Fishery Data Series No. 12-80

Early-run Chinook Salmon Creel Survey, Kasilof River, Alaska, 2009–2010

by

Jenny L. Cope

December 2012

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)

Measures (fisheries)

fork length	FL
mid eye to tail fork	METF
standard length	SL
total length	TL

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 creel survey of anglers for Chinook salmon (*Oncorhynchus tshawytscha*) was conducted on the Kasilof River in 2009 and 2010. The project was operated from 16 May to 30 June during both years. Catch, harvest, and angler effort estimates were generated for both naturally- and hatchery-produced Chinook salmon. In 2009, catch was 2,276 (SE 344) fish: 1,239 (SE 173) naturally-produced fish and 1,005 (SE 178) hatchery-produced fish. Harvest for 2009 was 1,532 (SE 270) fish: 576 (SE 122) naturally-produced fish and 956 (SE 177) hatchery-produced fish. In 2010, catch was 3,128 (SE 462) fish: 1,960 (SE 270) naturally-produced fish and 1,152 (SE 212) hatchery-produced fish. Harvest for 2010 was 1,333 (SE 219) fish: 273 (SE 44) naturally-produced fish and 1,060 (SE 206) hatchery-produced fish. The estimated number of anglers was 11,393 (SE 955) in 2009 and 10,500 (SE 785) in 2010, while effort was 48,911 (SE 4,734) angler-hours in 2009 and 52,973 (SE 5,143) angler-hours in 2010. Naturally- and hatchery-produced Chinook salmon catch, harvest, and effort estimates by angler type and method are also included in this report as well as harvest estimates by age and sex.

Key words: Kasilof River, *Oncorhynchus tshawytscha*, Chinook salmon, creel survey, effort, harvest, age composition.

INTRODUCTION

Kasilof River flows approximately 19.6 river miles (RM) from the outlet of Tustumena Lake to Cook Inlet (Figure 1). Its origin in the glaciers of the Kenai Mountains makes it turbid throughout the year. Four species of Pacific salmon including Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), and pink salmon (*O. gorbuscha*) are present in the drainage, as well as anadromous and resident steelhead or rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma*), resident lake trout (*S. namaycush*), and round whitefish (*Prosopium cylindraceum*) (Johnson and Weiss 2006). Sport fisheries exist for all Pacific salmon species present, although most of the fishing effort is directed at Chinook salmon. The Kasilof River early-run Chinook salmon fishery is the subject of this report.

To increase sport fishing opportunity, the Alaska Department of Fish and Game (ADF&G), Fisheries Rehabilitation, Enhancement and Development Division (FRED) constructed a hatchery adjacent to Crooked Creek in the early 1970s (Kyle and Litchfield 1989). Crooked Creek originates in the Caribou Hills and flows approximately 49.7 RM to its confluence with the Kasilof River at approximately RM 6.8 (Figure 1).

Crooked Creek originally had a stock of wild Chinook salmon. The enhancement program supplemented the wild return with hatchery-produced Chinook salmon smolt of Crooked Creek origin. Since the inception of the stocking program, the annual Chinook salmon escapement has been monitored through a weir at the Crooked Creek Facility (except 1997 and 1998). Escapement at Crooked Creek was comprised of wild Chinook salmon when the stocking program began. Some returning hatchery-produced Chinook salmon are used for hatchery production; however, excess hatchery-produced Chinook salmon are allowed to pass upstream of the weir and spawn. Because these naturally-spawning, hatchery-produced fish become part of the spawning stock, subsequent generations may differ from the original wild stock. This mixed population is referred to as *naturally-produced* in this paper. Naturally-produced fish made up 96% of the escapement in 1978, but declined in proportion as hatchery production increased during the 1980s (Todd 1990, unpublished data[1]).

[1] Unpublished summary report, 1990, entitled Crooked Creek Chinook enhancement project 1990 summary report, by G.L. Todd, located at Alaska Department of Fish and Game, Soldotna.

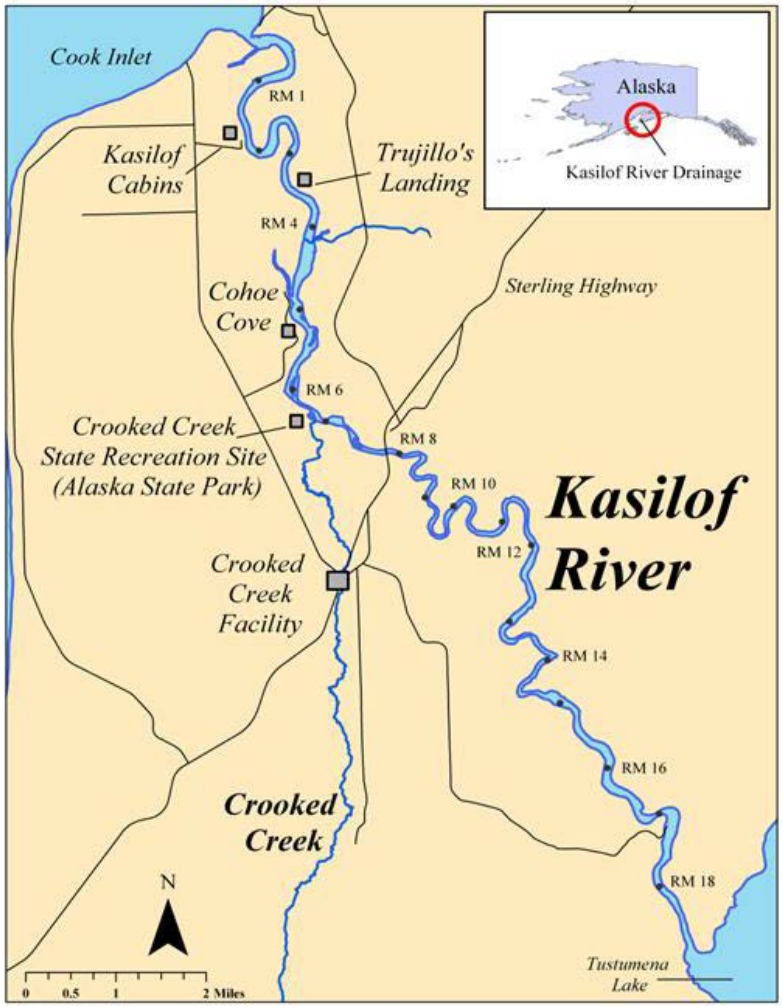


Figure 1.–Creel survey access locations on the Kasilof River, western Kenai Peninsula, Alaska.

The Crooked Creek Hatchery facility was operated by ADF&G until 1995, when Cook Inlet Aquaculture Association (CIAA) assumed operations (Nelson 1995). CIAA continued Chinook salmon escapement monitoring until 1997 when the facility was returned to ADF&G (Nelson et al. 1999). There was no activity at the Crooked Creek Facility during 1997 and 1998. ADF&G resumed escapement monitoring in 1999 (Bethe et al. 2002). From 1988 to 1996, the number of naturally-produced Chinook salmon was limited to 700 fish in the spawning escapement (Gamblin et al. 2004, page 29). Beginning in 1999, all returning Chinook salmon (minus broodstock needs) were allowed upstream of the weir to spawn (Gamblin et al. 2004, page 29). The current management policy, adopted in 2001, requires ADF&G to achieve a sustainable escapement goal (SEG) at the Crooked Creek weir of 650–1,700 age-1.2+ naturally-produced adult Chinook salmon (Bue and Hasbrouck, 2001–2002, unpublished report[2]). Hatchery-produced Chinook salmon are discernible from naturally-produced Chinook salmon by a healed adipose finclip (AFC), while naturally-produced Chinook salmon can be identified by the presence of an adipose fin (Cope 2011).

[2] Unpublished report to the Alaska Board of Fisheries, November 2001 and February 2002, entitled Escapement goal review of salmon stocks of Upper Cook Inlet, by Brian G. Bue and J. J. Hasbrouck, located at Alaska Department of Fish and Game, Anchorage.

The sport fishery targeting early-run Chinook salmon returning to Crooked Creek occurs on the Kasilof River from May through June. Traditionally, this was a shorebased, road accessible fishery that has evolved to be predominately a drift boat fishery. Anglers fishing from shore generally fish near the confluence with Crooked Creek (RM 6.8). Anglers utilizing drift boats access Kasilof River at the Sterling Highway Bridge (RM 8) and typically fish to RM 4.3.

The Kasilof River sport fishery for Chinook salmon was monitored for harvest and angler effort from 1978 to 1989 through a creel survey. In 1988, an informal creel census was conducted by FRED in conjunction with a sockeye salmon smolt enumeration project. In 1989, sport fish catch was estimated by a stratified random sampling schedule for shore angler catches, and from a survey census of fishing guides for drift boat catches. After 1989, the sport fish harvest was not monitored again until 2002, when restrictions on the Kenai River Chinook salmon fishery prompted management biologists to monitor the sport fish harvest of Kasilof River Chinook salmon through a harvest monitoring program. The harvest monitoring program was repeated in 2003. An annual direct expansion, stratified creel survey has been conducted since 2004 (Cope 2011).

FISHING REGULATIONS/EMERGENCY ORDERS

Although Chinook salmon do not enter Kasilof River in appreciable numbers until mid-May, by regulation, the king (Chinook) salmon season is open 1 January through 31 July. The area open to Chinook salmon fishing extends from the Kasilof River mouth upstream to Tustumena Lake, although the area from the Sterling Highway Bridge and above is closed to Chinook salmon fishing from 1 July through 31 December. Prior to 2002, the daily bag and possession limit for Chinook salmon 20 inches or more in length in the Kasilof River was 1 per day (7 days per week), naturally- or hatchery-produced, with an annual limit of 5 fish. Bait and multiple hooks were allowed from 16 May to 30 August. Since 2002, the Kasilof River early-run Chinook salmon fishery has undergone many regulatory changes affecting harvest.

Kasilof River Chinook salmon regulations were modified by the Alaska Board of Fisheries (BOF) prior to the 2002 fishing season. Motorized vessels were prohibited from fishing downstream from the Sterling Highway Bridge from 1 January through 31 July and similarly, motorized vessels were prohibited from fishing upstream of the Sterling Highway Bridge from 1 January through 30 June. The annual limit of Chinook salmon was reduced to 3. Gear was restricted to no more than 1 single hook, with bait allowed. Further restrictions were implemented for fishing guides and guided anglers. Fishing guides were prohibited from fishing while with clients and were limited to 1 trip daily.

In 2002, a Kenai River early-run Chinook salmon fishing closure prompted inseason restrictions on the Kasilof River. Emergency Order No. 2-KS-1-13-02, issued for 14 June through 30 June, prohibited the retention of naturally-produced Chinook salmon (i.e., only Chinook salmon with a healed AFC could be retained through the end of the season). Additionally, anglers who harvested a Chinook salmon could not continue to fish for any other species of fish in Kenai Peninsula waters where Chinook salmon fishing was open.

The prohibition on the retention of naturally-produced Chinook salmon was put into regulation by the BOF for the 2003 and 2004 seasons. Regulations were also adopted stipulating that no person may possess a Chinook salmon that is filleted or disfigured to prevent AFC recognition until the fish is offloaded from a vessel or removed from a fishing site. BOF also prohibited fishing from an anchored vessel near the confluence of Crooked Creek at the Crooked Creek State Recreation Site (commonly referred to as “People Hole”) and invoked liberalizations

regarding motor use in the lower reaches of the Kasilof River (Figure 1). Prior to the 2005 fishing season, BOF liberalized regulations for Kasilof River Chinook salmon by allowing the retention of naturally-produced Chinook salmon 2 days per week (Tuesdays and Saturdays). BOF also liberalized the annual harvest limit on Kasilof River Chinook salmon from 3 to 5. Anglers were also allowed to fish with multiple hooks and bait from 16 May through 31 August.

In 2006 and 2007, the harvest of naturally-produced (non-AFC) Chinook salmon was expanded by emergency order (Emergency Order No. 2-KS-1-05-06 and 2-KS-1-07-07) to include Thursdays.

Prior to the 2008 fishing season, BOF further liberalized the regulations to allow the harvest of naturally-produced fish on Tuesdays, Thursdays, and Saturdays. An additional sport fish regulation increased the bag limit for hatchery-produced Chinook salmon from 1 fish per day, 1 in possession, to 2 fish per day, 2 in possession. Bag limits on Tuesdays, Thursdays, and Saturdays (non-AFC days) could only include 1 naturally-produced fish. These regulations remained in effect in 2009 and 2010.

In 2010, another Kenai River early-run Chinook salmon fishing closure prompted restrictions on the Kasilof River. ADF&G determined that a concurrent emergency order (Emergency Order No. 2-KS-1-13-10) to close the early-run Chinook salmon sport fishery in the Kenai River drainage would likely result in an increase in the sport fishing effort for and harvest of naturally-produced Chinook salmon in the Kasilof River. In response, Emergency Order 2-KS-1-13-10 was issued for 5 June through 30 June, to prohibit the retention of naturally-produced Chinook salmon (i.e., only Chinook salmon with a healed AFC scar could be retained through the end of the season). This emergency order was rescinded on 17 June and the retention of naturally-produced Chinook salmon was allowed on Tuesdays, Thursdays, and Saturdays through 30 June.

OBJECTIVES 2009–2010

1) Estimate the total catch and harvest of naturally-produced Chinook salmon by anglers exiting the Kasilof River fishery from 16 May to 30 June such that the estimate of harvest is within 30% of the true value 95% of the time.
2) Estimate age composition, sex composition, and age-by-sex composition of naturally- and hatchery-produced Chinook salmon harvested in the early-run (16 May–30 June) sport fishery in the Kasilof River, such that the estimates are within 10 percentage points of the true value 90% of the time.

In addition to the objectives outlined above, the project was responsible for completing the following tasks:

1) Estimate angler effort in angler-hours for the early run (16 May–30 June) sport fishery.
2) Estimate the total catch and harvest of hatchery-produced Chinook salmon by anglers exiting the Kasilof River from 16 May to 30 June.
3) Estimate mean length-at-age of naturally- and hatchery-produced Chinook salmon harvested in the early-run Kasilof River sport fishery.

METHODS

EFFORT, CATCH, AND HARVEST

A direct expansion onsite 3-stage stratified creel survey (Bernard et al. 1998) was conducted at the Crooked Creek State Recreation Site, Cohoe Cove, and Kasilof Cabins access locations on the Kasilof River from 16 May to 30 June 2009 and 2010 (Figure 1). Sampling stage units were

days, shift and location combinations within days, and angler trips within shifts. The creel surveys were stratified by day of week, access location, and time of day.

In 2009, we used a sampling design similar to that used in 2008 (Cope 2011) with the exception that Trujillo's Landing did not operate as a boat launch in 2009 and thus was not used as a survey location. Because it was initially difficult to predict how this closure would affect the other 2 boat launches (Cohoe Cove and Kasilof Cabins), we treated each access location and shift equally (Appendix A1). In 2010, Trujillo's Landing remained closed. Tuesdays, Thursdays, and Saturdays comprised a separate stratum (TRS) in order to facilitate the primary objective of estimating the harvest of naturally-produced fish. All Tuesdays, Thursdays, and Saturdays (i.e., days of the week when harvest of naturally-produced fish was allowed) were sampled. Each sampling day had 2 possible shifts: 0800–1500 hours (early) and 1500–2200 hours (late). Within each day of stratum TRS, 2 of the possible 6 combinations of location and shift were selected at random for sampling (stage 1 sampling fraction = 0.33) in 2009. In 2010, a third creel survey technician was scheduled to conduct angler interviews on all Tuesdays, Thursdays, and Saturdays in an effort to increase precision of harvest estimates for naturally-produced Chinook salmon. Consequently, within each day of stratum TRS, 3 of the possible 6 combinations of location and shift were selected at random for sampling (stage 1 sampling fraction = 0.5) in 2010. The third technician did not sample the TRS stratum during the emergency order closure (5 June through 17 June) when the retention of naturally-produced Chinook salmon was prohibited. This was a 2-stage design because all days for stratum TRS (Tuesday, Thursday, Saturday) were sampled. Sampling stage units were (1) shift-location combinations within days, and (2) angler trips within shifts (Appendix A2).

The remaining days of the week, stratum SMWF (Sunday, Monday, Wednesday and Friday), were sub-sampled by randomly selecting 2 of the possible 4 days. Within each day, 2 of the possible 6 combinations of location and shift were selected at random for sampling (stage 2 sampling fraction = 0.33). This was a 3-stage design because days of the week were randomly selected (stage 1 sampling fraction = 0.5).

Creel technicians attempted to interview all exiting anglers. Data collected from each angler included the following: time of day, access location, guided vs. unguided angler type, boat vs. shore angler type, number of hours fished, finclip marking status, sex and length for harvested fish, and the number of Chinook salmon caught and released. Some anecdotal information on catch and harvest of non-target species was also noted.

Estimates of catch, effort, and harvest were calculated using equation 2.2 in Bernard et al. (1998, Table 2.1, page 20); variances followed equation 2.6 in Bernard et al. (1998, Table 2.4, page 24) using the random-selection-of-sampling-units form of the equation.

Relative imprecision (RIXX) was calculated as a shorthand way to gauge the achievement of project precision goals. RIXX for the abundance estimates was the half-width of the XX% confidence interval divided by the point estimate. Thus, the RI95 of the estimate of quantity y was calculated as

$$RI95(\hat{y}) = 1.96\frac{\sqrt{V(\hat{y})}}{\hat{y}}, \quad (1)$$

where 1.96 is the critical value of the standard normal distribution used to construct a 95% confidence interval with 0.025 probability in each tail and $V(\hat{y})$ is the variance of the estimate. The corresponding critical value for a 90% interval is 1.645.

AGE, SEX, AND LENGTH

Harvested Chinook salmon were sampled for age, sex, and length (ASL) during angler interviews during both years of the creel survey. Sex was identified from external morphological characteristics. AFC status was determined by the presence or absence of an adipose finclip and the mid eye to tail fork (METF) length was measured to the nearest millimeter. Three scales were removed from the right side of the fish approximately 2 rows above the lateral line along a diagonal line downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin and placed on an adhesive coated card (Clutter and Whitesel 1956, Welander 1940). Acetate impressions of the scales were aged by trained personnel using a microfiche reader. All hatchery-produced fish harvested in the fishery were freshwater age 1. Naturally-produced fish were assumed to be freshwater age 1. For purposes of this report, only ocean ages are presented.

In 2009, *every third* Chinook salmon encountered during the early-run creel survey, regardless of AFC status, was sampled for age, sex, length, and marking status data. In 2010, *every other* Chinook salmon encountered was sampled.

Sex and age composition were estimated separately for naturally- and hatchery-produced fish.

The proportion of adult Chinook salmon in the early-run harvest of age or sex class *j* ($\hat{p}_j$) and its variance were estimated as follows (Cochran 1977):

$$\hat{p}_j = \frac{n_j}{n} \quad \text{and} \tag{2}$$

$$\text{var}(\hat{p}_j) = \frac{\hat{p}_j(1-\hat{p}_j)}{n-1} \tag{3}$$

where

n_j = the number of adult Chinook salmon of age or sex class *j*, and

n = the total number of adult Chinook salmon scale samples that could be aged.

Mean length-at-age by sex ($\bar{l}_j$) and its variance were estimated using the procedures outlined by Sokal and Rohlf (1981, Boxes 4.2 and 7.1, pages 56 and 139):

$$\bar{l}_j = \frac{1}{n_j}\sum_{i=1}^{n_j} l_i \tag{4}$$

where

l_i = the length of fish i in a sample n_j, and

n_j = the number of Chinook salmon of age or sex class j.

The variance of the mean length-at-age or sex class *j* was estimated as follows:

$$\text{var}(\bar{l}_j) = \frac{1}{n_j}\frac{\sum_{i=1}^{n_j}(l_i - \bar{l}_j)^2}{n_j - 1}. \tag{5}$$

RESULTS

EFFORT, CATCH, AND HARVEST

2009

The 2009 creel survey was conducted 5 days per week from 16 May to 30 June. The creel survey sampled 34 days of the sport fishery (73.9%) and a total of 3,004 interviews were conducted: 1,348 boat anglers and 1,656 shore anglers (Table 1).

Table 1.–Kasilof River early-run Chinook salmon creel survey sampling summary, 2009–2010.

	Number of creel survey interviews conducted by category					
Year	Boat anglers	Shore anglers	Combined total (boat plus shore anglers)	Guided anglers	Unguided anglers	Combined total (guided plus unguided anglers)
2009	1,348	1,656	3,004	2,022	982	3,004
2010	1,813	1,374	3,187	1,492	1,695	3,187

The early-run Chinook salmon creel survey estimated the total harvest to be 1,532 (SE 270) fish (Table 2). The estimated harvest of naturally-produced Chinook salmon was 576 (SE 122) fish and hatchery-produced Chinook salmon was 956 (SE 177) fish. Guided anglers accounted for 78.1% of the Kasilof River early-run Chinook salmon harvest compared to 21.9% for unguided anglers. Boat anglers accounted for 89.0% of the harvest compared to 11.0% for shore anglers. The estimated catch of both naturally- and hatchery-produced Chinook salmon was 2,276 (SE 344) fish, indicating 32.7% of the fish were released. Individual estimates of catch do not sum because the origin of the fish (naturally- or hatchery-produced) was unknown at the time the angler was interviewed. The total estimated effort was 48,911 (SE 4,734) angler-hours with 11,393 (SE 955) anglers participating in the fishery.

The estimate of harvest of naturally-produced Chinook salmon for 2009 did not satisfy the project precision objective (realized RI95 = 0.42, vs. objective RI95 = 0.30).

2010

The 2010 creel survey was conducted 5 days per week from 16 May to 30 June. The creel survey sampled 34 days of the sport fishery (73.9%) and a total of 3,187 interviews were conducted: 1,813 boat anglers and 1,374 shore anglers (Table 1).

The early-run Chinook salmon creel survey estimated the total harvest to be 1,333 fish (SE 219) (Table 3). The estimated harvest of naturally-produced Chinook salmon was 273 fish (SE 44) and hatchery-produced Chinook salmon was 1,060 fish (SE 206). Guided anglers accounted for 81.7% of the Kasilof River early-run Chinook salmon harvest compared to 18.3% for unguided anglers. Boat anglers accounted for 87.2% of the harvest compared to 12.8% for shore anglers. The estimated catch of both naturally- and hatchery-produced Chinook salmon was 3,128 (SE 462), indicating 57.3% of the fish were released. Individual estimates of catch do not sum because the origin of the fish (naturally- or hatchery-produced) was unknown at the time the angler was interviewed. The total estimated effort was 52,973 (SE 5,143) angler-hours with 10,500 (SE 785) anglers participating in the fishery.

The estimate of the harvest of naturally-produced Chinook salmon for 2010 did not satisfy the project precision objective (realized RI95 = 0.32, vs. objective RI95 = 0.30).

Table 2.–Creel survey estimates of Kasilof River early-run Chinook salmon catch, harvest, and effort by angler category and method, 16 May–30 June 2009.

	Naturally-produced[a] Chinook salmon		Hatchery-produced Chinook salmon		Total[b]		Effort	
Category	Catch	Harvest	Catch	Harvest	Catch[c]	Harvest	Angler-hours	No. of anglers
Angler type/method subtotals								
Guided shore (SE)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	204 (87)	50 (22)
Percentage	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.4%
Guided boat (SE)	916 (174)	438 (122)	784 (178)	758 (175)	1,711 (349)	1,196 (271)	24,255 (4,674)	3,526 (640)
Percentage	73.9%	76.0%	78.0%	79.3%	75.2%	78.1%	49.6%	30.9%
Unguided shore (SE)	225 (57)	84 (23)	109 (28)	85 (25)	354 (83)	169 (42)	17,091 (2,925)	6,242 (1,030)
Percentage	18.2%	14.6%	10.8%	8.9%	15.6%	11.0%	34.9%	54.8%
Unguided boat (SE)	99 (20)	54 (15)	112 (28)	112 (28)	211 (43)	166 (35)	7,361 (1,503)	1,575 (326)
Percentage	8.0%	9.4%	11.1%	11.7%	9.3%	10.8%	15.0%	13.8%
Angler type subtotals								
Guided (SE)	916 (174)	438 (122)	784 (178)	758 (175)	1,711 (349)	1,196 (271)	24,459 (4,671)	3,576 (639)
Percentage	73.9%	76.0%	78.0%	79.3%	75.2%	78.1%	50.0%	31.4%
Unguided (SE)	324 (55)	138 (21)	221 (34)	198 (32)	565 (80)	336 (43)	24,452 (2,788)	7,817 (997)
Percentage	26.1%	24.0%	22.0%	20.7%	24.8%	21.9%	50.0%	68.6%
Method subtotals								
Shore (SE)	225 (57)	84 (23)	109 (28)	85 (25)	354 (83)	169 (42)	17,295 (2,959)	6,292 (1,037)
Percentage	18.2%	14.6%	10.8%	8.9%	15.6%	11.0%	35.4%	55.2%
Boat (SE)	1,014 (182)	492 (129)	896 (185)	870 (183)	1,922 (365)	1,362 (283)	31,616 (5,413)	5,101 (770)
Percentage	81.8%	85.4%	89.2%	91.1%	84.4%	89.0%	64.6%	44.8%
Total (SE)[a]	1,239 (173)	576 (122)	1,005 (178)	956 (177)	2,276 (344)	1,532 (270)	48,911 (4,734)	11,393 (955)

[a] The naturally-produced Chinook salmon fishery was only open on Tuesdays, Thursdays, and Saturdays.

[b] Totals and subtotals may not sum due to rounding errors.

[c] Naturally- and hatchery-produced total does not sum due to unknown hatchery status.

Table 3.–Creel survey estimates of Kasilof River early-run Chinook salmon catch, harvest, and effort by angler category and method, 16 May–30 June 2010.

	Creel survey estimates							
	Naturally-produced[a] Chinook salmon		Hatchery-produced Chinook salmon		Total[b]		Effort	
Category	Catch	Harvest[c]	Catch	Harvest	Catch[d]	Harvest	Angler-hours	No. of anglers
Angler type/method subtotals								
Guided shore (SE)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	10 (7)	4 (3)
Percentage	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Guided boat (SE)	1,394 (297)	198 (41)	940 (219)	891 (209)	2,334 (498)	1,089 (221)	33,792 (5,685)	4,790 (775)
Percentage	71.1%	72.5%	81.6%	84.1%	74.6%	81.7%	63.8%	45.6%
Unguided shore (SE)	480 (112)	50 (18)	164 (44)	120 (30)	660 (153)	170 (38)	14,371 (2,771)	4,743 (826)
Percentage	24.5%	18.3%	14.2%	11.3%	21.1%	12.8%	27.1%	45.2%
Unguided boat (SE)	86 (23)	25 (7)	49 (22)	49 (22)	135 (42)	74 (24)	4,800 (696)	963 (155)
Percentage	4.4%	9.2%	4.3%	4.6%	4.3%	5.6%	9.1%	9.2%
Angler type subtotals								
Guided (SE)	1,394 (297)	198 (41)	940 (219)	891 (209)	2,334 (498)	1,089 (221)	33,802 (5,685)	4,794 (775)
Percentage	71.1%	72.5%	81.5%	84.1%	74.6%	81.7%	63.8%	45.7%
Unguided (SE)	566 (108)	75 (19)	213 (44)	169 (33)	795 (147)	244 (41)	19,172 (2,586)	5,706 (780)
Percentage	28.9%	27.5%	18.5%	15.9%	25.4%	18.3%	36.2%	54.3%
Method subtotals								
Shore (SE)	480 (112)	50 (18)	164 (44)	120 (30)	660 (153)	170 (38)	14,381 (2,772)	4,747 (826)
Percentage	24.5%	18.3%	14.2%	11.3%	21.1%	12.8%	27.1%	45.2%
Boat (SE)	1,480 (306)	223 (44)	989 (224)	940 (214)	2,468 (512)	1,163 (227)	38,592 (5,947)	5,753 (828)
Percentage	75.5%	81.7%	85.8%	88.7%	78.9%	87.2%	72.9%	54.8%
Total (SE)[a]	1,960 (270)	273 (44)	1,152 (212)	1,060 (206)	3,128 (462)	1,333 (219)	52,973 (5,143)	10,500 (785)

[a] The naturally-produced Chinook salmon fishery was only open on Tuesdays, Thursdays, and Saturdays.

[b] Totals and subtotals may not sum due to rounding errors.

[c] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order from 5 June through 17 June 2010.

[d] Naturally- and hatchery-produced total does not sum due to unknown hatchery status.

AGE, SEX, AND LENGTH

2009

Both naturally- and hatchery-produced fish were harvested during the 2009 Kasilof River early-run Chinook salmon sport fishery. Creel survey technicians collected ASL information from 149 Chinook salmon during the sampling period.

The age composition of naturally-produced fish in the harvest was 17.9% (SE 4.7%) ocean-age-2, 40.3% (SE 6.0%) ocean-age-3, and 41.8% (SE 6.1%) ocean-age-4 fish (Table 4). The sex composition was 35.8% females and 64.2% males (SE 5.9%). Mean length of naturally-produced fish was 796 mm (SE 14): 787 mm (SE 17) for males and 844 mm (SE 19) for females. The age composition of hatchery-produced fish in the harvest was 40.2% (SE 5.4%) ocean-age-2, 58.5% (SE 5.5%) ocean-age-3, and 1.2% (SE 1.2%) ocean-age-4 fish (Table 4). The sex composition was 54.9% females and 45.1% males (SE 5.5%). Mean length of hatchery-produced fish was 735 mm (SE 10): 698 mm (SE 14) for males and 765 mm (SE 13) for females.

All estimates of age and sex composition of naturally- and hatchery-produced Chinook salmon satisfied the project precision objective of being within 0.10 of the true values with 90% confidence level.

Table 4.–Creel survey estimates of harvest and length of Kasilof River early-run Chinook salmon by age and sex, 2009.

Parameter		Ocean-age[a] 2	3	4	Total[a]
Naturally-produced[b]					
Female (*N*)		2	4	18	24
	% (SE)	3.0% (2.1%)	6.0% (2.9%)	26.9% (5.5%)	35.8% (5.9%)
	Harvest estimate (SE)	17 (12)	34 (18)	155 (45)	206 (55)
	Mean METF length (SE)	620 (40)	778 (14)	884 (13)	844 (19)
	METF length range	580–660	750–815	825–1,050	580–1,050
Male (*N*)		10	23	10	43
	% (SE)	14.9% (4.4%)	34.3% (5.8%)	14.9% (4.4%)	64.2% (5.9%)
	Harvest estimate (SE)	86 (31)	198 (53)	86 (31)	370 (85)
	Mean METF length (SE)	645 (18)	765 (15)	902 (25)	787 (17)
	METF length range	575–730	545–873	840–1,040	545–1,040
Male and female combined (*N*)		12	27	28	67
	% (SE)	17.9% (4.7%)	40.3% (6.0%)	41.8% (6.1%)	100.0% (0.0%)
	Harvest estimate (SE)	103 (34)	232 (60)	241 (61)	576 (122)
	Mean METF length (SE)	640 (16)	767 (13)	890 (12)	796 (14)
	METF length range	575–730	545–873	825–1,050	545–1,050
Hatchery-produced					
Female (*N*)		9	35	1	45
	% (SE)	11.0% (3.5%)	42.7% (5.5%)	1.2% (1.2%)	54.9% (5.5%)
	Harvest estimate (SE)	105 (38)	408 (92)	12 (12)	525 (110)
	Mean METF length (SE)	615 (13)	802 (7)	800 (NA)	765 (13)
	METF length range	535–660	725–860	800–800	535–860
Male (*N*)		24	13	0	37
	% (SE)	29.3% (5.1%)	15.9% (4.1%)	0.0% (0.0%)	45.1% (5.5%)
	Harvest estimate (SE)	280 (70)	152 (47)	0 (0)	431 (95)
	Mean METF length (SE)	642 (9)	802 (8)	NA (NA)	698 (14)
	METF length range	535–755	750–860	NA–NA	535–860
Male and female combined (*N*)		33	48	1	82
	% (SE)	40.2% (5.4%)	58.5% (5.5%)	1.2% (1.2%)	100.0% (0.0%)
	Harvest estimate (SE)	385 (88)	560 (116)	12 (12)	956 (177)
	Mean METF length (SE)	635 (8)	802 (5)	800 (NA)	735 (10)
	METF length range	535–755	725–860	800–800	535–860

Note: length measured mid eye to tail fork (METF) in millimeters.

[a] Values given by age and sex may not sum to totals due to rounding errors.

[b] The naturally-produced Chinook salmon fishery was only open on Tuesdays, Thursdays, and Saturdays.

2010

Both naturally- and hatchery-produced fish were harvested during the 2010 Kasilof River early-run Chinook salmon sport fishery even though there was a temporary emergency order prohibiting the retention of naturally-produced fish from 5 June through 17 June. Creel survey technicians collected ASL information from 226 Chinook salmon during the sampling period.

The age composition of naturally-produced fish in the harvest was 20.0% (SE 4.8%) ocean-age-2, 44.3% (SE 6.0%) ocean-age-3, and 35.7% (SE 5.8%) ocean-age-4 fish (Table 5). The sex composition was 55.7% females and 44.3% males (SE 6.0%). Mean length of naturally-produced fish was 763 mm (SE 12): 707 mm (SE 19) for males and 806 mm (SE 10) for females. The age composition of hatchery-produced fish in the harvest was 26.3% (SE 3.5%) ocean-age-2, 62.2% (SE 3.9%) ocean-age-3, and 11.5% (SE 2.6%) ocean-age-4 fish (Table 5). The sex composition was 59.0% females and 41.0% males (SE 4.0%). Mean length of hatchery-produced fish was 730 mm (SE 7): 674 mm (SE 11) for males and 768 mm (SE 5) for females.

Table 5.–Creel survey estimates of harvest and length of Kasilof River early-run Chinook salmon by age and sex, 2010.

Parameter		Ocean age[a] 2	3	4	Total[a]
Naturally-produced[b,c]					
Female (*N*)		1	19	19	39
	% (SE)	1.4% (1.4%)	27.1% (5.4%)	27.1% (5.4%)	55.7% (6.0%)
	Harvest estimate (SE)	4 (4)	74 (19)	74 (19)	152 (29)
	Mean METF length (SE)	640 (NA)	775 (7)	846 (11)	806 (10)
	METF length range	640–640	725–816	750–984	640–984
Male (*N*)		13	12	6	31
	% (SE)	18.6% (4.7%)	17.1% (4.5%)	8.6% (3.4%)	44.3% (6.0%)
	Harvest estimate (SE)	51 (15)	47 (14)	23 (10)	121 (25)
	Mean METF length (SE)	619 (7)	711 (19)	876 (7)	707 (19)
	METF length range	585–680	605–799	855–905	585–905
Male and female combined (*N*)		14	31	25	70
	% (SE)	20.0% (4.8%)	44.3% (6.0%)	35.7% (5.8%)	100.0% (0.0%)
	Harvest estimate (SE)	55 (16)	121 (25)	98 (22)	273 (44)
	Mean METF length (SE)	621 (7)	750 (10)	853 (9)	763 (12)
	METF length range	585–680	605–816	750–984	585–984
Hatchery-produced					
Female (*N*)		6	71	15	92
	% (SE)	3.8% (1.5%)	45.5% (4.0%)	9.6% (2.4%)	59.0% (4.0%)
	Harvest estimate (SE)	41 (18)	482 (103)	102 (32)	625 (128)
	Mean METF length (SE)	646 (14)	773 (3)	795 (9)	768 (5)
	METF length range	605–700	695–850	740–864	605–864
Male (*N*)		35	26	3	64
	% (SE)	22.4% (3.4%)	16.7% (3.0%)	1.9% (1.1%)	41.0% (4.0%)
	Harvest estimate (SE)	238 (58)	177 (46)	20 (12)	435 (94)
	Mean METF length (SE)	616 (8)	730 (13)	854 (3)	674 (11)
	METF length range	500–704	570–822	850–860	500–860
Male and female combined (*N*)		41	97	18	156
	% (SE)	26.3% (3.5%)	62.2% (3.9%)	11.5% (2.6%)	100.0% (0.0%)
	Harvest estimate (SE)	279 (65)	659 (134)	122 (36)	1,060 (206)
	Mean METF length (SE)	621 (7)	761 (5)	805 (9)	730 (7)
	METF length range	500–704	570–850	740–864	500–864

Note: length measured mid eye to tail fork (METF) in millimeters.

[a] Values given by age and sex may not sum to totals due to rounding errors.

[b] Naturally-produced Chinook salmon fishery was only open on Tuesdays, Thursdays, and Saturdays.

[c] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order from 5 June through 17 June 2010.

All estimates of age and sex composition of naturally- and hatchery-produced Chinook salmon satisfied the project precision objective of being within 0.10 of the true values with 90% confidence level.

DISCUSSION

Estimates of naturally-produced Chinook salmon harvest did not satisfy project precision objectives in 2009 and 2010. The 2009 project objective was probably not met due to a small run, resulting in lower catch and harvest in the fishery. Programmatic changes from previous years in sampling locations (1 of 4 previous sampling locations, Trujillo's Landing, ceased operations in 2009 and 2010) and inability to predict angler behavior were also confounding factors because we were unable to predict how the closure of Trujillo's Landing would affect use of boat launches at the other 2 sampling locations.

Despite scheduling a third creel survey technician to conduct angler-interviews on Tuesdays, Thursdays, and Saturdays in 2010, the estimate of naturally-produced Chinook salmon harvest did not satisfy the project precision objective. During 2010, there was a 12-day emergency order during the sport fishery prohibiting the retention of naturally-produced Chinook salmon; this emergency order resulted in few naturally-produced Chinook salmon being harvested during the sport fishery and may explain why the project precision objective was not met. However, the addition of the third sampler in 2010 helped decrease the imprecision of harvest estimates of naturally-produced Chinook salmon from RI95=0.42 in 2009 to RI95=0.32 in 2010.

Angler participation (guided and unguided effort) declined in 2009 from previous years. Guided angler effort increased in 2010 while unguided angler effort continued to decline (Figure 2). Trends in boat versus shore angler effort followed trends in guided versus unguided angler effort (Figure 3). Similarities between boat and guided effort and between shore and unguided effort were expected because most boat anglers are guided and nearly all shore anglers are unguided. The number of unguided anglers exceeded the number of guided anglers participating in the fishery between 2004 and 2010, including similar numbers of angler-hours dedicated to the fishery. In 2010, unguided angler participation dropped substantially while guided angler participation increased. Similar numbers of shore anglers and boat anglers participated in the fishery; however, shore anglers fish for substantially less time than do boat anglers (Figure 3). This is most likely affected by the overall proximity of boat take-out sites and the accessibility of the Crooked Creek State Recreation Site.

Participation in the fishery has varied between days when naturally-produced harvest is allowed or prohibited. Since the inception of naturally-produced harvest days in 2005, more angler effort has been expended on days when harvest of naturally-produced Chinook salmon is permitted. In contrast, perhaps due to the emergency closure in 2010, more anglers participated on days when naturally-produced Chinook salmon harvest was prohibited. However, anglers who participated on days when naturally-produced Chinook salmon could be retained, fished for longer periods (relative to the number of anglers, a greater number of angler-hours were fished), indicating the preference, exhibited in previous years, for fishing on days when naturally-produced Chinook salmon harvest is allowed (Table 6).

In the years the creel survey has been conducted, the proportion of naturally-produced Chinook salmon caught early in the season has rarely fallen below 50% of the total catch. This continued to be true in 2009 and 2010 (Figure 4).

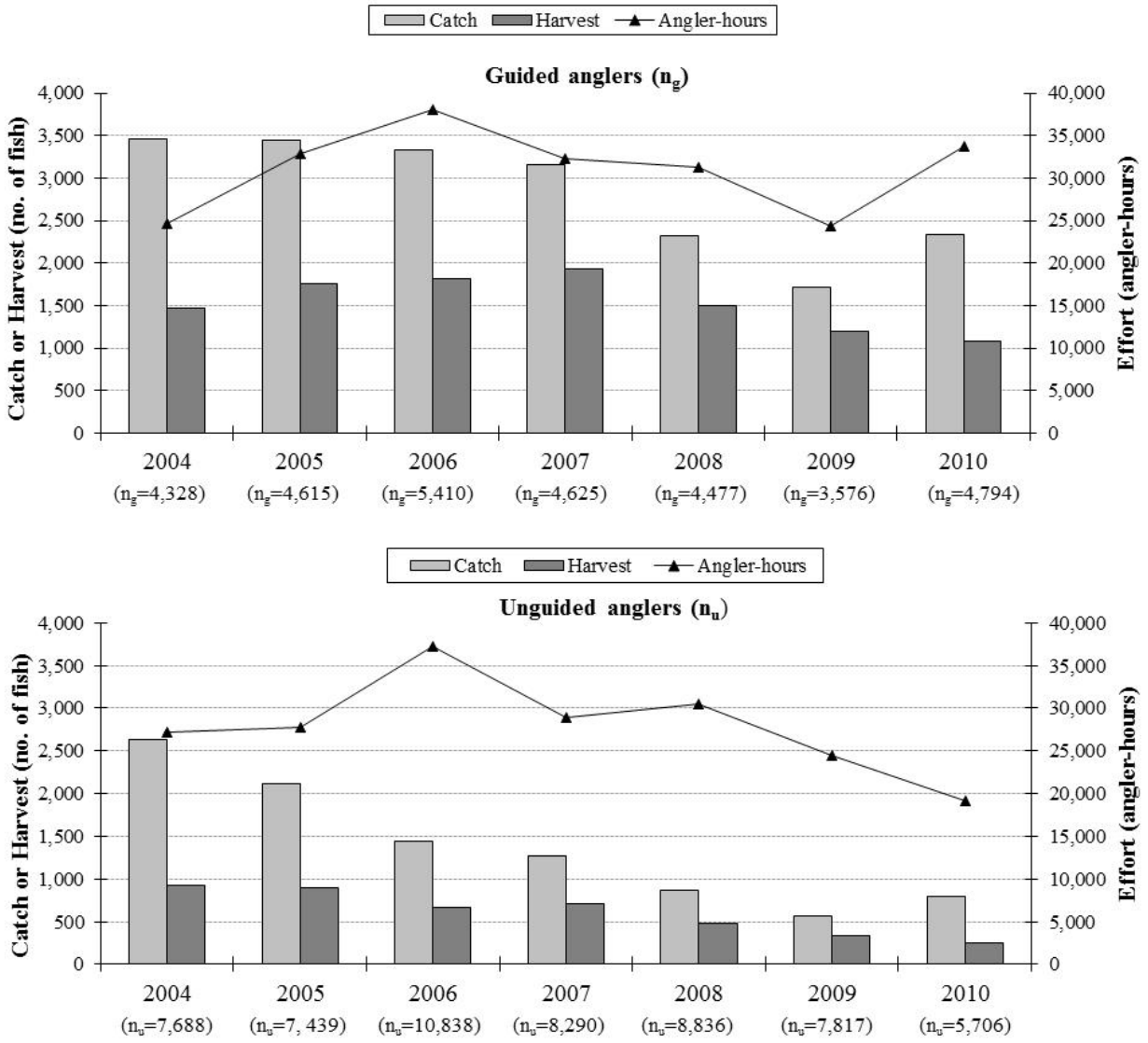


Figure 2.–Creel survey estimates of guided (top) and unguided (bottom) anglers Kasilof River early-run Chinook salmon catch, harvest, and effort, 2004–2010.

Source: 2004–2008 data (Cope 2011).

Note: For standard errors, refer to Tables 2–3 and Cope (2011, Tables 2–6)

Note: n_g = the estimated number of guided anglers; n_u = the estimated number of unguided anglers.

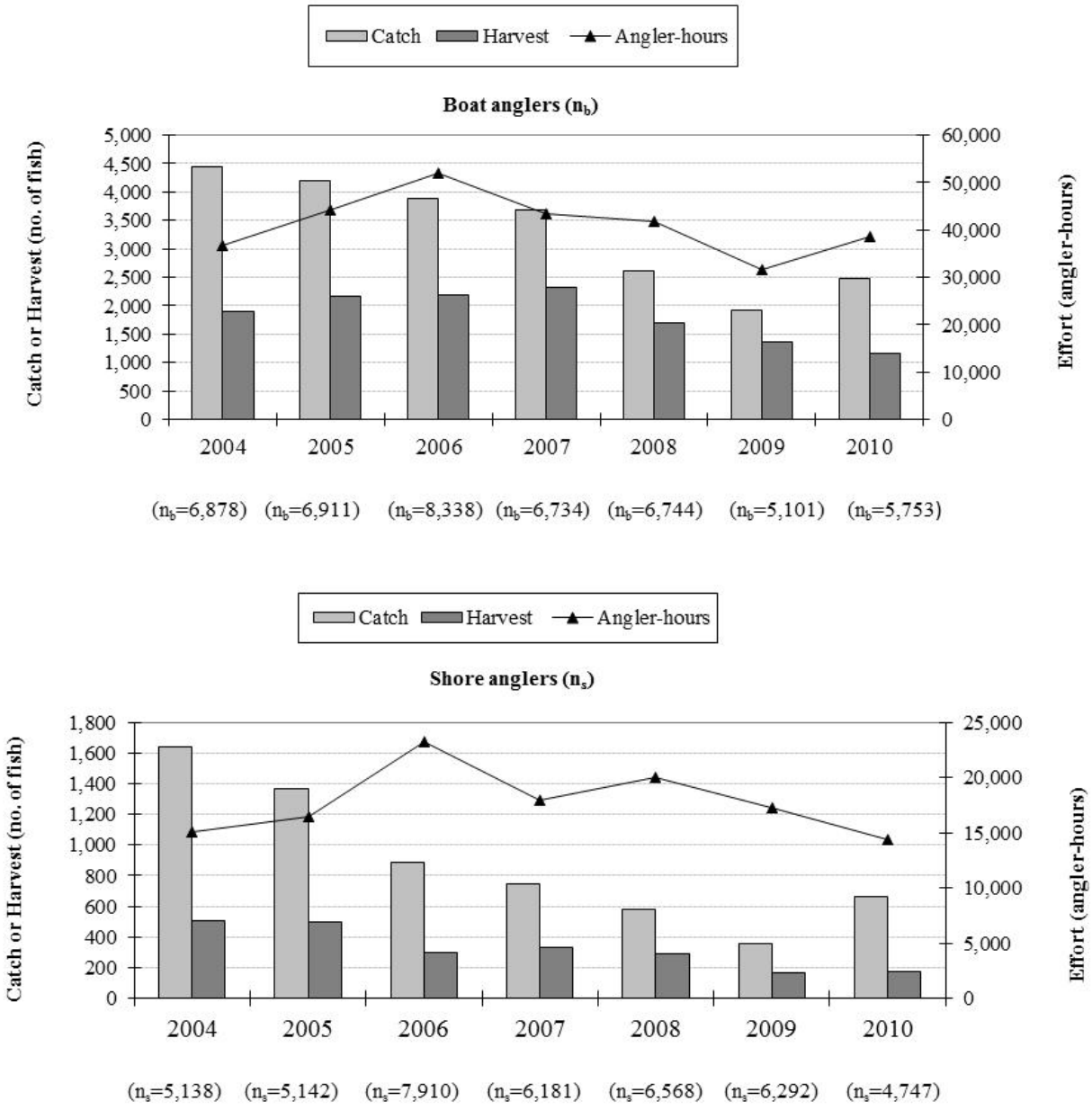


Figure 3.–Creel survey estimates of boat (top) and shore (bottom) anglers Kasilof River early-run Chinook salmon catch, harvest, and effort, 2004–2010.

Source: 2004–2008 data (Cope 2011).

Note: For standard errors, refer to Tables 2–3 and Cope (2011, Tables 2–6)

Note: n_b = the estimated number of boat anglers; n_s = the estimated number of shore anglers.

Note: axis scale differs between graphs.

Table 6.–Creel survey estimates of Kasilof River early-run Chinook salmon guided and unguided angler effort, 2005–2010.

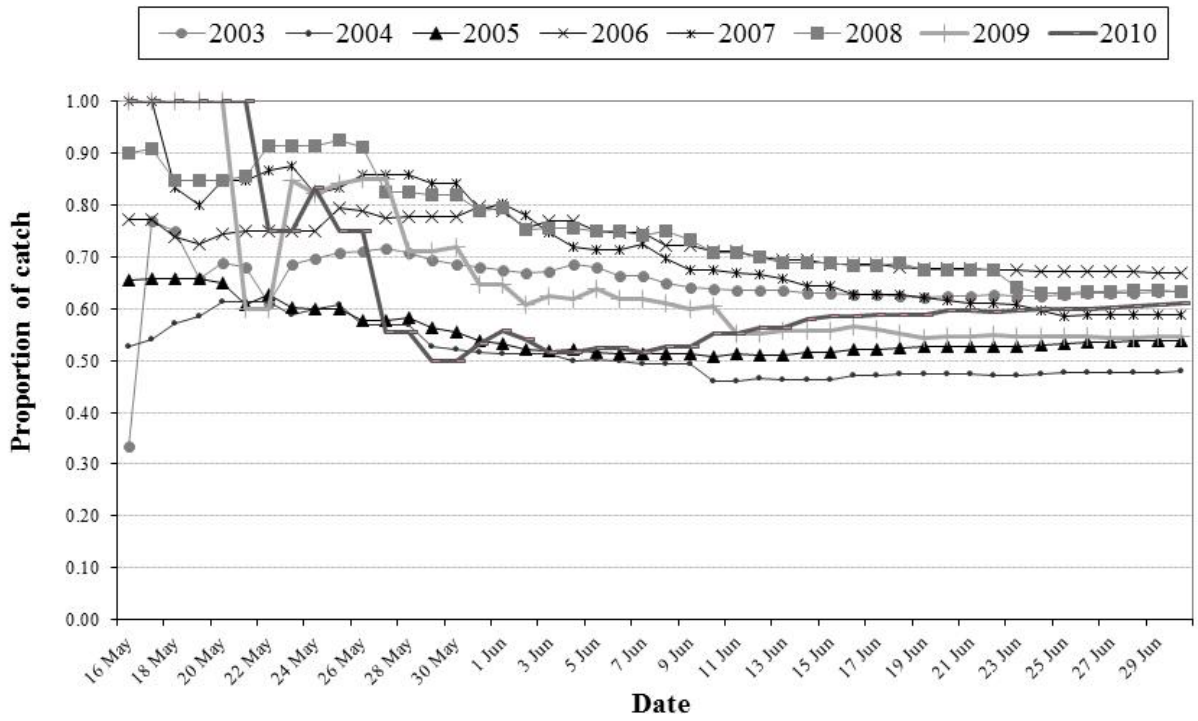
		Days when naturally-produced harvest is allowed[a]			Days when naturally-produced harvest is prohibited[b]		
		Days fished per	Effort		Days fished per	Effort	
Category	Year	week	Angler-hours	No. of anglers	week	Angler-hours	No. of anglers
Guided anglers	2005	2	9,057	1,265	5	23,784	3,349
	2006	3	18,809	2,755	4	19,256	2,656
	2007	3	18,872	2,685	4	13,492	1,940
	2008	3	16,934	2,349	4	14,427	2,128
	2009	3	15,723	2,211	4	8,736	1,365
	2010	3	18,451	2,569	4	15,351	2,225
Unguided anglers	2005	2	14,613	4,068	5	13,140	3,371
	2006	3	20,843	5,427	4	16,351	5,412
	2007	3	18,693	4,952	4	10,186	3,338
	2008	3	16,819	4,848	4	13,632	3,988
	2009	3	12,620	4,023	4	11,832	3,794
	2010	3	9,458	2,585	4	9,713	3,121
Total[c]	2005	2	23,669	5,333	5	36,923	6,721
	2006	3	39,651	8,181	4	35,607	8,067
	2007	3	37,565	7,637	4	23,677	5,278
	2008	3	33,753	7,196	4	28,060	6,116
	2009	3	28,343	6,234	4	20,568	5,159
	2010	3	27,909	5,154	4	25,064	5,346

Source: 2005–2008 data (Cope 2011).

[a] Tuesday and Saturday in 2005; Tuesday, Thursday, and Saturday from 2006 through 2010.

[b] Monday, Wednesday, Thursday, Friday and Sunday in 2005; Monday, Wednesday, Friday, and Sunday from 2006 through 2010.

[c] Totals may not sum due to rounding errors.



Source: 2003–2008 data (Cope 2011).

Note: "catch" = fish harvested plus fish released (Jennings et al. 2010, page 1).

Figure 4.–Proportion of naturally-produced Chinook salmon in the Kasilof River early-run Chinook salmon sport catch, 2003–2010.

The percentage of the naturally-produced Chinook salmon catch that was harvested in 2009 (46%) was similar to 2008 and 2007 (44%, Table 7). Because 43% of the season (3/7 days; 16 May–30 June) was open to harvest of naturally-produced Chinook salmon, this supports the idea that anglers maximize this harvest opportunity. In 2010, naturally-produced Chinook salmon harvest was approximately 14% of the catch. This decrease in proportion is a direct result of the 12-day emergency order prohibiting the retention of naturally-produced fish. The percentage of hatchery-produced Chinook salmon catch that was harvested in 2009 (95%) and 2010 (92%) was similar to 2008 when the daily bag limit for hatchery-produced Chinook salmon was liberalized to 2 fish (Table 7).

Table 7.–Naturally- and hatchery-produced Kasilof River early-run Chinook salmon estimated harvest, catch, and number of days per week that harvest of naturally-produced fish was allowed, 2004–2010.

	Naturally-produced harvest allowed[a]		Naturally-produced Chinook salmon			Hatchery-produced Chinook salmon		
	Days	Percent	Harvest			Harvest		
Year	per week	of season	No. of fish	Percent	Catch	No. of fish	Percent	Catch
2004	0	0%	0	0%	3,023	2,407	79%	3,066
2005	2	29%	572	19%	2,971	2,093	85%	2,476
2006	3	43%	1,057	35%	3,006	1,432	86%	1,661
2007	3	43%	1,107	44%	2,488	1,547	85%	1,810
2008	3	43%	832	44%	1,902	1,129	92%	1,222
2009	3	43%	576	46%	1,239	956	95%	1,005
2010[b]	3	43%	273	14%	1,960	1,060	92%	1,152

Source: 2004–2008 data (Cope 2011).

[a] Values given only for days open to naturally-produced Chinook salmon harvest.

[b] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

Since 2008, anglers have harvested a greater percentage of hatchery-produced fish caught on days when harvest of naturally-produced fish was prohibited. From 2006 to 2007, when naturally-produced Chinook salmon harvest was allowed (Tuesday, Thursday, and Saturday), the harvest of hatchery-produced Chinook salmon was 83% of the catch (Table 8). On days when harvest of naturally-produced fish was prohibited (Sunday, Monday, Wednesday, and Friday), harvest of hatchery-produced Chinook salmon averaged 89% of the catch. This relationship changed in 2008 after regulatory changes allowed the harvest of 2 Chinook salmon (only one of which could be naturally-produced on Tuesday, Thursday, and Saturday), 7 days a week. In 2009, anglers harvested 95% of hatchery-produced Chinook salmon caught on both types of days. In 2010, anglers harvested a smaller percentage of catch of hatchery-produced fish caught on days when harvest of naturally-produced fish was prohibited. On days when naturally-produced harvest was allowed, the harvest of hatchery-produced fish was 94% (Table 8). This angler use pattern demonstrates a greater propensity to harvest hatchery-produced fish caught on naturally-produced Chinook salmon harvest days than in previous years and most likely reflects the liberalized bag limit.

Table 8.–Kasilof River early-run percentage of hatchery-produced Chinook salmon harvested by day of the week, 2005–2010.

	Naturally-produced harvest allowed[a]				Naturally-produced harvest restricted[b]		
	Days	Harvest[c]			Harvest[c]		
Year	per week	No. of fish	Percent	Catch	No. of fish	Percent	Catch
2005	2	683	79%	869	1,410	88%	1,607
2006	3	669	83%	808	763	90%	852
2007	3	864	83%	1,045	683	89%	764
2008	3	586	94%	626	544	91%	596
2009	3	510	95%	537	446	95%	468
2010[d]	3	596	94%	634	464	90%	518

Source: 2005–2008 data (Cope 2011).

[a] Tuesday and Saturday in 2005; Tuesday, Thursday, and Saturday from 2006 through 2010.

[b] Monday, Wednesday, Thursday, Friday and Sunday in 2005; Monday, Wednesday, Friday, and Sunday in 2006–2010.

[c] Daily bag limit for hatchery-produced Chinook salmon was increased from 1 to 2 fish per day during 2008 BOF meetings.

[d] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

For the years 2008–2010, increasing the daily bag limit on hatchery-produced Chinook salmon appears to have had the desired effect of increasing the proportion of hatchery-produced Chinook salmon harvested from those caught. The average percent of hatchery-produced Chinook salmon harvested for the years 2004–2007 was 84%, and for the years 2008–2010, it increased to approximately 93% (Table 7).

Estimates of total harvest for 2009 and 2010 were well below the 2004–2008 average of 2,440 fish (Table 9). Estimates of total harvest have been decreasing since 2007 (2008–2010 mean harvest = 1,616 fish). This decline may reflect a decrease in overall Chinook salmon abundance because sport fishing regulations were liberalized during this period. Harvest of naturally-produced Chinook salmon has also been declining since 2007. Low harvest in 2010 may be the result of the emergency order restricting harvest of naturally-produced Chinook salmon for 12 days. Harvest of hatchery-produced Chinook salmon has been declining since 2004 with minimal increases in 2007 and 2010 (Figure 5). Total catch of both naturally- and hatchery-produced Chinook salmon decreased until 2009. In 2010, total catch of naturally-produced Chinook salmon increased while hatchery-produced catch remained relatively unchanged (Figure 5). These same trends are also observed when broken down by different user groups (guided vs. unguided anglers) and methods (boat vs. shore anglers) (Figures 2 and 3).

Table 9.–Creel survey estimates of naturally- and hatchery-produced Kasilof River early-run Chinook salmon sport catch and harvest, 2004–2010.

	Naturally-produced[a]		Hatchery-produced[b]		Total	
Year	Catch	Harvest	Catch	Harvest	Catch	Harvest
2004	3,023	0	3,066	2,407	6,089	2,407
2005	2,971	572	2,476	2,093	5,555	2,665
2006	3,006	1,057	1,661	1,432	4,771	2,489
2007	2,488	1,107	1,810	1,547	4,426	2,654
2008	1,902	832	1,222	1,129	3,184	1,984
2009	1,239	576	1,005	956	2,276	1,532
2010[c]	1,960	273	1,152	1,060	3,128	1,333
Mean 2004–2008	2,678	714	2,047	1,722	4,805	2,440
Mean 2004–2010	2,370	631	1,770	1,518	4,204	2,152

Source: 2004–2008 data (Cope 2011).

Note: "catch" = fish harvested plus fish released; "harvest" = fish kept (Jennings et al. 2010, page 1).

[a] Naturally-produced Chinook salmon harvest was prohibited by regulation in 2004; allowed on Tuesday and Saturday in 2005; and allowed Tuesday, Thursday, and Saturday in the years 2006–2010.

[b] Bag limits for hatchery-produced Chinook salmon increased from 1 to 2 fish per day in 2008.

[c] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

Age, sex, and length sampling indicates that harvested naturally-produced fish are larger in size than harvested hatchery-produced fish (Figure 6). Females of both naturally- and hatchery-produced origin tend to be the larger sex. Age-1.3 fish are the dominant age-class in the harvest, followed by age-1.2 and age-1.4 fish (Figure 7). Most of the age-1.4 harvest came from naturally-produced fish; larger average size may be partially explained by greater age-at-maturity of naturally-produced Chinook salmon.

No comparable data exists to evaluate regulatory decisions made in 2003 at BOF meetings with regard to “People Hole” located at Crooked Creek State Recreation Site. This regulation prohibits fishing from an anchored boat near the confluence of Crooked Creek. Although it is unknown how this regulation has impacted shore angler Chinook salmon catch and harvest success, data collected from 2004 through 2009 has indicated that catch levels have been decreasing with relatively little change in overall harvest or effort from shore anglers at Crooked Creek State Recreation Site (Figure 3). In 2010, estimates of catch increased slightly.

In summary, it appears harvest as a percentage of catch increased, but total harvest of early-run naturally- and hatchery-produced Kasilof River Chinook salmon declined. Anglers maximized harvest on naturally-produced harvest days as well as harvested more hatchery-produced Chinook salmon on both types of harvest days. With declining project monies within the Division of Sport Fish, and the inability to achieve some precision objectives in 2009 and 2010, the task of estimating early-run naturally- and hatchery-produced catch and harvest in the fishery might best be achieved via the ADG&G Statewide Harvest Survey. The Kasilof River early-run Chinook salmon creel survey was discontinued after the 2010 field season.

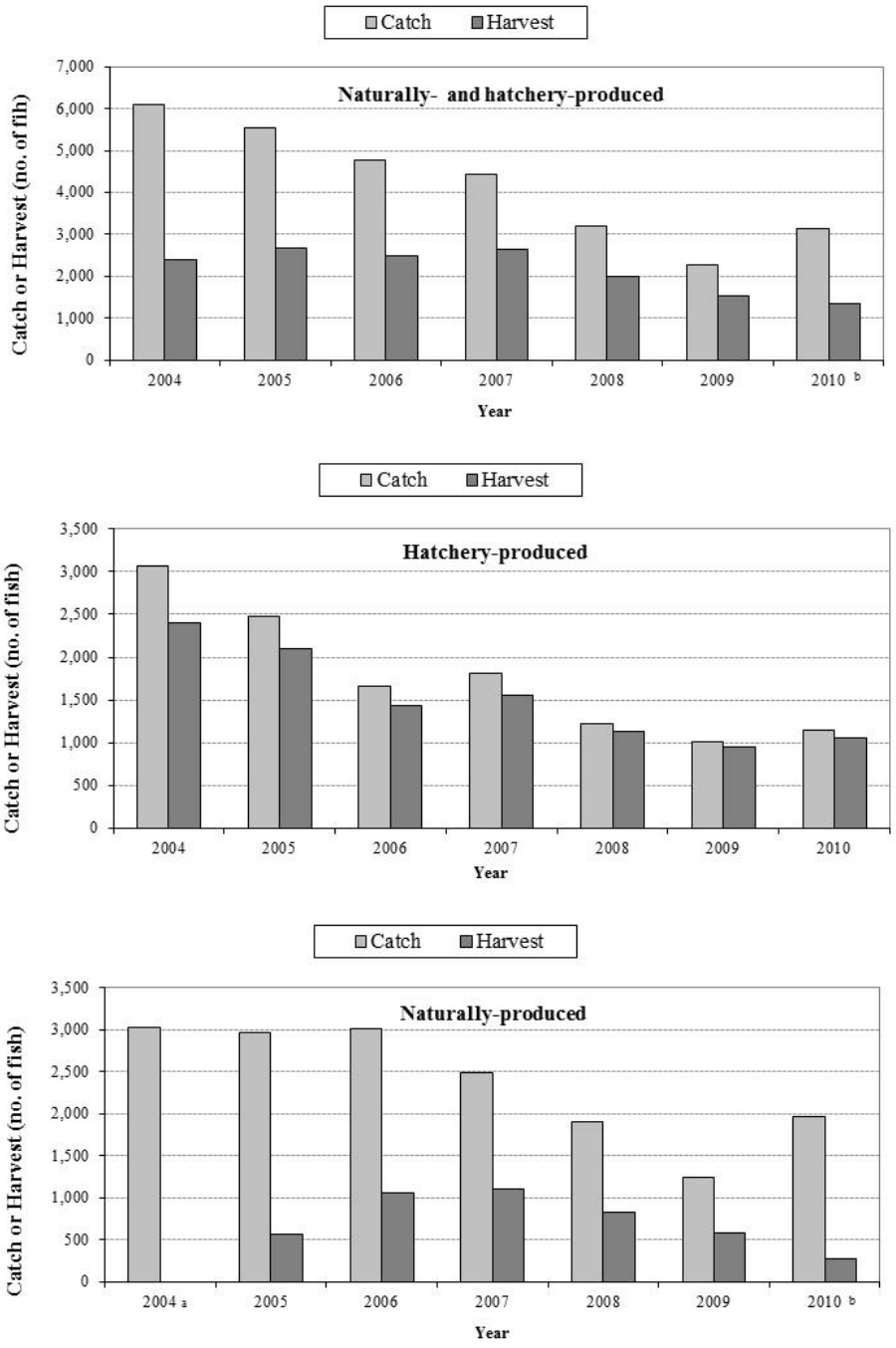


Figure 5.–Creel survey estimates of naturally-produced (bottom), hatchery-produced (middle), and combined (top) Kasilof River early-run Chinook salmon sport catch and harvest, 2004–2010.

Source: 2004–2008 data (Cope 2011).

Note: For standard errors, refer to Tables 2–3 and Cope (2011, Tables 2–6)

Note: "catch" = fish harvested plus fish released; "harvest" = fish kept (Jennings et al. 2010, page 1).

Note: axis scale differs between graphs

[a] Sport harvest of naturally-produced Chinook salmon prohibited by regulation.

[b] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

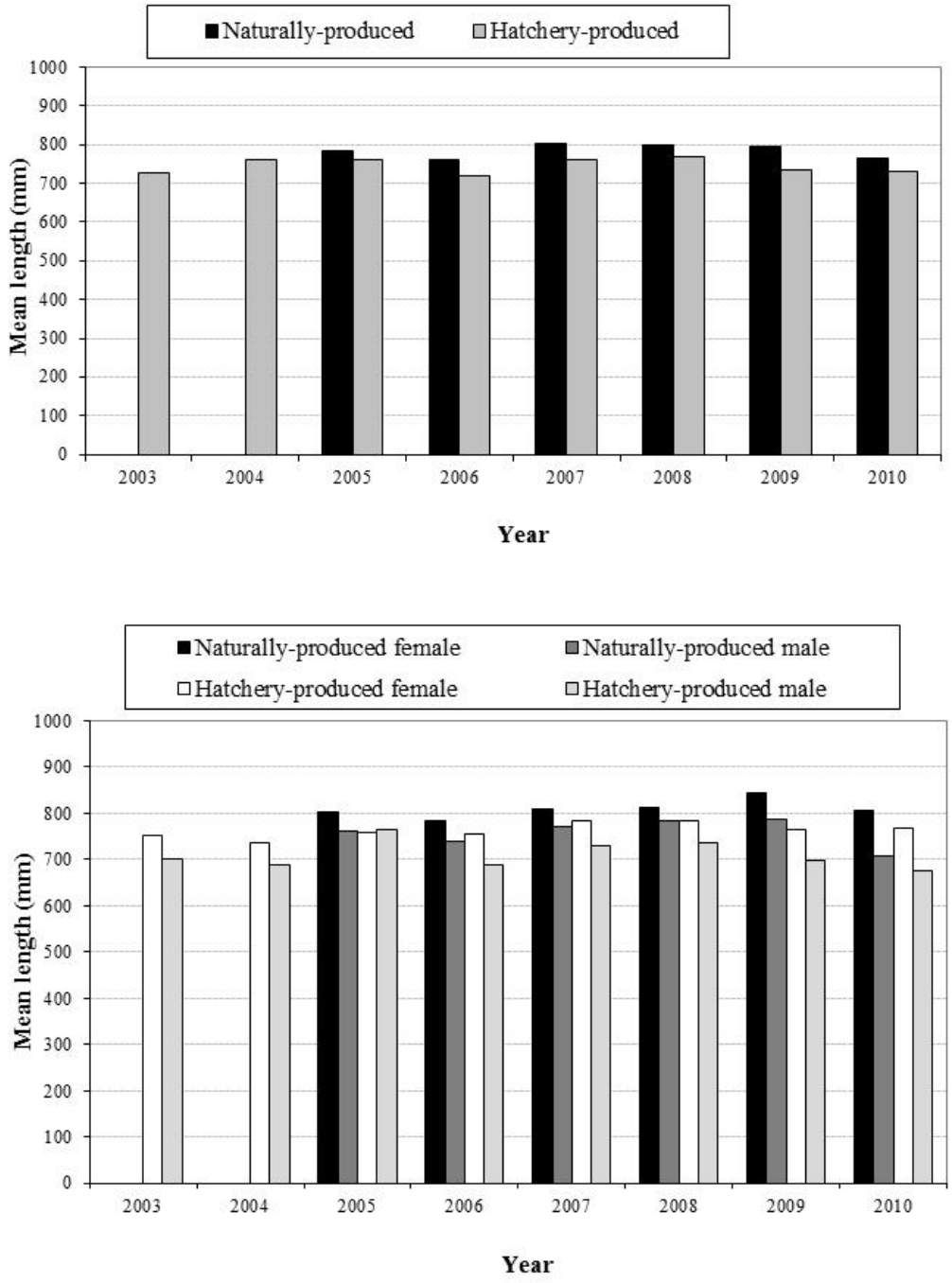


Figure 6.–Creel survey estimates of naturally- and hatchery-produced Kasilof River early-run Chinook salmon mean length composition, 2003–2010.

Source: 2003–2008 data (Cope 2011).

Note: For standard errors, refer to Tables 4–5 and Cope (2011, Tables 7–12)

Note: axis scale differs between graphs

[a] Sport harvest of naturally-produced Chinook salmon prohibited by regulation.

[b] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

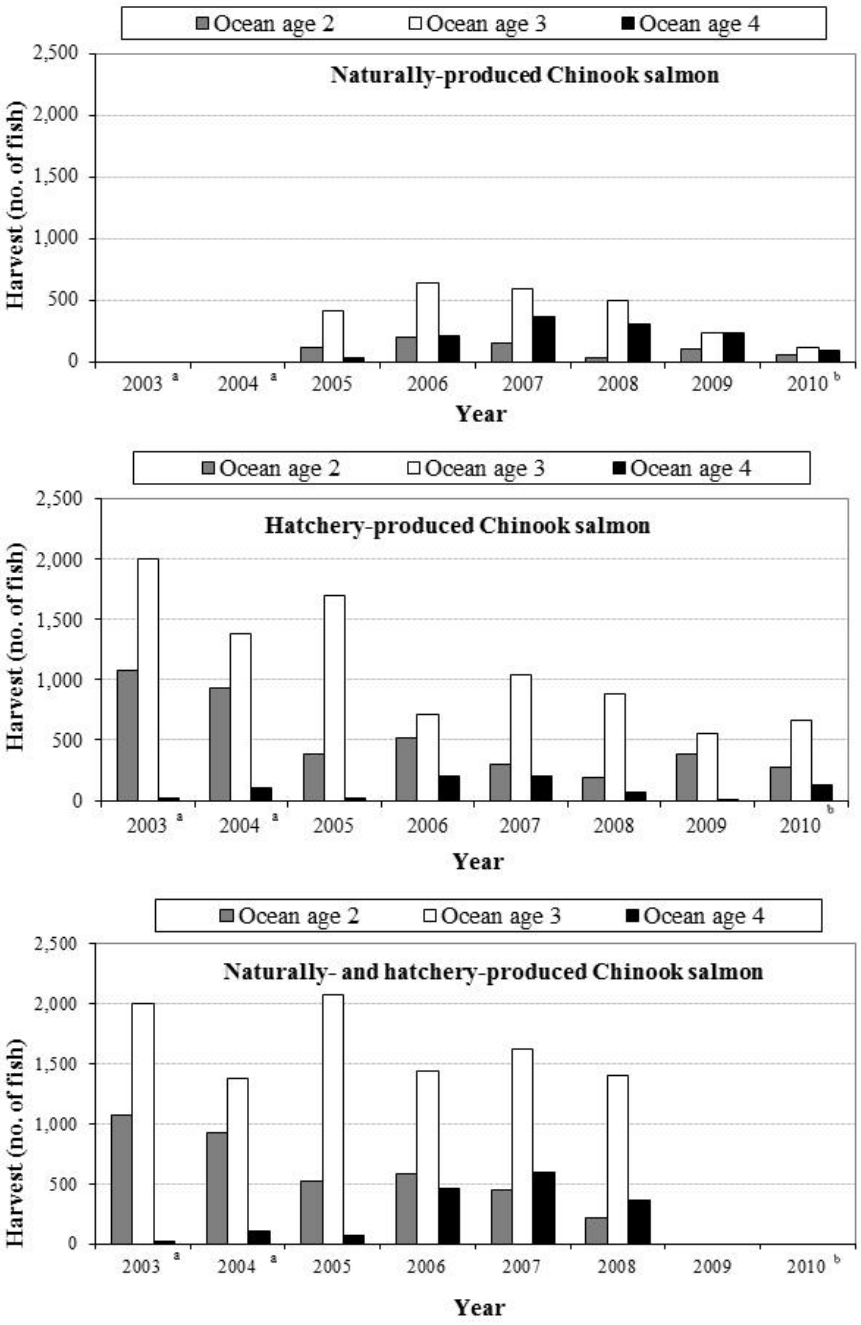


Figure 7.–Creel survey estimates of Kasilof River early-run Chinook salmon sport harvest by age for naturally-produced (top), hatchery-produced (middle), and combined (bottom) Chinook salmon, 2003–2010.

Source: 2003–2008 data (Cope 2011).

Note: For standard errors, refer to Tables 4–5 and Cope (2011, Tables 7–12)

Note: 2003 and 2004 harvests both composed of hatchery-reared Chinook salmon only.

Note: axis scale differs between graphs.

[a] Sport harvest of naturally-produced Chinook salmon prohibited by regulation.

[b] Harvest of naturally-produced Chinook salmon on the Kasilof River was prohibited by emergency order 5–17 June 2010.

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APPENDIX A: SUMMARY OF STRATIFICATION STRUCTURE AND SAMPLING CHARACTERISTICS FOR 2009–2010 KASILOF RIVER EARLY-RUN CHINOOK SALMON CREEL SURVEYS

Appendix A1.–Summary of stratification structure and sampling characteristics for the Kasilof River early-run Chinook salmon creel survey, 16 May–30 June 2009.

Stratum[a]	Sampling method for days[b]	Number of days	Days sampled	Locations[c]	Shifts	Number of shift × loc combinations	Sampling method for shift × loc[b]	Shift × loc sampled per day
TRS	CENS	20	20	ASP, CC, KC	early late	6	SRS	2
SMWF	SRS	26	13	ASP, CC, KC	early late	6	SRS	2

[a] TRS sampling days were Tuesday, Thursday, and Saturday; SMWF sampling days were Sunday, Monday, Wednesday, and Friday.

[b] CENS = census; SRS = simple random sample without replacement.

[c] ASP = Crooked Creek State Recreation Site (Alaska State Park); CC = Cohoe Cove, KC = Kasilof Cabins.

Appendix A2.–Summary of stratification structure and sampling characteristics for the Kasilof River early-run Chinook salmon creel survey, 16 May—30 June 2010.

Stratum[a]	Sampling method for days[b]	Number of days	Days sampled	Locations[c]	Shifts	Number of shift × loc combinations	Sampling method for shift × loc[b]	Shift × loc sampled per day
TRS	CENS	19	19	ASP, CC, KC	early late	6	SRS	3
SMWF	SRS	27	15	ASP, CC, KC	early late	6	SRS	2

[a] TRS sampling days were Tuesday, Thursday, and Saturday; SMWF sampling days were Sunday, Monday, Wednesday, and Friday.

[b] CENS = census; SRS = simple random sample without replacement.

[c] ASP = Crooked Creek State Recreation Site (Alaska State Park); CC = Cohoe Cove, KC = Kasilof Cabins.