



MEMORANDUM

To: Enric Fernandez – Senior Environmental Coordinator
Donlin Gold LLC

From: William Morris – Senior Aquatic Scientist *Wm*
Owl Ridge Natural Resource Consultants, Inc.

Date: July 7, 2016

Subject: 2016 Rainbow Smelt Spawning Migration Observations Summary –
Kuskokwim River, Alaska

INTRODUCTION

Owl Ridge Natural Resource Consultants, Inc. (Owl Ridge) conducted surveys of the rainbow smelt spawning migration and spawning habitat on the Kuskokwim River in 2014 and 2015 in support of the Donlin Gold Project. Results from this two-year survey (Owl Ridge, 2015) were used to describe characteristics of the annual spawning migration including: ice-out (breakup) conditions, water flow, water temperature, timing of rainbow smelt arrival in Bethel, upstream migration rates, spawning reaches, subsistence harvest timing, and spawning habitat.

In spring 2016, locations of smelt occurrence and water temperature data were reported to Owl Ridge by local scientists and fishers. The 2016 observations were compared to those collected in 2014 and 2015 surveys and this memorandum summarizes the results of the comparison.

ACKNOWLEDGEMENTS

Observations reported in 2016 provide valuable information that were only possible with support from the network of village observers that provided daily updates on the location of rainbow smelt during the 2016 migration. Thanks to:

Colleen Lauraux in Bethel for daily updates during the early days of the migration and for providing detailed information from the lower river.

Mark Leary with the Native Village of Napaimute, and Dave Cannon with the Kuskokwim River Watershed Council, who provided reports from villages throughout the migration. Dave provided daily water temperature data from Aniak throughout the migration.

Dan Ausdhal Jr. provided detailed observations and reports during the latter part of the migration, once smelt had reached the Kalskag region.

Dan provided the detail needed to determine the end of spawning as well as the reach of the Kuskokwim River used by smelt for spawning in 2016.

SUMMARY OF COMPARISON

Ice, Water Flow, and Water Temperature

Ice Conditions

Kuskokwim River rainbow smelt begin their annual spawning migration shortly after ice has cleared from the river and after peak breakup flows begin to recede. In 2016, breakup along the Kuskokwim River occurred in late April and reports from village observers indicate that the river was ice-free between Crooked Creek and Bethel by April 28. The U.S. Geological Survey (USGS) gage on the Kuskokwim River at Crooked Creek was no longer reporting the presence of ice by April 21. In contrast, in 2014 and 2015, the USGS gage did not begin recording river discharge until May 5, presumably near the time of ice-out in the Kuskokwim River at Crooked Creek.

Water Flow

In all three years, smelt initiated upstream migration on a receding hydrograph (Figure 1). Similarly, spawning was on the receding leg of the hydrograph in 2014 and 2015 – post breakup, but prior to rising flows in June. However, in 2016 smelt spawned on an ascending hydrograph. The timing of smelt migration and spawning does not appear to have been directly related to absolute discharge in 2014, 2015, or 2016, as flows at spawning have varied: 46,000 cubic feet per second (cfs) (2014); 65,000 cfs (2015); and 76,000 cfs (2016).

Water Temperature

Water temperature data were collected around the smelt spawning areas near Kalskag in 2014 and 2015, and near Aniak in 2016 (Figure 2). Warming water temperature, in combination with receding flows after breakup, likely trigger the upstream spawning migration of rainbow smelt. Water temperature appeared to influence the spawning migrations in 2015 and 2016. Post breakup water temperatures near Kalskag in May 2015 remained persistently cool, around 8°C, for several days after rainbow smelt were first detected in the river below Bethel. Smelt held in the lower river during that period and did not initiate their upstream migration until water temperature began to steadily rise. In 2016, smelt began their migration, passing Bethel, when water temperatures (as measured at Aniak) were still around 6°C; however, water temperature was steadily rising. Rainbow smelt appeared to hold briefly in reaches of the river downstream from Kalskag before making a final movement to spawning grounds, after water temperatures in Aniak exceeded 10°C.

In 2016, spawning began on the first day that water temperature exceeded 10°C; while in 2014 and 2015 spawning occurred at warmer water temperatures, between 11°C and 12°C (Figure 2). Just prior to the 2016 spawning, strong hail and rain persisted for much

of the day and by the end of the day the water had cooled to below 10°C. However, by the following morning smelt were no longer observed or harvested, indicating that spawning occurred during the afternoon and overnight on the day water first exceeded 10°C (Figure 2, Table 1).

Spawning Migration

Timing and Rate of Migration

The starting date of the spawning migration (loosely defined here as the passing of smelt by Bethel) has varied by two weeks over the period 2014-2016. The 2016 rainbow smelt spawning migration occurred between May 10 and 17, the earliest observed between 2014 and 2016. Historical knowledge of the fishery indicates that smelt usually spawn around the end of May, so spawning on May 16 was clearly very early. 2016 rainbow smelt movements were tracked beginning May 10, when fish were first reported in the lower river at Napakiak (21 river kilometers [rkm] downstream of Bethel), until May 17, when fish were no longer being reported in the river near spawning areas around Upper Kalskag (Figure 3).

By the morning of May 10, 2016, rainbow smelt harvesting had begun in Napakiak (Enoch 2016). By mid-day, smelt had arrived at Bethel and by evening, high harvest rates were reported. On May 11 and 12, smelt were moving between 21 and 34 rkm per day passing Kwethluk and Akiak. The migration rate increased May 13 and 14, with movements of 59 and 57 rkm per day, respectively. Similar to 2014 and 2015, within four days of their arrival at Bethel, smelt were being harvested within 25 rkm downstream of Upper Kalskag. However, once arriving in an 8-rkm reach of the river downstream from the Old River mouth (about 7 rkm downstream from Upper Kalskag), the migration slowed and smelt remained in the area for two days until they moved upstream of Lower and Upper Kalskag on May 16, presumably for spawning. Reports of smelt being harvested below Kalskag from an area between the Old River mouth to about 8 rkm downstream from the Old River mouth began on May 14 and persisted through the morning of May 16. Movement rates had dropped to around 10 to 13 rkm per day. Smelt first arrived at Lower Kalskag on May 16 at 13:00 hours, and by 20:00 hours harvests were being reported between Lower Kalskag and upstream of Upper Kalskag around river kilometer (RKM) 298 (measured upstream from the mouth of the Kuskokwim River), near two islands. Reports indicate that female smelt harvested between Lower Kalskag and RKM 298 were ripe females, with eggs spilling when handled. By morning on May 17, rainbow smelt were no longer being harvested or observed, and no gulls were present. 2016 rainbow smelt spawning was complete by the morning of May 17. Table 1 comprises a summary of 2016 rainbow smelt observations and approximate daily movement rates for the spawning migration.

In 2016, smelt moved an average of 28 rkm per day (rkm/day), considerably slower than the 48 rkm/day rate observed in 2014, but nearly identical to the 27 rkm/day rate observed in 2015, when smelt held in the lower river for two days prior to initiating their upstream migration. In 2016, the migration seemed to pause near the end, as rainbow smelt

approached spawning areas, rather than at the onset of the migration. Figure 3 depicts the rainbow smelt migration for 2014, 2015, and 2016.

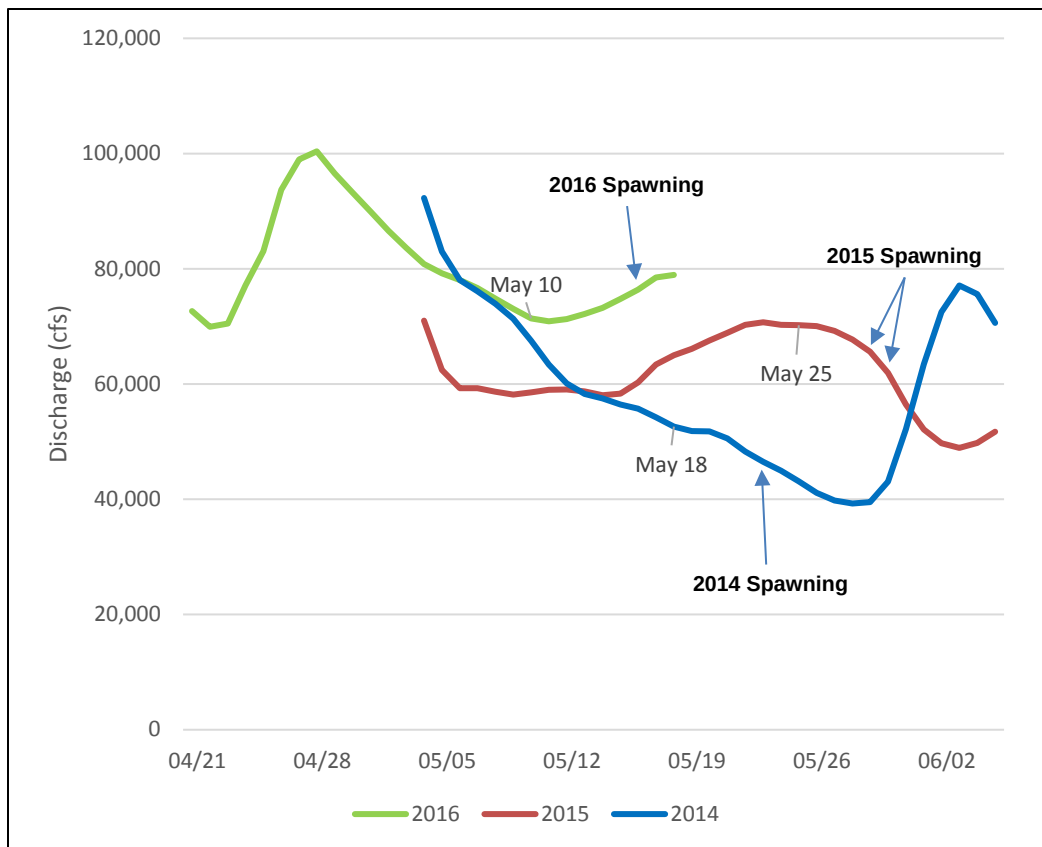
Rainbow Smelt Spawning Location

In 2016, rainbow smelt spawned in the same reaches as observed in 2014 – at Kalskag and just upstream. This area is indicated by local fishers as the usual spawning reach (Figure 4). Because substrate samples were not obtained in 2016 to define the extent of spawning, we have conservatively estimated the potential spawning reach as a 13 rkm area between the mouth of the Old River at RKM 285 and the islands immediately upstream from Upper Kalskag near RKM 298. However, the rapid upstream movement of fish into the area between Lower Kalskag and RKM 298 observed on May 16, and the immediate departure of fish by the morning of May 17, indicates that rainbow smelt likely spawned in nearly the same area used in 2014 (Figure 4). Despite the different breakup and river conditions during the spawning migrations in 2014, 2015, and 2016, rainbow smelt spawned within the same 35 rkm reach of the Kuskokwim River. In 2014 and 2016, the two years with the most disparate environmental conditions, smelt most likely spawned in the same 7 rkm reach beginning at and extending just upstream from Kalskag.

REFERENCES

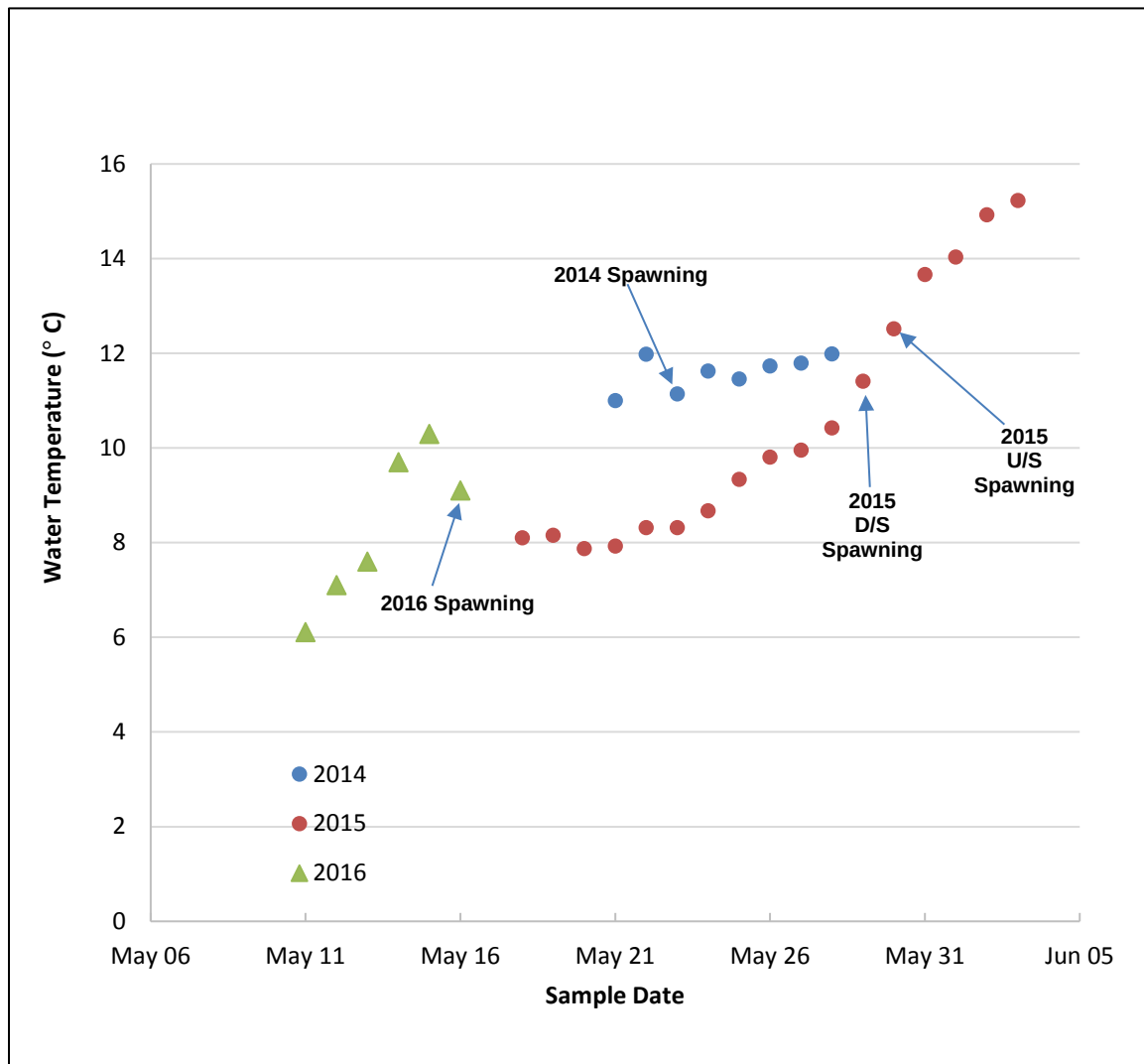
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<http://archive.kyuk.org/smelts-are-on-their-way-past-napakiak!/> KYUK, Bethel
Broadcasting, Inc. Bethel, Alaska.
- Owl Ridge Natural Resource Consultants, Inc. 2015. Final Report: Rainbow smelt
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Anchorage, Alaska. 43 pp.

FIGURES



Note: Dates noted on the hydrographs indicate the date smelt first arrived in Bethel, AK

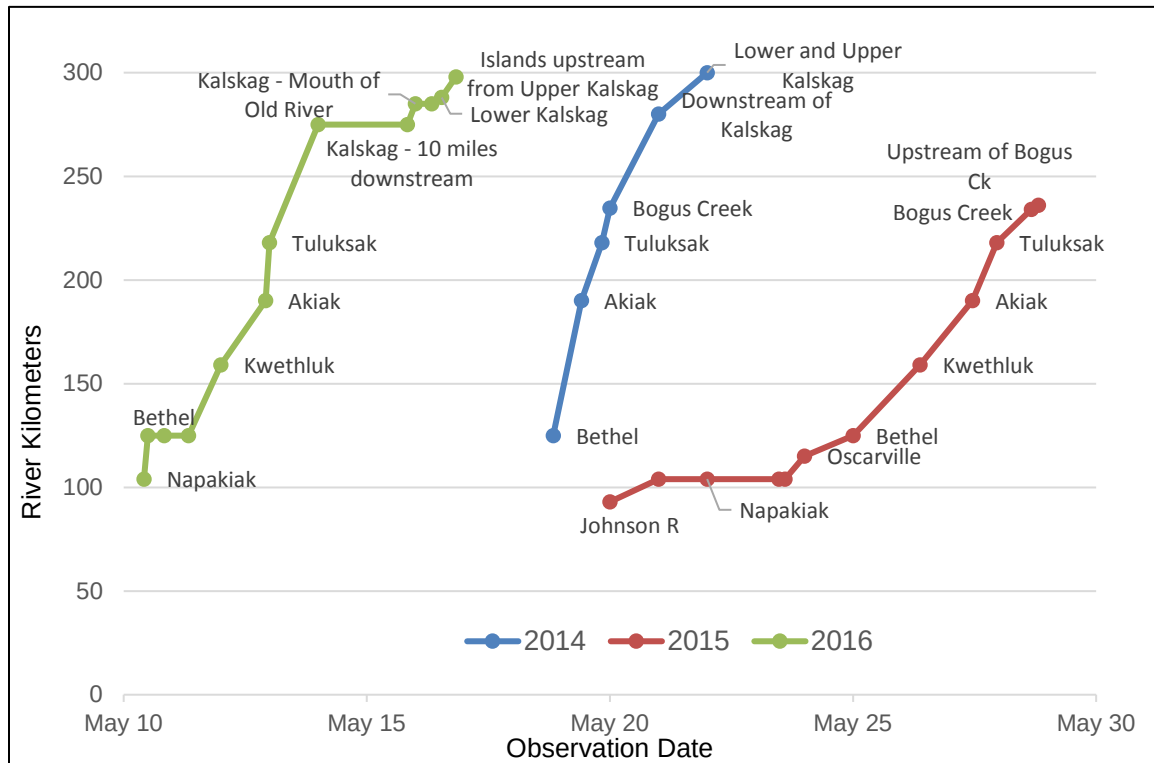
Figure 1. Kuskokwim River Discharge during April and May 2014, 2015, and 2016 – Depicting the Variability in River Flow Conditions during the Rainbow Smelt Migration



D/S = downstream; U/S = upstream

Note: 2014 and 2015 water temperature readings were recorded at Kalskag; 2016 water temperature readings were reported at Aniak by D. Cannon, Kuskokwim River Watershed Council.

Figure 2: Kuskokwim River Water Temperature near Kalskag during the Rainbow Smelt Migration (2014, 2015, 2016)



Note: River kilometers are measured from the mouth of the Kuskokwim River.

Figure 3: Spawning Migration of Rainbow Smelt in the Kuskokwim River as Reported by Village Observers (2014, 2015, 2016)

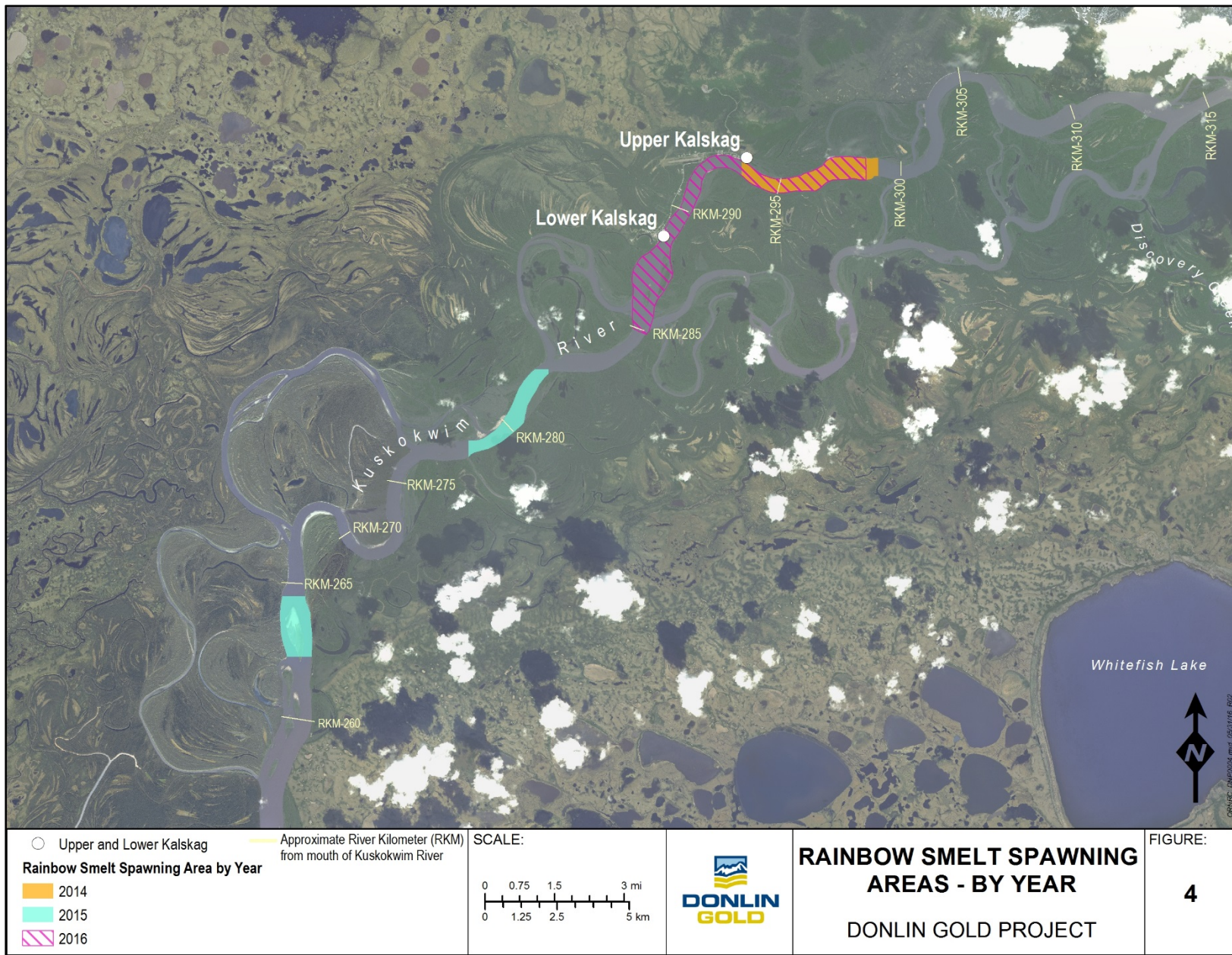


Figure 4: Rainbow Smelt Spawning Areas (2014, 2015, 2016)

2016 TABLE

Table 1: 2016 Upstream Movement of Rainbow Smelt in the Kuskokwim River as Reported by Village Observers

Date	Approx. Time	Location	Observation	River Kilometers	River Miles	Approx. rkm/day	Approx. miles/day
5/10/2016	AM	Napakiak	Fishing good - mostly 1/2 nets full	104	65	0	0
5/10/2016	mid-day	Bethel	Smelt being harvested but fishing slow	125	78		
5/10/2016	PM	Bethel	Hitting hard in evening	125	78		
5/11/2016	AM	Bethel	Smelt still being harvested along seawall	125	78	21	13
5/12/2016		Kwethluk	Smelt passed Kwethluk	159	98	34	20
5/12/2016	PM	Akiak	Smelt passed Akiak	190	116		
5/13/2016		Tuluksak	Smelt passed Tuluksak	218	135	59	37
5/14/2016		Kalskag - downstream	Smelt being harvested below bluffs downstream from Kalskag	275	171	57	36
5/15/2016	PM	Kalskag - 10 miles downstream	Smelt being harvested about 10 miles downstream from Kalskag	275	171		
5/15/2016		Kalskag	Smelt reported at mouth of Old River area	285	177	10	6
5/16/2016	AM	Kalskag	Smelt reported at mouth of Old River area	285	177	0	0
5/16/2016	13:00	Lower Kalskag	Smelt observed 13:00 hours; fish jumping and splashing	288	179		
5/16/2016	20:00	Lower Kalskag to upstream of Upper Kalskag	Smelt being harvested from Lower Kalskag to 2nd island upstream from Upper Kalskag, Females with eggs spilling being harvested, No smelt being harvested above islands, No gulls above islands	298	185	13	8
5/17/2016	AM	Kalskag	Fish no longer observed at islands above upper Kalskag or at town	298	185		
Total Upstream Migration:						194	120
Average Daily Movement Rate:						28	17
Sources:	D. Ausdhal, Upper Kalskag, 2016 D. Cannon, Kuskokwim River Watershed Council, 2016 C. Lauraux, Donlin Gold, Bethel, 2016 M. Leary, Native Village of Napaimute, 2016						