U.S. Fish & Wildlife Service

Inventory of Fish Distribution in Matanuska-Susitna Basin Streams, Southcentral Alaska, 2007

Alaska Fisheries Data Series Number 2008–15

The Alaska Region Fisheries Program of the U.S. Fish and Wildlife Service conducts fisheries monitoring and population assessment studies throughout many areas of Alaska. Dedicated professional staff located in Anchorage, Juneau, Fairbanks, and Kenai Fish and Wildlife Offices and the Anchorage Conservation Genetics Laboratory serve as the core of the Program's fisheries management study efforts. Administrative and technical support is provided by staff in the Anchorage Regional Office. Our program works closely with the Alaska Department of Fish and Game and other partners to conserve and restore Alaska's fish populations and aquatic habitats. Additional information about the Fisheries Program and work conducted by our field offices can be obtained at:

http://alaska.fws.gov/fisheries/index.htm

The Alaska Region Fisheries Program reports its study findings through two regional publication series. The **Alaska Fisheries Data Series** was established to provide timely dissemination of data to local managers and for inclusion in agency databases. The **Alaska Fisheries Technical Reports** publishes scientific findings from single and multi-year studies that have undergone more extensive peer review and statistical testing. Additionally, some study results are published in a variety of professional fisheries journals.

Alaska Fisheries Data Series Number 2008-15, July 2008
U. S. Fish and Wildlife Service

Inventory of Fish Distribution in Matanuska-Susitna Basin Streams, Southcentral Alaska, 2007

Jeffry L. Anderson and Theresa L. Tanner

Abstract

Residential and commercial development in the Matanuska-Susitna (Mat-Su) Borough in southcentral Alaska is a threat 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 water bodies 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. We sampled 13 reaches in seven different streams in 2007, resulting in eight nominations to update the AWC. Coho salmon *Oncorhynchus kisutch* and Dolly Varden *Salvelinus malma* were the most common species sampled in 2007. Juvenile coho salmon were captured in 10 of the 13 sample reaches, and Dolly Varden were present in eight of the 13 reaches. Other species captured in 2007 included Chinook salmon *O. tshawytscha*, Alaska blackfish *Dallia pectoralis*, threespine stickleback *Gasterosteus aculeatus*, and sculpin *Cottus* spp. Most streams sampled in 2007 were small (< 5 m width) first order streams. This project continues to support goals and objectives of the Mat-Su Basin Salmon Conservation Partnership and the National Fish Habitat Action Plan by increasing coverage of the AWC in the Mat-Su basin.

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 (U.S. Census Bureau 2001). 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 effectively protecting and restoring 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.

Goals of the NFHAP and the Partnership include protecting 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; Johnson and Weiss 2007).

Authors: The authors are fishery biologists with the U. S. Fish and Wildlife Service. They can be contacted at Anchorage Fish and Wildlife Field Office, 605 W. 4th Ave., Anchorage, AK 99501; or jeffry_anderson@fws; theresa_tanner@fws.gov.

Individuals or government agencies are required to obtain permit approval to use, divert, obstruct, pollute, or change the natural flow or bed of a waterbody specified in the AWC. Examples of activities requiring a permit for AWC-listed streams include construction, road crossings, gravel removal, mining, water withdrawals, the use of vehicles in the waterway, stream realignment or diversion, bank stabilization, blasting, and the placement, excavation, deposition, or removal of any material. 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 (The Nature Conservancy, unpublished data). 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 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, 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 introduced to Mat-Su basin water bodies.

Methods

Sampling methods were adapted from Buckwalter (2007) and targeted rearing salmonids at their maximum upstream distribution in late summer and early fall. Streams were selected for sampling based on consultations with the Habitat Restoration Branch of the U. S. Fish and Wildlife Service (USFWS), the Alaska Department of Fish and Game (ADF&G; Region V and Palmer Sport Fish Division Office), and the Alaska Department of Natural Resources, Office of Habitat Management and Permitting (OHMP). Criteria used by our partners for stream selection included on-going and expected development, key data gaps, and opportunities to verify or evaluate fish passage through culverts.

Sample reaches within a stream were chosen based on observations of stream size, water flow, and channel slope such that selected reaches were at or near the apparent upstream limit of anadromous fish distribution. Streams were accessed using the most direct route possible and permission from landowners was secured in advance when accessing private property. Sampling at each reach involved collection of fish and aquatic habitat parameters.

The spatial coordinates of the upstream terminus of each sampling reach were recorded in decimal degrees with a handheld global positioning system using the North American Datum of 1927 (NAD 27) geographic coordinate system. Reach length (m) was estimated by measuring along the thalweg using a tape measure or by pacing. Wetted channel width (m) was measured perpendicular to the thalweg at a representative transect. Reach lengths were set at 40 wetted channel widths for streams ≥ 3.75 m wide and reach lengths were set at 150 m for streams < 3.75 m wide (Reynolds et al. 2003). Maximum reach length was limited to 300 m for streams > 7.5 m wide to place a maximum effort threshold for each individual sampling reach and because sample length requirements remain relatively constant as wetted width increases (Patton et al. 2000).

Sample reaches were classified following general guidelines in Rosgen (1994) and included visual estimates of substrate type. Channel slope (%) was estimated with a Suunto PM5 hand-held clinometer following Gordon et al. (1992). Discharge (m^3/s) was estimated where water depth across a transect was greater than 0.15 m (Gordon et al. 1992). Depth and velocity measurements were estimated at three points (approximately ¼, ½, and ¾ of wetted channel width) using a Marsh-McBirney Flowmate Model 2000 meter and a top-setting wading rod. Stream order (Strahler 1952) was determined from topographic maps. Water temperature (°C) and conductivity (µmho/cm) were measured using a Sper Scientific Model 850081 water quality meter. Stream pH was measured using a Hach Model 43800-00 portable pH meter.

Fish sampling was conducted using a Smith-Root Model LR-24 backpack electrofisher following the safety guidelines outlined in Reynolds (1996) and USFWS (2004). Output voltage was adjusted to the minimum level necessary to achieve electrotaxis (forced swimming) and continuous DC was used to minimize fish injury (Dalbey et al. 1996). Electrical output parameters (voltage, current, and power) were recorded along with conductivity (µmho/cm) at each reach. A single electrofishing pass at each sample reach was completed starting at the downstream end and working upstream. The reach was sampled using a zigzag pattern, alternating between left bank, thalweg, and right bank. One person operated the backpack electrofisher and one person netted fish. Captured fish were placed in a 12-L bucket less than one half full with stream water. At the end of each reach, all fish were counted and identified to species, and length (total length, mm) was recorded for all juvenile salmon. All fish were released into a slack-water area within the sample reach.

Results

We sampled 13 reaches within seven different streams in 2007. Four streams are within the Little Susitna River watershed near Government Creek, two streams are within the Wasilla Creek watershed near the Palmer-Fishook Road, and one stream is in the Wasilla Creek watershed near Rabbit Slough (Figure 1; Table 1). Sampling in 2007 resulted in eight nominations to update the AWC.

Coho salmon and Dolly Varden were the most common species sampled in 2007 (Table 2). Juvenile coho salmon were captured in 10 of the 13 sample reaches, and Dolly Varden were present in eight of the 13 reaches. Length was measured for 229 of the 231 coho salmon captured and ranged from 34 to 109 mm (Figure 2). Most coho salmon were probably age 0 fish based on length, but we did not collect age data in 2007. Other species captured in 2007 included Chinook salmon, Alaska blackfish *Dallia pectoralis*, threespine stickleback, and sculpin. Electrical output necessary to achieve electrotaxis varied with conductivity (Table 3).

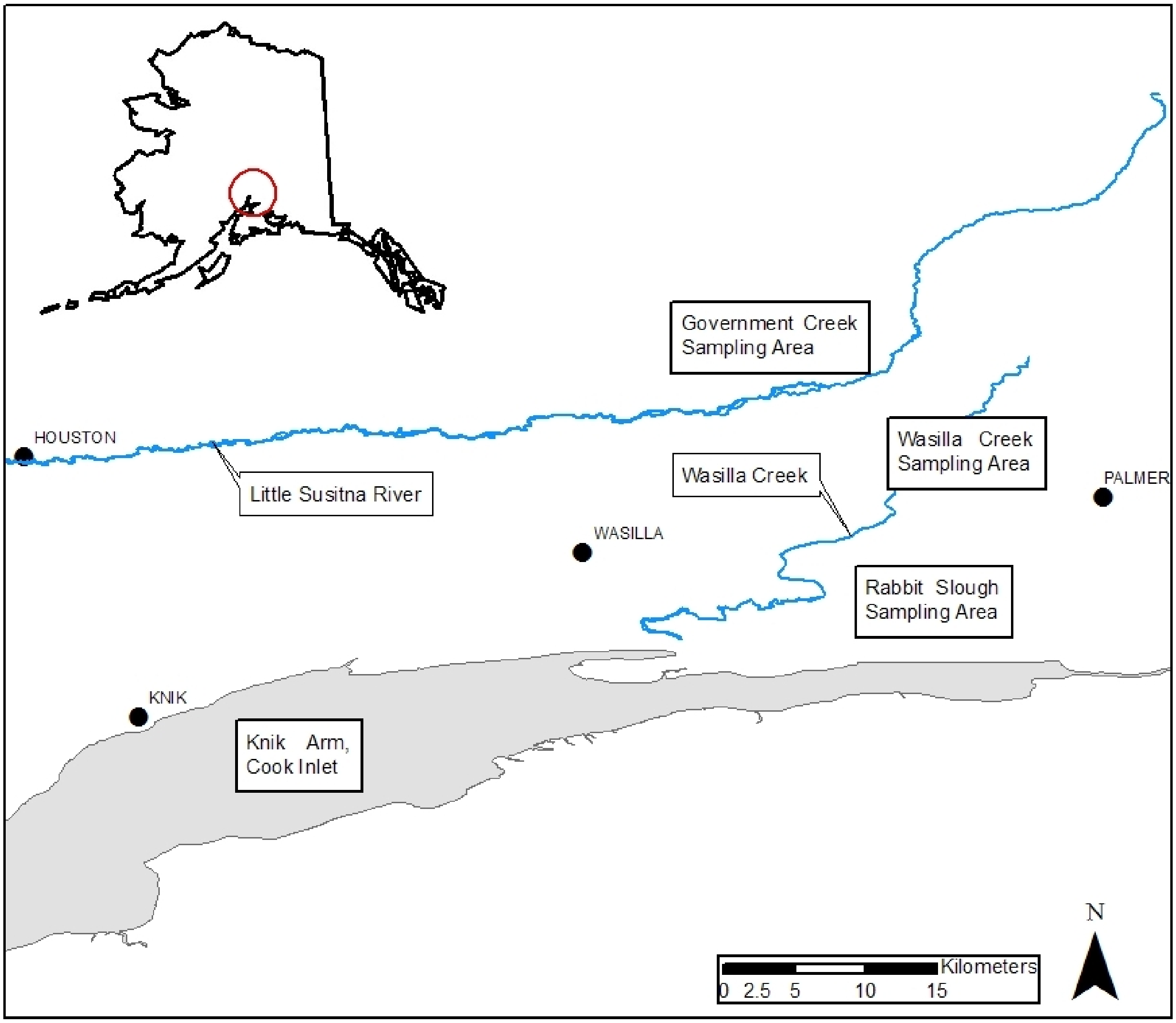

Figure 1. Sampling areas in the Mat-Su basin, 2007.

Table 1. Sampling dates and site locations for selected streams in the Mat-Su basin, 2007. Latitude and longitude coordinates are in decimal degrees, NAD 27.

Date	Site No.	Watershed	Sample Area	Latitude	Longitude
14 August	01	Wasilla Creek	Rabbit Slough	61.53762	149.23376
14 August	02	Wasilla Creek	Rabbit Slough	61.54205	149.20816
15 August	03	Little Susitna River	Government Creek	61.70012	149.33023
15 August	04	Little Susitna River	Government Creek	61.69602	149.32806
16 August	05	Wasilla Creek	Wasilla Creek	61.64753	149.18936
21 August	06	Little Susitna River	Government Creek	61.70254	149.31055
21 August	07	Little Susitna River	Government Creek	61.70724	149.31319
22 August	08	Little Susitna River	Government Creek	61.69745	149.28276
22 August	09	Little Susitna River	Government Creek	61.70058	149.27405
23 August	10	Little Susitna River	Government Creek	61.70095	149.30386
23 August	11	Little Susitna River	Government Creek	61.69421	149.29643
23 August	12	Wasilla Creek	Wasilla Creek	61.61409	149.20731
23 August	13	Wasilla Creek	Wasilla Creek	61.62053	149.18803

Table 2. Summary of fish sampling by watershed and site number for streams sampled in the Mat-Su basin, 2007. Lengths are reported in mm.

Species	Number Sampled	Minimum Length	Maximum Length
Wasilla Creek watershed			
Site Number 01, Unnamed Tributary to Rabbit Slough			
Coho salmon	9	44	98
Chinook salmon	1	--	77
Threespine stickleback	7	--	--
Alaska blackfish	17	--	--
Site Number 02, Unnamed Tributary to Rabbit Slough			
Coho salmon	28	43	80
Threespine stickleback	2	--	--
Alaska blackfish	6	--	--
Site Number 05, Unnamed Tributary to Wasilla Creek			
Coho salmon	2	104	109
Dolly Varden	9	--	--
Sculpin spp.	18	--	--
Site Number 12, Unnamed Tributary to Wasilla Creek			
Coho salmon	11	56	106
Threespine stickleback	10	--	--
Sculpin spp.	1	--	--
Site Number 13, Unnamed Tributary to Wasilla Creek			
Coho salmon	1	--	70
Threespine stickleback	78	--	--
Sculpin spp.	1	--	--

Table 2. continued.

Species	Number Sampled	Minimum Length	Maximum Length
Little Susitna River watershed			
Site Number 03, Unnamed Tributary to Government Creek			
Dolly Varden	45	--	--
Site Number 04, Unnamed Tributary to Government Creek			
Coho salmon	41	40	66
Dolly Varden	17	--	--
Site Number 06, Government Creek			
Coho salmon	2	--	--
Dolly Varden	6	--	--
Site Number 07, Government Creek			
Dolly Varden	43	--	--
Site Number 08, Unnamed Tributary to Little Susitna River			
Coho salmon	47	36	61
Dolly Varden	12	--	--
Sculpin spp.	3	--	--
Site Number 09, Unnamed Tributary to Little Susitna River			
Coho salmon	86	34	60
Site Number 10, Unnamed Tributary to Little Susitna River			
Dolly Varden	2	--	--
Site Number 11, Unnamed Tributary to Little Susitna River			
Coho salmon	4	48	50
Dolly Varden	1	--	--

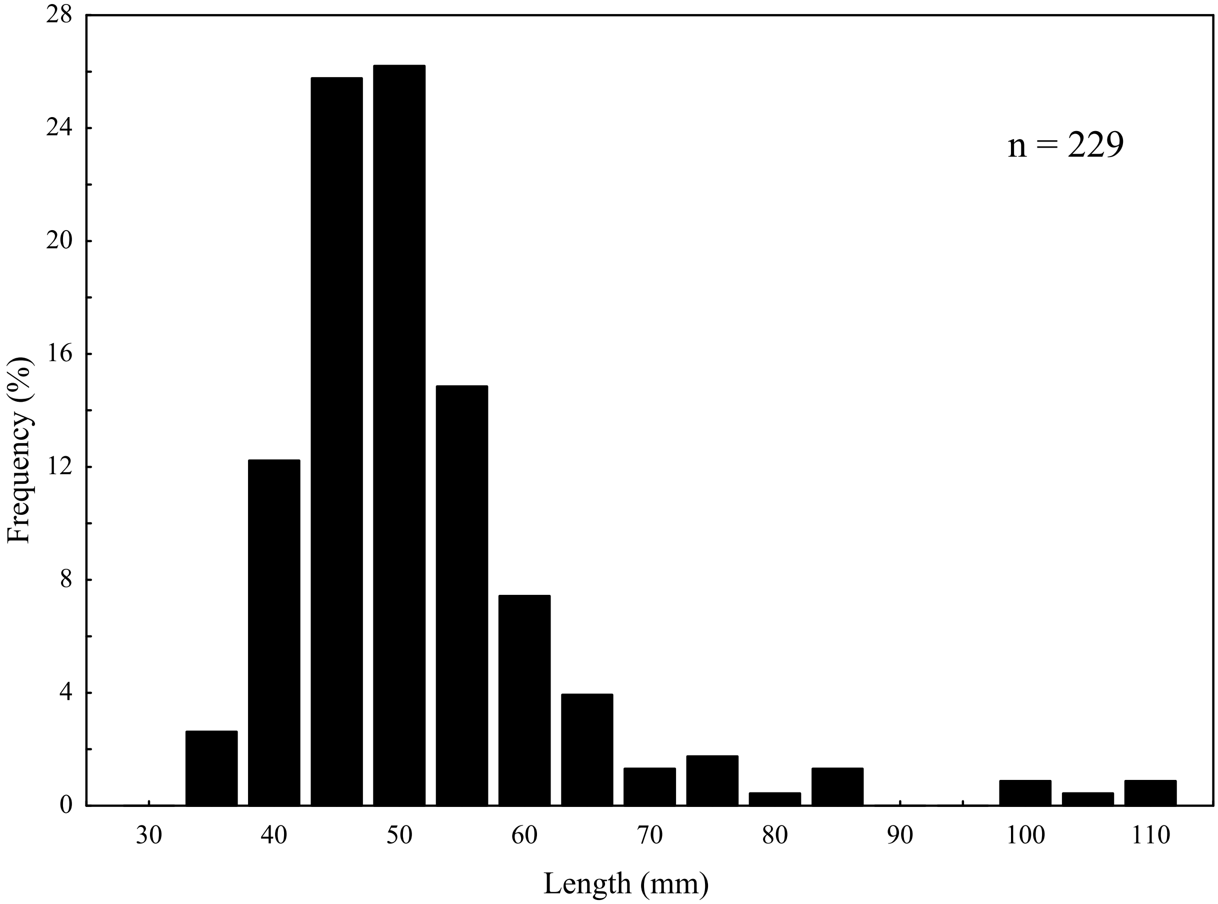

Figure 2. Length-frequency distribution of coho salmon sampled in Mat-Su basin streams, 2007.

Table 3. Water chemistry and electrical parameters necessary to achieve electrotaxis by watershed and site number for streams sampled in the Mat-Su basin, 2007. All electrical parameters are for continuous DC.

					Electrical Output		
Site No.	Sample Area	Temperature (°C)	Conductivity (μmho/cm)	pH	Volts	Amps	Watts
			Wasilla Creek watershed				
01	Rabbit Slough	16.8	365	4.6	120	14.0	1,680
02	Rabbit Slough	18.0	425	5.4	120	11.0	1,320
05	Wasilla Creek	15.0	121	5.9	265	0.7	186
12	Wasilla Creek	16.2	267	--	175	0.9	158
13	Wasilla Creek	16.0	253	--	200	0.6	110
			Little Susitna River watershed				
03	Government Creek	9.2	108	5.3	320	10.0	3,200
04	Government Creek	--	--	--	320	5.0	1,600
06	Government Creek	8.8	112	--	285	0.6	171
07	Government Creek	9.4	97	4.8	305	0.6	174
08	Government Creek	9.2	65	6.3	395	0.7	276
09	Government Creek	8.4	63	6.7	295	0.4	133
10	Government Creek	9.7	48	--	470	0.4	169
11	Government Creek	--	--	--	240	0.4	98

Wasilla Creek watershed

The unnamed tributary to Rabbit Slough appears to be a perennial side channel to Rabbit Slough and the Matanuska River (Figure 3), but we did not have time to walk the stream all the way to its source in 2007. Juvenile coho salmon were present at both reaches (Sites 01 and 02), and a single juvenile Chinook salmon was sampled at Site Number 01 (Table 2).

Juvenile coho salmon were found in both unnamed tributaries to Wasilla Creek we sampled in 2007 (Table 2; Figure 4). A barrier to upstream migration of juvenile fish probably occurs at the upstream terminus of Site Number 05. The stream passes through a small culvert crossing under an abandoned private road that appears to be impassable to fish. Juvenile coho salmon were present at Site Number 12 and a single coho salmon was captured at Site Number 13 (Table 2). We did not have time to sample a small pond at the headwaters of this stream in 2007.

Little Susitna River watershed

Juvenile coho salmon were found in all streams sampled in the Little Susitna River watershed in 2007 (Table 2, Figure 5). The streams sampled in the Government Creek area originate on Mat-Su Borough-owned land near Government Peak north of the Edgerton-Parks Road (Figure 5). Site Number 07 on Government Creek and Site Number 03 on the unnamed tributary to Government Creek both appear to be above the limit of anadromy, most likely due to high stream gradient. Coho salmon were present in both streams below our high gradient sample sites (Sites Numbers 04 and 06; Figure 5), but the exact upstream limit of anadromy is unknown.

The unnamed tributary to Little Susitna River immediately east of Government Creek (Figure 5) flows through several tracts of private property before it crosses at a culvert immediately above Site Number 11. We did not find anadromous fish present at our upper reach on this stream (Site Number 10) although juvenile coho salmon were present at our lower reach (Site Number 11; Table 2). We assume that a barrier to anadromous fish migration exists somewhere between the two reaches. However, this was not verified in 2007 because we were unable to find landowners in the mixed ownership parcels. Local residents reported observing adult coho salmon spawning at Site Number 11 in 2006.

Site Numbers 08 and 09 on an unnamed tributary to the Little Susitna River provide rearing habitat for juvenile coho salmon for as far as we were able to sample (Figure 5; Table 2). Both forks probably continue to support anadromous fish until stream size decreases or a gradient barrier is encountered. We did not determine the upstream limit of anadromy on either stream in 2007.

Habitat

Stream habitat characteristics are summarized in Table 4. Most streams sampled in 2007 were small (< 5 m wide) first order streams with channel slopes of less than 2%. Observed substrates were predominantly gravel and cobble, although the unnamed tributary to Rabbit Slough was a mud-bottomed stream. Most reaches were Rosgen (1994) type B channels. Observed water temperatures ranged from 8.4 to 18.0°C and were higher in the Rabbit Slough and Wasilla Creek areas than sites near Government Creek. Observed pH values ranged from 4.6 to 6.7. Discharge was only estimated at two sites where a depth transect exceeded 0.15 m (Table 4). Sufficient depth was present at Site Number 01 but our meter malfunctioned and we did not return to the site once the meter was replaced.

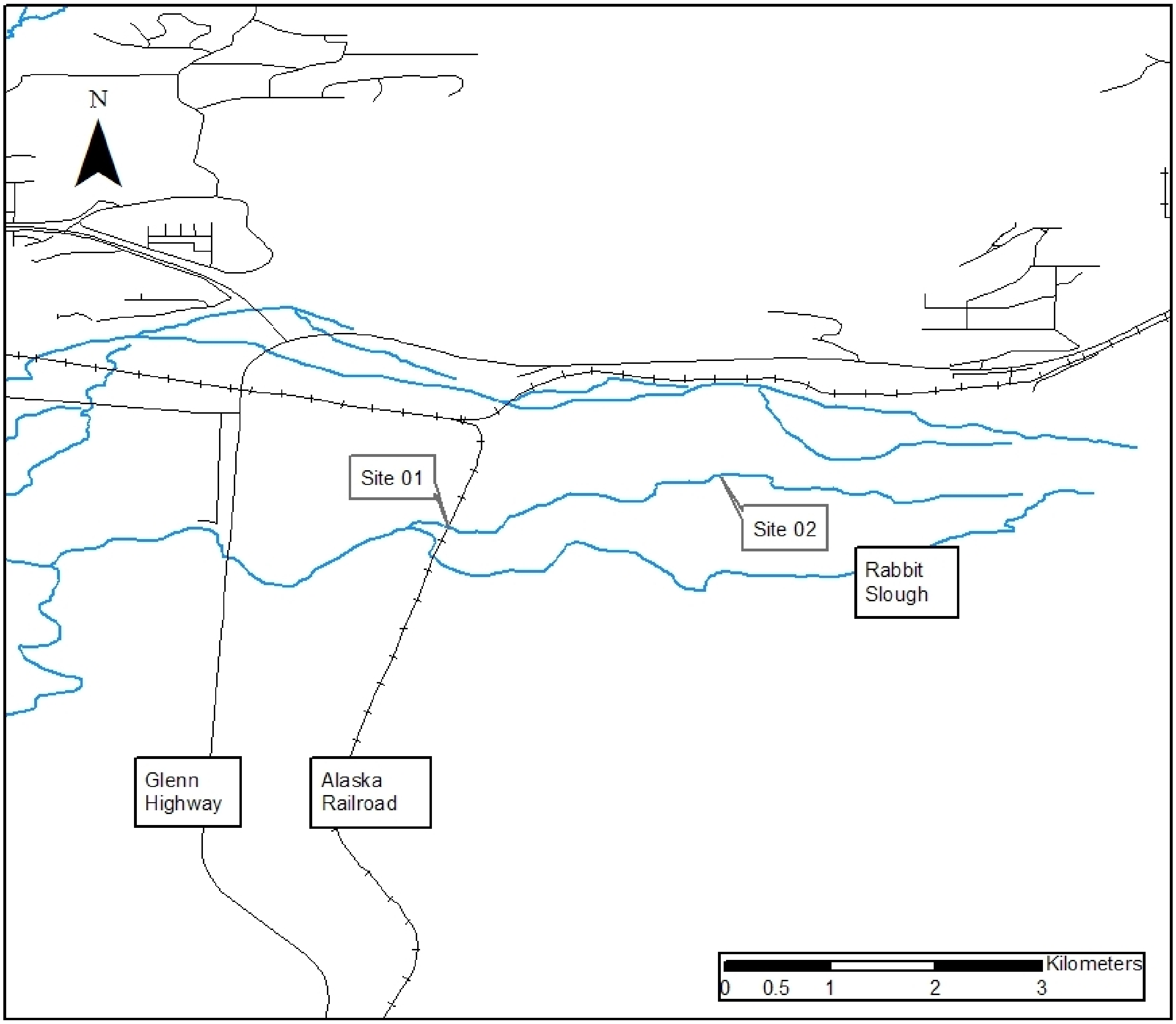

Figure 3. Rabbit Slough sampling area in the Wasilla Creek watershed, 2007. Blue lines represent streams and black lines represent roads and railroads.

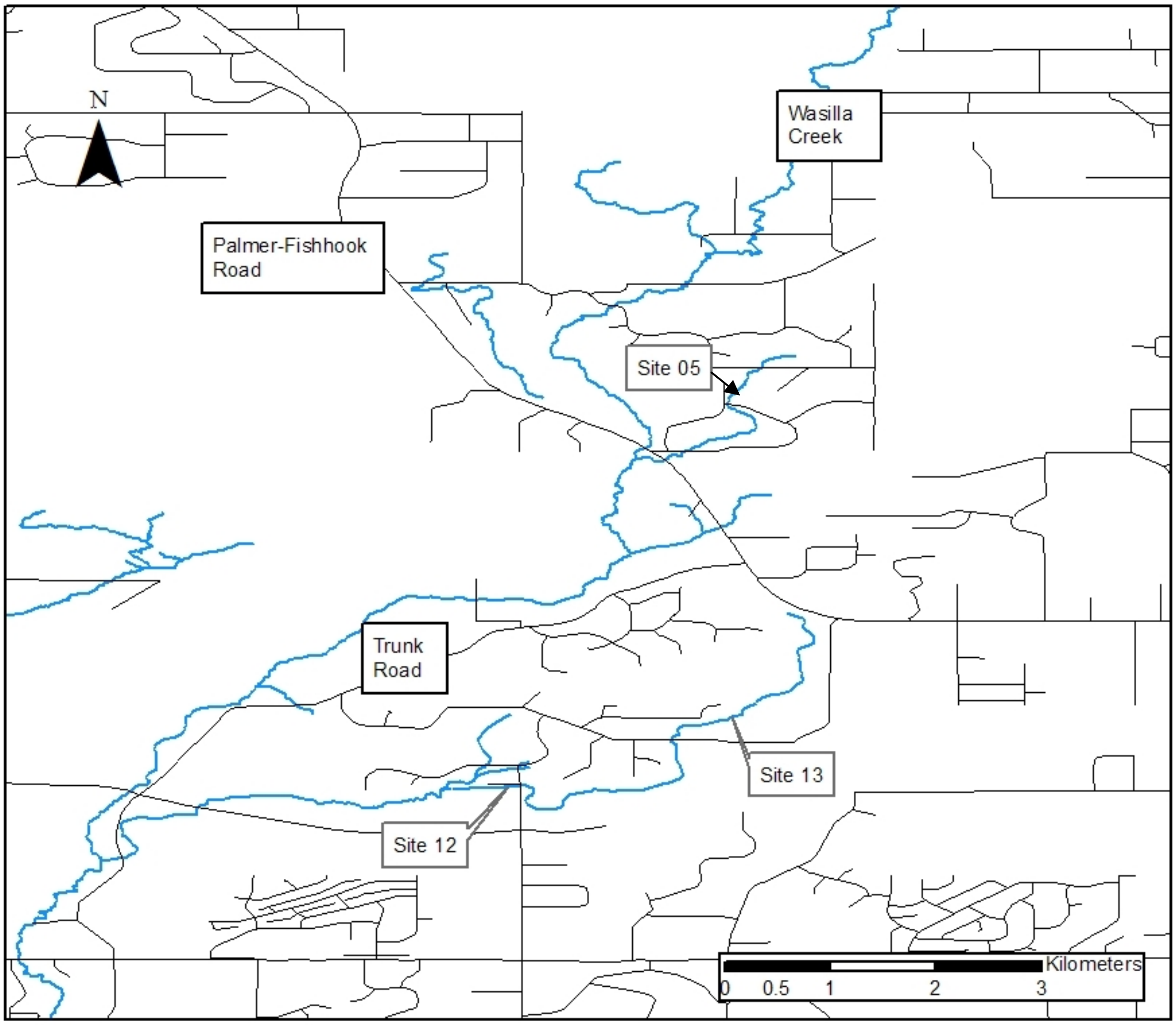

Figure 4. Wasilla Creek sampling area near Palmer-Fishhook Road, 2007. Blue lines represent streams and black lines represent roads.

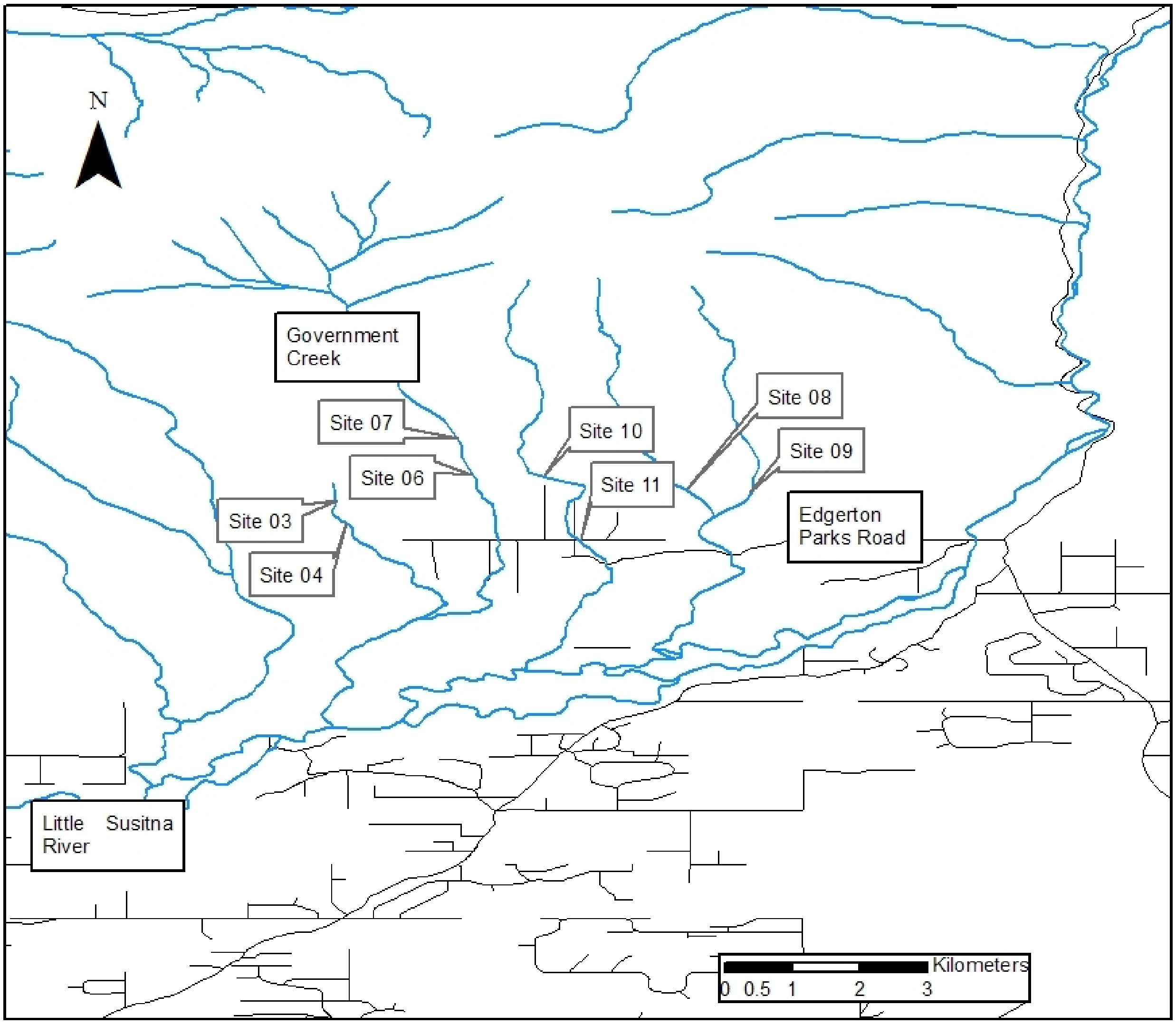

Figure 5. Government Creek sampling area in the Little Susitna River watershed, 2007. Blue lines represent streams and black lines represent roads.

Table 4. Summary of physical habitat parameters by watershed and site number for streams sampled in the Mat-Su basin, 2007. Channel types from Rosgen (1994); Stream order from Strahler (1952).

Site No.	Sample Area	Channel Type	Reach Length (m)	Wetted Width (m)	Gradient (%)	Stream Order	Discharge (m^3/s)
			Wasilla Creek watershed				
01	Rabbit Slough	Slough	180	4.5	<2	--	--
02	Rabbit Slough	Slough	164	4.1	--	--	--
05	Wasilla Creek	B4	--	--	<2	1	--
12	Wasilla Creek	C5	165	--	--	1	--
13	Wasilla Creek	B5	--	--	--	1	--
			Little Susitna River watershed				
03	Government Creek	B3	150	1.4	5	1	--
04	Government Creek	B3	150	1.2	<2	1	0.19
06	Government Creek	B2	--	--	--	3	--
07	Government Creek	A2	150	3.3	>10	3	0.91
08	Government Creek	B4	380	1.7	<2	1	--
09	Government Creek	B4	220	0.8	<2	1	--
10	Government Creek	B4	--	--	--	1	--
11	Government Creek	B4	--	--	--	1	--

Discussion

Our sampling in 2007 was successful for updating the AWC, but we were not very efficient and only averaged about two sample reaches per day. We were not efficient because our crew did not have time to scout access sites or contact landowners prior to sampling, so we often had to backtrack or knock on doors to get permission to access private property. We also spent about 3 hr each day commuting to and from Anchorage. In future years, time spent scouting and obtaining landowner permission in advance of field work would allow us to be more efficient. Basing the field crew out of a location closer to the Mat-Su basin would also save on daily commuting time.

We did not consistently collect all habitat data at each site. Some omissions were intentional if the sample reaches were only separated by a few hundred meters and some were the result of equipment malfunctions. However, some omissions were the result of poor planning. Future sampling efforts should use a standard form, either electronic or hard copy, for habitat data collection.

The backpack electrofisher was effective over the range of water conductivity encountered in 2007. However, some small fish might not have been captured. We observed small stickleback (< 20 mm) that were not affected by the electrical field even though we were able to induce electrotaxis on larger fish (> 50 mm) at the same site. We may have been able to induce electrotaxis on the smaller fish by increasing the power output, but we did not want to risk injury to the larger fish.

This project should be continued in future years in support of the Mat-Su Basin Salmon Conservation 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 Mat-Su Partnership. Consultations with USFWS, ADF&G, and OHMP personnel to select sample areas should continue in future years.

Acknowledgements

We thank C. Dion, D. Hildreth, and D. McBride for their persistence in the field. We thank J. Buckwalter, J. Johnson, and R. Snow with ADF&G for assistance and training. Finally, we thank the numerous residents of the Mat-Su basin who gave us permission to sample on private property.

References

Buckwalter, J. 2007. Inventory of fish distribution in the upper Kuskokwim River drainage, draft Operational Plan FY2008. Alaska Department of Fish and Game, Anchorage, Alaska.

Dalbey, S. R., T. E. McMahon, and W. Fredenberg. 1996. Effect of electrofishing pulse shape and electrofishing-induced spinal injury on long-term growth and survival of wild rainbow trout. North American Journal of Fisheries Management 16:560-569.

Gordon, N. D., T. A. McMahon, and B. L. Finlayson. 1992. Stream hydrology: an introduction for ecologists. John Wiley & Sons Ltd., Chichester, England.

Johnson, J., and E. Weiss. 2007. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Southcentral Region, Effective June 1, 2007. Alaska Department of Fish and Game, Special Publication No. 07-05, Anchorage, Alaska.

Reynolds, J. B. 1996. Electrofishing. Pages 221 – 253 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Reynolds, L., A. T. Herlihy, P. R. Kaufmann, S. V. Gregory, and R. M. Hughes. 2003. Electrofishing effort requirements for assessing species richness and biotic integrity in western Oregon streams. North American Journal of Fisheries Management 23:450-461.

Rosgen, D. L. 1994. A classification of natural rivers. Catena 22:169-199.

Strahler, A. N. 1952. Dynamic basis of geomorphology. Geological Society of America Bulletin 63:923-938.

U. S. Census Bureau. 2001. Counties ranked by percent population change: 1990 to 2000. Census 2000 Gateway, Population Distribution Branch. Available: http://www.census.gov/population/www/cen2000/phc-t4.html.

USFWS (U. S. Fish and Wildlife Service). 2004. Electrofishing. Chapter 6, part 241. Safety operations, occupational safety and health. USFWS, Washington, D.C.