Fishery Data Series No. 18-36

Spawning Locations of Tanana River Summer Resident Sheefish 2010 and 2011

by

Andrew D. Gryska

December 2018

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA REPORT NO. 18-36

PRELIMINARY REPORT ON THE SPAWNING LOCATIONS OF TANANA RIVER SUMMER RESIDENT SHEEFISH

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ABSTRACT

The Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (USFWS) cooperated in a radiotelemetry project that investigated the spawning locations of summer resident Tanana River sheefish *Stenodus luecicthys*. Between mid-May and mid-August 2010, 37 sheefish of mature size (i.e., ≥700 mm FL) were implanted with radio tags having a 5-year operational life at several locations in the Tanana River drainage between the Chitanana River and Minto Flats. Three sheefish were subsequently captured in subsistence nets and one of those tags was redeployed, so that 35 radiotagged sheefish were available for tracking. During 2011, 15 radio tags were deployed during June at the Chitanana River mouth and during September and October in the Chatanika and Tanana rivers near spawning areas. Preliminary results of aerial surveys conducted during September and October of 2010 and 2011 indicated that they spawn in the Yukon River Flats, Chatanika River, Sulukna River, and in the Tanana River between Fairbanks International Airport and Eielson Air Force Base. The Tanana River area was a significant finding because it was previously undocumented and it received the highest number of radiotagged sheefish among all observed spawning areas during the fall spawning surveys. Because transmitters will be operational through at least the fall spawning season of 2014, the locations and movements of radiotagged sheefish will continue to be monitored by the USFWS using aerial surveys and a stationary tracking station near Manley.

Keywords: sheefish, inconnu, Stenodus leucichthys, radiotelemetery, seasonal distributions, Tanana River, Alaska.

INTRODUCTION

The Tanana River is the largest tributary, by discharge, of the Yukon River. Five coregonid species have been documented in the drainage: sheefish *Stenodus leucichthys* (inconnu), humpback whitefish *Coregonus pidschian*, broad whitefish *C. nasus*, least cisco *C. sardinella*, and round whitefish *Prosopium cylindraceum*. Sheefish, humpback whitefish, and broad whitefish are regularly taken in food fisheries in the communities of Nenana and Minto (Andrews 1988; Shinkwin and Case 1984) and elsewhere in the lower drainage. Sport fisheries for sheefish also occur, although they are not regularly documented by the Statewide Harvest Survey and are therefore likely to be small (A. Brase, Fisheries Biologist, ADF&G, Fairbanks, personal communication). Based on capture records, the upstream range of sheefish (Alt 1979) likely falls short of the Delta River mouth, located approximately 160 km upstream from Fairbanks. Although the summer feeding range of sheefish has been fairly well documented in the Tanana River (Alt 1979), only one spawning location in the Chatanika River has been identified (Alt 1987).

Despite only one spawning area being documented, at least one other spawning area has been thought to exist based on evidence, such as pre-spawning females captured in the Chena River (Alt 1987). More compelling evidence of other spawning areas comes from a relatively large abundance of sheefish observed in September at a video-equipped (Daum 2005) fish wheel in the Tanana River downstream from Nenana (Borba 2007). This location is approximately 28 km upstream of Swan Neck Slough, which is the nearest entrance to the Chatanika River's distant upstream spawning location; these observations suggest a spawning migration similar to that for sheefish and other coregonid species on the Yukon River at Rapids (Brown 2000; Brown et al. 2007). In addition, a large number of Yukon River whitefish spawn in the braided reaches of the upper region of the Yukon Flats (Brown 2000). The stream morphology of the Middle Tanana River between the mouths of the Chena and Delta rivers is analogous to the upper reaches of the Yukon Flats (R. Brown, Fishery Biologist, U.S. Fish and Wildlife Service, Fairbanks, personal communication), and humpback whitefish were recently found to spawn in the Middle Tanana River (Dupuis 2010).

Pending development activities in the Middle Tanana River valley are likely to alter the riverbed and affect fish habitat. A railroad bridge crossing over the Tanana River has been constructed

approximately midway between the mouths of the Chena and Delta rivers to facilitate an extension of the railroad line from the Fairbanks area to Delta Junction. According to the draft environmental impact statement, the Alaska Railroad Corporation is planning to use riverbed gravel from numerous sites along the railroad route between the Tanana River crossing near Salcha and its terminus near Delta Junction for construction of the rail bed (Surface Transportation Board 2008). Additional demand for riverbed gravel in the suspected sheefish spawning reach is likely to grow as development continues in the Middle Tanana River valley. Mining in or near gravels used by river-spawning coregonid fishes may have detrimental effects on their spawning success. Gravel mining of known coregonid spawning areas in Lake Lucerne in Switzerland was found to dramatically reduce spawning success of Albeli whitefish *C. exiguus*, a major commercial species in the lake (Meng and Müller 1988).

Potential spawning areas and the pending development in the Middle Tanana River Valley prompted this cooperative study between the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish, and the U.S. Fish and Wildlife Service (USFWS). Specifically, the 5-year study was designed to identify spawning areas for sheefish that inhabit the Tanana River during summer. ADF&G's responsibility was to assist during the first 18 months of the project that entailed deployment of 50 radio tags, maintaining one tracking station near Manley, conducting boat surveys of the spawning area, and drafting a report documenting the results for the first 18 months of work conducted by both agencies. The USFWS provided the radio tags, conducted all aerial surveys, opportunistically assisted with tag deployment, provided annual summaries of results, and will draft the final report. This initial report details the work that was completed between May 2010 and October 2011.

OBJECTIVES

The objective for this study was to use radiotelemetry techniques to:

1) locate spawning areas of sheefish ≥700 mm FL that resided in the Tanana River drainage during late May and early July 2010 and 2011.

METHODS

STUDY AREA

The study area encompassed the lower 381 km of the Tanana River (Figure 1). It stretched from the Yukon River upstream to the Salcha River mouth, and included the lower 85 km of the Tolovana River. The study area (Figure 1) was divided into 3 sample regions: 1) the lower 129 km of the Tanana River between Fish Creek and the Kantishna River (Manley), 2) the lower 132 km of the Tolovana River drainage (Tolovana), and 3) the 143 km stretch of the Tanana River between Nenana and the Salcha River mouth (Salchaket). Sampling was largely focused at tributary mouths of the Tanana River and in tributaries up to several km from their mouth. Aerial tracking flights, in conjunction with other sheefish telemetry projects, were conducted throughout the Lower Yukon River drainage from Circle to Holy Cross.

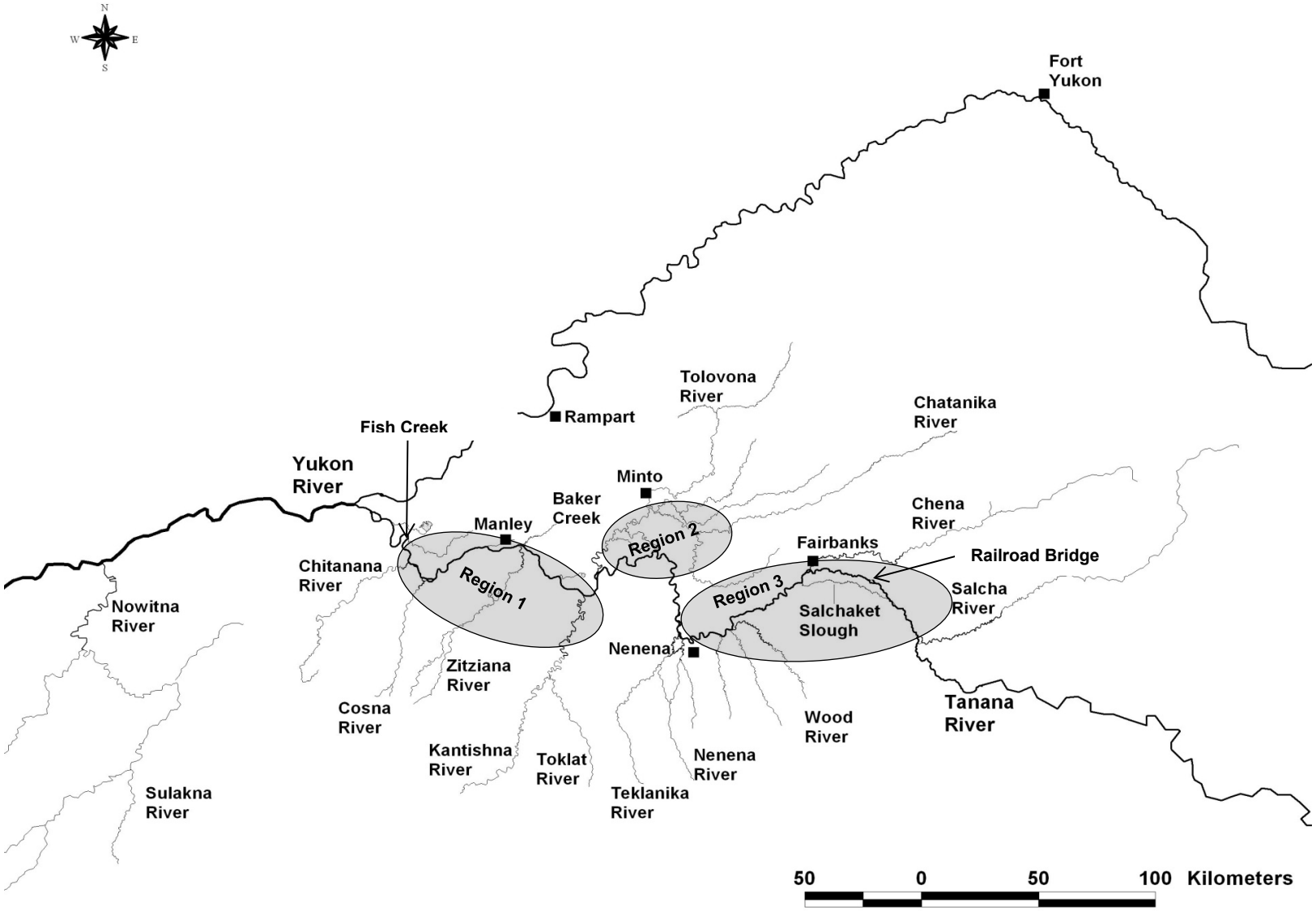

Figure 1.–A map demarcating the 3 sampling regions within the Tanana River study area.

SAMPLING DESIGN AND TELEMETRY

Radiotelemetry techniques were used to document spawning areas of mature-sized sheefish that inhabit the Tanana River during summer. Efforts were made to distribute radio tags over the entire sample area during 2 periods of summer (Table 1). However, sheefish were inconsistently found and efforts were ultimately focused at those few areas where they could be captured most consistently. Data related to movements and spawning locations were collected using a combination of aerial tracking surveys, a ground-based receiving station, and boat surveys. Although aerial surveys could not cover all possible areas sheefish might spawn, they did likely cover the majority of potential spawning areas within the Tanana River drainage. Radiotagged sheefish that migrated up or down the Tanana River were recorded by the receiving station near Manley. Spawning areas previously documented in the Yukon River drainage were also surveyed in conjunction with another Yukon River drainage sheefish radiotelemetry project.

To capture sheefish, crews used power boats to travel throughout the study area during 40 field trips of 1 to 10 days between mid-May and mid-August 2010, and mid-May and early October 2011. Among the 3 sample regions (Table 1 and Figure 1), specific sample locations (termed "daily reaches") of varying length and considered most likely to hold sheefish were selected based on intuition, availability of suitable habitat, and previously documented catch locations (Alt 1979; William Morris, Fisheries Biologist, ADF&G, Fairbanks, personal communication). Within a reach, discretion was given to a crew to sample the most suspect locations. Optimally, 1 to 3 sheefish would have been tagged in any given daily reach; however, previous sampling information indicated catches would be few and sporadic (Alt 1979).

Sheefish were captured primarily by rod and reel gear and to a lesser extent by electrofishing and gill nets (18 m x 3 m, 13 cm stretch mesh). Captured sheefish ≥700 mm FL were immediately tagged with a radio transmitter. All incidentally captured fishes were identified, tallied, and released. Radio tags were surgically implanted following the basic surgical methods detailed by Brown (2006) and Morris (2003). Because most fish were captured 2 to 4 months prior to spawning, sex and spawning condition (e.g., likely to spawn fall 2010) were difficult to identify. Therefore, sheefish ≥700 mm FL were preferentially radiotagged because they were likely to be mature, however some smaller sheefish (e.g. 670 mm FL) were tagged out of necessity. For each radiotagged fish, length (nearest 5 mm FL), capture/release location as a GPS waypoint (decimal degree NAD27 Alaska datum), and radiotag frequency and code were recorded.

Radio tags operated on 1 of 4 frequencies, and each transmitter was digitally coded for identification. Radio tags were operational over a 5-year period (May 2010–November 2014), and they were programmed to operate for 26 weeks per year (mid-May through mid-November), transmitting 24 hours per day. Radio tags were located using a combination of ground-based tracking stations, aerial surveys, and boat surveys. One tracking station was erected downstream of Manley on a bluff above the Tanana River. This station detected entry and exit of sheefish into and out of the Middle Tanana River between mid-May and mid-November. The station included a battery bank, a solar array, a steel housing box, a Yagi antenna, and a Lotek SRX 400 receiver. The receiver monitored the frequencies continuously and when a signal of sufficient strength was encountered, the tag frequency, tag code, signal strength, date, and time were recorded on the data logger. Recorded data were downloaded to a laptop computer every 3 to 9 months.

Table 1.–Preliminary schedule for deploying radio tags by sample period and region during 2010.

Sample Period	Sample Region		
	Salchaket	Tolovana	Manley
Late May	10	15*	10
Early July	5	5	5

* No more than 7 radio tags were to be deployed upstream of the Chatanika River mouth.

Radiotagged sheefish were periodically located from mid-June through early November using aerial surveys conducted by USFWS, but during the spawning period, survey frequency increased beginning mid-September. While conducting surveys, a Lotek SRX 400 receiver was used to locate fish. Recorded data included date and time of the survey, radio tag frequency and code for all located tags, a geographic description of the tag location (e.g., Tanana River–Cosna River mouth), and a latitude and longitude.

Surveys were flown over suspected spawning reaches such as the Tanana River between the mouths of the Chena and Salcha rivers, and known spawning locations including the Chatanika River between the pipeline crossing and the Steese Highway Bridge and other spawning areas in the Yukon River drainage. These flights were continued until almost all sheefish (e.g., 95%) were observed making pronounced downstream migrations (e.g., >50 km) after the spawning period. The geographic distribution of sheefish during the two or more surveys when they were at their furthest upstream points of migration was interpreted as the approximate geographic range of the spawning reach. Boat surveys were also conducted in the Tanana and Chatanika rivers in late September and October.

DATA ANALYSIS

Analysis was limited to the first 17 months of this project; consequently, this was a preliminary assessment of suspected spawning locations, which will not be fully resolved until project completion by USFWS in November 2014. Following aerial surveys, dates and location coordinates were entered into a Microsoft Excel spreadsheet and plotted on maps using ARCView. Seasonal locations and migratory periods were described verbally and depicted on maps. Final fates will not be fully determined until project completion. The remaining long-term analyses and reporting are the responsibility of the USFWS. While attempting to capture sheefish, a number of other fish were captured. Species composition of catch data by location, date, and capture gear was recorded and presented in summary tables as appendices to this report.

RESULTS

Between mid-May and mid-August 2010, 37 sheefish were radiotagged, and 3 of these were caught and killed in subsistence fisheries within a month; one of these tags was redeployed in August 2010 (Table 2, Figure 2). The final number of radiotagged fish during 2010 was 35 sheefish, leaving 15 radio tags to be deployed during 2011. During June 2011, 2 radio tags were deployed, but difficulty capturing sheefish and scheduling conflicts resulted in the remaining 13 radio tags being deployed in spawning areas of the Chatanika (9) and Tanana (4) rivers during September and October, 2011 (Table 2, Figure 3).

Table 2.–Date of capture, fork length (mm), release location, capture gear, and notes for each radiotagged sheefish.

Date	Location	FL (mm)	Frequency MHz	Channel	Code	Latitude decimal degrees	Longitude decimal degrees	Capture gear	Notes
5/20/2010	Cosna	820	162.231	1	105	64.86028	-151.40485	Gill net	
5/20/2010	Chatanika	710	162.581	4	103	65.08858	-149.29935	angle	
5/22/2010	Cosna	695	162.469	3	107	64.86028	-151.40485	Gill net	Mortality June 2010
5/24/2010	Baker Creek	760	162.231	1	103	64.97207	-150.47150	Gill net	
5/25/2010	Tolovana	690	162.581	4	108	65.00910	-149.55131	angle	
5/27/2010	Zitziana	770	162.231	1	106	64.97127	-150.49196	angle	
5/27/2010	Zitziana	700	162.419	2	103	64.97127	-150.49196	angle	
6/14/2010	Chitanana	750	162.469	3	103	64.92360	-151.52997	angle	
6/14/2010	Chitanana	700	162.581	4	102	64.92360	-151.52997	angle	
6/14/2010	Chitanana	710	162.581	4	105	64.92360	-151.52997	angle	
6/16/2010	Cosna	715	162.419	2	101	64.85010	-151.38396	angle	
6/16/2010	Cosna	670	162.419	2	107	64.85010	-151.38396	angle	
6/16/2010	Cosna	730	162.469	3	39	64.85010	-151.38396	angle	
6/16/2010	Zitziana	675	162.469	3	45	64.96934	-150.50940	angle	Mortality July 2010
6/16/2010	Cosna	705	162.469	3	49	64.85010	-151.38396	angle	
6/16/2010	Cosna	690	162.469	3	51	64.85010	-151.38396	angle	
6/16/2010	Zitziana	775	162.581	4	48	64.96934	-150.50940	angle	
6/16/2010	Cosna	700	162.581	4	49	64.85010	-151.38396	angle	
6/16/2010	Cosna	670	162.581	4	101	64.85010	-151.38396	angle	
6/16/2010	Cosna	790	162.581	4	106	64.85010	-151.38396	angle	
6/22/2010	Tolovana	695	162.231	1	101	65.02030	-149.53270	angle	Mortality July 2010
6/22/2010	Tolovana	720	162.419	2	102	65.02030	-149.53270	angle	
6/22/2010	Tolovana	715	162.419	2	104	65.02030	-149.53270	angle	
6/22/2010	Tolovana	685	162.419	2	105	65.02030	-149.53270	angle	
6/22/2010	Tolovana	755	162.469	3	104	65.02030	-149.53270	angle	
6/28/2010	Tolovana	715	162.581	4	104	65.02030	-149.53270	angle	
6/28/2010	Tolovana	730	162.581	4	107	65.02030	-149.53270	angle	
6/30/2010	Chatanika	704	162.469	3	106	65.07461	-149.27989	angle	

Table 2.–Page 2 of 2.

Date	Location	FL (mm)	Frequency MHz	Channel	Code	Latitude decimal degrees	Longitude decimal degrees	Capture gear	Notes
7/26/2010	Zitziana	740	462.231	1	107	64.96934	-150.50940	angle	
7/26/2010	Zitziana	790	162.469	3	107	64.96934	-150.50940	angle	Redeployed
7/27/2010	Cosna	710	162.469	3	108	64.85010	-151.38396	angle	
8/2/2010	Zitziana	756	162.231	1	45	64.96903	-150.50478	angle	
8/3/2010	Zitziana	706	162.419	2	38	64.96676	-150.50281	angle	
8/4/2010	Zitziana	694	162.231	1	50	64.96583	-150.50058	angle	
8/4/2010	Tolovana	675	162.419	2	51	65.02208	-149.52664	angle	
8/4/2010	Tolovana	705	162.469	3	50	65.02208	-149.52664	angle	
8/4/2010	Cosna	752	162.581	4	45	64.85066	-151.38065	angle	
8/16/2010	Zitziana	810	162.469	3	101	64.96326	-150.50394	angle	
6/16/2011	Chitanana	750	162.419	2	50	64.92360	-151.52997	angle	
6/16/2011	Chitanana	700	162.469	3	102	64.92360	-151.52997	angle	
9/8/2011	Chatanika	805	162.231	1	47	65.08087	-147.75304	EF	
9/8/2011	Chatanika	660	162.231	1	102	65.06048	-147.81993	EF	
9/8/2011	Chatanika	790	162.419	2	47	65.08577	-147.74524	EF	
9/8/2011	Chatanika	695	162.419	2	49	65.06861	-147.76981	EF	
9/8/2011	Chatanika	725	162.469	3	45	65.08485	-147.75003	EF	Redeployed
9/27/2011	Chatanika	670	162.231	1	101	65.08408	-147.74527	EF	Redeployed
9/27/2011	Chatanika	682	162.469	3	46	65.08569	-147.73785	EF	
9/28/2011	Chatanika	815	162.419	2	48	65.08146	-147.73578	EF	
9/28/2011	Chatanika	815	162.469	3	105	65.08146	-147.73578	EF	
10/5/2011	Tanana	715	162.419	2	46	64.75235	-147.46390	EF	
10/5/2011	Tanana	650	162.419	2	106	64.72906	-147.39474	EF	
10/6/2011	Tanana	700	162.231	1	51	64.75703	-147.47972	EF	
10/6/2011	Tanana	620	162.419	2	45	64.75703	-147.47972	EF	

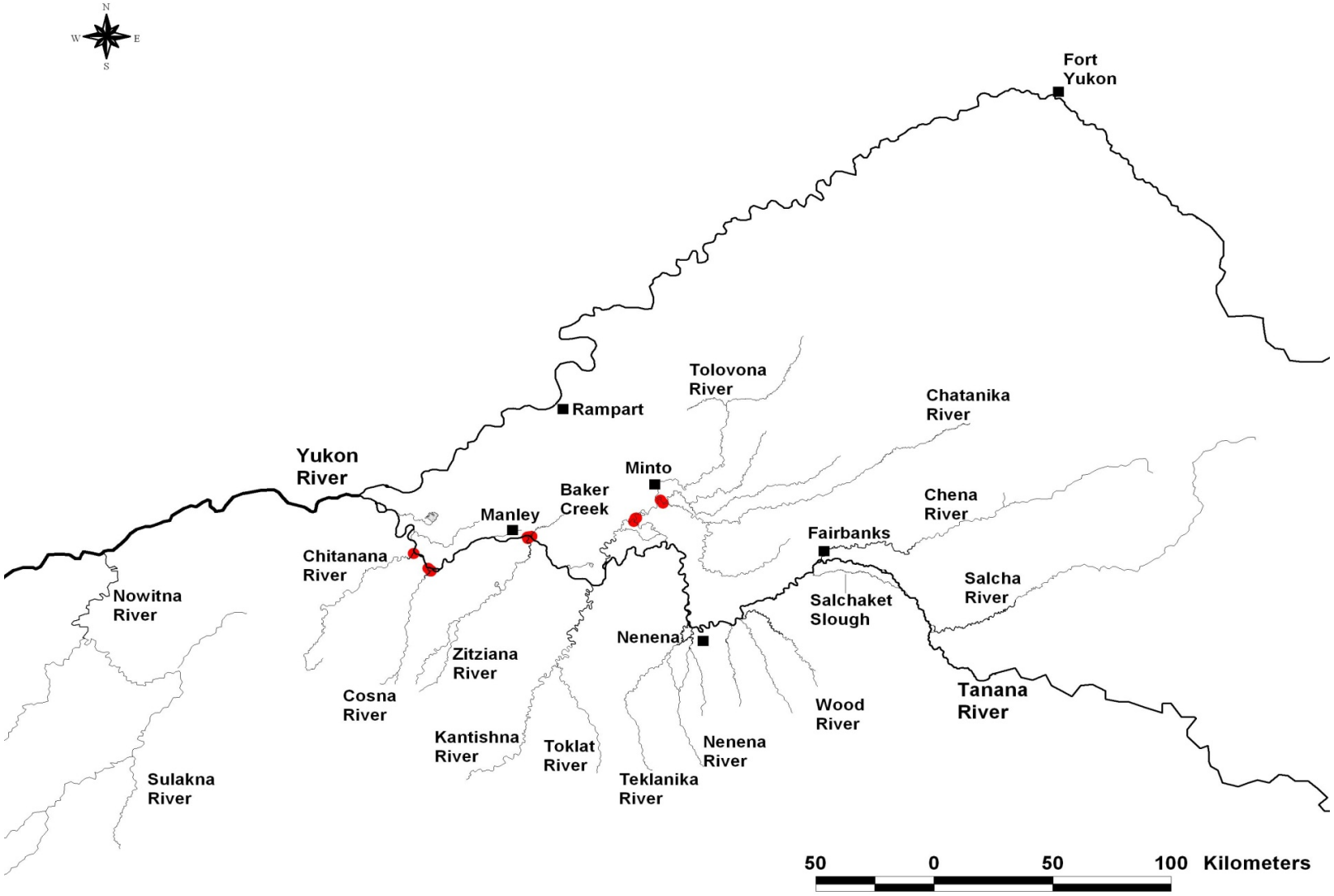

Figure 2.–Tagging locations (some locations overlap) of 35 sheefish radiotagged in the Tanana River drainage during summer 2010.

During late September and early October 2010, surveys of the Tanana and Yukon River drainages were conducted. Of the 35 sheefish radiotagged during 2010, 10 were located in the Tanana River between Fairbanks International Airport and Eielson Air Force Base, 2 were found in the Upper Sulukna River (tributary to the Nowitna River), 1 was in the Yukon River upstream of Fort Yukon, and the whereabouts of the other 22 radiotagged fish were not determined (Figure 3). During June 20, 2011, the Tanana River drainage was surveyed. Seventeen radiotagged fish were found between the Chitanana River and the Middle Chatanika River (Figure 4), and 18 other radiotagged fish were at-large. During late September and early October 2011, surveys detected 4 fish in the Tanana River near Fairbanks, 1 in the Middle Chatanika River near the Elliot Highway Bridge, and 1 in the Yukon River upstream of Fort Yukon (Figure 5). Of the remaining radiotagged fish, 4 were found in non-spawning areas (1 in the Tanana River near the Kantishna River mouth, 2 in the Lower Tolovana River, and 1 near the Chatanika River mouth), 26 were not found, 1 was apparently dead (dying during or after spawning in the Sulukna River), and 13 others had only recently been tagged near spawning grounds in the Chatanika and Tanana rivers.

Other fish species captured during this study included lake chub *Couesius plumbeus*, longnose sucker *Catastomus catastomus*, least cisco, humback whitefish, broad whitefish, round whitefish, burbot *Lota lota*, and northern pike *Esox lucius*.

DISCUSSION

The preliminary results from this project indicated those sheefish residing in the Tanana River drainage during the summer spawn in at least 1 of 4 discrete areas located in the Sulukna, Yukon, Chatanika, or Tanana rivers. Although 3 of these areas had been previously identified as spawning areas, the Tanana River aggregation between Fairbanks International Airport and Eielson Air Force Base was previously unknown. The area is similar to braided reaches of the upper region of the Yukon Flats, and recently humpback whitefish had also been found to spawn in the vicinity (Dupuis 2010). Spawning activity was confirmed by capturing and handling sheefish in the area during early October 2010 because milt and eggs were easily extruded.

Although this study was not designed to estimate the proportion of summer residents that migrated to any particular spawning reach, the initial findings suggest Tanana River resident sheefish are more likely to spawn in the Tanana River spawning reach than the other 3 locations. Greater insights relative to spawning areas will be available after all surveys are completed in 2014. For example, are the relatively low numbers of sheefish observed in 2011 due to tagging mortality or skip-spawning? During the interim, developments such as the construction of the new bridge across the Tanana River near Salcha should be closely monitored and any potential impacts prevented or minimized.

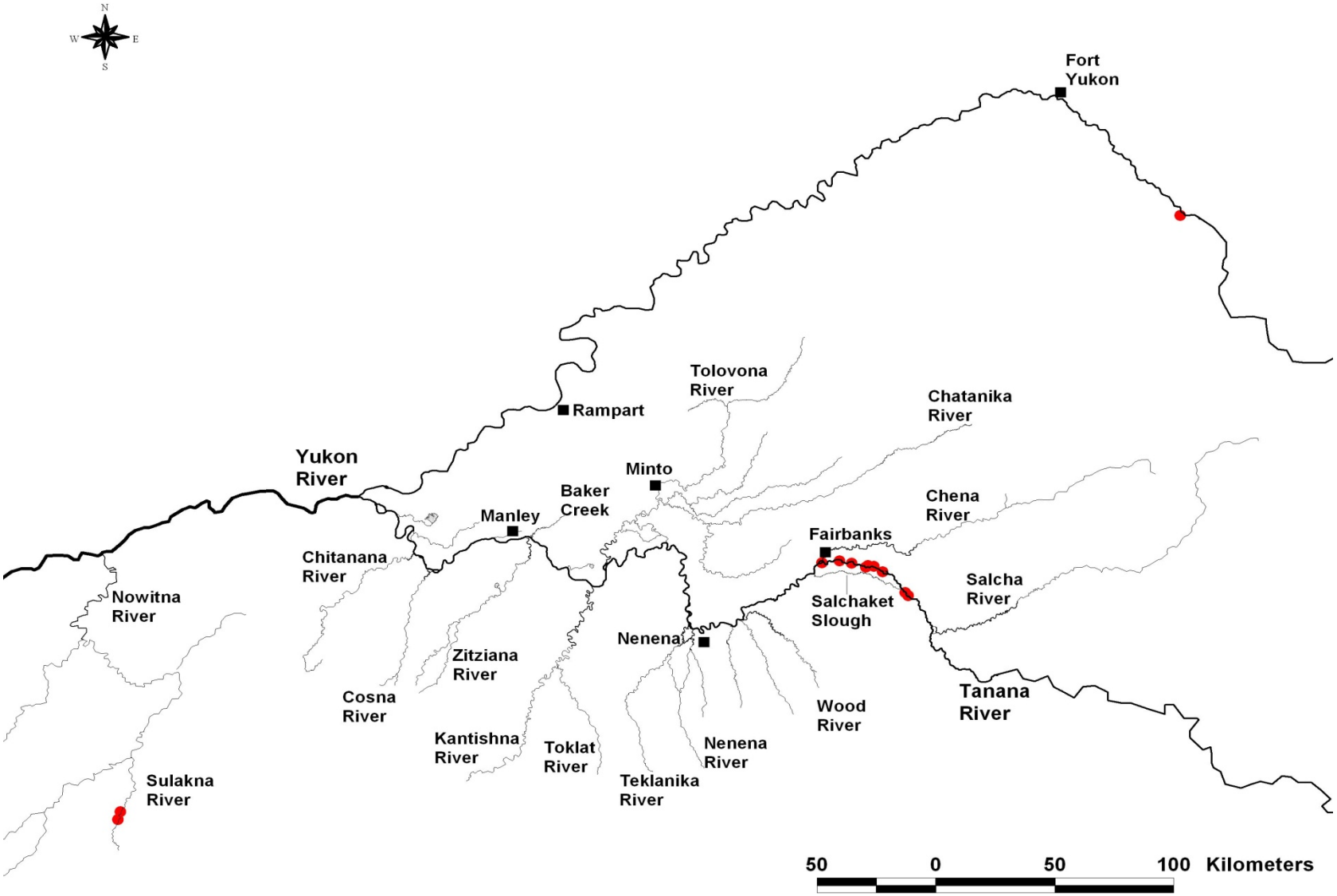

Figure 3.–Spawning locations (some locations overlap) during fall 2010 of 14 sheefish radiotagged in the Tanana River.

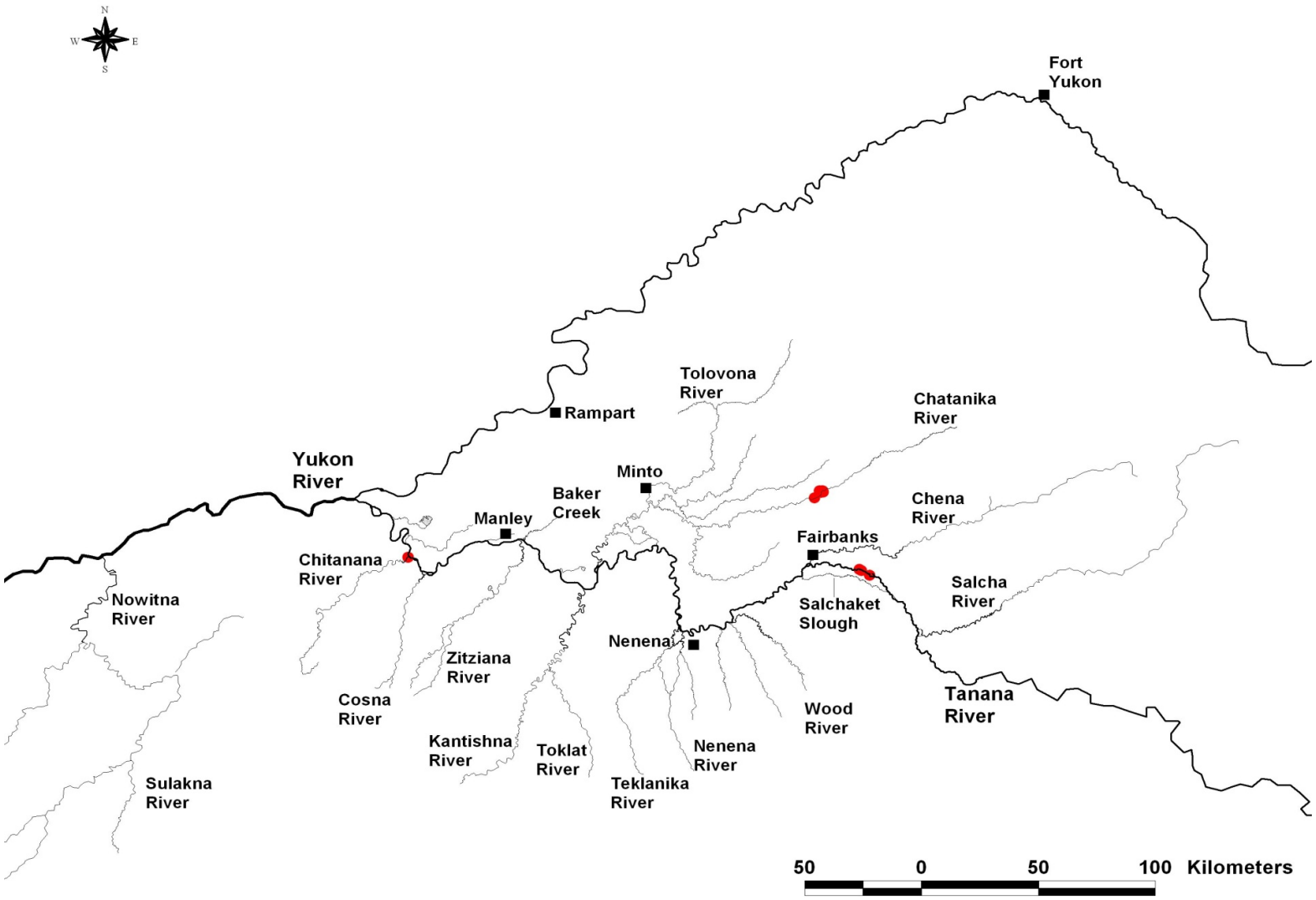

Figure 4.–Tagging locations (some locations overlap) of 15 sheefish radiotagged in the Tanana River drainage during summer and fall 2011.

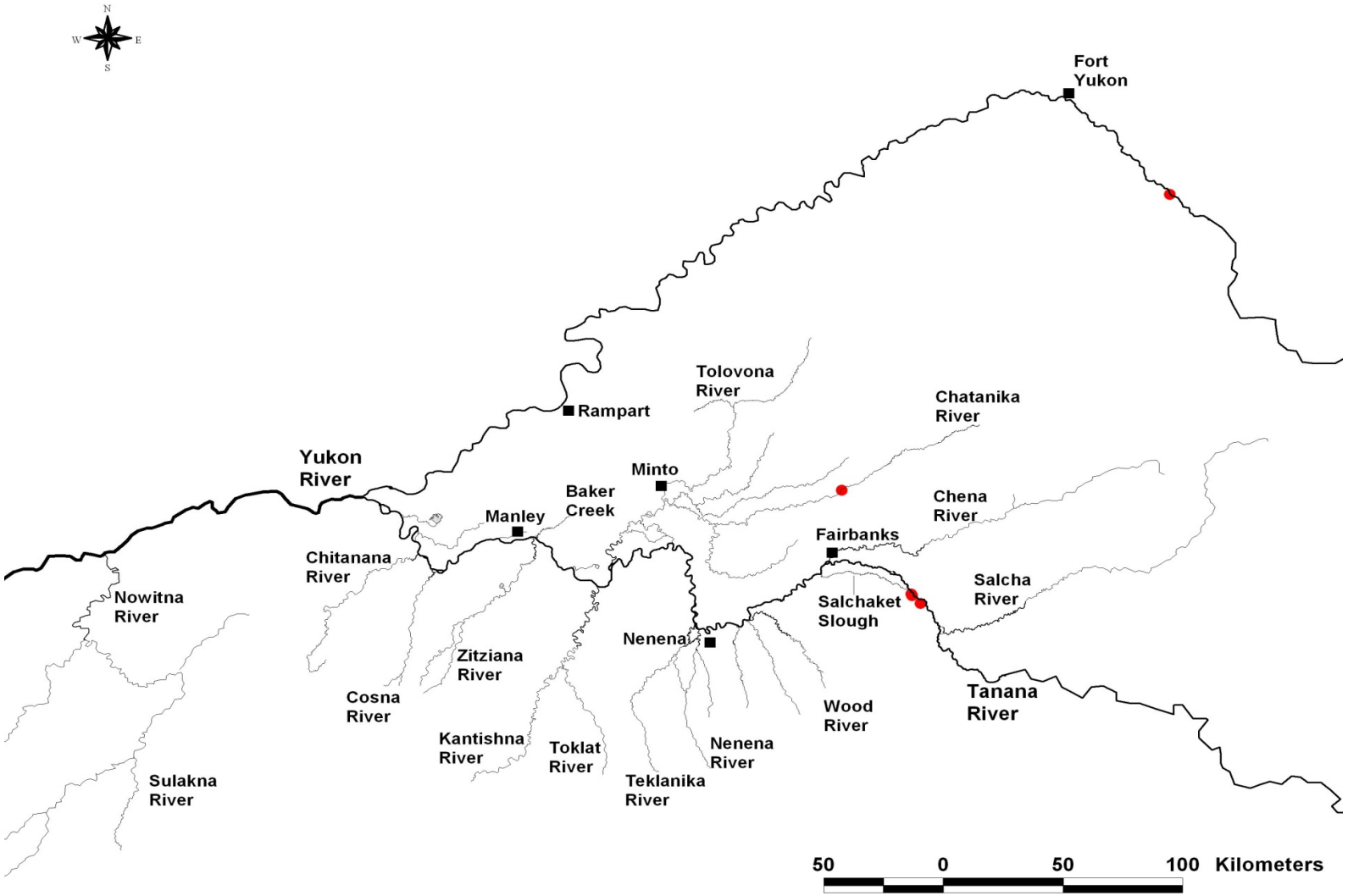

Figure 5.–Spawning locations during fall 2011 of 6 sheefish (some locations overlap) radiotagged in the Tanana River drainage during summer 2010 and 2011.

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APPENDIX A:
DATA FILE LISTING

Appendix A1.–Data files for radiotelemetry of sheefish tagged in the Tanana River, 2010–2011.

File name
Tanana River sheefish radiotelemetry data files for archive-2010-2011.xls

Note: Data files are archived at and available from the Alaska Department of Fish and Game, Division of Sport Fish, 1300 College Road, Fairbanks, Alaska 99701-1599.