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Abundance, Run Timing, and Age, Sex, and Length Composition of Adult Chinook Salmon in the Funny River, Kenai Peninsula, Alaska, 2015

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James K. Boersma and Kenneth S. Gates

Abstract

A fish weir equipped with an underwater video system was installed and operated in the Funny River between May 11 and July 30, 2015, to collect demographic information about adult Chinook Salmon *Oncorhynchus tshawytscha*. The total escapement of adult Chinook Salmon into the Funny River was 1,727. Several non-target species were also enumerated including 417 Dolly Varden *Salvelinus malma*, 51 Rainbow Trout/steelhead *O. mykiss*, 44 Pink Salmon *O. gorbuscha*, 3 Sockeye Salmon *O. nerka*, 14 Round Whitefish *Prosopium cylindraceum*, and 1 Chum Salmon *O. keta*. Peak weekly Chinook Salmon passage occurred between June 14 and 20 (n=505). Age, sex, and length sampling occurred from June 4 to July 23 and resulted in 334 samples. Sex was also determined for all passing Chinook Salmon by examining recorded video images. Female Chinook Salmon comprised 18% of the escapement (video and ASL combined) and averaged 789 mm in length (mid eye to tail fork). The lengths of male Chinook Salmon averaged 608 mm (mid eye to tail fork). Ages of Chinook Salmon determined from scale analysis ranged from 3 to 6 years.

Introduction

Annual abundance estimates of adult Chinook Salmon returning to the Kenai River indicate that recent returns have somewhat rebounded, yet 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).

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). 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.

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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 fisheries, 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 2012, annual sport harvests ranged from 419 to 15,209 fish and averaged 5,129 fish annually (McKinley and Fleischman 2013). No harvest of early-run fish occurred prior to 30 June during 2013, 2014 and 2015 because the in-river sport fishery was either restricted to catch and release or closed during the early run (Alaska Department of Fish and Game 2013, 2014a, 2015a). However, some early-run Chinook Salmon are available to harvest during the late-run Chinook Salmon fishery (Reimer 2013; Reimer et al. 2016). 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; 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). In an effort to increase the accuracy and precision of in-season abundance estimates, Adaptive Resolution Imaging Sonar (ARIS) has been deployed at rkm 22 on the Kenai River since 2013. The resulting early-run estimates have been 2,308 (2013), 4,214 (2014) and 6,190 (2015) Chinook Salmon (Alaska Department of Fish and Game 2015b). The Department manages the early-run fishery to achieve a watershed-wide 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-arriving 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 2014b).

The abundance and relative contribution of individual tributary stocks provide important in-season 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.

Our study during 2015 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 length composition of Chinook Salmon returning to the Funny River provides 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 km^2 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.

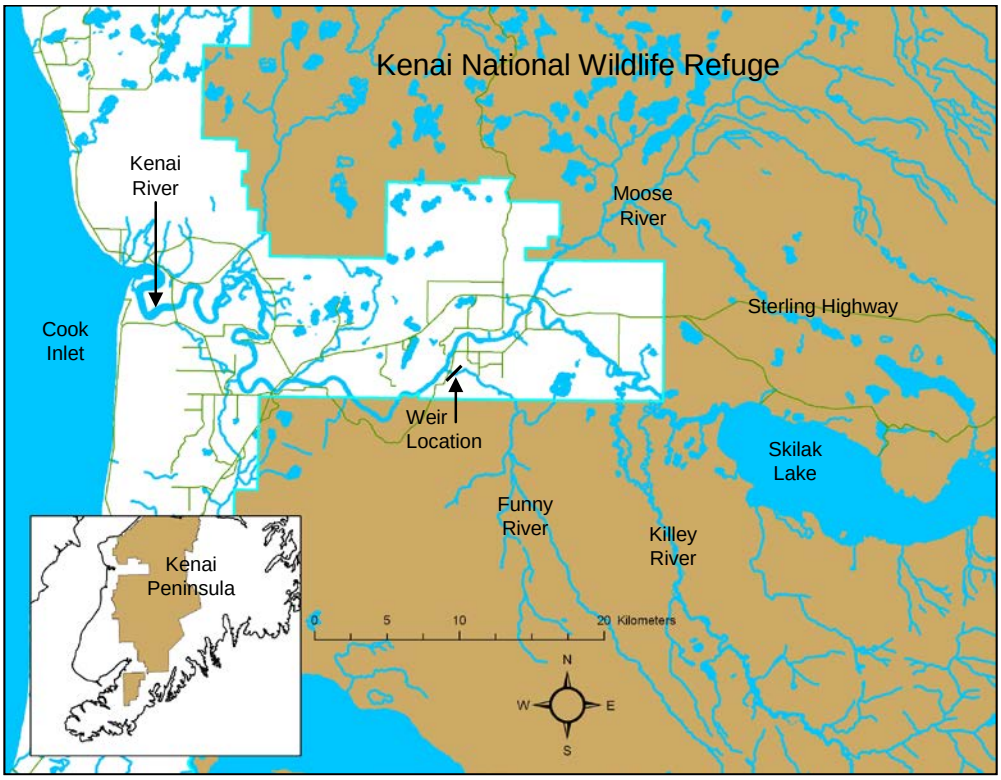

FIGURE 1. —Map of the Kenai River watershed downstream of Skilak Lake showing the weir location on Funny River.

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 May 11, through July 30, 2015. 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 allow fish to pass through a modified 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 15% 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. Lengths for Chinook Salmon were measured to the nearest 5 mm from mid eye to tail fork (METF) and from the tip of the nose to the tail fork. 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

$$\hat{V}\left[\hat{A}_{hij}\right] = \hat{N}_h^2 \left(1 - \frac{n_h}{N_h}\right)\left(\frac{\hat{P}_{hij}\left(1 - \hat{P}_{hij}\right)}{n_h - 1}\right) \tag{2}$$

where

N_h = total escapement during stratum *h*;
$\hat{p}_{hij}$ = 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 sex-specific escapements for the season as follows:

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

and

Error! Bookmark not defined. $$\hat{V}\left[\hat{A}_{ij}\right] = \sum_h \hat{V}\left[\hat{A}_{hij}\right]. \tag{4}$$

Basic data summaries, scatter plots, bar graphs, and statistical analyses (i.e., means, standard errors, and ranges) were used to describe the length distribution of Chinook Salmon sampled at the Funny River weir.

Results

Weir and Video Operations

The weir and video system was installed on May 11 and operated through July 30. The video system and weir ran smoothly the entire operational period, except for 16 hours of image loss between May 25 and 26. The image loss was due to a power inverter failure, resulting in no or incomplete counts. This issue was discovered and repaired as soon as possible; no attempt was made to estimate passage for these dates.

Biological Data

Chinook Salmon. —A total of 1,727 Chinook Salmon were enumerated at the Funny River weir during 2015. Chinook Salmon were observed passing through the weir from May 24 to July 24 (Figure 2; Appendix 2). Peak weekly weir passage (*n*=505) occurred between June 14 and 20. The highest daily count (*n*=172) occurred on July 5 and the median cumulative passage occurred on July 3 (Appendix 2).

Age, sex, and length samples were collected from 334 Chinook Salmon between June 4 and July 23. Ten percent (n=32) of the sampled fish were excluded from the ASL analysis because of inconclusive age determinations. Of the aged scales, female Chinook Salmon were comprised of two age groups, ages 1.3 (87.9%) and 1.4 (12.1%). Male Chinook Salmon were comprised of five age groups, ages 1.1 (15.7%), 1.2 (66.5%), 1.3 (16.1%), 1.4 (1.3%), and 2.2 (0.4%; Tables 1 and 2). Age-1.2 males comprised 55% of the total run (Table 2). Females comprised 21.9% of the ASL sample and 17.1% of the sexed video images. Overall, females comprised 18% of the run (video and ASL combined) and METF lengths averaged 789 mm (Tables 1 and 2; Appendix 2). Male METF lengths averaged 608 mm. Combined male and female METF lengths averaged 647 mm and ranged from 300 to 970 mm (Table 2; Figure 3). Sex ratios favored males throughout most of the run (Figure 4).

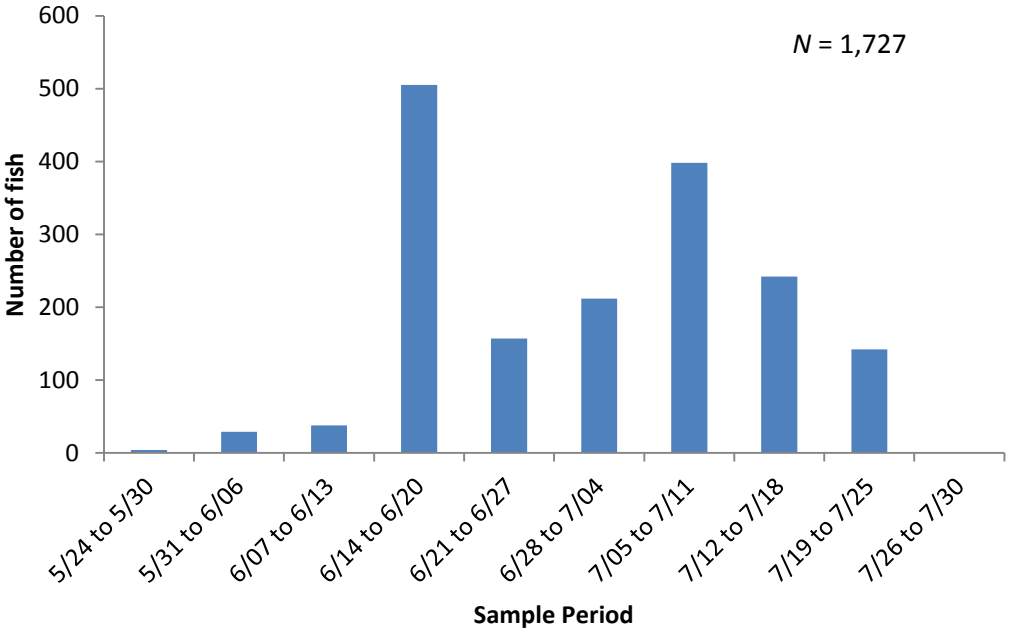

FIGURE 2. —Weekly passage of adult Chinook Salmon through the Funny River weir during 2015. Chinook Salmon were observed passing upstream through the weir from May 24 to July24.

TABLE 1. —Length-at-age for adult Chinook Salmon sampled at the Funny River weir during 2015.

			Mid Eye to Tail Fork Length		
Sex	Age	n [a]	Mean	Range	Standard Error
Female	1.3	58	779	710 - 870	5.1
	1.4	8	859	785 - 970	21.0
Female Total		66	789	710 - 970	6.0
Male	1.1	37	372	300 - 515	7.9
	1.2	157	620	500 - 710	3.6
	1.3	38	769	680 - 870	6.2
	1.4	3	852	825 - 885	17.6
	2.2	1	650	N/A	N/A
Male Total		236	608	300 - 885	8.2
Cumulative Total		302	647	300 - 970	7.8

[a] Fish with inconclusive ages were omitted from this table (n=32)

TABLE 2. —Estimated age and sex composition for Chinook Salmon returning to the Funny River during 2015.

		Brood Year and Age Group					
		2012	2011	2010		2009	
		1.1	1.2	2.2	1.3	1.4	Total
Sample Period: June 4 to July 23							
Female:	Number in Sample:				58	8	66
	% Females in Age Group:				87.9	12.1	100
	Estimated % of Escapement:[c]				15.7	2.2	18.0 [c]
	Estimated Escapement:				272	38	310 [b]
	Standard Error:				35.6	14.5	
Male:	Number in Sample:	37	157	1	38	3	236
	% Males in Age Group:	15.7	66.5	0.4	16.1	1.3	100
	Estimated % of Escapement:[c]	12.9	54.6	0.3	13.2	1.0	82.0 [c]
	Estimated Escapement:	222	943	6	228	18.0	1,417 [b]
	Standard Error:	30.7	39.9	5.5	31.0	9.5	
Total:	Number in Sample:	37	157	1	96	11	302 [a]
	Estimated % of Escapement:	12.9	54.6	0.3	29.0	3.2	100
	Estimated Escapement:	222	943	6.0	500	56	1,727

[a] Fish with inconclusive ages were omitted from this analysis (n=32)

[b] Rounding error may affect totals

[c] Combined ASL and video records determine overall sex composition

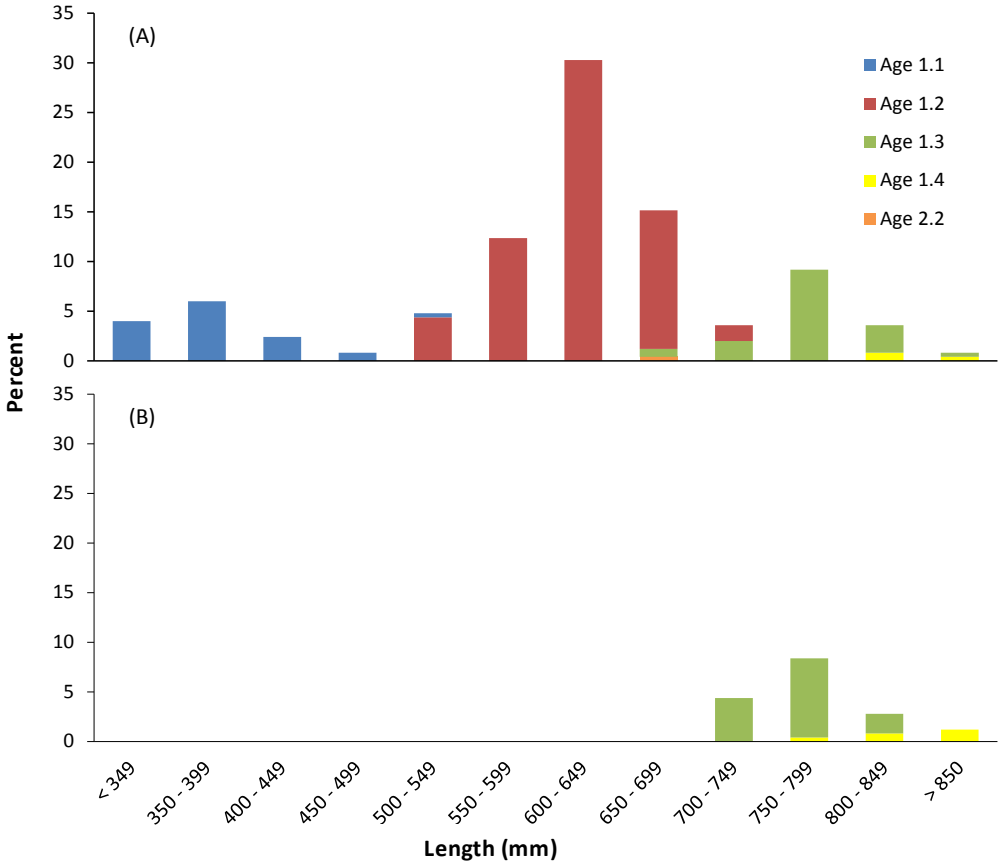

FIGURE 3. —Mid eye to tail fork length-at-age frequency distributions of adult (A) male and (B) female Chinook Salmon sampled at the Funny River weir during 2015.

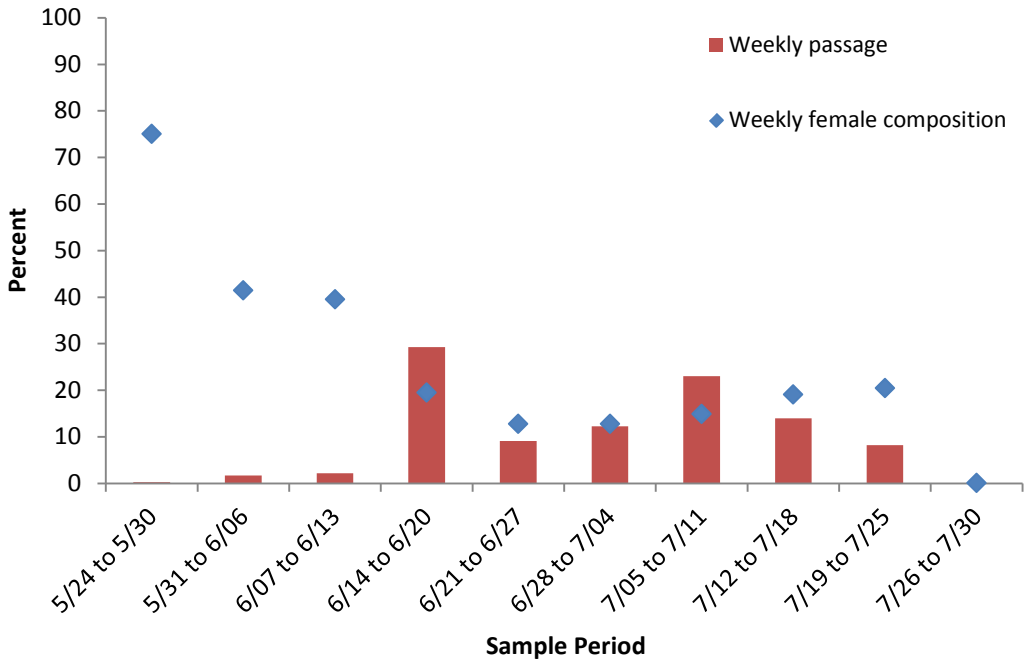

FIGURE 4. —Weekly passage (%) of Chinook Salmon including adult female Chinook Salmon composition (%) observed at the Funny River video weir from May 24 to July 24, 2015. Passage includes video review and ASL sampling.

Other species. —Six additional fish species observed passing the Funny River weir included 417 Dolly Varden *Salvelinus malma*, 51 Rainbow Trout/steelhead *O. mykiss*, 44 Pink Salmon *O. gorbuscha*, 3 Sockeye Salmon *O. nerka*, 14 Round Whitefish *Prosopium cylindraceum* and 1 Chum Salmon *O. keta* (Appendix 3).

Discussion

The observed weir passage of 1,727 Chinook Salmon represents the run strength and timing of Chinook Salmon returning to the Funny River during 2015. The 302 ASL samples accurately describe the ASL composition of Chinook Salmon returning to the Funny River watershed.

Total escapement of Chinook Salmon in the Funny River during 2015 was relatively strong (third largest on record); however, adult Chinook Salmon returning to the Funny River appear progressively smaller and younger through time (2006 - 2015; Gates and Palmer 2007, 2008; Gates and Boersma 2009a, 2009b, 2011, 2014; Boersma and Gates 2012, 2013, 2014). The observed shift in size and age are not unique to this population or temporal scale as many stocks throughout Alaska display similar patterns across extended periods (Lewis et al. 2015). Ricker (1980) suggested that such decreases in size and age would be limited by equilibrium between the minimal sizes required to sustain spawning populations and larger sizes needed to maximize fecundity. Ricker (1980) also hypothesized that this equilibrium would be reached when almost all females mature as 3-ocean fish and males as 2-ocean fish. Adult Chinook Salmon returning to the Funny River seem to have reached or are approaching such equilibrium (Figure 3).

Lewis et al. (2015) identified size selective harvest, ocean conditions, and competitive interactions with other species of salmon as possible drivers of earlier maturation and declines in size for Chinook Salmon stocks in Alaska, but the evidence is not conclusive for a specific cause. Regardless of the mechanisms, a persistence of the selective pressures favoring the survival of younger smaller fish may prevent a rebound in the proportion of larger, older fish. Even if selective pressures are removed, it may take years (50 to 100) to observe an opposite trend in size and age at maturity (Ricker 1980; Bromaghin et al. 2011).

Several remedies can be used to slow or prevent the continued decrease in size and age of Chinook Salmon. Ricker's (1980) recommendation for Chinook Salmon stocks included stabilizing or reducing the size, efficiency, or both, of the fishery, eliminating harvest of non-maturing individuals, size selective gear that would target smaller fish, and using hatchery operations where possible to select for larger fish. Bromaghin et al. (2011) recommended linking exploitation and selectivity of the fishery as a management strategy to prevent continued declines in size and age at maturation and increase the potential persistence for a viable and phenotypically diverse population.

We recommend continuation of this project to augment this growing data set. We also recommend further investigation of these data to gain insights into the scope and potential impacts of demographic shifts within the Funny River population.

Acknowledgements

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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 2015.

Item	Model #	Manufacturer	Contact
Digital Video Recorder	DVSM 4-120	Veltek International, Inc.	No longer available
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 2015. Boxed areas represent the second and third quartile and median passage dates. Shaded areas represent days when age, sex, and length sampling occurred.

Date	Male	Female	Unknown	Daily Total	Daily Cumulative	Cumulative Proportion
5/24	0	1	0	1	1	0.0006
5/25	0	0	0	0	1	0.0006
5/26	0	0	0	0	1	0.0006
5/27	0	0	0	0	1	0.0006
5/28	1	0	0	1	2	0.0012
5/29	0	0	0	0	2	0.0012
5/30	0	2	0	2	4	0.0023
5/31	0	0	0	0	4	0.0023
6/1	2	3	0	5	9	0.0052
6/2	11	5	0	16	25	0.0145
6/3	4	2	0	6	31	0.0180
6/4	0	1	0	1	32	0.0185
6/5	0	0	0	0	32	0.0185
6/6	0	1	0	1	33	0.0191
6/7	1	0	0	1	34	0.0197
6/8	0	0	0	0	34	0.0197
6/9	0	0	0	0	34	0.0197
6/10	0	1	0	1	35	0.0203
6/11	0	1	0	1	36	0.0208
6/12	10	4	0	14	50	0.0290
6/13	12	9	0	21	71	0.0411
6/14	35	10	0	45	116	0.0672
6/15	66	8	0	74	190	0.1100
6/16	20	4	0	24	214	0.1239
6/17	59	7	0	66	280	0.1621
6/18	91	22	0	113	393	0.2276
6/19	102	41	0	143	536	0.3104
6/20	34	6	0	40	576	0.3335
6/21	6	0	0	6	582	0.3370
6/22	4	0	0	4	586	0.3393
6/23	11	1	0	12	598	0.3463
6/24	34	7	0	41	639	0.3700
6/25	37	5	0	42	681	0.3943
6/26	16	0	0	16	697	0.4036
6/27	29	7	0	36	733	0.4244
6/28	11	0	0	11	744	0.4308
6/29	9	0	0	9	753	0.4360
6/30	8	1	0	9	762	0.4412
7/1	41	9	0	50	812	0.4702
7/2	20	0	0	20	832	0.4818
7/3	48	6	0	54	886	0.5130
7/4	48	11	0	59	945	0.5472
7/5	140	32	0	172	1,117	0.6468
7/6	57	19	0	76	1,193	0.6908

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APPENDIX 2. —(Page 2 of 2)

Date	Male	Female	Unknown	Daily Total	Daily Cumulative	Cumulative Proportion
7/7	72	6	0	78	1,271	0.7360
7/8	14	0	0	14	1,285	0.7441
7/9	30	0	0	30	1,315	0.7614
7/10	11	0	0	11	1,326	0.7678
7/11	15	2	0	17	1,343	0.7776
7/12	31	4	0	35	1,378	0.7979
7/13	2	1	0	3	1,381	0.7997
7/14	70	11	0	81	1,462	0.8466
7/15	12	2	0	14	1,476	0.8547
7/16	10	2	0	12	1,488	0.8616
7/17	38	13	0	51	1,539	0.8911
7/18	33	13	0	46	1,585	0.9178
7/19	53	11	0	64	1,649	0.9548
7/20	34	10	0	44	1,693	0.9803
7/21	12	5	0	17	1,710	0.9902
7/22	9	3	0	12	1,722	0.9971
7/23	4	0	0	4	1,726	0.9994
7/24	1	0	0	1	1,727	1.0000
7/25	0	0	0	0	1,727	1.0000
7/26	0	0	0	0	1,727	1.0000
7/27	0	0	0	0	1,727	1.0000
7/28	0	0	0	0	1,727	1.0000
7/29	0	0	0	0	1,727	1.0000
7/30	0	0	0	0	1,727	1.0000
Total	1,418	309	0	1,727		

APPENDIX 3. —Daily count of non-target fish species passing through the Funny River weir during 2015.

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

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APPENDIX 3. —(Page 2 of 2)

Date	Dolly Varden	Rainbow Trout/ Steelhead	Pink Salmon	Sockeye Salmon	Round Whitefish	Chum Salmon
6/22	1	0	0	0	0	0
6/23	0	0	0	0	0	0
6/24	4	0	0	0	0	0
6/25	3	0	0	0	0	0
6/26	4	0	0	0	0	0
6/27	0	0	0	0	0	0
6/28	1	0	0	0	0	0
6/29	0	0	0	0	0	0
6/30	0	1	0	0	0	0
7/1	1	0	0	0	0	0
7/2	2	0	0	0	0	0
7/3	2	0	0	0	0	0
7/4	1	1	0	0	0	0
7/5	3	1	0	0	0	0
7/6	9	0	3	0	1	0
7/7	13	0	0	0	0	0
7/8	17	0	0	0	0	0
7/9	5	0	0	0	0	0
7/10	4	0	1	0	1	0
7/11	11	0	1	0	0	0
7/12	9	0	3	0	0	0
7/13	2	0	1	0	0	0
7/14	41	0	0	0	0	1
7/15	4	0	1	1	1	0
7/16	8	0	2	0	0	0
7/17	39	0	0	0	0	0
7/18	55	0	3	0	0	0
7/19	65	0	8	0	0	0
7/20	41	0	10	0	0	0
7/21	34	0	8	0	0	0
7/22	1	0	2	0	0	0
7/23	6	0	1	0	0	0
7/24	0	0	0	0	0	0
7/25	1	0	0	0	0	0
7/26	0	0	0	0	0	0
7/27	0	0	0	0	0	0
7/28	0	0	0	0	0	0
7/29	1	0	0	0	0	0
7/30	0	0	0	0	0	0
Total	417	51	44	3	14	1