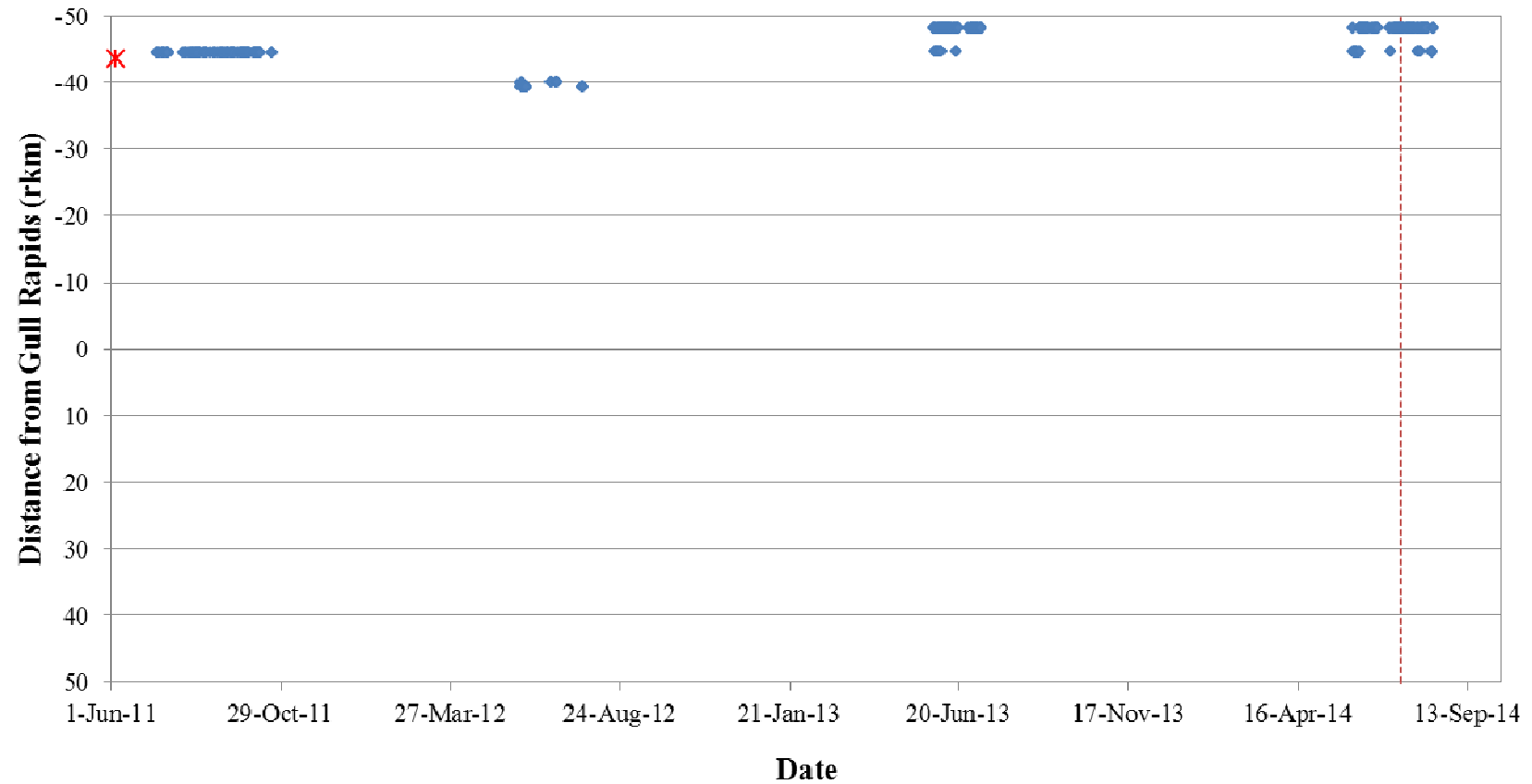


Figure A2- 4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16042) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

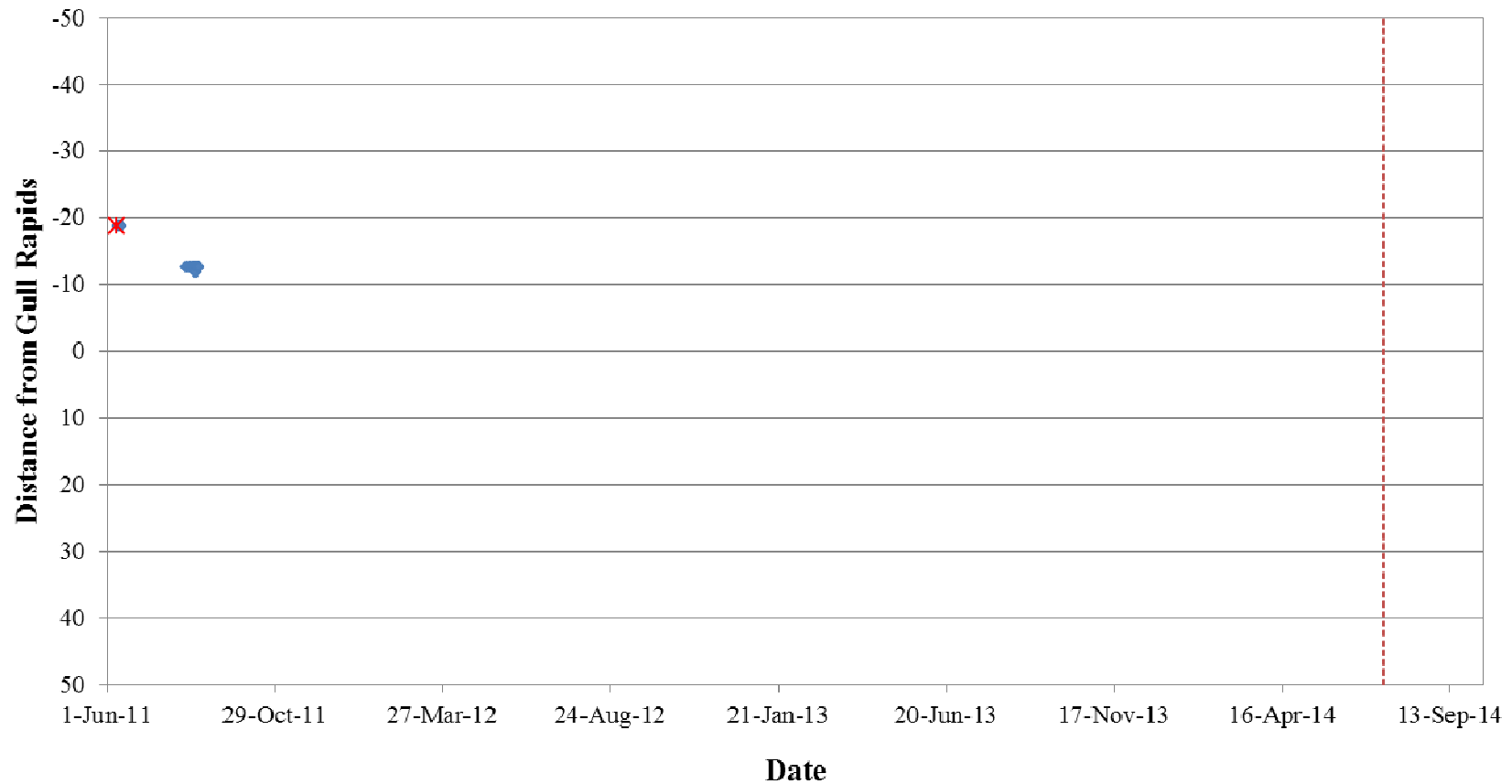


Figure A2- 5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16045) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

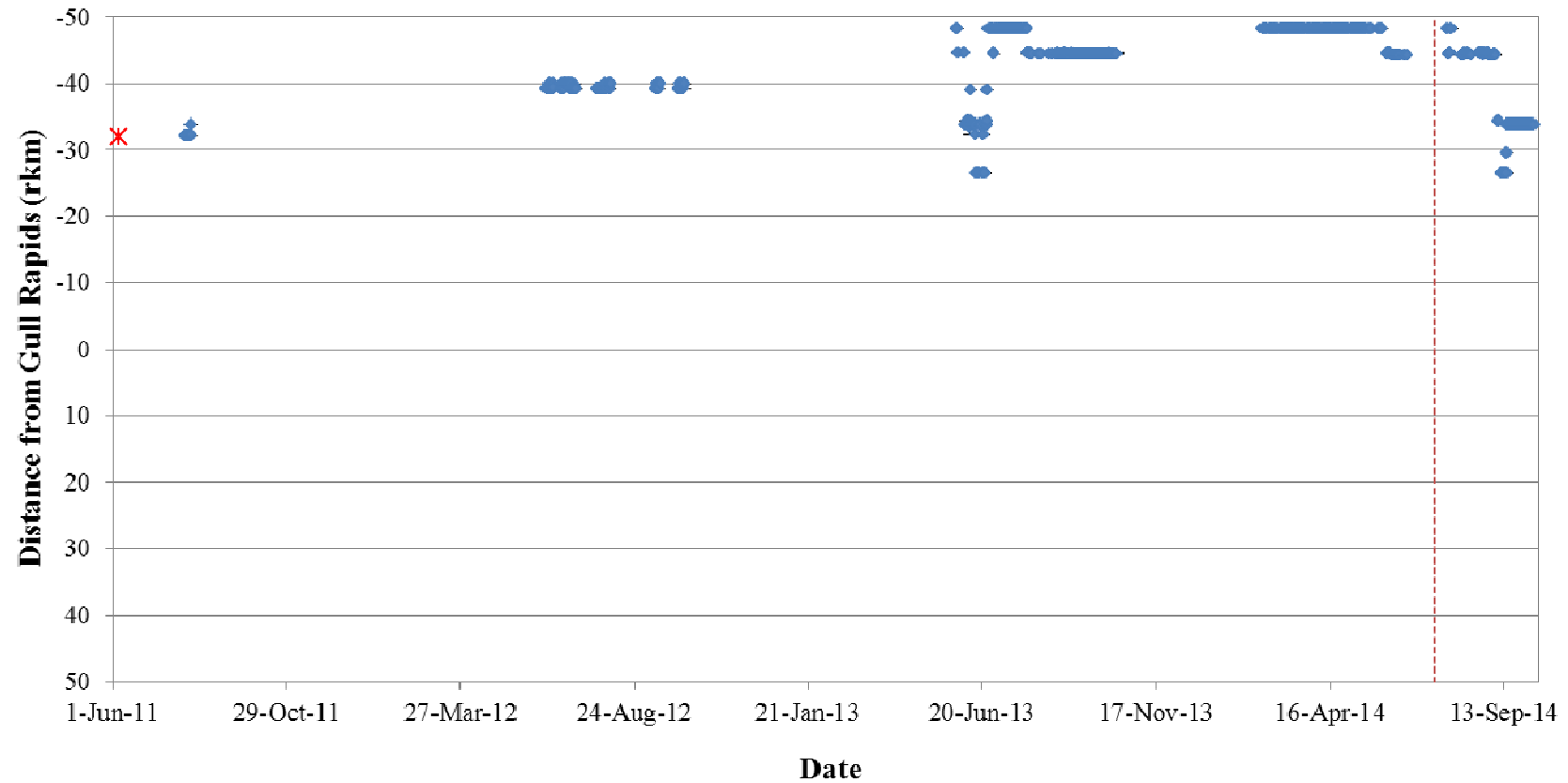


Figure A2- 6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16048) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

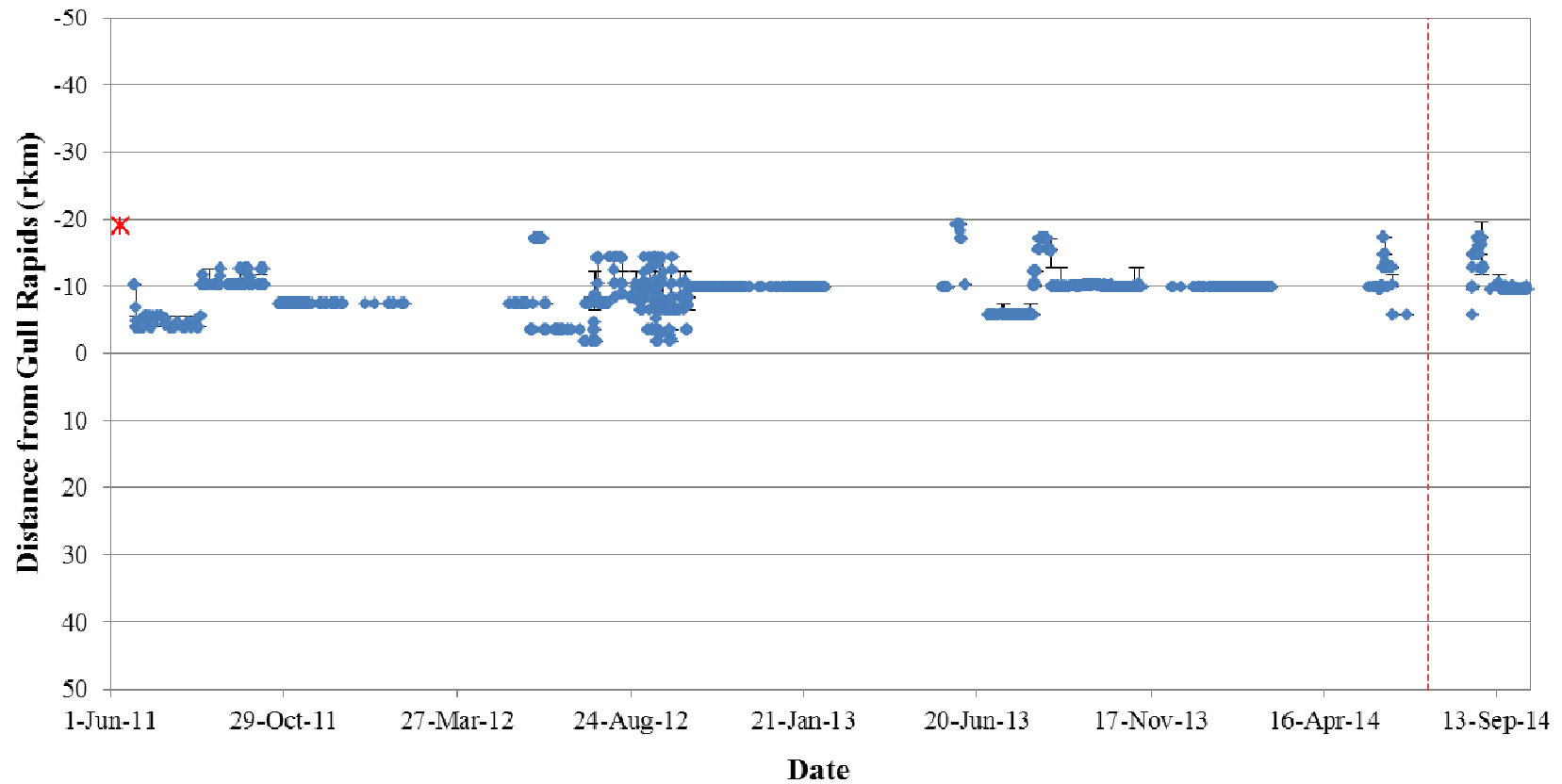


Figure A2- 7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16051) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

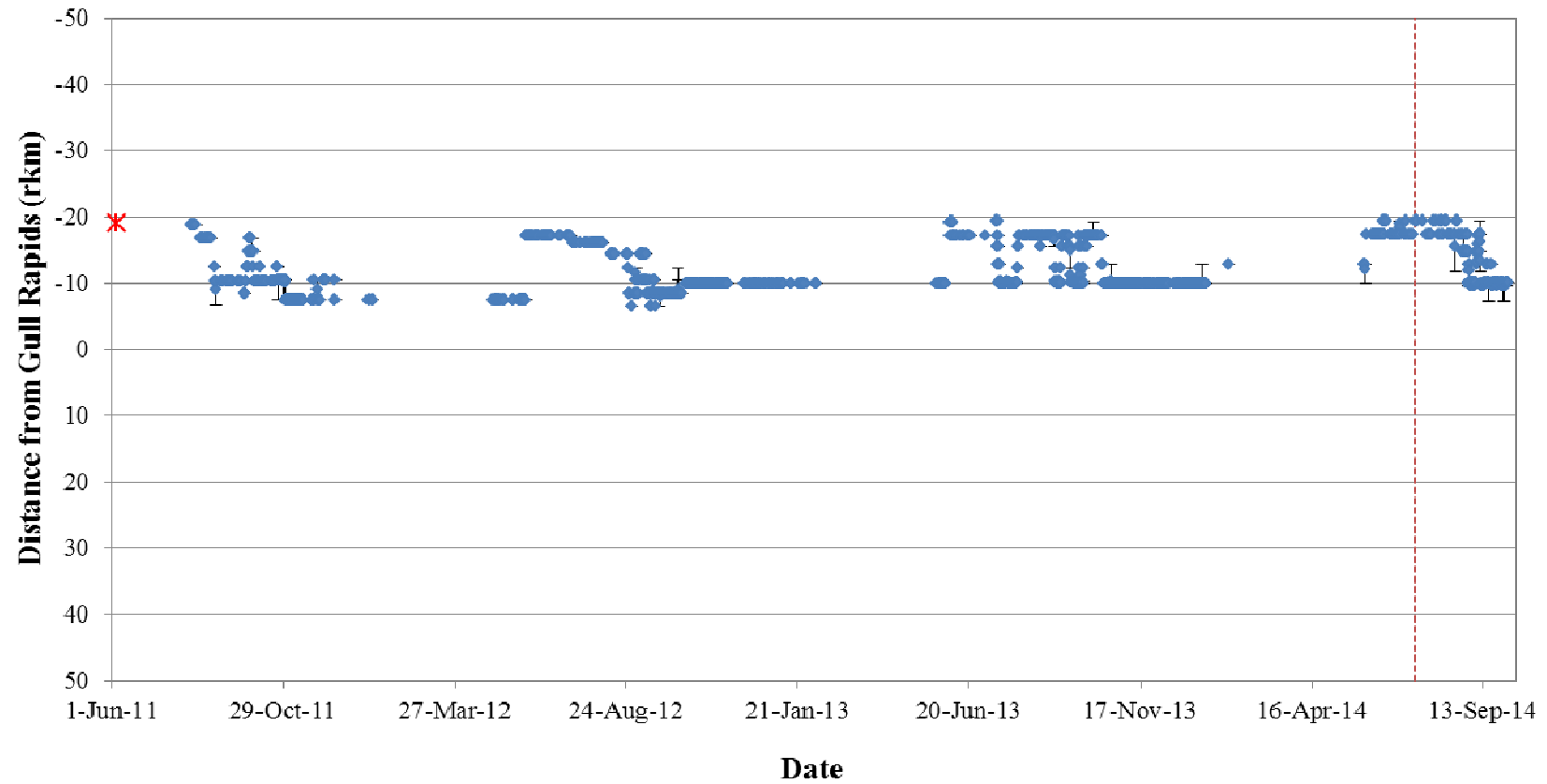


Figure A2- 8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16054) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

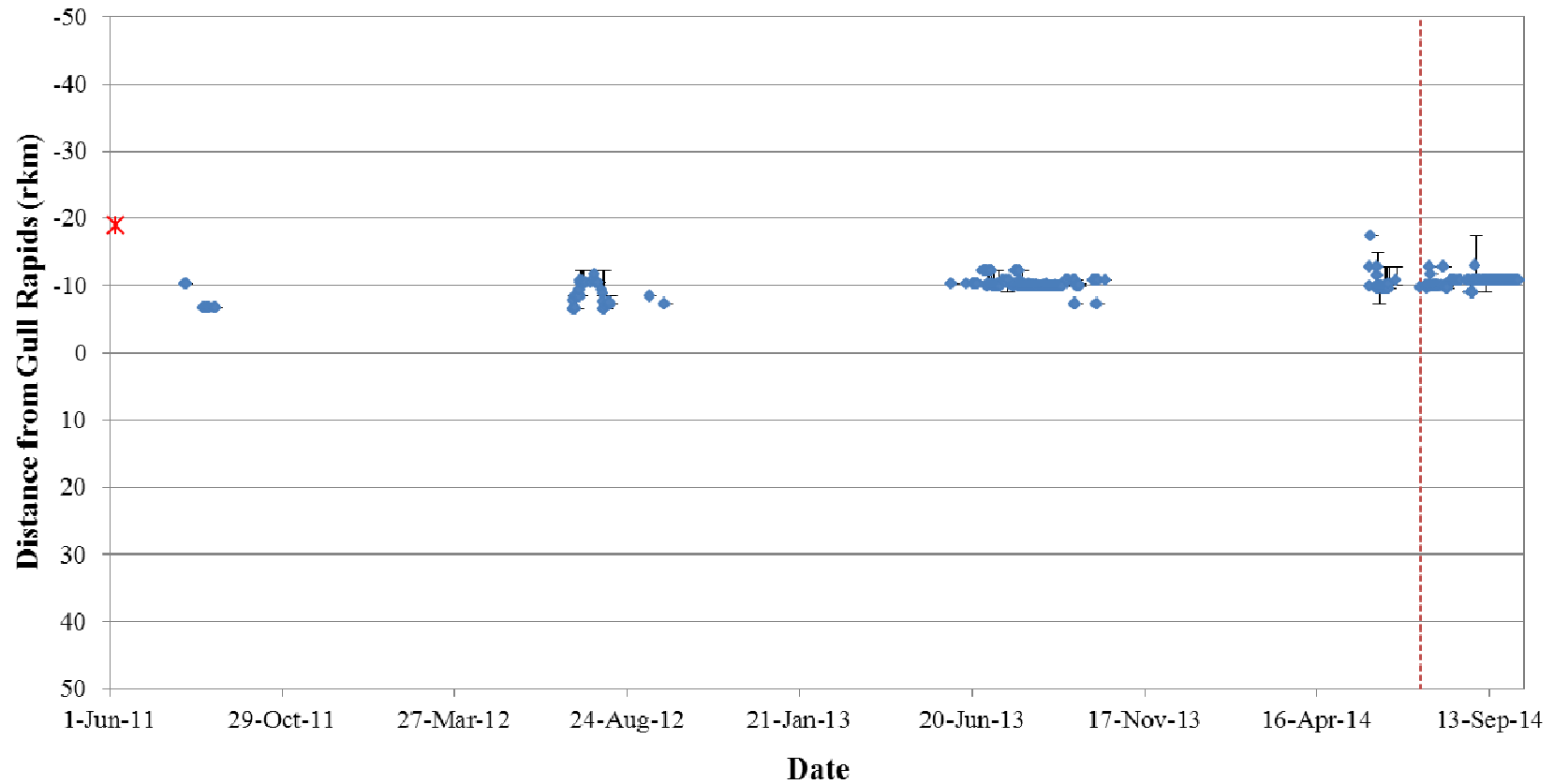


Figure A2- 9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16055) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

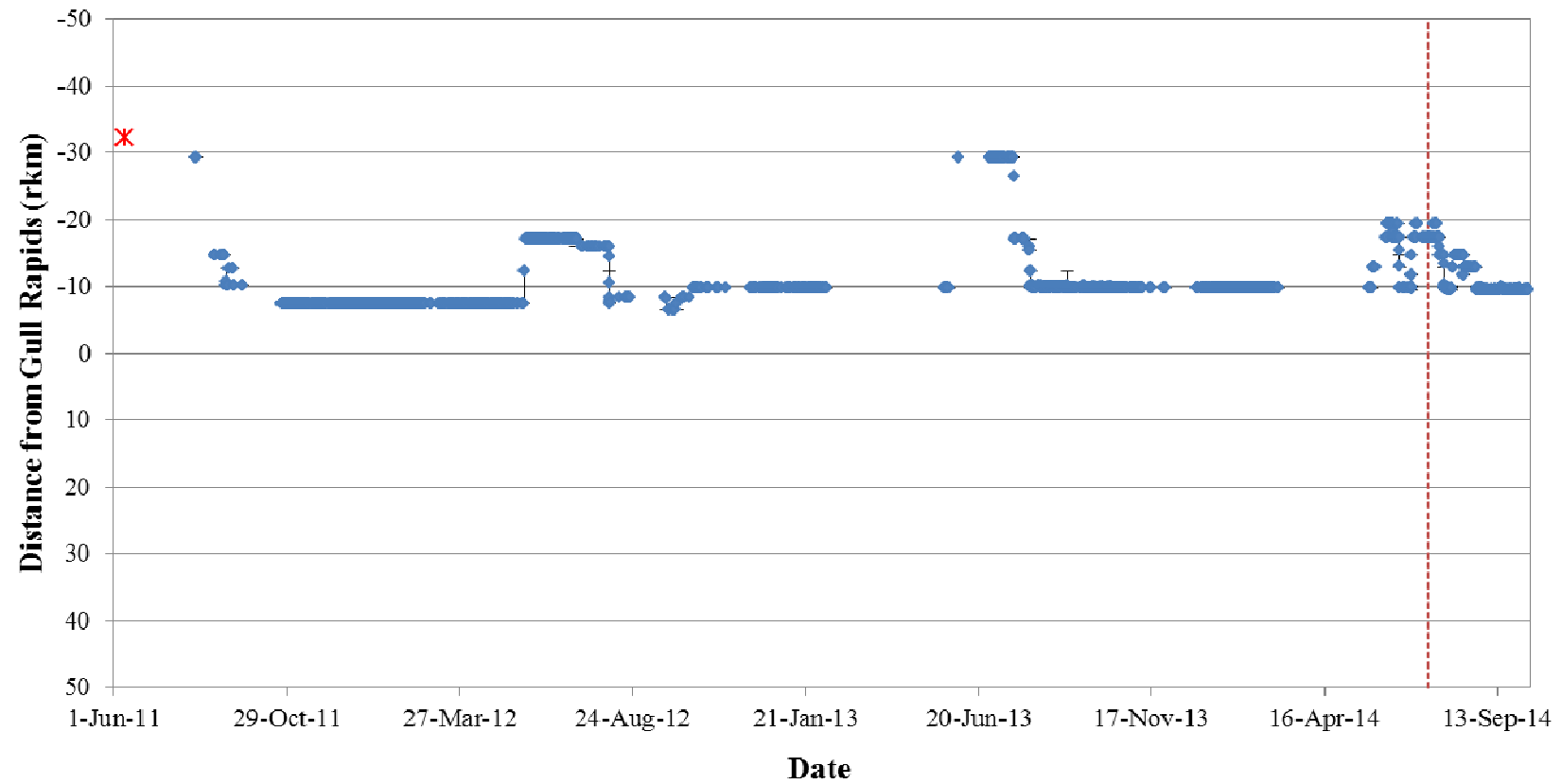
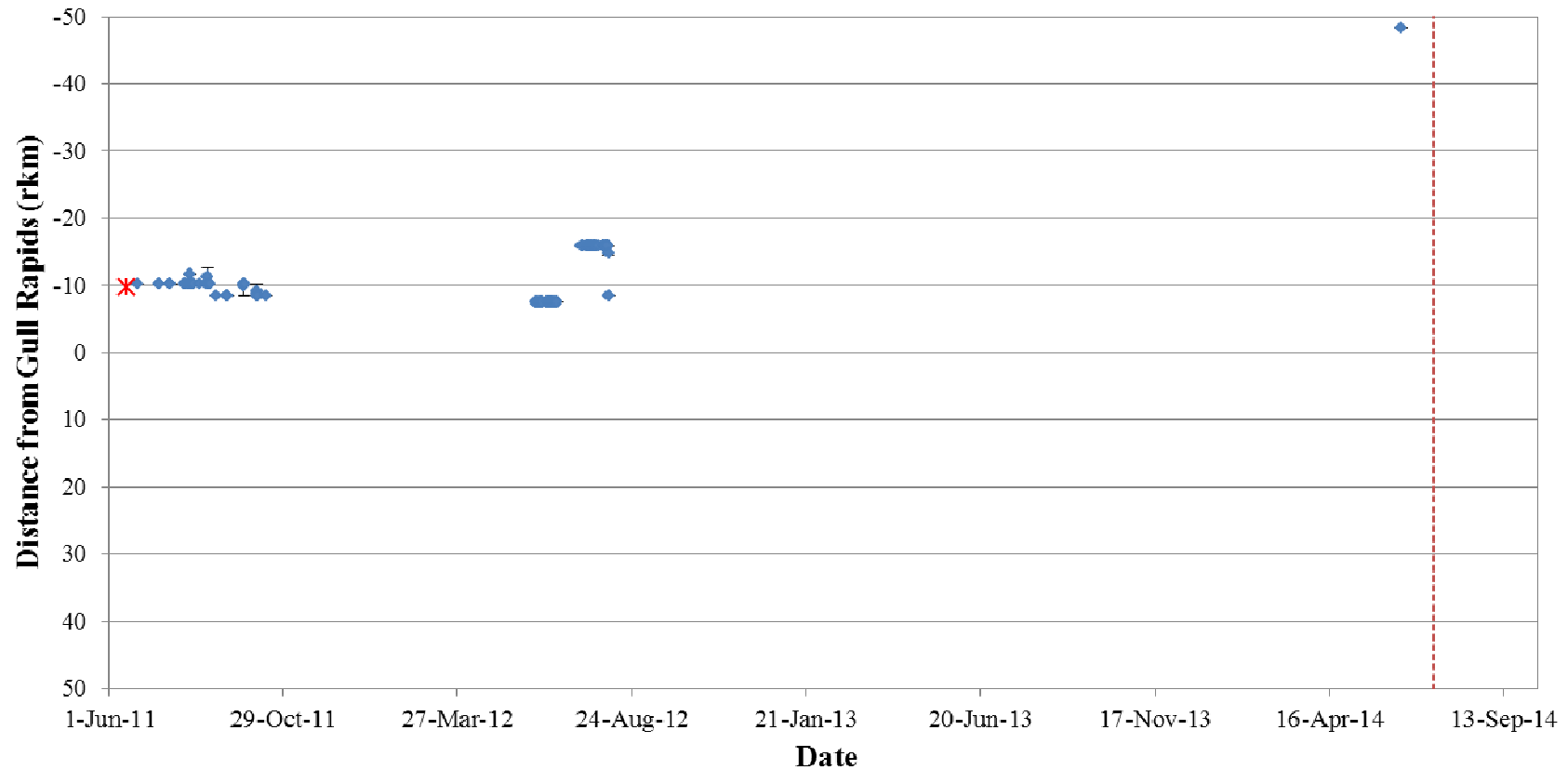


Figure A2- 10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16056) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



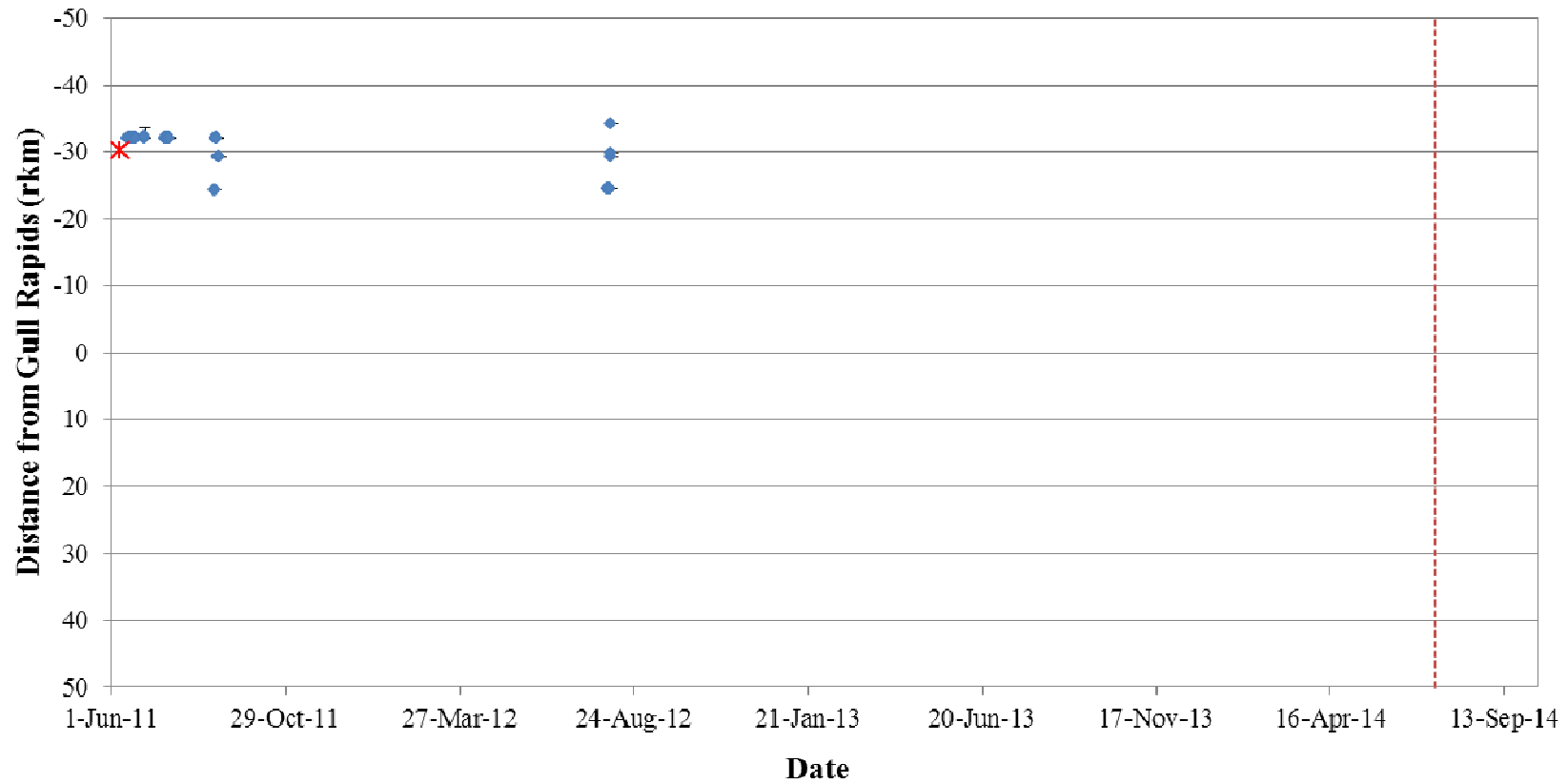


Figure A2- 12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16058) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 15 October, 2013. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

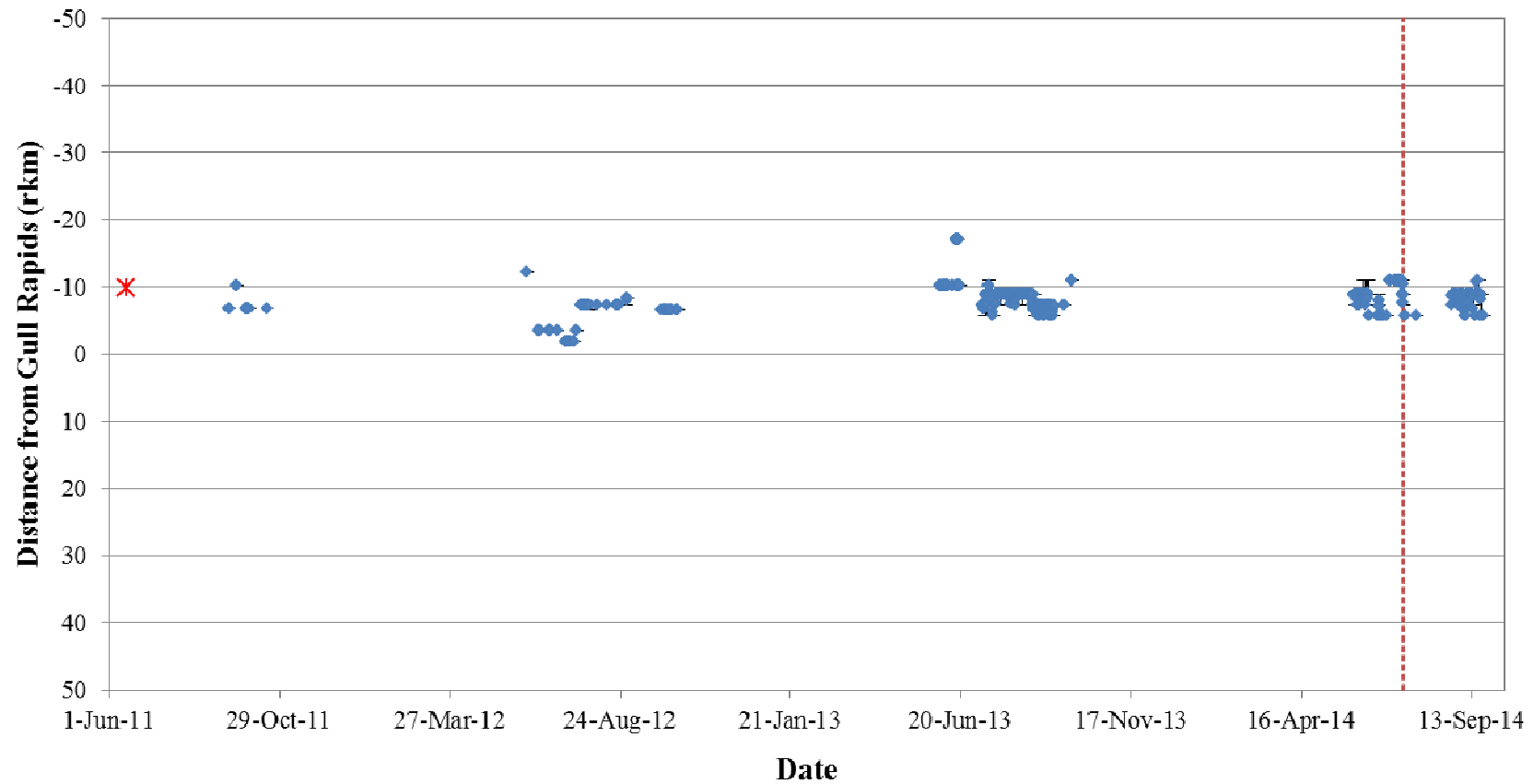


Figure A2- 13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16059) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

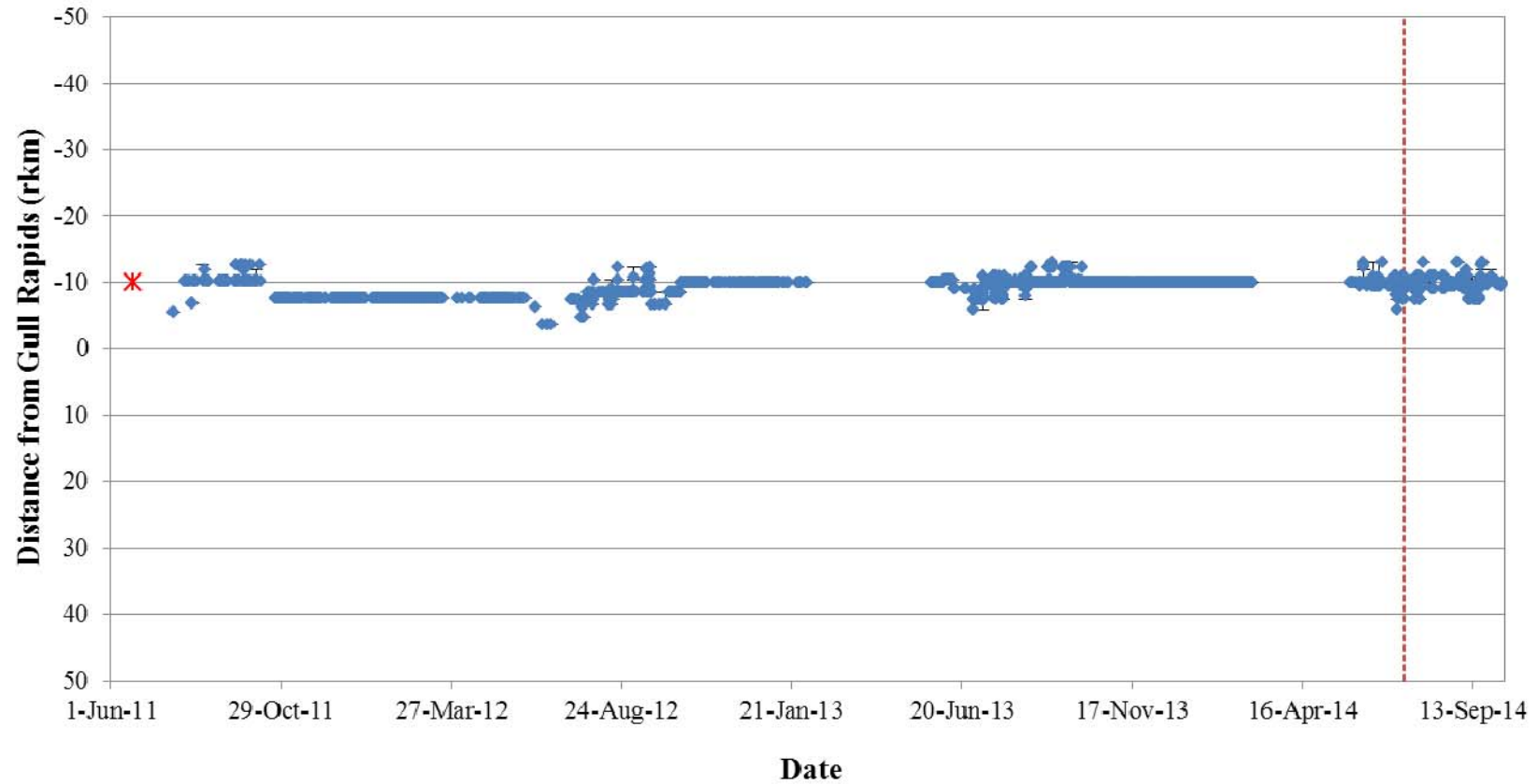


Figure A2- 14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16060) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

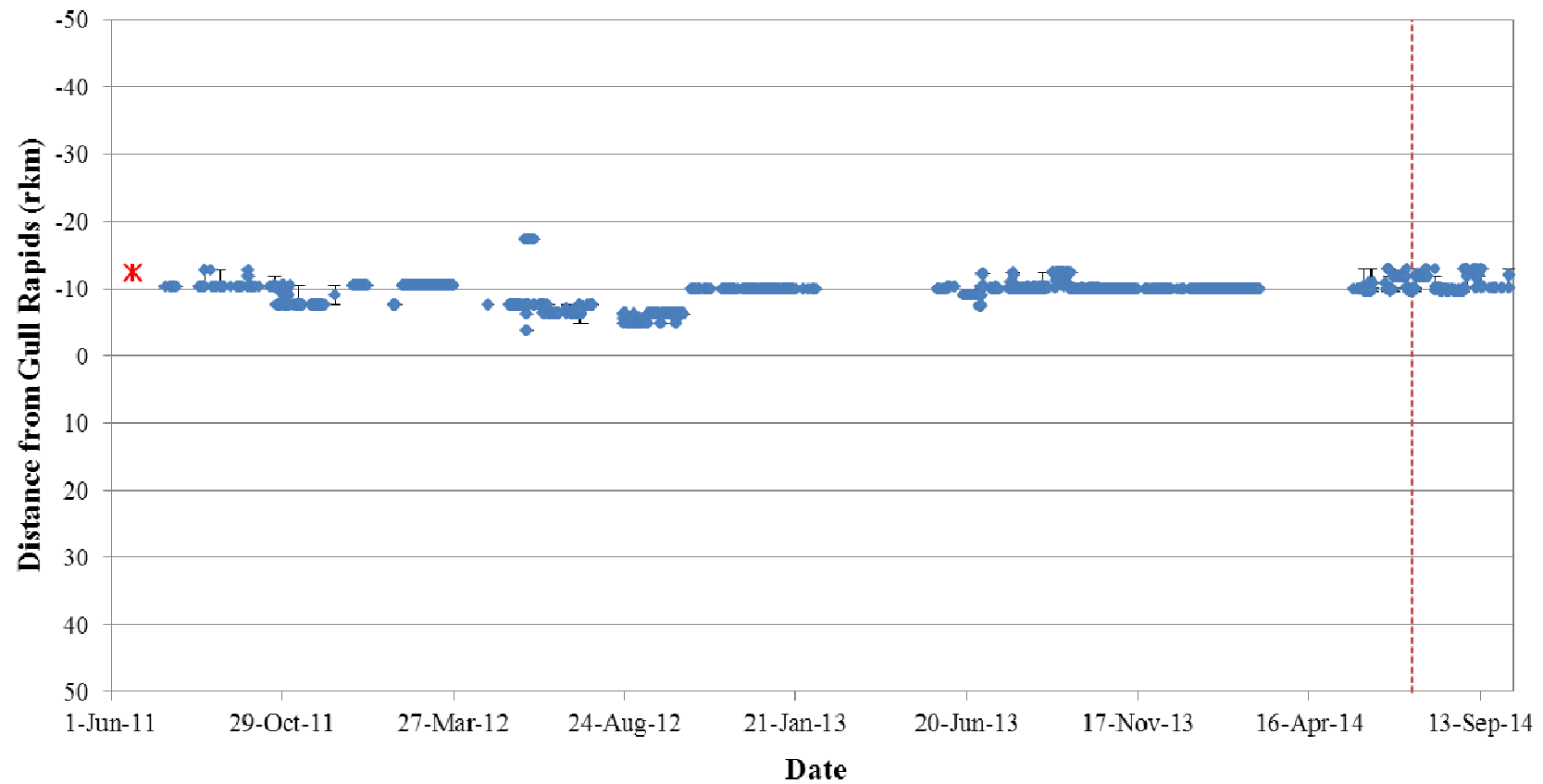


Figure A2- 15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16061) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

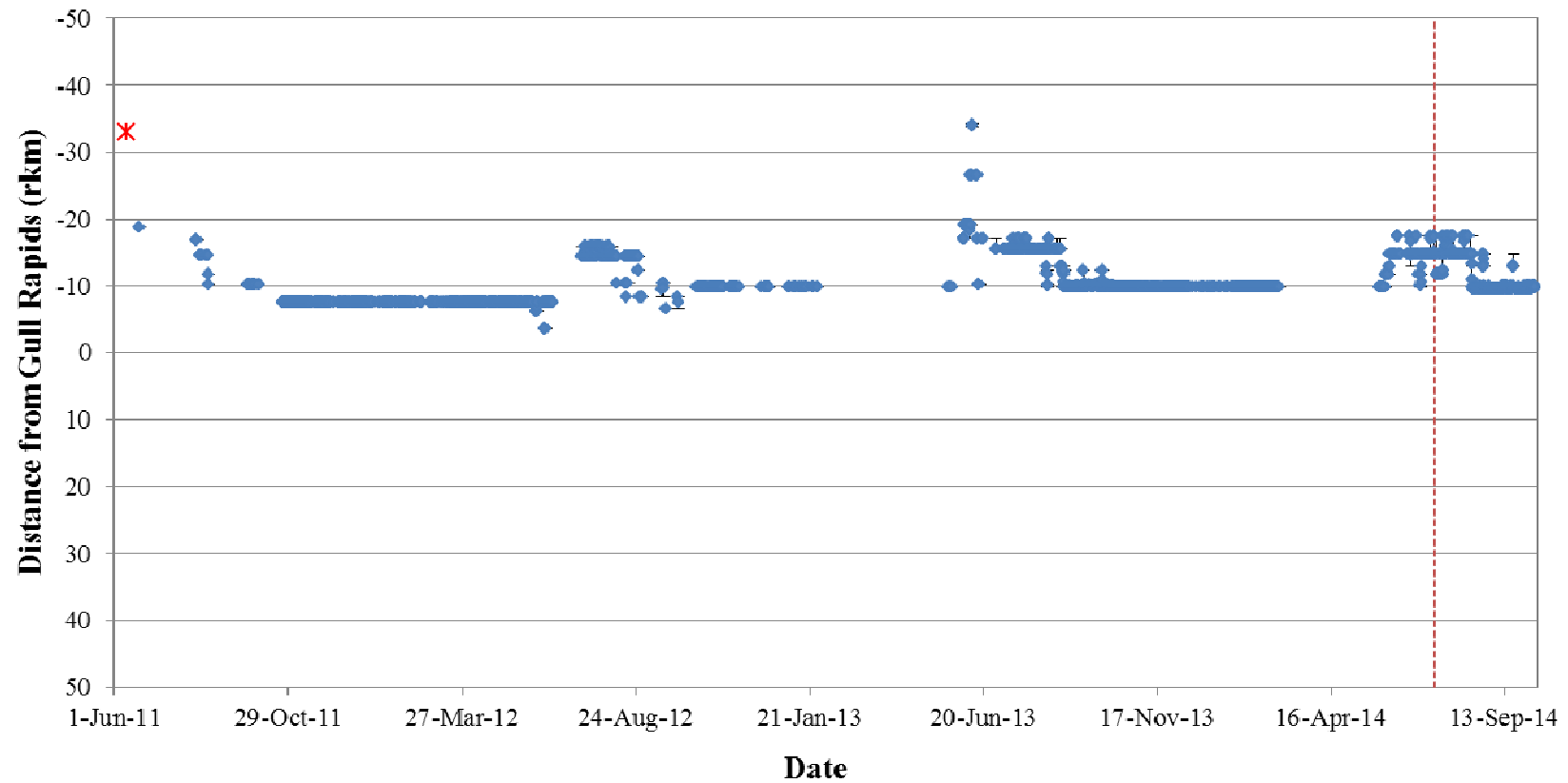


Figure A2- 16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16062) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

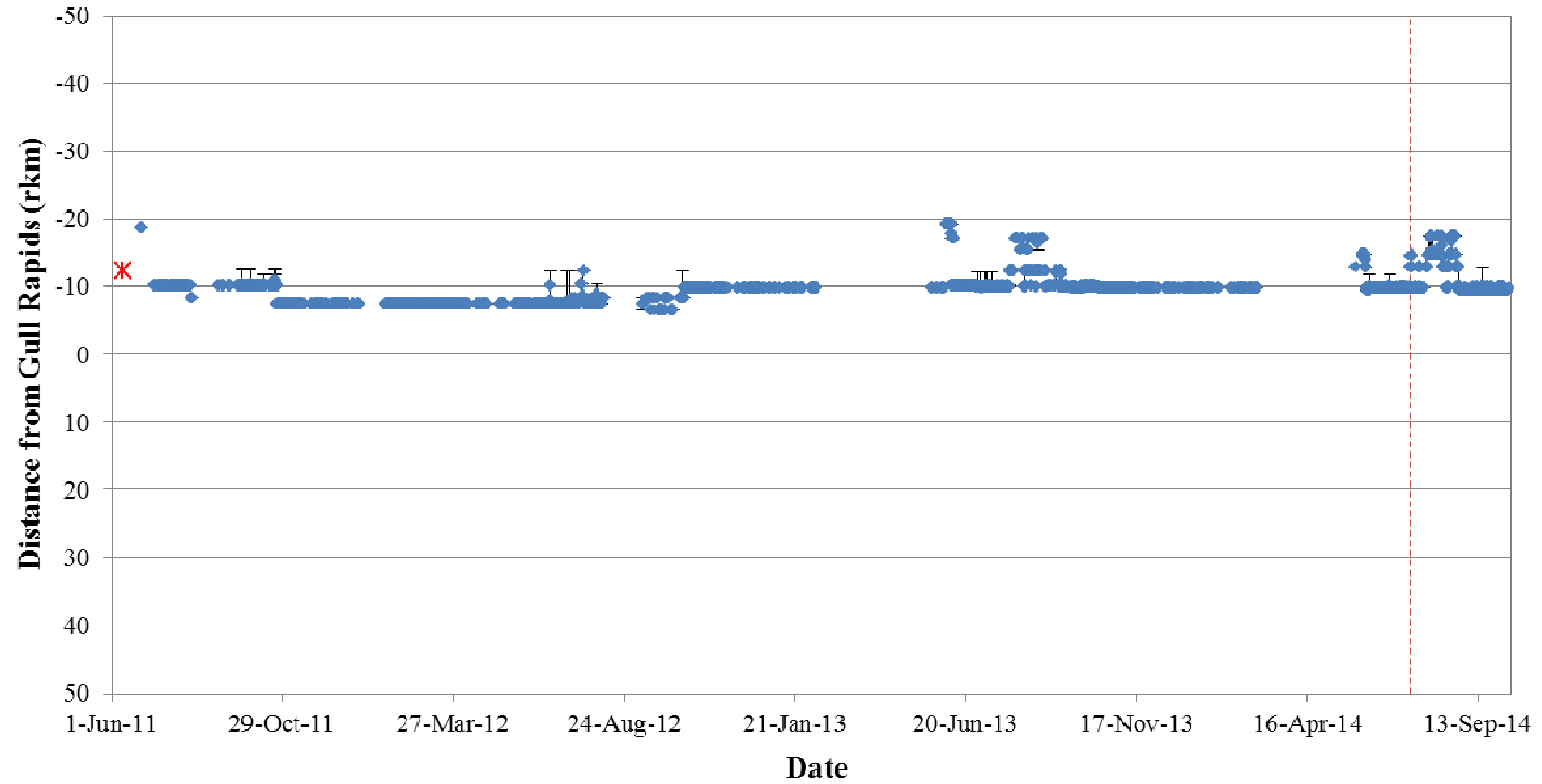
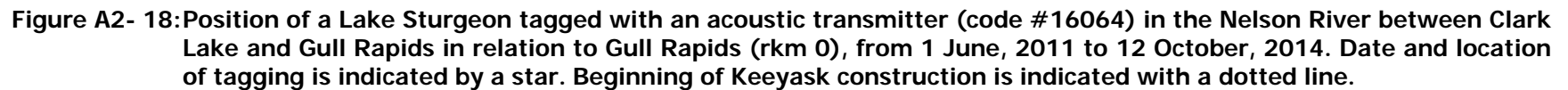


Figure A2- 17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16063) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



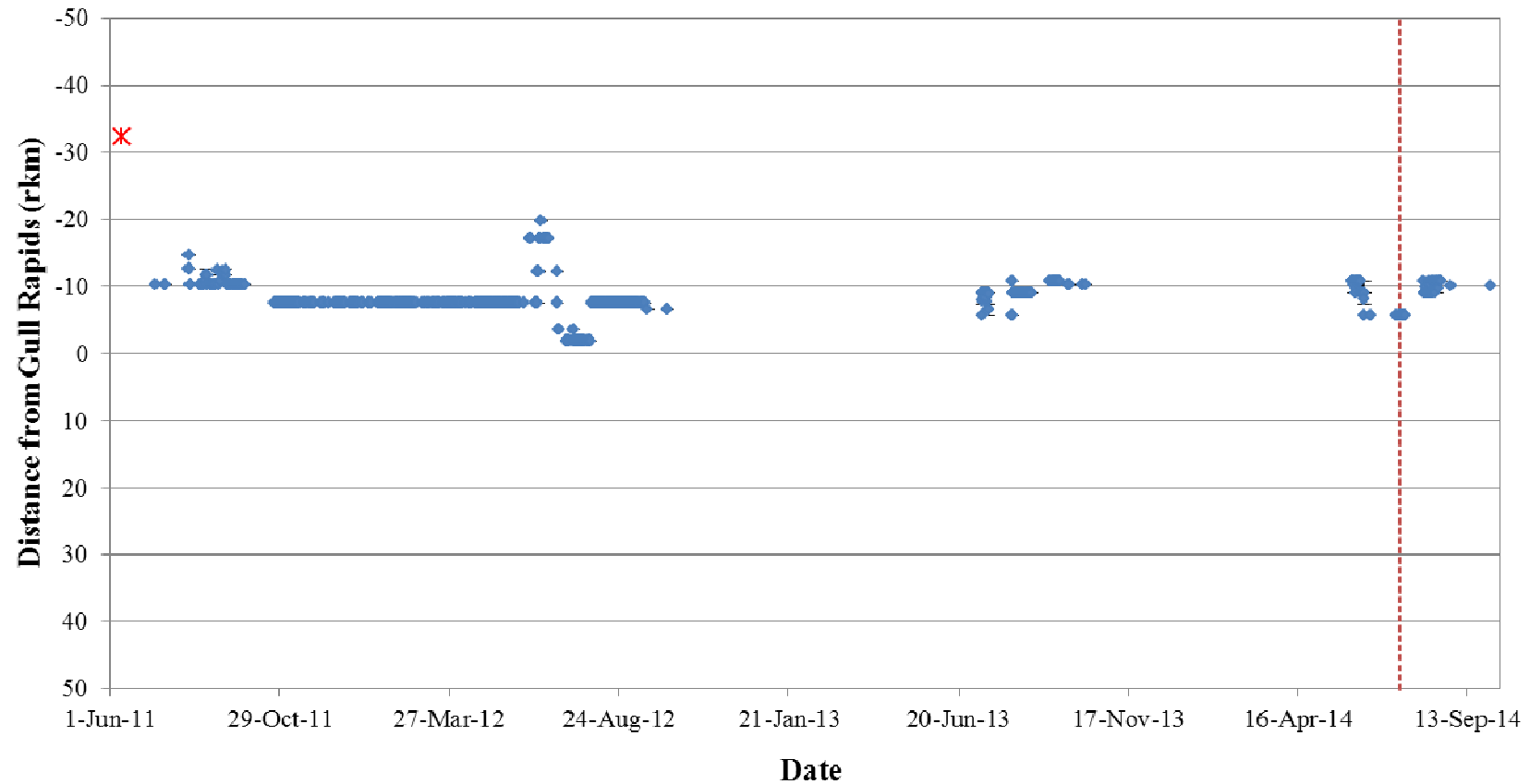


Figure A2- 19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16065) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

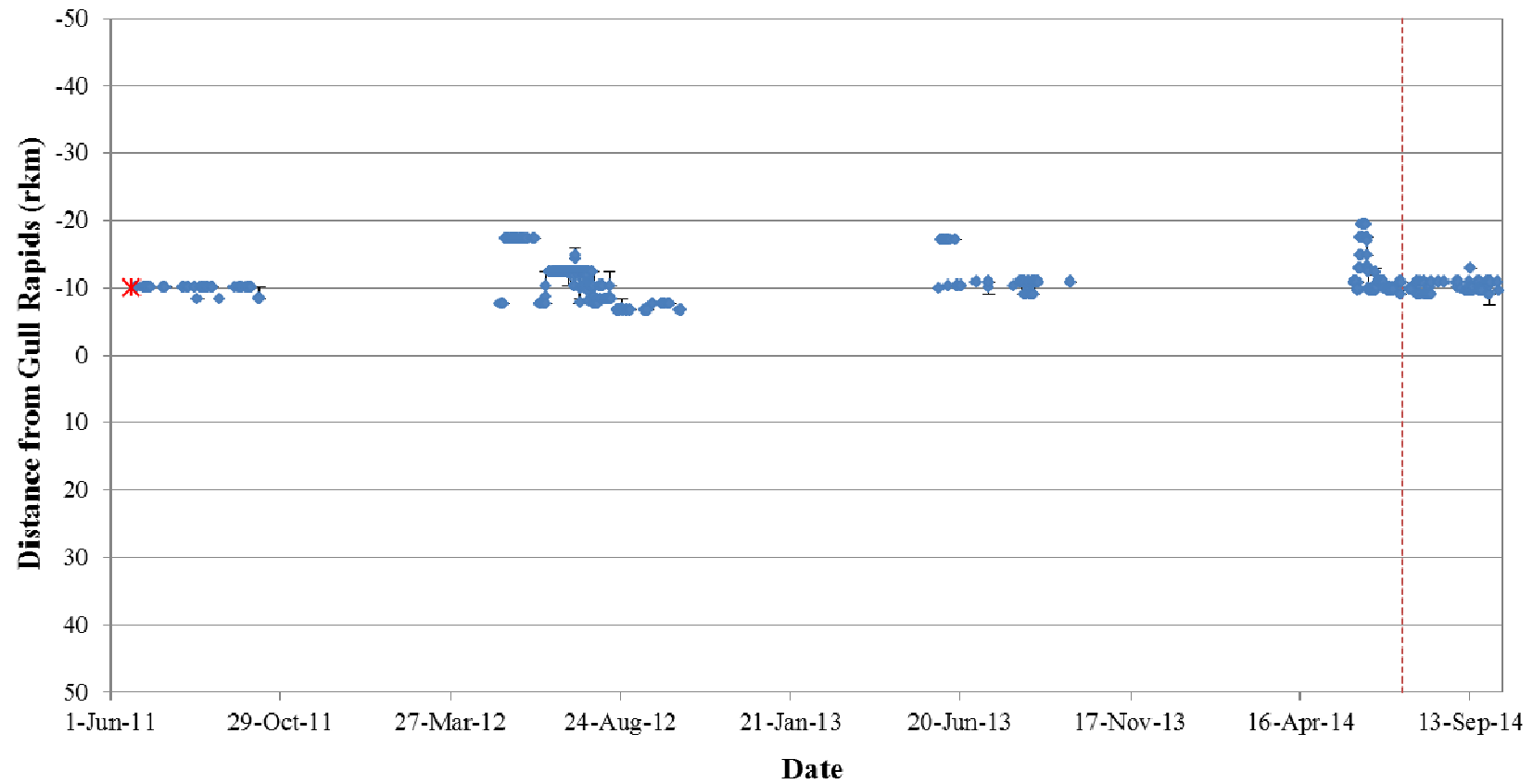
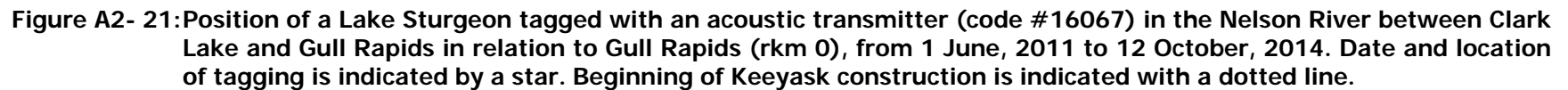


Figure A2- 20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16066) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



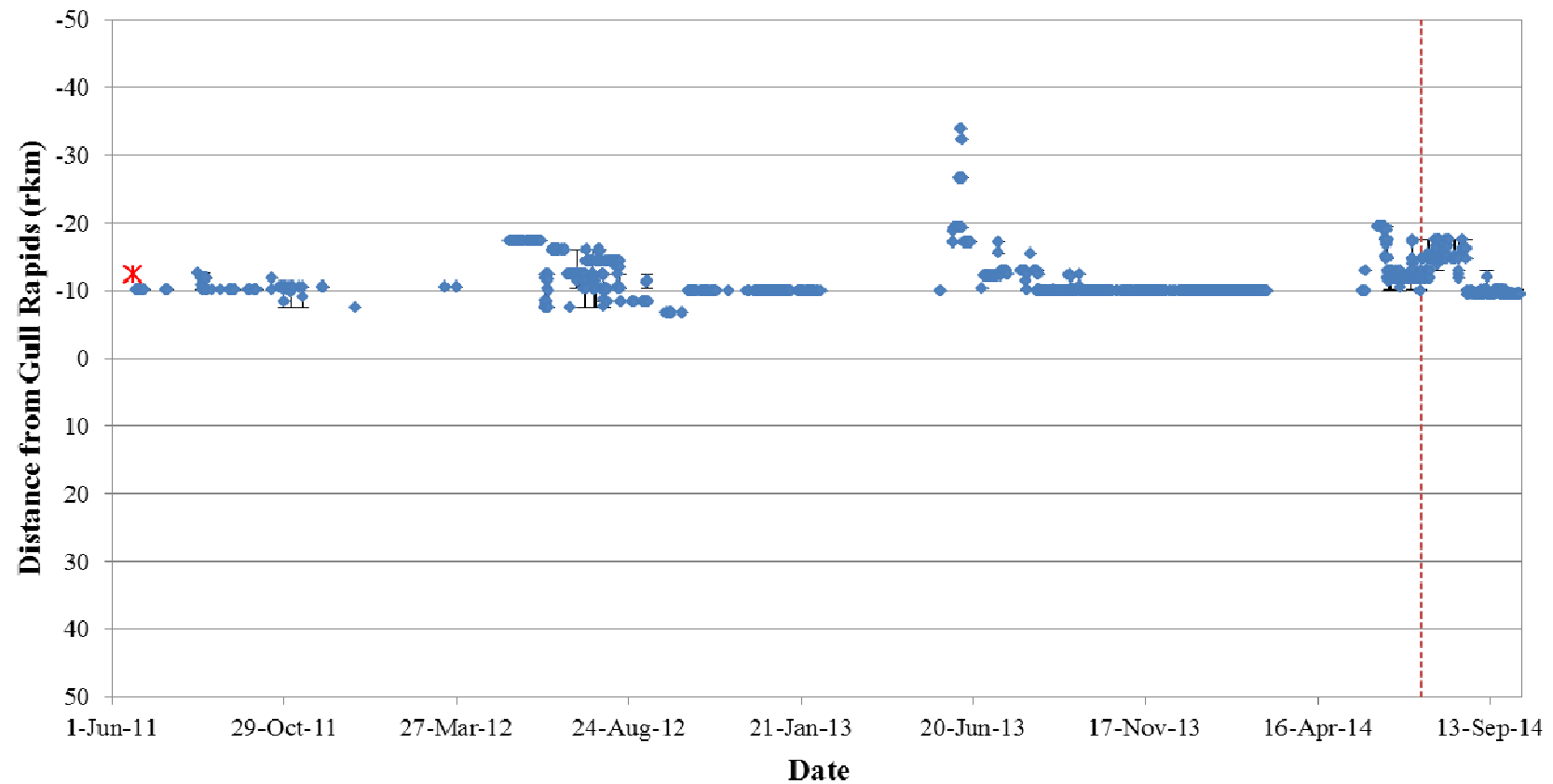


Figure A2- 22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16068) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

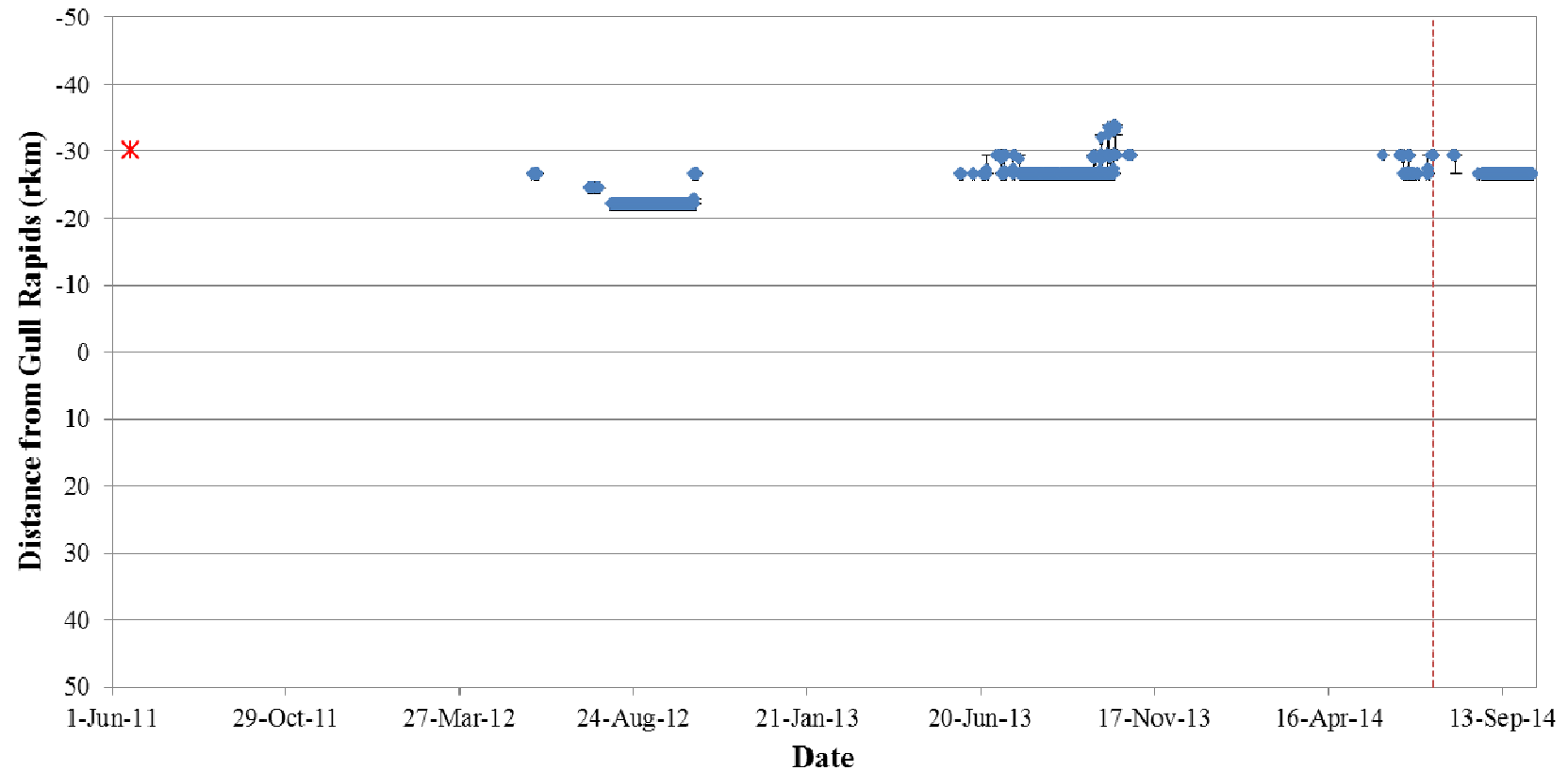


Figure A2- 23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16069) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

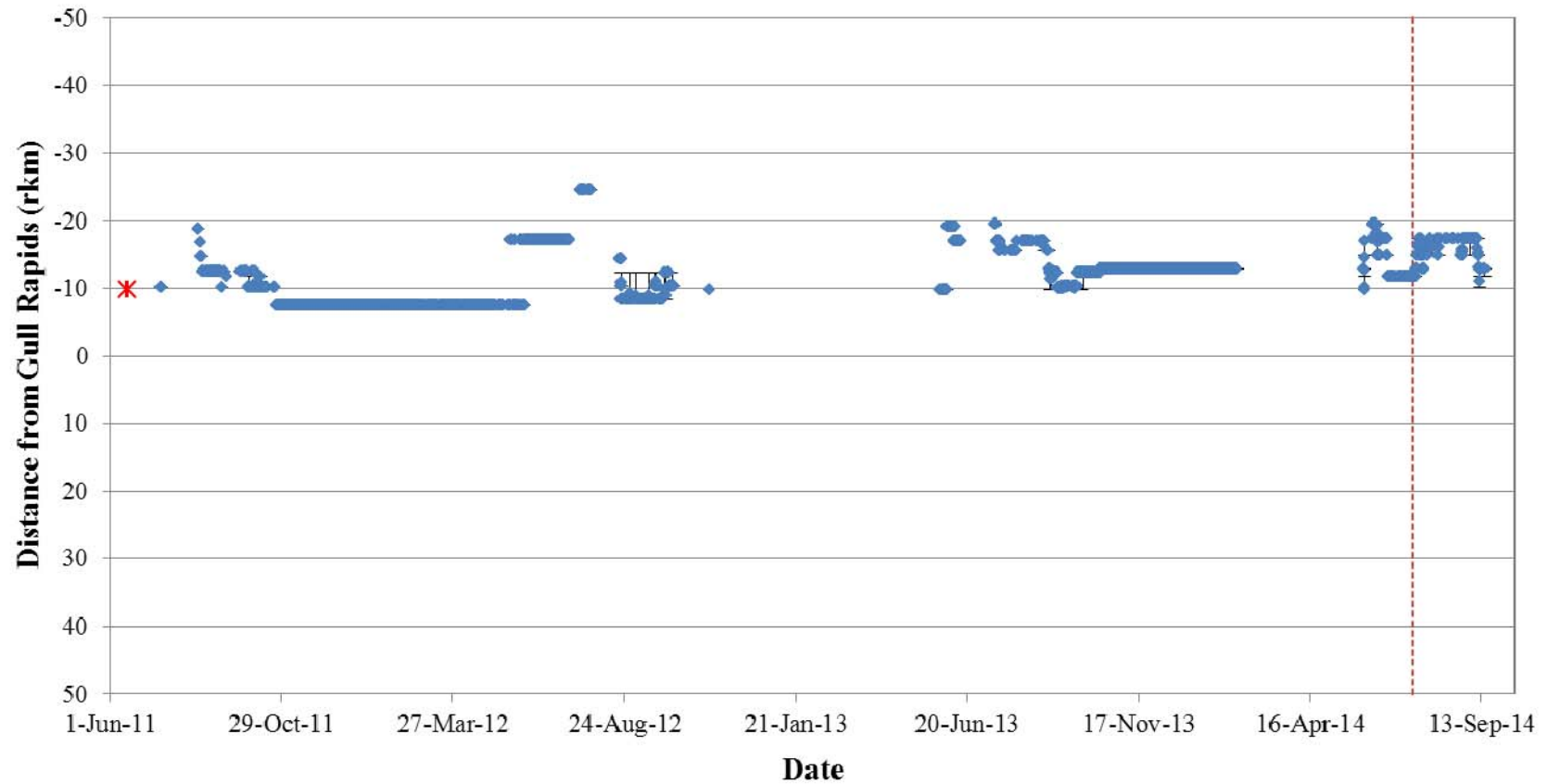


Figure A2- 24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16070) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

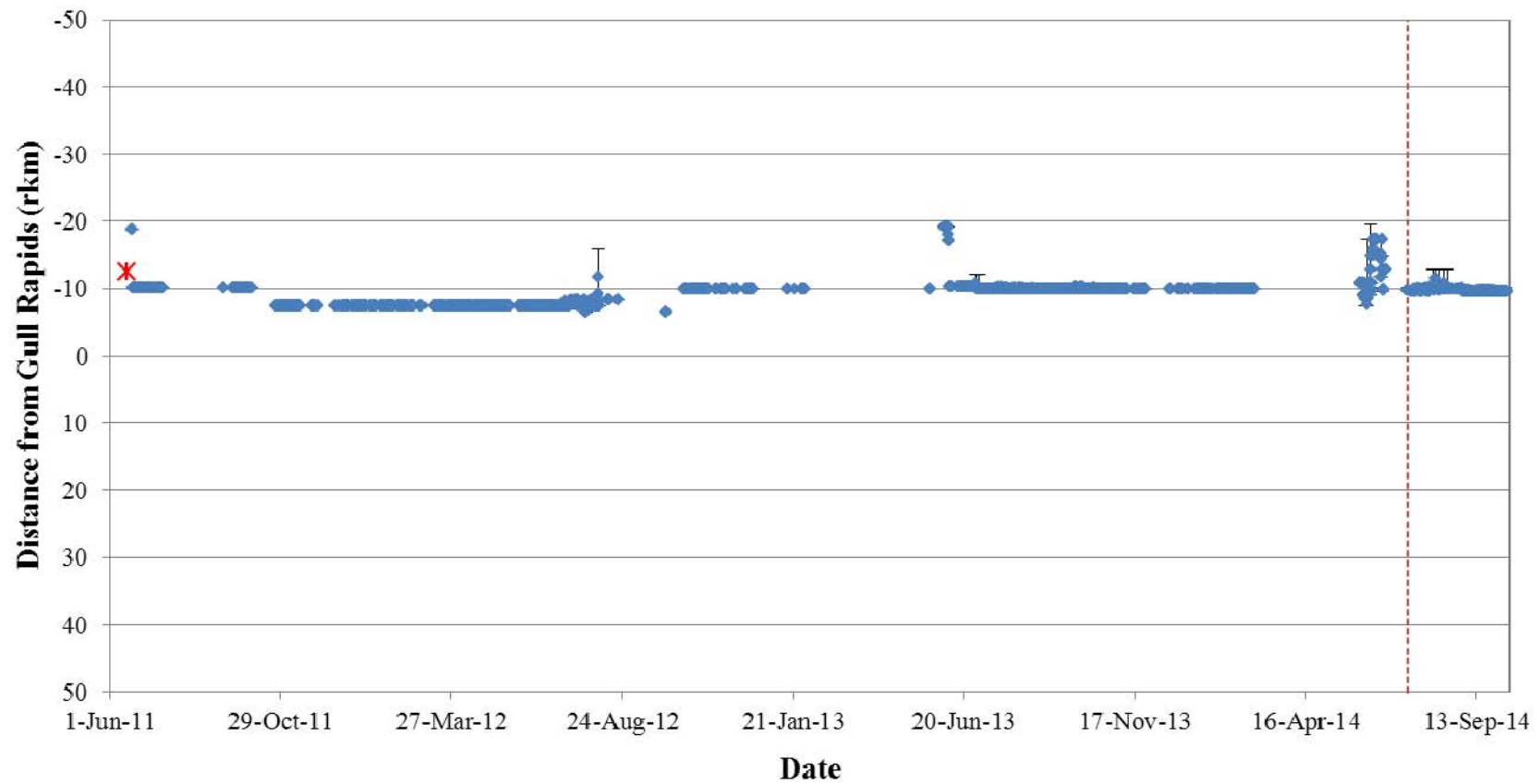


Figure A2- 25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16071) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. The Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

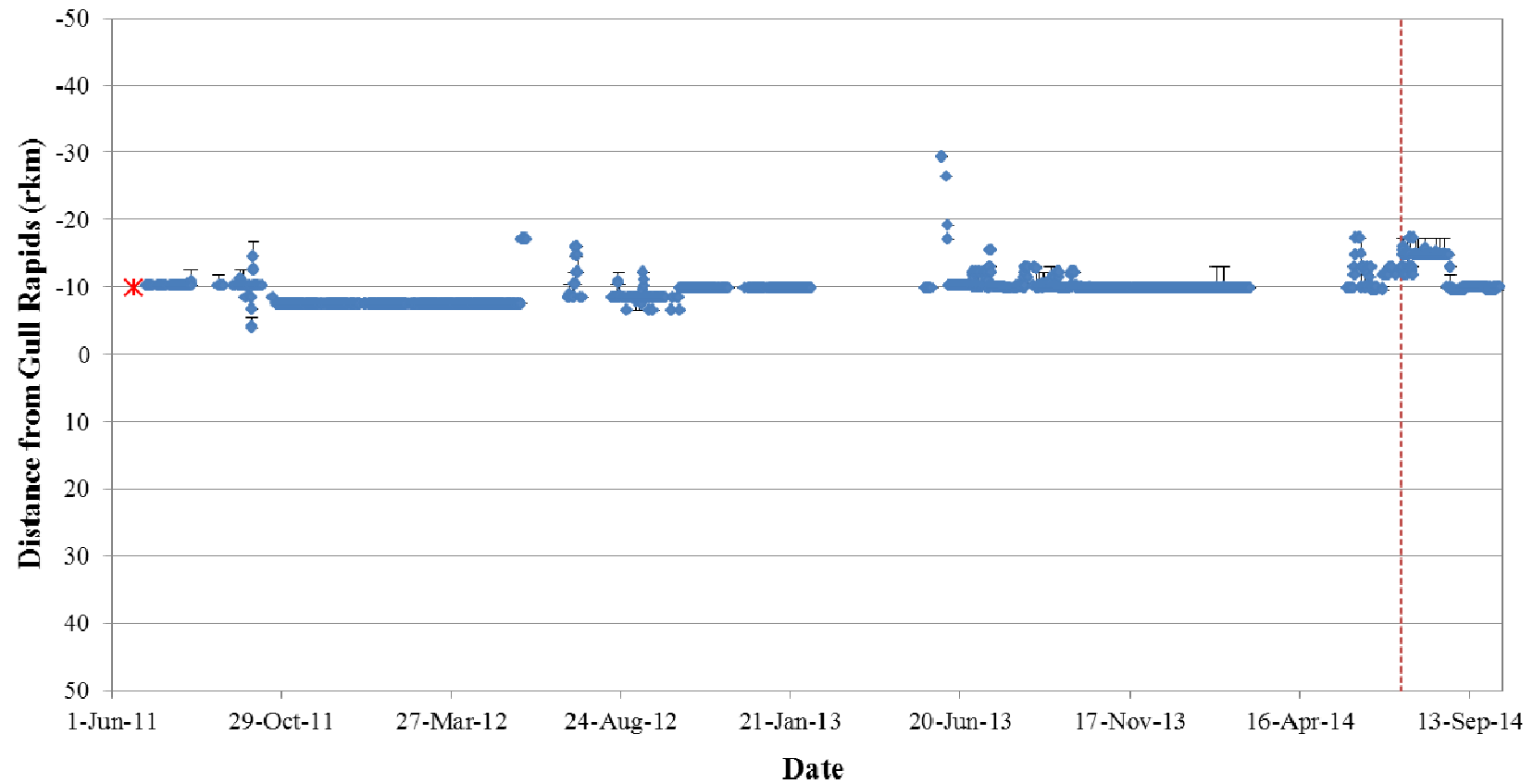


Figure A2- 26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16072) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

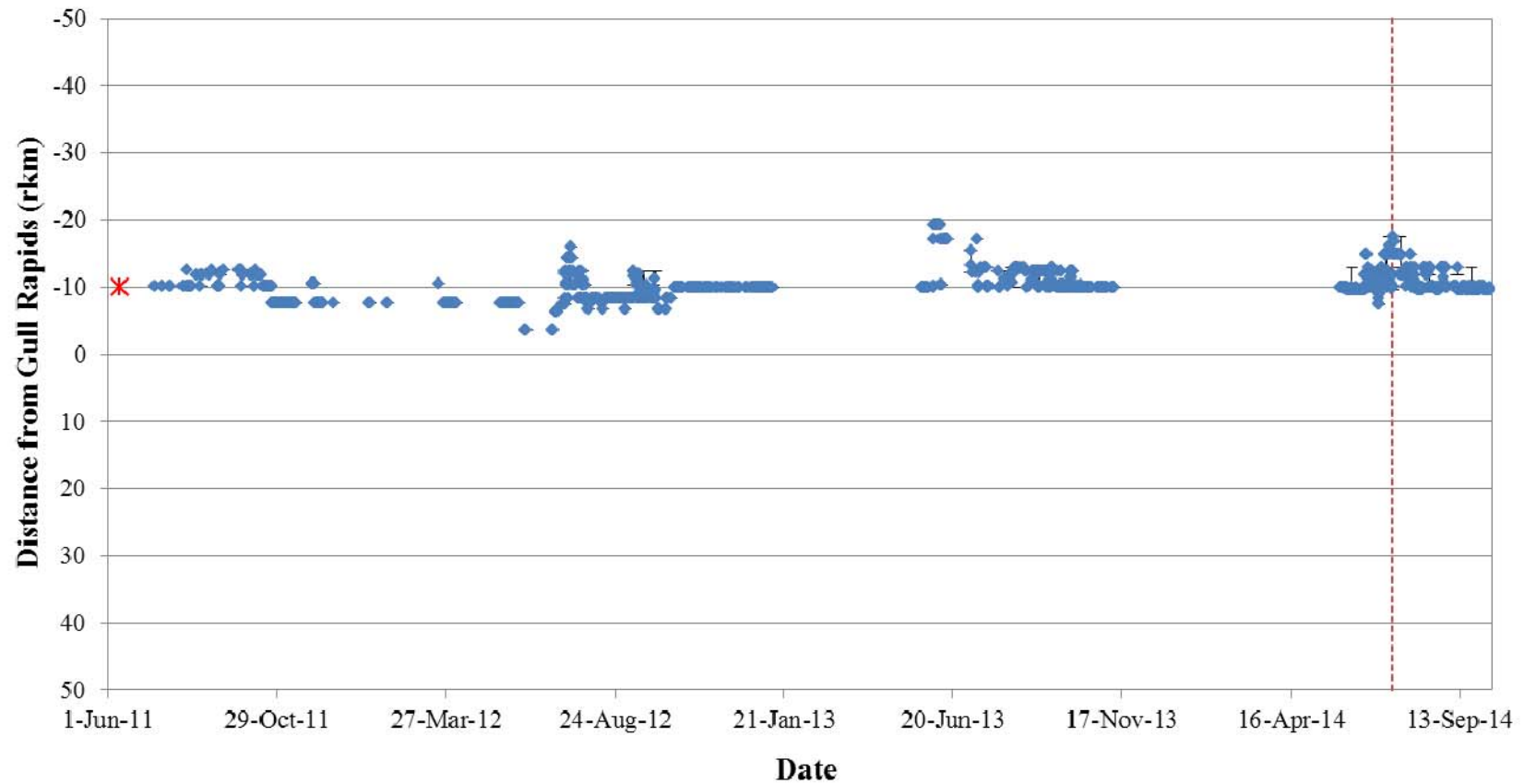


Figure A2- 27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16073) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

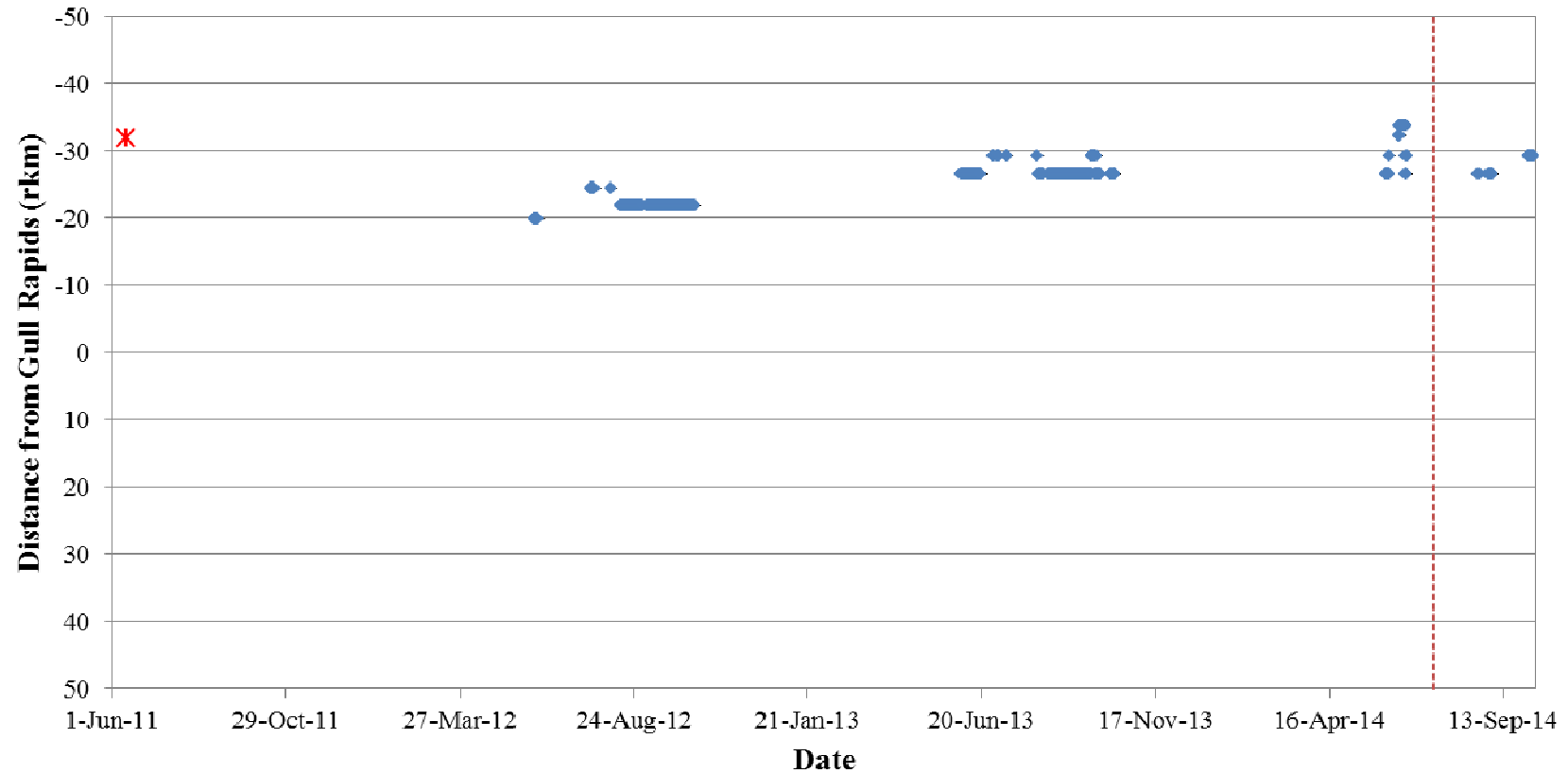
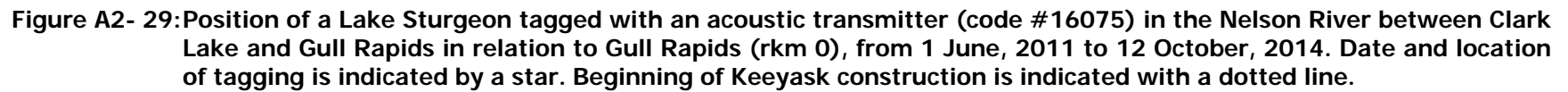


Figure A2- 28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16074) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.



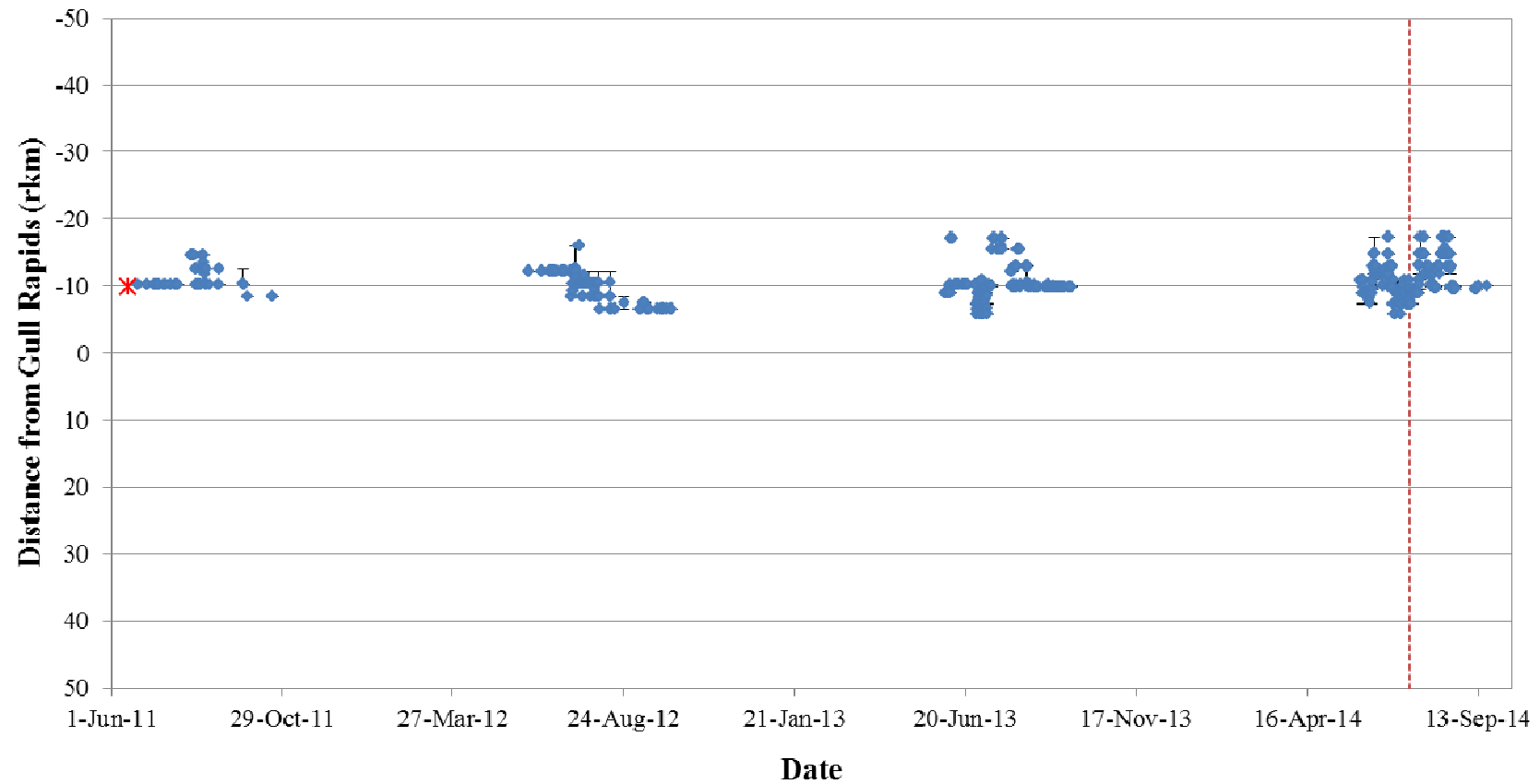


Figure A2- 30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16076) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

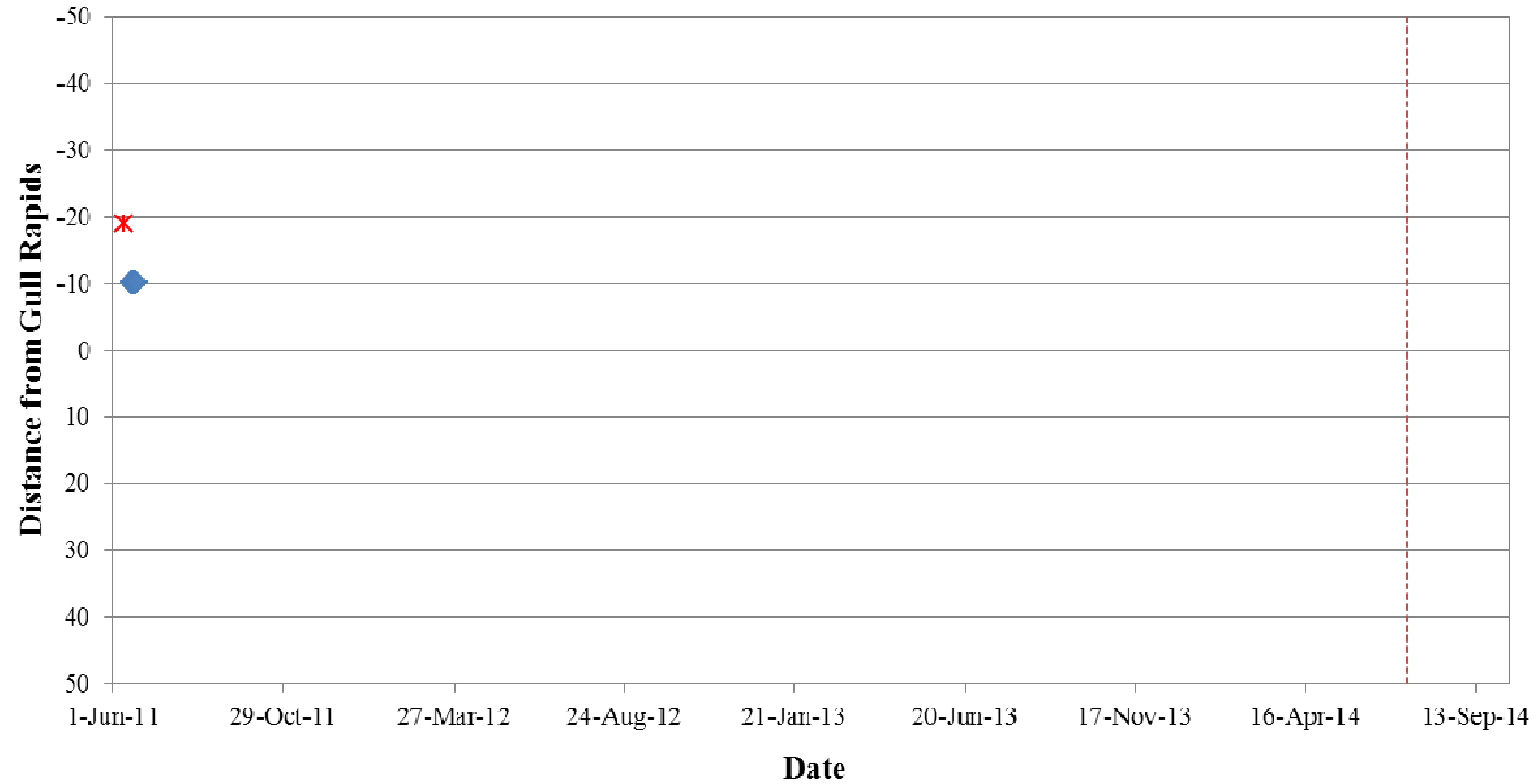


Figure A2- 31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16077) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

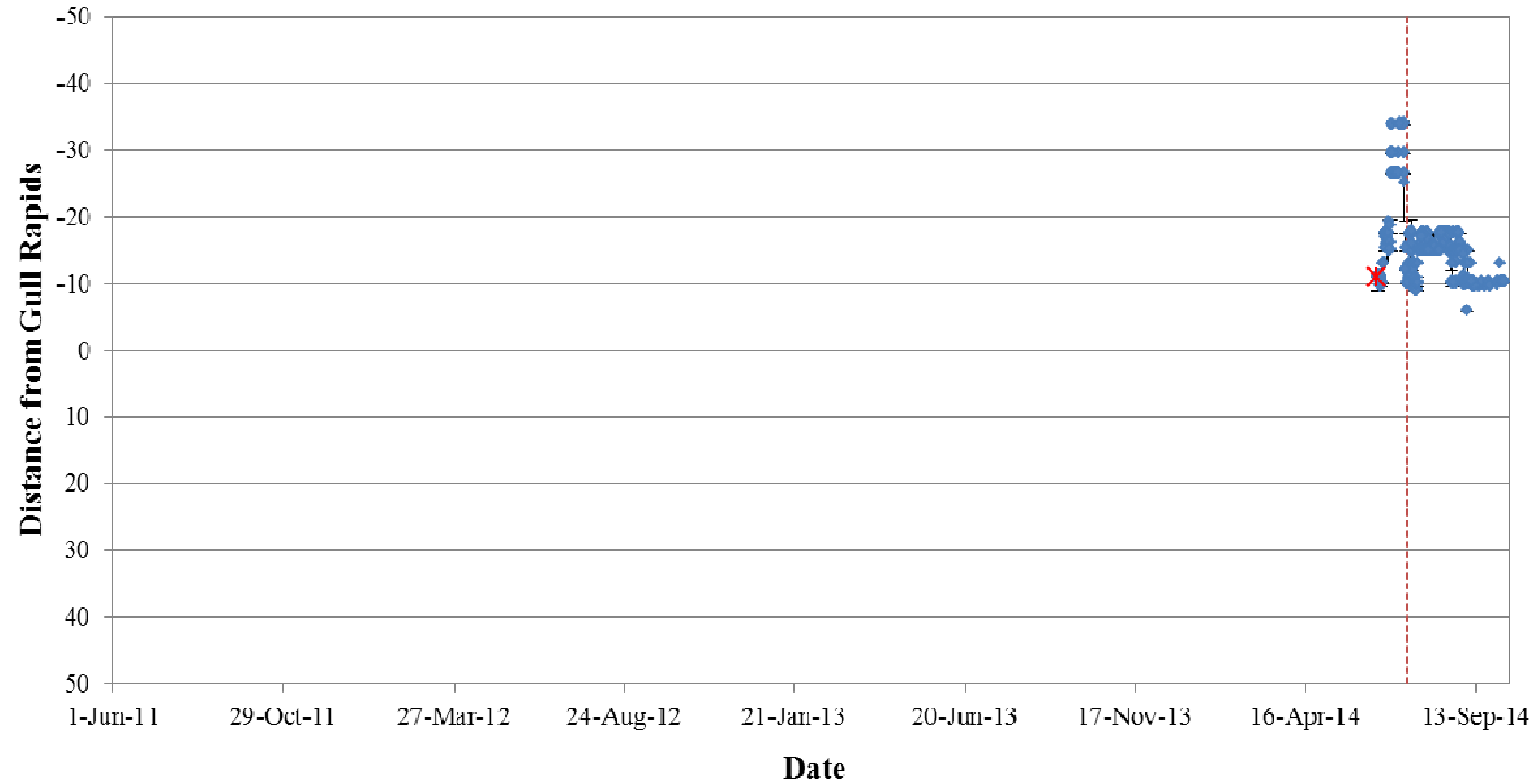


Figure A2- 32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32174) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

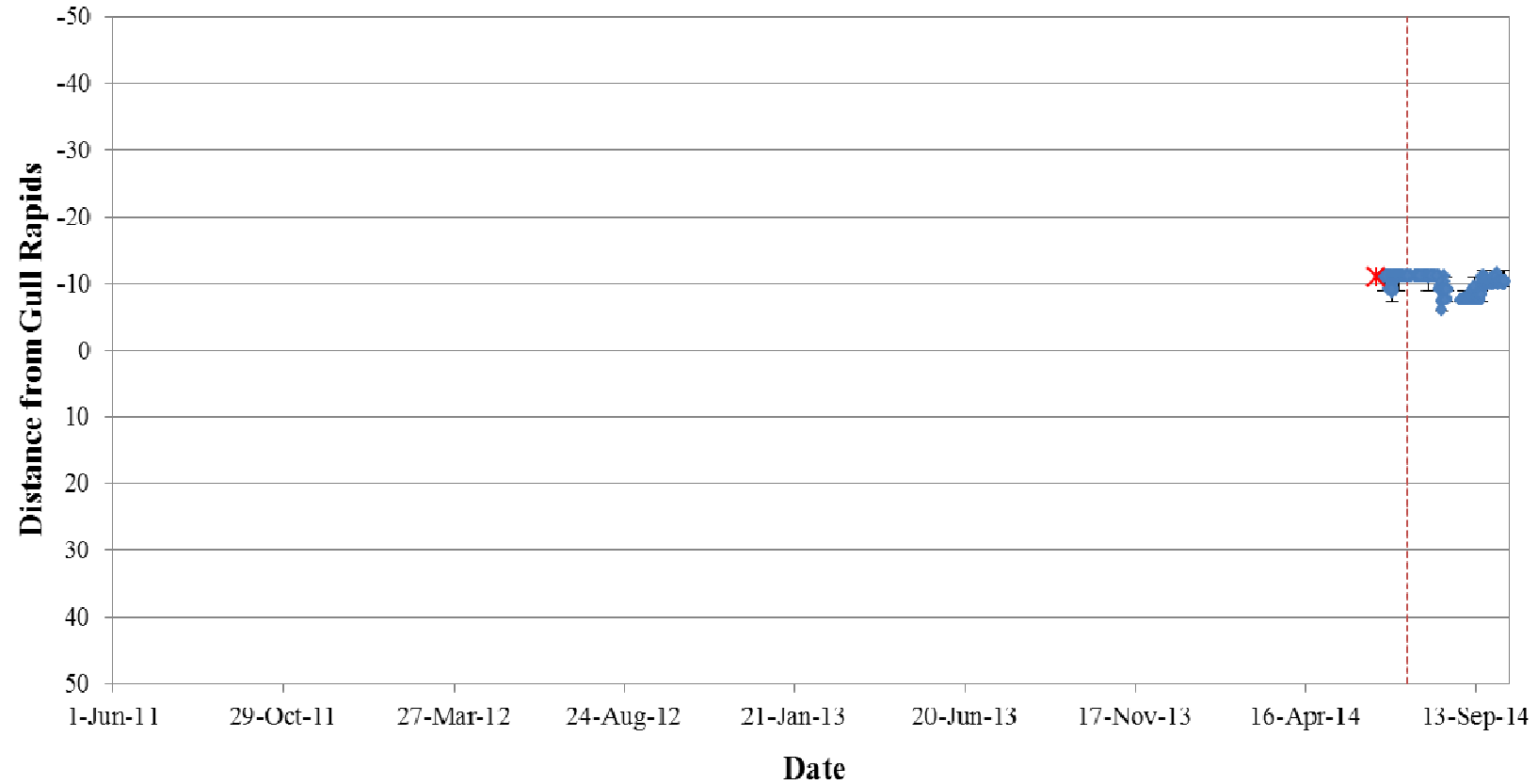


Figure A2- 33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32175) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

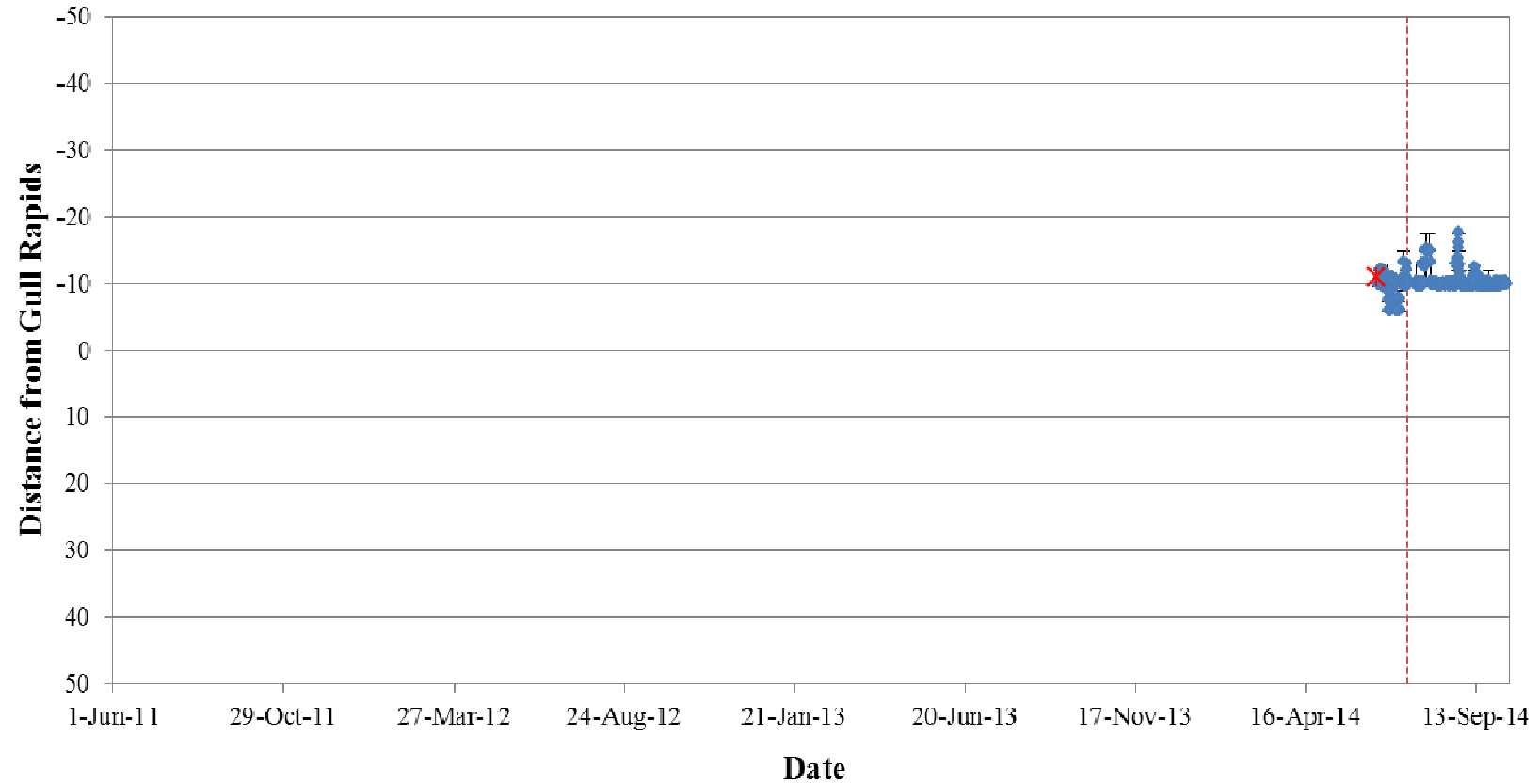


Figure A2- 34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32176) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

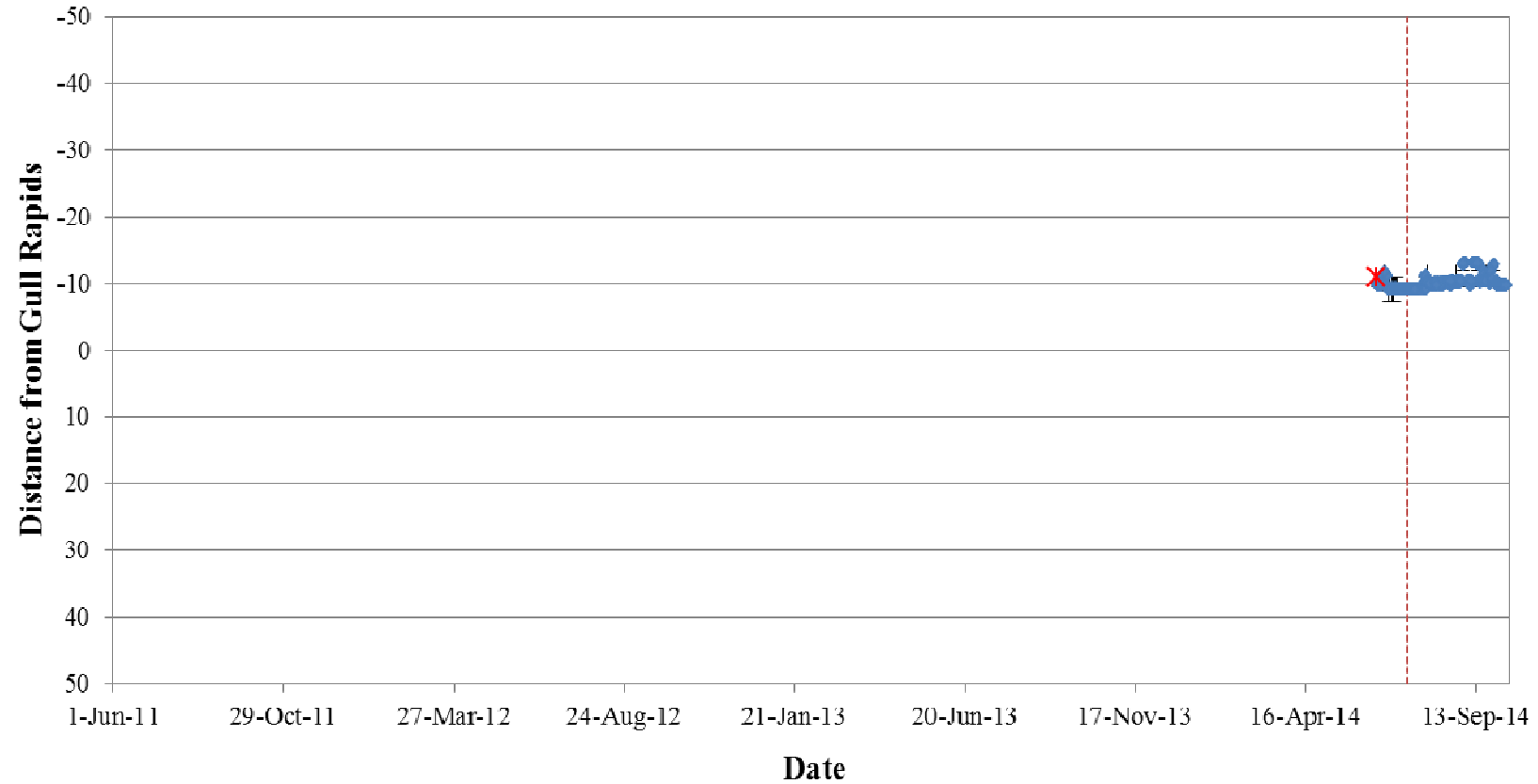


Figure A2- 35: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32177) in the Nelson River between Clark Lake and Gull Rapids in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

APPENDIX 3:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON DOWNSTREAM OF GULL RAPIDS, JUNE 2011 TO OCTOBER 2014

- Figure A3- 1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16018) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 105
- Figure A3- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 106
- Figure A3- 3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16020) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 107
- Figure A3- 4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 108
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2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 112

Figure A3- 9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16029) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 113

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- Figure A3- 22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16046) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 126
- Figure A3- 23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16047) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 127
- Figure A3- 24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16049) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 128
- Figure A3- 25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16050) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 129
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- Figure A3- 27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16053) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line. 131

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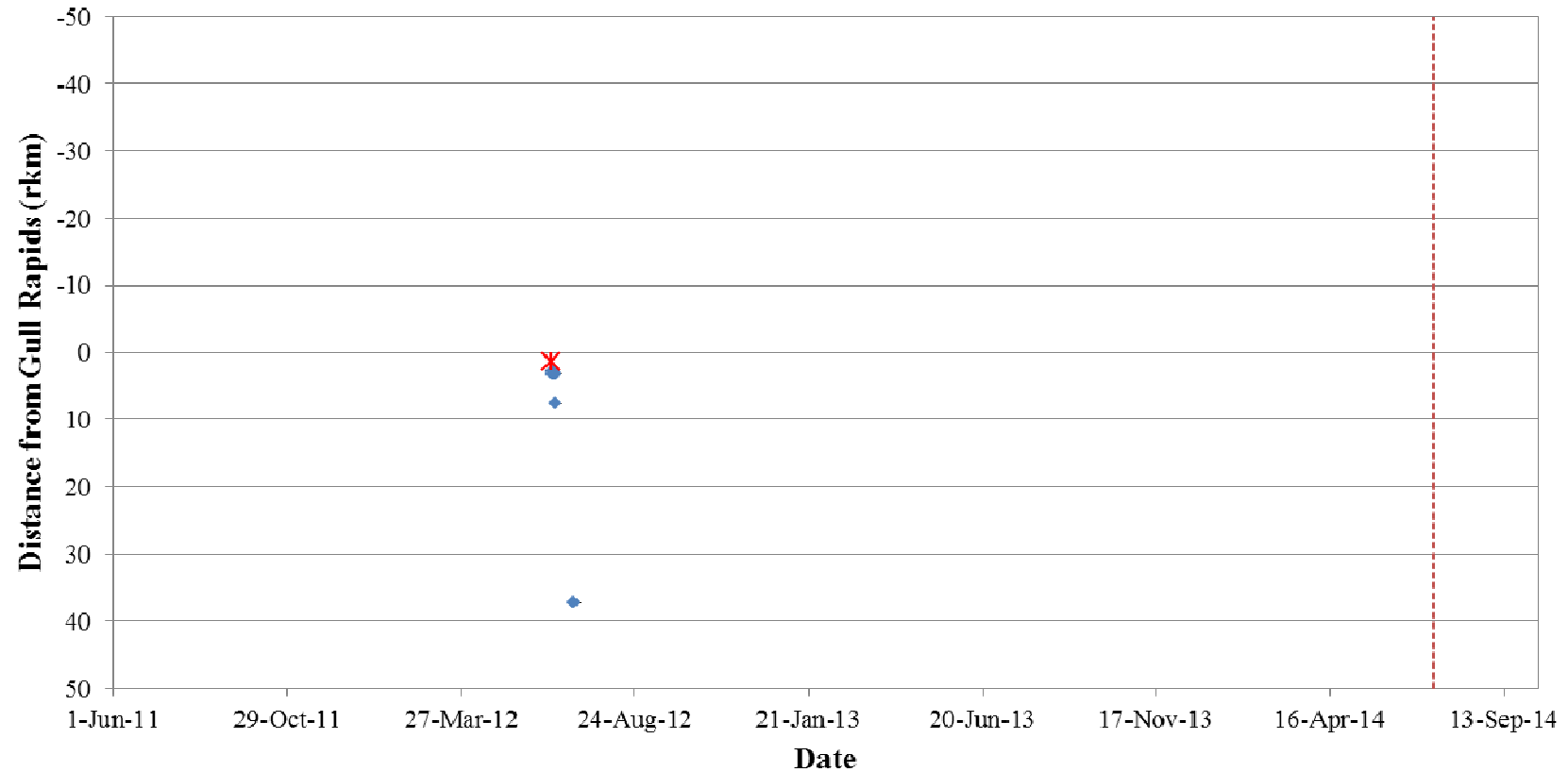


Figure A3- 1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16018) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

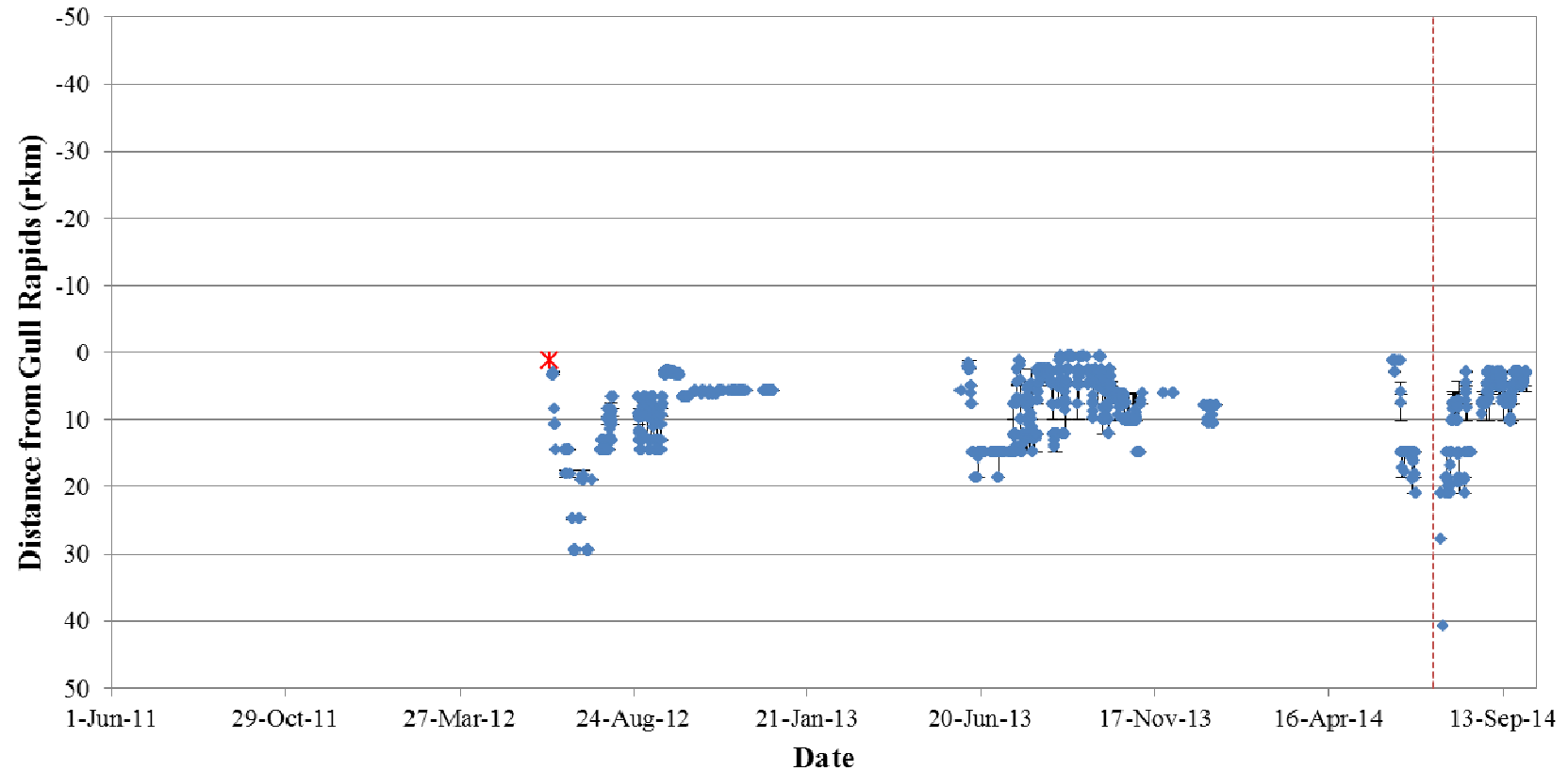


Figure A3- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16019) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

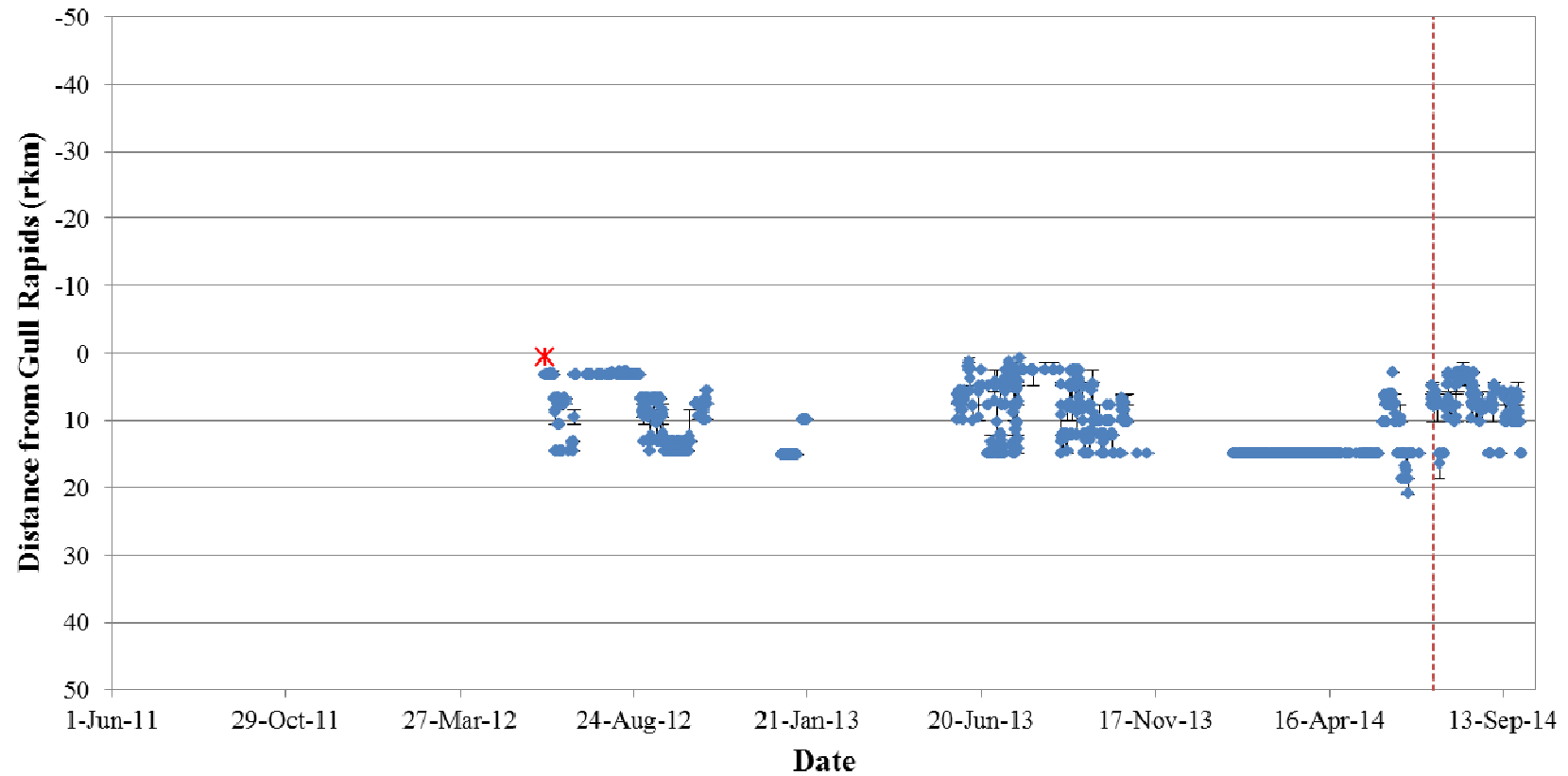


Figure A3- 3: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16020) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

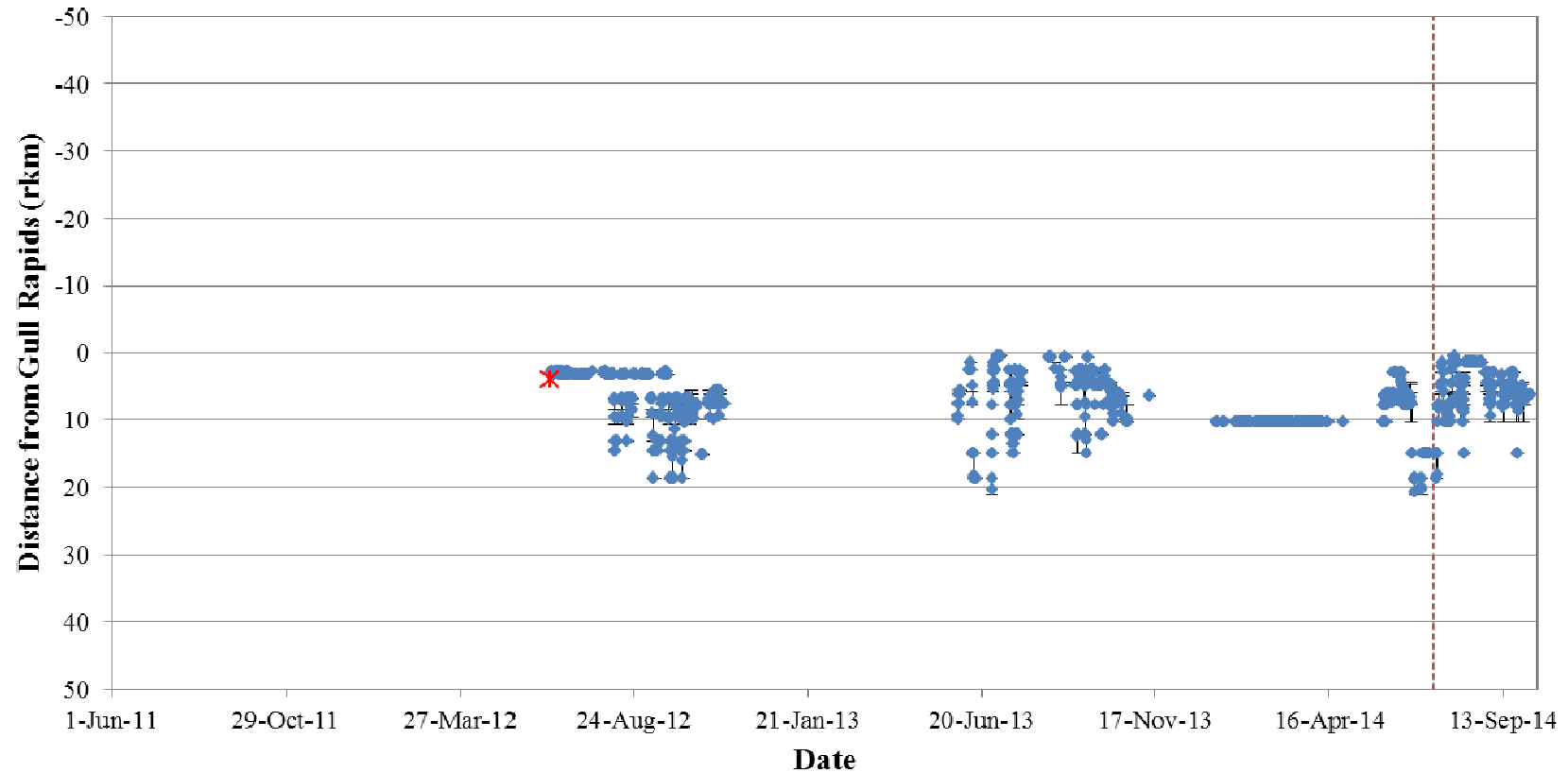


Figure A3- 4: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16022) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

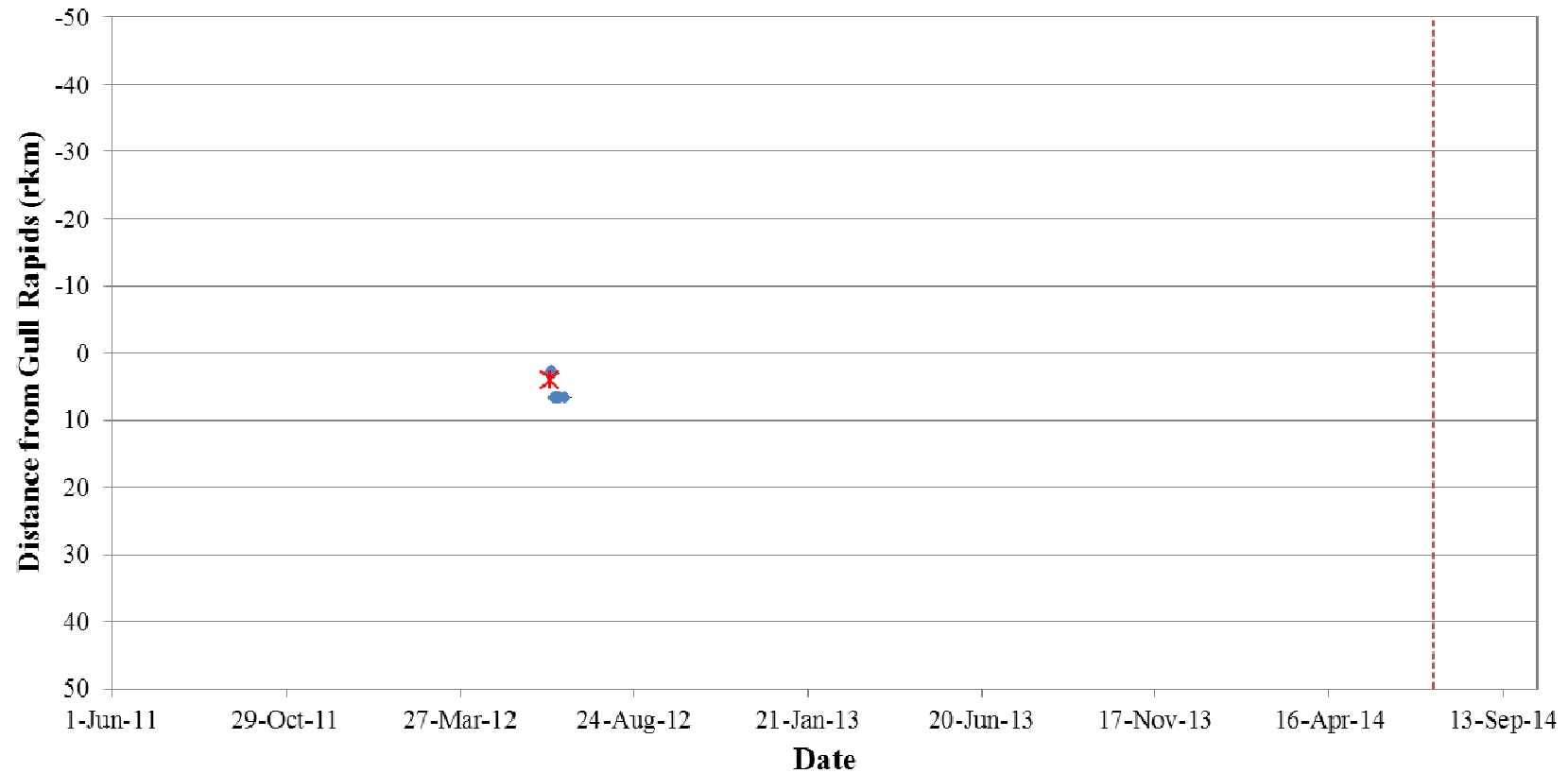


Figure A3- 5: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16024) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

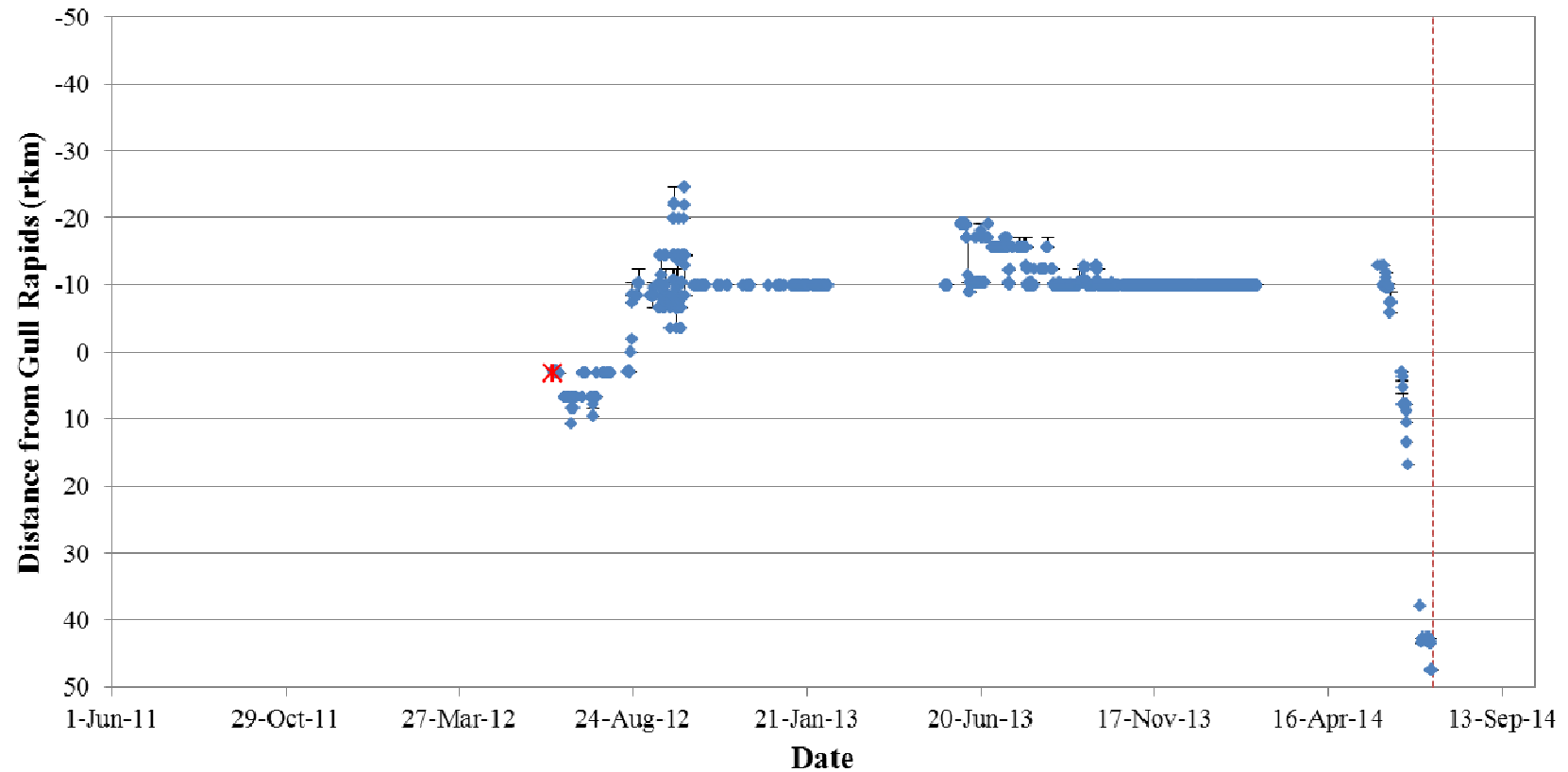


Figure A3- 6: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16025) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 14 October, 2012. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

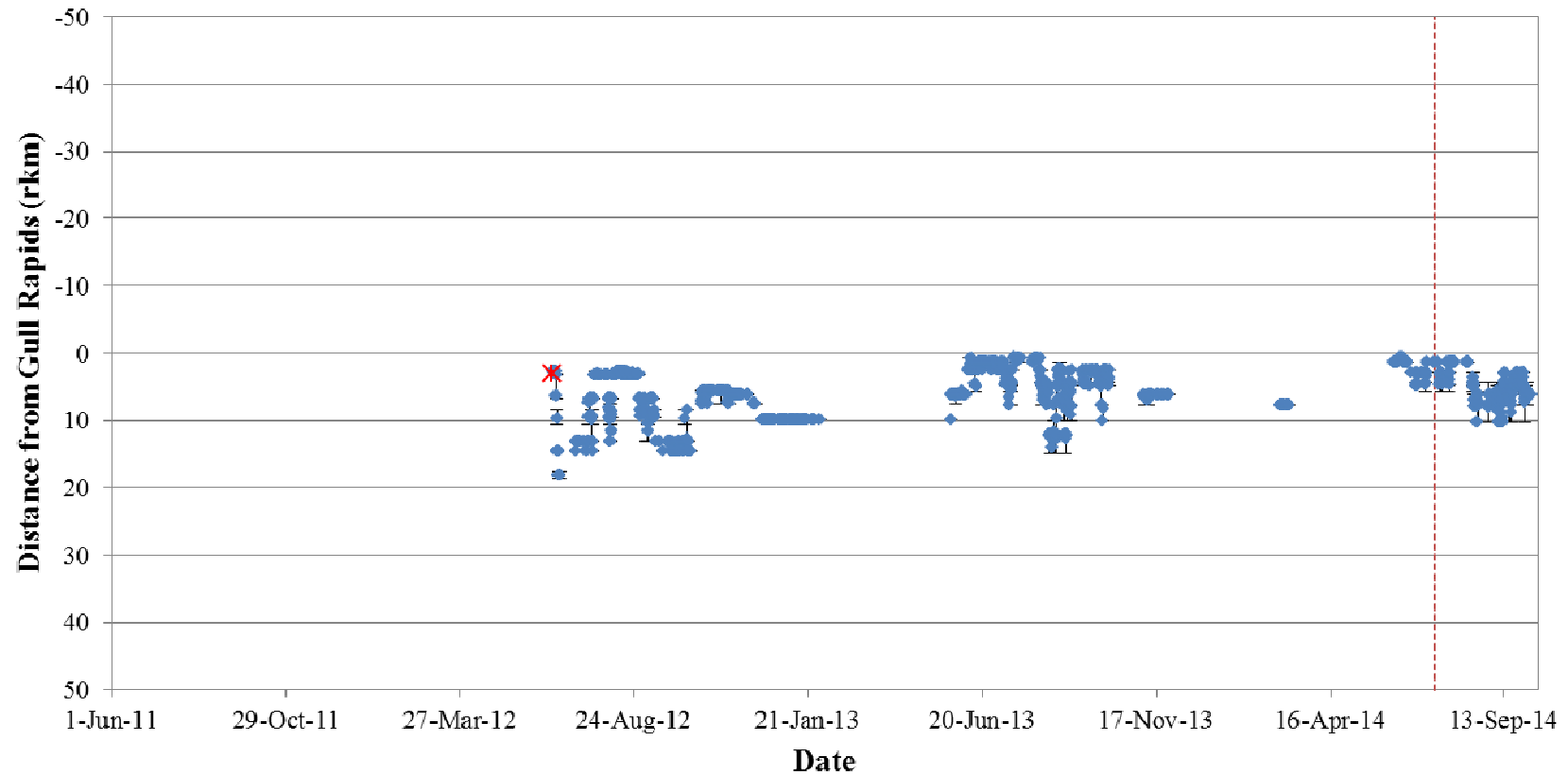


Figure A3- 7: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16027) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

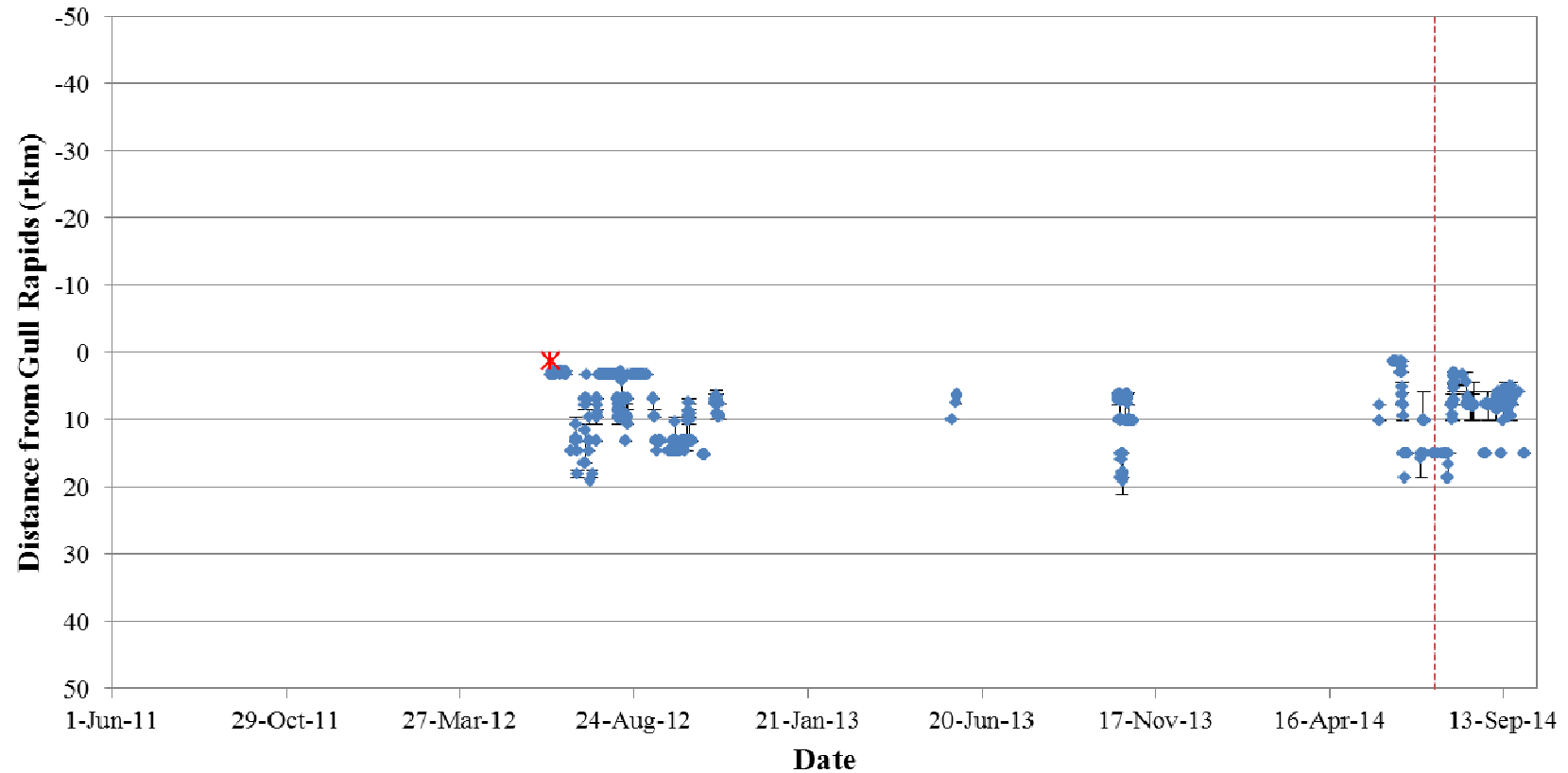


Figure A3- 8: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16028) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

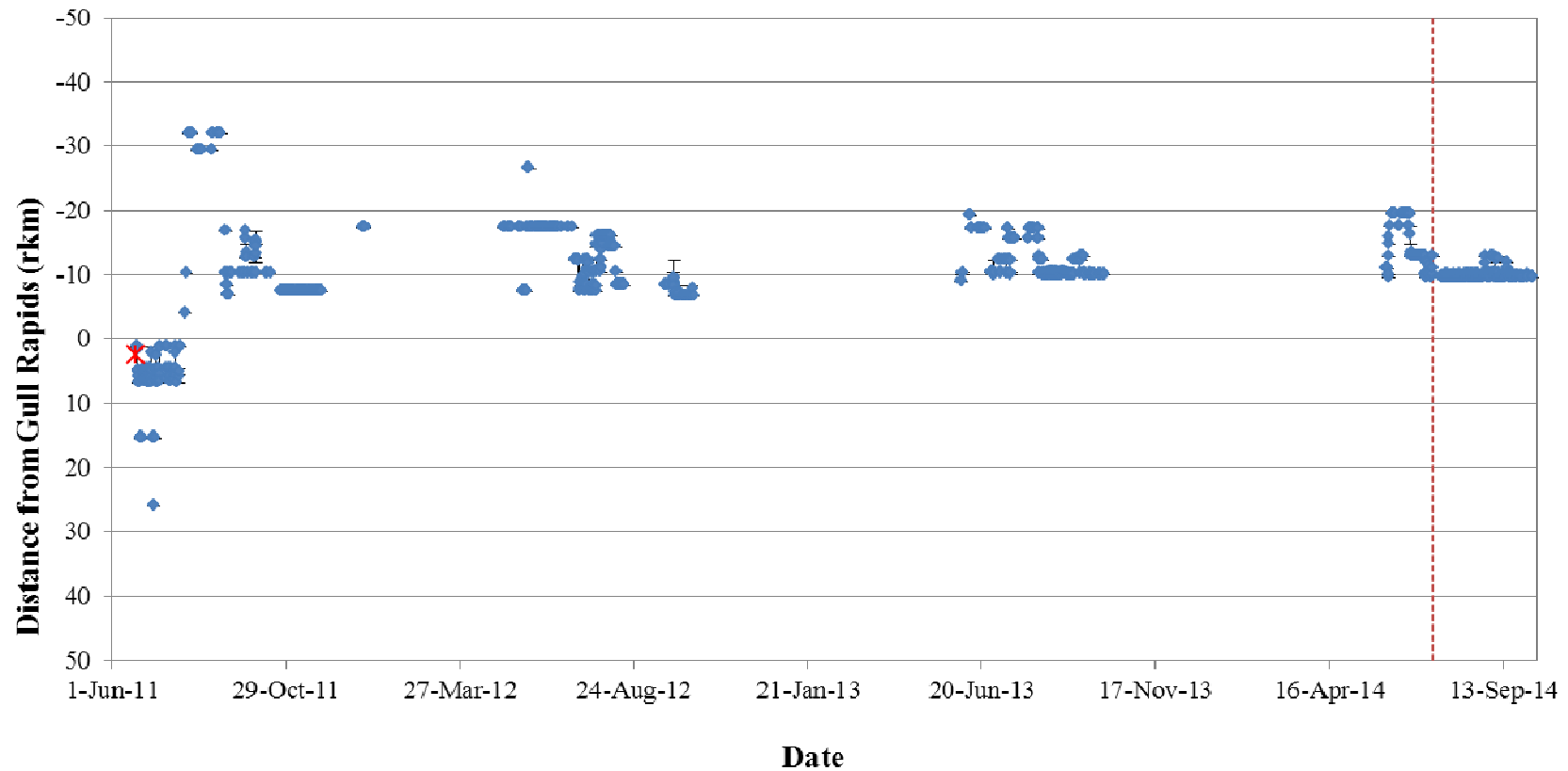


Figure A3- 9: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16029) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

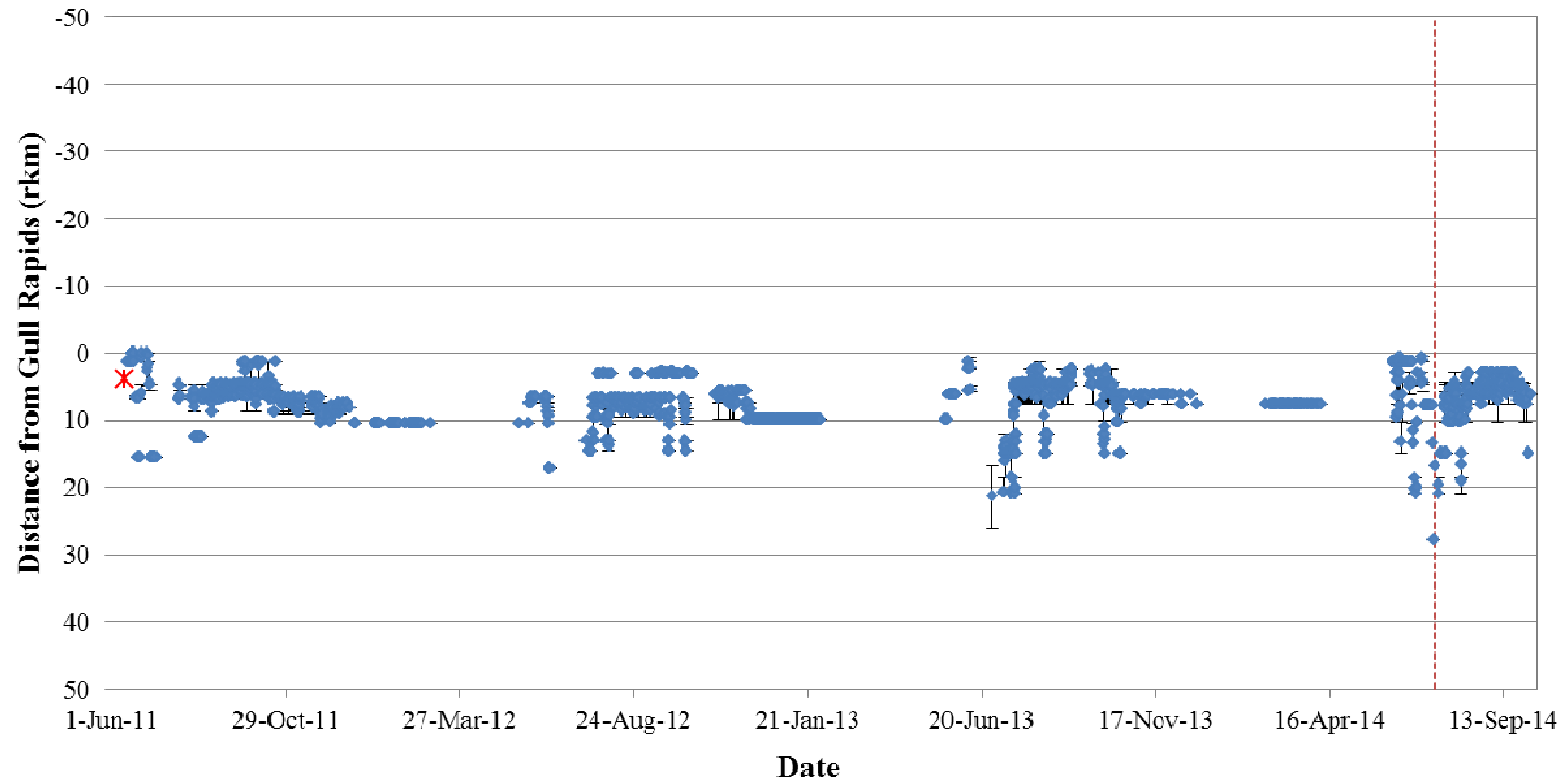


Figure A3- 10: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16030) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

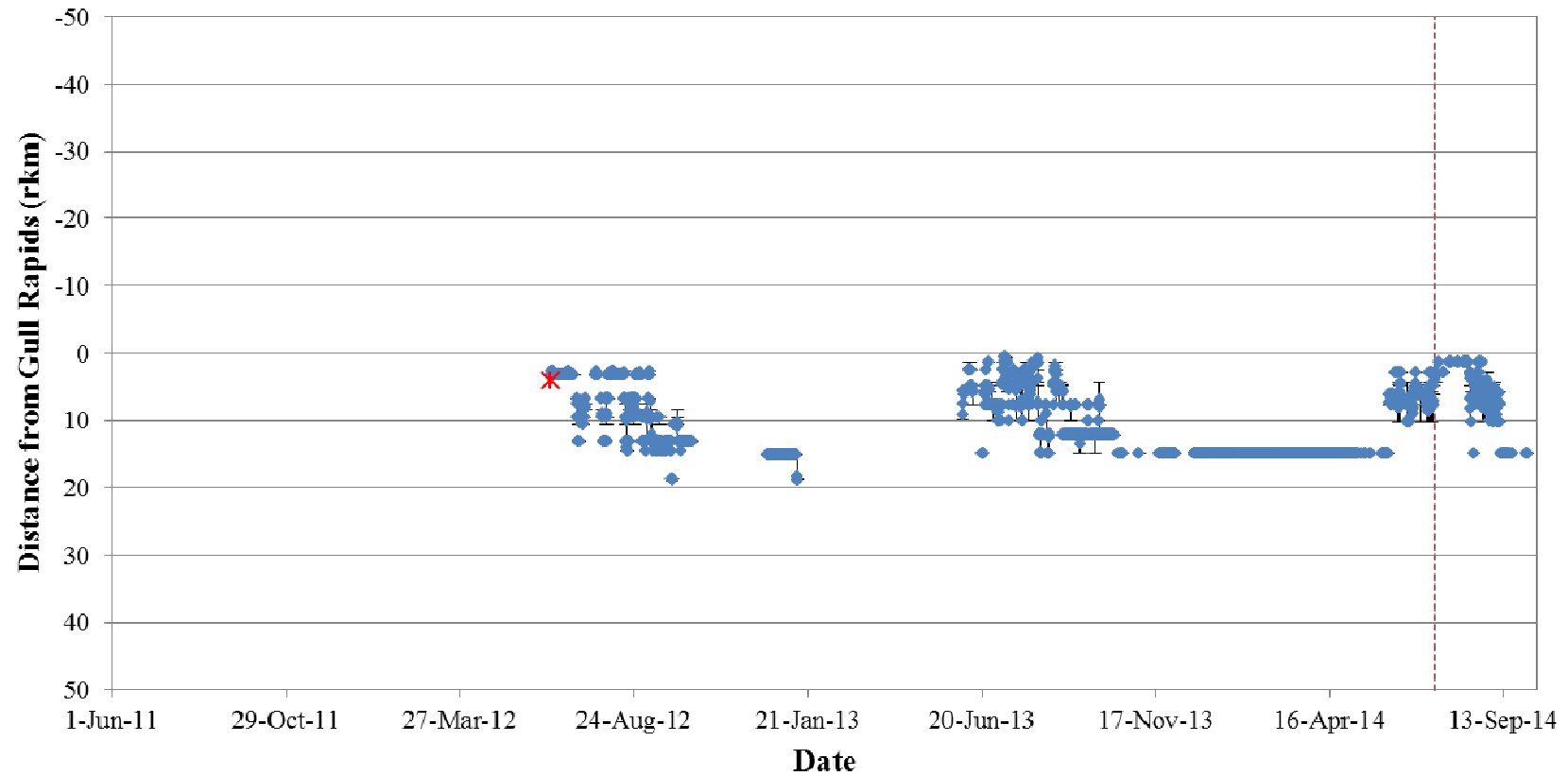


Figure A3- 11: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16031) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

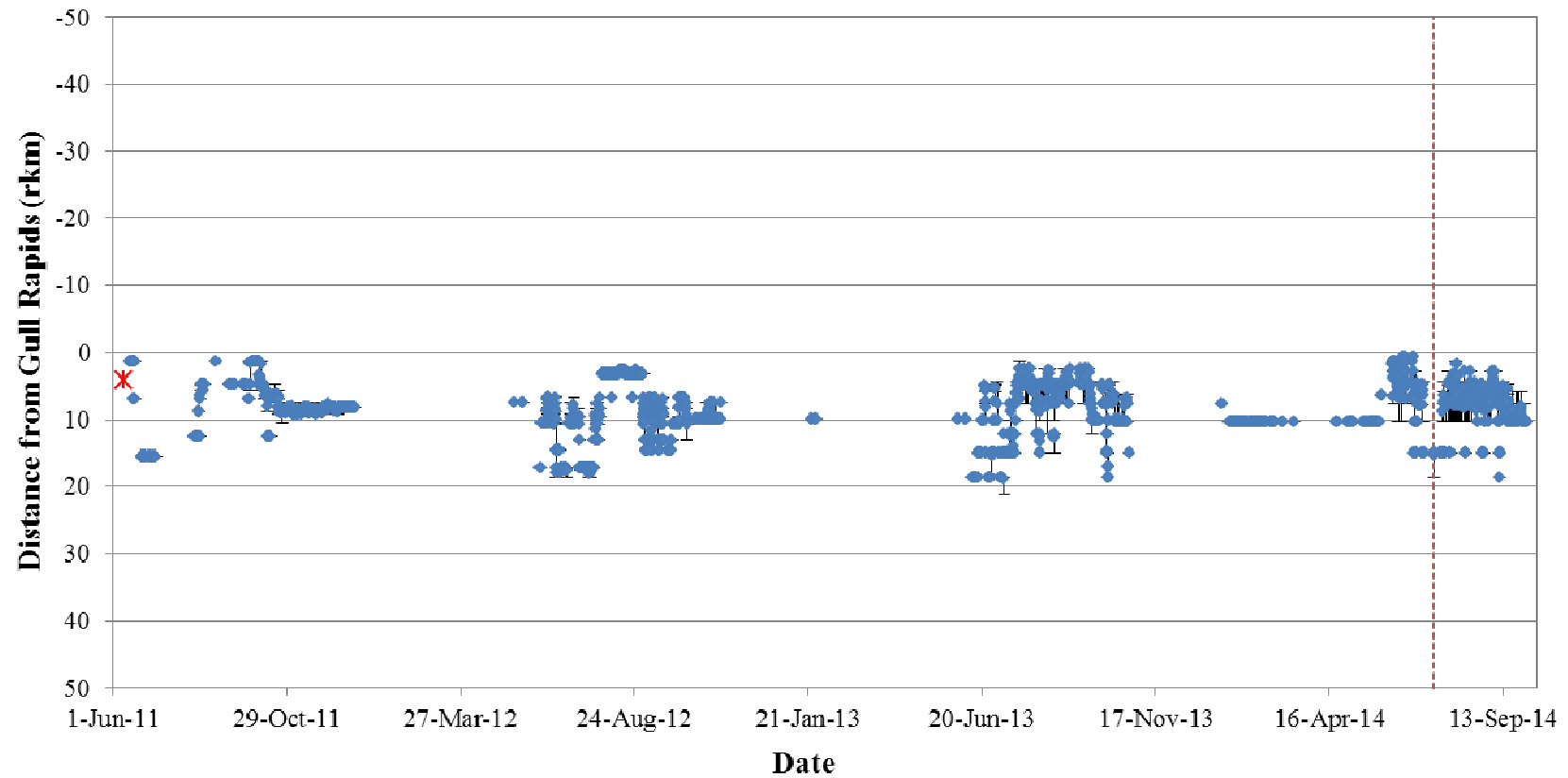


Figure A3- 12: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16032) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

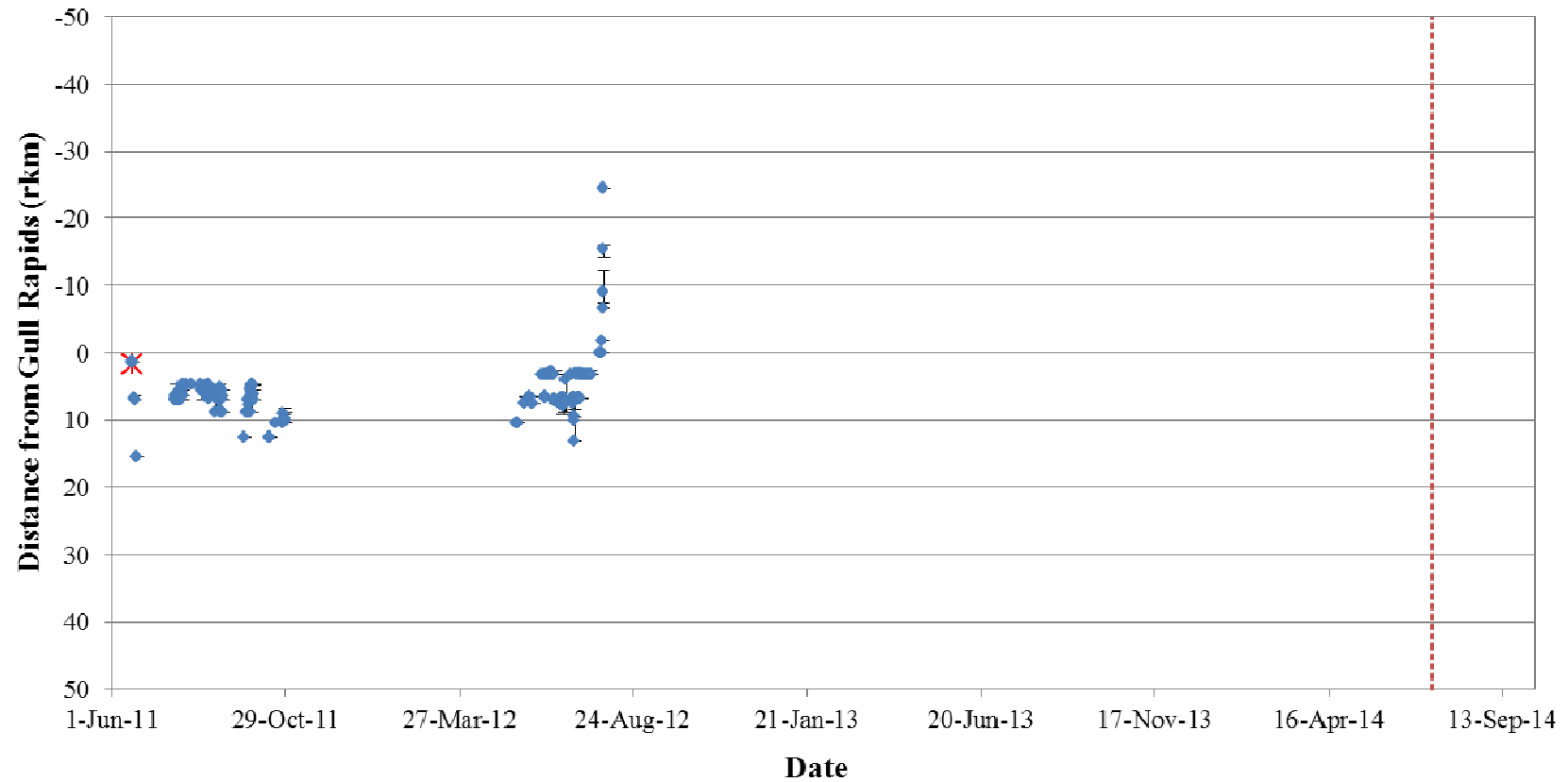


Figure A3- 13: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16033) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

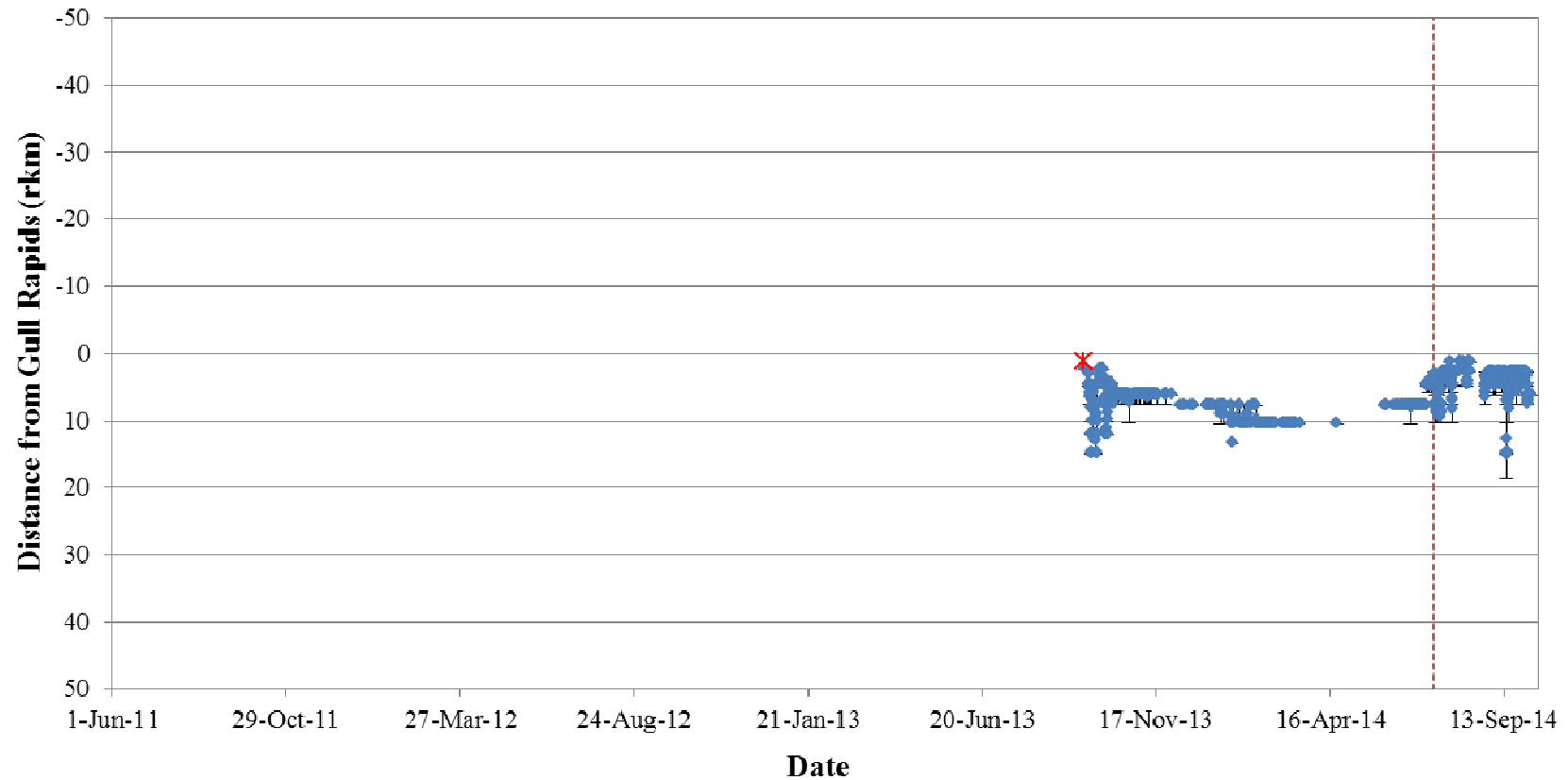


Figure A3- 14: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16033b) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

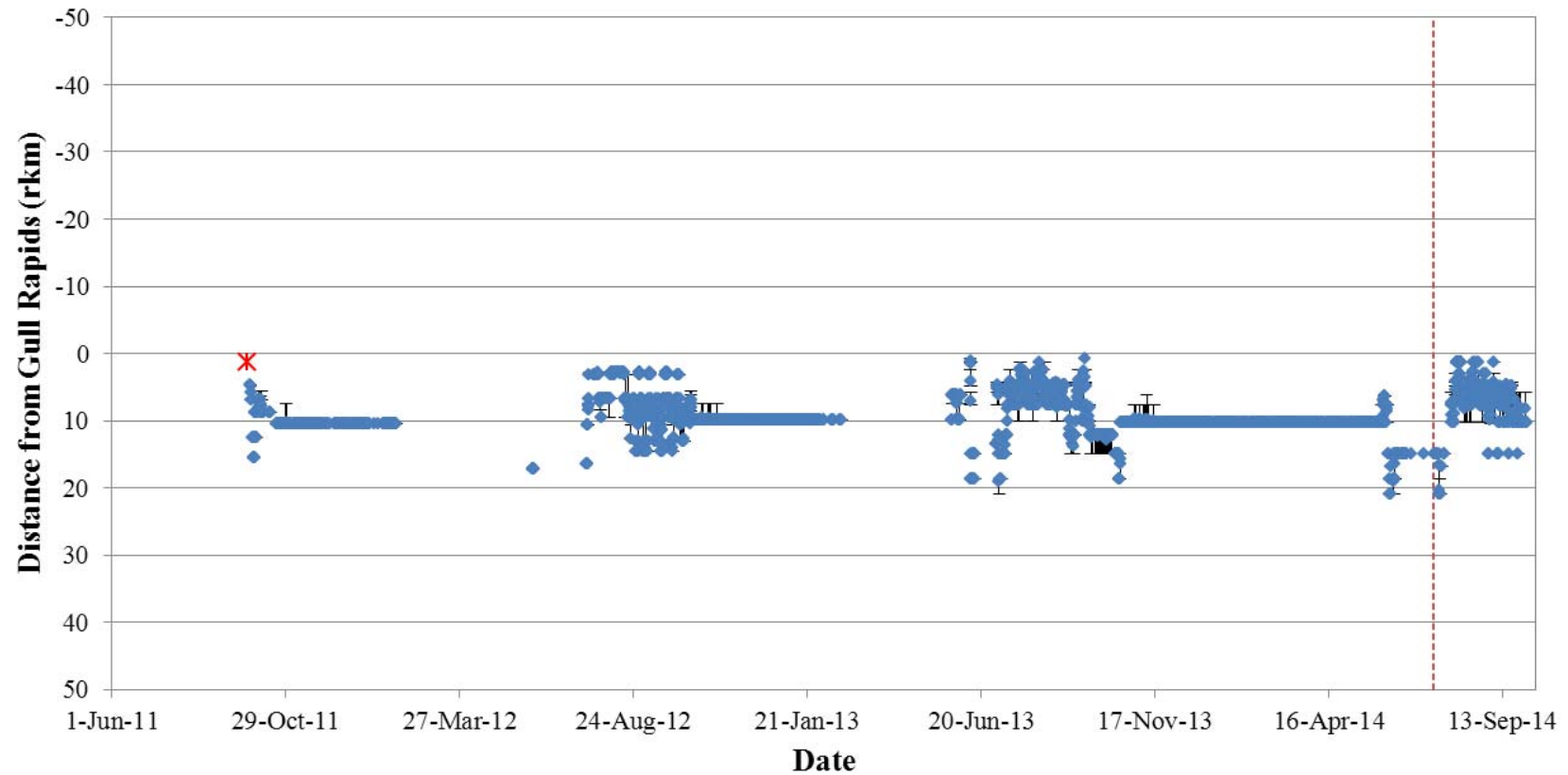


Figure A3- 15: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16035) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

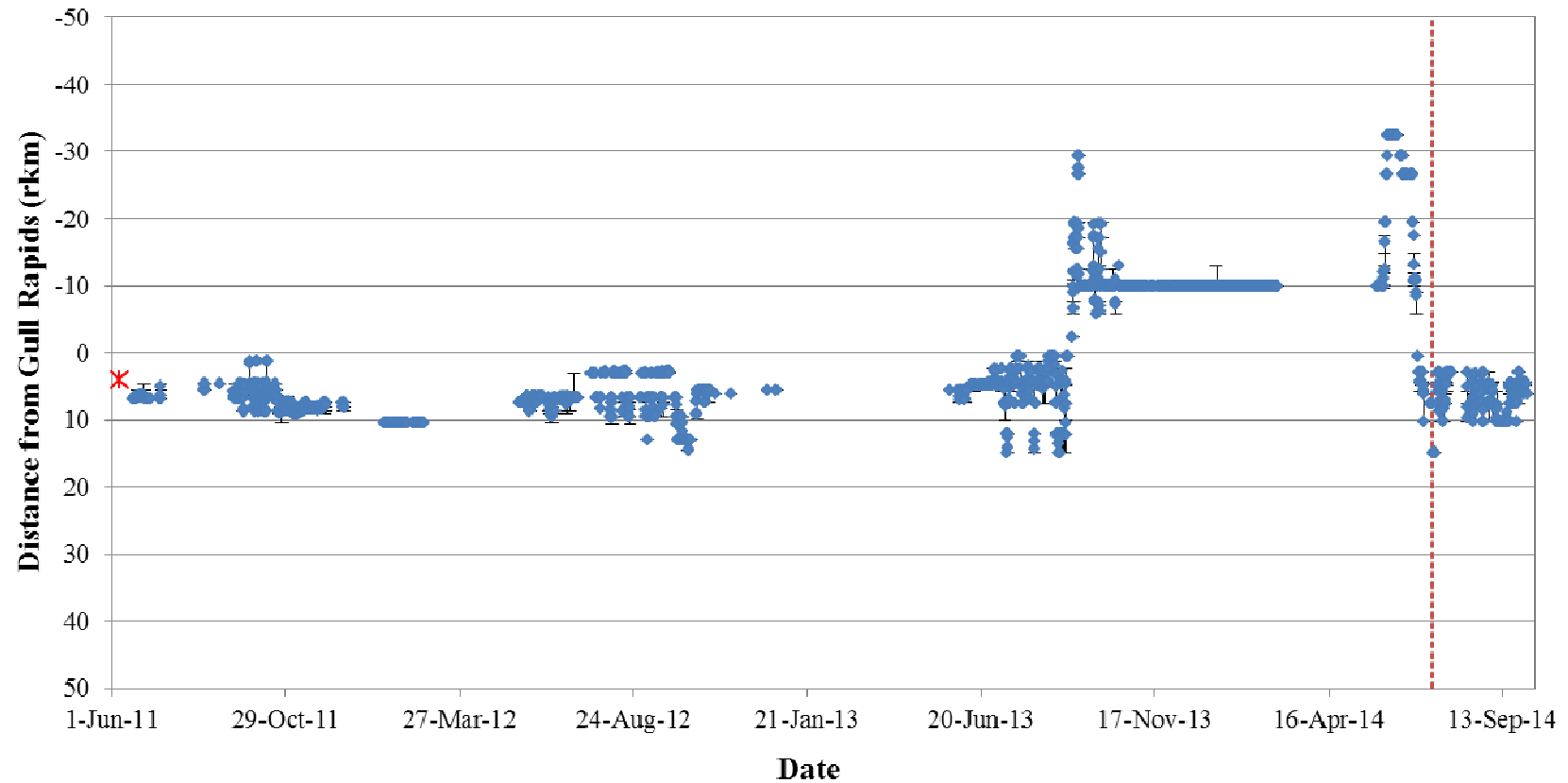


Figure A3- 16: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16037) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

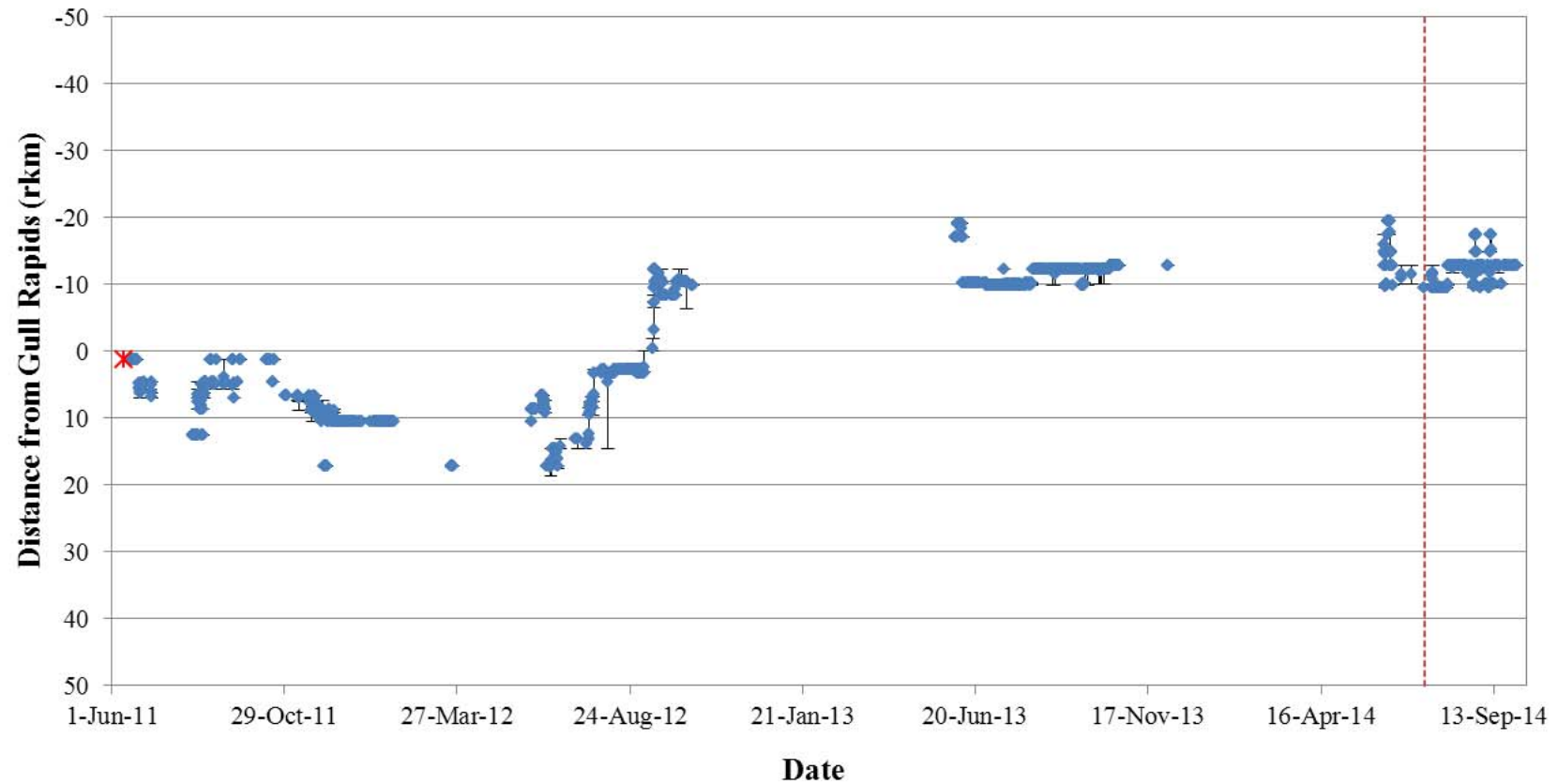


Figure A3- 17: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16038) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

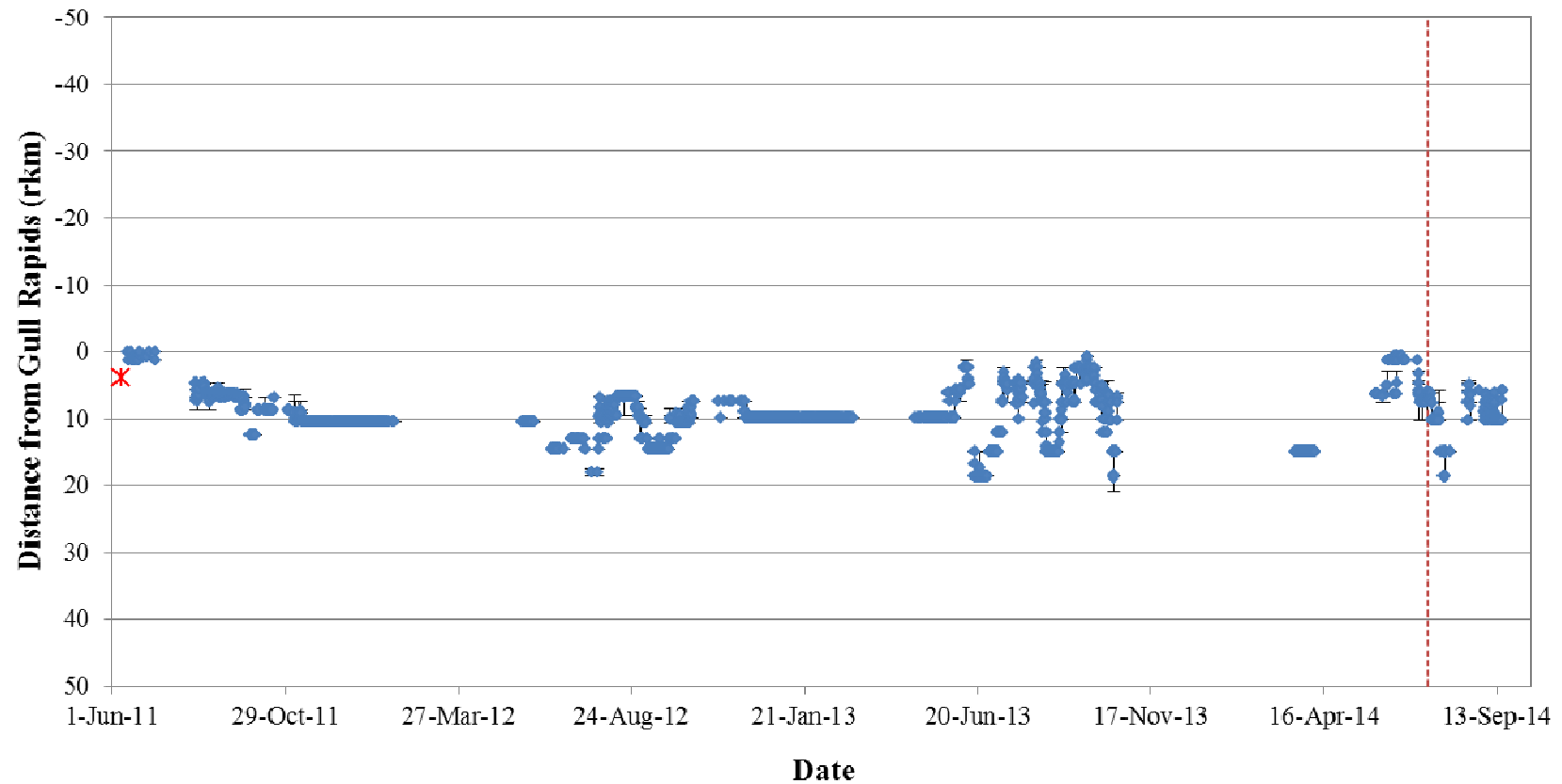


Figure A3- 18: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16040) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

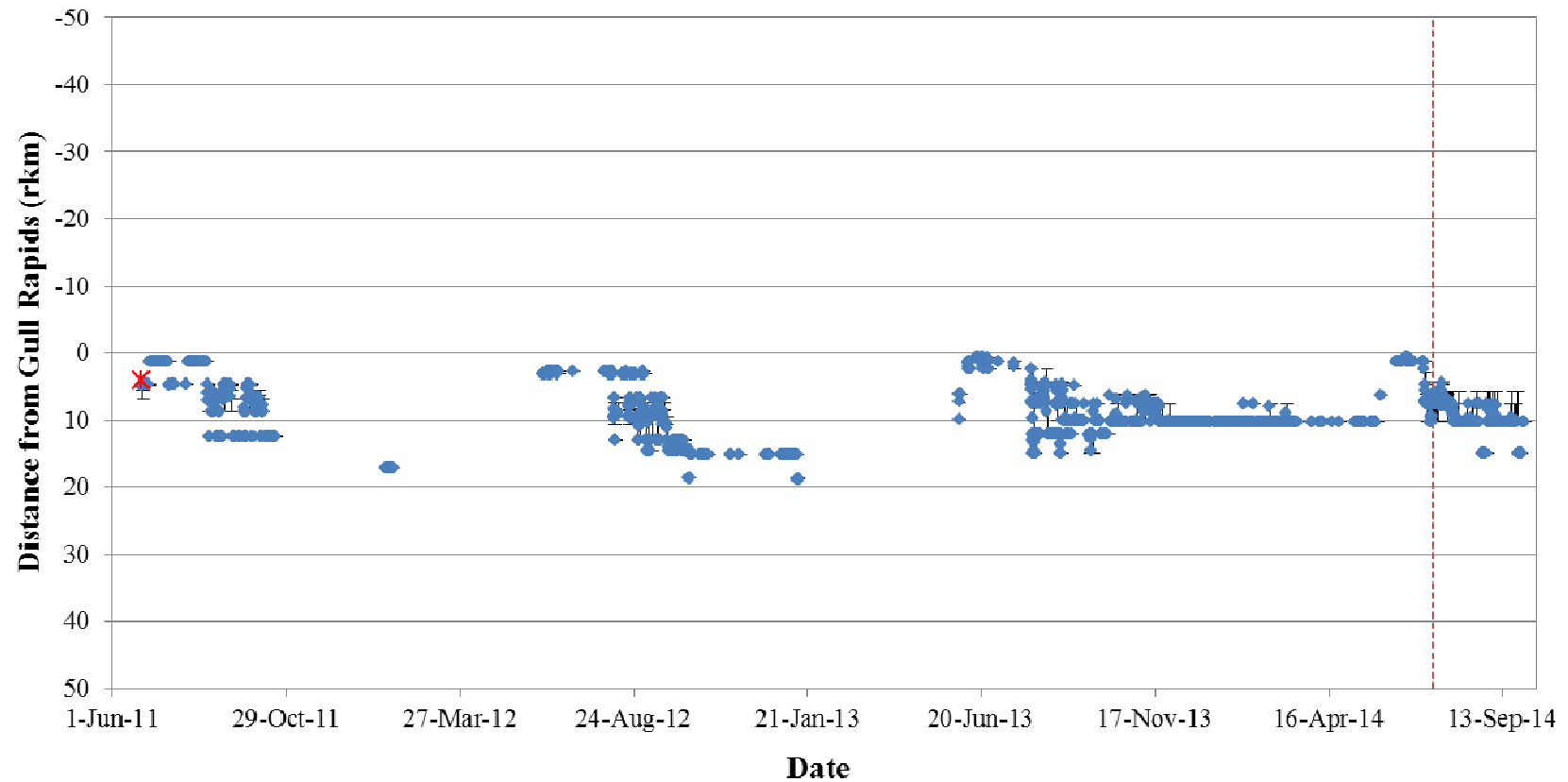


Figure A3- 19: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16041) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

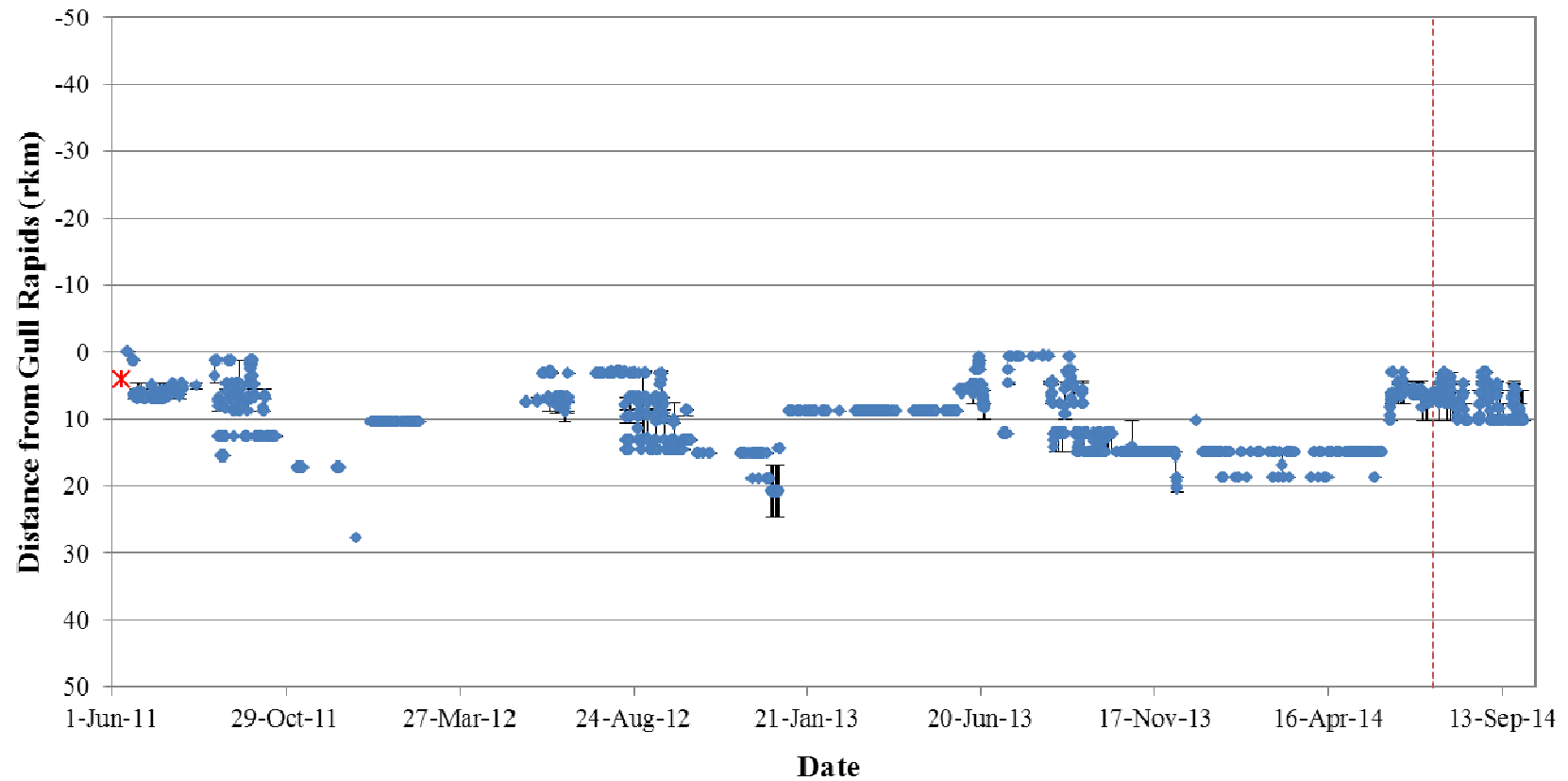


Figure A3- 20: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16043) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

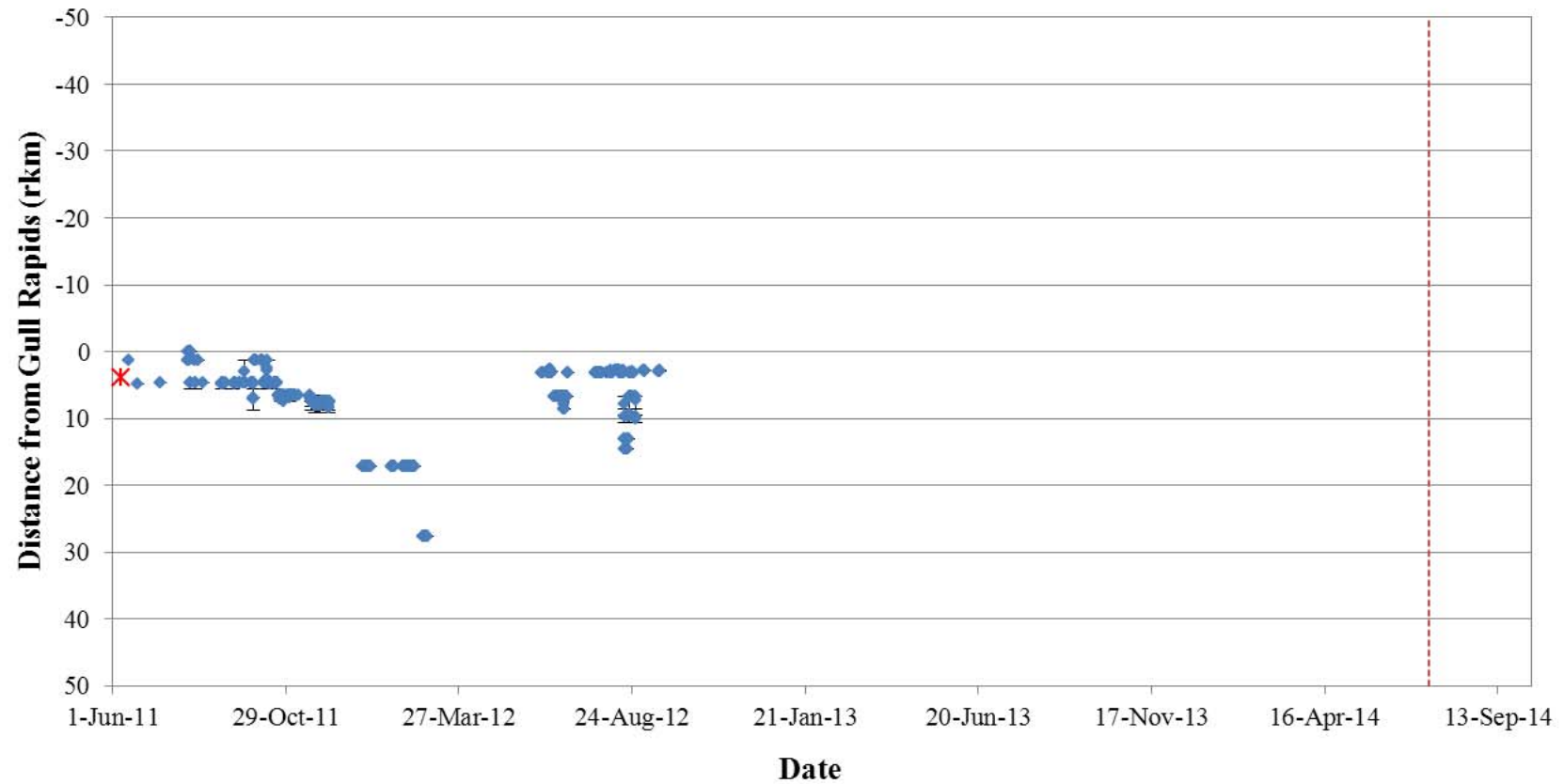


Figure A3- 21: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16044) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

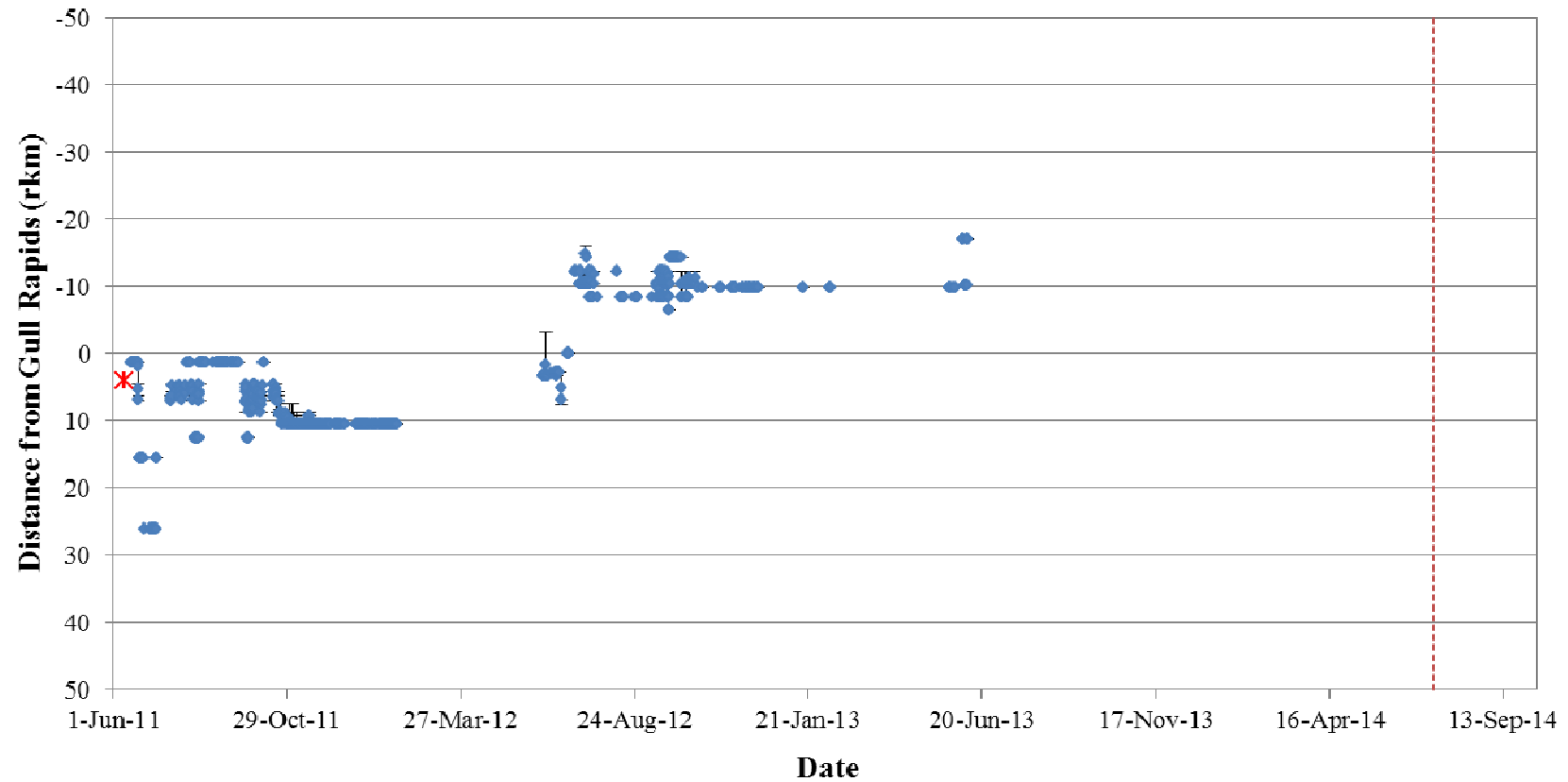


Figure A3- 22: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16046) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

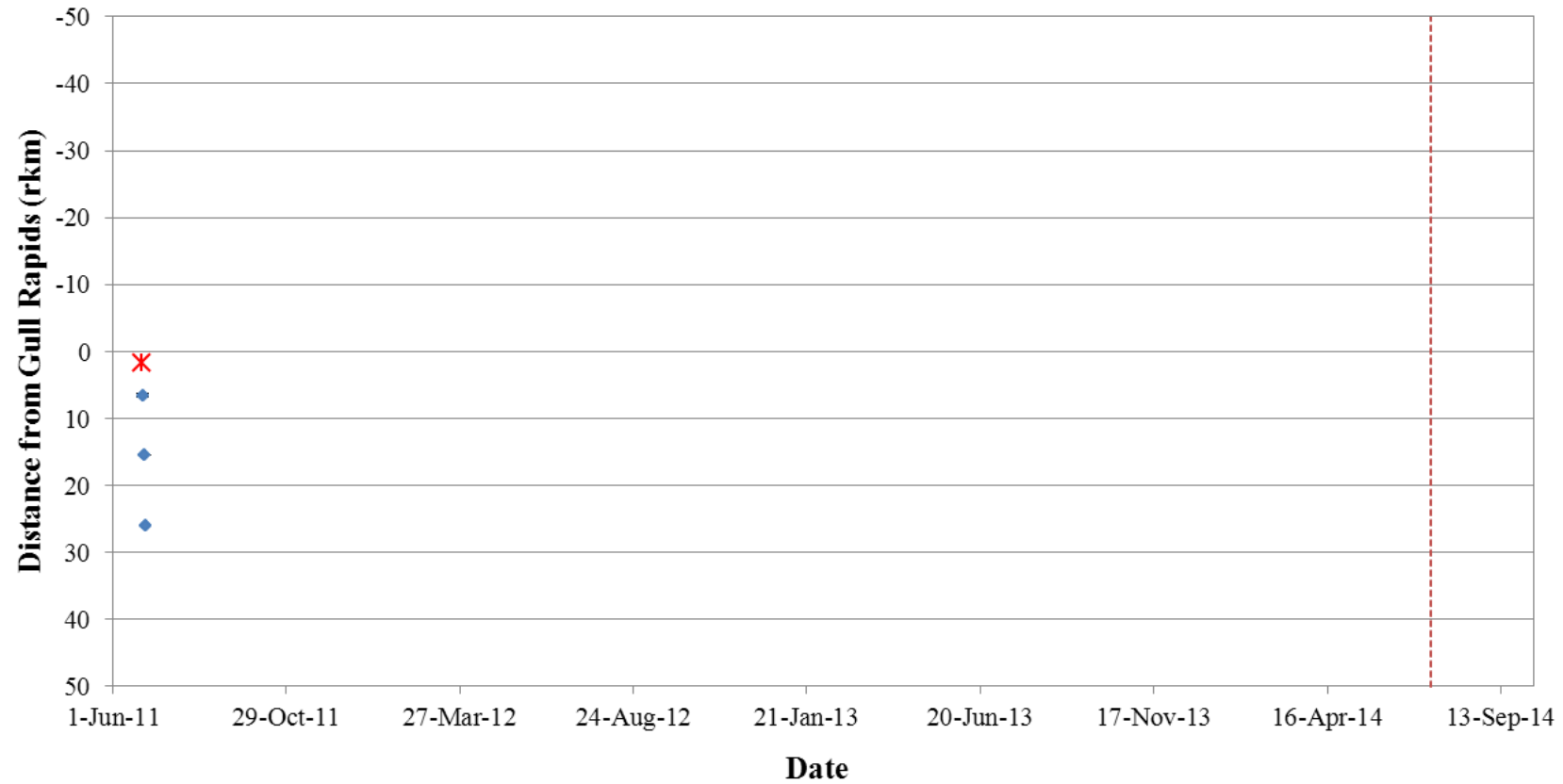


Figure A3- 23: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16047) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

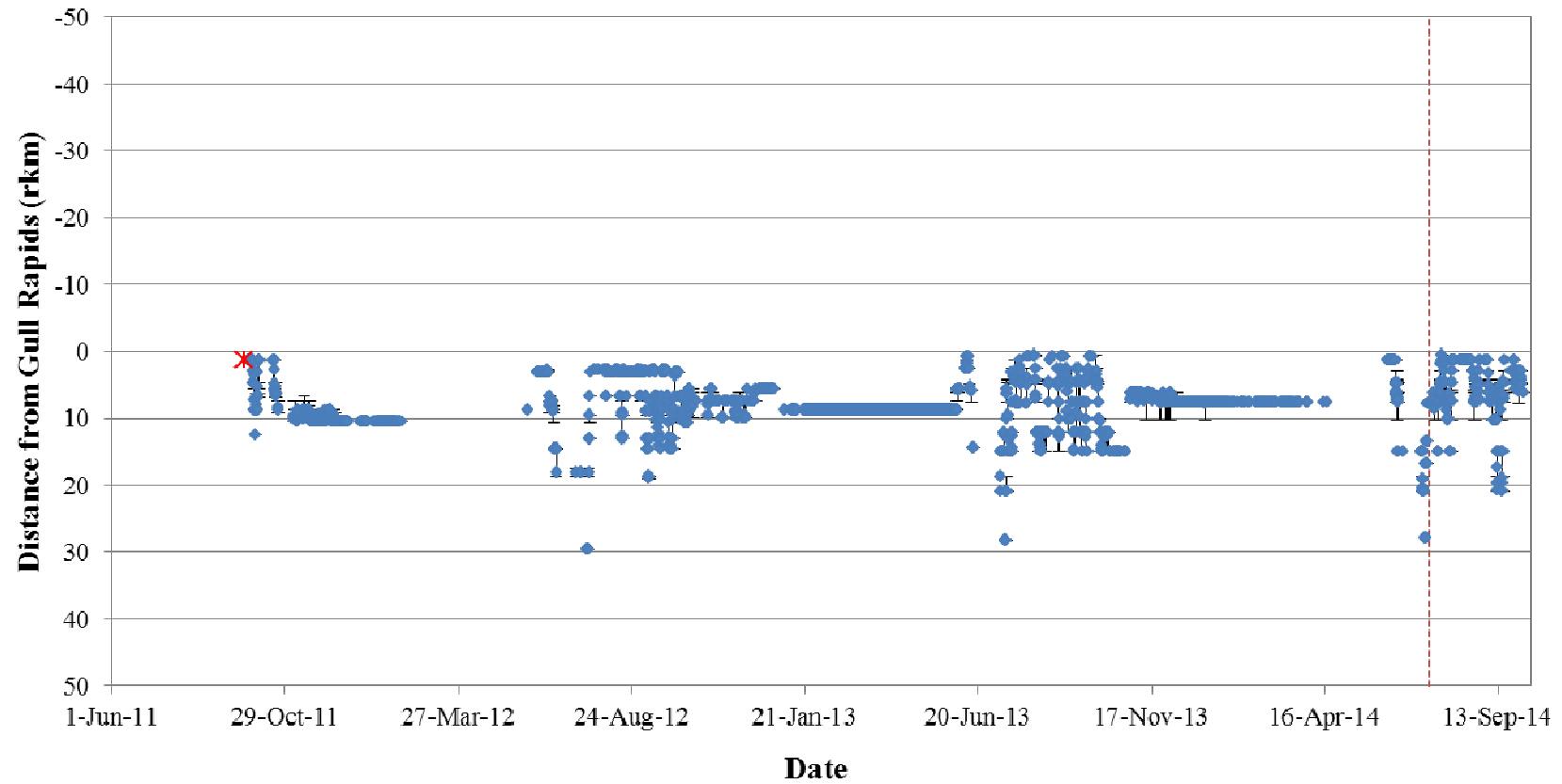


Figure A3- 24: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16049) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

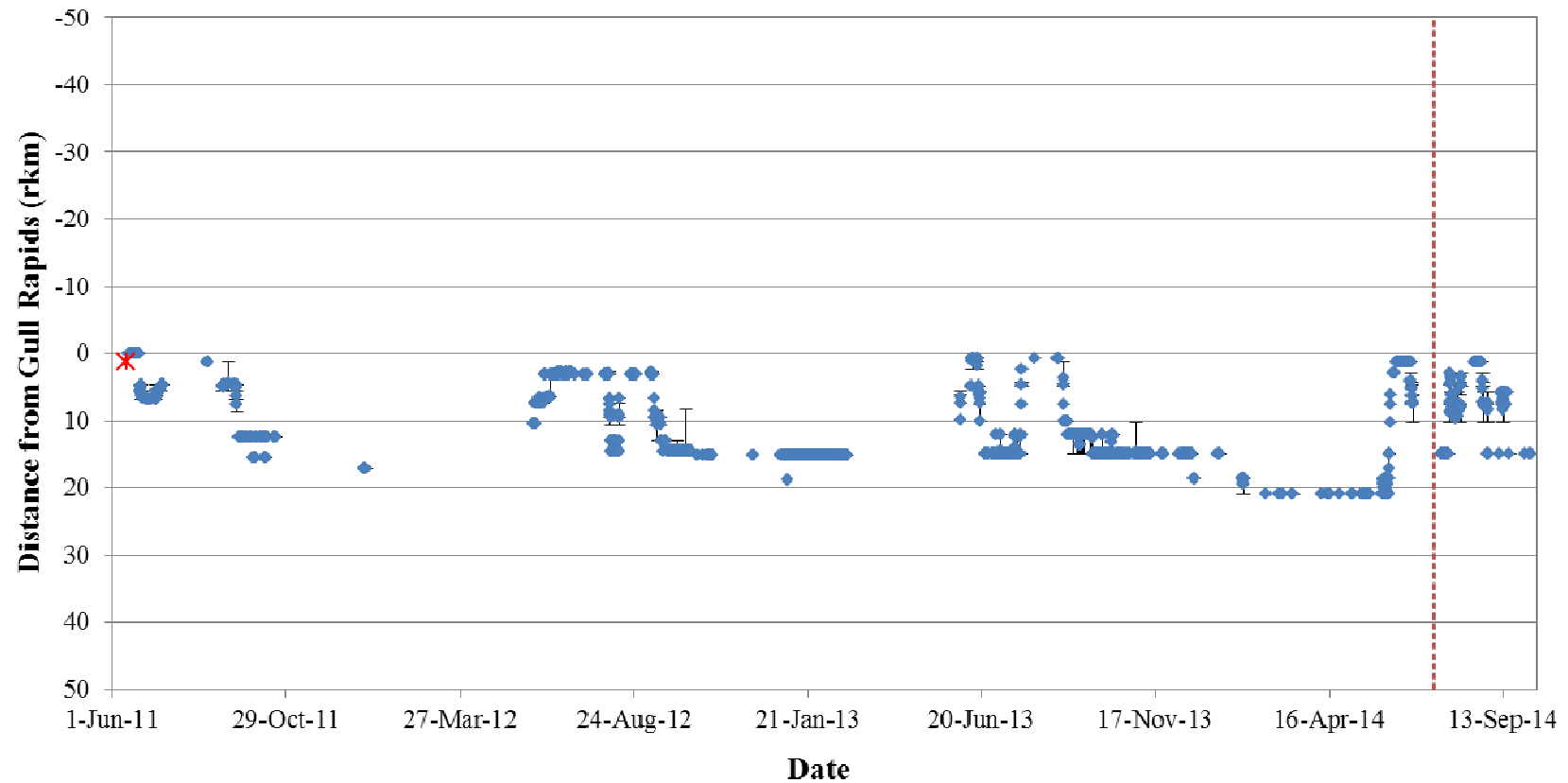


Figure A3- 25: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16050) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

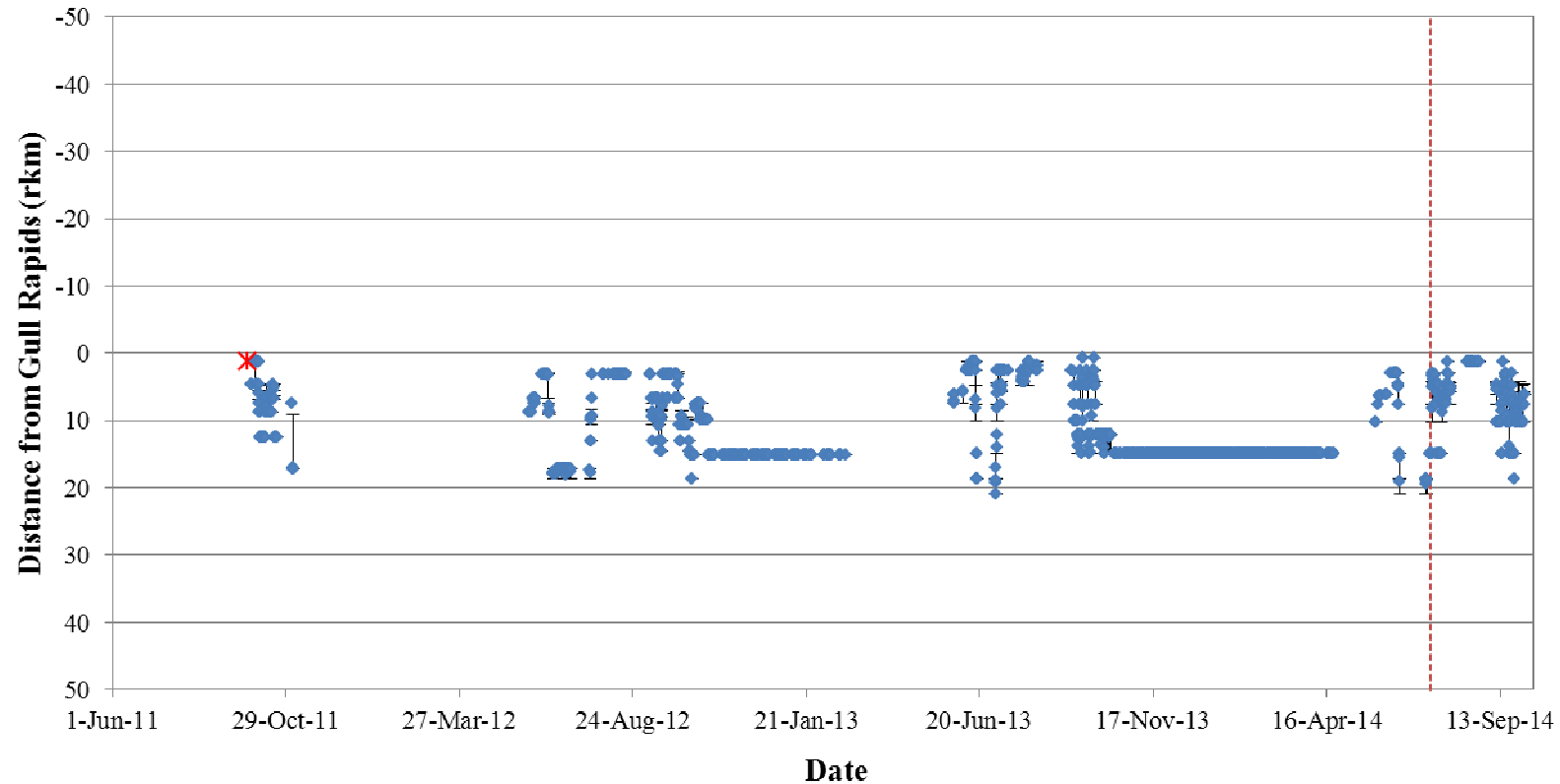


Figure A3- 26: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16052) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

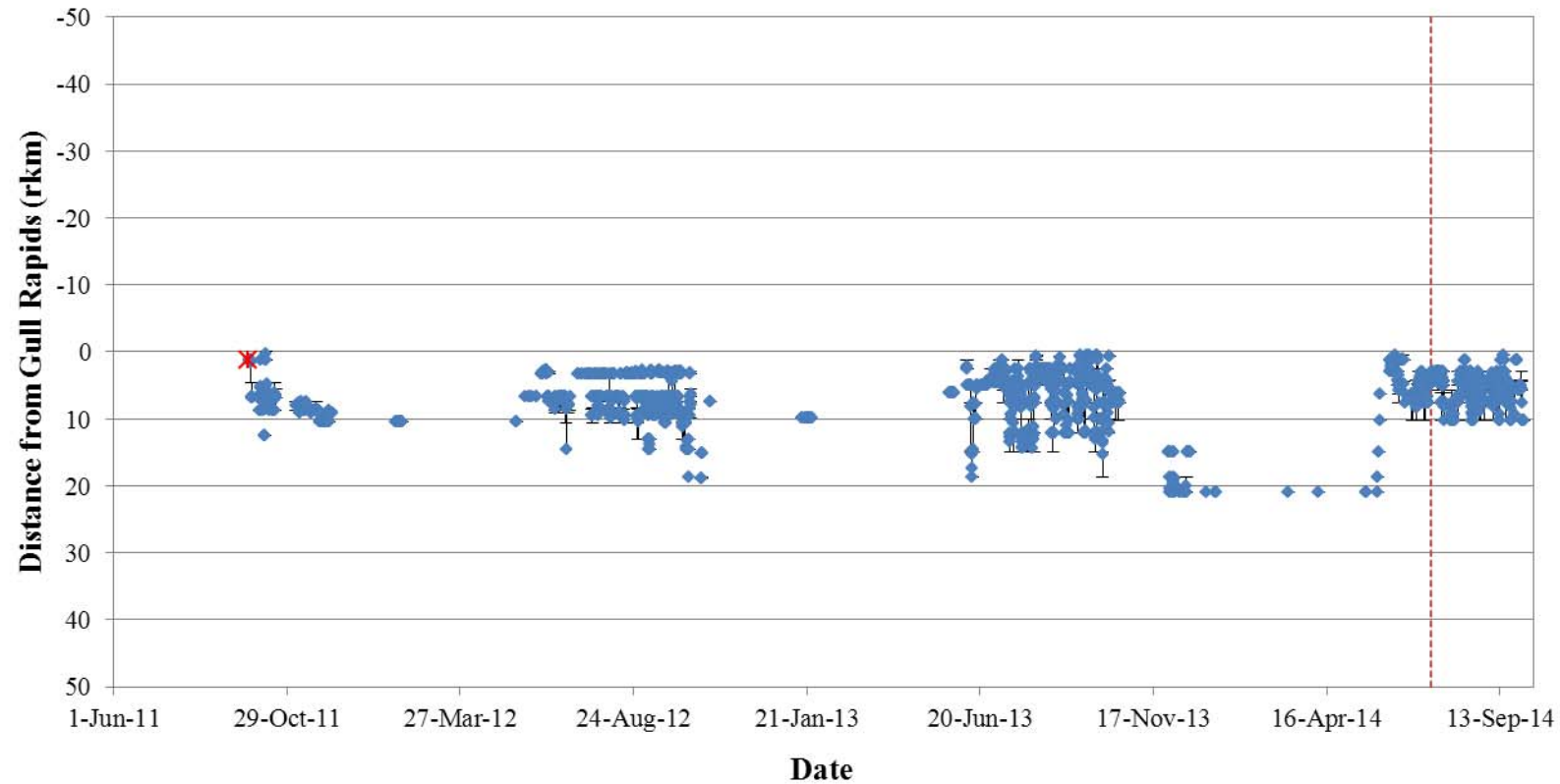


Figure A3- 27: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16053) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

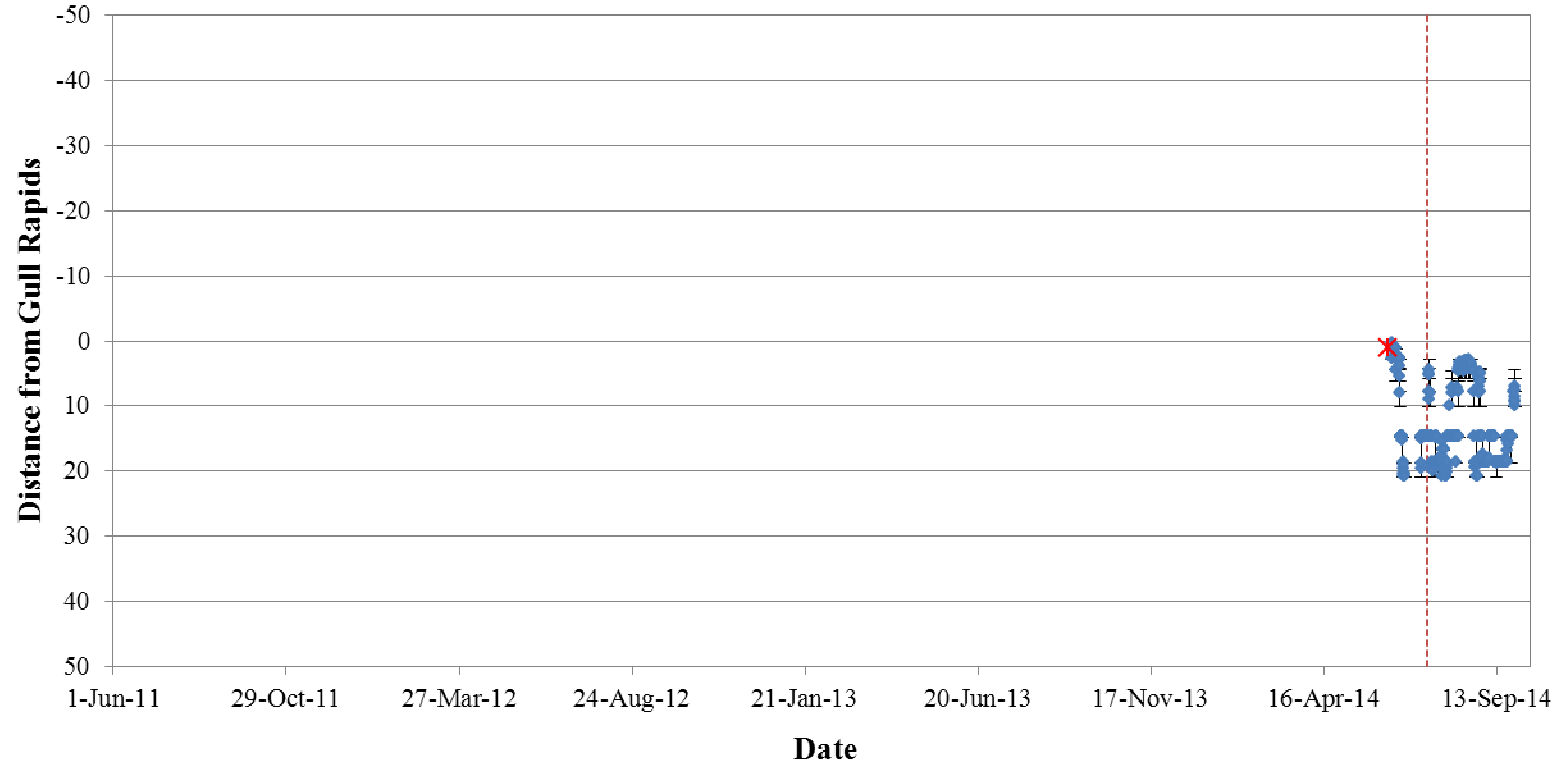


Figure A3- 28: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32167) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

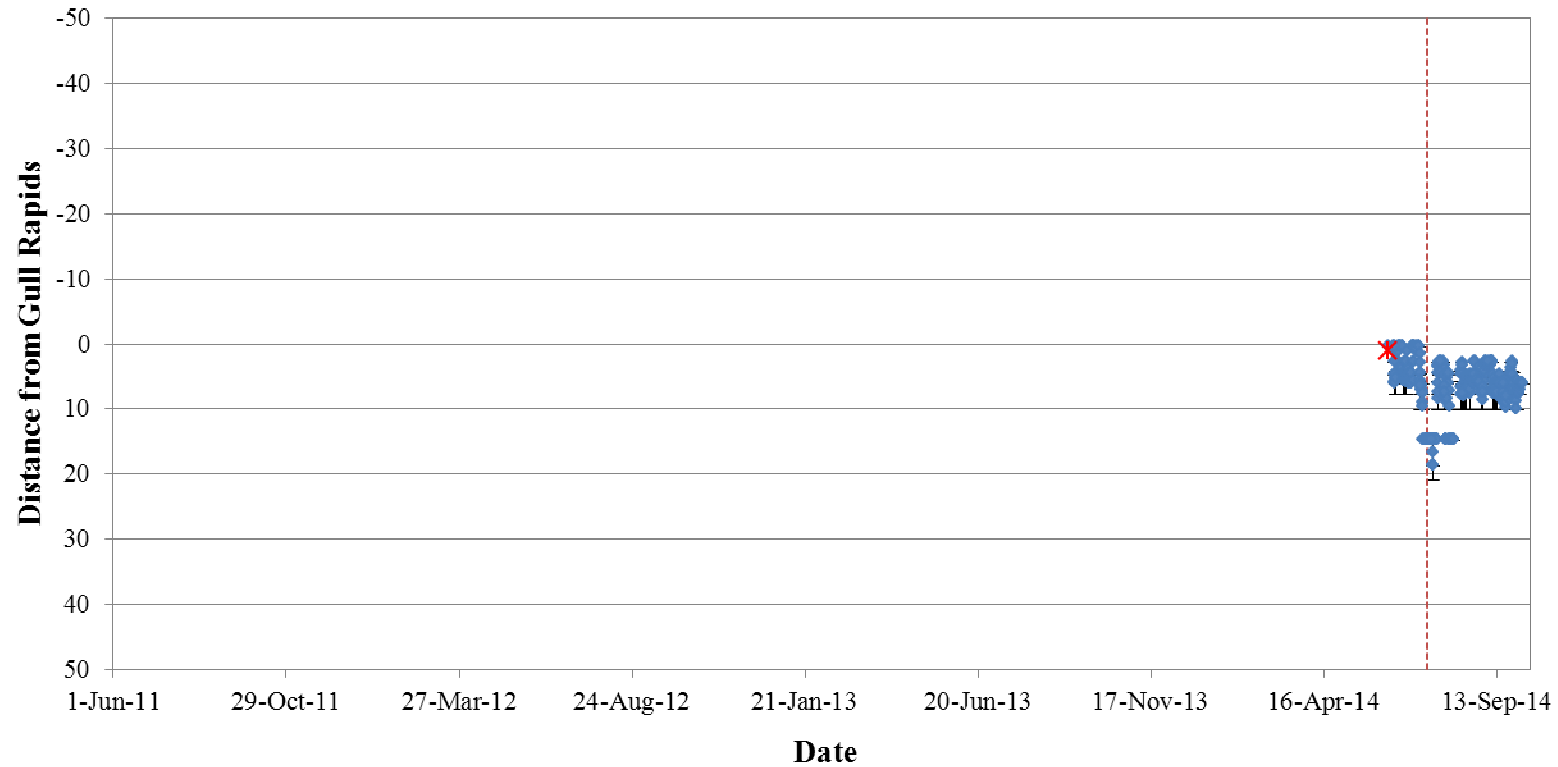


Figure A3- 29: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32168) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

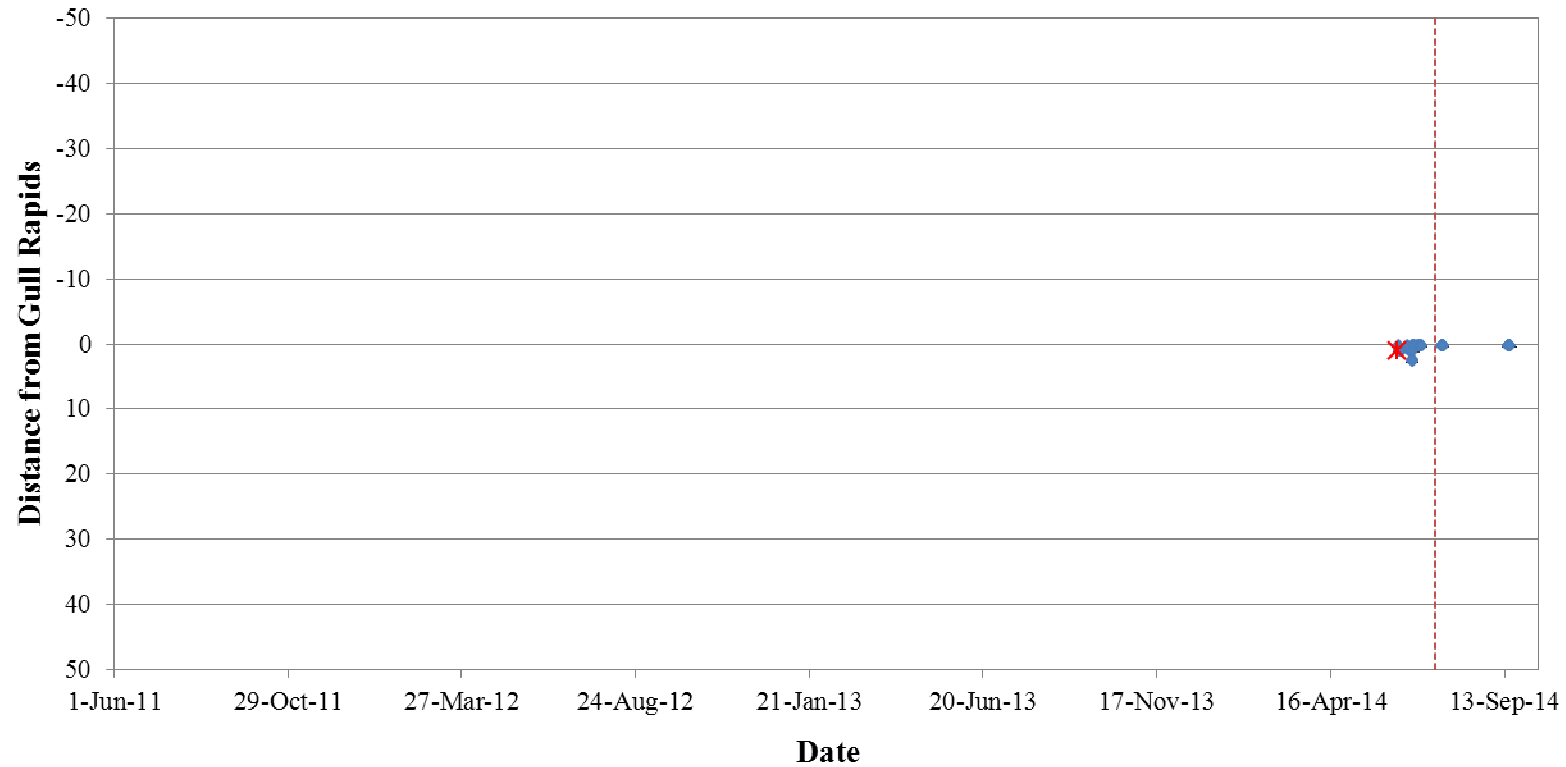


Figure A3- 30: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32169) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

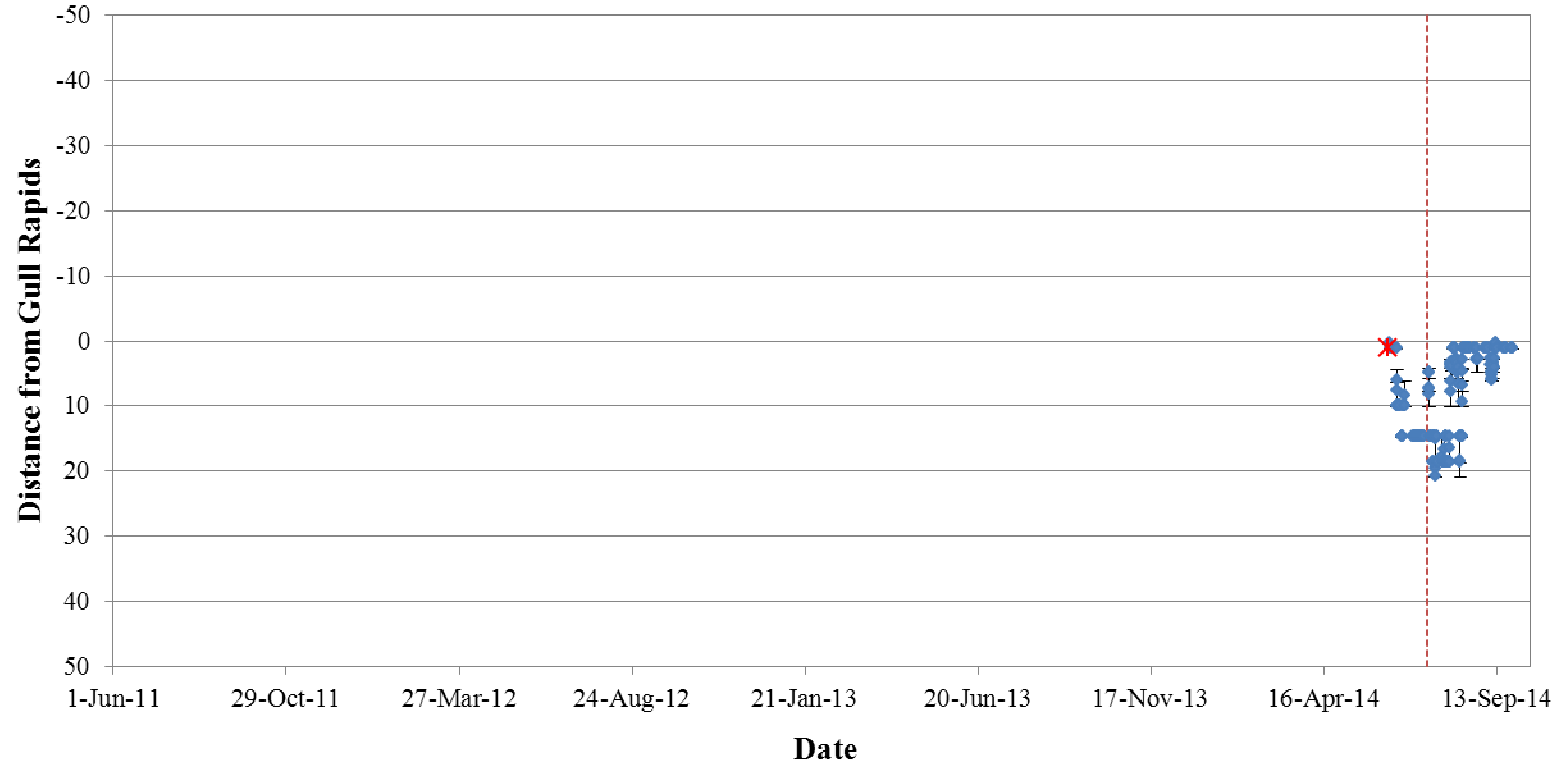


Figure A3- 31: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32170) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

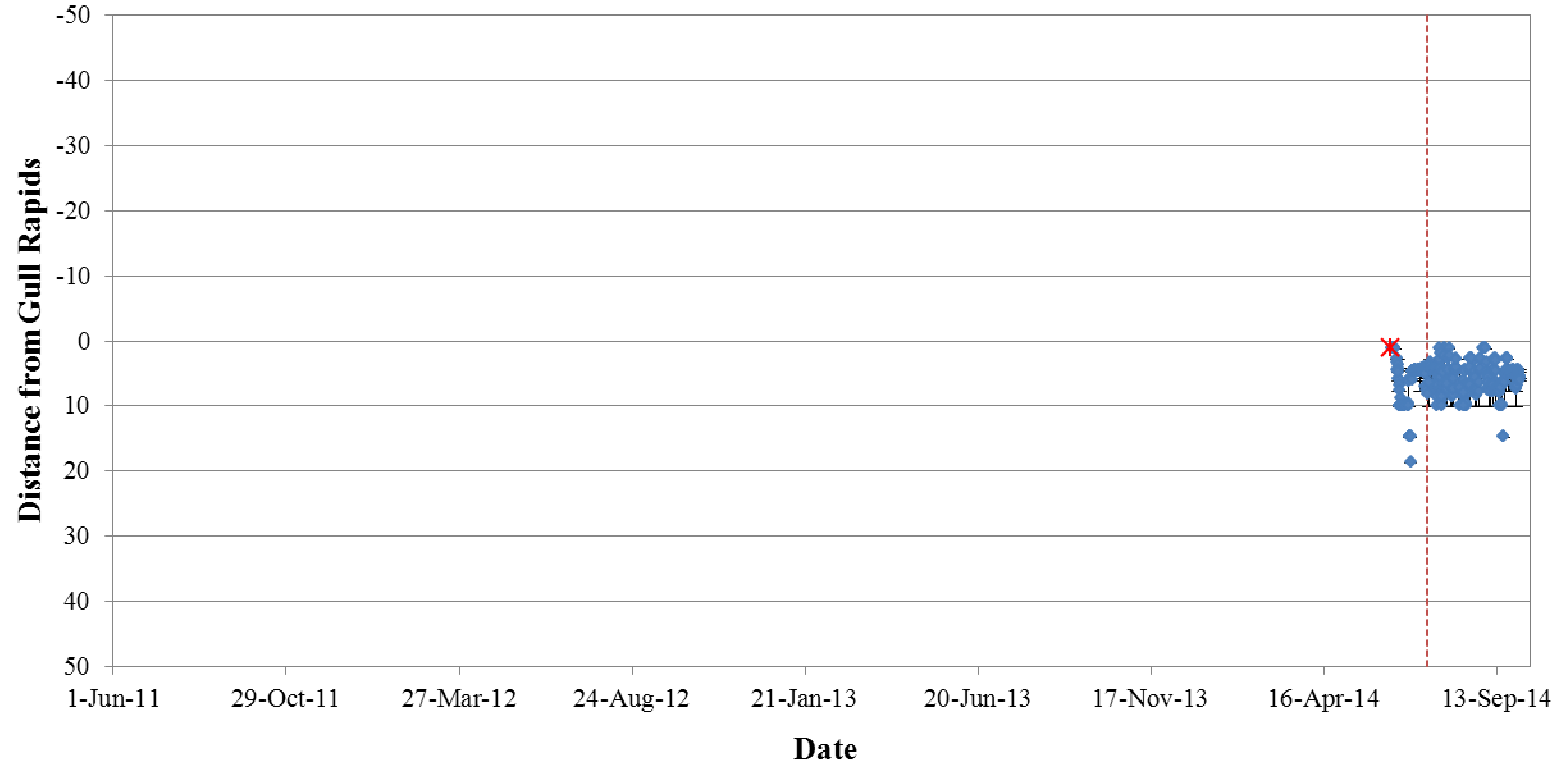


Figure A3- 32: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32171) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

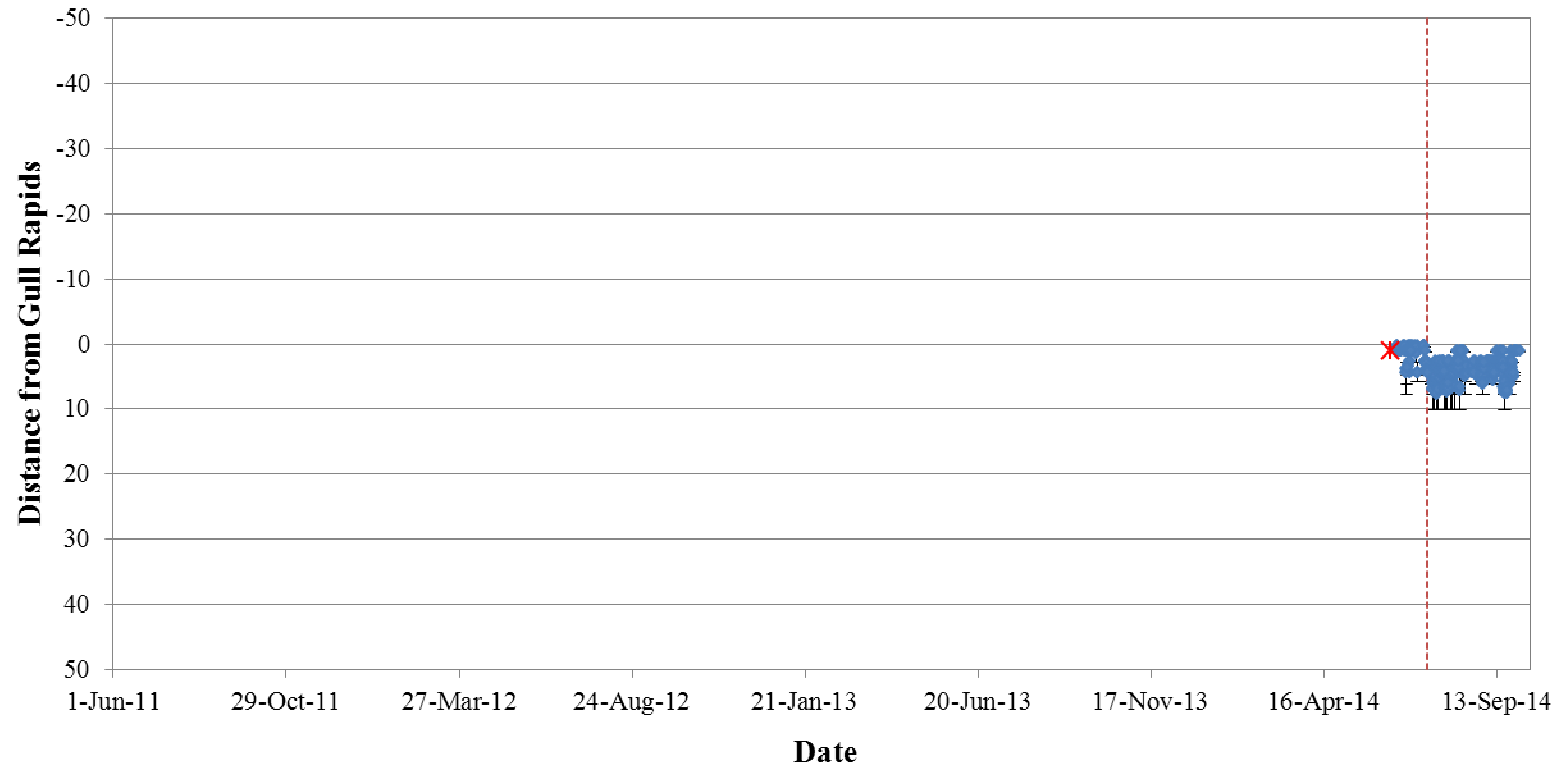


Figure A3- 33: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32172) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

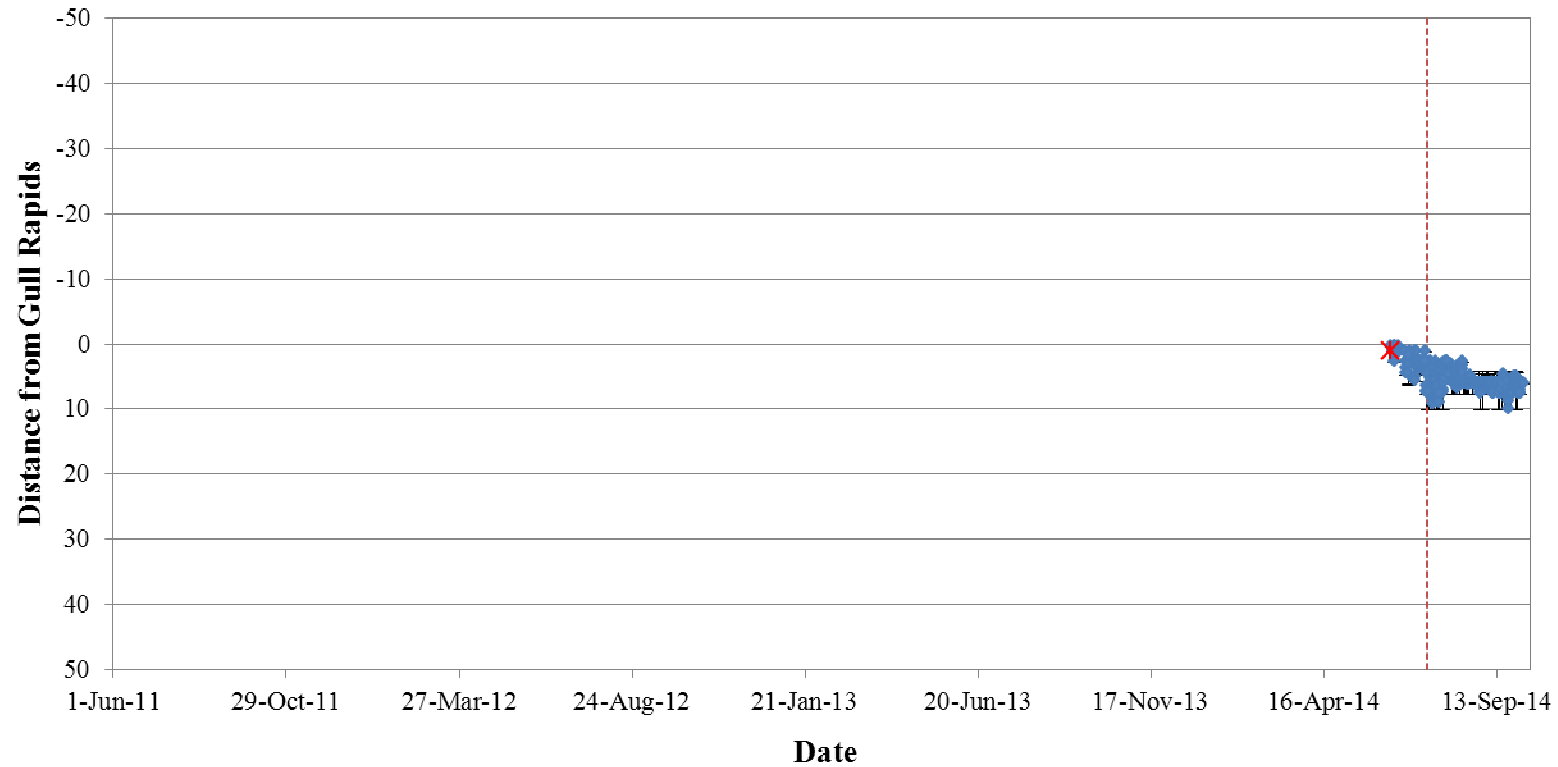


Figure A3- 34: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #32173) in Stephens Lake in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

APPENDIX 4:

LOCATION SUMMARY FOR INDIVIDUAL ACOUSTIC TAGGED ADULT LAKE STURGEON IN THE LONG SPRUCE RESERVOIR, JUNE 2011 TO OCTOBER 2014

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- Figure A4- 1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16021) in the Long Spruce Reservoir in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line..... 140
- Figure A4- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16034) in the Long Spruce Reservoir in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line..... 141

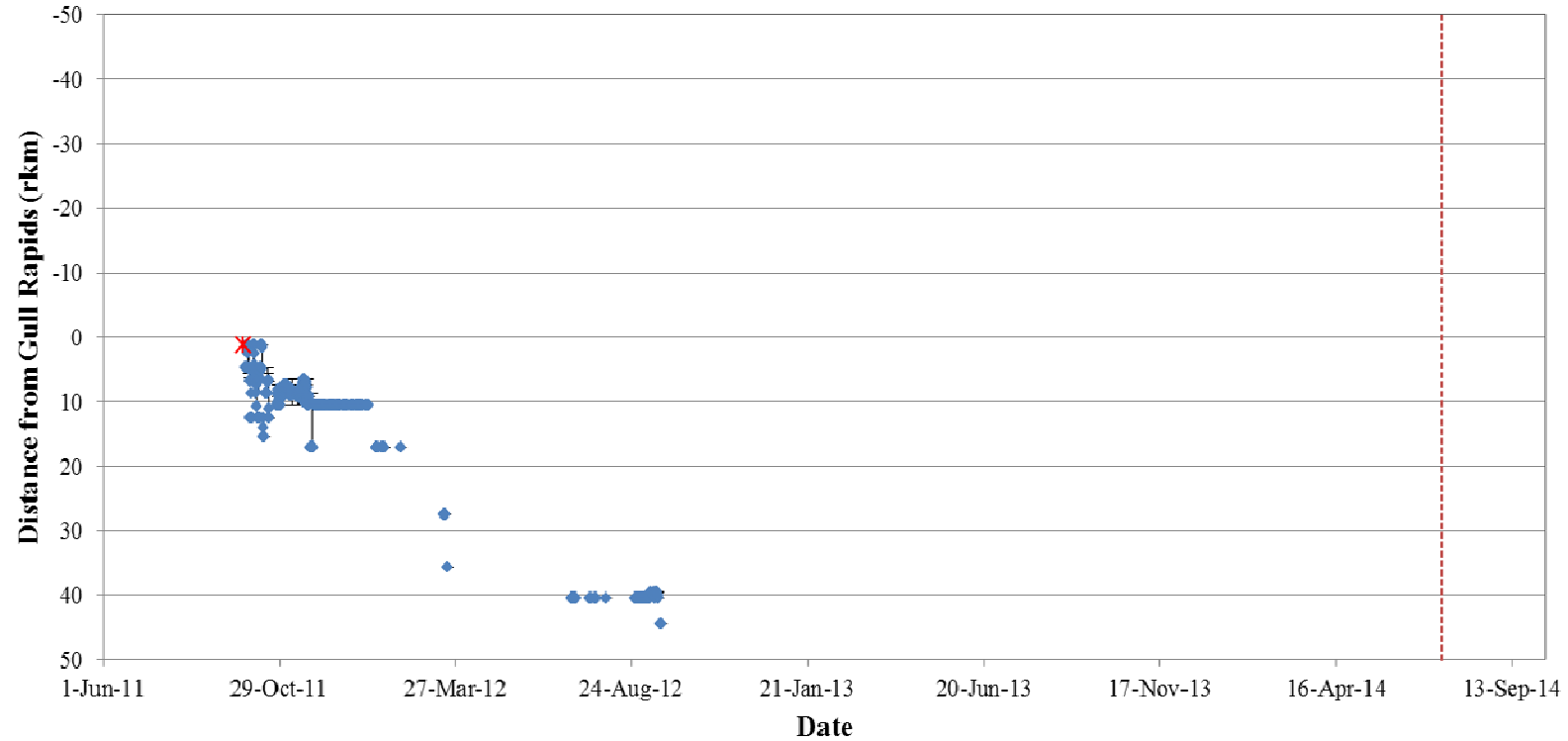


Figure A4- 1: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16021) in the Long Spruce Reservoir in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.

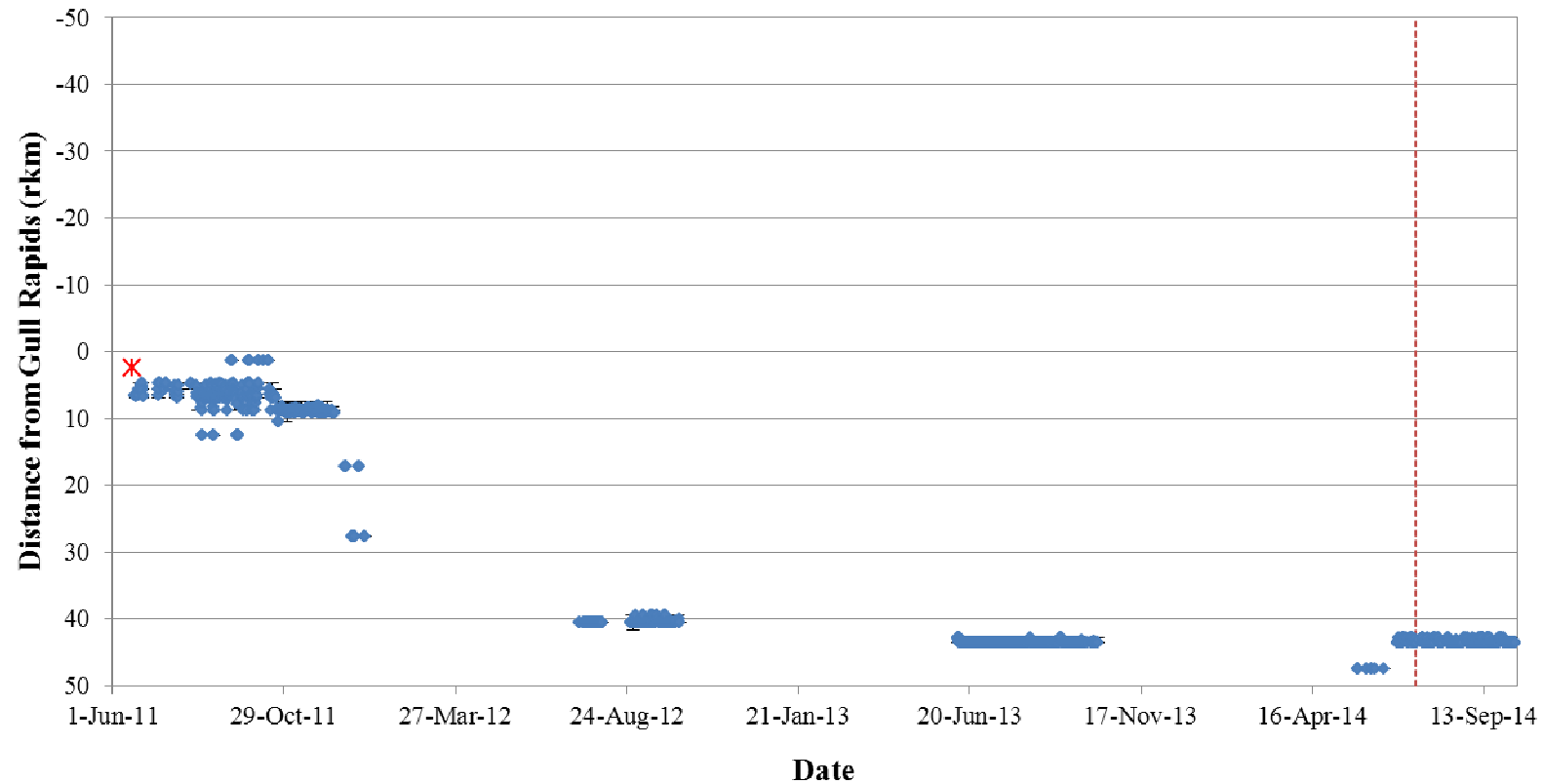


Figure A4- 2: Position of a Lake Sturgeon tagged with an acoustic transmitter (code #16034) in the Long Spruce Reservoir in relation to Gull Rapids (rkm 0), from 1 June, 2011 to 12 October, 2014. Date and location of tagging is indicated by a star. Beginning of Keeyask construction is indicated with a dotted line.