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Inventory of Fish Distribution in the Matanuska-Susitna Basin, Southcentral Alaska, 2010

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Elizabeth B. Benolkin

Abstract

Anthropogenic activities, particularly residential and commercial development, in the Matanuska-Susitna (Mat-Su) Borough, Alaska, are likely threats to fish habitat. Fish habitat protection authorities and planning processes in Alaska are constrained by the extent of current knowledge of fish distributions and their habitats. Some protections provided under the Anadromous Fish Act (AS 41.14.870) only apply to waters specified in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (AWC). The Anchorage Fish and Wildlife Field Office initiated this project to increase coverage of the AWC for Mat-Su basin water bodies in support of Mat-Su Basin Salmon Habitat Partnership. Sampling during 2010 was focused in the Knik River Public Use Area based on consultations with Alaska Department of Fish and Game biologists. Fisheries and land managers have concerns that intense recreational use in these extensive wetlands could impact salmon production. Sampling for the AWC was initiated as a first step in gaining a better understanding of the use of these wetlands by juvenile salmon. Fish and aquatic habitat parameters were collected from 10 sites within the Knik River drainage, resulting in 9 nominations to update the AWC in 2010. Approximately 647 hectares of lake/wetland complexes and 10 kilometers of streams were surveyed in 2010. Juvenile coho salmon *Oncorhynchus kisutch* were the most common anadromous species captured in Knik River drainage sites by baited minnow traps (n = 391; 49 - 148 mm), followed by juvenile sockeye salmon (*O. nerka;* n = 10; 65 - 115 mm). Spawning sockeye salmon were also documented in areas not previously included in the AWC. Dolly Varden *Salvelinus malma*, Alaska blackfish *Dallia pectoralis*, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, and sculpin *Cottus spp*. were also captured in 2010. This project will continue in the Knik River drainage of the Mat-Su basin during 2011.

Introduction

The human population of the Matanuska-Susitna (Mat-Su) Borough is one of the fastest growing in the U.S., with a growth rate of 49% from 1990 to 2000. Population growth and associated development continue to challenge the ability of fisheries and land managers to balance fish habitat conservation with these changes over time. Maintaining healthy fish habitat, including water quality and quantity, is critical to maintain healthy fish populations in the Mat-Su basin.

Concerns for how to effectively protect and restore salmon production in the face of rapid development led to the formation of the Mat-Su Basin Salmon Habitat Partnership (Partnership). The Partnership is one of 13 fish habitat partnerships approved nationwide under the National Fish Habitat Action Plan (NFHAP), a national effort to protect and restore the nation's waterways and fisheries through science-based partnerships of affected stakeholders. The Partnership has developed a Strategic Action Plan (Mat-Su Basin Salmon Habitat Partnership

Authors: The primary author is a fishery biologist with the U. S. Fish and Wildlife Service and can be contacted at Anchorage Fish and Wildlife Field Office, 605 W. 4th Ave., Anchorage, AK 99501 or elizabeth_benolkin@fws.gov.

2008), which identifies objectives, actions, and research necessary to protect salmon and salmon habitat in the Mat-Su basin.

Fish habitat protection authorities and planning processes in Alaska are constrained by the extent of current knowledge of fish distributions and their habitats. Some protections provided under the Anadromous Fish Act (AS 41.14.870) only apply to waters specified in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (Anadromous Waters Catalog, AWC; Johnson and Blanche 2010). Currently, the AWC contains less than 4,200 miles of the more than 23,900 miles of streams that have been mapped in the Mat-Su basin. Management and regulatory tools cannot be applied to their full extent until the remainder of likely anadromous fish habitat in the basin is surveyed.

The Anchorage Fish and Wildlife Field Office initiated this project in 2007 to support the Partnership's Strategic Action Plan and the NFHAP by increasing coverage of the AWC for Mat-Su basin water bodies. The overall goal of this project is to provide information needed for protection and management of the freshwater habitats that support Alaska's anadromous and freshwater fish. The specific objectives of the project are to

1. Maximize the spatial extent of mapped anadromous fish habitat depicted in the AWC within the Mat-Su basin; and
2. Record characteristics of aquatic habitats at each sampling location.

Study Area

The Matanuska and Susitna river watersheds encompass about 24,500 square miles in southcentral Alaska. The watersheds meet freshwater life history needs of all five species of Pacific salmon and support populations of other salmonids including Arctic grayling *Thymallus arcticus*, rainbow trout *O. mykiss*, and Dolly Varden *Salvelinus malma*, as well as many other species such as threespine *Gasterosteus aculeatus* and ninespine *Pungitius puntitius* stickleback, and sculpin *Cottus* spp. Sampling efforts were focused in streams, lakes, and wetlands in the Knik River Public Use Area (KRPUA) of the Mat-Su, which is a legislatively designated area managed by the Department of Natural Resources (DNR), Division of Mining, Land, and Water (Figure 1).

Sampling sites were selected based on consultations with the Habitat-Restoration Branch of the U. S. Fish and Wildlife Service (USFWS) and the Alaska Department of Fish and Game (ADF&G; Sport Fish and Habitat Divisions, Palmer Alaska). Criteria for study site selection included on-going and expected recreational use, key data gaps, and potential threats to anadromous streams. Areas specified for priority sampling include streams, lakes, and wetland complexes north of the Knik River, including Jim Creek, Jim Lake, Mud Lake, McRoberts Creek, Gull Lake, Leaf Lake, Chain Lakes and Swan Lake (Figure 1).

Some parts of these priority areas are currently included in the AWC, but life stages, species, and their distributions remain limited. For example, Jim Lake was previously cataloged as an anadromous water body for rearing coho salmon and the presence of sockeye salmon, but the wetland areas to the southeast of the lake are not included in the catalog. Adult coho salmon have been documented in Gull, Leaf, and Chain Lakes, but no other species or life stages have.

The KRPUA was established to preserve, perpetuate, and enhance public recreation, enjoyment of fish and wildlife, and the traditional use of fish and wildlife resources, and is popular among recreationalists who enjoy activities ranging from salmon fishing to riding off-road vehicles to hunting, boating and bird-watching. It also provides habitat for rich and diverse fish and wildlife populations, including anadromous fish such as sockeye and coho salmon. However specific habitats which may be important to these anadromous fish is still not documented for much of this area. In addition to a lack of information about which areas may be important habitat for salmon, resource managers have expressed concerns that increased and intense recreational use in these extensive wetlands could impact water quality, riparian habitat, and salmon production. Data gaps and concerns about potential threats to fish habitat in the KRPUA prompted the focus of AWC sampling here.

Methods

Sampling methods were adapted from Buckwalter (2010) and from the Alaska Department of Fish & Game's AWC polygon sampling guidelines (ADFG 2010) and targeted rearing salmonids in streams, lakes, and wetland complexes considered important for anadromous fish in late summer and early fall.

Sample sites were chosen based on observations of size, water flow, and apparent limits of anadromous fish distribution. Sites were accessed using the most direct route possible and permission from landowners was secured in advance when accessing private property. Fish and aquatic habitat parameters were collected at each sampling site. Data were recorded on sampling forms printed on Rite in the Rain paper, and transferred to laptops each week.

The extent of the lake or wetland complex was identified using topographic maps, satellite imagery, and with on the ground observations. Once a sampling site was identified, the site was delineated as a polygon by walking the perimeter of the wetted area with a hand-held Global Positioning System (GPS; Garmin Map76Sx). Spatial coordinates of the delineated polygon were recorded in decimal degrees in the North American Datum of 1983 (NAD 83) geographic coordinate system.

Fish surveys –Fish were sampled with baited minnow traps placed around the perimeter of the polygon and at sites within the delineated polygon. Minnow traps (Gee, G-40, ¼" mesh) were baited with cured salmon roe, and set from canoes within the lakes or by foot in wetland areas. Traps were marked with a small float and anchored when necessary. The number of minnow traps set at each site was determined by on-the-ground observations to adequately document the presence of fish throughout the sampling area. Spatial coordinates at each trap site were recorded with a GPS.

Captured fish were placed in a 12-L bucket less than one half full with stream water. Fish were counted and identified to species (Pollard et al. 1997). Total forked length (mm) was recorded for all juvenile sockeye salmon, coho salmon, and Dolly Varden. All fish were released back to the sample area.

Habitat Measurements

Habitat parameters were collected at each site where a minnow trap was set. Water depth (ft) was recorded with a stadia rod and later converted to meters. Water temperature (°C), pH, and ambient conductivity (µS/cm), were measured using a YSI 63 water quality multimeter. Photos were taken at each site to document habitat characteristics and presence of salmon.

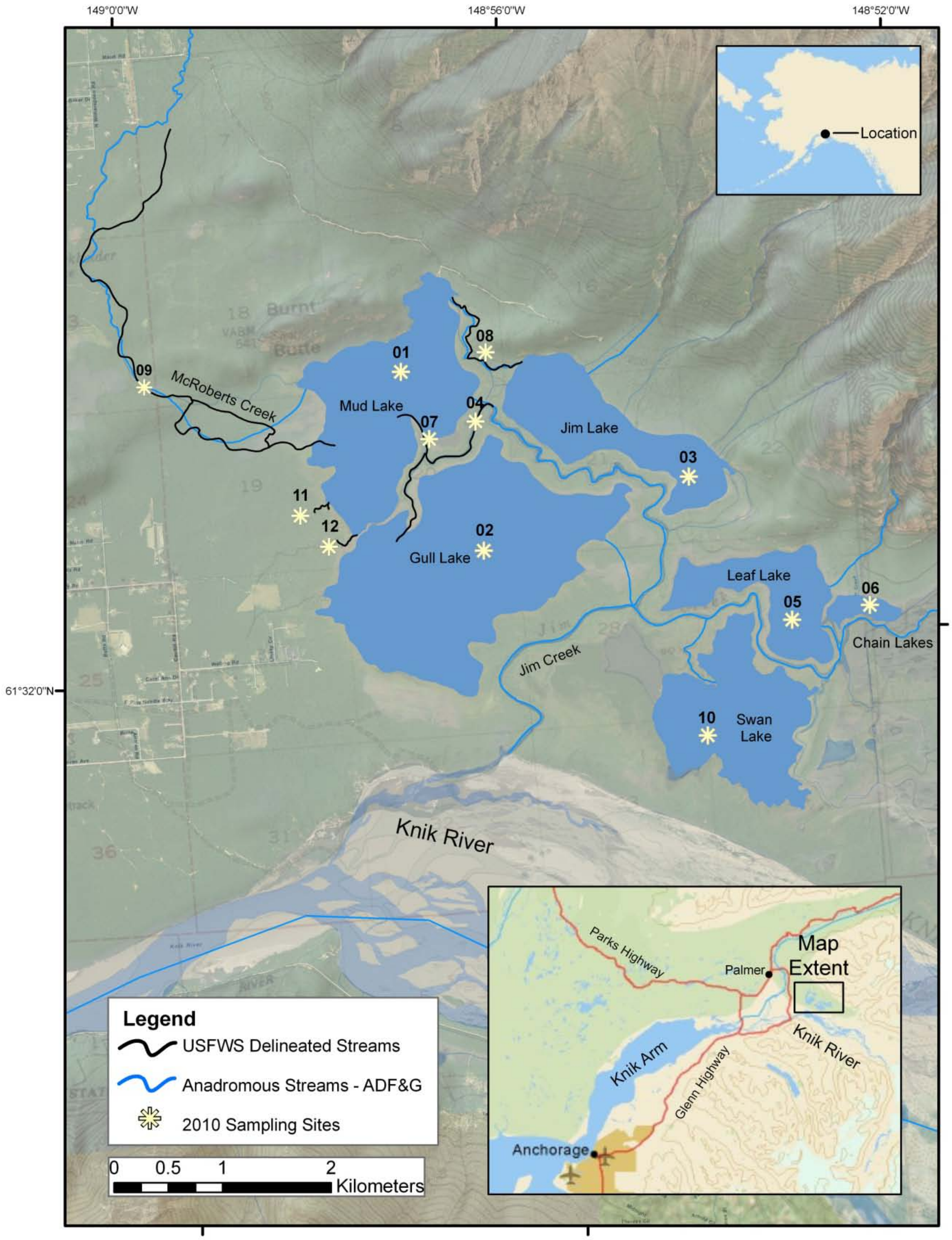

Figure 1. Sampling areas in the Knik River Public Use Area, 2010. Anadromous streams, indicated in blue, are those which were included in the AWC prior to this study. No fish or habitat sampling was conducted at Site 09, but a foot survey was conducted to verify hydrography of this stream section.

Results

Approximately 647 hectares of lakes and wetlands and about 9.6 km of streams were surveyed in the Knik River Public Use area from 13 July to 25 August 2010 (Figures 1-12). Six lake and wetland areas were sampled for fish in 2010; all but Site 10 were delineated as polygons. Three stream sections (Sites 04, 07, and 08) and two small channels of Mud Lake (Sites 11 and 12) were delineated and sampled for fish, and one section of stream was delineated to verify channel location (Site 09, Upper McRoberts Creek; Figure 1).

Fish Surveys

Anadromous juvenile coho salmon (n = 390) were documented in five of the six lake/wetland areas (Sites 01, 02, 03, 05, and 06) and in four of the five stream channels surveyed in 2010 (Sites 04, 07, 08, and 12; Figure 1; Table 1). No juvenile coho salmon were captured in Swan Lake, though this site was not extensively sampled in 2010, and few (n = 11) juvenile coho salmon were captured in Gull Lake, despite extensive sampling (130 minnow traps in July and 30 traps in August; Table 1). Anadromous juvenile sockeye salmon were documented in Mud Lake (n = 8), Jim Lake Wetlands (n = 1) Leaf Lake (n = 1), and one juvenile sockeye salmon carcass was found during the foot survey to delineate Site 09 (Table 1; Figures 2, 4, 6, and 10).

Approximately 30 adult coho salmon were observed in Leaf Lake (Figure 6), and approximately 10 adult sockeye salmon were observed in Upper McRoberts Creek (Figure 11). Numerous migrating adult coho and sockeye salmon were observed in Jim Creek and McRoberts Creek during travel to study sites throughout August.

Dolly Varden (n = 39) were captured at all but 2 sites surveyed (Site 02 and 07; Figure 1; Table 1). Threespine stickleback (n = 13,588) were captured in every area sampled, and ninespine stickleback (n = 182) were documented at all but 2 Sites (01 and 07; Figure 1; Table 1). Sticklebacks were not identified to the species level until sampling began in Jim Lake wetlands on 4 August, so it is possible that ninespine sticklebacks were actually captured at Site 01, but not identified. Alaska blackfish (n = 71) were captured in all but 2 Sites (04 and 11), and one sculpin was captured in Mud Lake (Table 1).

Coho salmon (n = 390) averaged 97 mm and ranged in length from 49 to 148 mm (Table 1; Figure 13). Of the 390 juvenile coho salmon captured, six were not measured for length. A total of ten juvenile sockeye salmon were captured in 2010, but only four of these were measured for length (mean = 85 mm; range = 65 to 115mm; Table 1). Dolly Varden (n = 39) averaged 114 mm and ranged in length from 40 to 163 mm (Table 1; Figure 14).

Habitat Measurements

Water depth, water temperature, pH, and conductivity measurements were collected from the lake, wetland, and stream sampling areas at each location where a minnow trap was set (n = 458; Table 2). Surveyed Sites were generally shallow with warm, near or above neutral pH, and had conductivity values within median ranges reported values for Jim Creek (Table 2; Figures 15-16; Wolfe et al. 2009).

The most shallow water depth was measured in Gull Lake (0.1m), and the deepest water depth was recorded at one of the stream channels of Mud Lake (Site 12; 1.8m; Table 2; Figures 15-16). Water depths averaged between 0.4m at three lake Sites (03, 06, and 10) and 1.3m at Site 12, a small tributary of Mud Lake (Table 2; Figures 15-16). Mean water temperatures were coolest (12.9 °C) at one of the tributary Sites (08) measured on 13 July, and were warmest at Chain Lake (Site 06), measured on 24 August, where temperatures averaged 19.1° C and ranged from 13.8°C to over 23°C (Table 2; Figures 15-16). Mean water temperatures were above 13°C at most sites and on most dates sampled, except at one of the tributary Sites (08) collected on 13 July and again on 17 August, in Gull Lake on 26 July, and in Jim Lake wetlands on 9 August. Mean pH values were nearly neutral at three of the tributary Sites (07, 08, and 11), ranged from 9.07 to 9.74 at tributary Site 12, and averaged between 7.5 and 9.4 at the lake Sites (Table 2; Figures 15-16). The highest pH values were collected at Swan Lake (Site 10) on 24 August, where values ranged from 8.2 to 10.1, and all but one measurement was above a pH of 8.5. The lowest mean conductivity measurements were recorded at tributary Site 11 (88.2 µS/cm) on 20 July, and the highest mean measurements (223 µS/cm) were recorded in Jim Lake Wetlands (Site 03), measured on 2, 3, and 9 August (Table 2; Figures 15-16).

AWC Nominations

Nine nominations were submitted to update the AWC in 2010 (Table 3). Most nominations were made to add or extend the distribution of rearing coho salmon. Juvenile coho salmon were captured in all lakes or polygon sampling areas with the exception of Swan Lake (Site 10) which was not sampled extensively due to time constraints. Nominations were made to extend the distribution of coho salmon in Mud Lake and the wetlands of Jim Lake (Figure 1). Nominations to add new life stages (rearing coho salmon) were made for Gull Lake, Leaf Lake, and Chain Lake (Table 3). Three of the five stream sections of streams that were sampled for juvenile fish (Sites 04, 07, and 08) were nominated for the presence of juvenile coho salmon. No juvenile salmon were captured in the tributary Site 11 (Figure 12; Table 1). Three coho salmon were captured at Site 12, but these data were overlooked during the nomination preparation and were subsequently not nominated. A nomination to add rearing coho salmon for this site will be made in 2011. The nomination for Site 08 was submitted to provide additional backup information for rearing coho salmon presence, and the other 2 Sites (04 and 07) were nominated to add a new species and to add new stream sections that were not previously in the catalog. A nomination was submitted to add a new species (rearing sockeye salmon) to Mud Lake. A single juvenile sockeye was captured in each sample of Jim Lake, Chain Lake, and upper McRoberts Creek, which was not sufficient for AWC nominations of these waters. Upper McRoberts Creek (Site 09) and Chain Lake were nominated to add adult sockeye salmon. Finally, a nomination was submitted to update the hydrography at Site 09 (upper McRoberts Creek), where it split into 2 branches (Figure11).

Table 1. Summary of total number of juvenile fish, mean fork length (mm), standard deviation (SD), and range of total fish length (mm) from lake, wetland, and tributary sampling sites in the Knik River Drainage, AK, 2010. Fish length was collected from salmonids only.

[a]A total of 68 coho salmon were captured in Mud Lake; three were not measured for length. . [b] An additional coho salmon was captured at each Sites 03, 04, and 07 which were not measured for length. [c] A total of 8 sockeye salmon were captured in Mud Lake; six were not measured for length. Juvenile fish were not actively sampled at Site 09, but one juvenile sockeye salmon was observed.

Location	Statistic	Coho salmon	Sockeye salmon	Dolly Varden	3-spine stickleback	9-spine stickleback	Alaska blackfish	Sculpin (spp.)
01 Mud Lake	Count	65[a]	2[c]	7	4,446	0	12	1
	Mean	96	104	85	-	-	-	-
	SD	14	16	28	-	-	-	-
	Min	64	93	40	-	-	-	-
	Max	126	115	128	-	-	-	-
02 Gull Lake	Count	11	0	0	4,351	21	12	0
	Mean	116	-	-	-	-	-	-
	SD	10	-	-	-	-	-	-
	Min	97	-	-	-	-	-	-
	Max	129	-	-	-	-	-	-
03 Jim Lake Wetlands	Count	111[b]	1	6	2,325	8	71	0
	Mean	104	-	95	-	-	-	-
	SD	10	-	22	-	-	-	-
	Min	55	67	72	-	-	-	-
	Max	127	67	125	-	-	-	-
04 McRoberts Creek	Count	27[b]	0	1	406	38	0	0
	Mean	108	-	-	-	-	-	-
	SD	20	-	-	-	-	-	-
	Min	54	-	107	-	-	-	-
	Max	135	-	107	-	-	-	-
05 Leaf Lake								
	Count	58	0	0	592	90	1	0
	Mean	92	-	-	-	-	-	-
	SD	29	-	-	-	-	-	-
	Min	52	-	-	-	-	-	-
	Max	148	-	-	-	-	-	-
06 Chain Lake	Count	86[b]	1	20	425	12	2	0
	Mean	83	-	131	-	-	-	-
	SD	25	-	21	-	-	-	-
	Min	49	65	87	-	-	-	-
	Max	141	65	163	-	-	-	-
07 Gull to McRoberts Trib	Count	5	0	0	142	0	7	0
	Mean	114	-	-	-	-	-	-
	SD	3	-	-	-	-	-	-
	Min	110	-	-	-	-	-	-
	Max	118	-	-	-	-	-	-

Table 1 continued.

Location	Statistic	Coho salmon	Sockeye salmon	Dolly Varden	3-spine stickleback	9-spine stickleback	Alaska blackfish	Sculpin (spp.)
08 Jim to Mud Trib	Count	18	0	5	694	12	25	0
	Mean	97	-	107	-	-	-	-
	SD	16	-	29	-	-	-	-
	Min	75	-	73	-	-	-	-
	Max	125	-	135	-	-	-	-
09 Upper McRoberts	Count	0	1	0	0	0	0	0
	Mean	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-
	Min	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-
10 Swan Lake	Count	0	0	0	19	1	4	0
	Mean	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-
	Min	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-
11 Mud Lake Trib 1	Count	0	0	0	136	0	0	0
	Mean	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-
	Min	-	-	-	-	-	-	-
	Max	-	-	-	-	-	-	-
12 Mud Lake Trib 2	Count	3	0	0	52	0	0	0
	Mean	99	-	-	-	-	-	-
	SD	5	-	-	-	-	-	-
	Min	94	-	-	-	-	-	-
	Max	103	-	-	-	-	-	-
All Sites	Count	384	4	39	13,588	182	134	1
	Mean	96	85	114	-	-	-	-
	SD	21	24	29	-	-	-	-
	Min	49	65	40	-	-	-	-
	Max	148	115	163	-	-	-	-

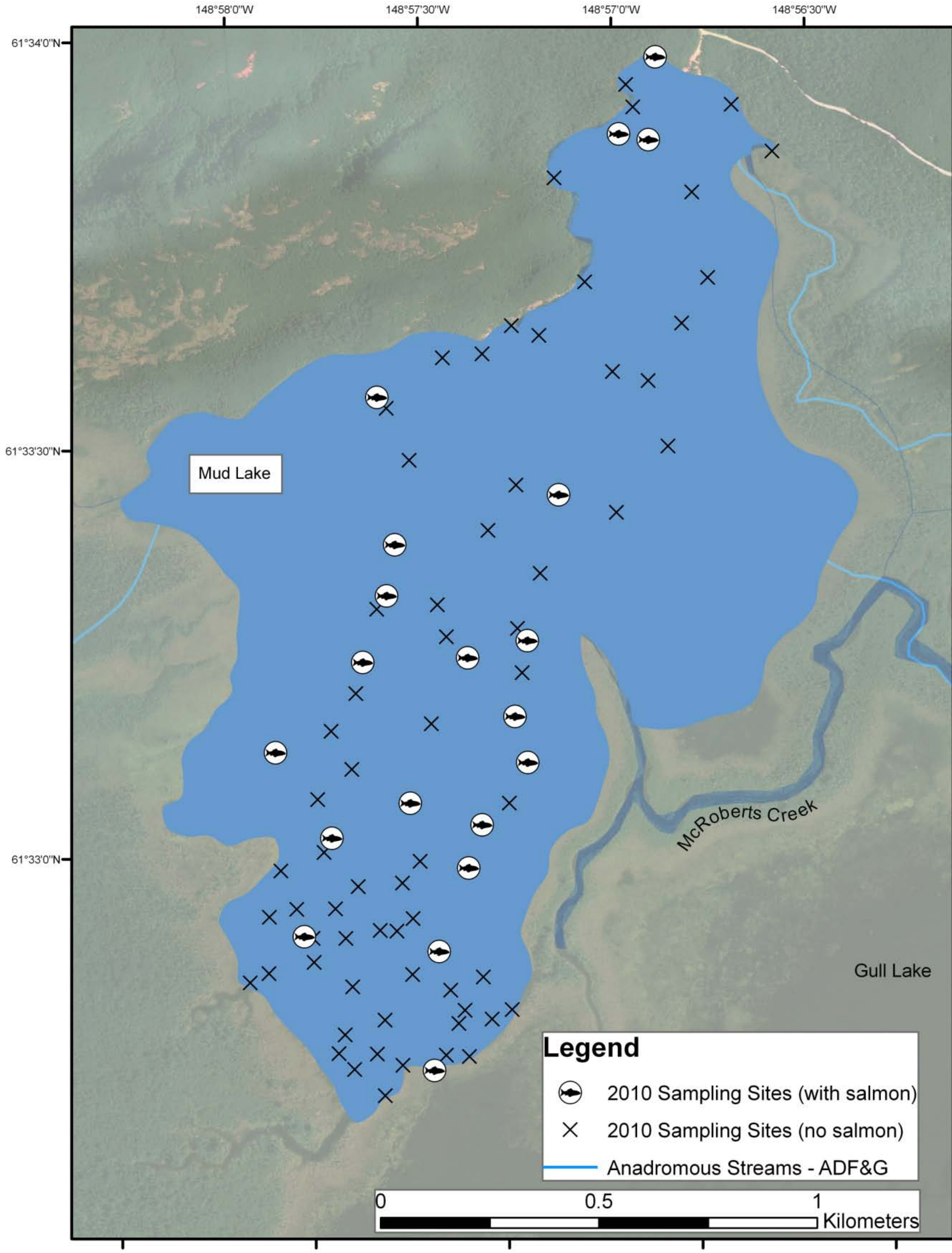

Figure 2. Sampling locations in Mud Lake, July 2010. Black X's indicate locations where minnow traps were set and no anadromous fish were captured. Sixty-eight juvenile coho and 8 juvenile sockeye salmon were captured in Mud Lake.

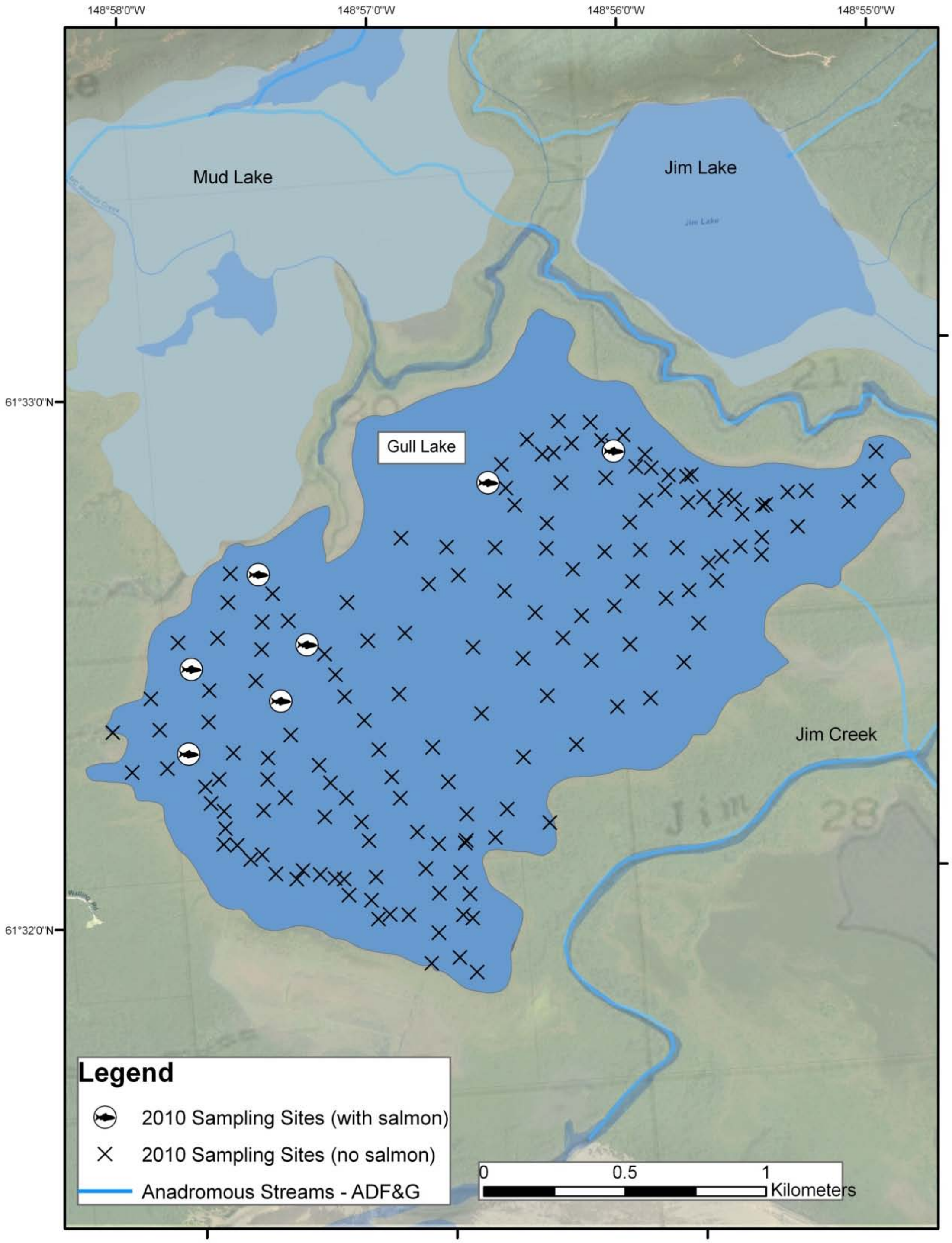

Figure 3. Sampling locations in Gull Lake, July 2010. Eleven juvenile coho salmon were captured in Gull Lake.

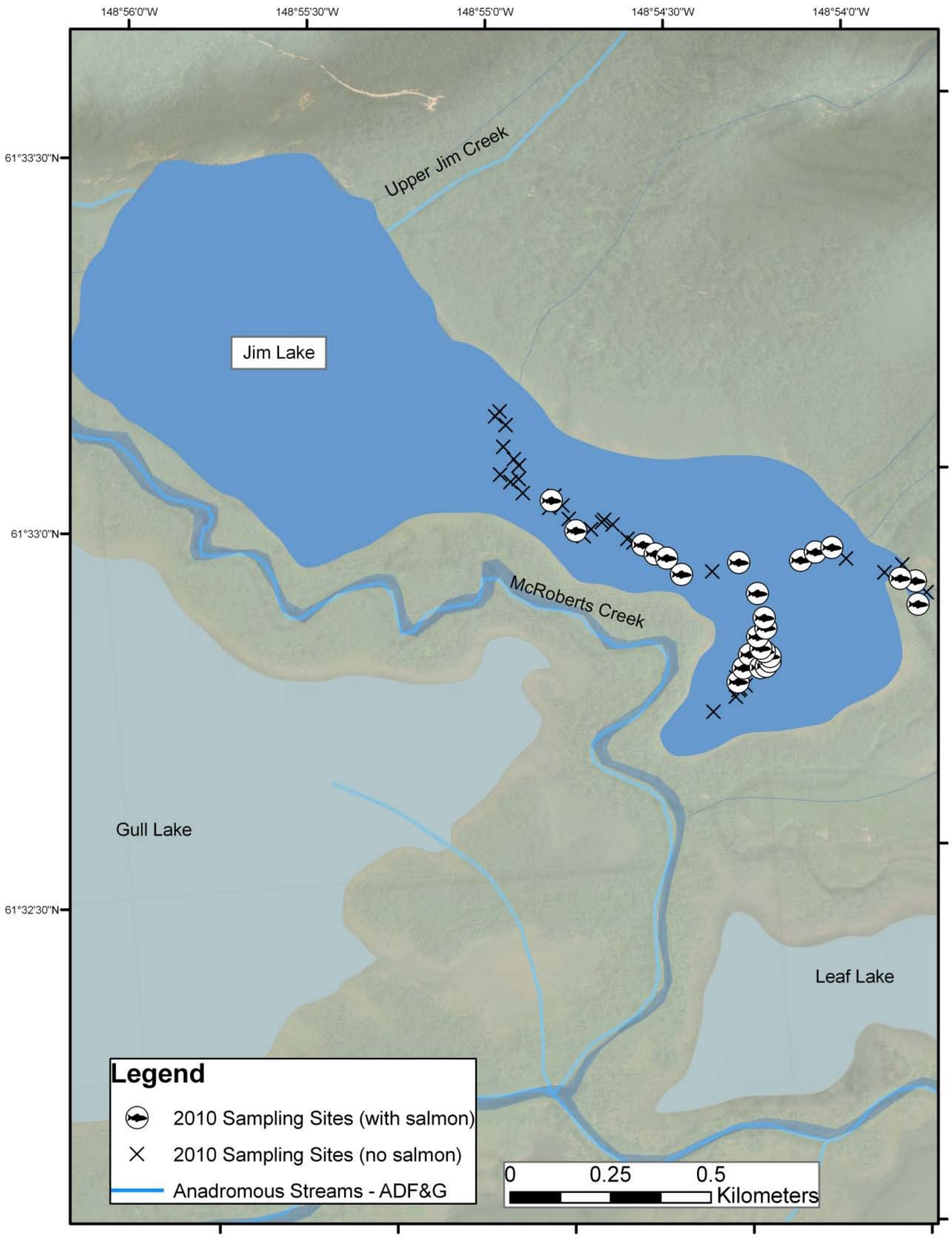

Figure 4. Sampling locations in Jim Lake wetlands, 2010. One-hundred eleven juvenile coho and 1 juvenile sockeye salmon were captured in Jim Lake wetlands.

Figure 5. Sampling locations in McRoberts Creek, 2010. This stream section was not previously included in the AWC. Twenty-seven juvenile coho salmon were captured in 7 of 12 minnow traps in McRoberts Creek.

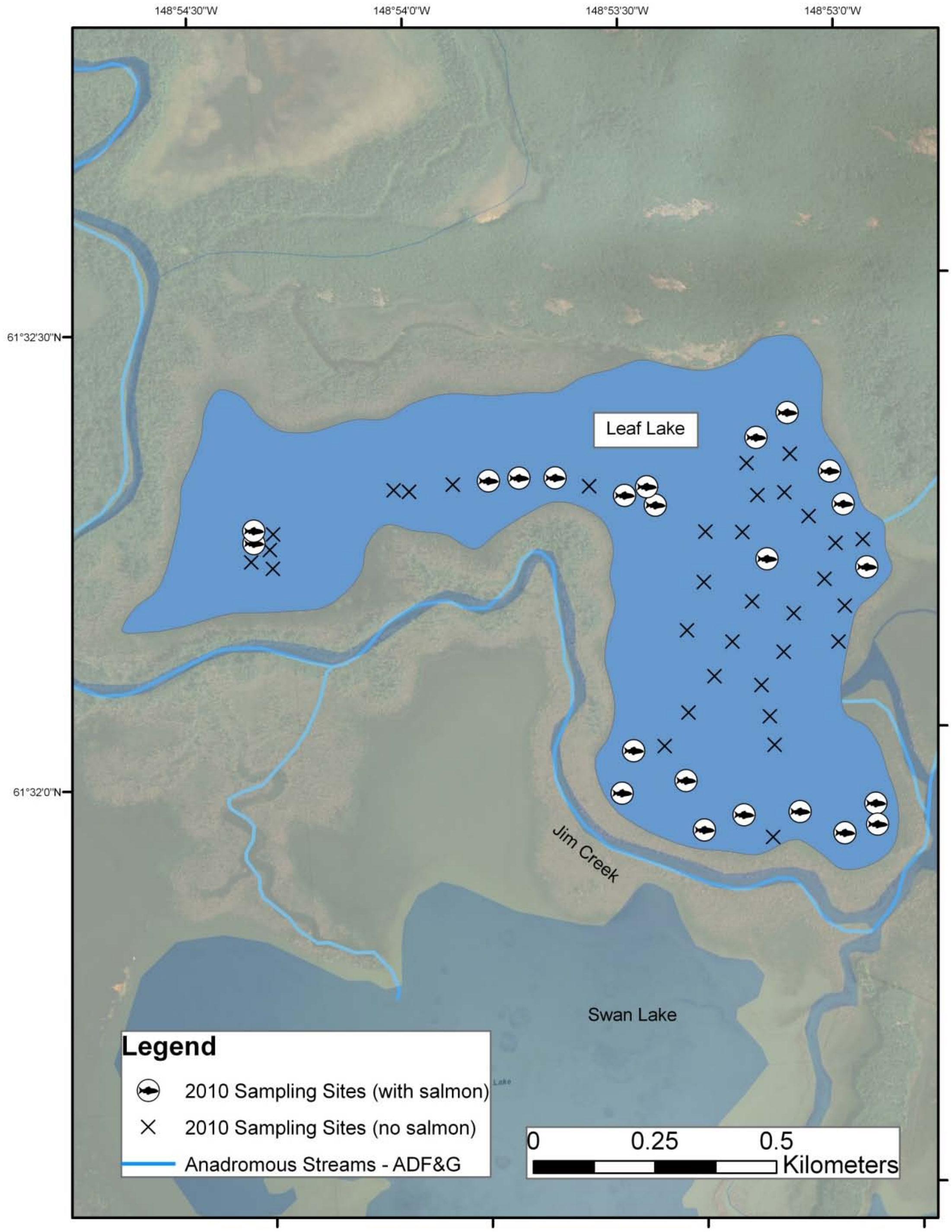

Figure 6. Sampling locations in Leaf Lake, 2010. Fifty-eight juvenile coho salmon were captured in Leaf Lake.

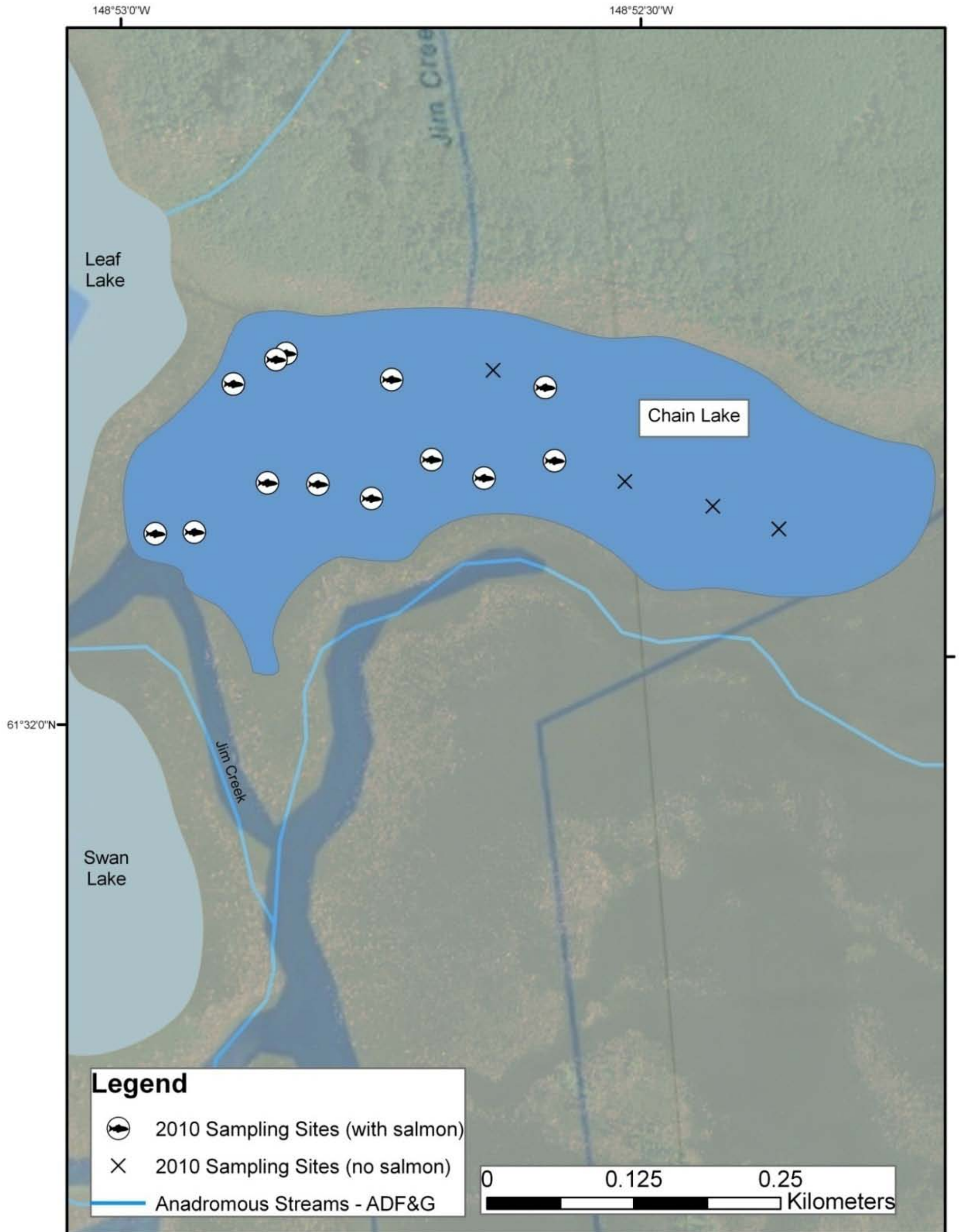

Figure 7. Sampling locations in Chain Lake, 2010. Eighty-six juvenile coho and one juvenile sockeye salmon were captured in 13 of the 17 minnow traps set at this location.

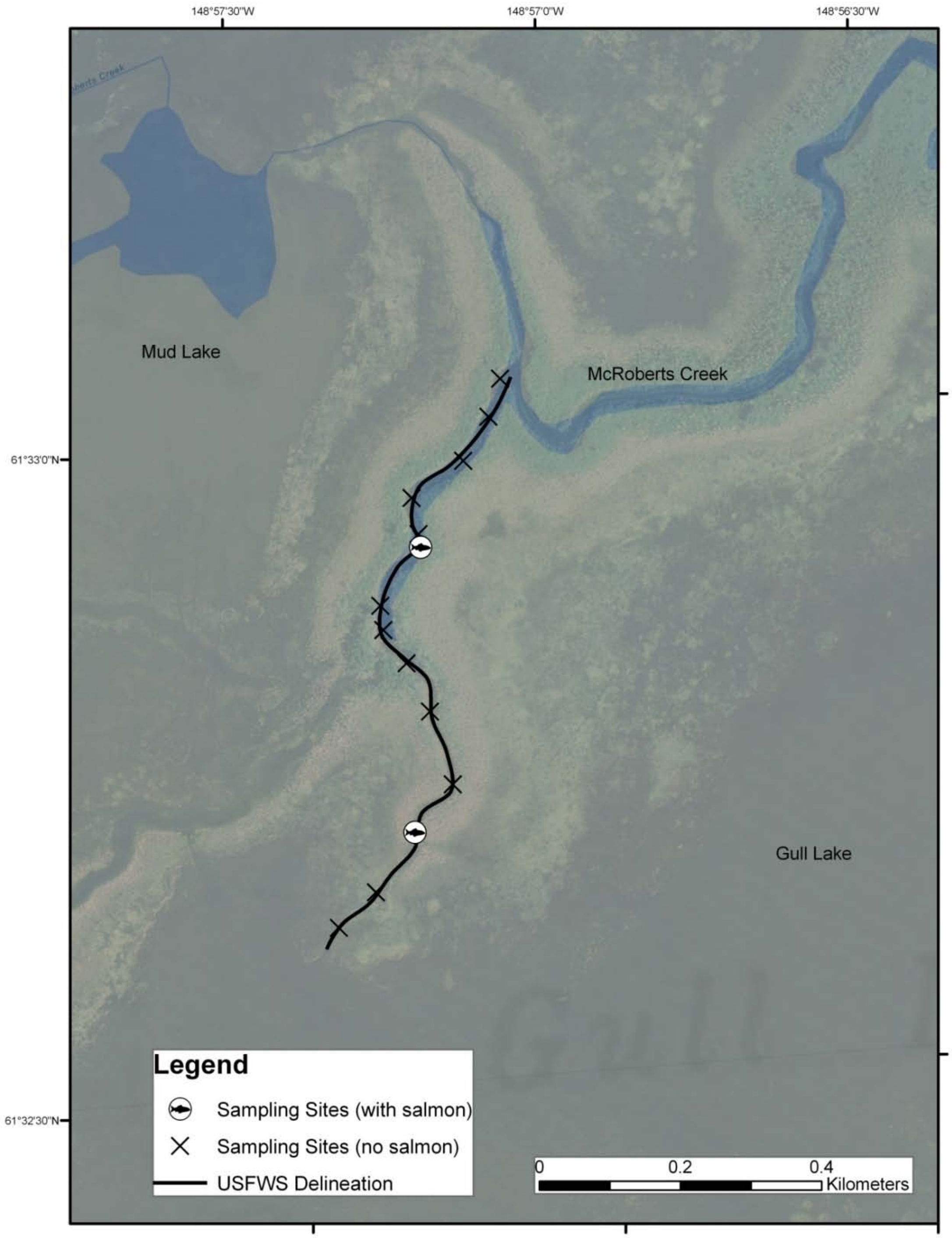

Figure 8. Sampling locations in the unnamed tributary from Gull Lake (lower portion of the map) to McRoberts Creek, 2010. Five coho salmon were captured in 2 minnow traps in this section of the creek, which was not previously delineated.

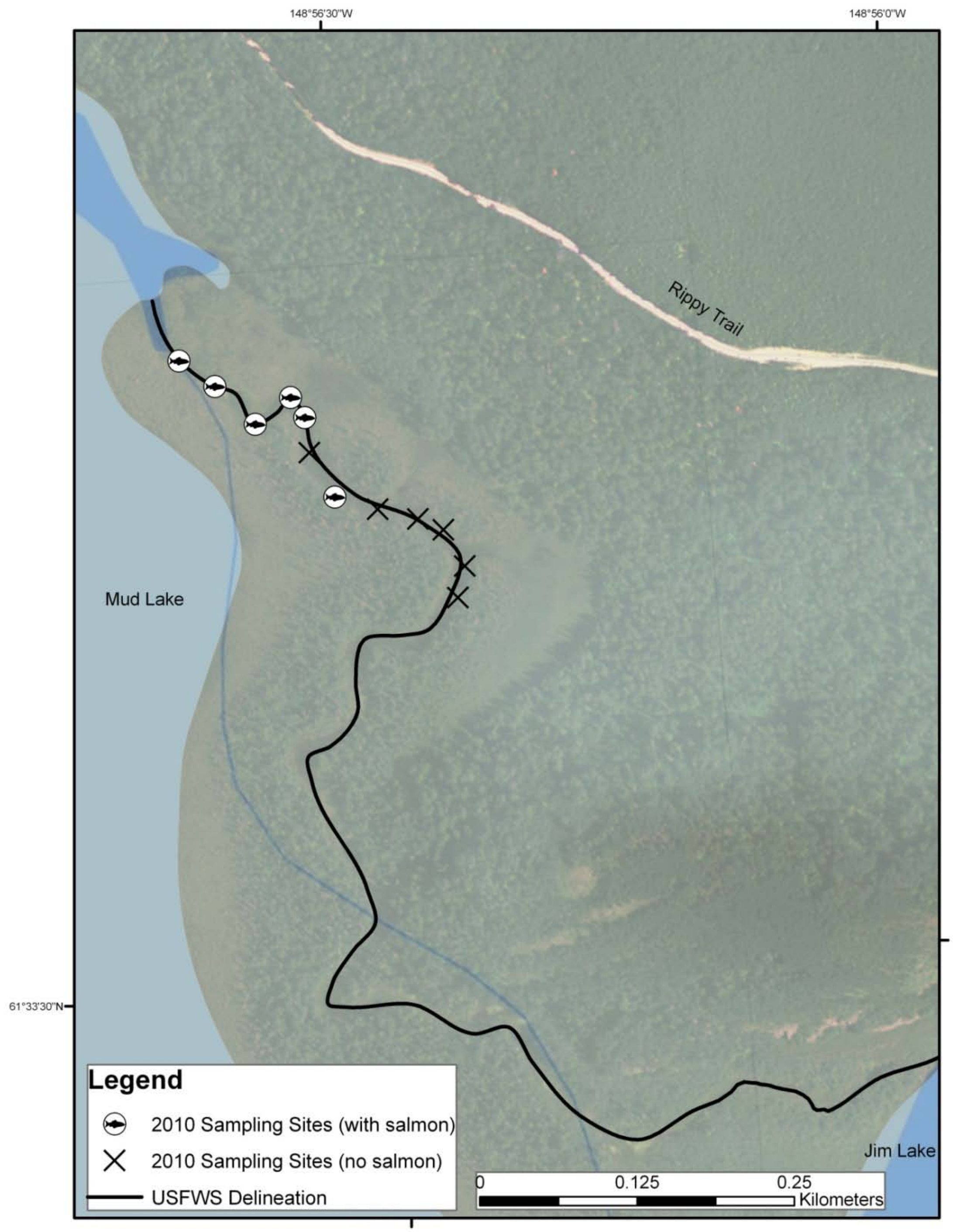

Figure 9. Sampling locations in the unnamed tributary from Jim Lake (lower right corner) to Mud Lake (upper left corner of map), 2010. Eighteen coho salmon were captured in 6 minnow traps in this section of stream.

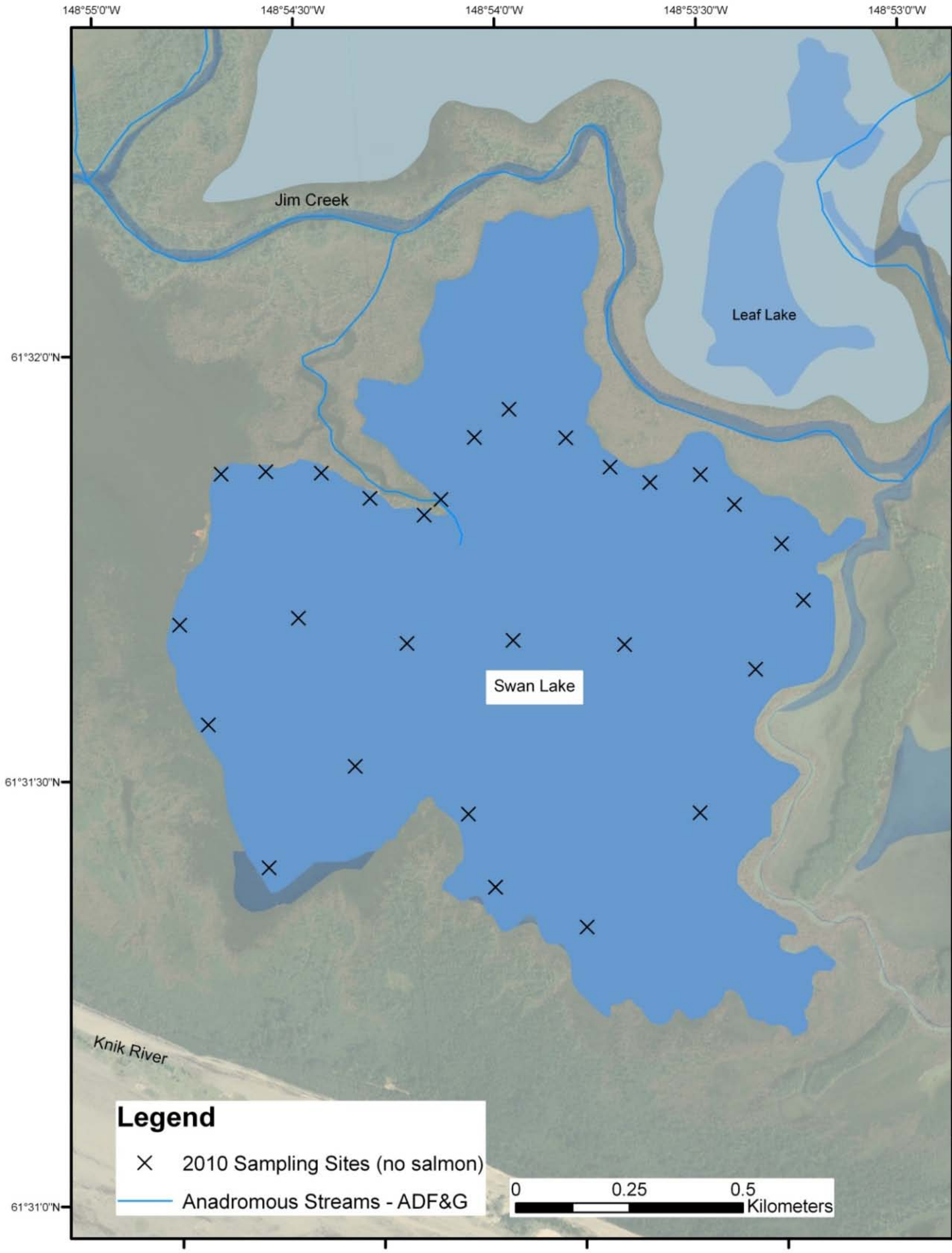

Figure 10. Sampling locations in Swan Lake, 2010. Swan Lake was not exhaustively sampled in 2010, and no salmon were captured or observed at this location. It will be delineated on the ground with GPS, and more thoroughly sampled in 2011.

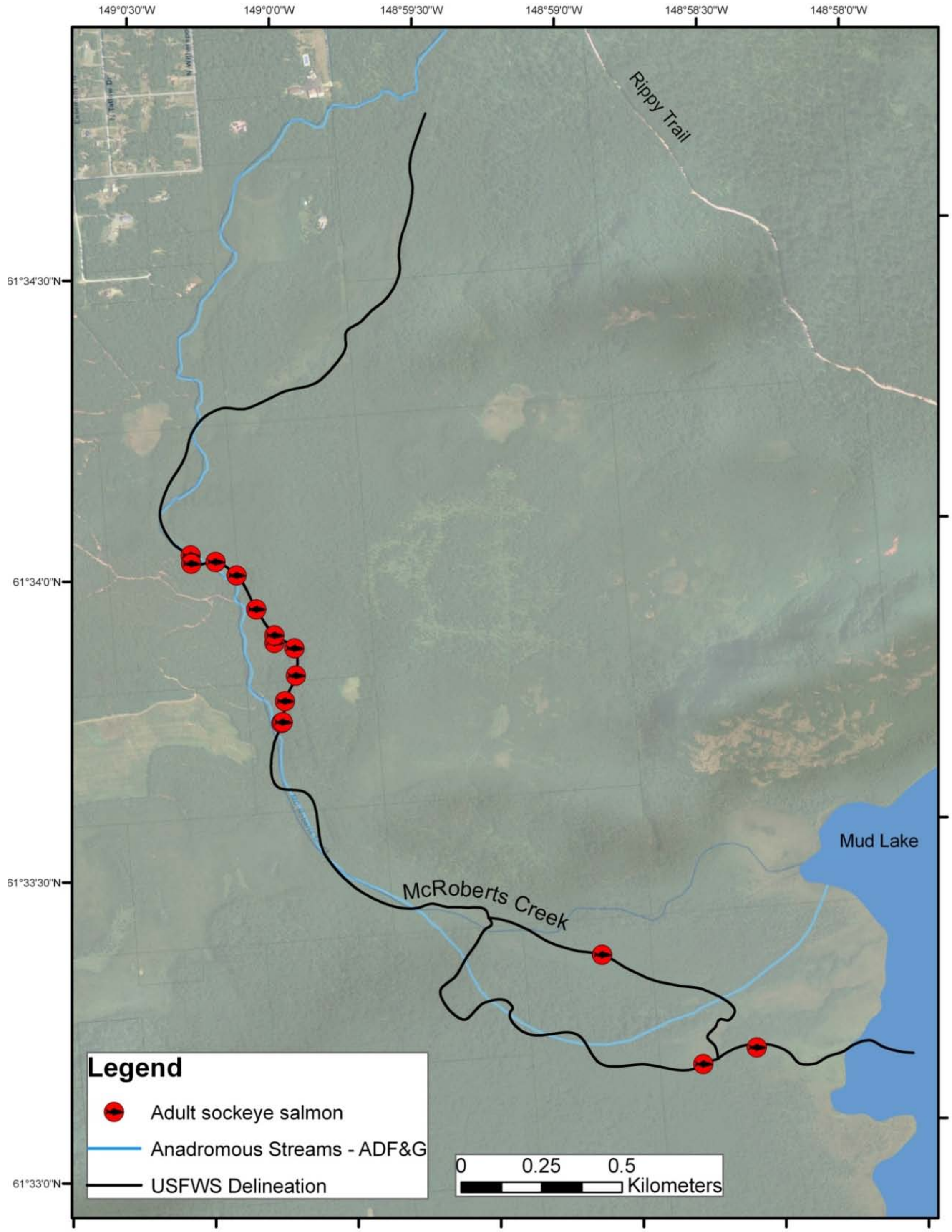

Figure 11. Upper McRoberts Creek channel delineation (black line), indicating differences from previously cataloged stream (blue line). No sampling was conducted at this site, but spawning adult sockeye salmon (red dots) and a single juvenile sockeye salmon were observed during foot surveys. This stream was previously cataloged for spawning coho salmon, but not sockeye salmon.

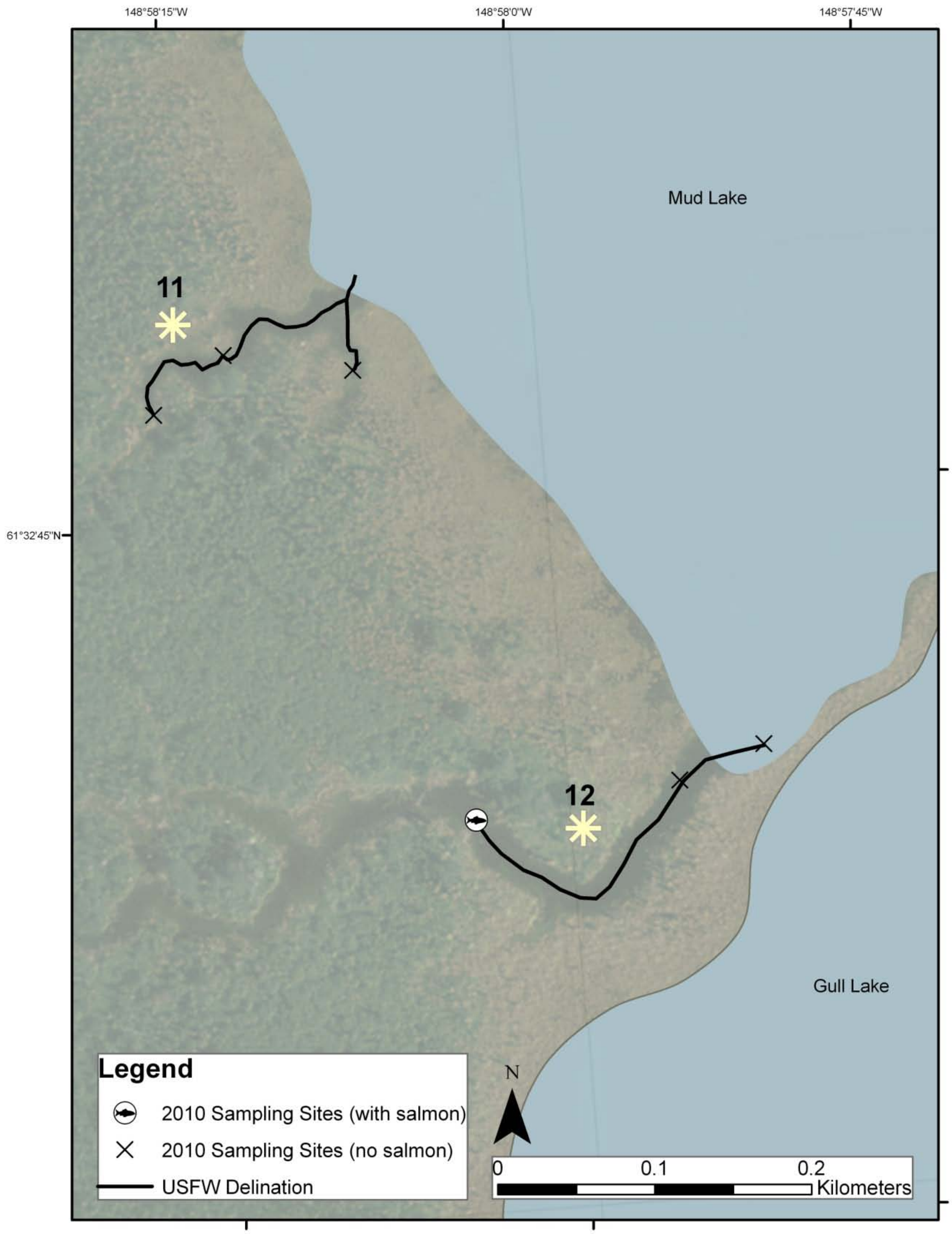

Figure 12. Sampling locations in Mud Lake Tributary 1 (Site 11) and 2 (Site 12), 2010. No anadromous fish were captured in Site 11, but 3 juvenile coho salmon were captured in one of three minnow traps set at Site 12.

Table 2. Summary of basic habitat measurements collected from lake, wetland, and tributary sampling sites in the Knik River drainage, AK, 2010. Habitat measurements were not collected at Site 09. Site 2 and Site 8 were sampled on two different occasions, once in July and once in August.

Site	Sample Dates	Statistic	Water Depth (m)	Water Temp (° C)	pH	Conductivity (µS/cm)
01 Mud Lake	13,14, 19 July	n	87	87	87	87
		Mean	0.5	14.9	7.78	109.2
		Standard Deviation	0.2	1.9	0.55	16.0
		Minimum	0.2	4.9	6.93	60.2
		Maximum	1.0	19.0	9.60	138.1
02 Gull Lake	21, 26, 27 July	n	130	131	130	131
		Mean	0.5	14.6	8.08	118.4
		Standard Deviation	0.3	1.9	0.46	7.7
		Minimum	0.1	10.9	6.86	98.6
		Maximum	1.7	17.8	9.2	147.2
02 Gull Lake	23 August	n	30	30	30	30
		Mean	0.6	18.2	8.15	138.0
		Standard Deviation	0.2	0.6	0.37	13.2
		Minimum	0.2	17.4	7.18	128.3
		Maximum	1.1	19.3	9.14	197.4
03 Jim Lake Wetlands	2,3, 9 August	n	65	62	62	62
		Mean	0.4	16.5	7.64	223.1
		Standard Deviation	0.1	2.8	0.44	17.0
		Minimum	0.2	7.3	6.65	172.7
		Maximum	0.9	19.9	8.70	275.9
04 McRoberts Creek	18 August	n	10	12	12	12
		Mean	0.7	13.9	7.54	105.5
		Standard Deviation	0.1	0.2	0.11	12.5
		Minimum	0.5	13.6	7.35	100.3
		Maximum	1.0	14.4	7.81	145.0
05 Leaf Lake	11, 17 August	n	55	56	56	56
		Mean	0.5	14.2	8.17	137.8
		Standard Deviation	0.3	1.9	0.48	24.8
		Minimum	0.2	8.1	6.74	112.8
		Maximum	1.0	17.1	9.00	218.2
06 Chain Lake	24 August	n	16	17	17	17
		Mean	0.4	19.1	8.78	221.7
		Standard Deviation	0.1	2.9	0.40	56.3
		Minimum	0.2	13.8	7.89	138.6
		Maximum	0.7	23.2	9.53	316.1

Table 2 continued.

Site	Sample Dates	Statistic	Water Depth (m)	Water Temp (° C)	pH	Conductivity (µS/cm)
07 Gull- McRoberts trib	17 August	n	14	14	14	14
		Mean	0.6	14.2	7.15	111.6
		Standard Deviation	0.2	0.6	0.24	5.5
		Minimum	0.3	13.4	6.93	100.0
		Maximum	0.9	15.2	7.63	117.5
08 Jim - Mud trib	13 July	n	1	1	1	1
		Mean	*	*	*	*
		Standard Deviation	*	*	*	*
		Minimum	0.4	9.9	6.81	116.4
		Maximum	0.4	9.9	6.81	116.4
08 Jim - Mud trib	17, 18 August	n	10	11	11	11
		Mean	0.4	12.8	7.01	150.4
		Standard Deviation	0.1	2.4	0.1	24.8
		Minimum	0.3	9.4	6.84	108.5
		Maximum	0.5	15.4	7.08	174.8
09 Upper McRoberts Creek	-	n	-	-	-	-
		Mean	-	-	-	-
		Standard Deviation	-	-	-	-
		Minimum	-	-	-	-
		Maximum	-	-	-	-
10 Swan Lake	25 August	n	28	28	28	28
		Mean	0.6	17.7	9.43	153.7
		Standard Deviation	0.3	0.61	0.39	10.0
		Minimum	0.2	16.7	8.22	136.1
		Maximum	1.2	19.2	10.06	182.3
11 Mud Lake Tributary 1	20 July	n	3	3	3	3
		Mean	0.5	14.7	7.13	88.2
		SD	0.1	0.3	0.23	2.4
		Minimum	0.4	14.3	6.92	85.4
		Maximum	0.5	14.9	7.37	89.9
12 Mud Lake Tributary 2	20 July	n	3	3	3	3
		Mean	1.3	15.8	9.45	89.2
		SD	0.5	0.1	0.34	1.6
		Minimum	0.7	15.7	9.07	87.6
		Maximum	1.8	15.9	9.74	90.7

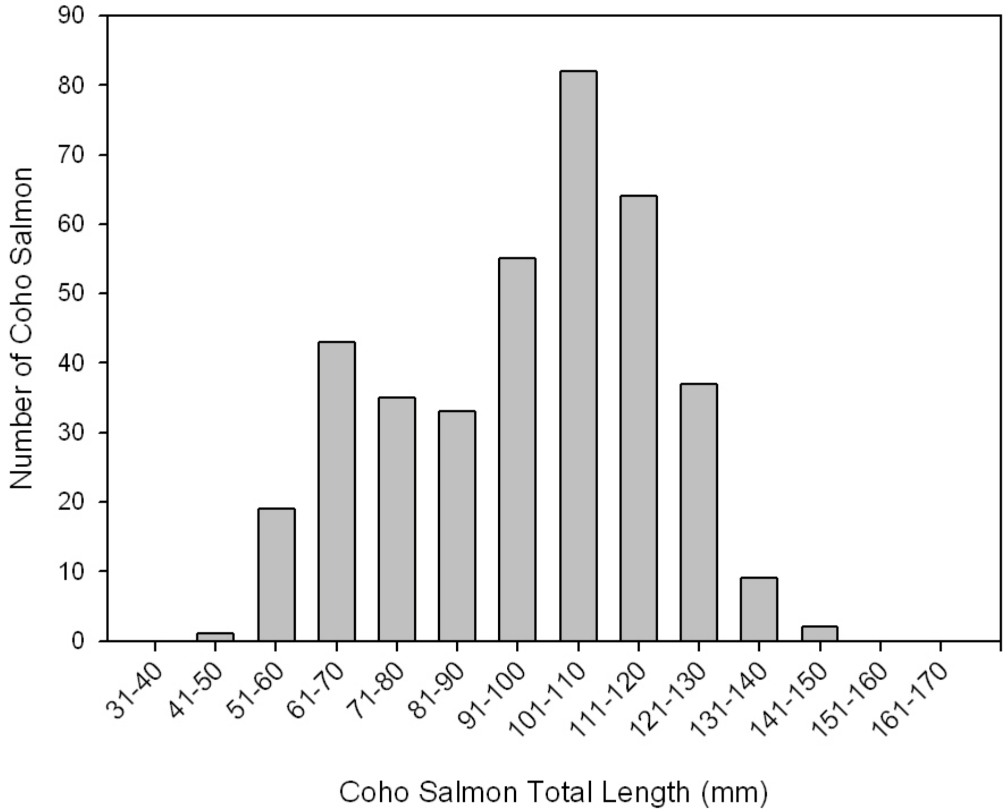

Figure 13. Length-frequency distribution of coho salmon (n = 380) captured in lakes, wetlands, and tributaries of the Knik River drainage, Alaska, 13 July to 24 August 2010.

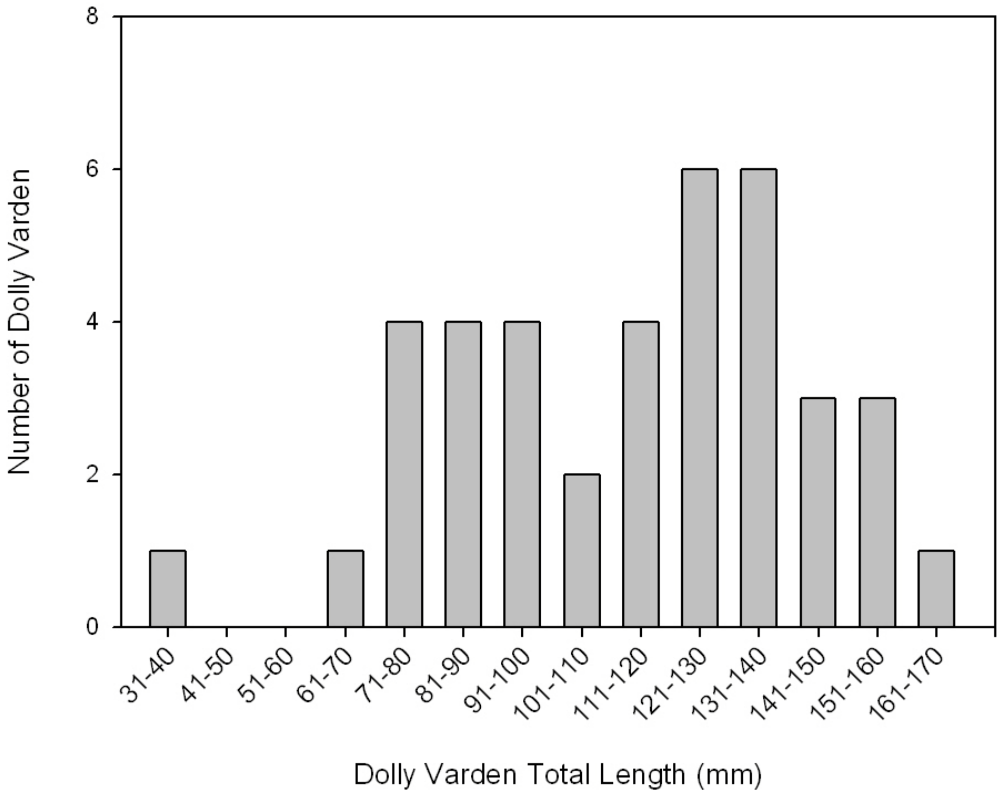

Figure 14. Length-frequency distribution of Dolly Varden (n = 39) captured in lakes, wetlands, and tributaries of the Knik River drainage, Alaska, 13 July to 24 August 2010.

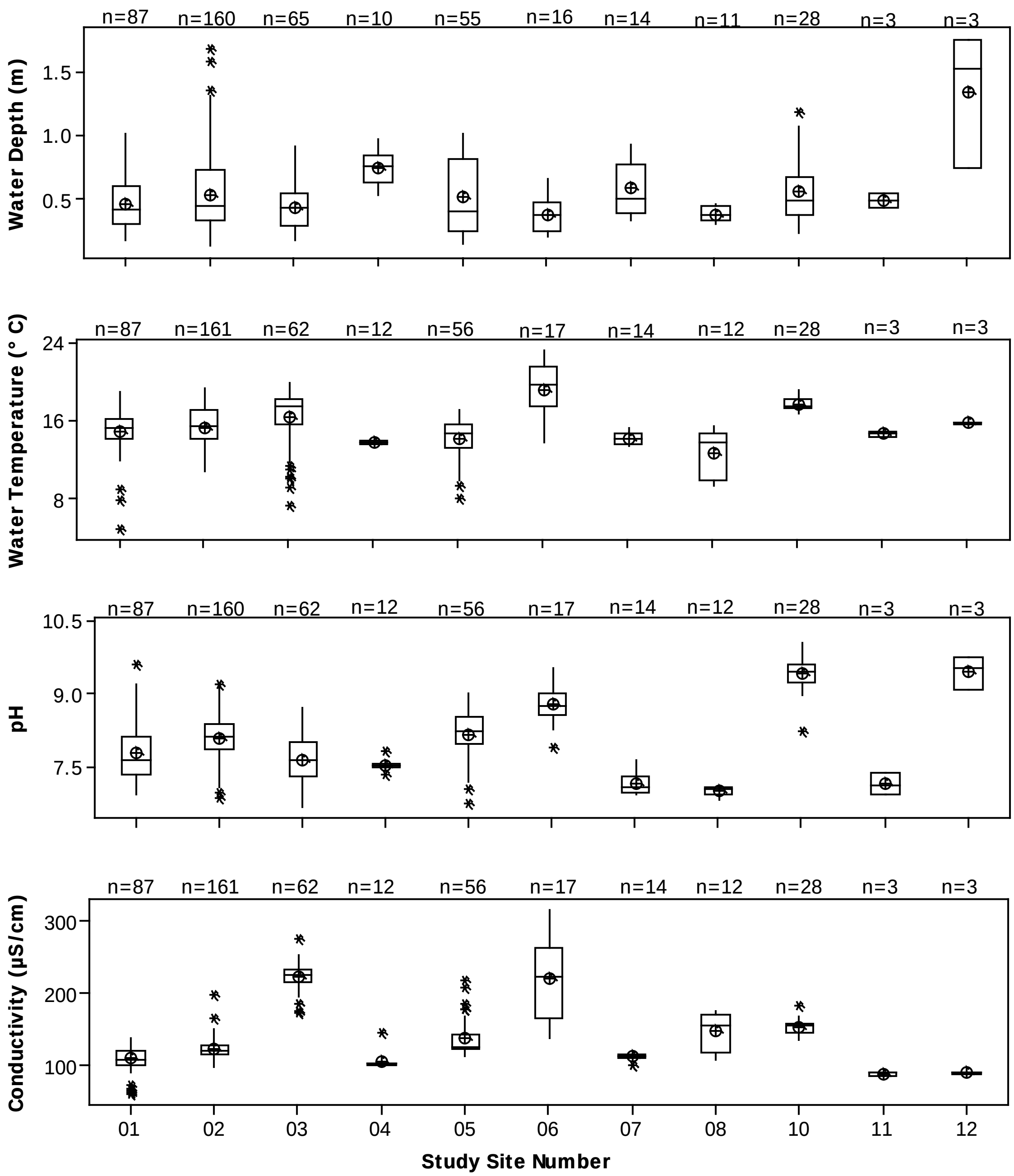

Figure 15. Boxplots of habitat measurements collected from Knik River Public Use Area study sites in 2010. Circles indicate mean value, asterisks are potential outliers. No habitat measurements were collected from study Site 09, upper McRoberts Creek, which was surveyed to verify hydrography only.

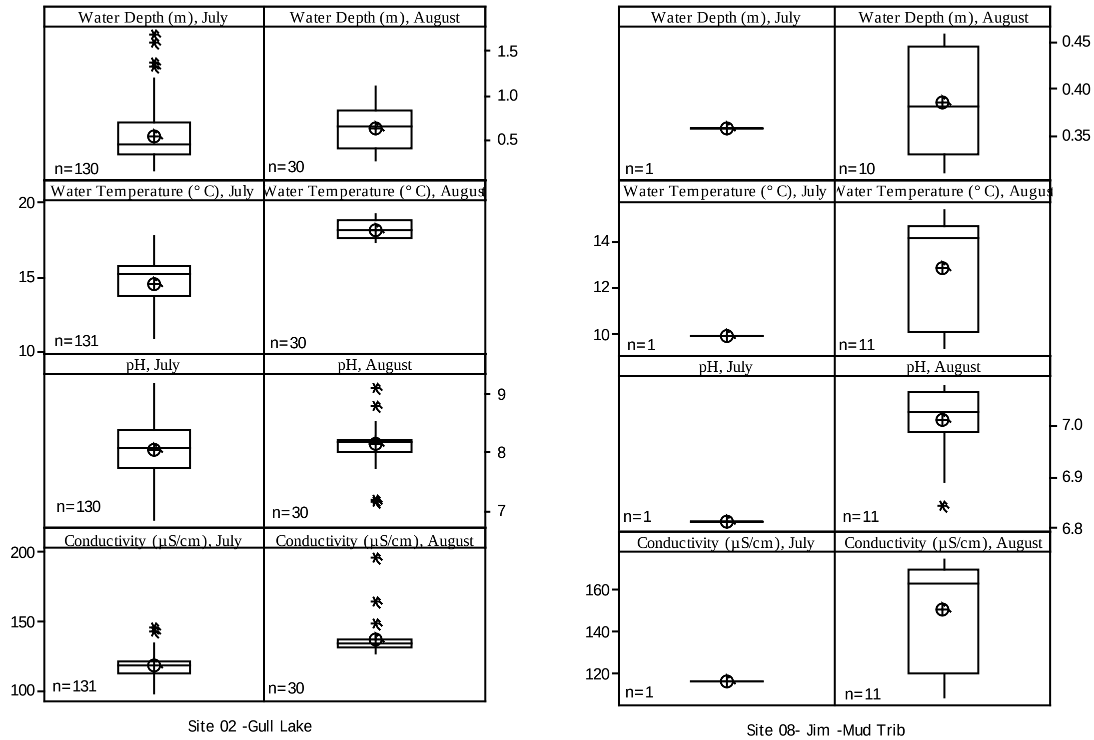

Figure 16. Boxplots of habitat measurements collected from two Sites (02 and 08) that were sampled on two occasions in July and August of 2010. Circles indicate mean value, asterisks are potential outliers.

Table 3. Summary of nominations submitted for inclusion in the Anadromous Waters Catalog from the Knik River drainage in 2010. Waterway numbers ending with 09__ indicate that the nomination was submitted as a polygon. Species codes are CO = coho salmon, S = sockeye salmon. Life stage codes are: r = rearing, p = present, s = spawning.

Water body Name	USFWS Site ID	AWC Nomination Number	AWC Waterway # 247-50-10200-2081-	USGS Quad	New or Extended Water body	New Species	Backup Species
Mud Lake	AWC10-01	10-817	3025-0930	Anchorage C6-SE	Y	COr, Sr, Sp	COr
Gull Lake	AWC10-02			Anchorage C6-SE	Y	COr	
Jim Lake Wetlands	AWC10-03	10-856	3025-4030-0040	Anchorage C6-SE	Y	COr	
Jim Lake Wetlands	AWC10-03	10-856	3025-4030-0910	Anchorage C6-SE			
McRoberts Creek (short section south of Mud Lake)	AWC10-04	10-857	3025-4030	Anchorage C6-SE	Y	COr	
Leaf Lake	AWC10-05	10-858	0020	Anchorage C6-SE	Y	COr	
Leaf Lake	AWC10-05	10-858	0940	Anchorage C6-SE			
Chain Lake	AWC10-06	10-855	0010	Anchorage C6-SE	Y	COr	
Chain Lake (where it flows into Jim Creek)	AWC10-06	10-855	3041	Anchorage C6-SE			
Unnamed Trib from Gull to McRoberts Creek	AWC10-07	10-854	3025-4029	Anchorage C6-SE	Y	COr	
Unnamed Trib from Mud Lake to Jim Lake	AWC10-08	10-853	3025-4030	Anchorage C6-SE	N		COr
McRoberts Creek (upper)	AWC10-09	10-852	3025	Anchorage C6-SE	N	Ss	

Discussion

Juvenile fish sampling efforts in the Knik River Public Use Area resulted in 9 nominations to update the AWC in 2010. Most nominations were made to add or extend the distribution of juvenile coho salmon, which were captured in all but 2 sites. Although few juvenile sockeye salmon were captured, spawning sockeye salmon were documented at 2 study sites, which may indicate that these areas provide important rearing habitat for sockeye salmon as well as coho salmon. Because sampling occurred in lake and wetland areas, minnow traps were used to capture fish. Minnow traps are both size and species selective, and in particular are not effective at capturing sockeye salmon which are not attracted to baited traps (Magnus et al. 2006). Other methods such as seining and electrofishing will be employed in the future in an effort to capture additional species.

Two age classes (age 0 and 1) can likely be inferred from the juvenile coho salmon length distribution, but salmon were not aged in 2010. Scales will be collected from a subsample of salmon during 2011surveys to verify age and size classes from length frequency distributions. This information may provide information about important rearing or overwintering habitats, which in turn may assist managers with identification and protection of important overwintering habitat.

The numerous interconnected lakes, ponds, and wetlands within the Knik River Public Use area provide important habitat for fish and wildlife (ADNR 1985, Sweet et al. 2004), and offer a range of recreational activities for various users including sport fishing, hunting, riding off road vehicles (ORV), and boating. Though we did not formally quantify or assess potential impacts to water quality or riparian habitat from intense recreational activity, we did observe evidence of anthropogenic alterations in areas where anadromous fish were captured. For example, numerous ORV trails were observed in wetlands during fish sampling efforts throughout the summer (Figures 17-18). Off-road vehicle trails, particularly those in saturated soils, have the potential to negatively impact fish, wildlife, or plant communities by compressing or shearing vegetation, reducing suitable habitat for various life stages or species, limiting fish passage by altering hydrography, or reducing survival of fish eggs through increased siltation (Wooding & Sparrow 1978, Webb & Wilshire 1983, Sinnott 1990, Slaughter et al. 1990, Racine & Ahlstrand 1991, Meyer 2002). Off-road vehicle use can have both direct and indirect impacts on fish and wildlife resources, and have caused soil and vegetation damage, restriction or displacement of wildlife, habitat fragmentation or modification, and may allow over-exploitation of resources (Rickard & Brown 1974, Sparrow et al. 1978, Wilshire et al. 1978, Meyer 2002).

Upper McRoberts Creek was surveyed on 20 August to verify hydrography after differences in flow between topographic maps and on-the-ground observations were identified. Foot surveys started west of Rippy Trail, south of Maude Road, and followed the tributary downstream towards Gull Lake (Figure 11). Flow from the creek was diverted from its natural path and jumped its bank at the site of an ORV trail (Figure 18), creating a new channel through previously unchannelized wooded areas to the southwest of the original channel. Numerous adult sockeye salmon were observed spawning upstream of this site and in the original northern channel as well as in the lower sections of the stream (Figure 11). In addition, a single Dolly Varden carcass and juvenile sockeye salmon carcass were documented during foot surveys of this section. Monitoring of this site and others should continue in future years to assess potential impacts to fish or wildlife species as a result of channel and wetland modifications. Fish passage and access to spawning or rearing areas could be reduced if water levels decreased as the channel widened.

Figure 17. Off road vehicle trails, located in the wetlands southwest of Gull Lake (top photo; N 61.53400 W -148.96564), and south of Gull Lake (bottom photo; N 61.53123 W-148.95058).

Figure 18. Site of newly created channel of upper McRoberts Creek, shown flowing southwest into an ORV trail (towards upper right in top photo) from its original channel. Spawning sockeye salmon were observed upstream and downstream of this site. Newly formed channel flowing through wooded area (bottom photo).

Though our temperature data provide only a snapshot of conditions during the specific date they were collected, water temperatures in most sites were relatively warm. Continuous temperature monitoring in Jim Creek in 2008, 2009 (Wolfe 2009), and 2010 (Sue Mauger, Cook Inlet Keeper, unpublished data) indicated that temperatures repeatedly exceeded state water quality standards for fish migration and rearing (15°C) and for spawning and incubation (13°C). Water temperature monitoring of Jim Creek will continue to be monitored by Cook Inlet Keeper in 2011. In addition, we will deploy temperature monitors in several of the surrounding lakes during 2011 surveys to better evaluate seasonal variation in water temperature.

No anadromous fish and few other fish species (20 stickleback) were captured during surveys of Swan Lake in late August. Water temperatures and pH measurements collected at this site were in general higher than other sites, and little aquatic vegetation and bark and wood residues from past timber processing were observed in the lake bottom, any of which could influence the likelihood of capturing fish at this location. Higher water temperatures and pH values may be related to the time of sampling in late summer, increased influence of solar radiation from lack of aquatic vegetation, or increased turbidity from glacial run-off from Friday Creek. Swan Lake will be re-sampled in 2011 to better evaluate conditions.

Anadromous fish were captured in only 8 of 162 minnow traps set in Gull Lake (Figure 3). It is unclear why so few salmon were captured this location, which was sampled on 2 occasions. We did not formally test for differences in habitat variables among sites, but water depth, temperature, pH, and conductivity measurements collected at Gull Lake appeared to be similar to those at other sites (Table 2). Salmon use of particular areas could be related to a number of factors including differences in substrate, food availability, water flow, inter and intra-species interactions, water quality, or interactions between biological and physical factors (Reiser and Bjornn 1979, Bisson et al. 1988). Gull Lake will be re-sampled in 2011during June, July and again in August.

Recommendations

A systematic coverage approach for polygon sampling should be developed to standardize sampling effort in lake and wetland areas. In order to better evaluate the potential relationships between habitat and water quality variables and presence of anadromous fish, a broader suite of water quality and habitat variables should be collected to develop habitat preference models. Where feasible, other fishing methods such as electrofishing or seining should be used to target other fish species in lake and wetland areas. This project should be continued in future years in support of the Mat-Su Basin Salmon Habitat Partnership's strategic action plan and the NFHAP. Inclusion of stream reaches in the AWC offers basic levels of protection under AS 41.14.870, which addresses goals and objectives of the NFHAP and the Partnership. Consultations with USFWS and ADF&G personnel to select sample areas should continue in future years.

Acknowledgements

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Title: Investigation Plan: Inventory of Fish Distribution in the Mat-Su Basin, 2010

Principal Investigator: Elizabeth Benolkin, USFWS, Anchorage Fish and Wildlife Field Office

Objectives:

1. Maximize the spatial extent of mapped anadromous fish habitat depicted in the AWC within the Mat-Su drainage; and
2. Record gross characteristics of aquatic habitats at each sampling location.

Introduction

The human population of the Matanuska-Susitna (Mat-Su) Borough is one of the fastest growing in the U.S., with a growth rate of 49% from 1990 to 2000. Population growth and associated development continue to challenge the ability of fisheries and land managers to balance fish habitat conservation with these changes over time. Maintaining healthy fish habitat, including water quality and quantity, is critical to maintain healthy fish populations in the Mat-Su basin.

Concerns for how to effectively protect and restore salmon production in the face of rapid development led to the formation of the Mat-Su Basin Salmon Conservation Partnership (Partnership). The Partnership is one of only four fish habitat partnerships approved nationwide under the National Fish Habitat Action Plan (NFHAP). The NFHAP is a national effort to protect and restore the nation's waterways and fisheries through science-based partnerships of affected stakeholders. The Partnership has developed a Strategic Action Plan, which identifies objectives, actions, and research necessary to protect salmon and salmon habitat in the Mat-Su basin.

Fish habitat protection authorities and planning processes in Alaska are constrained by the extent of current knowledge of fish distributions and their habitats. Some protections provided under AS 41.14.871 only apply to waters specified in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* (Anadromous Waters Catalog, AWC; Johnson and Weiss 2007). Currently, the AWC contains only 4,200 miles of the more than 23,900 miles of streams that have been mapped in the Mat-Su basin. Management and regulatory tools cannot be applied to their full extent until the remainder of likely anadromous fish habitat in the basin is surveyed.

The Anchorage Fish and Wildlife Field Office initiated this project in 2007 to support the Partnership's Strategic Action Plan and the NFHAP by increasing coverage of the AWC for Mat-Su basin water bodies. The overall goal of this project is to provide information needed for protection and management of the freshwater habitats that support Alaska's anadromous and freshwater fish. Efforts from this project in 2007 resulted in eight nominations for the AWC. We sampled 83 reaches in 36 different streams in 2008, resulting in 20 nominations to update the AWC, and sampled 154 reaches in 73 different streams in 2009, resulting in 86 nominations to update the AWC.

Background

The Matanuska and Susitna river watersheds encompass about 24,500 square miles in southcentral Alaska, ranging in elevation from near the highest point in North America (Mount

McKinley) to sea level at Cook Inlet. The watersheds meet all freshwater life history needs for Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, coho *O. kisutch*, pink *O. gorbuscha*, and sockeye *O. nerka* salmon. Other fishes common to Mat-Su water bodies include Arctic grayling *Thymallus arcticus*, rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, burbot *Lota lota*, eulachon *Thaleichthys pacificus*, longnose sucker *Catostomus catostomus*, threespine *Gasterosteus aculeatus* and ninespine *Pungitius puntitius* stickleback, as well as several species of whitefish (*Coregonus* spp. and *Prosopium* spp), lamprey *Lampetra* spp., and sculpin *Cottus* spp. Northern pike *Esox lucius* are also common in numerous lakes and streams, although they are not native to Mat-Su basin water bodies.

Procedures

Study Design

Sampling methods are adapted from Buckwalter (2007) and Barbour et al. (1999). Methods target rearing salmonids in streams, lakes, and wetland complexes considered important for anadromous fish in late summer and early fall. Streams, lakes, and wetland complexes selected for sampling are based on consultations with the Habitat Restoration Branch of the U. S. Fish and Wildlife Service (USFWS) and the Alaska Department of Fish and Game (Region V and Palmer Sport Fish Division and Habitat Division Offices). Criteria for selection included on-going and expected development, key data gaps, and identification of potential threats to anadromous streams. Additionally, extant streams in the AWC are prioritized for substantiation.

Areas specified for priority sampling include streams, lakes, and wetland complexes north of the Knik River, which are part of the Knik River Public Use Area (KRPUA) and include Jim Creek, Jim Lake, Mud Lake, McRoberts Creek, Gull Lake, Swan Lake, Leaf Lake, and Chain Lakes. The KRPUA is a legislatively designated area (AS 41.23.180-230) managed by the Department of Natural Resources (DNR), Division of Mining, Land, and Water, Southcentral Regional Office. Within the boundary of the KRPUA are approximately 200,000 acres of state owned lands, 60,000 acres of federally owned lands, and about 1000 acres of privately owned lands. The KRPUA was established to preserve and perpetuate public recreation and the traditional use and enjoyment of fish and wildlife resources. Sampling efforts in all areas will be subject to change in-season based on ground findings and logistics.

Data Collection

Sample sites will be chosen based on observations of size, water flow, and apparent limits of anadromous fish distribution. Sites will be accessed using the most direct route possible and permission from landowners will be secured in advance when accessing private property. Sampling at each reach will involve collection of fish and aquatic habitat parameters. Data will be immediately recorded on sampling forms printed on Rite in the Rain paper, then transferred to a laptop each week.

Habitat Assessment – Reach length (m) will be estimated by measuring along the thalweg using a tape measure or by pacing. Wetted channel width (m) will be measured perpendicular to the thalweg at a representative transect. Reach lengths will be set at 40 wetted channel widths for streams ≥ 3.75 m wide and reach lengths will be set at 150 m for streams < 3.75 m wide (Reynolds et al. 2003); maximum reach length will be capped at 300 m for streams > 7.5 m wide.

Sample reaches will be classified following Rosgen (1994) including visual estimates of substrate type. Channel slope (%) will be estimated by stretching a line from one feature (e.g. the head of a riffle) to the next in a representative section of the sample reach. Holding the line taunt, a line level will be used to ensure that the line is horizontal, and the distance from each end of the line to the surface of the water and the distance between ends will be measured to the nearest cm. Stream order (Strahler 1952) will be determined from topographic maps.

The extent of the lake or wetland complex will be identified on the ground and spatial coordinates will be delineated as a polygon around both the wetted area and surrounding wetland area with GPS tracks. A single GPS waypoint will be collected near the middle of the lake or wetland polygon to serve as the site identification number.

The spatial coordinates of the upstream terminus of each stream reach or the delineated polygon will be recorded in decimal degrees with a handheld global positioning system using the North American Datum of 1983 (NAD 83) geographic coordinate system. Photos will be used to document each site. Camera and GPS clocks will be synchronized in order to use the *GPS – photo link* software, and all photos will be digitally stamped with the latitude and longitude for the sample sites where the photos are taken. Water temperature (°C), conductivity (μmho/cm) and pH will be measured using a YSI 63 water quality multimeter.

Fish Assessment –Fish sampling in streams will be conducted using a Smith-Root Model LR-24 backpack electrofisher following the safety guidelines outlined in Reynolds (1996) and USFWS (2004). Output voltage will be adjusted to the minimum level necessary to achieve electrotaxis (forced swimming) and continuous DC will be used to minimize fish injury (Dalbey et al. 1996); electrical output parameters (voltage, current, and power) will be recorded along with conductivity (μmho/cm) at each reach. A single electrofishing pass at each sample reach will be completed starting at the downstream end and working upstream. The reach will be sampled using a zigzag pattern in each encountered habitat unit, alternating between left bank, thalweg, and right bank, with an emphasis on cover types.

Fish sampling in lakes or wetland polygons or other areas unsuitable for electrofishing will be conducted by minnow trapping. Traps with be baited with cured roe and placed around the perimeter of the polygon and at several sites within the polygon. Trap sites will be recorded as GPS waypoints, and the start, end, and total soak time will be recorded.

Captured fish will be placed in a 12-L bucket less than one half full with stream water. Fish will be counted and identified to species (Pollard et al. 1997). Length (total length, mm) will be recorded for all juvenile sockeye salmon, coho salmon, and Dolly Varden. All fish will be released into a slack-water area within the sample site and allowed to recover.

Analysis and Reporting

Project data will be used to nominate water bodies for inclusion in the AWC and thereby provide protections under AS 41.14.871. Nominations to the AWC may include (1) adding new streams or polygons, (2) adding species to cataloged streams, (3) extending species distribution in cataloged streams, (4) deleting streams or parts of them, (5) updating survey data on cataloged streams, or (6) revising stream channels, labeling errors, or identifying barriers to fish passage. For each nomination, copies of the actual sampling forms, maps, and photos will be provided. The data will also be used by ADF&G Habitat Division to address development pressures in the Mat-Su Basin. The information will allow managers to better understand the importance of wetland complexes and off-channel habitats for fish populations in the Mat-Su basin, and will provide data needed to help prioritize fish passage barrier removal and habitat restoration projects. A USFWS Fisheries Data Series Report will summarize efforts in 2010 and make recommendations for future work.

Project Timeline

Activity	Time Frame
Identify priority areas for sampling	1 – 31 April 2010
Pre-season logistics	1 – 30 June 2010
Crew training & preparation	21 June– 9 July 2010
Sampling- Mud Lake	12 – 16 July 2010
Sampling- Mud Lake, McRoberts Creek, Jim Creek	19 – 23 July 2010
Sampling- Gull Lake	26 –30 July 2010
Sampling- Jim Lake Wetlands	2 – 13 August 2010
Sampling- Leaf Lake/Gull Lake	16 August– 3 September 2010
AWC nomination forms submitted	29 September 2010
Data summary and analysis	15 October – 15 November 20010
Draft report for review	31 December 20010
Final Data Series report published	31 January 2011

Funding

This project is supported by multiple funding sources. NFHAP funds in the amount of $30,000 will provide for field gear, equipment, and some housing. AKSSF funds in the amount of $18,544 support two seasonal employees. The Chickaloon Native Village will provide a match of $31,089 in personnel salary. The USFWS Anchorage Fish and Wildlife Field Office will provide matching funds in the amount of $109,000 in personnel salary and some housing.

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