Fishery Management Report No.14-37

Pasagshak River Weir Report, 2014

by

Mark J. Witteveen

September 2014

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

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ABSTRACT

A fish-counting weir was installed in the Pasagshak River during 2014 by the Alaska Department of Fish and Game to enumerate sockeye salmon *Oncorhynchus nerka* escapement into Lake Rose Teed. Escapement was enumerated through a conventional wood tripod and aluminum panel weir daily from June 11 through August 12. Heavy rainfall during the second week of August coinciding with high tidal cycles resulted in high water in the Pasagshak River, causing the weir to be pulled a few days early to prevent blowout. The total number of sockeye salmon counted through the weir was 1,582 fish. Peak passage occurred during mid-July; however, escapement was erratic on a daily basis and no trends were observed. The low escapement levels prompted the department to expand closed waters to all of Pasagshak Bay for commercial and subsistence fishing on July 17 and close the sport fishery within the Pasagshak River drainage on July 18. Additionally, 14 pink salmon *O. gorbuscha* and 1 chum salmon *O. keta* were counted through the weir. Sockeye salmon were sampled for age, sex, and length from a trap built onto the weir, with a beach seine behind the weir, and from the subsistence gillnet harvest in Pasagshak Bay. The average length (mid eye to tail fork) of Pasagshak River sockeye salmon escapement was 547 mm, and the dominant age class was age-1.3.

Key words: sockeye salmon, ASL, subsistence, Pasagshak River, Lake Rose Teed.

INTRODUCTION

Pasagshak River, located on the Kodiak road system (Figures 1 and 2), has recently supported one of the largest sockeye salmon *Oncorhynchus nerka* subsistence fisheries for Kodiak Island residents (Alaska Department of Fish and Game [ADF&G] subsistence database; Figures 3 and 4). During the past two decades, subsistence harvest of Pasagshak River sockeye salmon has increased disproportionately to escapement (Figure 3). More sockeye were harvested from Pasagshak Bay in 2013 for subsistence use than from any other area in the Kodiak Archipelago (Figure 4; ADF&G subsistence database). Previous escapement enumeration methodology provided only postseason estimates via aerial and foot surveys of the spawning grounds, making inseason subsistence and sport fisheries management impossible and refinement of an escapement goal for this stock problematic. A conventional wood tripod and aluminum panel weir was constructed near the outlet of the lake by ADF&G during 2011 through 2014 to provide timely and accurate escapement information to help maintain the sustainability of this important subsistence and recreational use salmon run.

The Pasagshak River is located on the northeast side of Kodiak Island and is accessible by car from the city of Kodiak (Figure 1). Lake Rose Teed (formerly spelled Rose Tead), which drains into the Pasagshak River, is a small, shallow lake (0.94 km^2; 2.1 m average depth). Prior to the 1964 earthquake and subsequent tsunami, Lake Rose Teed had little salmon rearing habitat; however, the earthquake lowered the elevation of the lake, allowing nutrient rich marine water to enter the lake during high tide cycles, dramatically increasing the salmon rearing potential (Murray 1986). Pasagshak River State Recreational Site is the only designated park land that is outside of the immediate city area but still within the road system (Figure 2). The mouth of the Pasagshak River is also a prehistoric native settlement site (P. Saltonstall, Curator, Alutiiq Museum, Kodiak, personal communication).

Since 1968, Pasagshak River salmon escapement had been estimated postseason using both aerial and foot surveys of the spawning grounds. Although annual survey estimates have been highly variable, sockeye salmon production has generally increased since that time (Figure 3). Because surveys took place on the spawning grounds, estimates of the escapement were not made until well after the fish escaped the subsistence, sport, and commercial fisheries. Because escapement was not estimated in season, no management action to regulate harvests was

possible, and overharvest could have occurred without being detected until any action was too late. The current escapement goal for Pasagshak River sockeye salmon is a lower-bound sustainable escapement goal of 3,000 fish (Sagalkin et al. 2013).

Subsistence harvest of this salmon stock has been increasing since subsistence records were initiated in 1986. During 2008, 2009, and 2013, the Pasagshak River was the largest subsistence salmon fishery in the Kodiak Management Area (Figure 4; ADF&G Subsistence Database; KMA). During recent years prior to 2010, two other significant sockeye salmon runs near the City of Kodiak, Afognak and Buskin lakes, experienced significant reductions in run size, restricted fishing opportunities, and total subsistence fishing closures in some years (Baer et al. 2009; Dinnocenzo et al. 2009; Jackson et al. 2010). Such restrictions on stocks can displace users to other systems (Magdanz et al. 2003), leading to concern that without a weir in place, Pasagshak River sockeye salmon would incur increased harvest pressure while ADF&G was unable to monitor escapement in season.

Timely inseason estimates of Pasagshak River sockeye salmon escapement were made during 2011 through 2014 by operation of a weir near the outlet of Lake Rose Teed. Age, sex, and length (ASL) data was also collected with a trap attached to the upstream portion of the weir.

In addition to the installation and annual operation of the escapement monitoring weir, important information on subsistence effort at the Pasagshak River was obtained through harvester interviews conducted by ADF&G technicians. ASL data obtained from subsistence harvests augment ASL data obtained from the weir trap and provide valuable information on the harvest composition, size selectivity, and magnitude relative to escapement.

METHODS

The Pasagshak River weir was installed and fish tight on June 11, 2014 (Figure 5), approximately 300 m downstream of the outlet of Lake Rose Teed, and escapement was enumerated through August 12. Operation of the weir was conducted in accordance with the Pasagshak River salmon weir operational plan (Witteveen 2014). The gate to allow fish passage was opened daily, approximately every two to three hours between 7:00 AM and midnight. All species including sockeye, pink *O. gorbuscha*, chum salmon *O. keta*, and Dolly Varden *Salvelinus malma*, were enumerated.

During the high tidal cycles (with higher high tides of about 9.3 ft), a strong upstream current took place at the weir location. With the knowledge gained from the 2011 season that weir panels had to be secured to the tripods with Telespar®[1] and lagbolts, the weir was able to withstand those currents during 2012 through 2014. Changes to the river bottom during a high-water event in August 2013 created a narrower, deeper channel at the weir location. This created difficulty in 2014 with water levels that were close to the height of the weir panels during high tidal cycles.

ASL sampling from sockeye salmon caught in the fish trap was conducted with a season goal of 600 fish. All scales, when possible, were collected from the preferred area of each fish following procedures outlined by the International North Pacific Fisheries Commission (INPFC 1963). The "preferred scale" (located on the left side of the fish, two rows above the lateral line on the diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin) was

[1] Product names are included for completeness but do not constitute endorsement.

removed with forceps and mounted on a scale "gum" card. The sex and length of the fish (fish length in millimeters from mid eye to tail fork [METF]) was recorded to a rugged digital assistant, and the data was downloaded to a laptop computer daily.

All scales collected were mounted on scale cards and impressions were made on cellulose diacetate (Clutter and Whitesel 1956). Fish ages were assigned by examining scale impressions for annual growth increments using a microfiche reader fitted with a 48× lens following designation criteria established by Mosher (1968). Ages were entered directly into the salmon database using European notation (Koo 1962), in which a decimal separates the number of winters spent in fresh water (after emergence) from the number of winters spent in salt water.

Subsistence fishermen were interviewed, and ASL samples of their catch were taken. ADF&G technicians opportunistically contacted sockeye salmon subsistence fishermen on the fishing grounds in front of the Pasagshak River or at Pasagshak State Recreation Area boat landing; however, there was very limited opportunity due to low effort. Following a set of brief introductory remarks by the technician, all subsistence users who agreed to be interviewed were asked a short series of questions to determine their level of effort at Pasagshak River (Appendix A). An effort was made to conduct interviews in a weekly quantity proportional to subsistence effort.

RESULTS

The total sockeye salmon escapement through the Pasagshak River weir in 2014 was 1,582 fish (Table 1). In addition, 14 pink salmon and 1 chum salmon (Table 1) passed through the weir. Sockeye salmon escapement was well below the escapement goal of 3,000 fish. The daily sockeye salmon escapement peaked during mid-July. (Figures 6 and 7). Larger pulses of daily passage did not correlate as well with increasing tidal cycles (Figures 6 and 7) as observed in 2011; however, there appears to be some relationship between the two. Sockeye salmon were often observed holding in various portions of the river for several days before they approached and passed through the weir, so salmon entry in to the river may be related to tidal cycles but passage through the weir may be delayed, masking the relationship.

During early August, torrential rains and high water conditions caused the river level to rise above the weir panels. The excessive plant debris from the lake necessitated large amounts of effort to keep the weir clean to prevent erosion under the weir panels (Figure 8). With continued high tides and large amounts of rain forecasted, the weir was pulled on August 12 to prevent weir blowout and damage to weir components and to avoid unsafe working conditions. Due to the relatively low counts prior to the high water and the short amount of time until the targeted weir pullout date of August 15, the weir was not reinstalled when the water receded. Based on the counts during the week prior to the washout and observations by the weir crew, it was determined that a very small number of fish remained in the run, and no post-weir estimate was made.

Trapping fish at the weir for ASL samples continued to be difficult in 2014. Because fish were observed entering the trap and then going back downriver in 2013 despite a small trap opening, a cod trigger (a device typically used on a commercial cod pot) was fitted to the trap entrance. This required the fish to push through plastic "fingers" to enter the trap but then made it more difficult to escape the trap. This method was again used in 2014, but low escapement numbers limited the number of fish available to sample. On July 22, a moderate number of fish were observed schooling just behind the weir, so a beach seine was deployed, and 144 fish were caught and

sampled. A total of 178 ageable fish were sampled from the escapement during 2014 (Table 2). Due to low subsistence fishing effort, few fish were sampled from the subsistence fishery, with only 11 fish sampled.

The dominant age of Pasagshak River sockeye salmon escapement collected at the weir trap was age-1.3 fish, which composed about 70.6 percent of the escapement (Table 2). With such a small sample size, temporal trends in age compositions were not examined. The 2014 age composition structure was different from 2013, when age-0.3 were dominant (Witteveen 2013), but similar to 2012, when age-1.3 fish were dominant (Witteveen 2012). During the 2011 season, age-0.3 were dominant early in the season and diminished substantially throughout the season (Witteveen 2011).

Pasagshak River sockeye salmon are large compared to other Kodiak Management Area sockeye salmon (ADF&G Age, sex, and length salmon database) with an average length of 547 mm from the escapement (Table 3).

DISCUSSION

Passage of sockeye salmon through the Pasagshak River occurred primarily during July, later than most Kodiak-area early sockeye salmon runs but earlier than most late sockeye salmon runs (Foster 2011). Daily escapement seemed to be less dependent on tidal cycle (Figure 6) than during the 2011 season. Sockeye salmon escapement into Lake Rose Teed during 2014 was poor, with only about half of the escapement goal of 3,000 fish being achieved.

Age composition of Pasagshak River fish was primarily age-1.3 fish in 2014, but it also had a high proportion of age-0.3 fish. The high proportion of age-0.3 fish is less common in most Kodiak area sockeye salmon systems (Foster 2011). Age-0 fish are typically found in locations similar to the Pasagshak system, such as Cinder and Ilnik rivers and Upper Station. These systems have a significant estuarine environment, areas with significant marine nutrient input, a lack of deepwater overwintering area, or protected marine rearing environments (Foster 2011; Moore 2011).

The parent year for the dominant age-1.3 fish was 2009. Although there was not a weir in place in 2009, the aerial survey estimate of sockeye salmon escapement was only 1,400 fish, well below the escapement goal of 3,000 fish. Additionally, the parent year escapement for the age-0.3 fish (2010) met the escapement goal of 3,000 fish but was still rather low, with approximately 5,000 sockeye salmon escaping. Thus, with the parent years of the two main sockeye salmon age classes having lower-than-average escapement, it is reasonable to assume that this was part of the reason that the run was low this season. It is likely that other environmental factors such as temperature, freshwater nutrients, and ocean conditions played a role as well.

The variable age composition and varying age trends inseason suggest a dynamic system in which fish exhibit different life histories depending on variable fresh water conditions (Figure 9). It is reasonable to conclude that run size in this system could be widely variable between years. Although there is little data to draw from, it is possible that age-0.3 fish exhibit an odd-year dominance and age-1.3 fish exhibit an even-year dominance.

Subsistence harvest was too low to assess trends in effort, and Pasagshak Bay was closed to subsistence and commercial fishing on July 17. Subsistence harvest records are not available until later in the year.

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TABLES AND FIGURES

Table 1.–Daily and cumulative counts of salmon passage through the Pasagshak River weir, 2014.

	Number of Salmon					
	Daily	Sockeye		Pink		Chum
Date	Sockeye	Cumulative	Pink	Cumulative	Chum	Cumulative
11-Jun	0	0	0	0	0	0
12-Jun	0	0	0	0	0	0
13-Jun	1	1	0	0	0	0
14-Jun	0	1	0	0	0	0
15-Jun	0	1	0	0	0	0
16-Jun	16	17	0	0	0	0
17-Jun	0	17	0	0	0	0
18-Jun	32	49	0	0	0	0
19-Jun	0	49	0	0	0	0
20-Jun	44	93	0	0	0	0
21-Jun	0	93	0	0	0	0
22-Jun	0	93	0	0	0	0
23-Jun	0	93	0	0	0	0
24-Jun	31	124	0	0	0	0
25-Jun	11	135	0	0	0	0
26-Jun	0	135	0	0	0	0
27-Jun	5	140	0	0	0	0
28-Jun	1	141	0	0	0	0
29-Jun	23	164	0	0	0	0
30-Jun	1	165	0	0	0	0
1-Jul	0	165	0	0	0	0
2-Jul	7	172	0	0	0	0
3-Jul	88	260	0	0	0	0
4-Jul	8	268	0	0	0	0
5-Jul	0	268	0	0	0	0
6-Jul	0	268	0	0	0	0
7-Jul	0	268	0	0	0	0
8-Jul	0	268	0	0	0	0
9-Jul	12	280	0	0	0	0
10-Jul	19	299	0	0	0	0
11-Jul	0	299	0	0	0	0
12-Jul	51	350	0	0	0	0
13-Jul	11	361	0	0	0	0
14-Jul	49	410	0	0	0	0
15-Jul	53	463	0	0	0	0
16-Jul	5	468	0	0	0	0
17-Jul	80	548	0	0	0	0
18-Jul	78	626	0	0	0	0
19-Jul	52	678	0	0	0	0

-continued-

Table 1.–Page 2 of 2.

	Number of Salmon					
Date	Sockeye Adults	Sockeye Cumulative	Pink	Pink Cumulative	Chum	Chum Cumulative
20-Jul	88	766	0	0	0	0
21-Jul	0	766	0	0	0	0
22-Jul	54	820	0	0	0	0
23-Jul	104	924	0	0	0	0
24-Jul	9	933	0	0	0	0
25-Jul	46	979	0	0	0	0
26-Jul	3	982	0	0	0	0
27-Jul	16	998	0	0	0	0
28-Jul	0	998	0	0	0	0
29-Jul	187	1,185	0	0	0	0
30-Jul	0	1,185	0	0	0	0
31-Jul	16	1,201	5	5	0	0
1-Aug	0	1,201	0	5	0	0
2-Aug	0	1,201	0	5	0	0
3-Aug	0	1,201	0	5	0	0
4-Aug	0	1,201	0	5	0	0
5-Aug	2	1,203	0	5	0	0
6-Aug	85	1,288	1	6	0	0
7-Aug	21	1,309	0	6	0	0
8-Aug	104	1,413	8	14	0	0
9-Aug	67	1,480	0	14	0	0
10-Aug	2	1,482	0	14	0	0
11-Aug	68	1,550	0	14	1	1
12-Aug	32	1,582	0	14	0	1

Table 2.–Estimated age composition of Pasagshak River sockeye salmon escapement, 2014 (interpolated between sampling events).

			Ages								
Stat Week	Sample Fish		0.2	0.3	0.4	1.2	1.3	1.4	2.2	2.3	Total Fish
24 (June 11-13)	0	Percent	0	0	0	0	100	0	0	0	100
		Numbers	0	0	0	0	1	0	0	0	1
25 (June 14-20)	0	Percent	0	0	0	0	100	0	0	0	100
		Numbers	0	0	0	0	92	0	0	0	92
26 (June 21-27)	0	Percent	0	0	0	0	100	0	0	0	100
		Numbers	0	0	0	0	47	0	0	0	47
27 (June 28 - July 4)	1	Percent	0.1	0.1	0.0	0.1	99.7	0.0	0.0	0.1	100.0
		Numbers	0	0	0	0	128	0	0	0	128
28 (July 5-11)	0	Percent	2.7	2.4	0.0	4.4	88.1	0.0	0.7	1.8	100.0
		Numbers	1	1	0	2	26	0	0	1	31
29 July 12-18)	0	Percent	6.4	5.8	0.0	10.6	71.3	0.0	1.6	4.2	100.0
		Numbers	22	20	0	36	229	0	5	15	327
30 (July 19-25)	119	Percent	8.5	7.8	0.9	14.2	60.6	0.0	2.1	5.7	100.0
		Numbers	31	28	3	51	213	0	8	20	353
31 (July 26 - Aug 1)	12	Percent	2.3	1.9	6.5	3.8	82.5	0.3	0.7	2.0	100.0
		Numbers	3	3	16	5	191	0	1	2	222
32 (Aug 2-8)	46	Percent	6.9	3.5	3.4	10.4	58.5	3.5	3.5	10.4	100.0
		Numbers	18	9	5	28	106	9	9	28	212
33 (Aug 9-12)	0	Percent	8.7	4.3	2.2	13.0	50.0	4.3	4.3	13.0	100.0
		Numbers	15	7	4	22	85	7	7	22	169
Totals	178	Percent	5.7	4.3	1.7	9.1	70.6	1.1	1.9	5.5	100.0
		Numbers	90	68	27	144	1,118	17	31	88	1,582

Table 3.–Length composition of Pasagshak River sockeye salmon escapement samples by age and sex, 2014.

	Ages								
	0.2	0.3	0.4	1.2	1.3	1.4	2.2	2.3	Total
Mean Length Females	489	519	521	489	540	568	504	494	522
Standard Error Females	9.8	16.4	0.0	8.9	4.9	2.5	26.5	29.1	4.2
Range Females	465-580	435-560	521-521	426-538	425-632	565-570	477-530	445-562	425-632
Sample Size Females	11	7	1	12	49	2	2	4	88
Mean Length Males	535	563	630	533	584	0	555	577	571
Standard Error Males	21.8	12.4	0.0	12.8	3.2	0.0	12.6	15.9	4.1
Range Males	485-600	520-600	630-630	384-579	540-640		530-570	444-620	384-640
Sample Size Males	5	6	1	14	51	0	3	10	90
Mean Length	503	539	576	512	562	568	534	553	547
Standard Error	10.7	11.9	54.5	9.0	3.6	2.5	16.6	17.0	3.5
Range	465-600	435-600	521-630	384-579	425-640	565-570	477-570	444-620	384-640
Sample Size	16	13	2	26	100	2	5	14	178

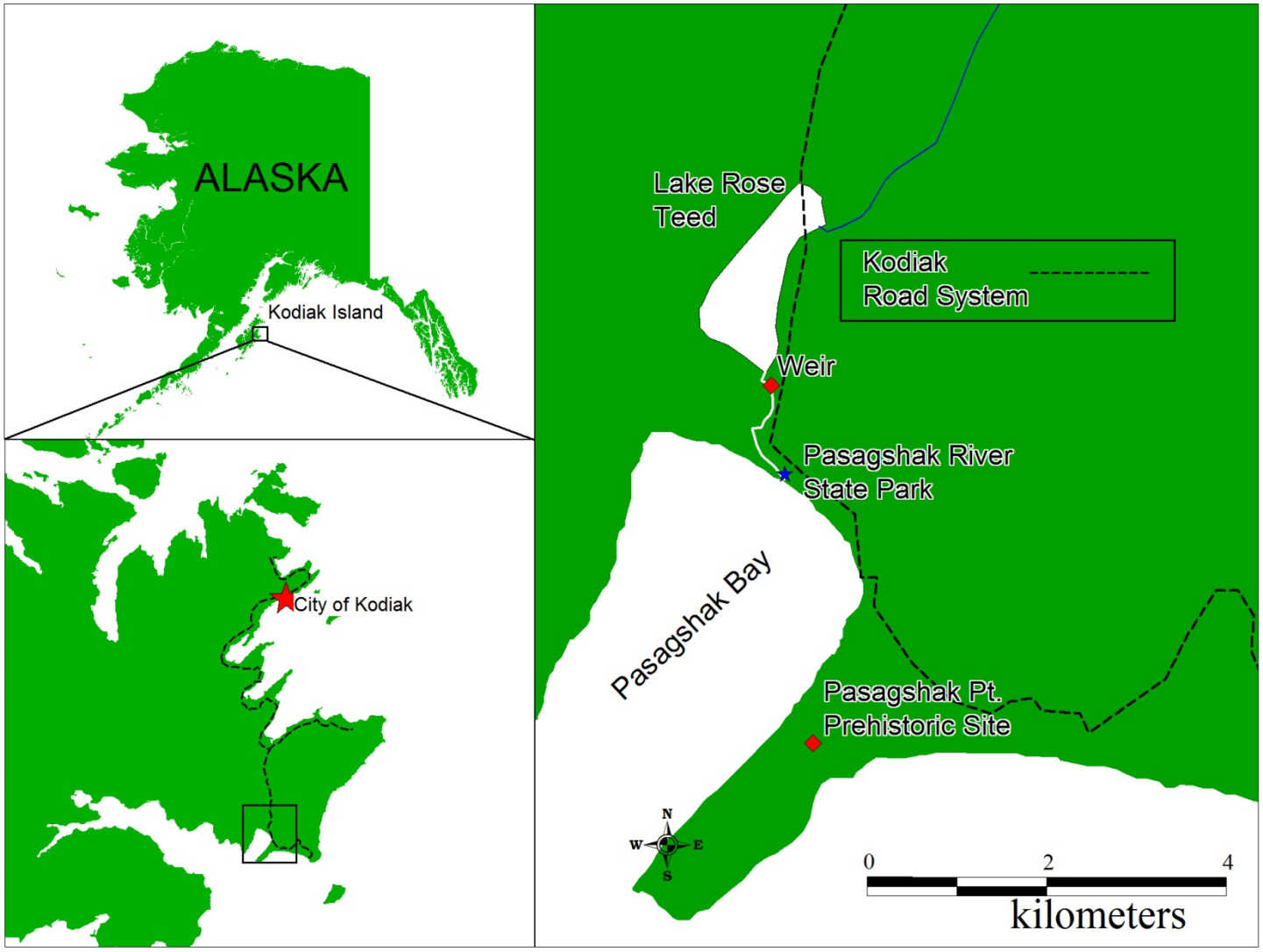

Figure 1.–Map depicting Pasagshak Bay and Lake Rose Teed area on the Kodiak road system.

Figure 2.–Aerial view of Pasagshak River State Recreation Area.

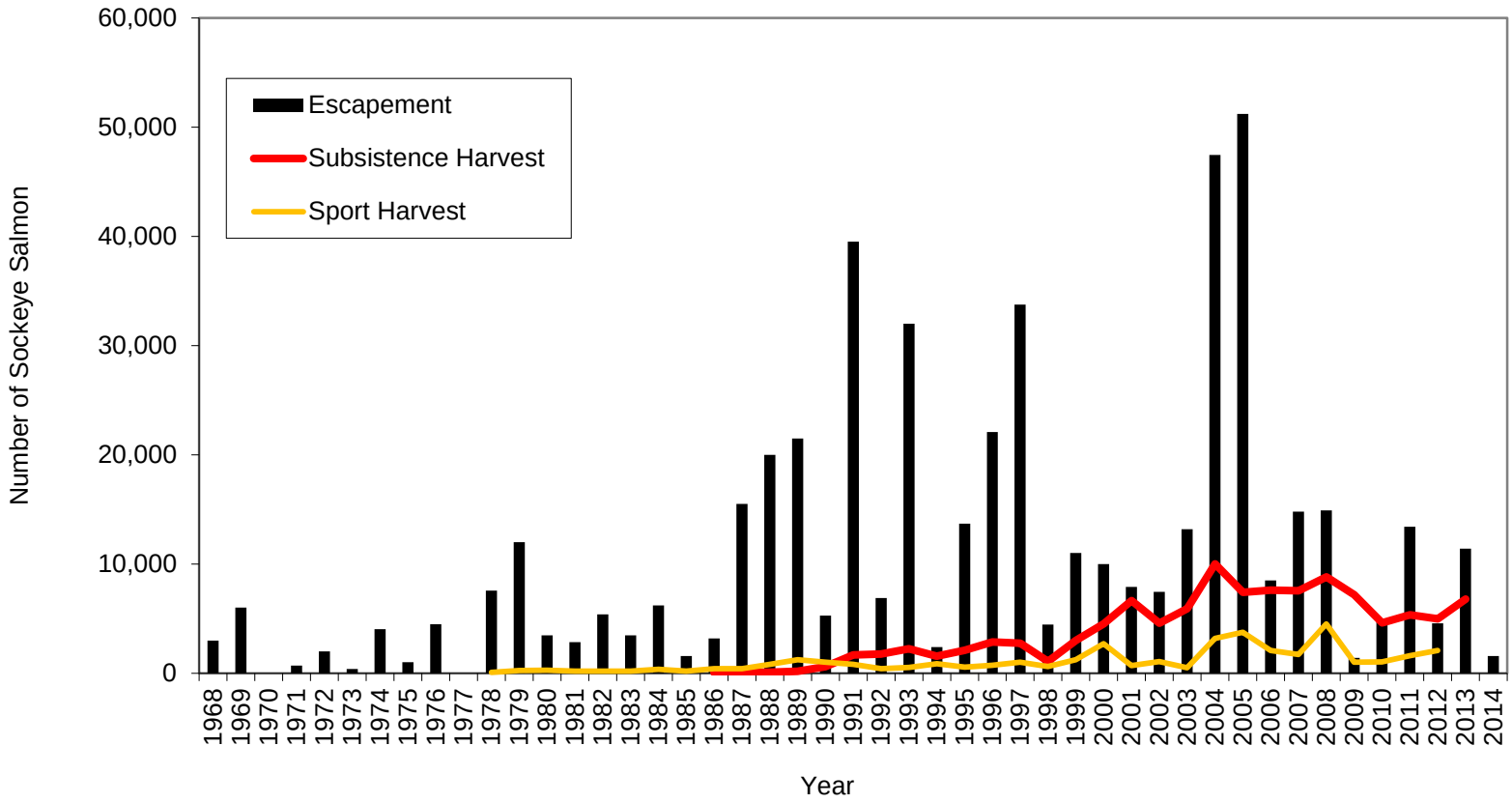

Figure 3.–Historical estimated sockeye salmon escapement and sport and subsistence harvest at Pasagshak River.

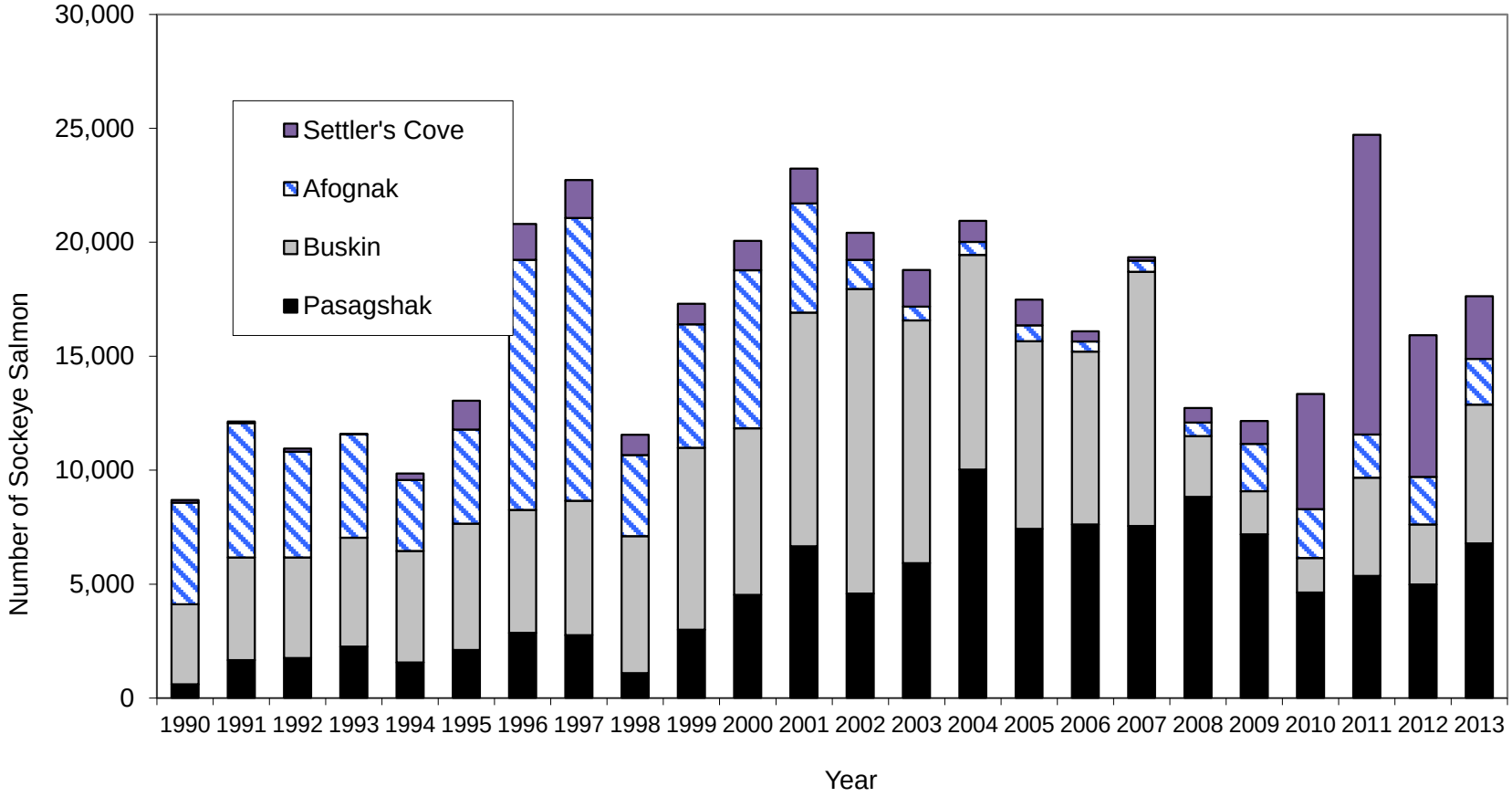

Figure 4.–Historical sockeye salmon subsistence harvest estimates for four important subsistence systems near the City of Kodiak.

Figure 5.–Pasagshak Weir fish tight on June 11, 2014.

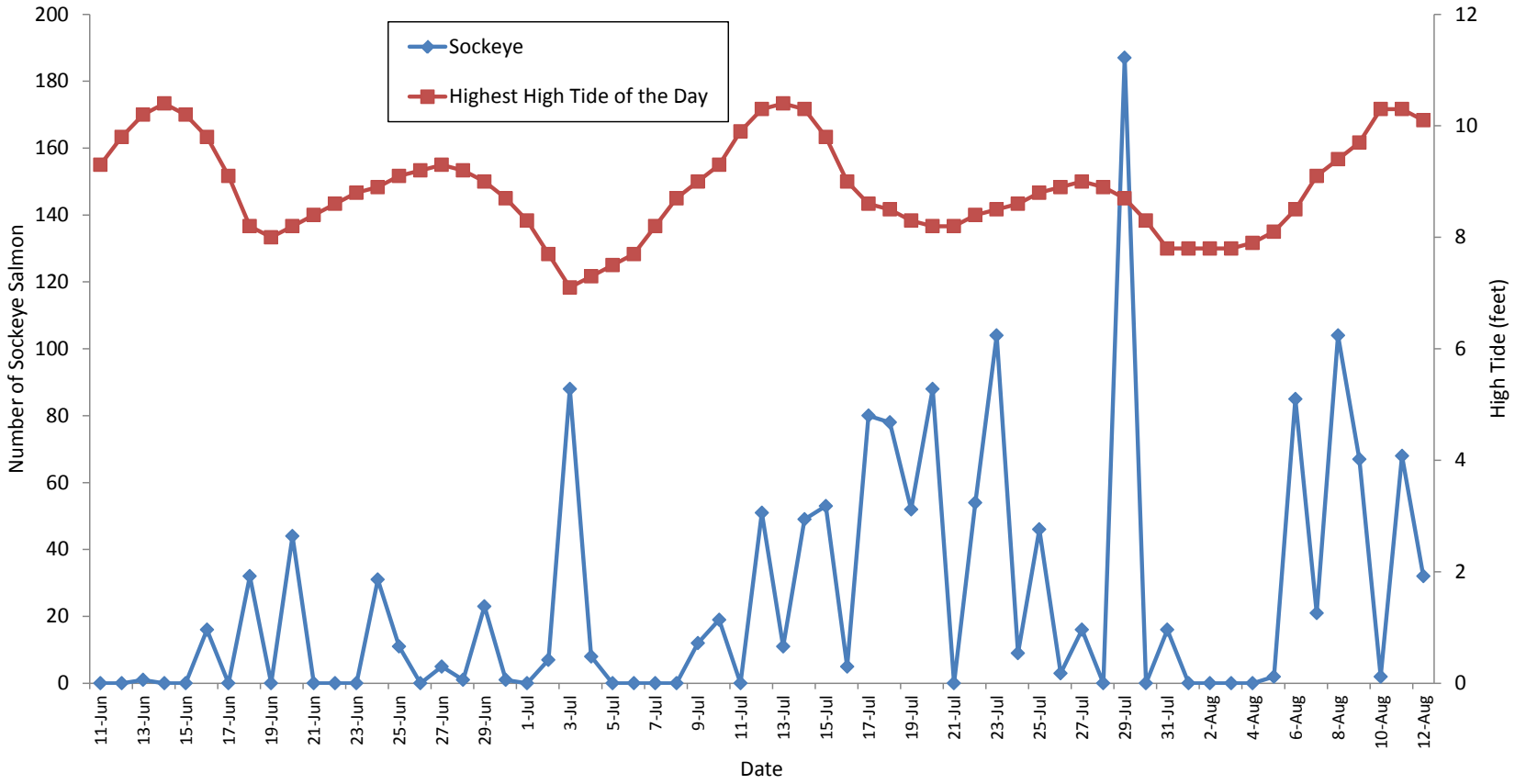

Figure 6.–Daily sockeye salmon passage through the Pasagshak River weir and the corresponding highest high tide of the day, 2014.

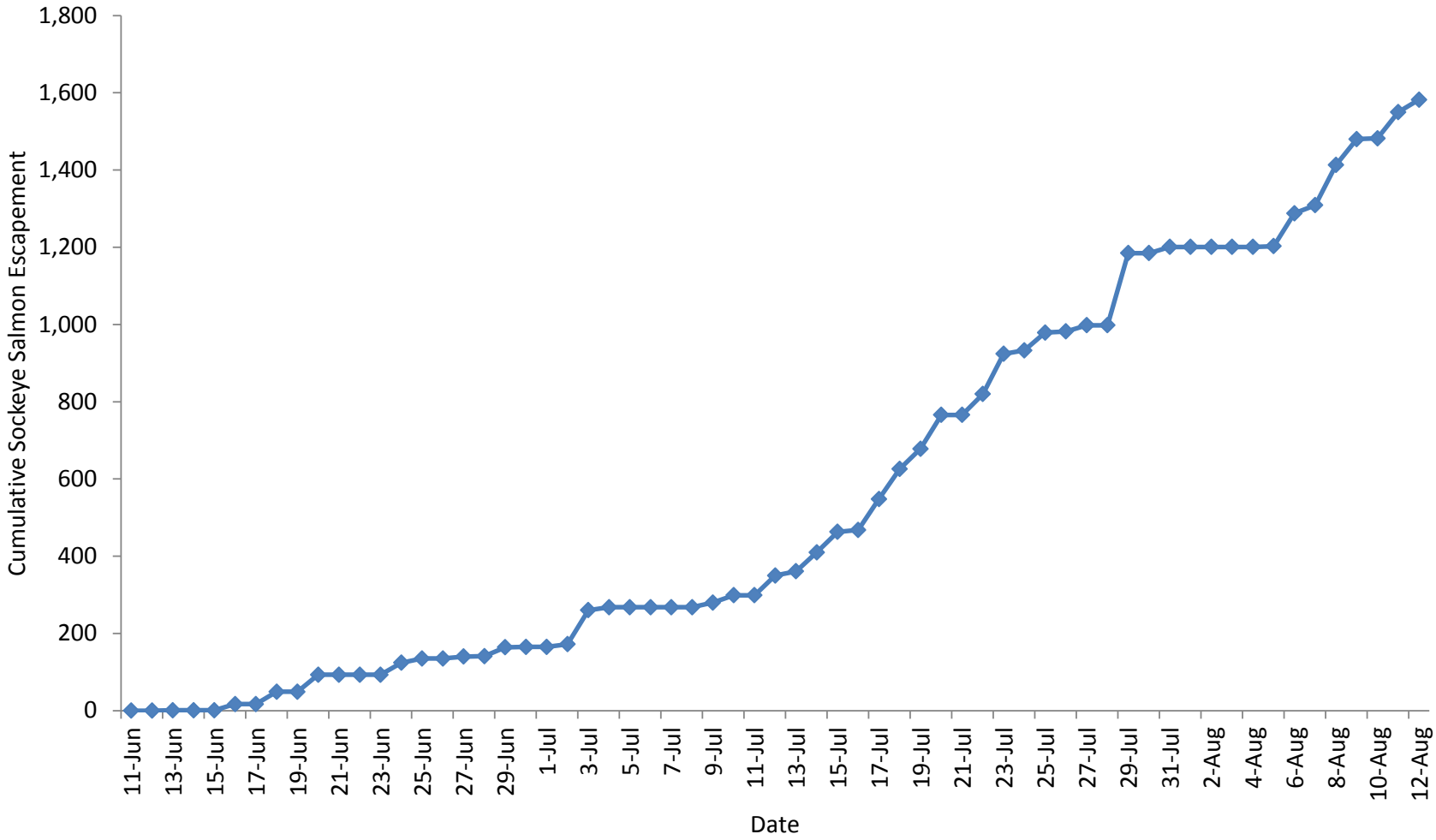

Figure 7.–Pasagshak River sockeye salmon cumulative escapement by day, 2014.

Figure 8.–Pasagshak River with high water conditions and extreme amounts of debris during weir removal on August 12.

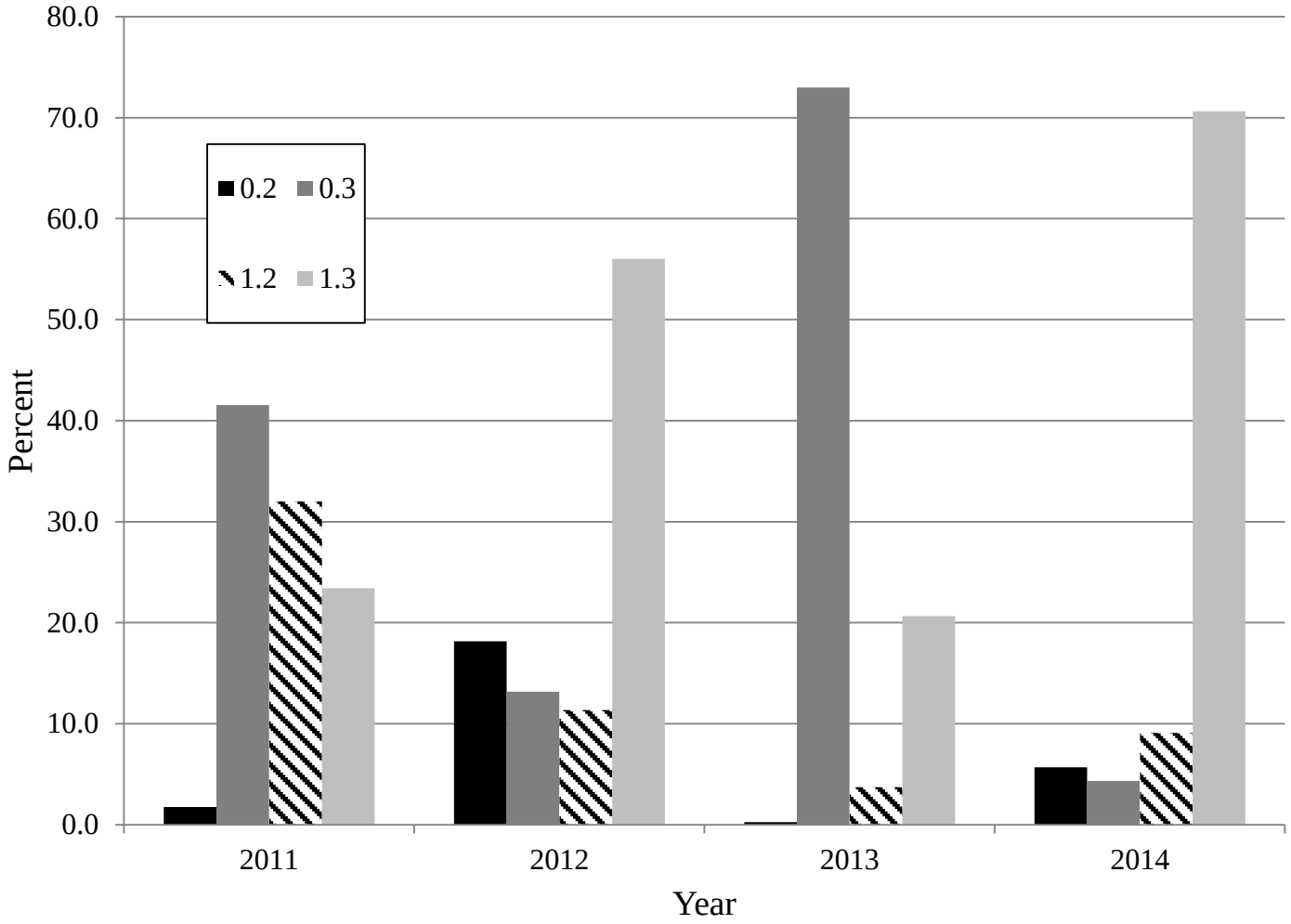

Figure 9.–Major age-class percentage of Pasagshak River sockeye salmon escapement, 2011–2014.

APPENDIX A. SUBSISTENCE FISHERY INTERVIEW FORM

Appendix A1.–Subsistence fishery interview form.

Daily Pasagshak Subsistence Fishery Data Sheet

Date: _____ Personnel: _____

Wx: _____

Peak Estimate of Effort
(Units of gear/boats)

Fishermen Interviews

Fisherman Name (Optional)	Number of Nets	Mesh Size	Hours Fished	Number of Sockeye Salmon Caught	# Collected For ASL	Card #	Fish #