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Abundance, Run Timing, and Age, Sex, and Length Composition of Adult Chinook Salmon in the Funny River, Kenai Peninsula, Alaska, 2014

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Abundance, Run Timing, and Age, Sex, and Length Composition of Adult Chinook Salmon in the Funny River, Kenai Peninsula, Alaska, 2014

Kenneth S. Gates and James K. Boersma

Abstract

A fish weir equipped with an underwater video system was installed and operated in the Funny River between 25 April and 30 July 2014 to collect demographic information about adult Chinook Salmon *Oncorhynchus tshawytscha*. The total escapement of adult Chinook Salmon into the Funny River was 1,308. Several non-target species were enumerated and included 412 Dolly Varden *Salvelinus malma*, 138 Rainbow Trout/Steelhead *O. mykiss*, 35 Pink Salmon *O. gorbuscha*, 7 Sockeye Salmon *O. nerka*, and 30 Round Whitefish *Prosopium cylindraceum*. Peak weekly Chinook Salmon passage occurred between 29 June and 5 July (*n*=422). Age, sex, and length sampling occurred from 10 June to 18 July and resulted in 385 samples. Sex was determined for nearly the entire (99.2%) population of Funny River Chinook Salmon through examination of video records and active sampling. Female Chinook Salmon comprised 24% of the escapement and averaged 789 mm in length (mid eye to tail fork). The average mid eye to tail fork length of male Chinook Salmon sampled was 612 mm. Ages of Chinook Salmon determined from scale analysis ranged from 3 to 7 years.

Introduction

The Kenai River traditionally is one of the largest recreational fisheries for Chinook Salmon *Oncorhynchus tshawytscha* in Alaska (Nelson et al. 1999), with an annual in-river sport fishery effort that was often in excess of 250,000 fishing hours (Eskelin 2010). Annual abundance estimates of adult Chinook Salmon returning to the Kenai River indicate that recent returns remain at historical lows resulting in in-season management actions to restrict harvest in commercial, sport, personal use, and Federal subsistence fisheries. The recent declines in productivity and abundance highlight the need for continued intensive management and research programs focusing on Kenai River Chinook Salmon stocks (Alaska Department of Fish and Game Chinook Salmon Research Team 2013).

A series of radiotelemetry studies and in-river abundance estimation techniques have identified differential run times and spawning distributions for Chinook Salmon returning to the Kenai River. Indices of run strength for Chinook Salmon entry times into the Kenai River indicate a bimodal distribution with the early component of the run peaking between 8 and 20 June and a later component peaking between 17 and 25 July (Hammarstrom and Larson 1986; Conrad and Larson 1987; Conrad 1988; Carlon and Alexandersdottir 1989; Alexandersdottir and Marsh 1990; Miller et al. 2011; Reimer 2013).

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Chinook Salmon returning to the Kenai River during May and June are referred to as "early-run" fish spawning primarily in tributaries during late July and early August (Burger et al. 1983, 1985; Reimer 2013). All radiotelemetry studies to date conclude that most early-run fish spawn in the Killey (42% to 66%) and Funny (10% to 21%) rivers while the remainder spawn in smaller tributaries (3% to 10%) and the main-stem Kenai River (9% to 28%) (Burger et al. 1985; Bendock and Alexandersdottir 1991, 1992; Reimer 2013). Chinook Salmon entering the Kenai River during July and August are considered "late-run" fish and almost exclusively spawn during August and early September in the main-stem Kenai River (Burger et al.1985; Bendock and Alexandersdottir 1991, 1992; Reimer 2013). Each run, early and late, are managed independently primarily because of differences in run size, run timing, and spatial distribution of spawning fish. Recognizing this, the Alaska Board of Fisheries (BOF) adopted independent management plans for early-run fish entering the river during May and June, and late-run fish entering the river after 30 June (McBride et al. 1989).

Chinook Salmon returning to the Funny River are considered part of the early run, with run timing in the lower Kenai River beginning during late May (Reimer 2013). Many Chinook Salmon destined for the Funny River and other tributaries tend to mill for long periods in the main-stem Kenai River at or below their destination confluence (Burger et al.1983; Bendock and Alexandersdottir 1991, 1992; Reimer 2013), and are thus susceptible to harvest throughout most of July (Bendock and Alexandersdottir 1991, 1992; Reimer 2013). Funny River spawners exhibit this behavior along the south bank of the Kenai River between river kilometers (rkm) 45 and 48. In 1992, BOF adopted a fishery closure to prevent anglers from targeting Chinook Salmon staging at the mouth of the Funny River. Additional protective measures were enacted in 1996 closing the confluence and the first half-mile of the Funny River to all fishing to prevent anglers from catching Chinook Salmon while ostensibly fishing for other species (Gamblin et al. 2004).

Most early-run Chinook Salmon harvest occurs during May and June in the main-stem Kenai River sport fishery. Harvest also occurs, although not in great numbers, in three other fisheries: the Central Cook Inlet marine sport fishery, the Upper Cook Inlet Sub-district set gillnet commercial fishery, and an in-river educational fishery (McKinley and Fleischman 2013). Sport harvest of early-run Chinook Salmon is monitored by the Alaska Department of Fish and Game (Department) through an in-river creel survey between the Warren Ames Bridge at rkm 8 and the Soldotna Bridge at rkm 32, and through the Statewide Harvest Survey between the Soldotna Bridge and Kenai Lake (rkm 132). From 1986 through 2013, annual sport harvests ranged from 0 to 15,209 fish and averaged 4,739 fish annually (McKinley and Fleischman 2013; Alaska Department of Fish and Game 2013a). No harvest of early-run fish occurred prior to 30 June during 2013 and 2014 because the in-river sport fishery was either restricted to catch and release (2013) or closed (2014) during the early run (Alaska Department of Fish and Game 2013b; Alaska Department of Fish and Game 2014a). However, some early-run Chinook Salmon were available to harvest during the late-run Chinook Salmon fishery from 1-12 July 2013 (Reimer 2013). Actual numbers of early-run Chinook salmon available to harvest during the late-run Chinook Salmon fishery are unknown, vary among years (Reimer 2013), and are largely dependent on areas open to fishing and harvest. Much of the annual variation in harvest since 1986 is likely explained by fluctuations in run strength, changes in management strategy, environmental conditions affecting fishing success, and in-season liberalization or restriction of the sport fishery.

The number of early-run Chinook Salmon returning to the Kenai River has been estimated since 1986 using various sonar technologies at rkm 13.8; however, accurate estimates of Chinook Salmon numbers using sonar tools has proven difficult. The Department recently reconstructed the Kenai River Chinook Salmon run using a state space model that incorporates a number of measures of relative abundance to provide more robust historical annual abundance estimates. The resulting estimates ranged from 5,605 to 23,460 fish between 1986 and 2012 (McKinley and Fleischman 2013). Dual frequency identification sonar (DIDSONTM) has been deployed at two sites within the Kenai River since 2013 (rkm 13.8 and 22) in an attempt to permanently relocate the sonar program and provide more accurate estimates of abundance. The resulting early-run estimates were 2,037 (rkm 13.8) and 2,366 (rkm 22) Chinook Salmon during 2013 (Alaska Department of Fish and Game 2013a). The 2014 sonar estimate at rkm 13.8 was 5,311 Chinook Salmon (Alaska Department of Fish and Game 2014b). The upriver sonar information for 2014 is currently unavailable. The Department manages the early-run fishery to achieve a watershedwide optimal escapement goal (OEG) of 5,300 to 9,000 Chinook Salmon, as mandated by the Kenai River and Kasilof River Early-Run King Salmon Management Plan (5 AAC 57.160). The OEG is achieved primarily through restrictions and liberalizations of the in-river recreational fishery because most early-run fish are harvested by sport anglers. Management actions are triggered when the lower OEG limits are not met or the upper limits are exceeded (McKinley and Fleischman 2010). Disproportionately harvesting early- or late-run fish could be detrimental to smaller populations of early-run Chinook Salmon (McKinley et al. 2002).

In addition to specific management plans that outline escapement goal ranges, the State of Alaska Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222(c)(2)(d)) also mandates that Salmon escapements be managed "to maintain genetic and phenotypic characteristics of the stock by assuring appropriate geographic and temporal distribution of spawners as well as consideration of size range, sex ratio, and other population attributes". To actively address this mandate, a slot limit protecting fish between 40 and 55 inches total length (TL; 1,016–1,397 mm), was adopted by the BOF in 2002 to reverse a declining proportion of ocean-age-5 Chinook Salmon within the early run. This slot limit was contracted in 2003 protecting fish between 44 and 55 inches TL (1,118–1,397 mm), and again in 2008 protecting fish between 46 and 55 inches TL (1,168–1,397 mm; McKinley and Fleischman 2010). Recently at the 2014 Upper Cook Inlet BOF meeting, the slot limit was again addressed resulting in the lower end of the slot limit being lowered to 42 inches from 46 inches TL (Alaska Department of Fish and Game 2014c).

The abundance and relative contribution of individual tributary stocks provide important inseason and historical data sets that inform management actions and provide the basis for the validation of larger mixed-stock abundance estimates. The need for this unbiased accurate information prompted the development of the Funny River study in 2006. Since 2006, the primary focus has been on estimating abundance and run timing and characterizing the age, sex, and length structures of adult Chinook Salmon returning to the Funny River. Secondarily, the project has also provided the Department with information to populate a stock-specific abundance and run-timing (SSART) model.

The SSART model is designed to produce an independent abundance estimate for Kenai River Chinook Salmon, which is used to investigate bias associated with the abundance estimates produced by the Department's newer DIDSONTM. To accomplish this, the Department and the U.S. Fish and Wildlife Service (Service) entered into a cooperative agreement during 2012 to

focus on adult Chinook Salmon. The information collected at the Funny River weir will be used in conjunction with abundance estimates produced from other tributaries monitored with weirs including the Killey River, Quartz Creek, Slikok Creek, and Russian River.

Our study during 2014 used a resistance board weir and fish trap in conjunction with an underwater video system to: (1) enumerate adult Chinook Salmon entering the Funny River, (2) determine the run timing of Chinook Salmon entering the Funny River, and (3) estimate the age, sex and length composition of the Chinook Salmon escapement into the Funny River. Information pertaining to the run size, timing, age, sex and genetic composition of Chinook Salmon returning to the Funny River will provide managers valuable information to refine existing management strategies.

Study Area

The glacially turbid Kenai River originates in Cooper Landing at the outlet of Kenai Lake and flows 132 km before entering Cook Inlet (Figure 1). The watershed consists of mountains, glaciers, forests, and the Kenai Peninsula's second and third largest lakes, Skilak and Kenai lakes. The Funny River, one of several tributaries, enters the Kenai River at rkm 49 (60° 29.47'N and 150° 51.92'W; WGS84). The Funny River drains approximately 218 km² and most of the watershed lies within the Kenai National Wildlife Refuge. The river channel near the weir location has a moderate gradient, moderate to high sinuosity, and predominately coarse gravel substrate. Vegetation along the banks and throughout the floodplain consists primarily of willow *Salix* spp. and alders *Alnus sinuata* with some stands of spruce *Picea* spp. (Moser 1997). Water depth varies throughout the channel but is usually deepest near the outside bends and shallowest through the crossovers.

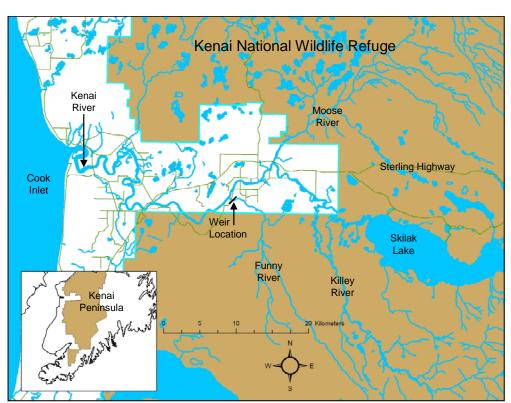


FIGURE 1. —Map of the Kenai River watershed downstream of Skilak Lake showing the weir location on Funny River.

Methods

Weir and Video Operations and Design

A resistance board weir and underwater video system was operated in the Funny River approximately 1.1 km upstream of the bridge crossing the Funny River Road from 25 April through 30 July 2014. The weir was constructed using a combination of floating resistance board panels and rigid-picket panels. The floating resistance board panels were constructed using specifications outlined by Tobin (1994), with minor changes to some materials, panel width, and resistance boards. The panels were attached to a steel rail anchored to the river bottom and were configured to pass fish near the deepest part of the channel through a passage panel. The rigid-picket panels were installed between the bank and bulkhead of the resistance board weir to create a fish-tight weir. The rigid-picket panel framework was comprised of an "A" frame constructed from three pieces of 6.4-cm aluminum angle and two additional 2.1-m pieces of aluminum angle, drilled with 28.6-mm holes every 3.2 cm, spanning between the bulkhead and the "A" frame. Individual pickets were inserted into the framework by sliding them through the drilled holes. Pickets were schedule 40 aluminum pipe measuring 25-mm in diameter by 1.8-m in length. The weir was unmanned, except when maintenance was required, and was outfitted with an underwater video monitoring system to monitor upstream fish passage. A live trap facilitated biological sampling and was attached upstream of the fish passage panel. The video system, consisting of a sealed camera box and fish passage chute, was attached upstream of the live trap.

Setup and design of the video system was similar to that used by Gates et al. (2010) in Crooked and Nikolai creeks, and Anderson et al. (2004) in Big Creek. One underwater video camera was located inside a sealed video box attached to the fish passage chute. The video box was constructed of 3.2-mm aluminum sheeting and was filled with filtered water. Safety glass was installed on the front of the video box for a scratch-free, clear surface through which images were captured. The passage chute was constructed from aluminum angle and was enclosed in plywood isolating it from exterior light. The backdrop of the passage chute could be adjusted laterally to reduce the number of fish passing through the chute at one time and to guide fish closer to the camera during turbid water conditions. The backdrop could also be easily removed from the video chute for cleaning and replacement when needed. The video box and fish passage chute were artificially lit using a pair of 12-V DC underwater pond lights. Pond lights were equipped with 20-W bulbs which produced a quality image and provided a consistent source of lighting during day and night. All video images were recorded on an external 500 gigabyte hard drive at 30 frames-per-second using a computer-based digital video recorder (DVR). The DVR was equipped with motion detection to minimize the amount of blank video footage and review time. Fish passage was recorded 24 hours per day 7 days each week. Stored video files were generally reviewed daily. All video equipment was supplied with 110-V AC power and converted to 12-V DC for the underwater camera and lights. A 1,000-W charger/inverter was used in-line with two 6-V DC batteries rated at 400 Ampere-hours creating a large battery backup in the event of a power outage. Appendix 1 contains a complete list of all equipment used.

Biological Sampling

Data on fish age, sex, and length (ASL) were collected from Chinook Salmon using a temporally stratified sample design (Cochran 1977). Sampling effort was divided into strata and was scaled in real time to consistently sample at least 20% of the run from one stratum to the next. Each

stratum was a calendar week consisting of 7 days in which sampling took place in proportion to the Chinook Salmon run. Samples were collected as quickly as possible within each stratum to minimize fish handling and sampling effort.

The ASL sampling consisted of sex determination, length measurements, and scale collections. Sex was determined by observing external characteristics during video review and stratified ASL sampling. Females were identified as having blunt-shaped heads, presence of an ovipositor (ASL sampling only), and a round-shaped belly, whereas males generally exhibit a prolonged head accompanied with a kype, a gradual dorsal hump, and a stream-lined belly. Length measurements for Chinook Salmon were taken to the nearest 5 mm from mid eye to tail fork (MEF) and from the tip of the nose to the tail fork. Only MEF measurements are reported herein. Scales were removed from the preferred area using methods described by Mosher (1968) and Koo (1962). The preferred area is located on the left side of the fish, two scale rows above the lateral line and on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin. Four scales were taken from each Chinook Salmon, mounted on gummed cards, and pressed on acetate to make an impression. Chinook Salmon scales were aged by the Service. Scale analysis and reporting methods are described by Mosher (1969). Age determinations for Chinook Salmon include the number of years spent in fresh water as a juvenile and the number of years spent in salt water as an adult.

Data Analysis

Age and sex composition for the total escapement of Chinook Salmon were estimated directly from the age and sex composition in the weekly weir sample using a stratified sampling design (Cochran 1977), with the escapement in each stratum as a weight. Age (i) and sex (j) specific escapements in a stratum (h), A_{hij} , and their variances, $V[A_{hij}]$ were estimated as:

$$\hat{A}_{hij} = N_h \hat{P}_{hij} \tag{1}$$

and

$$\hat{V}[\hat{A}_{hij}] = \hat{N}_{h}^{2} \left(1 - \frac{n_{h}}{N_{h}}\right) \left(\frac{\hat{P}_{hij}(1 - \hat{P}_{hij})}{n_{h} - 1}\right)$$
(2)

where

 N_h = total escapement during stratum h;

 \hat{p}_{hii} = estimated proportion of age *i* and sex *j* fish in stratum *h*; and

 n_h = total number of fish in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to estimate age and sexspecific escapements for the season as follows:

$$\hat{A}_{ij} = \sum_{h} \hat{A}_{hij} \tag{3}$$

and

$$\hat{V}\left[\hat{A}_{ij}\right] = \sum_{h} \hat{V}\left[\hat{A}_{hij}\right]. \tag{4}$$

Results

The weir and video system were installed on 25 April and operated smoothly until removal on 30 July after no Chinook Salmon passage was observed for three consecutive days.

Biological Data

Chinook Salmon. — A total of 1,308 Chinook Salmon were enumerated at the Funny River weir during 2014. Chinook Salmon were observed passing through the weir from 12 May to 27 July (Figure 2; Appendix 2). Peak weekly weir passage (n=422) occurred between 29 June and 5 July. The highest daily count (n=107) occurred on 3 July and the median cumulative passage occurred on 30 June.

Age, sex, and length samples were collected from 385 Chinook Salmon between 10 June and 18 July. Seven percent (n=28) of the sampled fish were excluded from the ASL analysis because of inconclusive age determinations or missing length information. Of the aged scales, female Chinook Salmon were comprised of four age groups, ages 1.3 (80.8%), 1.4 (16.4%), 2.3 (1.4%), and 2.4 (1.4%). Male Chinook Salmon were comprised of six age groups, ages 1.1 (6%), 1.2 (69%), 1.3 (20.4%), 1.4 (1.8%), 2.2 (1.4%). and 2.3 (1.4%; Tables 1 and 2). Age-1.2 males comprised 52.4% of the total run (Table 2). Overall, the ASL sample was comprised of 20.4% (n=73) females averaging 789 mm in length (MEF; Tables 1 and 2). Male MEF lengths averaged 612 mm. Combined male and female MEF lengths averaged 648 mm and ranged from 300 mm to 985 mm (Table 2; Figure 3). The estimated sex composition for the entire run of Chinook Salmon including both ASL and video records was 24% female (Appendix 2). Sex ratios favored males throughout most of the run (Figure 4).

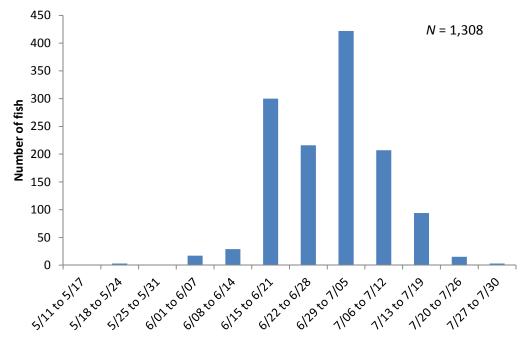


FIGURE 2. —Weekly passage of adult Chinook Salmon through the Funny River weir during 2014. Chinook Salmon were observed passing upstream through the weir from 12 May to 27 July.

TABLE 1. —Length-at-age for adult Chinook Salmon sampled at the Funny River weir during 2014.

			Mid Eye to Tail Fork Length			
Sex	Age	n ^a	Mean	Range	Standard Error	
Female	1.3	59	775	710 - 855	3.7	
	1.4	12	863	785 - 975	15.1	
	2.3	1	770	N/A	N/A	
	2.4	1	775	N/A	N/A	
Female Total		73	789	710 - 975	9.5	
Male	1.1	15	439	300 - 600	25.5	
	1.2	198	589	400 - 800	4.1	
	1.3	57	715	535 - 885	10.7	
	1.4	6	848	780 - 985	28.7	
	2.2	4	545	500 - 600	20.6	
	2.3	4	651	570 - 730	34.5	
Male Total		284	612	300 - 985	5.8	
Cumulative Total		357	648	300 - 985	6.1	

^a Fish with inconclusive ages were omitted from this table (n=28)

TABLE 2. —Age and sex composition for Chinook Salmon returning to the Funny River during 2014.

	_	Brood Year and Age Group							
		2011 2010		2009		2008		2007	
		1.1	1.2	1.3	2.2	1.4	2.3	2.4	Total
Sample p	eriod: 10 June to 18 July								
Female:	Number in sample:			59		12	1	1	73
	Percent age group			80.8		16.4	1.4	1.4	100
	Estimated escapement:			253		52	4	4	313
	Percent of sexed escapement:			19.5		4.0	0.3	0.3	24
	Standard error:			12.7		12.0	3.8	3.8	
Male:	Number in sample:	15	198	57	4	6	4		284
	Percent age group:	5.3	69.7	20.1	1.4	2.1	1.4		100
	Estimated escapement:	52	686	197	14	21	14		984
	Percent of sexed escapement:	4.0	52.9	15.2	1.1	1.6	1.1		76
	Standard error:	11.0	22.7	19.8	5.8	7.1	5.8		
Total:	Number in Sample:	15	198	116	4	18	5	1	357
	Estimated Escapement:	52	686	450	14	73	18	4	1297 ^a
	Percent of sexed escapement:	4.0	52.9	34.7	1.1	5.6	1.4	0.3	100

^a Total Chinook salmon passage with sex determined from video review and age, sex, and length sampling. Chinook salmon with inconclusive sex determinations were omitted from this analysis (n=11).

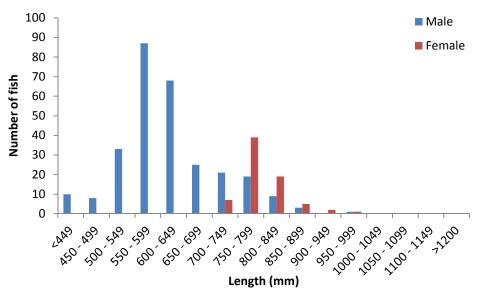


FIGURE 3. —Mid eye to tail fork length frequency distribution of male and female Chinook Salmon sampled at the Funny River during 2014.

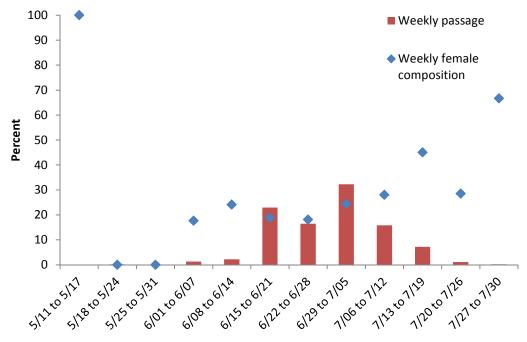


FIGURE 4. —Weekly passage (%) of Chinook Salmon including adult female Chinook Salmon composition (%) observed at the Funny River video weir from 12 May to 30 July, 2014. Passage includes video review and ASL sampling.

Other species. —Five additional fish species observed passing the Funny River weir included 412 Dolly Varden Salvelinus malma, 138 Rainbow Trout/Steelhead O. mykiss, 35 Pink Salmon O. gorbuscha, 7 Sockeye Salmon O. nerka, and 30 Round Whitefish Prosopium cylindraceum (Appendix 3).

Discussion

The use of underwater video is an inexpensive and reliable method to collect abundance, run timing, and sex information for Chinook Salmon in the Funny River. The observed weir passage of 1,308 Chinook Salmon accurately represents the run strength and timing of Chinook Salmon returning to the Funny River. The inception of the 2014 Funny River Chinook Salmon run was the earliest since 2006, which demonstrates that installing the weir and video system during late April ensures that all early arriving fish are enumerated. Documenting this variation in runtiming is important for management especially when the median passage date (e.g., Funny River 2014 Chinook Salmon run) remains within the observed variation for all years. A false appearance of an early or late run-timing could lead to premature liberalizations or restrictions of fisheries.

The collection of age, sex, and length information used to describe the biological characteristics of Funny River Chinook Salmon is an important component of the project. Our strategy during 2014 was to sample throughout the entire run and proportional to Chinook Salmon passage observed with the underwater video system. This strategy yielded the largest (n=385) annual sample collected to date, representing 29% of the run. We believe the identified age groups from our sample accurately represent the ages of Chinook Salmon present in the Funny River during 2014 because 29% of the run was sampled. The nearly complete census of male and female Chinook Salmon using combined video and ASL records yielded a sex ratio of 0.32 females for every one male. This sex ratio is similar to sex compositions observed between 2006 and 2013; however, the composition of female Chinook Salmon in the Funny River has shifted from nearly equal numbers of age-1.3 and -1.4 fish from 2006 to 2009 to primarily age-1.3 fish since 2010 (see Appendix 4 in Boersma and Gates 2014).

We recommend that future investigations for Funny River Chinook Salmon focus on updating the genetic baseline, incorporating genetic monitoring into the existing project objectives to test and monitor for allelic richness, and using a mixed-stock analysis to evaluate spatial and temporal patterns of juvenile migration and habitat use. This updated information would be insightful to managers and would help identify possible sources of demographic change. We plan to continue operating the video weir during 2015 and will use the run timing observed between 2006 and 2014 to determine our ASL sampling strategy during 2015. Additional analysis and discussion pertaining to the observed age and length structure of Funny River Chinook Salmon will be published in a separate report. Information collected from the Funny River remains useful in formulating future management strategies for early-run Chinook Salmon in the Kenai River watershed.

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APPENDIX 1. —List of video equipment used to monitor adult Chinook Salmon abundance and run timing in the Funny River during 2014.

			
Item	Model #	Manufacturer	Contact
Digital Video Recorder	DVSM 4-120	Veltek International, Inc.	http://www.veltekcctv.com/
Underwater Camera	Model 10	Applied Micro Video	http://www.appliedmicrovideo.com/
Underwater Lights	Lunaqua 2 12-v	OASE	http://www.pondusa.com
External Harddrive	Expansion 1 TB	Seagate	http://www.seagate.com
400 Ah 6 Volt Battery	S-530	Rolls	http://www.rollsbattery.com/
Inverter/Charger	Prosine 2.0	Xantrex	http://www.xantrex.com

APPENDIX 2. —Daily passage totals including cumulative and proportional passage of adult Chinook Salmon observed at the Funny River weir during 2014. Boxed areas represent the second and third quartile and median passage dates. Shaded areas represent days when age, sex, and length sampling occurred.

ites. Si	snaded areas represent days			s when age, sex, and length samplin			
_				Daily	Daily	Cumulative	
Date	Male		Unknown	Total	Cumulative	Proportion	
5/12	0	1	0	1	1	0.0008	
5/13	0	0	0	0	1	0.0008	
5/14	0	0	0	0	1	0.0008	
5/15	0	0	0	0	1	0.0008	
5/16	0	0	0	0	1	0.0008	
5/17	0	0	0	0	1	0.0008	
5/18	1	0	0	1	2	0.0015	
5/19	1	0	0	1	3	0.0023	
5/20	1	0	0	1	4	0.0031	
5/21	0	0	0	0	4	0.0031	
5/22	0	0	0	0	4	0.0031	
5/23	0	0	0	0	4	0.0031	
5/24	0	0	0	0	4	0.0031	
5/25	1	0	0	1	5	0.0038	
5/26	0	0	0	0	5	0.0038	
5/27	0	0	0	0	5	0.0038	
5/28	0	0	0	0	5	0.0038	
5/29	0	0	0	0	5	0.0038	
5/30	0	0	0	0	5	0.0038	
5/31	0	0	0	0	5	0.0038	
6/1	3	1	0	4	9	0.0069	
6/2	1	0	0	1	10	0.0076	
6/3	3	1	0	4	14	0.0107	
6/4	3	0	0	3	17	0.0130	
6/5	2	1	0	3	20	0.0153	
6/6	2	0	0	2	22	0.0168	
6/7	0	0	0	0	22	0.0168	
6/8	5	0	0	5	27	0.0206	
6/9	2	1	0	3	30	0.0229	
6/10	8	3	0	11	41	0.0313	
6/11	4	1	0	5	46	0.0352	
6/12	1	0	0	1	47	0.0359	
6/13	1	1	0	2	49	0.0375	
6/14	1	1	0	2	51	0.0390	
6/15	73	19	0	92	143	0.1093	
6/16	7	0	0	7	150	0.1147	
6/17	47	14	0	61	211	0.1613	
6/18	57	5	0	62	273	0.2087	
6/19	19	3	1	23	296	0.2263	
6/20	14	5	0	19	315	0.2408	
6/21	25	10	1	36	351	0.2683	
6/22	3	0	0	3	354	0.2706	
6/23	56	17	0	73	427	0.3265	
6/24	48	11	0	59	486	0.3716	
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APPENDIX 2. —(Page 2 of 2)

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				Daily	Daily	Cumulative
Date	Male	Female	Unknown	Total	Cumulative	Proportion
6/25	15	3	0	18	504	0.3853
6/26	18	1	0	19	523	0.3998
6/27	14	5	0	19	542	0.4144
6/28	22	2	1	25	567	0.4335
6/29	47	10	4	61	628	0.4801
6/30	43	14	0	57	685	0.5237
7/1	20	5	0	25	710	0.5428
7/2	57	14	0	71	781	0.5971
7/3	69	38	0	107	888	0.6789
7/4	17	3	0	20	908	0.6942
7/5	63	18	0	81	989	0.7561
7/6	20	8	0	28	1017	0.7775
7/7	24	7	0	31	1048	0.8012
7/8	12	4	0	16	1064	0.8135
7/9	7	1	0	8	1072	0.8196
7/10	10	0	0	10	1082	0.8272
7/11	45	19	0	64	1146	0.8761
7/12	31	19	0	50	1196	0.9144
7/13	12	7	0	19	1215	0.9289
7/14	7	9	0	16	1231	0.9411
7/15	5	4	1	10	1241	0.9488
7/16	9	3	0	12	1253	0.9580
7/17	9	5	0	14	1267	0.9687
7/18	3	7	0	10	1277	0.9763
7/19	5	6	2	13	1290	0.9862
7/20	1	1	1	3	1293	0.9885
7/21	3	0	0	3	1296	0.9908
7/22	0	0	0	0	1296	0.9908
7/23	2	1	0	3	1299	0.9931
7/24	3	1	0	4	1303	0.9962
7/25	0	0	0	0	1303	0.9962
7/26	1	1	0	2	1305	0.9977
7/27	1	2	0	3	1308	1.0000
7/28	0	0	0	0	1308	1.0000
7/29	0	0	0	0	1308	1.0000
7/30	0	0	0	0	1308	1.0000
Total	984	313	11	1308		

APPENDIX 3. —Daily count of non-target fish species passing through the Funny River weir during 2014.

		Rainbow			
	Dolly	trout/	Pink	Sockeye	Round
Date	Varden	Steelhead	Salmon	Salmon	Whitefish
4/25	0	0	0	0	0
4/26	0	0	0	0	0
4/27	0	0	0	0	0
4/28	0	0	0	0	0
4/29	0	20	0	0	0
4/30	0	8	0	0	0
5/1	0	3	0	0	0
5/2	0	13	0	0	1
5/3	0	8	0	0	0
5/4	0	5	0	0	0
5/5	0	1	0	0	0
5/6	0	2	0	0	0
5/7	0	1	0	0	3
5/8	0	4	0	0	1
5/9	0	3	0	0	1
5/10	0	7	0	0	0
5/11	0	9	0	0	1
5/12	0	7	0	0	4
5/13	0	4	0	0	1
5/14	0	5	0	0	2
5/15	1	2	0	0	0
5/16	1	3	0	0	0
5/17	0	4	0	0	1
5/18	0	6	0	0	1
5/19	0	2	0	0	1
5/20	0	0	0	0	1
5/21	0	2	0	0	0
5/22	0	1	0	0	0
5/23	0	1	0	0	1
5/24	0	0	0	0	2
5/25	0	0	0	0	0
5/26	0	1	0	0	0
5/27	0	0	0	0	1
5/28	0	0	0	0	0
5/29	0	0	0	0	0
5/30	1	2	0	0	1
5/31	1	0	0	0	0
6/1	1	0	0	0	1
6/2	0	0	0	0	0
6/3	0	1	0	0	2
6/4	0	1	0	0	0
6/5	0	0	0	0	0

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e 2 01 3))	Rainbow			
	Dolly	trout/	Pink	Sockeye	Round
Date	Varden	Steelhead	Salmon	Salmon	Whitefish
6/6	0	0	0	0	1
6/7	0	0	0	0	0
6/8	0	0	0	0	0
6/9	0	0	0	0	1
6/10	0	0	0	0	0
6/11	0	0	0	0	0
6/12	0	0	0	0	0
6/13	0	1	0	0	0
6/14	0	0	0	0	0
6/15	1	0	0	0	0
6/16 6/17	0 1	0 2	0 0	0 0	0 1
6/18	0	1	0	0	0
6/19	0	0	0	1	0
6/20	0	0	0	0	0
6/21	0	0	0	0	0
6/22	1	0	0	0	0
6/23	0	0	0	0	0
6/24	0	1	0	0	0
6/25	2	0	0	0	0
6/26	3	0	0	0	0
6/27	1	0	0	0	0
6/28	3	0	0	0	0
6/29	1	0	0	0	0
6/30	3	0	0	0	0
7/1	2	0	0	1	0
7/2	2	1	0	0	0
7/3 7/4	0 1	0 1	0 0	0 1	0
7/4 7/5	0	0	0	0	0 0
7/6	2	1	0	0	0
7/7	1	1	0	0	0
7/8	19	2	0	0	0
7/9	17	0	0	0	0
7/10	6	0	0	0	0
7/11	10	0	0	0	0
7/12	37	0	0	0	0
7/13	40	0	0	0	0
7/14	44	0	0	0	1
7/15	28	0	1	0	0
7/16	0	0	0	0	0
7/17	6	0	2	0	0
7/18	3	0	0	0	0
7/19	43	0	1	0	0

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2 01 3	<i>,</i>	Rainbow			
		Rainbow			
	Dolly	trout/	Pink	Sockeye	Round
Date	Varden	Steelhead	Salmon	Salmon	Whitefish
7/20	21	0	0	1	0
7/21	11	0	0	0	0
7/22	2	0	5	0	0
7/23	7	0	3	0	0
7/24	3	0	3	1	0
7/25	12	0	4	1	0
7/26	20	0	4	0	0
7/27	16	0	5	0	0
7/28	17	0	3	1	0
7/29	9	0	2	0	0
7/30	12	1	2	0	0
Total	412	138	35	7	30