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Inventory of Anadromous and Resident Fish Species in Tributaries to the Tanana River between Nenana and Delta Junction, Alaska, 2008 and 2009

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Identification and Inventory of Anadromous and Resident Fish Species in Tributaries to the Tanana River between Nenana and Delta Junction, Alaska

Raymond F. Hander and Nicole M. Legere

Abstract

The Tanana River valley near Fairbanks has experienced human population growth and development that may decrease available fish habitat. Some areas of the Tanana River drainage lack fish distribution data in developed areas and areas with development potential. During 2008 and 2009, portions of eight Tanana River tributary streams between Nenana and Delta Junction were sampled for fish species presence. Attempts were made to sample each stream portion three times in the open water season using a suite of capture gears including minnow traps, a backpack electrofisher, seine, gill net, dip net, angling, fyke net, cast net, and observation. Fish sampling resulted in Clear and Beaver creeks and the Lower South Fork Chena River being nominated to the *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* and approved for the addition of juvenile Chinook salmon *Oncorhynchus tshawytscha* rearing. Beaver Creek and the Lower South Fork Chena River were approved for the addition of adult Chinook salmon spawning and present. Kiana Creek was nominated and approved for juvenile coho salmon *Oncorhynchus kisutch* rearing. Other fish species captured included Arctic lamprey *Lampetra camtschatica*, lake chub *Couesius plumbeus*, longnose sucker *Catostomus catostomus*, northern pike *Esox lucius*, round whitefish *Prosopium cylindraceum*, humpback whitefish *Coregonus pidschian*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, and slimy sculpin *Cottus cognatus*. Within sampled stream portions, aquatic habitat characteristics were collected to document current conditions at the time of fish sampling that included stream stage, water color, stream order, gradient, Rosgen stream classification, water temperature, specific conductivity, and pH.

Introduction

The Tanana River and its tributaries support spawning, rearing, and migratory habitat for a variety of fish species, including juvenile and adult Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho *O. kisutch* salmon, anadromous and resident forms of whitefish *Corigoninae*, Arctic grayling *Thymallus arcticus*, northern pike *Esox lucius*, burbot *Lota lota*, Arctic lamprey *Lampetra camtschatica*, and other resident species (Barton 1992; Ott et al. 1998; Hemming and Morris 1999; Durst 2001). The documentation of habitats important to these species is incomplete and jeopardizes permitting agencies' abilities to recommend site-specific mitigation measures associated with urban development projects (ADFG 2006). Habitat alterations resulting from development are visible throughout the drainage, including rock-armored river banks, riparian vegetation removal, soil erosion, and inadequate passage structures for fish and

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other aquatic organisms. The Tanana River drainage, particularly near the Fairbanks area, has recently experienced an increase in human population, with new housing, roads, and commercial development. Increased military training activities, potential oil and gas development near Nenana and Minto, a proposed railroad extension, and anticipated natural gas pipeline construction may increase pressures on aquatic resources. Cumulative effects from these projects and other activities such as logging and gravel extraction may further degrade fisheries habitat and negatively affect aquatic production in the Tanana River drainage. These development projects may lead to increased siltation, degradation of water quality and quantity, and reduction of shoreline rearing habitat for fish populations (Waters 1995). A decline in available habitat may affect production and sustainability of many species that are important to subsistence, sport, and commercial fisheries throughout the drainage (Hemming and Morris 1999).

In 2008 and 2009, a study was conducted to identify the presence of anadromous and resident fish species and catalog anadromous water bodies in Tanana River tributaries between Nenana and Delta Junction, Alaska, during the open water season. This project was identified as a high priority by the Alaska Department of Fish and Game (ADFG) and the Fort Wainwright Natural Resources Office (FWNRO; U.S. Army Alaska 2002). Another goal of the project was to identify the location of critical spawning, rearing, and migratory habitats along with site-specific aquatic habitat characteristics such as water chemistry, and hydrology. Additionally, data gaps identified in the ADFG *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* (AWC; ADFG 2006) were investigated. The AWC is an important reference source that identifies specific streams, rivers, and lakes that are used by anadromous fish species. The water bodies cataloged in the AWC are afforded protections under Alaska state statute AS 16.05.870. The timely collection of critical habitat data provide land managers information to make informed decisions when responding to permitting of development projects affecting anadromous waters. The objectives of this project were to (1) document the presence of anadromous and resident fish species in selected streams of the Tanana River basin between Nenana and Delta Junction, Alaska, during the open water season; (2) describe the life history stages of anadromous and resident fish species in the selected streams; (3) publish fish species information in the AWC; and (4) qualitatively describe water quality and aquatic habitat characteristics at fish sampling sites for the purpose of documenting current stream conditions.

Study Area

The Tanana Lowlands region of Interior Alaska, as defined by Wahrhaftig (1965), encompasses the area between the Tanana River and the drainage divide along the southern boundary (i.e., the Alaska Range and the Wrangell Mountains). These mountain areas (1,830 to 2,745 m elevation) are dominated by glaciated valleys and small to extensive ice fields (above 2,745 m). Large valley glaciers emanate from this region and feed large braided river systems, such as the Delta River, the Little Delta River, and Delta Creek (Figure 1). North of the glaciated uplands lay the lower foothills of the Alaska Range and extensive lowland areas of the Tanana River valley. North of the Tanana River valley is the central foothills of the Yukon-Tanana uplands. The project area is located within the Tanana River valley and the adjacent Yukon-Tanana uplands. The lowland areas are comprised of extensive glaciofluvial sedimentary deposits and large alluvial fans along the north and west sides of the Tanana River (Anderson 1970). The valley floor is wide with rolling hills and elevations ranging from 215 to 365 m (Brabets et al. 2000). Drainage from the lowland area generally flows northwesterly towards the Tanana River. Stream flows within the lowland areas are dominated by clear groundwater springs, or breakup processes and runoff where groundwater sources are not substantial. Tanana River drainage sub-basins such as the Chena River and Shaw Creek (Figure 1) drain in a southwesterly direction out of the adjacent Yukon-Tanana uplands. Yukon-Tanana upland streams are fed by snowmelt and rain runoff and are humic stained.

Methods

Study Design and Stream Selection

In 2008 and 2009, a temporal sampling approach was used to document anadromous and resident fish species present during the open water season in portions of: Beaver, Clear, Gilles, Kiana, and Willow creeks, and South Fork Chena and Wood rivers (Figure 1). The South Fork Chena River was divided into two separate sections, above and below the Beaver Creek confluence, because access was not allowed through the U.S. Army's Stuart Creek Impact Area. These two sections will be referenced as Upper and Lower South Fork Chena River in this report. Sample streams were chosen by consultation with the ADFG Divisions of Habitat, Sport Fisheries, and Commercial Fisheries and the FWNRO. Data gaps identified in the AWC and proximity to potential development and military training areas were used to further define the study areas.

Study streams were initially divided into sections to distribute sampling effort and to provide spatial coverage. In each stream, two preliminary sampling sections were selected before going to the field using a combination of Geographic Information System software, U.S. Geological Survey (USGS) maps, and aerial and satellite imagery. Within sections, the study area was categorized into main channel and major tributary confluences. Helicopter reconnaissance of selected study stream reaches revealed access and navigation issues for sampling caused by deadfall trees and log jams across the stream channels and limited helicopter landing sites. The spatial coverage sampling design was abandoned by necessity and evolved into an opportunistic sampling scheme defined by helicopter landing site availability and flight scheduling, floatable sections of streams for moving gear downstream with minimal blockage, and time and financial constraints. A two or three-person crew was dropped off by helicopter at the farthest feasible upstream point in each sample stream and inflatable canoes were used to carry crew and gear downstream. Three sampling periods were chosen to increase the opportunity of encountering the maximum number of fish species that have differential migratory timing (Barton 1992; Finn et al. 1998). Period 1 was from late May to early June, period 2 was from late July to early August, and period 3 was from late August to mid-September. Sampling sites established during period 1 were re-sampled in the subsequent sampling periods each year. When feasible, sample sites were added further upstream of a previous period's established sites to increase the survey distance and for greater AWC documentation potential.

Fish Sampling

Electrofishing (Reynolds 1996) and other fish sampling techniques, such as seines, baited minnow traps, and gill nets were used to capture fish. Electrofishing was the principal fish collection method used in wadeable water because it was recognized as the most comprehensive and effective method for collecting fish in lotic systems (Barbour et al. 1999; Simon and Sanders 1999; Flotemersch and Blocksom 2005). To reduce spinal and associated electrofishing-induced injuries (Dalbey et al. 1996), electrofishing was not conducted in the vicinity of observed fish >200 mm in length.

Captured fish were identified to species and life stage except for slimy sculpin. Fish length was measured to the nearest 1 mm using fork length or total length depending on the species. For instance, juvenile salmon lengths were measured using fork length and slimy sculpin *Cottus cognatus* were measured using total length. Fish life stage was determined through observation of characteristics such as spawning and comparison of meristics from published literature. All fish were externally examined for secondary sex and life stage characteristics. After a period of recuperation in still water, fish were released into the stream. Specimens requiring laboratory techniques to determine species or life stage were euthanized and brought to the U.S. Fish and Wildlife Service (USFWS) laboratory in Fairbanks for processing. Pyloric caeca were counted to separate juvenile Chinook and coho salmon because their external meristics may overlap and lead to misidentification in a field setting. Juvenile Chinook salmon have pyloric caecum counts that range from 90–240 and coho salmon range from 45–114 (McPhail and Lindsey 1970; Trautman 1973). Fish that were processed for pyloric caecum counts were performed twice for quality control.

Wadeable site fishing protocols.—At each sample site, one stream reach was sampled for fish. Sampling reaches extended 150–300 m upstream from a sample site or tributary mouth (Lyons 1992; Patton et al. 2000; Reynolds et al. 2003). This range of sample reach lengths was consistent with the National Water-Quality Assessment Program stream habitat characterization protocols (Fitzpatrick et al. 1998) and with recommendations developed for small stream sampling (Patton et al. 2000). Samplings in tributaries were recorded as distinct sample sites. At wadeable sites, fish were collected in a single pass with a Smith-Root Model LR-24 backpack electrofisher. Electrofisher power settings were made according to stream specific conductivity calculated by the electrofisher and adjusted based on fish catches and observed response by fish. Fishing time, species, and the number of fish caught per species was recorded for each electrofishing event. Catch per unit effort (CPUE) was calculated as fish per second. Beach seines (9.0 x 1.2 m with 0.64 cm ace mesh), minnow traps (23 x 45 cm, 0.6 cm wire mesh, with 2.5 cm diameter openings) baited with salmon roe, and angling were used to maximize the probability of encountering as many fish species and life stages as possible. The CPUE for beach seines was calculated as fish per haul, minnow traps as fish per hour, and angling as fish per hour.

Non-wadeable site fishing protocols.—Experimental gill nets (12.2 x 2.4 m monofilament with four 3.0 m panels of 1.3, 2.5, 3.8, and 5.0 cm bar mesh), gill nets (30.5 x 3.7 m with 10.2 cm bar monofilament mesh and 30.5 x 3.0 m with 7.4 cm bar monofilament mesh), dip nets (0.64 cm ace mesh), beach seines, cast net, minnow traps, and angling were used to maximize the probability of encountering as many fish species and life stages as possible. Gear description and CPUE calculation are similar to those used for wadeable site fishing protocols. Gill net CPUE was calculated as fish per hour and dip nets as fish per dip. Gill nets were monitored closely to avoid fish capture mortality. A dip net was used for discrete point area capture attempts. Samplings in tributaries were recorded as distinct sample sites.

Aquatic Habitat Measurements

Water quality and aquatic habitat conditions were qualitatively characterized at fish sampling sites. Geospatial coordinates of sample sites were recorded in decimal degrees (to the 5th decimal) with handheld global positioning system (GPS) units (Garmin GPSMAP 76S) set for the WGS84 datum. Stream gradient (%) of study streams was determined using USGS 1:63,360 scale topographic maps (McMahon et al. 1996). Stream order was assigned based on Strahler

(1957) and major stream type classification followed Rosgen (1996). Aquatic habitat characteristics at each sample site were sampled for relative flow stage and water color. Water quality measurements, including temperature, specific conductivity (μS/cm), and pH, were measured using a Hach HQ40d portable water meter. Water temperature was taken using a handheld, pocket case thermometer and read to the nearest 0.5°C while submerged. Photographs were taken of survey sites with digital cameras. Physical features that appear to block upstream or downstream movement of fish were photographed and recorded by GPS location. Analysis of aquatic habitat data was limited to the characterization of point observations for stream conditions encountered during sampling.

Results

Three streams were sampled in 2008 (Clear, Kiana, and Willow creeks) and five streams in 2009 (Beaver Creek, Lower South Fork Chena River, Upper South Fork Chena River, Gilles Creek, and the Wood River; Figure 1). A total of 11 fish species was captured during 2008 and eight species in 2009. Variable combinations of fishing gear were used within and among streams based on stream morphology during both years of sampling. High water events in Kiana Creek in 2008 and wildfire on the Wood River in 2009 caused cancellation of sample period 2 in both streams.

Fish Sampling 2008

Clear Creek was sampled during three periods in 2008: June 20–26, August 12–13, and August 30–September 7. Sample period 2 was delayed and partially completed by boat access via the Tanana River because of persistent high water conditions and lack of helicopter availability. Eighteen sites were sampled during the study, including two tributary streams (Table 1; Figure 2). Approximately 48 river kilometers (rkm) were surveyed. A total of eight fish species was captured (Table 2) including: adult and juvenile Chinook salmon, longnose sucker *Catostomus catostomus,* northern pike, and Arctic grayling; adult round whitefish *Prosopium cylindraceum*, humpback whitefish *Coregonus pidschian*, and burbot (carcass observed); and slimy sculpin. Juvenile Chinook salmon were captured on September 1 at sample site 15 and adult Chinook salmon carcasses were observed near sample sites 3 and 13 on September 2. Sample site 15 was nominated and approved for inclusion into the AWC for rearing Chinook salmon (Table 3). The carcass locations were inside existing AWC boundaries, therefore they were not nominated. Pyloric caeca counts ranged from 122–148 for the three captured juvenile Chinook salmon, confirming preliminary field identification (Table 4). Fishing effort and gear types varied by sample site and sample period (Table 5). Slimy sculpin were the most widely distributed species, found throughout the sampling area (sites 1–15). The two tributary sites contained longnose sucker, northern pike, Arctic grayling, and slimy sculpin.

Kiana Creek was sampled during two periods in 2008: June 13–17 and September 11–16. Sample period 2 was cancelled because of persistent high water during mid to late July that created hazardous navigation conditions. Five sites were sampled during the study (Table 1; Figure 3). Approximately 21 rkm were surveyed. A total of six fish species was captured: Arctic lamprey, adult lake chub *Couesius plumbeus* and Arctic grayling, juvenile longnose sucker and coho salmon. Juvenile coho salmon were captured on June 14, 15, 16, and 17 at sample sites 1, 2, 3, and 5, and on September 12 and 13 at sample site 2 (Table 6; Figure 3). Sample site 1 was nominated and approved for inclusion into the AWC for rearing coho salmon (Table 3). Pyloric caeca counts ranged from 61–84 for eight of the captured juvenile coho salmon, confirming preliminary field identification (Table 4). Fishing effort and gear types varied by sample site and sample period (Table 6). Juvenile longnose sucker was the most widely distributed species and was found throughout the sampling area (sites 1–5).

Willow Creek was sampled during three periods in 2008: June 26–29, July 25–30, and August14–29. Nine sites were sampled during the study, including one tributary stream (Table 1; Figure 4). Approximately 10 rkm were surveyed. A total of three fish species was captured (Table 2) including: juvenile and adult longnose sucker and humpback whitefish, and adult northern pike. Fishing effort and gear types varied by sample site and sample period (Table 7). Juvenile longnose sucker was the most widely distributed species, found at sampling sites 2, 5, 6, 7, and 8. The tributary site contained northern pike.

Fish Sampling 2009

Beaver Creek was sampled during three periods in 2009: June 2–4, July 23–25, and September 8–10. Nine sites were sampled during the study (Table 1; Figure 5). Approximately 3 rkm were surveyed. A total of three fish species was captured (Table 2) including juvenile and adult Chinook salmon and Arctic grayling, and slimy sculpin. Juvenile Chinook salmon were captured on September 9 (n = 3) and 10 (n = 1) at sample sites 1 and 2 respectively. Adult Chinook salmon were observed at sample site 6 and 7 on July 24 (Table 8). Sample sites 1 and 2 were nominated and approved for inclusion into the AWC for rearing Chinook salmon (Table 3). Sample site 7 was nominated and approved for the inclusion into the AWC for Chinook salmon spawning and sample site 6 for Chinook salmon present (Table 3). Pyloric caeca counts were 127 and 111 for two of the captured juvenile Chinook salmon, confirming preliminary field identification (Table 4). Fishing effort and gear types varied by sample site and sample period (Table 8). Arctic grayling were the most widely distributed species, found at sample sites 1, 2, 4, 5, and 8.

Lower South Fork Chena River was sampled during three periods in 2009: June 4–6, July 25–26, and September 10–11. Six sites were sampled during the study (Table 1; Figure 6). Approximately 5 rkm were surveyed. A total of five fish species was captured (Table 2) including juvenile and adult Chinook salmon and Arctic grayling, adult round whitefish, juvenile burbot, and slimy sculpin. Juvenile Chinook salmon were captured on June 5, July 26, and September 11 (n = 4) at sample site 1. Adult Chinook salmon were observed at sample site 4 on July 25. Sample site 1 was nominated and approved for inclusion into the AWC for rearing Chinook salmon (Table 3). Sample site 4 was nominated and approved for the inclusion into the AWC for Chinook salmon spawning (Table 3). Pyloric caeca counts were 109 and 123 for two of the captured juvenile Chinook salmon, confirming preliminary field identification (Table 4). Fishing effort and gear types varied by sample site and sample period (Table 9). Slimy sculpin were the most widely distributed species, found at sample sites 1, 4, and 5.

The Upper South Fork Chena River was sampled during three periods in 2009: May 21–25, July 9–13, and September 4–8. Six sites were sampled during the study (Table 1; Figure 7). Approximately 11 rkm were surveyed. A total of two fish species was captured (Table 2) including adult Arctic grayling and slimy sculpin. Fishing effort and gear types varied by sample site and sample period (Table 10). Slimy sculpin were the most widely distributed species, found at sample sites 1–6.

Gilles Creek was sampled during three periods in 2009: June 23–26, August 24–27, and September 29–October 2. Eight sites were sampled during the study (Table 1; Figure 8). Approximately 3 rkm were surveyed. A total of two fish species was captured (Table 2) including juvenile and adult Arctic grayling and slimy sculpin. Fishing effort and gear types varied by sample site and sample period (Table 11). Slimy sculpin were the most widely distributed species, found at sample sites 1, 2, 3, 4, 7, and 8.

The Wood River was sampled during two periods in 2009: June 15–21 and September 18–24. Twenty-one sites were sampled during the study (Table 1; Figure 9). Approximately 86 rkm were surveyed. A total of five fish species was captured (Table 2) including adult lake chub, juvenile longnose sucker, northern pike, and Arctic grayling, and slimy sculpin. Fishing effort and gear types varied by sample site and sample period (Table 12). Lake chub were the most widely distributed species, found at sample sites 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, and 20. Sample period 2 was canceled because of hazardous wildfire conditions. An attempt to partially complete sample period 2 was made via accessing the lower Wood River by boat, but failed because of low water conditions. There are anecdotal reports from Wood River subsistence fishers of the presence of coho salmon so additional survey effort may be warranted to confirm their presence.

Aquatic Habitat Assessment 2008

Clear Creek was sampled for habitat and water quality during three periods during 2008: June 20–26, August 12–13, and August 30–September 7 (Table 1; Figure 2). Seventeen sites were sampled during the study (Table 13). Clear Creek is a 2nd order stream and the gradient of the sampled portion is approximately 0.08%. Clear Creek is a meandering single channel stream dominated by a pool and riffle flow regime with well vegetated banks and had an E4 Rosgen classification (Figure 10). Water temperature ranged from 6.0–15.5°C in the main-stem and 8.5–19.0°C in tributaries (Table 13). Main-stem conductivity ranged from 247–427 µS/cm, while tributary conductivity was less variable, ranging from 228–327 µS/cm. In the main-stem and tributaries of Clear Creek, the pH measurements ranged from 7.1–8.0. Clear Creek was overflowing its banks during sample period 2 and limited the ability to obtain some habitat measurements and gain access to some sample sites (Figure 10, panel 4).

Kiana Creek was sampled for habitat and water quality during two periods during 2008: June 14–16, and September 11–15 (Table 1; Figure 3). Five sites were sampled during the study (Table 14). Sample period 2 was cancelled because of persistent high water during mid to late July that created hazardous navigation conditions. Kiana Creek is a 2nd order stream and the gradient of the sampled portion is approximately 0.4%. Kiana Creek is a single channel, moderately entrenched stream dominated by a run and riffle flow regime with vegetated banks and a Rosgen classification of B4 (Figure 11). Water temperature ranged from 4.0–11.0°C, with sample period 3 cooling from the onset of autumn. Conductivity ranged from 41–256 µS/cm and pH ranged from 6.9–7.7 (Table 14).

Willow Creek was sampled for habitat and water quality during three periods during 2008: June 27–29, July 26–30, and August14–28 (Table 1; Figure 4). Seven sites were sampled during the study (Table 15). Willow Creek is a 2nd order stream and the gradient of the sampled portion is approximately 0.09%. Willow Creek is a single channel stream dominated by a run flow regime with only vegetated banks and a Rosgen classification of A5 (Figure 12). Water temperature ranged from 9.0–16.0°C. Conductivity ranged from 203–335 µS/cm and pH ranged from 7.3–7.7 (Table 15). Tributary A that drained into Willow Creek from the south was similar in habitat characteristics to the main stem. Willow Creek was notable for the aquatic vegetation that covered a substantial portion of the bottom substrate and for the numerous dead trees fallen across the stream (Figure 12).

Aquatic Habitat Assessment 2009

Beaver Creek was sampled for habitat and water quality during three periods during 2009: June 2–4, July 23–25, and September 8–10 (Table 1; Figure 5). Three sites were sampled during the study (Table 16). Beaver Creek is a 2nd order stream and the gradient of the sampled portion is approximately 1.18%. Beaver Creek is a single channel stream with a pool–riffle flow regime and a Rosgen classification of A4 (Figure 13). Water temperature ranged from 4.0–11.0°C. Conductivity ranged from 195–258 µS/cm and pH ranged from 7.3–8.0 (Table 16). A permafrost thaw slump was discovered emitting silt into Beaver Creek approximately 0.8 rkm up from its confluence with the Lower South Fork Chena River, on the south side of the creek (Figure 13, panel 3). Beaver Creek also had numerous fallen trees creating log jams that had to be portaged during each survey period.

Lower South Fork Chena River was sampled for habitat and water quality during three periods during 2009: June 5–6, July 25–26, and September 10–11 (Table 1; Figure 6). Three sites were sampled during the study (Table 17). Lower South Fork Chena River is a 3rd order stream and the gradient of the sampled portion is approximately 0.05%. Lower South Fork Chena River is a single channel stream with a pool–riffle flow regime and a Rosgen classification of B4 (Figure 14). Water temperature ranged from 4.5–11.0°C. Conductivity ranged from 117–186 µS/cm and pH ranged from 7.0–7.8 (Table 17).

Upper South Fork Chena River was sampled for habitat and water quality during three periods during 2009: May 21–25, July 9–13, and September 4–6 (Table 1; Figure 7). Six sites were sampled during the study (Table 18). Upper South Fork Chena River is a 2nd order stream and the gradient of the sampled portion is approximately 0.29%. Upper South Fork Chena River has a riffle dominated flow regime and a Rosgen classification of B3 (Figure 15). Water temperature ranged from 1.5–7.0°C and resulted in the narrowest range and the lowest maximum recorded temperature among all the sampled streams in this study. Conductivity ranged from 71–108 µS/cm and pH ranged from 7.0–7.8 (Table 18). A beaver dam complex approximately 1.5 km downstream of sample site 5 (Figure 7) may pose a barrier to upstream migration during low water conditions (Figure 15, panel 4). The dam was underpinned by logs and large woody debris that spanned the entire width of the stream, trapped a sizable amount of stream debris, and created a 2–3 m elevation difference in water surface.

Gilles Creek was sampled for habitat and water quality during three periods during 2009: June 23–25, August 24–26, and September 29–October 1 (Table 1; Figure 8). Four sites were sampled during the study (Table 19). Gilles Creek is a 2nd order stream and the gradient of the sampled portion is approximately 0.57%. The dominant flow regime in Gilles Creek was riffle and run with a Rosgen classification of C5 (Figure 16). Water temperature ranged from -1.0–8.0°C (Table 19). The -1.0°C temperature occurred on October 1 as Gilles Creek was icing over and had begun forming anchor ice on the previous day. Conductivity ranged from 93–138 µS/cm and pH ranged from 7.1–8.0 (Table 19). Gilles Creek was the only stream during this study that was accessed solely by foot travel.

The Wood River was sampled for habitat and water quality during two periods during 2009: June 15–19, August 12, and September 18–24 (Table 1; Figure 9). Sample period 2 was cancelled because of an active wildfire that bordered a majority of the Wood River sample reach. Nine sites were sampled during the study (Table 20). Wood River is a 2nd order stream and the gradient of the sampled portion is approximately 0.11%. The dominant flow regime is run and has a Rosgen classification of C4. Water temperature ranged from -1.0–16.0°C. Conductivity ranged from 384–580 µS/cm and pH ranged from 7.8–8.4 (Table 20). Conductivity and pH values were the overall highest of all streams sampled during this study. An attempt to access the lower Wood River by boat failed because of low water and the only sampling that occurred was at sample site 5 (Figure 9). Wood River is the only stream during this study that was glacially fed (Figure 17).

Discussion

Sampling resulted in six approved AWC nominations that represent four separate streams: Clear Creek, Kiana Creek, Beaver Creek, and the Lower South Fork Chena River. Clear Creek and Kiana Creek are in the Tanana Lowlands and the Lower South Fork Chena River and Beaver Creek are in the central foothills of the Yukon-Tanana uplands. The distribution of rearing Chinook salmon in Clear Creek may extend further upstream as the juveniles that were captured were at the upper limit of the Clear Creek survey. The upstream range of rearing and spawning Chinook salmon in the Lower South Fork Chena River is likely conservative as our surveys were restricted by Fort Wainwright's Yukon Training Area, Stuart Creek Impact Area. Aerial surveys during spawning could potentially expand their range upstream into the restricted area. The greatest diversity of fish species was found in Clear Creek. Upper South Fork Chena River and Gilles Creek had the least diversity of fish species. Slimy sculpin and Arctic grayling were the most common species captured among all streams, except Willow Creek where they were not captured.

This project benefitted from repetitive sampling throughout the open water season in each stream that resulted in the potential to capture the greatest diversity of fish species possible. Sampling periods for each stream were on a schedule and did not allow for as much stream distance to be covered per stream as desired. Sampling time was often impacted by deadfall timber that hindered downstream travel. When feasible, sample sites on some study streams were added during sample periods 2 and 3. Adding sample sites upstream of those initiated in period 1 took advantage of stream debris that was previously cleared and provided the potential for additional fish encounters. In some instances, fish sampling sites were not periodically visited within a stream because of high water, dangerous wildfire conditions, or the extension of sample areas.

Documentation of aquatic habitats was limited to the characterization of point observations of conditions at most fish sampling sites. The impetus for collecting basic aquatic habitat characteristics was to document current conditions during fish sampling. As with fish sampling, most aquatic habitat sampling sites were re-visited except during high water, dangerous wildfire conditions, or subsequent additions to original sample sites.

Sampling Design Problems

The use of stream stratification to distribute sampling effort along a stream reach was modified to account for the inability to efficiently navigate streams in 2008 and 2009. Aerial reconnaissance was conducted prior to deployment in all sampled streams to maximize the amount of sampling time versus travel time because of the density of stream debris and fallen trees. The greatest hindrance encountered during the project was the inability to survey more stream distance in Willow and Kiana creeks in 2008 and in Beaver Creek and Upper South Fork Chena River in 2009.

Despite logistical limitations to the original sampling scheme, this study provided a focused and comprehensive inventory of resident and anadromous fish species for the stream portions that were surveyed. Information was added to the AWC and provided a contemporary baseline for future research interests in an area of interior Alaska that is under development pressure.

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Table 1. Sample stream, latitude, longitude, and sample site type for stream sampled during 2008 and 2009. Location data is expressed in WGS 84 datum. Sample site number for a tributary is denoted by a capital letter.

Sample stream	Latitude (N)	Longitude (W)	Sample site number	Sample site type[a]	Sample site visit by period
Clear Creek	64.58937	147.73570	1	FH	1
	64.66888	147.77928	2	FH	1, 2, 3
	64.64048	147.75865	3	FH	1, 2, 3
	64.65600	147.76006	4	FH	1, 2, 3
	64.68664	147.79344	5	FH	1, 2, 3
	64.71163	147.83707	6	FH	1, 2, 3
	64.72854	147.87469	7	FH	1, 2, 3
	64.73782	147.91226	8	FH	1, 2, 3
	64.73774	147.91251	9	FH	1
	64.64532	147.75652	10	FH	2, 3
	64.66610	147.77385	11	FH	2
	64.58121	147.71230	12	FH	3
	64.61208	147.73579	13	FH	2, 3
	64.70326	147.80325	14	FH	3
	64.58940	147.73575	15	FH	3
	64.60081	147.73162	16	F	3
	64.64215	147.75745	A	FH	1, 2, 3
	64.68812	147.79079	B	FH	1, 3
Kiana Creek	64.23072	146.44432	1	FH	1, 3
	64.23575	146.42650	2	FH	1, 3
	64.24738	146.45372	3	FH	1, 3
	64.25452	146.48622	4	FH	1, 3
	64.25738	146.53975	5	FH	1, 3
Willow Creek	64.63446	148.05803	1	FH	1, 2, 3
	64.63848	148.06421	2	FH	1, 2, 3
	64.65266	148.09898	3	FH	1, 3
	64.65360	148.10416	4	FH	2, 3
	64.65950	148.13531	5	FH	2, 3
	64.66157	148.14684	6	FH	2, 3
	64.67160	148.18895	7	FH	2
	64.67130	148.18823	8	F	3
	64.64516	148.09480	A	FH	3
Beaver Creek	64.76124	146.41089	1	FH	1, 2, 3
	64.76020	146.44495	2	FH	1, 2, 3
	64.76067	146.45435	3	FH	1, 2, 3
	64.76206	146.41872	4	F	2
	64.76102	146.42479	5	F	1
	64.76016	146.43478	6	F	2
	64.75977	146.43843	7	F	2
	64.76154	146.42148	8	F	2
	64.76284	146.41635	9	F	3

Table 1. continued.

Sample stream	Latitude (N)	Longitude (W)	Sample site number	Sample site type	Sample site visit by period
Lower South Fork Chena River	64.75958	146.46918	1	FH	1, 2, 3
	64.76052	146.46680	2	FH	1, 2, 3
	64.77782	146.49060	3	FH	1, 2, 3
	64.75790	146.47298	4	F	1
	64.76903	146.47002	5	F	1
	64.75839	146.47159	6	F	2
Upper South Fork Chena River	64.71294	146.21596	1	FH	1, 2, 3
	64.70645	146.25200	2	FH	1
	64.70350	146.25934	3	FH	1
	64.69447	146.27788	4	FH	1, 2, 3
	64.68818	146.31650	5	FH	1, 2, 3
	64.69073	146.36397	6	FH	2, 3
Gilles Creek	64.36537	145.56282	1	FH	1, 2, 3
	64.37721	145.57378	2	FH	1, 2, 3
	64.38342	145.58313	3	FH	1
	64.35305	145.54457	4	FH	2, 3
	64.38013	145.58049	5	F	1
	64.37384	145.57057	6	F	2
	64.37541	145.57378	7	F	2
	64.35641	145.55296	8	F	2
Wood River	64.45048	148.21512	1	FH	1, 3
	64.50594	148.32695	2	FH	1, 3
	64.56366	148.43967	3	FH	1, 3
	64.61198	148.53941	4	FH	1, 3
	64.58870	148.66232	5	FH	1, 2, 3
	64.34595	148.05576	6	FH	3
	64.41689	148.19240	7	FH	3
	64.49314	148.27097	8	FH	3
	64.54739	148.42085	9	FH	3
	64.37931	148.10646	10	F	3
	64.38625	148.13210	11	F	3
	64.43785	148.22076	12	F	3
	64.51578	148.34941	13	F	3
	64.52527	148.36653	14	F	3
	64.59535	148.47580	15	F	3
	64.46204	148.22171	16	F	1
	64.51503	148.33580	17	F	1
	64.54927	148.42052	18	F	1
	64.48749	148.25957	19	F	1
	64.59642	148.48714	20	F	1
	64.58070	148.43848	21	F	1

[a] Abbreviations represent fish and habitat sample site (FH), fishing site only (F)

Table 2. Fish species captured in Clear, Kiana, and Willow creeks in 2008 and Beaver Creek, Gilles Creek, Lower South Fork Chena River, Upper South Fork Chena River, and Wood River in 2009.

		Sample year and stream name							
		2008			2009				
Family and scientific name	Common name	Clear Creek	Kiana Creek	Willow Creek	Beaver Creek	Lower S Fork Chena River	Upper S Fork Chena River	Gilles Creek	Wood River
Petromyzontidae									
Lampetra camtschatica	Arctic lamprey		X_j						
Cyprinidae									
Couesius plumbeus	lake chub		X_a						X_a
Catostomidae									
Catostomus catostomus	longnose sucker	X_{aj}	X_j	X_{aj}					X_j
Esocidae									
Esox lucius	northern pike	X_{aj}		X_a					X_j
Salmonidae									
Prosopium cylindraceum	round whitefish	X_a				X_a			
Coregonus pidschian	humpback whitefish	X_a		X_{aj}					
Oncorhynchus tshawytscha	Chinook salmon	X_{aj}			X_{aj}	X_{aj}			
Oncorhynchus kisutch	coho salmon		X_j						
Thymallus arcticus	Arctic grayling	X_{aj}	X_a		X_{aj}	X_{aj}	X_a	X_{aj}	X_j
Gadidae									
Lota lota	burbot	X_a				X_j			
Cottidae									
Cottus cognatus	slimy sculpin	X	X		X	X	X	X	X

$_a$ – adult life stage
$_j$ – juvenile life stage

Table 3. AWC approved nominations, species, and life stage for Clear, Kiana, and Beaver creeks, and Lower South Fork Chena River (LSFCR).

Stream	Location (Datum WGS 84)	Salmon species	Life stage	AWC approval year	AWC nomination number
Clear Creek	64.58940N 147.73575W	Chinook	Rearing juvenile	2010	09-186
Kiana Creek	64.23072N 146.44432W	coho	Rearing juvenile	2010	09-185
Beaver Creek	64.76124N 146.41089W	Chinook	Rearing juvenile	2010	09-1501
Beaver Creek	64.76020N 146.44495W	Chinook	Rearing juvenile	2010	09-1501
Beaver Creek	64.76102N 146.42479W	Chinook	Spawning adult	2010	09-1501
LSFCR	64.75958N 146.46918W	Chinook	Rearing juvenile	2010	09-1502
LSFCR	64.75790N 146.47298W	Chinook	Spawning adult	2010	09-1502

Table 4. Pyloric caecum counts of Chinook and coho salmon captured from Clear, Kiana, and Beaver creeks, and Lower South Fork Chena River (LSFCR).

Stream name	Salmon species	Pyloric caecum counts	Fork length (mm)
Clear Creek	Chinook	148	86
Clear Creek	Chinook	144	85
Clear Creek	Chinook	122	84
Kiana Creek	coho	73	74
Kiana Creek	coho	66	78
Kiana Creek	coho	67	89
Kiana Creek	coho	65	96
Kiana Creek	coho	69	97
Kiana Creek	coho	73	99
Kiana Creek	coho	84	108
Kiana Creek	coho	61	110
Beaver Creek	Chinook	127	68
Beaver Creek	Chinook	111	62
LSFCR	Chinook	109	84
LSFCR	Chinook	123	103

Table 5. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 20 to September 7, 2008, on Clear Creek.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2, 3, 4, 5, 6, 9	592.5 h	SLSC	7	0.01 /h
2	10	79.5 h	SLSC	2	0.03 /h
3	3, 5, 6, 7, 12, 13, 14, 15	817.5 h	SLSC	4	0.00 /h
	15		CHIN	3	0.00 /h
Total		1,489.5 h	SLSC	13	0.01 /h
			CHIN	3	0.00 /h
			Seine		
1	A	2 hauls	LNSU	30	15.0 /haul
	A		NOPI	1	0.5 /haul
3	12, 14	13 hauls	RDWF	6	0.5 /haul
	14		HBWF	1	0.1 /haul
	7, B		LNSU	2	0.2 /haul
	7, 14, 16		ARGR	2	0.2 /haul
	B		SLSC	5	0.4 /haul
Total		15 hauls	LNSU	32	2.1 /haul
			NOPI	1	0.1 /haul
			RDWF	6	0.4 /haul
			HBWF	1	0.1 /haul
			ARGR	2	0.1 /haul
			SLSC	5	0.3 /haul
			Dipnet		
1	7	1 dip	UNKW[b]	1	1.0 /dip
	7	1 dip	UNKW[b]	16	16.0 /dip
	B	1 dip	ARGR	1	1.0 /dip
Total		3 dips	UNKW[b]	17	8.5 /dip
			ARGR	1	1.0 /dip
			Gillnet		
1	3, 8	3.9 h	LNSU	1	0.26 /h
2	3, 11	4.2 h	LNSU	3	0.71 /h
3	16	4.1 h	NOPI	1	0.24 /h
Total		12.2 h	LNSU	4	0.32 /h
			NOPI	1	0.08 /h
			Electrofish		
1	7	493 s	---	0	0 /s
	A	495 s	SLSC	1	0.0 /s
Total		988 s	SCLC	1	0.0 /s
			Observation		
3	3, 13	carcass	CHIN	3	---
3	5	carcass	BURB	1	---
Total			CHIN	3	
			BURB	1	

Table 5. continued.

Period	Site	Effort	Species[a]	n	CPUE
		Angling			
2	A	2.3 h	---	0	0 /h
3	12	0.3 h	ARGR	3	9 /h
Total		2.7 h	---	3	1.1 /h

[a] Abbreviations represent longnose sucker (LNSU), northern pike (NOPI), round whitefish (RDWF), humpback whitefish (HBWF), Chinook salmon (CHIN), Arctic grayling (ARGR), slimy sculpin (SLSC), unknown whitefish (UNKW)[b]
[b]Whitefish juveniles could not be identified to species using dissecting microscope and juvenile fish key

Table 6. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 13 to September 16, 2008 in Kiana Creek.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2, 3, 5	465.7 h	COHO	5	0.01 /h
	1, 2, 3, 5		LNSU	10	0.02 /h
	1, 3, 5		LKCB	18	0.04 /h
	1, 2		SLSC	4	0.01 /h
3	2	570.5 h	COHO	6	0.01 /h
	5		LKCB	1	0.00 /h
	1, 2, 3		SLSC	6	0.01 /h
Total		1,036.2 h	COHO	11	0.01 /h
			LNSU	10	0.01 /h
			SLSC	10	0.00 /h
			LKCB	19	0.02 /h
			Seine		
3	1	1 haul	---	0	0 /haul
Total		1 haul	---	0	0 /haul
			Electrofish		
1	1,2	2,893 s	SLSC	9	0.00 /s
	4		ARLA	1	0.00 /s
	4		LKCB	1	0.00 /s
	4		LNSU	4	0.00 /s
3	1, 5	5,995 s	SLSC	20	0.00 /s
	5		LKCB	2	0.00 /s
	2		LNSU	2	0.00 /s
Total		8,888 s	SLSC	29	0.00 /s
			ARLA	1	0.00 /s
			LKCB	3	0.00 /s
			LNSU	6	0.00 /s
			Angling		
3	1, 2	3.3 h	ARGR	1	0.3 /h
Total		3.3 h	ARGR	1	0.3 /h

[a] Abbreviations represent Arctic lamprey (ARLA), lake chub (LKCB), longnose sucker (LNSU), coho salmon (COHO), Arctic grayling (ARGR), slimy sculpin (SLSC)

Table 7. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 26 to August 29, 2008 in Willow Creek.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2, 3, 4	325.0 h	---	0	0 /h
2	2, 5, 6, 7	664.9 h	LNSU	1	0.00 /h
3	1, 3, 4, 6	421.2 h	---	0	0 /h
Total		1,411.1 h	LNSU	1	0.00 /h
			Seine		
2	5	1 haul	---	0	0 /haul
Total		1 haul	---	0	0 /haul
			Dipnet		
3	8	2 dips	LNSU	9	4.5 /dip
Total		2 dips	LNSU	9	4.5 /dip
			Gillnet		
2	1	32.8 h	NOPI	6	0.18 /h
	4		LNSU	1	0.03 /h
3	6	10.2 h	--	0	0 / h
	7	4.1 h	HBWF	2	0.49 /h
Total		47.1 h	NOPI	6	0.13 /h
			HBWF	2	0.04 /h
			LNSU	1	0.02 /h
			Angling		
3	A	0.03 h	NOPI	1	33.3 /h
Total		0.03 h	NOPI	1	33.3 /h
			Fyke net		
3	7	18.3 h	---	0	0 /h
Total		18.3 h	---	0	0 /h

[a] Abbreviations represent longnose sucker (LNSU), northern pike (NOPI), humpback whitefish (HBWF)

Table 8. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 2 to September 10, 2009 in Beaver Creek.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2	227.0 h	SLSC	12	0.05 /h
2	1, 2	322.0 h	SLSC	8	0.02 /h
3	1, 2	306.0 h	SLSC	4	0.01 /h
	1, 2		CHIN	4	0.01 /h
Total		895.0 h	SLSC	24	0.03 /h
			CHIN	4	0.00 /h
			Seine		
1	1, 3	10 hauls	SLSC	14	1.40 /haul
2	2, 4, 8	3 hauls	ARGR	13	4.33 /haul
3	1	3 hauls	SLSC	1	0.33 /haul
	9	1 haul	---	0	0 /haul
Total		17 hauls	SLSC	15	0.88 /haul
			ARGR	13	0.76 /haul
			Electrofish		
2	1	229 s	ARGR	1	0.00 /s
Total		229 s	ARGR	1	0.00 /s
			Observation		
2	6, 7		CHIN	4	
Total			CHIN	4	
			Angling		
1	1, 2, 5	0.8 h	ARGR	5	6.25 /h
Total		0.8 h	ARGR	5	6.25 /h

[a] Abbreviations represent Chinook salmon (CHIN), Arctic grayling (ARGR), slimy sculpin (SLSC)

Table 9. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 4 to September 11, 2009 in the Lower South Fork Chena River.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1	210.0 h	SLSC	4	0.02 /h
	1		CHIN	1	0.00 /h
	3		BURB	2	0.01 /h
2	1	152.0 h	SLSC	10	0.07 /h
	1		CHIN	1	0.01 /h
3	1	159.3 h	SLSC	4	0.03 /h
	1		BURB	1	0.01 /h
	1		CHIN	2	0.01 /h
Total		521.3 h	SLSC	18	0.03 /h
			CHIN	4	0.01 /h
			BURB	3	0.00 /h
			Seine		
1	1, 4, 5	6 hauls	SLSC	5	0.83 /haul
2	1, 6	1 haul	ARGR	4	4.00 /haul
Total		7 hauls	SLSC	5	0.71 /haul
			ARGR	4	0.57 /haul
			Observation		
2	4		CHIN	18	
Total			CHIN	18	
			Angling		
1	1	0.3 h	ARGR	1	3.33 /h
Total		0.3 h	ARGR	1	3.33 /h
			Cast net		
2	2	8 casts	ARGR	5	0.63 /cast
			RDWF	1	0.12 /cast
Total		8 casts	ARGR	5	0.63 /cast
			RDWF	1	0.12 /cast

[a] Abbreviations represent round whitefish (RDWF), Chinook salmon (CHIN), Arctic grayling (ARGR), burbot (BURB), slimy sculpin (SLSC)

Table 10. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from May 21 to September 8, 2009 in the Upper South Fork Chena River.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2, 3	355.5 h	SLSC	38	0.11 /h
2	1, 4, 5 ,6	402.2 h	SLSC	56	0.14 /h
3	4, 5, 6	641.2 h	SLSC	55	0.09 /h
Total		1,398.9 h	SLSC	149	0.11 /h
			Seine		
1	2, 5	3 hauls	---	0	0 /haul
2	6	6 hauls	SLSC	3	0.50 /haul
	6		ARGR	2	0.33 /haul
3	5	1 haul	---	0	0 /haul
Total		10 hauls	SLSC	3	0.30 /haul
			ARGR	2	0.20 /haul
			Electrofish		
1	1, 4	376 s	SLSC	1	0.00 /s
2	1	1,891 s	SLSC	42	0.02 /s
3	4, 5, 6	1,548 s	SLSC	42	0.03 /s
Total		3,815 s	SLSC	85	0.02 /s
			Angling		
1	4	0.1 h	ARGR	1	12.5 /h
Total		0.1 h	ARGR	1	12.5 /h

[a] Abbreviations represent Arctic grayling (ARGR), slimy sculpin (SLSC)

Table 11. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 23 to October 2, 2009 in Gilles Creek.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow Trap		
1	1, 2, 3	343.5 h	SLSC	58	0.17 /h
2	1, 2	440.0 h	SLSC	4	0.01 /h
	1	496.0 h	SLSC	4	0.01 /h
	1		ARGR	1	0.00 /h
3	1, 4	496.0 h	SLSC	5	0.01 /h
	3		---		
Total		1,775.5 h	SLSC	71	0.04 /h
			ARGR	1	0.00 /h
			Seine		
2	2, 4, 7, 8	6 hauls	SLSC	19	3.17 /haul
	2, 6		ARGR	6	1.00 /haul
Total		6 hauls	SLSC	19	3.17 /haul
			ARGR	6	1.00 /haul
			Electrofish		
1	1, 2, 3	1,711 s	SLSC	16	0.01 /s
2	1	756 s	SLSC	17	0.02 /s
	1		ARGR	1	0.00 /s
Total		2,467 s	SLSC	33	0.01 /s
			ARGR	1	0.00 /s
			Angling		
1	5	0.3 h	ARGR	3	9.09 /h
Total		0.3 h	ARGR	3	9.09 /h

[a] Abbreviations represent Arctic grayling (ARGR) and slimy sculpin (SLSC)

Table 12. Sample period, sample site, effort, species, number of fish captured (n), and catch-per-unit-effort (CPUE) of all fish species captured from June 15 to September 24, 2009 in the Wood River.

Period	Site	Effort	Species[a]	n	CPUE
			Minnow trap		
1	1, 2, 3	499.5 h	LKCB	39	0.08 /h
2	5	83.8 h	LKCB	8	0.10 /h
3	4, 6, 7, 8, 9	740.0 h	LKCB	138	0.19 /h
	6, 8		SLSC	4	0.01 /h
	6		ARGR	1	0.00 /h
	8		LNSU	2	0.00 /h
Total		1,323.3 h	LKCB	185	0.14 /h
			SLSC	4	0.00 /h
			ARGR	1	0.00 /h
			LNSU	2	0.00 /h
			Seine		
1	1, 16, 17, 18, 19, 20	8 hauls	LKCB	42	5.25 /haul
	16		ARGR	1	0.13 /haul
	19		NOPI	1	0.13 /haul
	16, 18		SLSC	8	1.00 / haul
3	11, 12, 13, 14	11 hauls	LKCB	43	3.91 /haul
	6		SLSC	2	0.18 /haul
	6, 10, 15		ARGR	4	0.36 /haul
Total		19 hauls	LKCB	85	4.47 /haul
			ARGR	5	0.26 /haul
			NOPI	1	0.05 /haul
			SLSC	10	0.53 /haul
			Gillnet		
1	1, 21	8.3 h	---	0	0 /h
Total		8.3 h	---	0	0 /h

[a] Abbreviations represent lake chub (LKCB), longnose sucker (LNSU), northern pike (NOPI), Arctic grayling (ARGR), slimy sculpin (SLSC)

Table 13. Habitat characteristics for sample sites in Clear Creek, 2008. Table acronym: MNT=measurement not taken.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
20-Jun	1	medium	humic	15.0	348	7.9
22-Jun	2	medium	ferric	15.0	350	7.8
23-Jun	3	medium	humic	15.5	351	7.8
23-Jun	4	medium	humic	15.0	351	7.8
24-Jun	5	medium	humic	14.5	350	7.9
25-Jun	6	medium	humic	13.5	354	7.8
25-Jun	7	medium	muddy	14.0	MNT	MNT
25-Jun	8	medium	humic	14.0	MNT	MNT
26-Jun	9	medium	humic	13.0	350	7.7
22-Jun	A	medium	ferric	19.0	251	7.1
24-Jun	B	medium	humic	16.0	327	7.8
			Period 2			
13-Aug	2	high	muddy	12.5	254	7.4
12-Aug	3	high	muddy	9.5	269	7.4
13-Aug	4	high	muddy	12.5	254	7.4
13-Aug	5	high	muddy	11.5	254	7.3
13-Aug	6	high	muddy	11.5	251	7.4
13-Aug	7	high	muddy	11.0	251	7.4
13-Aug	8	high	muddy	11.2	247	7.4
13-Aug	10	high	muddy	11.0	251	7.4
12-Aug	13	high	muddy	8.5	276	7.5
			Period 3			
3-Sep	2	medium	muddy	7.5	356	7.9
2-Sep	3	medium	muddy	7.5	370	8.0
3-Sep	4	medium	muddy	7.0	359	7.8
4-Sep	5	medium	muddy	7.0	354	7.9
5-Sep	6	medium	muddy	8.0	340	7.9
6-Sep	7	medium	muddy	8.5	353	7.8
7-Sep	8	medium	muddy	9.0	333	7.7
3-Sep	10	medium	muddy	6.0	360	7.8
3-Sep	11	medium	muddy	6.0	427	7.4
30-Aug	12	high	muddy	8.5	374	8.0
2-Sep	13	medium	muddy	6.5	377	8.0
5-Sep	14	medium	muddy	8.0	344	8.0
1-Sep	15	medium	muddy	7.5	373	8.0
3-Sep	A	medium	humic	8.5	228	7.4
3-Sep	B	medium	clear	9.0	294	7.8

Table 14. Habitat characteristics for sample sites in Kiana Creek, 2008. Table acronym: MNT=measurement not taken.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
14-Jun	1	medium	ferric	7.0	41	6.9
15-Jun	2	medium	ferric	8.0	MNT	MNT
16-Jun	3	medium	ferric	9.0	214	7.3
16-Jun	4	medium	ferric	MNT	MNT	MNT
16-Jun	5	medium	ferric	11.0	221	7.6
			Period 3			
11-Sep	1	low	ferric	4.5	64	6.9
12-Sep	2	low	ferric	7.0	64	6.9
14-Sep	3	medium	humic	4.0	255	7.3
15-Sep	4	medium	humic	4.5	256	7.6
15-Sep	5	medium	humic	5.0	253	7.7

Table 15. Habitat characteristics for sample sites in Willow Creek, 2008.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
27-Jun	1	medium	clear	16.0	335	7.3
28-Jun	2	medium	humic	14.0	309	7.5
29-Jun	3	medium	humic	13.0	302	7.5
			Period 2			
27-Jul	1	medium	clear	14.0	317	7.4
28-Jul	2	medium	clear	13.5	311	7.6
26-Jul	4	medium	humic	15.0	324	7.3
29-Jul	5	medium	clear	13.0	295	7.5
30-Jul	6	medium	clear	13.0	292	7.5
14-Aug	7	medium	humic	15.0	203	7.5
			Period 3			
26-Aug	1	medium	humic	11.5	254	7.4
27-Aug	2	medium	humic	11.5	252	7.6
27-Aug	3	medium	humic	11.5	251	7.6
26-Aug	4	medium	humic	9.0	246	7.3
28-Aug	5	medium	humic	10.5	257	7.6
28-Aug	6	medium	humic	11.0	256	7.7
27-Aug	A	medium	humic	11.5	282	7.6

Table 16. Habitat characteristics for sample sites in Beaver Creek, 2009.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
2-Jun	1	medium	humic	7.0	195	7.3
4-Jun	2	medium	ferric	4.0	210	7.7
4-Jun	3	medium	muddy	8.0	210	7.6
			Period 2			
23-Jul	1	low	clear	10.0	258	7.8
24-Jul	2	low	clear	11.0	255	7.8
25-Jul	3	medium	muddy	9.0	253	8.0
			Period 3			
8-Sep	1	medium	humic	5.5	200	7.9
9-Sep	2	medium	humic	4.0	206	7.8
10-Sep	3	medium	humic	4.0	210	7.9

Table 17. Habitat characteristics for sample sites in the Lower South Fork Chena River, 2009.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
5-Jun	1	medium	clear	7.0	126	7.0
5-Jun	2	medium	clear	7.0	158	7.2
6-Jun	3	medium	clear	6.0	186	7.1
			Period 2			
25-Jul	1	low	clear	8.0	131	7.5
25-Jul	2	low	clear	11.0	162	7.4
26-Jul	3	low	clear	11.0	162	7.8
			Period 3			
10-Sep	1	medium	humic	4.5	117	7.6
10-Sep	2	medium	humic	6.0	141	7.4
11-Sep	3	medium	humic	5.0	144	7.6

Table 18. Habitat characteristics for sample sites in the Upper South Fork Chena River, 2009. Table acronym: MNT=measurement not taken.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
21-May	1	medium	humic	3.0	71	7.5
23-May	2	medium	humic	1.5	79	7.0
25-May	3	medium	humic	1.5	86	7.4
			Period 2			
9-Jul	1	medium	clear	7.0	98	7.5
9-Jul	4	medium	clear	6.0	105	7.4
12-Jul	5	medium	clear	MNT	106	7.6
13-Jul	6	medium	clear	7.0	108	MNT
			Period 3			
4-Sep	4	medium	clear	4.0	93	7.8
5-Sep	5	medium	clear	5.0	98	7.6
6-Sep	6	medium	clear	4.5	99	7.6

Table 19. Habitat characteristics for sample sites in Gilles Creek, 2009. Table acronym: MNT=measurement not taken.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
23-Jun	1	medium	clear	8.0	116	7.3
24-Jun	2	medium	clear	6.0	116	MNT
25-Jun	3	medium	clear	6.0	93	MNT
			Period 2			
24-Aug	1	medium	clear	7.0	133	8.0
25-Aug	2	medium	clear	5.0	132	7.8
26-Aug	4	medium	clear	6.0	133	8.0
			Period 3			
29-Sep	1	medium	clear	-1.0	137	7.2
30-Sep	2	high	clear	-1.0	138	7.2
1-Oct	4	medium	clear	-1.0	138	7.1

Table 20. Habitat characteristics for sample sites in the Wood River, 2009.

Date	Sample Site	Stream stage	Water color	Water Temperature (°C)	Conductivity (µS/cm)	pH
			Period 1			
15-Jun	1	medium	glacial	12.0	389	8.0
17-Jun	2	medium	glacial	14.0	389	8.0
18-Jun	3	medium	glacial	13.0	400	8.2
19-Jun	4	high	glacial	13.0	384	8.0
19-Jun	5	high	glacial	16.0	456	8.0
			Period 2			
12-Aug	5	high	glacial	9.0	580	8.2
			Period 3			
20-Sep	1	low	glacial	5.0	496	8.3
21-Sep	2	medium	glacial	5.0	492	8.3
22-Sep	3	low	glacial	5.0	493	8.4
22-Sep	4	low	glacial	5.0	491	8.4
24-Sep	5	low	glacial	-1.0	500	7.8
18-Sep	6	low	glacial	9.0	568	8.2
19-Sep	7	low	glacial	7.5	489	8.3
20-Sep	8	low	glacial	6.0	494	8.3
21-Sep	9	low	glacial	6.0	490	8.3

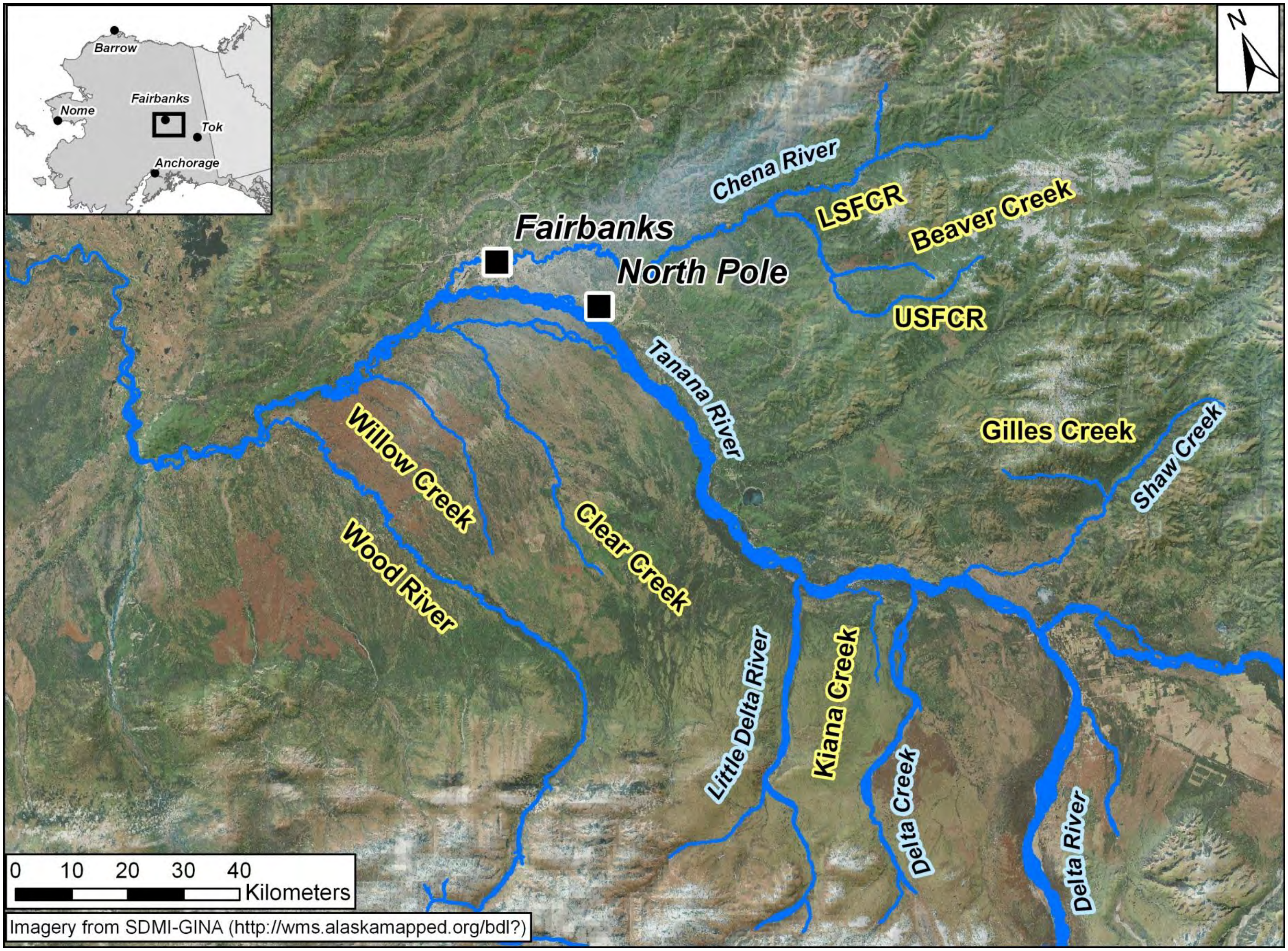

Figure 1. Streams sampled (yellow highlight) during 2008 and 2009 in the lowland region of the Tanana River watershed. South Fork Chena River main stem was divided into Upper (USFCR) and Lower (LSFCR) sections.

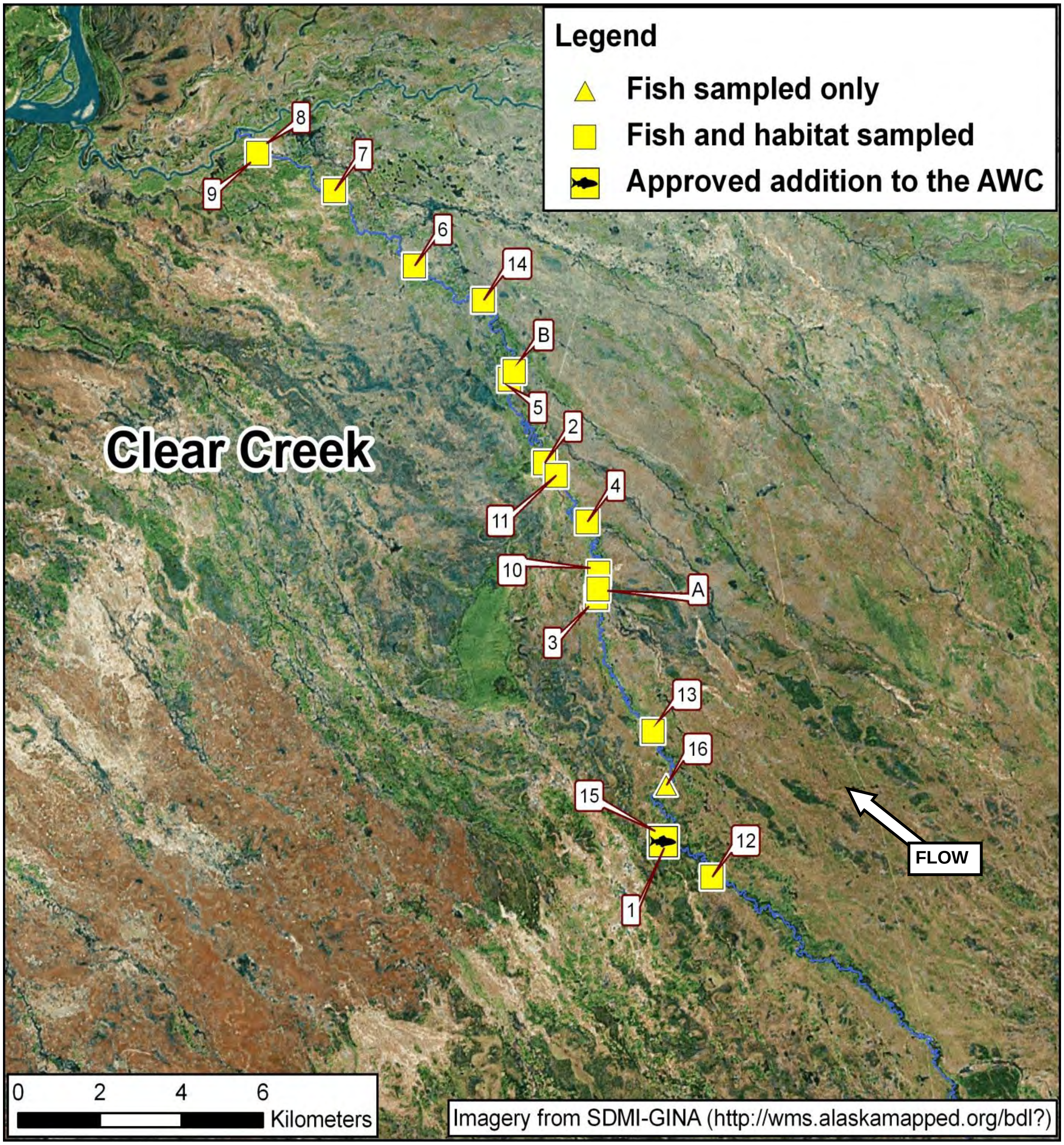

Figure 2. Clear Creek sample sites and approved addition to the AWC, 2008 (rearing Chinook salmon at site 15). Capitol letter represent tributary sampling sites. Specific coordinates for each sample site are given in Table 1.

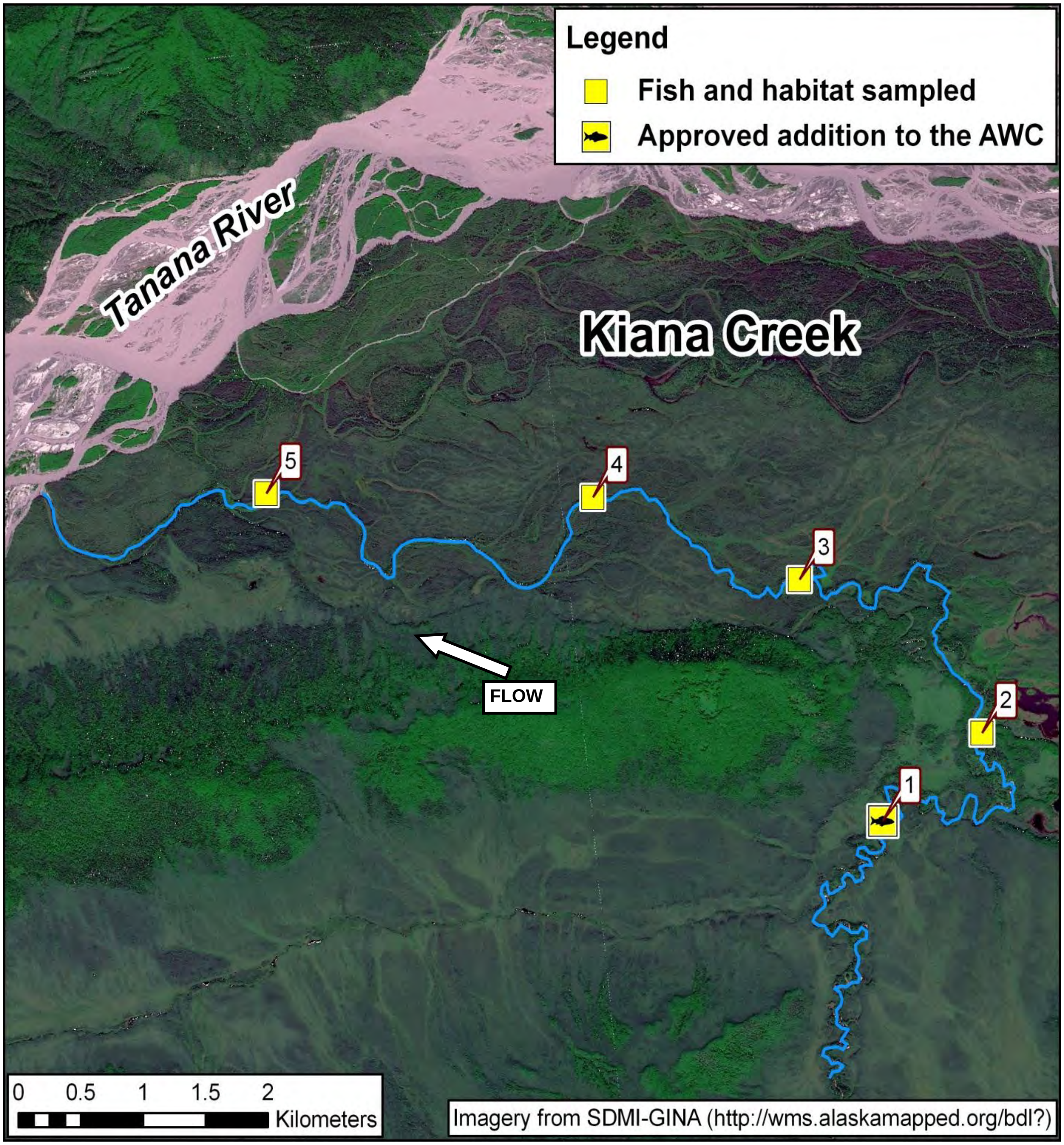

Figure 3. Kiana Creek sample sites and approved addition to the AWC, 2008 (rearing coho salmon at site 1). Specific coordinates for each sample site are given in Table 1.

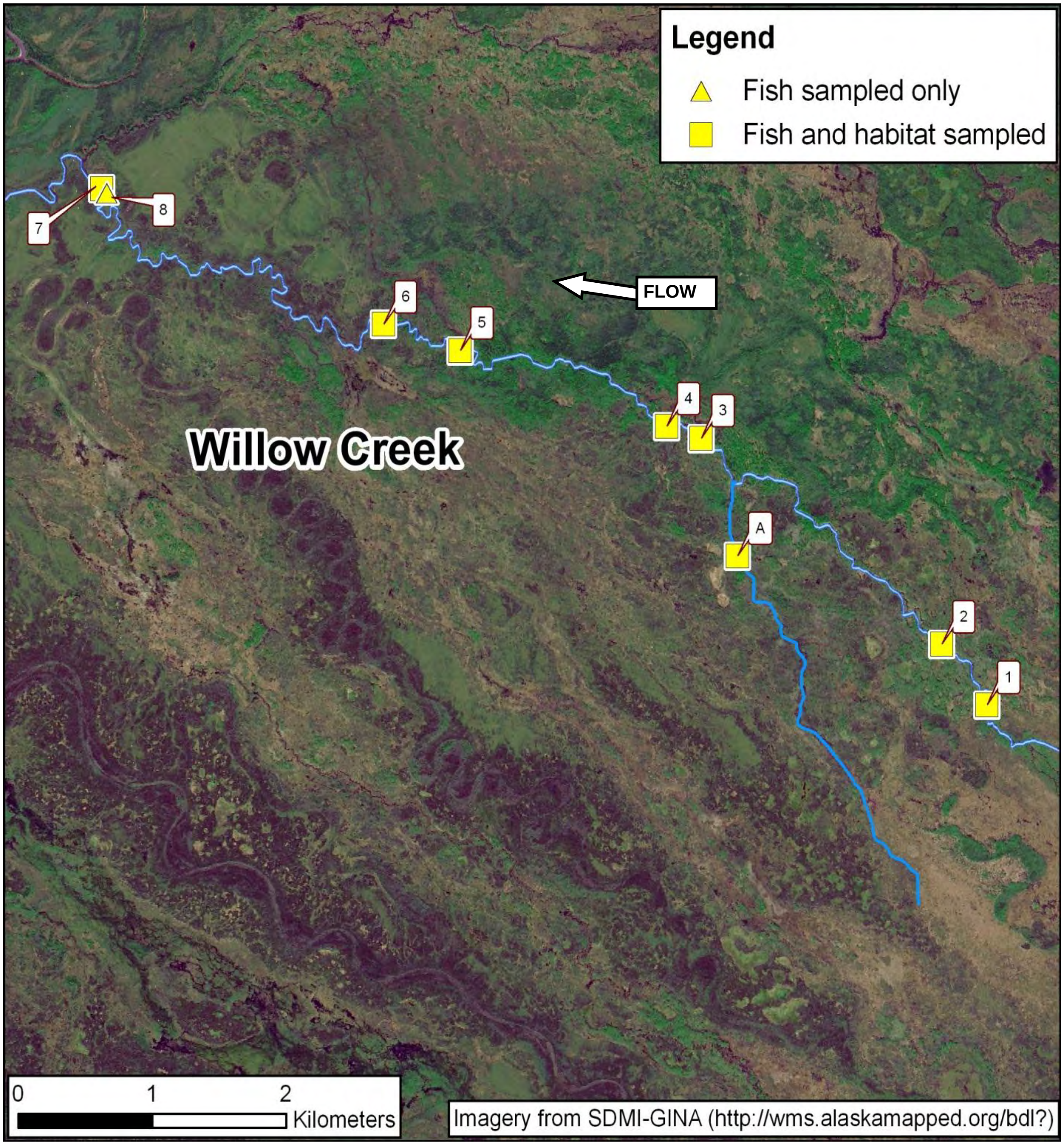

Figure 4. Willow Creek sample sites, 2008. Specific coordinates for each sample site are given in Table 1.

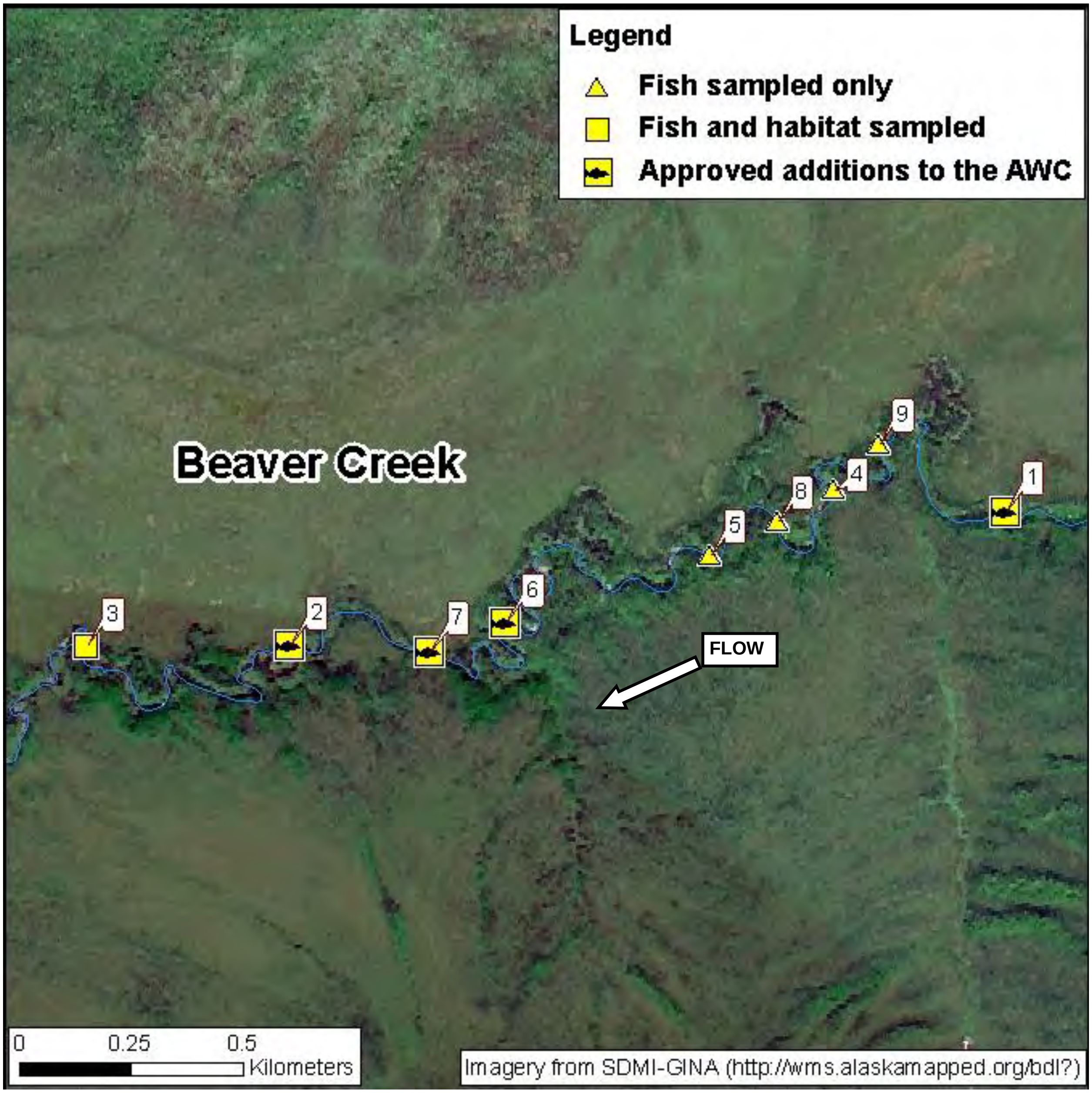

Figure 5. Beaver Creek sample sites and approved addition to the AWC, 2009 (present Chinook salmon at site 6, spawning Chinook salmon at site 7, and rearing Chinook salmon at site 1 and 2). Specific coordinates for each sample site are given in Table 1.

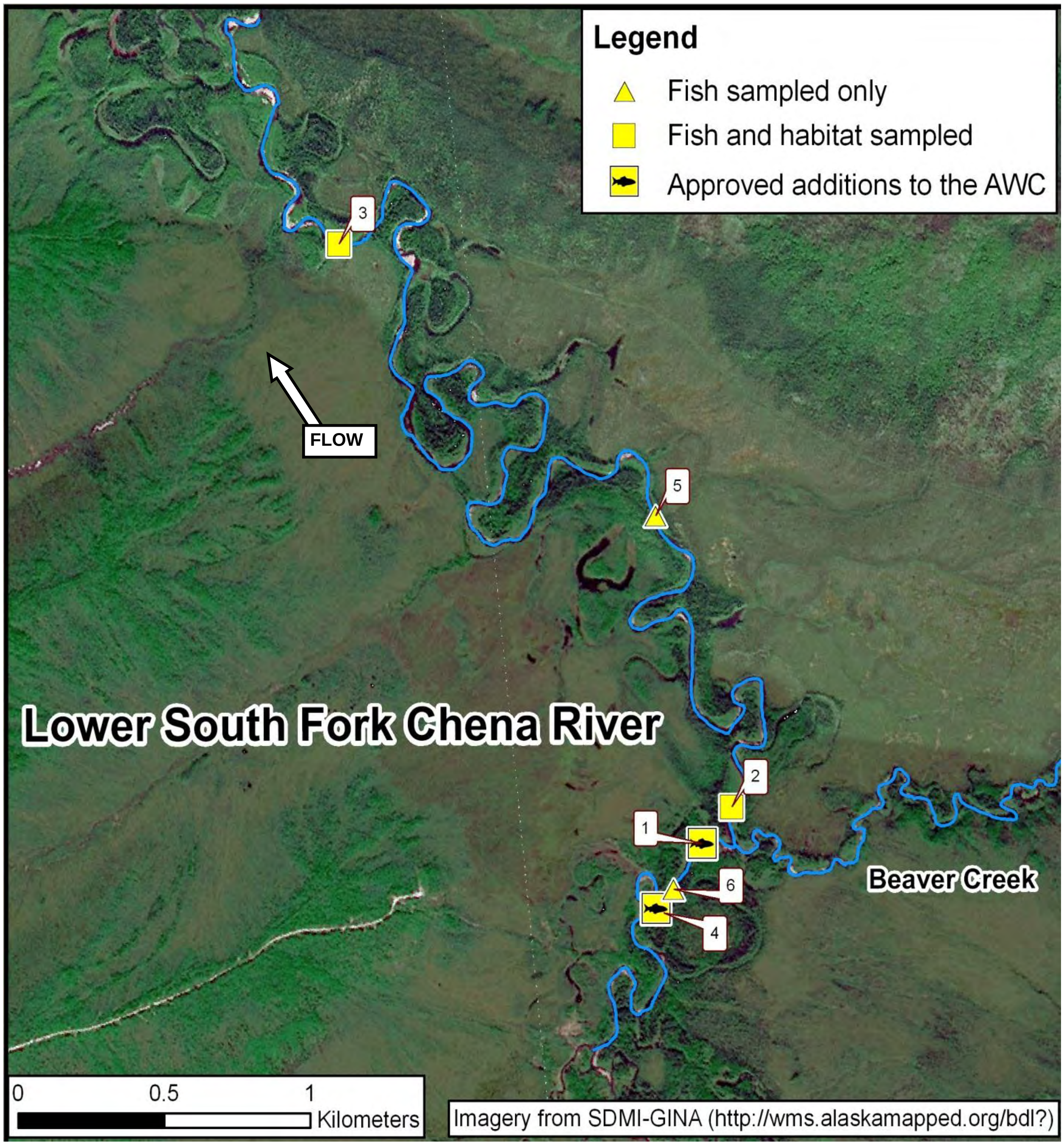

Figure 6. Lower South Fork Chena River sample sites and approved additions to the AWC, 2009 (spawning Chinook salmon at site 4 and rearing Chinook salmon at site 1). Specific coordinates for each sample site are given in Table 1.

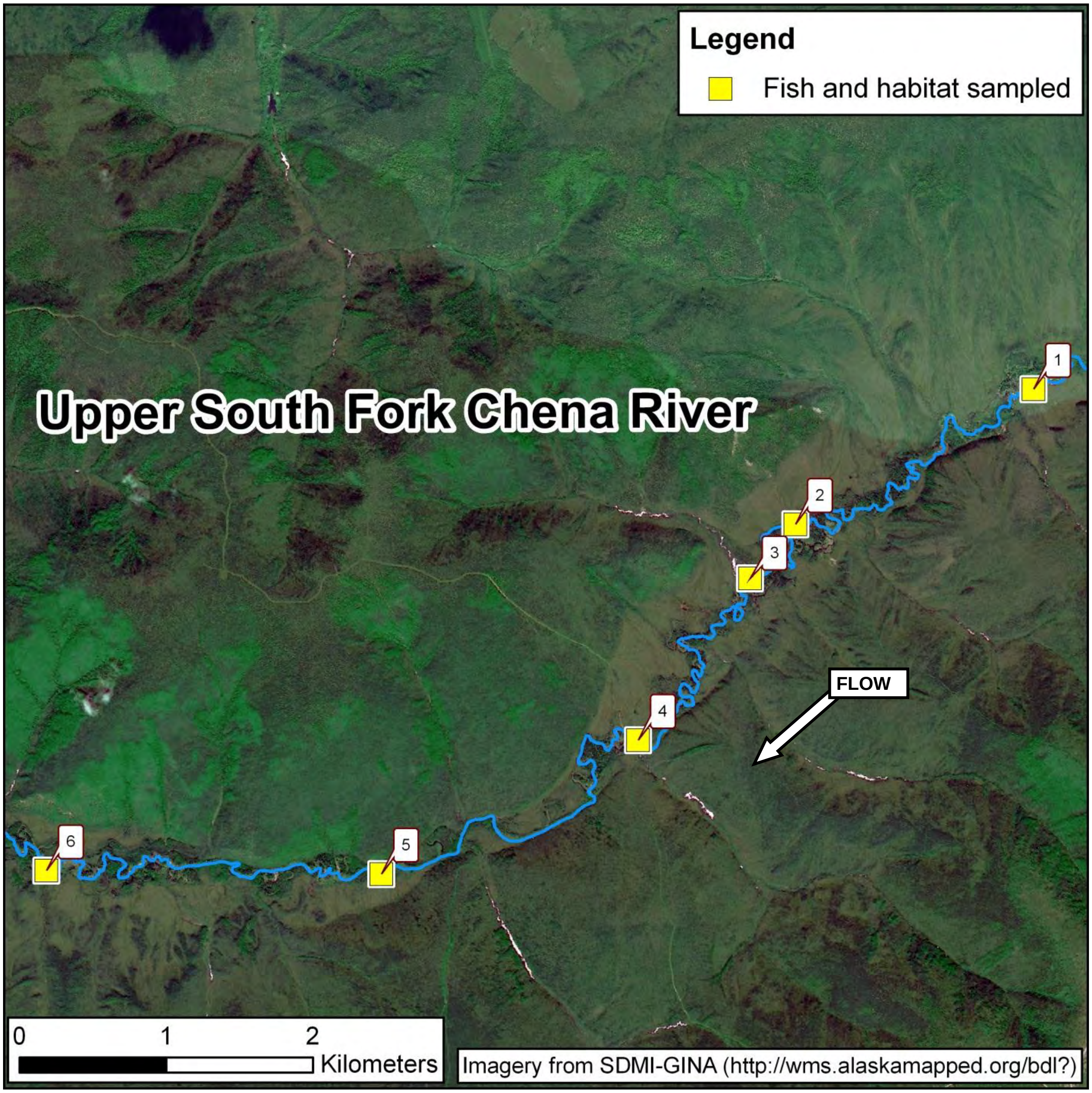

Figure 7. Upper South Fork Chena River sample sites, 2009. Specific coordinates for each sample site are given in Table 1.

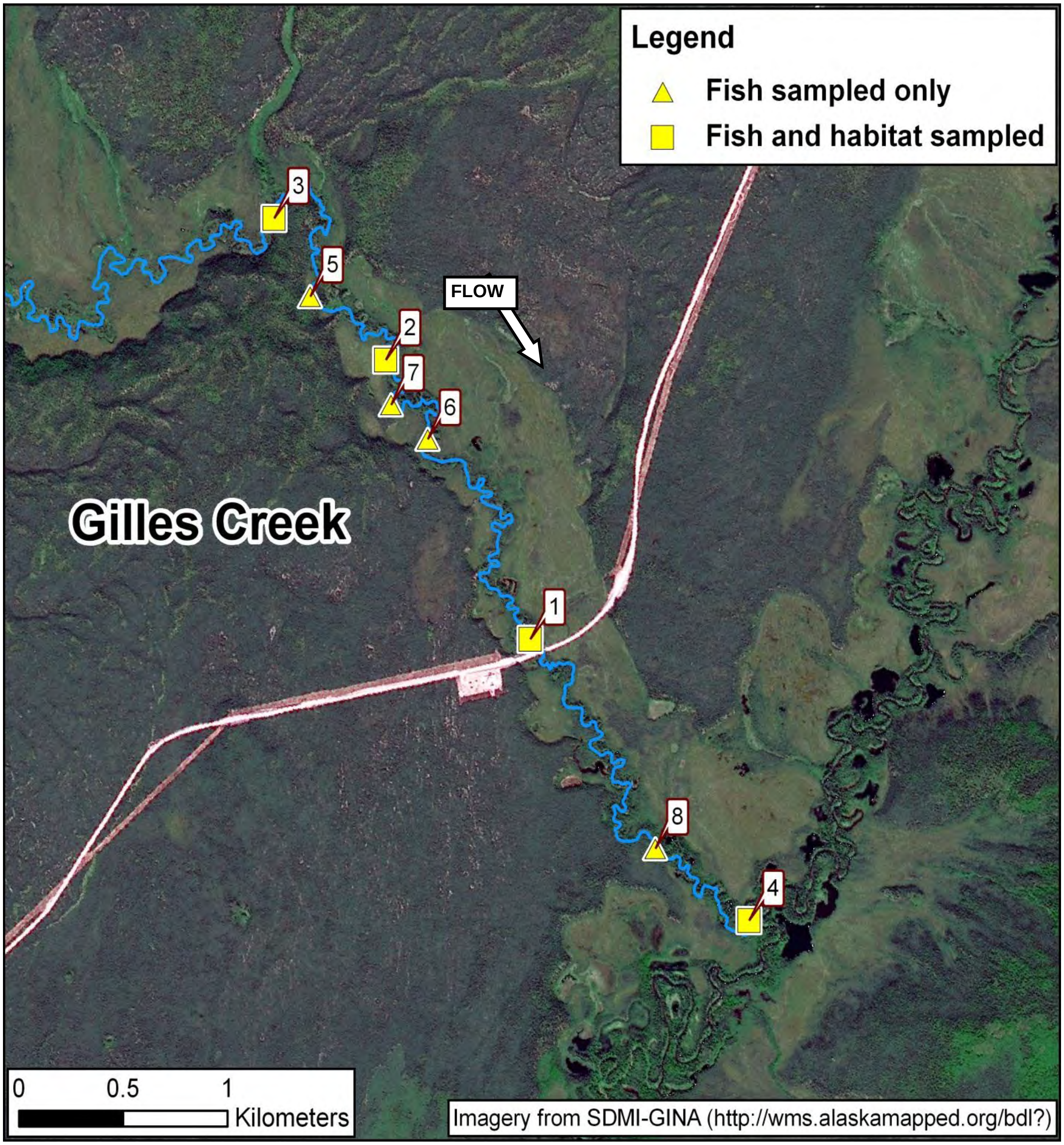

Figure 8. Gilles Creek sample sites, 2009. Specific coordinates for each sample site are given in Table 1.

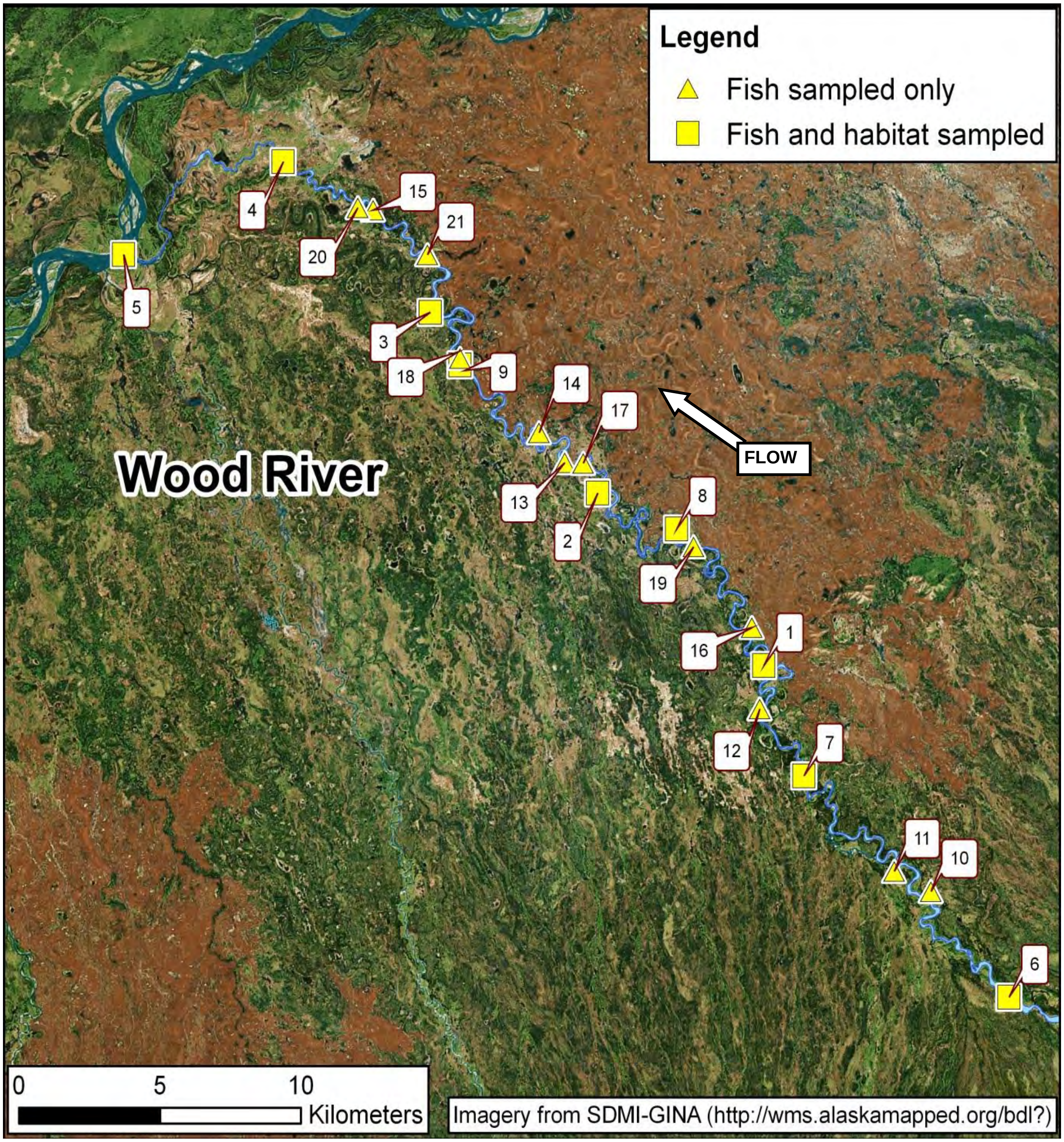

Figure 9. Wood River sample sites, 2009. Specific coordinates for each sample site are given in Table 1.

Figure 10. Pictures of Clear Creek taken during 2008 sampling trips. Panel 2 depicts a log jam and panel 4 was taken during the high water event that coincided with period 2 sampling.

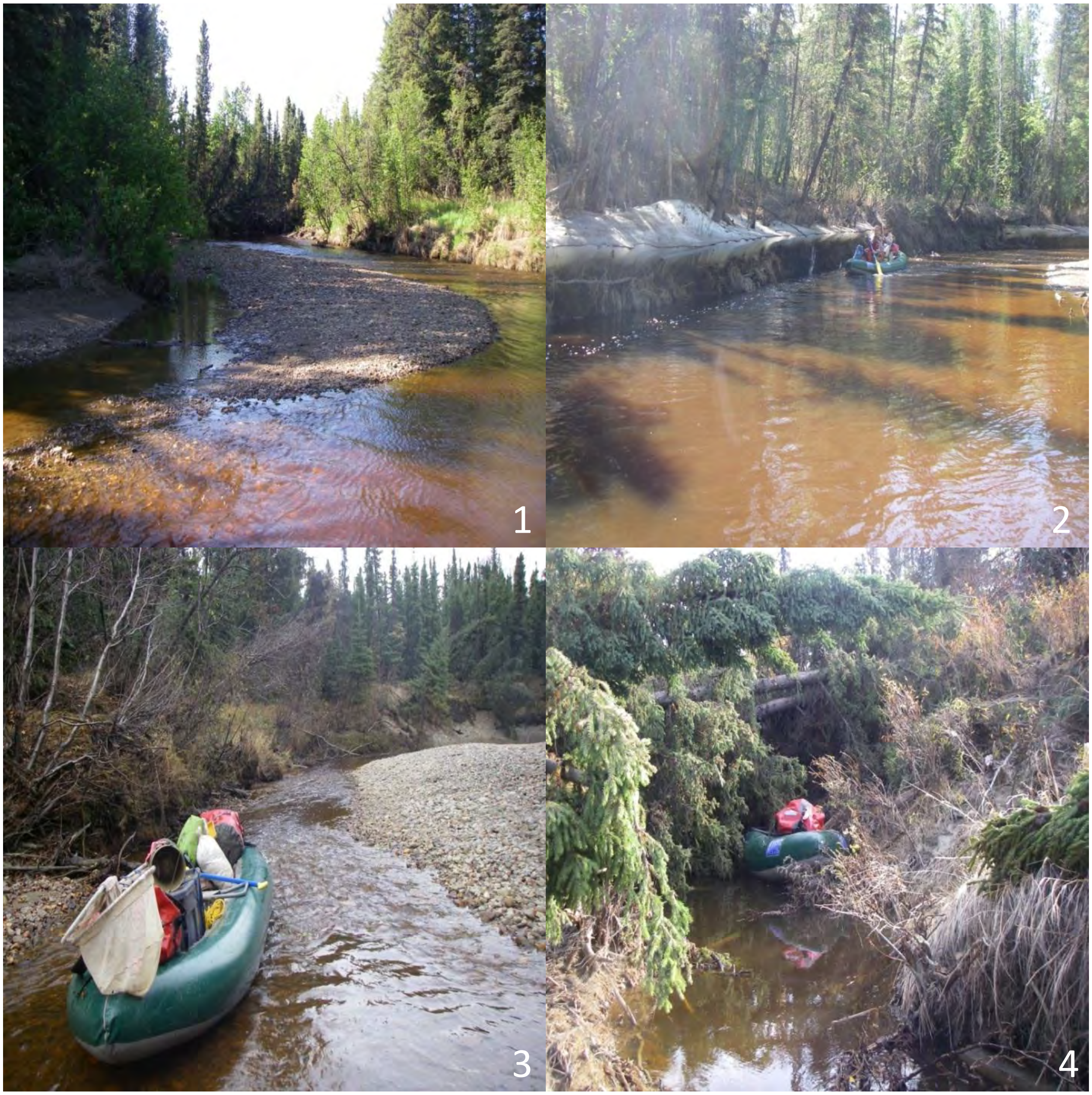

Figure 11. Pictures of Kiana Creek taken during 2008 sampling trips.

Figure 12. Pictures of Willow Creek taken during 2008 sampling trips.

Figure 13. Pictures of Beaver Creek taken during 2009 sampling trips. Panel 3 shows a permafrost thaw slump near Beaver Creek's confluence with the South Fork of the Chena River. Panel 4 shows spawning Chinook salmon.

Figure 14. Pictures of the Lower South Fork Chena River taken during 2009 sampling trips. Panel 4 shows spawning Chinook salmon.

Figure 15. Pictures of the Upper South Fork Chena River taken during 2009 sampling trips. Panel 2 and 4 show some impediments to downstream travel.

Figure 16. Picture of Gilles Creek taken during 2009 sampling trips.

Figure 17. Pictures of the Wood River taken during 2009 sampling trips.