Fishery Management Report No. 17-49

McLees Lake Salmon Escapement Monitoring Report, 2012-2017

by

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And

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

Symbols and Abbreviations

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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 and operated in the McLees Lake outlet during June and July of 2012–2017 by the Alaska Department of Fish and Game (ADF&G) to enumerate sockeye salmon *Oncorhynchus nerka* escapement into McLees Lake. Escapement was enumerated through a picket weir daily from early June through late July. The total sockeye salmon escapement through the McLees Lake weir in 2012 was 15,111 fish, in 2013 was 15,688 fish, in 2014 was 12,424 fish, in 2015 was 20,248 fish, in 2016 was 39,892 fish, and in 2017 was 13,195 fish. In 2012, personnel issues delayed the installation of the weir until July 10. By this time, a large portion of the escapement had already entered McLees Lake and the missed escapement was interpolated. Sockeye salmon escapement met the lower end of the goal by July 1 in 2013, 2014, 2015, and 2016, so emergency orders were issued by department staff to reduce waters closed to subsistence salmon fishing to the outlet stream terminus of McLees Lake. In 2017 sockeye salmon escapement had not met the lower end of the escapement goal by July 1. Subsequently, the department issued emergency orders extending the regulatory closed waters within 500 yards of the stream outlet terminus with the ocean shoreline to subsistence fishing until July 22. Sockeye salmon subsistence harvest in the Reese Bay (Wislow Island) area near McLees Lake ranged from 48% to 89% of all Unalaska Island sockeye salmon subsistent harvest from 2012–2016. Subsistence harvest data from 2017 is still being received and was not finalized by the time of this report. Sampling for zooplankton was conducted at one station in each year to assess freshwater rearing conditions.

Key words: sockeye salmon, ASL, subsistence, McLees Lake, Unalaska Island, *Oncorhynchus nerka*

INTRODUCTION

Unalaska Village, on Unalaska Island, lies approximately 1,250 km southwest of Anchorage and is best known for its proximity to neighboring Dutch Harbor and the commercial fisheries based there. With the decline of the sockeye salmon *Oncorhynchus nerka* returns to Unalaska Lake, Unalaska Village residents shifted their fishing efforts to the McLees Lake sockeye salmon run, also referred to as the Wislow Island or Reese Bay sockeye salmon fishery. This drainage is an important spawning and rearing habitat for sockeye salmon, it and provides a relatively protected fishing area within Reese Bay, where the system empties into the Bering Sea (Figure 1). Management of this fishery is often difficult due to its remoteness and run size variability. This project improved the reliability of sockeye salmon escapement estimates of this highly utilized subsistence stock.

Subsistence harvests of sockeye salmon returning to McLees Lake have been monitored since 1985 and have ranged from 815 to 5,267 sockeye salmon (Tschersich and Russ 2008). In 2016, an estimated 2,257 sockeye salmon (89% of the Unalaska District subsistence sockeye salmon harvest) were harvested from the Reese Bay fishery (Johnson and Lipka 2017). Annual fluctuations in the Reese Bay subsistence harvest have generally corresponded to the number of permits issued for the Unalaska District subsistence fishery. Since 1985, the number of subsistence permits issued for this fishery steadily increased, from 65 in 1985 to a peak of 249 in 2012 (Tschersich and Russ 2008). A total of 238 permits were issued in 2016 (Hartill and Keyse 2011), still well above the 1985 levels. These numbers reflect the continuing importance of sockeye salmon as a subsistence resource for the Unalaska community.

Prior to 2001, management of the fishery was based upon escapement estimates from aerial surveys, which had been conducted since 1974, and subsistence harvest data, which has been collected since 1985 (Palmer 2002). Aerial surveys were generally limited to one survey each year, and counts ranged from 300–34,000 fish (Shaul and Dinnocenzo 2000). While aerial counts served as an index of abundance, they were greatly influenced by several factors including time of survey, poor weather, lack of suitable aircraft, and variation among observers.

Local residents and the Alaska Department of Fish and Game (ADF&G) were concerned that lack of reliable escapement estimates for sockeye salmon into McLees Lake could jeopardize the health of the run, as well as future opportunities for subsistence fishing. These concerns prompted the Kodiak/Aleutians Federal Subsistence Regional Advisory Council to identify an escapement monitoring project on McLees Lake as a high priority. To address these concerns, the U. S. Fish and Wildlife Service (USFWS) and the Qawalangin Tribe of Unalaska entered into a partnership agreement to monitor the sockeye salmon return to McLees Lake from 2001–2003; the USFWS Office of Subsistence Management provided funding to the Kenai Fish and Wildlife Field Office for the work through the Fisheries Resource Monitoring Program (FRMP) as project number FIS 01–059. Monitoring was continued by the King Salmon Fish and Wildlife Field Office from 2004–2006 as project FIS 04–404. In 2007, the King Salmon office became the Fisheries Branch of the Anchorage Fish and Wildlife Field Office and continued to conduct work on sockeye salmon in McLees Lake until 2011. From 2012–2017, ADF&G operated the weir from the Cold Bay Field office and was funded through the Alaska Sustainable Salmon Fund within two separate funding cycles. Currently a proposal to the Federal Office of Subsistence Management through the FRMP is requesting funding to continue the project through 2021.

Estimated annual escapements of sockeye salmon into McLees Lake have been highly variable since operation of the weir began. During the period 2001–2004, escapements ranged from 45,866–101,793 sockeye salmon. During the period 2005–2009, escapements ranged from 8,661–21,428 sockeye salmon (Figure 2). In 2008, due to the low escapement numbers, the subsistence fishery was closed and did not re-open for the season.

This project seeks timely escapement information in order to optimize subsistence fishing opportunity and maintain the sustainability of the sockeye salmon resource at McLees Lake. The collection of limnological data will also provide insight into possible bottlenecks in McLees Lake rearing habitat. If escapements continue to decline, further restrictions of the subsistence fishery may be needed to protect the population of sockeye salmon and maintain a healthy subsistence harvest. Current regulation establishes a closed waters area to subsistence fishing within 500 yards of the streams terminus with the ocean shoreline from July 1–July 9. This closure can then be extended or shortened by emergency order based upon current year escapement in relation to the sustainable escapement goal (SEG) of 10,000–60,000 sockeye salmon (Schaberg et al. 2015).

METHODS

The ADF&G operated this project consistent with the methods used by the USFWS from 2001–2011 and outlined in Hildreth and Finkel 2010. A picket weir was constructed to span a section of stream that is approximately 35 m wide at the outlet of McLees Lake, approximately 100 m upstream from Reese Bay (Figure 3 and 4). The weir was operated from approximately June 1 to August1 during each year of the project. The weir framework consisted of several pieces of 6.4 cm aluminum angle bolted together forming a self-standing frame. The weir pickets were made from 25 mm schedule 40 aluminum pipes. Each picket measured 1.5 m in length and was attached to the frame by individually sliding through 28.6 mm holes drilled in two 3.6 m pieces of aluminum angle bolted to the front of the weir frame. A trap and holding area was installed on the upstream side of the weir to facilitate sampling fish and passing adult salmon through the weir. The weir and sampling trap was inspected daily and maintained as needed to insure integrity.

Fish were passed and counted intermittently as needed depending on the magnitude of the migration. All fish passing upstream were identified by species and enumerated. Daily escapement counts were relayed to ADF&G office in Cold Bay via satellite phone, allowing project data to be used in making in-season management decisions for the Reese Bay subsistence fishery. In 2012, the weir was not installed until July 10. Using the average mid-point of the run from previous years, it was estimated that only 34% of the run was observed. The remainder of the run was interpolated by expanding the cumulative count by 66% to estimate the total escapement to account for missed fish passage.

Data on sockeye salmon age, sex, and length (ASL) was collected using a temporally stratified sampling design (Cochran 1977), with statistical weeks defining strata. A sample of 135 fish was drawn weekly for ASL information. If run strength was not sufficient to reach the weekly sampling goal, about 20% of the weekly escapement was sampled. Samples were taken at the beginning of each stratum, and if not completed on the first day of the stratum, continued each successive day until the goal was reached. To avoid potential bias caused by the selection or capture of individual fish, all fish within the trap were included in the sample, even if the target number of fish was exceeded.

Sampling consisted of identifying species, measuring length, determining sex, collecting scales, and then releasing the fish upstream of the weir. 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 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 in a Rite in the Rain notebook and the data was downloaded to a laptop computer daily.

Gummed scale cards and an updated version of ADF&G procedures were made available at the beginning of each season. Scale sample cards were completed according to ADF&G procedures (Murphy 2000). At the end of the season, all scales collected were mounted on scale cards and impressions were made on cellulose diacetate (Clutter and Whitesel 1956). Scale cards were read to determine age from the scales and enter age data onto the ASL forms. Fish ages were assigned by examining scale impressions for annual growth increments using a microfiche reader fitted with a 48X lens following designation criteria established by Mosher (1968). Ages were entered directly into the salmon database using European notation (Koo 1962) where a decimal separates the number of winters spent in fresh water (after emergence) from the number of winters spent in salt water.

Between 1993 and 1995, the ADF&G conducted a limnological and fishery assessment of 23 Alaska Peninsula and Aleutian area lakes (Honnold et al. 1996). Limnological sampling was conducted in accordance with these ADF&G standard procedures, in order to assess the current zooplankton productivity, and estimate the capacity of McLees Lake to rear juvenile sockeye salmon.

One limnology station was established in McLees Lake, at WGS84 global positioning system (GPS) waypoint 53.984667, −166.731083. The station was set and marked with a buoy at this location to ensure consistency. Depth of the lake was measured each sampling day to ensure a precise sampling location is maintained throughout the season. Sampling took place at four-week

intervals. Temperature, dissolved oxygen, and light penetration parameters were measured, and a zooplankton sample was taken from the station. Sample data was recorded on all-weather field forms provided by ADF&G.

Water temperature (°C), dissolved oxygen (DO; mg/l), and conductivity (µS/m) was measured at 0.5 m intervals at the station with a dissolved oxygen meter. Prior to use, the meter's probe membrane was examined for wear (tears, folds, and air bubbles). A hand-held thermometer was used to measure the surface temperature which was compared to the meter's integrated thermometer to ensure it was working properly. The meter was calibrated according to the manufacturer's instructions prior to use. An incidence reading was taken above the water's surface. The probe was then lowered into the water and another reading was taken directly below the water's surface. A subsequent measurement was taken at 1 m depth. Secchi Disk (SD) transparency was measured to assess water clarity. SD depth was measured on the shaded side of the boat. The SD was lowered into the water on a metered line until it disappeared from view, lowered to the bottom to check water depth, and then pulled up until it reappeared. The depth of the disk when it disappeared, the depth it reappeared, and the average of the two readings were recorded. The bottom depth was used to verify that the sampling station had remained stationary.

A 0.2 m diameter, 153-micron mesh, conical net was used to collect zooplankton samples with vertical tows. Prior to sampling, the bottom depth at the station was determined by lowering a weighted, metered line. The collection basin and tow-net were cleaned of any debris by rinsing with filtered water. The plankton tow-net was lowered at a steady rate, ensuring the weighted cod-end stayed below the opening of the net, until the cod-end was approximately 1 m from the lake bottom or to the end of the towline. The net was manually retrieved at a constant rate of ~0.5 m/sec, stopping when the rim of the net was just above the water's surface. Contents of the net were washed with filtered water into the collection basin. The basin was removed from the net and all sample contents were emptied into a labeled, 125 ml bottle filled with 12.5 ml formalin (10% buffered solution by volume). Filtered water was used to rinse the collection basin and completely fill the bottle. The bottle was capped and sealed with electrical tape to prevent the contents from leaking.

The sample bottle was stored at room temperature and later sent to the ADF&G Kodiak Island Limnology Lab in Kodiak where macro-zooplankton taxa were identified and enumerated following established protocols (Koenings et al. 1987; Thomsen et al. 2002). Zooplankton was identified according to taxonomic keys (Pennak 1989; Thorp and Covich 2001). Zooplankton was enumerated and measured in triplicate 1 ml sub-samples taken with a graduated pipette and placed on a Sedgewick-Rafter counting chamber. Lengths of 15 animals of each species were measured to the nearest 0.01 mm and the mean body length for each taxon was calculated. Biomass was estimated from species-specific linear regression equations between length and dry weight derived by Koenings et al. (1987).

Characteristics of sockeye salmon passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum *m*, the proportion of species *i* passing the weir that are of sex *j* and age *k* (p_{ijkm}) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}},$$

where n_{ijkm} denotes the number of fish of species *i*, sex *j*, and age *k* sampled during stratum *m* and a subscript of "+" represents summation over all possible values of the corresponding variable; e.g., n_{i++m} denotes the total number of fish of species *i* sampled in stratum *m*. The variance of $\hat{p}_{ijkm}$ was estimated as

$$\hat{v}(\hat{p}_{ijkm}) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right) \frac{\hat{p}_{ijkm}(1 - \hat{p}_{ijkm})}{n_{i++m} - 1},$$

where N_{i++m} denotes the total number of species *i* fish passing the weir in stratum *m*. The estimated number of fish of species *i*, sex *j*, age *k* passing the weir in stratum *m* ($\hat{N}_{ijkm}$) was determined by

$$\hat{N}_{ijkm} = N_{i++m}\hat{p}_{ijkm},$$

with estimated variance

$$\hat{v}(\hat{N}_{ijkm}) = N_{i++m}^2 \hat{v}(\hat{p}_{ijkm}).$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right) \hat{p}_{ijkm},$$

with estimated variance

$$\hat{v}(\hat{p}_{ijk}) = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right)^2 \hat{v}(\hat{p}_{ijkm}).$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ijk} = \sum_m \hat{N}_{ijkm},$$

with estimated variance

$$\hat{v}(\hat{N}_{ijk}) = \sum_m \hat{v}(\hat{N}_{ijkm}).$$

If the length of fish of species *i*, sex *j*, and age *k* sampled in stratum *m* is denoted x_{ijkm}, the sample mean length of fish of species *i*, sex *j*, and age *k* within stratum *m* was calculated as

$$\bar{x}_{ijkm} = \frac{\sum x_{ijkm}}{n_{ijkm}},$$

with corresponding sample variance s^2_{ijkm} calculated as

$$s^2_{ijkm} = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}}\right) \frac{\sum \left(x_{ijkm} - \bar{x}_{ijkm}\right)^2}{n_{ijkm} - 1}.$$

The mean length of all fish of species *i*, sex *j*, and age *k* ($\hat{\bar{x}}_{ijk}$) was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\bar{x}}_{ijk} = \sum_m \left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}}\right) \bar{x}_{ijkm}.$$

An approximate estimator of the variance of $\hat{\bar{x}}_{ijk}$ will be obtained using the delta method,

$$\hat{v}\left(\hat{\bar{x}}_{ijk}\right) = \sum_m \left\{ \hat{v}\left(\hat{N}_{ijkm}\right) \left[\frac{x_{ijkm}}{\sum_x \hat{N}_{ijkx}} - \sum_y \frac{\hat{N}_{ijky}}{\left(\sum_x \hat{N}_{ijkx}\right)^2} x_{ijky} \right]^2 + \left(\frac{\hat{N}_{ijkm}}{\sum_x \hat{N}_{ijkx}} \right)^2 s^2_{ijkm} \right\}.$$

The mean euphotic zone depth (EZD) was determined (Koenings et.al 1987) for the lake and incorporated into a model for estimating sockeye salmon fry production (Koenings and Kyle 1997). A Secchi disk was used in conjunction with a light meter which is typically used for the EZD model. Temperature and dissolved oxygen measurements taken at 1 m increments were compared to assess the physical conditions in the euphotic zones of the lake. Zooplankton data was compared to physical and nutrient data via linear regression and published values of length and biomass.

RESULTS

Successful operation of the McLees Lake weir occurred in the summers of 2012–2017. The total interpolated sockeye salmon escapement through the McLees Lake weir in 2012 was 38,006 fish, in 2013 was 15,688, in 2014 was 12,424, in 2015 was 20,284, in 2016 was 39,892 fish, and in 2017 was 13,195 fish (Table 1, Figure 5). Sockeye salmon escapement was within the escapement goal of 10,000–60,000 fish in each year. The daily sockeye salmon escapement reached its peak in the last week of June from 2012–2016, whereas in 2017 the peak occurred in the first week of July (Figure 6).

A total of 619 sockeye salmon were ASL sampled in 2012. The mean length of all sampled fish was 508 mm, with a mean length of 500 mm for females and 513 mm for males. Of the fish sampled, 59.4 percent were male and 40.5 percent were female (Table 2). The dominant age classes in 2012 were age-1.2 at 72.2 percent, followed by age-1.3 at 26.0 percent (Table 3, Figure 7).

A total of 1,502 sockeye salmon were ASL sampled in 2013. The mean length of all sampled fish was 555 mm, with a mean length of 542 mm for females and 565 mm for males. Of the fish

sampled, 57.8 percent were male and 42.2 percent were female (Table 4). The dominant age class in 2013 was age-1.3 at 90.6 percent (Table 5, Figure 7).

A total of 842 sockeye salmon were ASL sampled in 2014. The mean length of all sampled fish was 518 mm, with a mean length of 504 mm for females and 525 mm for males. Of the fish sampled, 64.0 percent were male and 36.0 percent were female (Table 6). The dominant age classes in 2014 were age-1.2 at 38.2 percent, followed by age-2.2 at 31.2 percent (Table 7, Figure 7).

A total of 1,310 sockeye salmon were ASL sampled in 2015. The mean length of all sampled fish was 504 mm, with a mean length of 513 mm for females and 518 mm for males. Of the fish sampled, 56.2 percent were male and 43.8 percent were female (Table 8). The dominant age classes in 2015 were age-1.3 at 57.9 percent, followed by age-1.2 at 36.0 percent (Table 9, Figure 7).

A total of 1,006 sockeye salmon were ASL sampled in 2016. The mean length of all sampled fish was 515 mm, with a mean length of 503 mm for females and 524 mm for males. Of the fish sampled, 54.3 percent were male and 45.7 percent were female (Table 10). The dominant age classes in 2016 were age-1.3 at 87.7 percent, followed by age-1.2 at 12.3 percent (Table 11, Figure 7).

A total of 444 sockeye salmon were ASL sampled in 2017. The mean length of all sampled fish was 554 mm, with a mean length of 540 mm for females and 568 mm for males. Of the fish sampled, 43.7 percent were male and 56.3 percent were female (Table 12). The dominant age classes in 2017 were age-1.3 at 64.2 percent, followed by age-1.2 at 23.4 percent (Table 13, Figure 7).

Zooplankton samples were collected at one station three times per summer from 2012 through 2017. Analysis of McLees Lake zooplankton samples indicated variability of abundance and biomass between the years, and consistency of biodiversity and zooplankton lengths throughout the three summers of sampling. The species composition was dominated by *Bosmina* with lower numbers of *Cyclops* and *Chydorinae* (Table 14).The 2017 data was not available at the time of this publication.

Water temperature readings were collected at the same time and area as zooplankton samples from 2012 through 2017. Temperature readings were collected at 0.5 m increments from 0.5 m to 10 m in depth. In addition, a surface reading was collected at 0.03 m. The average temperature for the depth profiles ranged from 11.8 degrees C in 2012 to 13.1 degrees C in 2016 (Table 15). The 2017 data was not available at the time of this publication.

DISCUSSION

Passage of sockeye salmon through the McLees Lake weir occurred during June and July with the peak of the run typically occurring in the last week of June. The 2017 sockeye run peaked a week later than the average run timing, corresponding with late sockeye run timing observed elsewhere in the region. The average run size from 2001–2017 is 32,574 sockeye salmon. Only the 2012 estimated escapement and the 2016 escapement exceeded the average, whereas the 2013, 2014, 2015, and 2017 were below average escapements. ADF&G is confident that the installation of the weir captured the sockeye salmon escapement into McLees Lake and that daily weir passage rates were representative of the true return.

Age composition of McLees Lake sockeye salmon was primarily age-1.2 and age-1.3 fish from 2012–2017. A smaller component of 2-year freshwater fish is present along with 4-year saltwater fish. This trend has been seen in previous years, wherein an alternate-year pattern of abundance between larger numbers age-1.2 sockeye salmon in even years and larger numbers of age-1.3 sockeye salmon in odd years has occurred. Sex ratios and length averages of sampled fish have remained consistent over the course of the project with a greater proportion of the run being larger males over smaller females. The 2017 run was the only exception to this trend where smaller females had a greater proportion of the run over the larger males.

Sockeye salmon returning to McLees Lake continue to be an important subsistence resource for the community of Dutch Harbor on Unalaska Island. Due to the variability of the McLees Lake run size from year to year, inseason monitoring has been a valuable tool for continued sustainable subsistence utilization.

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TABLES AND FIGURES

Table 1.–Daily and cumulative counts of sockeye salmon passage through the McLees Lake weir, 2012-2017.

	2012		2013		2014		2015		2016		2017	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
6/1	-[a]	-[a]	-	-	-	-	-	-	-	-	-	-
6/2	-[a]	-[a]	-	-	-	-	-	-	-	-	-	-
6/3	-[a]	-[a]	-	-	-	-	-	-	-	-	-	-
6/4	-[a]	-[a]	-	-	-	-	-	-	-	-	-	-
6/5	-[a]	-[a]	0	0	-	-	0	0	-	-	-	-
6/6	-[a]	-[a]	59	59	-	-	1	1	-	-	-	-
6/7	-[a]	-[a]	38	97	-	-	7	8	5	5	-	-
6/8	-[a]	-[a]	121	218	-	-	3	11	134	139	-	-
6/9	-[a]	-[a]	5	223	-	-	4	15	16	155	0	0
6/10	-[a]	-[a]	199	422	-	-	75	90	11	166	3	3
6/11	-[a]	-[a]	99	521	-	-	93	183	329	495	9	12
6/12	-[a]	-[a]	108	629	57	57	177	360	6	501	5	17
6/13	-[a]	-[a]	72	701	282	339	240	600	73	574	4	21
6/14	-[a]	-[a]	339	1,040	121	460	510	1,110	446	1,020	6	27
6/15	-[a]	-[a]	454	1,494	78	538	144	1,254	537	1,557	6	33
6/16	-[a]	-[a]	861	2,355	163	701	741	1,995	89	1,646	5	38
6/17	-[a]	-[a]	793	3,148	547	1,248	847	2,842	416	2,062	27	65
6/18	-[a]	-[a]	356	3,504	215	1,463	743	3,585	878	2,940	18	83
6/19	-[a]	-[a]	568	4,072	233	1,696	536	4,121	517	3,457	43	126
6/20	-[a]	-[a]	1098	5,170	514	2,210	932	5,053	1,510	4,967	41	167
6/21	-[a]	-[a]	310	5,480	710	2,920	535	5,588	1,699	6,666	90	257
6/22	-[a]	-[a]	870	6,350	171	3,091	585	6,173	2,602	9,268	38	295
6/23	-[a]	-[a]	795	7,145	642	3,733	437	6,610	1,771	11,039	103	398
6/24	-[a]	-[a]	641[b]	7,786	650	4,383	328	6,938	996	12,035	253	651
6/25	-[a]	-[a]	250	8,036	796	5,179	486	7,424	2,120	14,155	130	781
6/26	-[a]	-[a]	459	8,495	1071[b]	6,250	908	8,332	1,584	15,739	112	893
6/27	-[a]	-[a]	696	9,191	426	6,676	714	9,046	978	16,717	46	939
6/28	-[a]	-[a]	946	10,137	631	7,307	520	9,566	1,448	18,165	107	1,046

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Table 1.–Page 2 of 3.

	2012		2013		2014		2015		2016		2017	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
6/29	-[a]	-[a]	309	10,446	346	7,653	755	10,321	1,546	19,711	97	1,143
6/30	-[a]	-[a]	356	10,802	126	7,779	1,169[b]	11,490	2,104[b]	21,815	222	1,365
7/1	-[a]	-[a]	983	11,785	482	8,261	778	12,268	1,278	23,093	437	1,802
7/2	-[a]	-[a]	521	12,306	253	8,514	234	12,502	1,047	24,140	198	2,000
7/3	-[a]	-[a]	459	12,765	468	8,982	325	12,827	626	24,766	266	2,266
7/4	-[a]	-[a]	124	12,889	269	9,251	272	13,099	949	25,715	249	2,515
7/5	-[a]	-[a]	346	13,235	402	9,653	618	13,717	1,018	26,733	1,602	4,117
7/6	-[a]	-[a]	354	13,589	352	10,005	604	14,321	1,060	27,793	476	4,593
7/7	-[a]	-[a]	130	13,719	221	10,226	379	14,700	1,097	28,890	358	4,951
7/8	-[a]	-[a]	309	14,028	285	10,511	337	15,037	564	29,454	259	5,210
7/9	-[a]	-[a]	25	14,053	146	10,657	514	15,551	2,401	31,855	843	6,053
7/10	1,086	1,086	297	14,350	58	10,715	389	15,940	1,391	33,246	365	6,418
7/11	1,410	2,496	271	14,621	281	10,996	278	16,218	1,587	34,833	323[b]	6,741
7/12	797	3,293	49	14,670	440	11,436	395	16,613	1,075	35,908	395	7,136
7/13	1,178	4,471	19	14,689	44	11,480	287	16,900	974	36,882	232	7,368
7/14	532	5,003	225	14,914	102	11,582	489	17,389	774	37,656	262	7,630
7/15	331	5,334	65	14,979	213	11,795	430	17,819	689	38,345	744	8,374
7/16	846	6,180	130	15,110	62	11,857	695	18,514	933	39,278	511	8,885
7/17	316	6,496	191	15,311	36	11,893	277	18,791	189	39,467	161	9,046
7/18	565	7,061	166	15,485	46	11,939	167	18,958	184	39,651	359	9,405
7/19	2,126	9,187	49	15,534	211	12,150	361	19,319	47	39,698	149	9,554
7/20	644	9,831	18	15,552	70	12,220	289	19,608	96	39,794	320	9,874
7/21	479	10,310	25	15,577	27	12,247	199	19,807	20	39,814	302	10,176
7/22	928	11,238	49	15,626	22	12,269	88	19,895	36	39,850	293	10,469
7/23	705	11,943	23	15,649	62	12,331	83	19,978	27	39,877	308	10,777
7/24	505	12,448	39[c]	15,688	37	12,368	106	20,084	15[c]	39,892	432	11,209
7/25	421	12,869	-	-	56[c]	12,424	86	20,170	-	-	355	11,564
7/26	222	13,091	-	-	-	-	72	20,242	-	-	263	11,827

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Table 1.–Page 3 of 3.

	2012		2013		2014		2015		2016		2017	
Date	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
7/27	538	13,629	-	-	-	-	42[c]	20,284	-	-	817	12,644
7/28	499	14,128	-	-	-	-	-	-	-	-	317	12,961
7/29	215	14,343	-	-	-	-	-	-	-	-	234[c]	13,195
7/30	355	14,698	-	-	-	-	-	-	-	-	-	-
7/31	413[c]	15,111	-	-	-	-	-	-	-	-	-	-
Total	-	15,111	-	15,688	-	12,424	-	20,284	-	39,892	-	13,195

[a] Weir installation delayed due to personnel issues. An estimated total escapement of 38,006 sockeye salmon was calculated from the average midpoint of previous seasons and expanding the counts from 34% of the returns to the remaining 66% of the returns.

[b] Mid-point.

[c] Weir removed.

Table 2.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2012.

	Ages				
	1.2	1.3	2.2	2.3	Total
Mean length females	490	527	515	0	500
Standard error females	1.9	3.2	15.5	0.0	2.1
Range females	371-577	442-581	493-545	-	371-581
Sample size females	181	67	3	0	251
Mean length males	502	543	496	564	513
Standard error males	1.6	3.4	15.7	5.8	1.7
Range males	435-597	435-597	461-537	553-573	435-597
Sample size males	267	93	5	3	368
Mean length all	497	536	503	564	508
Standard error all	1.2	2.5	11.2	5.8	1.3
Range all	371-597	435-597	461-545	553-573	371-597
Sample size all	448	160	8	3	619

Note: Data represents the observed escapement from July 10–July 31.

Table 3.–Estimated age composition of McLees Lake sockeye salmon, 2012.

			Ages				
Stat week	Sample		1.2	1.3	2.2	2.3	Total Fish
28 (7/5-7/11)	0	Percent	71.0	26.8	1.8	0.4	100
		Number	1,773	669	45	9	2,496
29 (7/12-7/18)	276	Percent	71.2	26.7	1.7	0.4	100
		Number	3,250	1,219	79	17	4,565
30 (7/19-7/25)	203	Percent	72.9	25.6	1.0	0.5	100
		Number	4,219	1,495	65	28	5,808
31 (7/26-8/1)	140	Percent	74.2	24.4	0.7	0.7	100
		Number	1,663	547	16	16	2,242
Totals	619	Percent	72.2	26.0	1.4	0.5	100
		Number	10,905	3,929	206	70	15,111

Note: Age classes have been interpolated between sampling events.

Table 4.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2013.

	Ages						
	0.3	1.2	1.3	1.4	2.2	2.3	Total
Mean length females	0	502	545	557	535	542	542
Standard error females	0	4.7	0.7	6.4	9.0	7.6	1.0
Range females	-	442-580	459-601	541-572	526-544	508-575	442-601
Sample size females	0	44	574	5	2	9	634
Mean length males	552.5	517	568	584	524	580	565
Standard error males	1.5	4.0	0.7	6.6	13.0	3.4	0.8
Range males	551-554	468-590	461-629	563-611	511-537	548-597	461-629
Sample size males	2	51	793	6	2	14	868
Mean length all	552.5	510	558	572	530	565	555
Standard error all	1.5	3.1	0.6	6.1	7.2	5.3	0.7
Range all	551-554	442-590	459-629	541-611	511-544	508-597	442-629
Sample size all	2	95	1,367	11	4	23	1,502

Table 5.–Estimated age composition of McLees Lake sockeye salmon escapement, 2013.

			Ages						
Stat week	Sample		0.3	1.2	1.3	1.4	2.2	2.3	Total Fish
23 (5/31-6/6)	0	Percent	0.0	4.7	89.5	0.5	1.6	3.7	100
		Number	0	3	53	0	1	2	59
24 (6/7-6/13)	191	Percent	0.0	4.6	89.9	0.5	1.5	3.5	100
		Number	0	29	577	3	10	23	642
25 (6/14-6/20)	221	Percent	0.1	3.9	92.8	0.5	0.5	2.2	100
		Number	7	178	4,151	24	19	92	4,470
26 (6/21-6/27)	242	Percent	0.6	6.8	90.7	0.7	0.1	1.1	100
		Number	25	271	3,649	30	3	43	4,021
27 (6/28-7/4)	204	Percent	0.1	10.5	87.7	0.7	0.0	1.0	100
		Number	5	394	3,240	23	0	36	3,698
28 (7/5-7/11)	258	Percent	0.0	7.7	89.9	1.3	0.0	1.1	100
		Number	0	136	1,556	21	0	19	1,732
29 (7/12-7/18)	219	Percent	0.0	5.6	92.9	0.6	0.0	1.0	100
		Number	0	46	803	4	0	9	862
30 (7/19-7/25)	167	Percent	0.0	3.7	94.5	0.6	0.0	1.2	100
		Number	0	8	192	1	0	2	203
31 (7/26-8/1)	0	Percent	0.0	3.6	94.6	0.6	0.0	1.2	100
		Number	0	0	0	0	0	0	0
32 (8/2-8/8)	0	Percent	0.0	3.6	94.6	0.6	0.0	1.2	100
		Number	0	0	0	0	0	0	0
33 (8/9-8/15)	0	Percent	0.0	3.6	94.6	0.6	0.0	1.2	100
		Number	0	0	0	0	0	0	0
Totals	1,502	Percent	0.2	6.8	90.6	0.7	0.2	1.4	100
		Number	37	1,064	14,220	107	32	226	15,687

Note: Age classes have been interpolated between sampling events.

Table 6.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2014.

	Ages								
	0.3	1.2	1.3	1.4	2.2	2.3	2.4	3.2	Total
Mean length females	0	493	538	0	490	532	570	0	504
Standard error females	0	2.3	3.4	0.0	2.1	4.1	0.0	0.0	2.0
Range females	-	410-590	435-570	-	435-555	470-560	570-570	-	410-590
Sample size females	0	128	53	0	89	32	1	0	303
Mean length males	520	510	558	592	508	558	0	505	525
Standard error males	10	1.8	3.0	10.2	2.0	3.3	0.0	0.0	1.5
Range males	510-530	425-590	460-620	520-630	410-590	500-610	-	505-505	410-630
Sample size males	2	194	91	9	174	68	0	1	539
Mean length all	520	503	550	592	502	550	570	505	518
Standard error all	10	1.5	2.4	10.2	1.6	2.9	0.0	0.0	1.2
Range all	510-530	410-590	435-620	520-630	410-590	470-610	570-570	505-505	410-630
Sample size all	2	322	144	9	263	100	1	1	842

Table 7.–Estimated age composition of McLees Lake sockeye salmon escapement, 2014.

Stat week	Sample		Ages 0.3	1.2	1.3	1.4	2.2	2.3	2.4	3.2	Total Fish
24 (6/7-6/13)	0	Percent	0.5	34	23.9	2.5	20.3	18.8	0	0	100
		Number	2	115	81	9	69	64	0	0	339
25 (6/14-6/20)	197	Percent	0.5	33.7	23.6	2.3	21.6	18.3	0	0	100
		Number	8	627	438	41	418	338	0	0	1,871
26 (6/21-6/27)	191	Percent	0	33.6	19.5	0.3	33.3	13	0.1	0.1	100
		Number	2	1,515	864	13	1,493	570	5	5	4,466
27 (6/28-7/4)	176	Percent	0	45.5	14.5	0.6	30.5	8	0.4	0.4	100
		Number	0	1,160	378	14	790	210	11	11	2,575
28 (7/5-7/11)	168	Percent	0.1	43.4	15.9	1.4	30.8	8.2	0.1	0.1	100
		Number	1	766	274	23	534	141	3	3	1,745
29 (7/12-7/18)	92	Percent	0.8	37.5	6.4	0.3	45.2	9.9	0	0	100
		Number	7	370	75	4	392	94	0	0	943
30 (7/19-7/25)	18	Percent	0.1	24.3	5.4	0	64	6.2	0	0	100
		Number	1	127	26	0	298	33	0	0	485
Totals	842	Percent	0.2	37.7	17.2	0.8	32.1	11.7	0.1	0.1	100
		Number	21	4,681	2,137	104	3,994	1,450	18	18	12,424

Note: Age classes have been interpolated between sampling events.

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Table 8.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2015.

	Ages						
	1.1	1.2	1.3	1.4	2.2	2.3	Total
Mean length females	-	482	534	533	485	529	513
Standard error females	-	1.2	1.0	6.0	6.5	3.7	1.3
Range females	-	430-538	466-577	527-539	467-503	503-556	430-577
Samples females	0	254	294	2	6	18	574
Mean length males	395	495	555	616	495	554	518
Standard error males	-	1.4	0.9	-	9.4	2.7	1.3
Range males	395-395	404-545	495-613	616-616	459-560	532-590	395-616
Samples males	1	256	436	1	10	32	736
Mean length all	395	488	547	561	491	545	504
Standard Error all	-	1.0	0.8	27.9	6.3	2.8	1.0
Range all	395-395	404-545	466-613	527-616	459-560	503-590	395-616
Samples all	1	510	730	3	16	50	1,310

Table 9.–Estimated age composition of McLees Lake sockeye salmon escapement, 2015.

			Ages						
Stat week	Samples		1.1	1.2	1.3	1.4	2.2	2.3	Total Fish
24 (6/7-6/13)	0	Percent	0.0	33.2	55.2	0.0	2.3	9.4	100
		Number	0	221	368	0	15	63	667
25 (6/14-6/20)	214	Percent	0.0	31.8	61.7	0.0	1.4	5.1	100
		Number	0	1,415	2,747	0	62	229	4,453
26 (6/21-6/27)	220	Percent	0.0	34.5	48.6	0.0	3.2	13.6	100
		Number	0	1,379	1,942	0	127	545	3,993
27 (6/28-7/4)	221	Percent	0.0	32.6	66.5	0.0	0.5	0.5	100
		Number	0	1,320	2,696	0	18	18	4,053
28 (7/5-7/11)	218	Percent	0.0	34.4	65.6	0.0	0.0	0.0	100
		Number	0	1,073	2,046	0	0	0	3,119
29 (7/12-7/18)	218	Percent	0.5	43.6	52.3	0.5	0.9	2.3	100
		Number	13	1,194	1,433	13	25	63	2,740
30 (7/19-7/25)	219	Percent	0.0	56.6	39.7	0.9	1.4	1.4	100
		Number	0	686	481	11	17	17	1,212
Total:	1,310	Percent	0.1	36.0	57.9	0.1	1.3	4.6	100
		Number	13	7,289	11,713	24	265	934	20,237

Note: Age classes have been interpolated between sampling events.

Table 10.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2016.

	Ages		
	1.2	1.3	Totals
Mean length females	486	520	503
Standard error females	2.7	0.9	1.0
Range females	445-537	428-598	428-598
Samples females	53	407	460
Mean length males	503	544	524
Standard error males	2.7	0.9	1.0
Range males	437-573	452-590	437-590
Samples males	71	475	546
Mean length all	496	533	515
Standard error all	2.1	0.7	0.8
Range all	437-573	428-598	428-598
Samples all	124	882	1,006

Table 11.–Estimated age composition of McLees Lake sockeye salmon escapement, 2016.

			Ages		
Stat week	Samples		1.2	1.3	Total
24 (6/7-6/13)	61	Percent	3.3	96.7	100.0
		Number	19	555	574
25 (6/14-6/20)	171	Percent	6.4	93.6	100.0
		Number	283	4,110	4,393
26 (6/21-6/27)	211	Percent	7.6	92.4	100.0
		Number	891	10,859	11,750
27 (6/28-7/4)	129	Percent	18.6	81.4	100.0
		Number	1,674	7,324	8,998
28 (7/5-7/11)	203	Percent	14.8	85.2	100.0
		Number	1,347	7,771	9,118
29 (7/12-7/18)	211	Percent	19.0	81.0	100.0
		Number	913	3,905	4,818
30 (7/19-7/25)	20	Percent	5.0	95.0	100.0
		Number	12	229	241
Total:	1,006	Percent	12.3	87.7	100.0
		Number	4,917	34,975	39,892

Note: Age classes have been interpolated between sampling events.

Table 12.–Length composition of McLees Lake sockeye salmon escapement samples by age and sex, 2017.

	Ages						
	1.2	1.3	1.4	2.2	2.3	2.4	Totals
Mean length females	500	545	563	519	549	565	540
Standard error females	2.3	1.5	10.3	4.0	14.0	-	1.7
Range females	455-535	493-588	535-584	490-544	495-580	565-565	455-588
Samples females	61	163	4	15	6	1	250
Mean length males	530	570	593	560	588	-	568
Standard error males	4.3	1.9	13.6	10.6	4.2	-	2.1
Range males	472-597	504-623	563-628	510-614	544-605	-	472-628
Samples males	43	122	5	9	15	0	194
Mean length all	513	556	580	534	576	565	554
Standard error all	2.6	1.4	9.9	6.2	6.2	-	1.5
Range all	455-597	493-623	535-628	490-614	495-605	565-565	455-628
Samples all	104	285	9	24	21	1	444

Table 13.–Estimated age composition of McLees Lake sockeye salmon escapement, 2017.

			Ages						
Stat week	Samples		1.2	1.3	1.4	2.2	2.3	2.4	Total
24 (6/7-6/13)	0	Percent	22.1	63.7	1.9	4.8	6.6	0.9	100.0
		Number	5	13	0	1	1	0	21
25 (6/14-6/20)	0	Percent	26.2	61.2	0.9	5.1	5.7	0.9	100.0
		Number	38	89	1	7	8	1	146
26 (6/21-6/27)	49	Percent	22.4	67.3	2.0	4.1	4.1	0.0	100.0
		Number	173	520	16	32	32	0	772
27 (6/28-7/4)	55	Percent	21.8	60.0	1.8	5.5	9.1	1.8	100.0
		Number	344	946	29	86	143	29	1,576
28 (7/5-7/11)	85	Percent	30.6	62.4	0.0	4.7	2.4	0.0	100.0
		Number	1,293	2,635	0	199	99	0	4,226
29 (7/12-7/18)	94	Percent	24.5	63.8	4.3	3.2	4.3	0.0	100.0
		Number	652	1,700	113	85	113	0	2,664
30 (7/19-7/25)	99	Percent	17.2	68.7	3.0	5.1	6.1	0.0	100.0
		Number	371	1,483	65	109	131	0	2,159
31(7/25-7/31)	76	Percent	23.7	63.2	0.0	9.2	3.9	0.0	100.0
		Number	386	1,030	0	150	64	0	1,631
Total:	458	Percent	23.4	64.4	2.0	5.2	4.8	0.2	100.0
		Number	3,083	8,499	259	691	634	29	13,195

Note: Age classes have been interpolated between sampling events.

Table 14.–McLees Lake seasonal weighted zooplankton biomass (mg/m2), 2012–2016.

		Year				
	Taxon	2012	2013	2014	2015	2016
Copepods:						
	Cyclops	16	16	43	123	54
	Ovig. *Cyclops*	-	-	-	8	
	Diaptomus	-	-	-	-	-
	Epischura	-	-	-	-	-
	Harpaticus	-	-	-	-	-
Total copepods:		16	16	43	131	54
Cladocerans:						
	Bosmina	4	31	44	320	48
	Ovig. *Bosmina*	1	13	2	58	34
	Ovig. *Chydorinae*	-	-	2	18	28
	Chydorinae	-	3	1	22	19
	Daphnia longiremis	1	2	-	-	-
	Ovig. *Daphnia longiremis*	1	-	-	-	-
Total cladocerans:		7	49	50	418	129
Total Copepods + Cladocerans		23	65	93	549	184

Table 15.–Historical water temperature depth profile for Mclees Lake, 2012–2016.

	Temperature (°C)				
Depth (m)	2012	2013	2014	2015	2016
0.03	12.0	13.1	12.2	13.3	13.6
0.5	12.0	13.0	12.1	13.3	13.4
1	12.0	12.9	12.1	13.3	13.4
1.5	11.9	12.9	12.1	13.2	13.3
2	11.9	12.8	12.1	13.2	13.3
2.5	11.9	12.8	12.1	13.2	13.3
3	11.9	12.8	12.1	13.1	13.3
3.5	11.9	12.8	12.1	13.1	13.3
4	11.9	12.7	12.1	13.1	13.2
4.5	11.9	12.7	12.1	13.1	13.2
5	11.9	12.7	12.1	13.1	13.2
6	11.9	12.7	12.1	13.1	13.1
7	11.8	12.7	12.0	12.9	13.1
8	11.4	12.6	12.0	12.8	13.0
9	11.3	12.1	12.0	12.5	12.9
10	11.2	11.8	11.9	12.4	11.7
Average	11.8	12.7	12.1	13.0	13.1

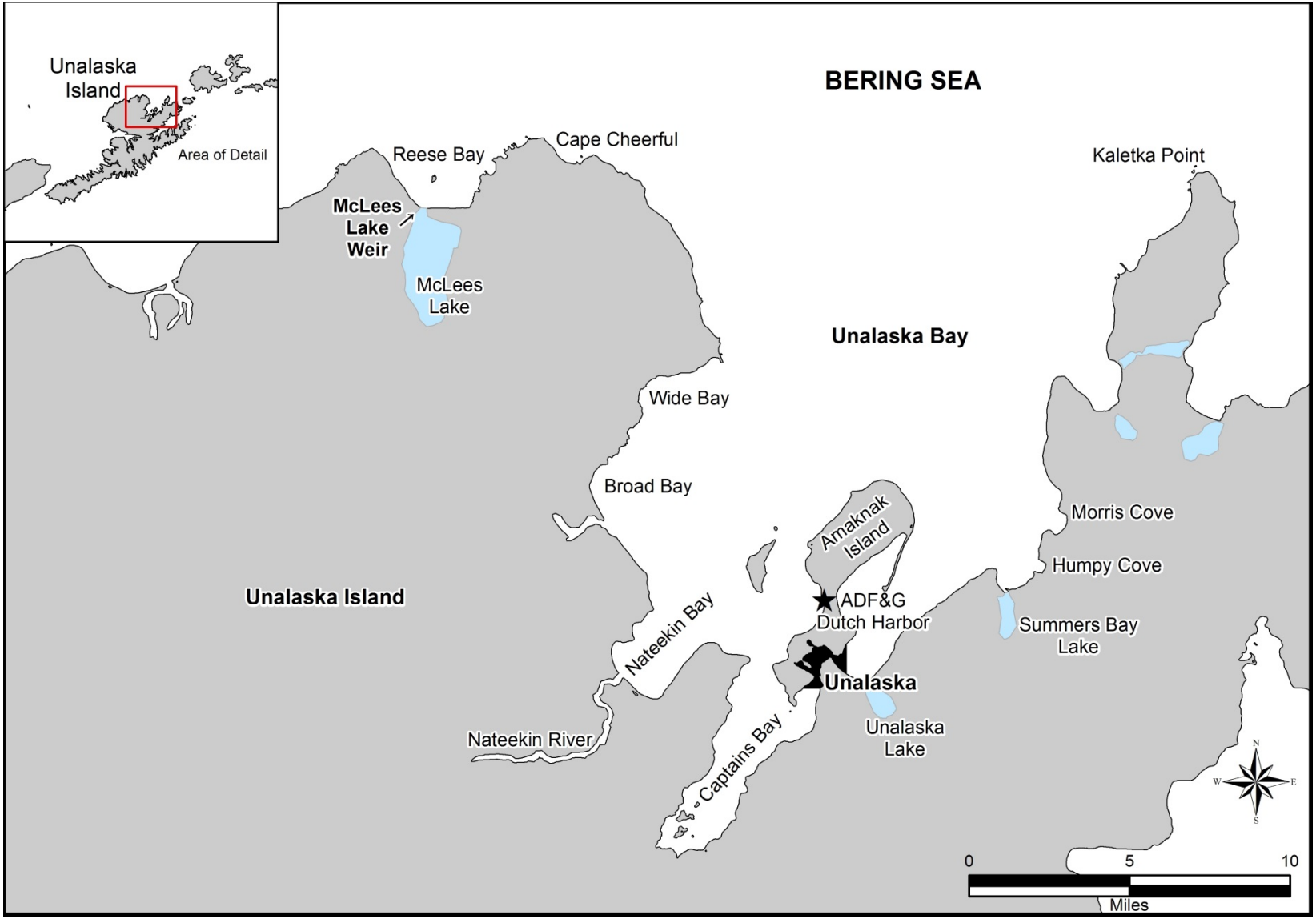

Figure 1.–McLees Lake, Unalaska Island.

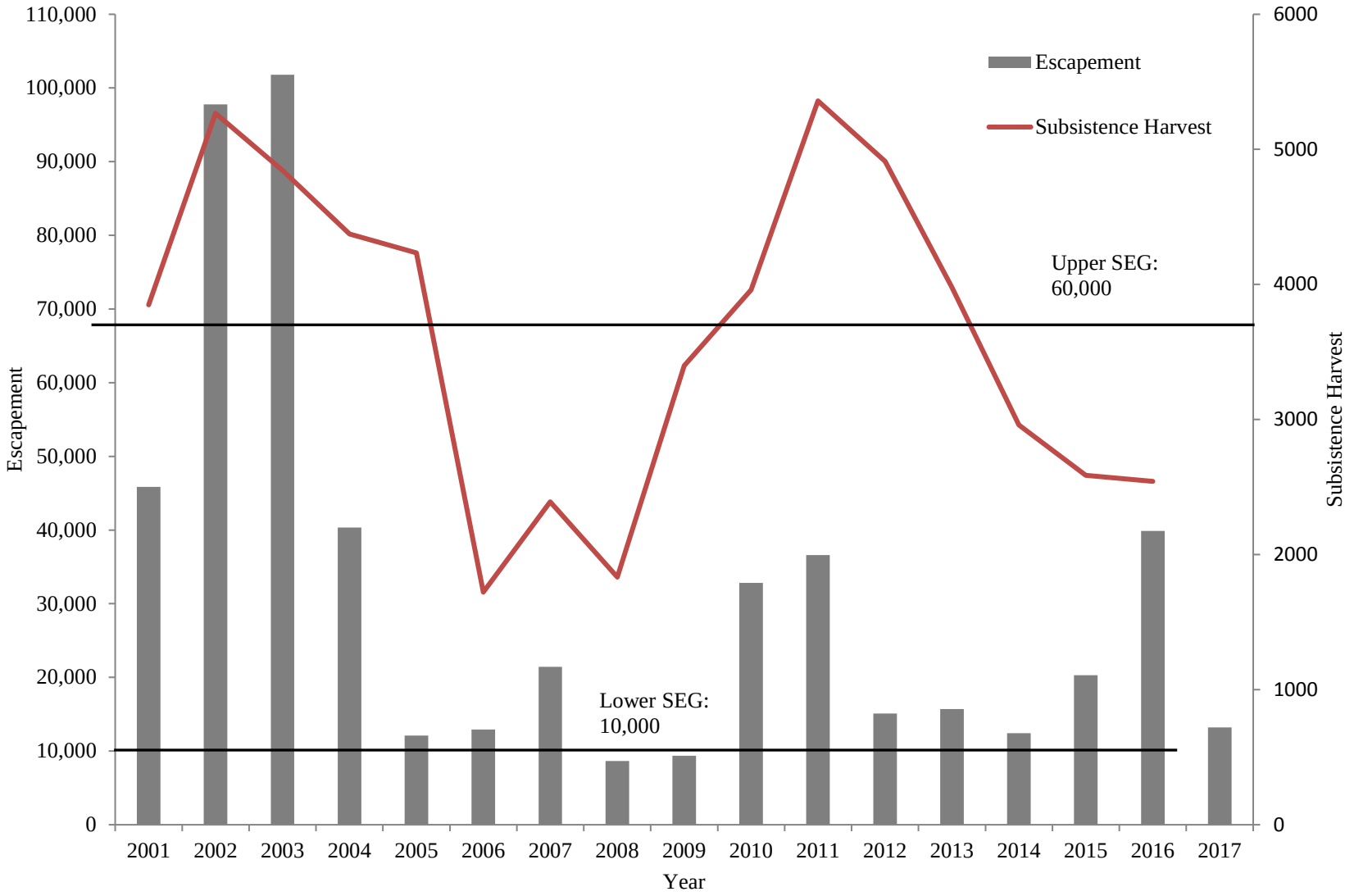

Figure 2.–Cumulative sockeye salmon escapement at the McLees Lake weir and total subsistence salmon harvest for the community of Unalaska, Alaska, from 2001–2017.

Figure 3.–McLees Lake Weir and field camp, 2017.

Figure 4.–McLees Lake weir, 2017.

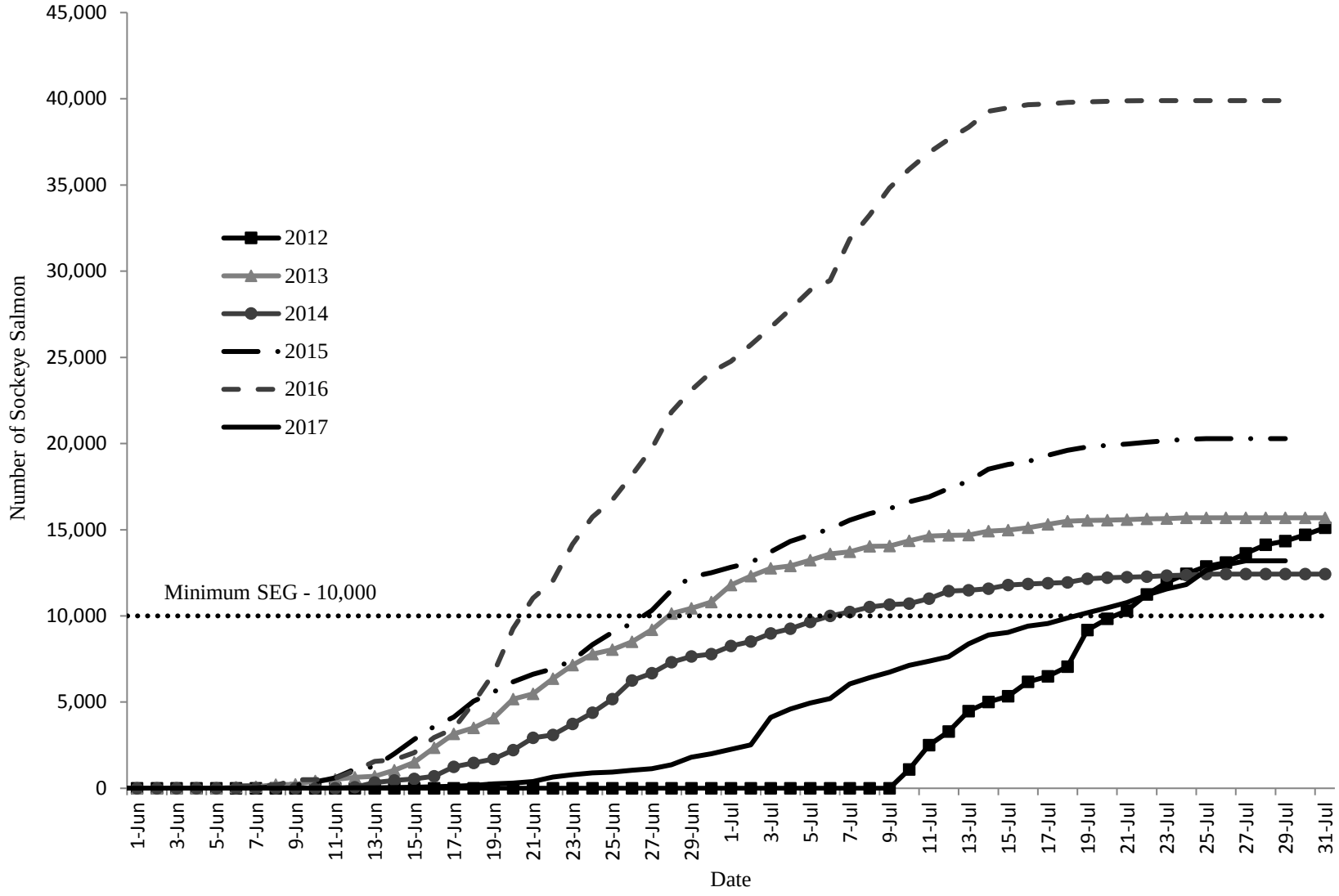

Figure 5.–Cumulative McLees Lake sockeye salmon escapement, 2012–2017.

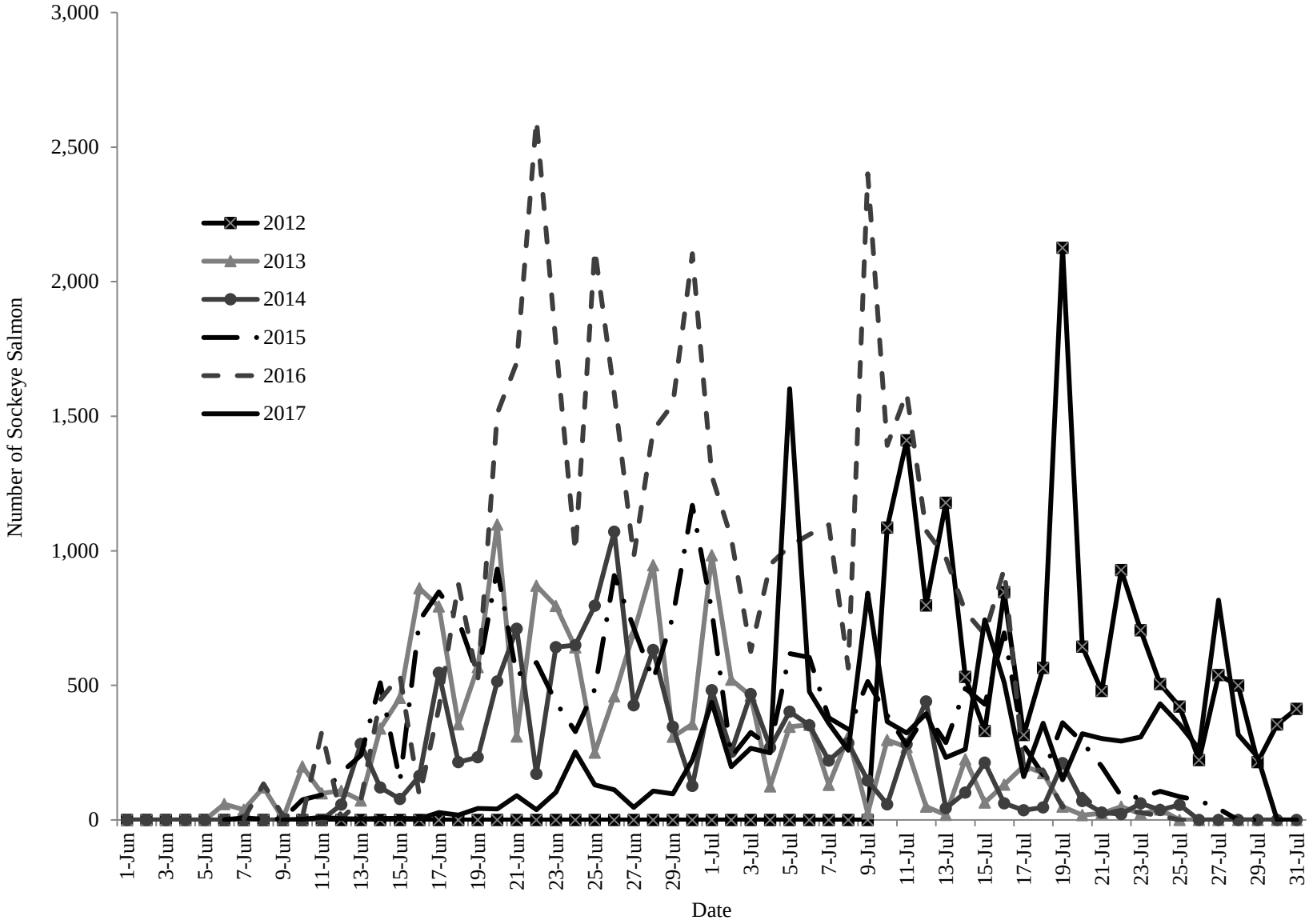

Figure 6.–Daily McLees Lake sockeye salmon escapement, 2012–2017.

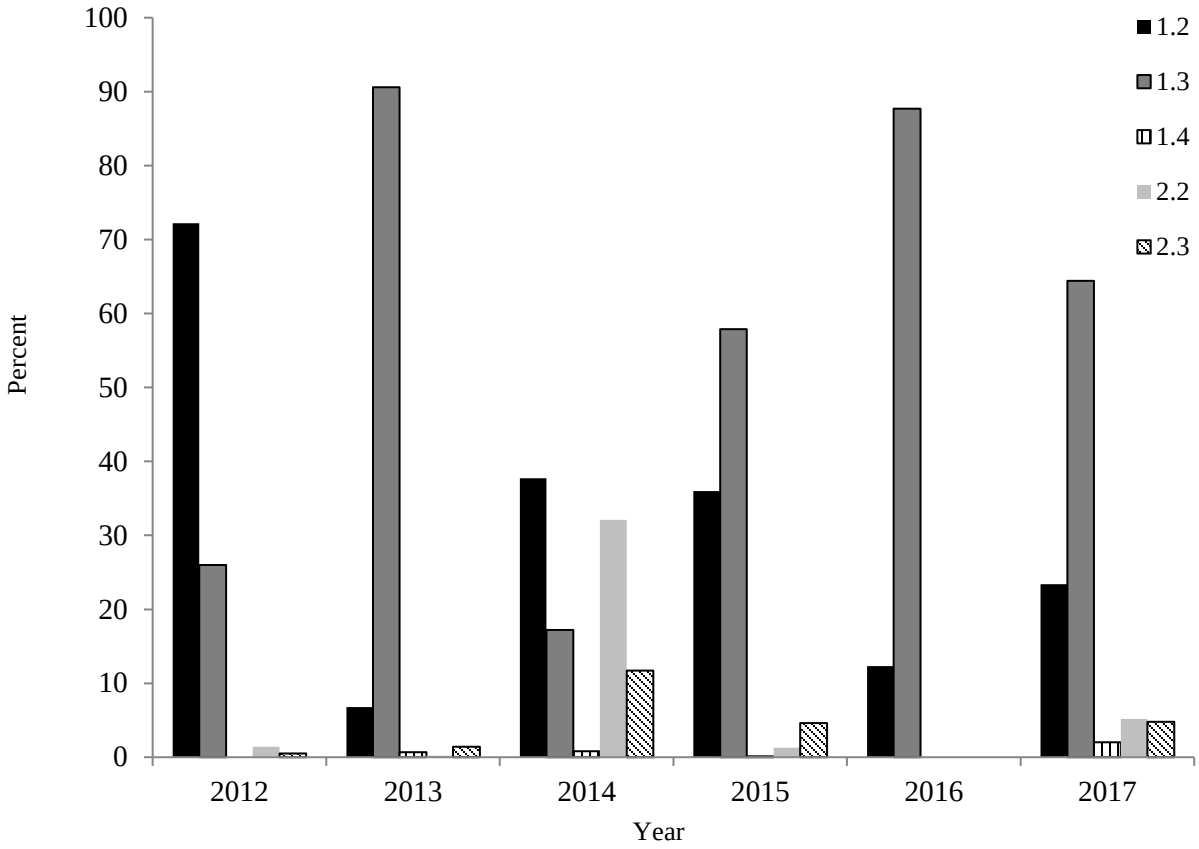

Figure 7.–Major age class percentage of McLees Lake sockeye salmon escapement, 2012-2017.