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ABSTRACT

The contribution of hatchery produced chinook salmon *Oncorhynchus tshawytscha* to the Ninilchik River sport harvest was estimated from 23 May to 22 June 1992. A roving creel survey two-stage sample design was used to estimate total effort, catch and harvest. Harvested chinook salmon were examined for adipose finclips to recover coded wire tags. A total of 12,606 salmon were caught with a total effort of 60,246 angler hours. An estimated 4,896 chinook salmon were harvested, with 2,789 estimated to be hatchery produced, for a hatchery contribution rate of 57%. Although total harvest was similar to 1991, hatchery contribution declined 26%. Poor weather and poor water clarity prevented estimation of escapement.

KEY WORDS: Ninilchik River, Kenai Peninsula, anadromous, chinook salmon, *Oncorhynchus tshawytscha*, creel survey, stocking, evaluation.

INTRODUCTION

The Ninilchik River (Figure 1) is one of three southern Kenai Peninsula streams that support inriver recreational fisheries for chinook salmon *Oncorhynchus tshawytscha*. The Ninilchik River is a small stream and the sport fishery is capable of harvesting a significant portion of the total return. Harvest is controlled by limiting the allowable time and area open to fishing. The Ninilchik River, from salt water to approximately 3 km (2 mi) upstream, is open to chinook salmon fishing for three consecutive weekends (Saturday, Sunday, and Monday) beginning with the Memorial Day weekend in May. These regulations have been in effect since 1978 with no emergency closures. The other two southern Kenai Peninsula streams, Anchor River and Deep Creek, are more liberally managed with a total of five weekends of fishing time.

The Alaska Department of Fish and Game (ADF&G), Division of Sport Fish and Division of Fisheries Rehabilitation, Enhancement and Development (FRED) initiated a stocking program to increase the chinook salmon returns to the Ninilchik River with the objective of increasing angler effort by 10,000 days, while still maintaining historic levels of natural spawning. Hatchery produced chinook salmon smolt from Ninilchik River brood stock have been released back into the system annually since 1988 (Table 1). To evaluate the return of these releases, a creel survey of the Ninilchik River chinook salmon fishery was conducted during 1992. The survey was used to estimate the contribution of the stocked chinook salmon to the fishery; sport fishing effort, catch (fish landed), and harvest (fish retained); and age and size composition of the sport harvest.

The objectives of this report are to present:

1. estimates of angler effort and catch and harvest of chinook salmon in the Ninilchik River sport fishery;

2. estimates of the contribution of stocked chinook salmon to the Ninilchik River sport fishery;

3. estimates of the age composition of adipose-clipped chinook salmon and chinook salmon without adipose clips in the Ninilchik River sport fishery; and

4. estimates of spawning escapement to the Ninilchik River.

METHODS

The sport fishery in the Ninilchik River in 1992 occurred from 23 May through 22 June. From 23 May to 8 June, three 3-day weekend fisheries were prosecuted. Each weekend, the fishery started at midnight Friday night and continued to midnight Monday night. The fishery was extended an additional weekend (13 June to 15 June) and an entire week (16 June to 22 June) by emergency order in response to a strong return of chinook salmon. Throughout the fishery, a daily bag and possession limit of one chinook salmon over 406 mm (16 in) and a seasonal limit of five chinook salmon was in effect.

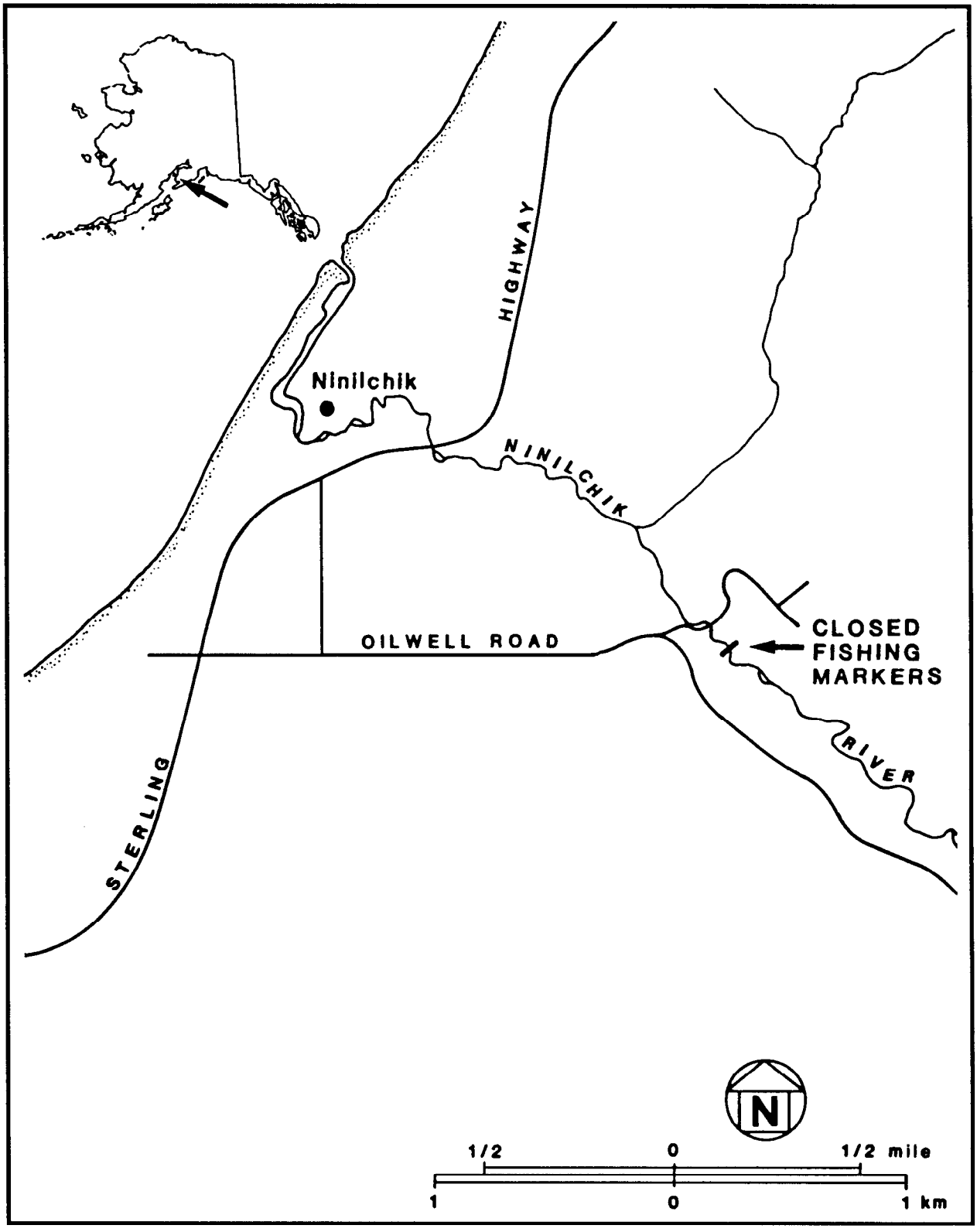

Figure 1. Study area on the Ninilchik River, Alaska.

Table 1. Ninilchik River chinook salmon stocking history, 1988-1991.

Release				Returning in years at age			
Year	Number	No. marked	% marked	1.1	1.2	1.3	1.4
1988	247,327	30,809	12.46	1989	1990	1991	1992
1989	199,831	18,772	9.39	1990	1991	1992	1993
1990	215,804	40,319	18.68	1991	1992	1993	1994
1991	87,992	21,074	23.95	1992	1993	1994	1995

Creel Survey

Study Design:

A two-stage roving creel survey was conducted to estimate angler effort (in angler-hours), catch, and harvest of chinook salmon in the Ninilchik River fishery. During each of the four 3-day weekend fisheries in May and June, Saturday and Sunday-Monday were separate strata. The last week of the fishery, from 16 June to 22 June, was considered one stratum. This resulted in nine total strata.

In the Saturday strata, two of three possible 8-hour periods were selected randomly for sampling. For the Sunday-Monday strata, three of six possible 8-hour periods were selected for sampling, with the first sampling period chosen at random and every-other period after that sampled. During the last week, one 6-hour period was chosen at random during each of the 7 days. Sample periods represented the first sampling stage. Within selected sample periods in each stratum, angler counts were conducted at systematically chosen times to estimate total effort (in angler-hours), and angler interviews were conducted to estimate catch and harvest per unit of effort (CPUE and HPUE). Angler counts and angler interviews represented the second sampling stage.

Three angler counts were made within each 8-hour sample period. Counts took 1 hour to complete, therefore, 5 hours of sampling time were available for angler interviews during sample periods of each weekend. The counts were systematically drawn, with the time for the first count randomly selected in the first 140 minutes (2 hours and 20 minutes) of the sample period and the second and third at 140 minute intervals. During the last week, two counts were made each period with the first count randomly selected in the first 150 minutes (2 hours and 30 minutes) of the period and the second count occurring 2.5 hours later.

Because of the low bag limit in effect, interviews were of completed-trip anglers only to eliminate potential bias in estimates of HPUE. The technician conducted interviews where large numbers of people were exiting the fishery and attempted to interview as many completed-trip anglers as possible.

Data Analysis:

Angler effort was estimated by multiplying (expanding) the mean count within each sampled period by the number of hours in the sample period. Then jack-knife (Efron 1982) estimates of mean CPUE and HPUE were obtained for all anglers interviewed within each sampled period. Estimates of CPUE and HPUE were multiplied by the estimated angler effort of the sample period to obtain the estimated catch and harvest, respectively, for the sample.

The estimated sample effort, catch, and harvest were averaged over all samples within each stratum and expanded by the number of periods in the stratum. This provided the estimated total effort, catch, and harvest of the stratum. Stratum estimates were considered independent so the estimates and their variances were summed across all strata to calculate total estimates of effort, catch, and harvest.

The jackknife sample mean CPUE (or HPUE) was estimated by:

$$\overset{*}{CPUE}_{hij} = \frac{\sum_{\substack{o=1 \\ o \neq j}}^{m_{hi}} c_{hio}}{\sum_{\substack{o=1 \\ o \neq j}}^{m_{hi}} e_{hio}}; \qquad (1)$$

where:

m_{hi} = number of anglers interviewed in period i of stratum h,

c_{hio} = total catch of each interviewed angler in period i of stratum h, and

e_{hio} = angler effort (in hours) of each interviewed angler in period i of stratum h.

The jackknife mean CPUE for sample period i of stratum h was then obtained as:

$$\overline{\overset{*}{CPUE}}_{hi} = \frac{\sum_{j=1}^{m_{hi}} \overset{*}{CPUE}_{hij}}{m_{hi}}, \qquad (2)$$

with a bias correction of:

$$\overline{\overset{*\dagger}{CPUE}}_{hi} = [m_{hi} (\overline{CPUE}_{hi} - \overline{\overset{*}{CPUE}}_{hi})] + [\overline{\overset{*}{CPUE}}_{hi}], \qquad (3)^1$$

where:

$$\overline{CPUE}_{hi} = \frac{\sum_{o=1}^{m_{hi}} c_{hio}}{\sum_{o=1}^{m_{hi}} e_{hio}}. \qquad (4)$$

The bias-corrected jackknife mean was then expanded by the estimated angler effort of the sample period to obtain the estimated catch in period i of stratum h:

$$\hat{C}_{hi} = \hat{E}_{hi} \overline{\overset{*\dagger}{CPUE}}_{hi}, \qquad (5)$$

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[1] If the bias correction resulted in a negative value, then the uncorrected version (equation 2) was used.

where:

$\hat{E}_{hi}$ = estimated angler effort (hours) in period i of stratum h

$$= H_{hi}\,\bar{x}_{hi}, \text{ and} \tag{6}$$

$\bar{x}_{hi}$ = mean angler count in period i of stratum h

$$= \frac{\sum_{q=1}^{r_{hi}} x_{hiq}}{r_{hi}}, \tag{7}$$

where:

H_{hi} = number of hours in sample period i of stratum h,

r_{hi} = total number of angler counts conducted in sample period i of stratum h, and

x_{hiq} = number of anglers counted fishing during count q in sample period i of stratum h.

The harvest of each sample period was estimated similarly by substituting the appropriate harvest statistics into equations 1 through 7.

Mean effort, catch, and harvest (represented by Y in the following equations) of each sampling stratum were estimated by:

$$\bar{\hat{Y}}_h = \frac{\sum_{i=1}^{p_h} \hat{Y}_{hi}}{p_h}, \tag{8}$$

where:

$\hat{Y}_{hi}$ = estimated sample value of effort (E_{hi}, from equation 6), catch or harvest (C_{hi} or H_{hi}, from equation 5) in period i of stratum h, and

p_h = number of periods sampled from stratum h.

Effort, catch, and harvest of each stratum were estimated by multiplying these means by the number of sample periods in the stratum:

$$\hat{Y}_h = P_h\,\bar{\hat{Y}}_h, \tag{9}$$

where:

P_h = total number of possible sample periods of stratum h.

The variance of catch in stratum h was estimated using the two-stage variance equation (Cochran 1977), omitting the finite population correction factor for the second stage units (anglers):

$$\hat{V}[\hat{C}_h] = \left[(1 - f_{1h}) P_h^2 \frac{s_{1h}^2}{p_h} \right] + \left[f_{1h} \frac{P_h^2}{p_h} \sum_{i=1}^{p_h} \hat{V}[\hat{C}_{hi}] \right], \quad (10)$$

where:

f_{1h} = the sampling fraction for first stage units (periods)

= p_h/P_h,

s_{1h}^2 = the among period variance of periods sampled in stratum h or

$$= \frac{\sum_{i=1}^{p_h} (\hat{C}_{hi} - \hat{C}_h)^2}{p_h - 1}, \quad (11)$$

for randomly selected periods of the Saturday and the last week strata, and

$$= \frac{\sum_{i=2}^{p_h} (\hat{C}_{hi} - \hat{C}_{h(i-1)})^2}{2 (p_h - 1)} \quad (12)$$

for systematically selected periods of the Sunday-Monday strata.

The within period variance of periods sampled in stratum h is:

$$\hat{V}[\hat{C}_{hi}] = \hat{E}_{hi}^2 s_{3hi}^{*2} + (\overline{CPUE}_{hi}^{*\dagger})^2 \hat{V}[\hat{E}_{hi}] - s_{3hi}^{*2} \hat{V}[\hat{E}_{hi}], \quad (13)$$

where:

$$s_{3hi}^{*2} = \frac{(m_{hi} - 1)}{m_{hi}} \sum_{j=1}^{m_{hi}} (CPUE_{hij}^{*} - \overline{CPUE}_{hi}^{*})^2, \text{ and} \quad (14)$$

$$\hat{V}[\hat{E}_{hi}] = \frac{H_{hi}^2}{r_{hi}} \frac{\sum_{q=2}^{r_{hi}} \left[x_{hiq} - x_{hi(q-1)} \right]^2}{2\,(r_{hi} - 1)}. \qquad (15)$$

Variance estimates of effort and harvest were obtained by replacing the appropriate effort and harvest statistics, respectively, for the catch statistics in equations 10 through 15. Note that the final term of the estimated effort variance of equation 10 is given in equation 15. These estimators assume anglers interviewed when leaving the fishery were representative of all anglers counted in the fishery during the period.

Age Composition and Mean Length-at-Age

A random sample of chinook salmon were measured and scales removed for aging. The proportion of fish in age class j (p_j) was estimated by:

$$\hat{p}_j = \frac{n_j}{n} \qquad (16)$$

where,

n_j = number of fish sampled in age class j,

n = total number of fish aged,

and the variance was estimated by:

$$\hat{Var}(\hat{p}_j) = \frac{\hat{p}_j\,(1-\hat{p}_j)}{n-1}. \qquad (17)$$

Mean length-at-age and its variance were estimated using equations for normal variates.

Hatchery Contribution

Harvested salmon were examined for adipose finclips. The head was removed from fish having a finclip with the permission of the angler and a numbered headstrap attached. The heads were sent to the ADF&G Coded Wire Tag Laboratory where the tags were removed and decoded.

Hatchery contribution was estimated using equations derived by Clark and Bernard (1987). The variance of the contribution estimate was estimated by bootstrapping (Efron 1982). Sample size for the bootstrapping was 2,000.

Escapement

Escapement was to be estimated from ground and aerial surveys (Boyle and Alexandersdottir 1992). However, poor weather and water visibility (high or

turbid water) prevented determining the escapement of chinook salmon to the Ninilchik River in 1992.

RESULTS

Creel Survey

The creel survey was conducted from 23 May through 25 May, 30 May through 1 June, 6 June through 8 June, 13 June through 15 June, and 16 June through 22 June (Table 2). The mean effort expended by 821 anglers interviewed during the survey ranged from 1.92 hours to 3.42 hours. The success rate (percent of anglers catching one or more fish) ranged from 0.0% to 62.5% while 0.0% to 35.7% of the anglers kept at least one fish. The mean angler count ranged from 19 to 303 and total effort ranged from 114 angler-hours to 2,424 angler-hours (Table 3). The estimated mean CPUE ranged from 0.0 to 0.35 and total catch ranged from 0 to 750 salmon. The estimated mean HPUE ranged from 0.0 to 0.17 and total harvest from 0 to 386 fish.

The estimated total harvest was 4,896 chinook salmon with a catch of 12,606 fish and total effort of 60,246 angler-hours (Table 4).

An important assumption of the creel survey design was that interviewed anglers were representative of the anglers counted during the sample period. If this assumption was violated, then estimates of mean CPUE and HPUE as well as total catch and harvest are biased. For example, if sample periods were shorter than the range of trip lengths, then anglers with long trip lengths did not have the same probability of being interviewed as those with short trip lengths. Trip lengths of interviewed anglers ranged from 0.5 hours to 7.0 hours and in all cases were of shorter length than the sample period (Figure 2). Anglers during the last week may have tended to round their reported trip length to the nearest hour rather than the nearest half hour. Although this may cause some bias in the estimates, there was no way to correct for this problem and the bias was likely relatively small.

In addition, estimates of mean CPUE and HPUE will be biased if the mean CPUE and HPUE of anglers with short trip length were different than the remaining anglers. This problem would likely be most evident when the fishery initially opened each weekend because a number of anglers may be successful in a short period of time while unsuccessful anglers may have extended trip lengths. There were no clear trends of differential success as a function of trip duration during sample period A on any of the three Saturdays sampled (Figure 3). There were also no periods sampled during the survey in which mean HPUE was extremely high and mean hours fished relatively low (Figure 4).

These factors suggested that the estimates of CPUE and HPUE were not biased during the 1992 creel survey.

Size and Age Composition

Scales were collected from 130 fish from the sport harvest, of which 29 (22%) had adipose finclips. Age-1.4 fish represented 54.6% of the sampled fish followed by age-1.3 fish (29.2%) and age-1.2 fish (10.0%; Table 5). There was no significant difference (range $t = 0.36$-0.97, range $df = 11$-69, $P > 0.33$) in

Table 2. Mean effort (hours), catch and harvest by period, and respective standard deviations (SD) of anglers interviewed in the chinook salmon creel survey at the Ninilchik River, 1992.

			Effort		Catch			Harvest		
Date	Period	n	Mean	SD	Mean	SD	%[a]	Mean	SD	%[a]
5/23	A	24	3.23	1.59	1.13	1.15	62.5	0.33	0.56	29.2
	C	17	2.24	0.96	0.41	0.51	41.2	0.18	0.39	17.6
5/24	A	1	2.00		0.00		0.0	0.00		0.0
	C	21	2.74	1.12	0.43	0.68	33.3	0.14	0.36	14.3
5/25	E	15	2.47	1.11	0.40	0.51	40.0	0.20	0.41	20.0
5/30	A	55	1.92	0.80	0.64	0.59	58.2	0.33	0.47	32.7
	B	45	2.69	1.15	0.82	1.39	46.7	0.24	0.43	24.4
5/31	B	47	2.45	0.85	0.83	0.99	57.4	0.26	0.44	25.5
6/01	D	24	2.63	0.81	0.46	0.59	41.7	0.17	0.38	16.7
	F	70	2.98	0.99	0.43	0.50	42.9	0.24	0.43	24.3
6/06	B	48	2.80	1.05	0.69	0.78	52.1	0.25	0.44	25.0
	C	31	2.68	1.14	0.48	0.63	41.9	0.16	0.37	16.1
6/07	B	58	2.53	1.05	0.57	0.93	41.4	0.19	0.43	17.2
6/08	D	23	2.15	1.00	0.39	0.58	34.8	0.26	0.45	26.1
	F	43	3.42	1.53	0.93	1.24	51.2	0.14	0.35	14.0
6/13	A	49	2.27	0.76	0.47	0.50	46.9	0.24	0.43	24.5
	B	40	3.10	1.16	0.65	0.66	55.0	0.33	0.47	32.5
6/14	A	21	2.10	1.01	0.14	0.36	14.3	0.10	0.30	9.5
	C	41	3.04	1.15	1.02	3.66	31.7	0.22	0.42	22.0
6/15	E	37	2.54	1.07	0.46	0.96	29.7	0.19	0.40	18.9
6/16	A	28	3.18	1.35	0.75	1.00	50.0	0.39	0.57	35.7
6/17	B	21	2.60	1.20	0.24	0.44	23.8	0.10	0.30	9.5
6/18	C	22	2.61	1.13	0.23	0.43	22.7	0.18	0.39	18.2
6/19	D	16	2.63	1.22	0.25	0.45	25.0	0.19	0.40	18.8
6/20	E	6	2.42	1.20	0.17	0.41	16.7	0.00	0.00	0.0
6/21	F	9	2.44	0.98	0.11	0.33	11.1	0.00	0.00	0.0
6/22	G	9	2.28	0.97	0.33	0.50	33.3	0.11	0.33	11.1

[a] Proportion of interviewed anglers with at least one fish.

Table 3. Estimated effort (hours), catch and harvest by sample period for the chinook salmon creel survey at the Ninilchik River, 1992.

		Counts		Effort			Catch per hour		Catch		Harvest per hour		Harvest	
Date	Period	n	Mean	Total	Variance	N[a]	Mean	Variance	Total	Variance	Mean	Variance	Total	Variance
5/23	A	3	180	1,440	60,043	24	0.3504	0.0028	504	13,006	0.1034	0.0012	149	2,976
	C	3	269	2,152	32,304	17	0.1846	0.0025	397	12,800	0.0798	0.0017	172	7,928
5/24	A	3	45	357	22,891	1	0.0000	0.0000	0	0	0.0000	0.0000	0	0
	C	3	243	1,947	127,899	21	0.1583	0.0022	308	11,415	0.0535	0.0007	104	2,935
5/25	E	3	157	1,253	16,453	15	0.1637	0.0020	205	3,527	0.0837	0.0015	105	2,400
5/30	A	3	283	2,264	693,291	55	0.3312	0.0017	750	83,643	0.1704	0.0011	386	24,916
	B	3	240	1,920	42,432	45	0.3057	0.0056	587	24,289	0.0913	0.0005	175	2,126
5/31	B	3	192	1,539	36,747	47	0.3402	0.0025	523	10,076	0.1046	0.0006	161	1,833
6/01	D	3	62	499	41,435	24	0.1747	0.0019	87	1,667	0.0633	0.0009	32	350
	F	3	161	1,288	38,667	70	0.1437	0.0004	185	1,477	0.0813	0.0003	105	775
6/06	B	3	303	2,424	2,187	48	0.2457	0.0013	596	7,562	0.0893	0.0005	216	2,796
	C	3	259	2,075	4,933	31	0.1814	0.0013	376	5,943	0.0609	0.0005	126	2,361
6/07	B	3	258	2,067	102,939	58	0.2263	0.0018	468	12,689	0.0753	0.0005	156	2,534
6/08	D	3	50	397	427	23	0.1820	0.0029	72	472	0.1201	0.0020	48	322
	F	3	136	1,088	38,507	43	0.2736	0.0020	298	5,120	0.0410	0.0002	45	320
6/13	A	3	295	2,360	483,888	49	0.2072	0.0009	489	25,397	0.1080	0.0007	255	9,441
	B	3	236	1,885	23,403	40	0.2100	0.0010	395	4,419	0.1045	0.0006	197	2,416
6/14	A	3	44	352	1,248	21	0.0692	0.0013	24	161	0.0457	0.0010	16	122
	C	3	127	1,019	40,043	41	0.3377	0.0349	344	39,371	0.0724	0.0004	74	649
6/15	E	3	94	749	4,933	37	0.1816	0.0035	136	2,119	0.0743	0.0007	56	397
6/16	A	2	71	426	4,356	28	0.2365	0.0030	101	780	0.1234	0.0011	53	261
6/17	B	2	97	579	3,969	21	0.0923	0.0019	53	427	0.0374	0.0006	22	206
6/18	C	2	70	420	1,764	22	0.0883	0.0010	37	182	0.0699	0.0010	29	179
6/19	D	2	73	438	90,000	16	0.0949	0.0018	42	991	0.0706	0.0015	31	604
6/20	E	2	19	114	7,056	6	0.0629	0.0053	7	59	0.0000	0.0000	0	0
6/21	F	2	67	402	324	9	0.0485	0.0021	19	333	0.0000	0.0000	0	0
6/22	G	2	35	210	1,764	9	0.1469	0.0048	31	242	0.0527	0.0024	11	105

[a] Number of anglers interviewed during the period.

Table 4. Estimates of total effort (hours), catch and harvest from the chinook salmon creel survey at the Ninilchik River, 1992.

Stratum Dates	Periods Ph	Periods ph	Mean	Variance	Total	Variance components Among	Variance components Within	Total Variance	Relative Precision
Effort									
5/23	3	2	1,796	253,472	5,388	380,208	138,520	518,728	26
5/24-25	6	3	1,186	751,673	7,115	4,510,037	334,485	4,844,523	61
Total					12,503			5,363,251	36
5/30	3	2	2,092	59,168	6,276	88,752	1,103,584	1,192,336	34
5/31-6/1	6	3	1,108	426,162	6,651	2,556,971	233,696	2,790,667	49
Total					12,927			3,983,003	30
6/06	3	2	2,249	61,017	6,748	91,525	10,680	102,205	9
6/07-08	6	3	1,184	815,924	7,104	4,895,541	283,744	5,179,285	63
Total					13,852			5,281,490	33
6/13	3	2	2,123	112,654	6,368	168,981	760,936	929,917	30
6/14-15	6	3	707	129,246	4,240	775,477	92,448	867,925	43
Total					10,608			1,797,842	25
6/16-22	28	7	370	24,350	10,356	2,045,412	436,932	2,482,344	30
Grand total					60,246			18,907,930	14
Catch									
5/23	3	2	481	8,438	1,353	8,465	38,709	47,354	32
5/24-25	6	3	182	29,252	1,027	158,314	67,237	225,552	91
Total					2,380			272,906	43
5/30	3	2	739	26,550	2,005	19,938	161,898	181,836	42
5/31-6/1	6	3	282	56,569	1,591	299,883	26,440	326,323	70
Total					3,596			508,159	39
6/06	3	2	531	26,044	1,458	36,062	20,258	56,320	32
6/07-08	6	3	318	62,012	1,675	310,800	36,561	347,360	69
Total					3,133			403,680	40
6/13	3	2	480	6,496	1,327	6,567	44,725	51,291	33
6/14-15	6	3	179	40,077	1,009	218,143	83,302	301,445	107
Total					2,336			352,736	50
6/16-22	28	7	43	943	1,161	76,296	12,058	88,354	50
Grand total					12,606			1,625,835	20

-continued-

Table 4. (Page 2 of 2).

Stratum Dates	Periods P_h	Periods p_h	Mean	Variance	Total	Variance components Among	Variance components Within	Total Variance	Relative Precision
Harvest									
5/23	3	2	171	186	481	386	16,356	16,742	53
5/24-25	6	3	74	3,036	418	16,252	24,007	40,260	94
Total					899			57,002	52
5/30	3	2	313	32,019	842	33,272	40,564	73,836	63
5/31-6/1	6	3	105	6,224	594	33,159	5,918	39,076	65
Total					1,436			112,912	46
6/06	3	2	187	4,475	514	6,091	7,737	13,828	45
6/07-08	6	3	96	3,285	496	17,505	6,352	23,857	61
Total					1,010			37,685	38
6/13	3	2	245	2,396	678	2,509	17,785	20,294	41
6/14-15	6	3	52	981	291	5,470	2,334	7,804	60
Total					969			28,098	34
6/16-22	28	7	22	378	582	30,039	5,417	35,456	63
Grand total					4,896			271,153	21

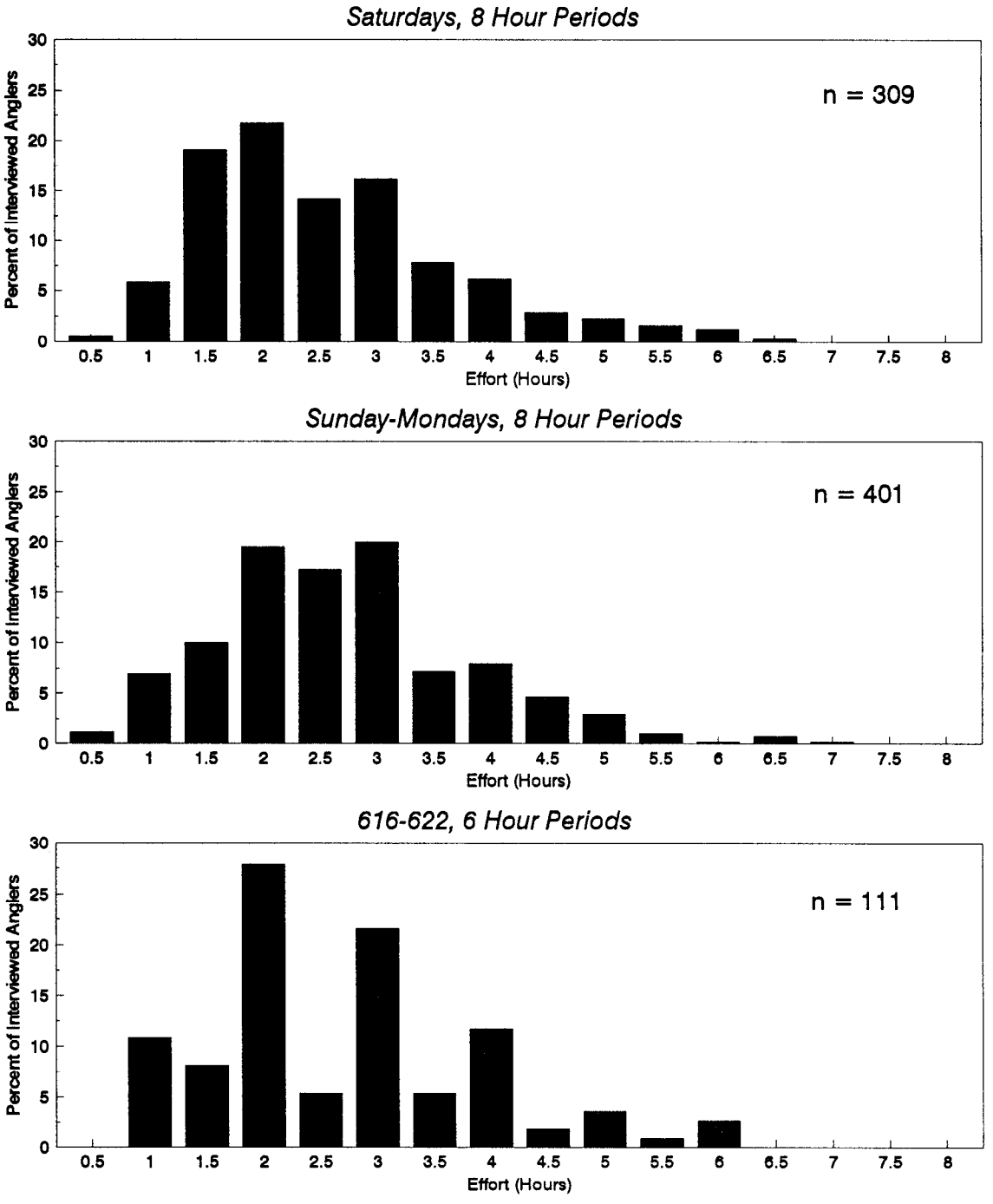

Figure 2. Percent of interviewed anglers expending a given effort (hours) during three strata of the chinook salmon creel survey at the Ninilchik River, 1992.

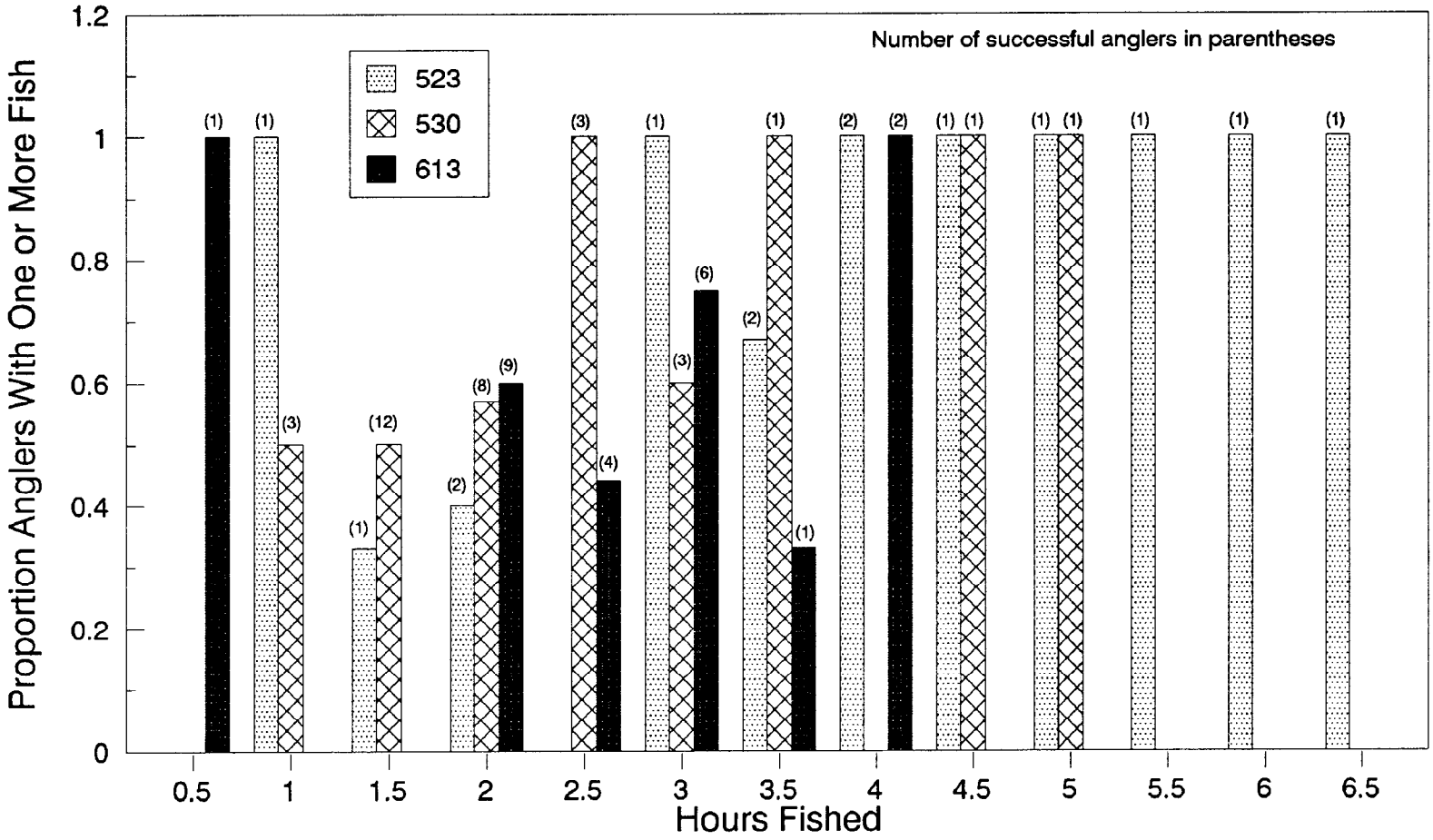

Figure 3. Proportion of successful anglers by hours fished for anglers interviewed during A-period on 23 and 30 May, and 13 June of the chinook salmon creel survey on the Ninilchik River, 1992.

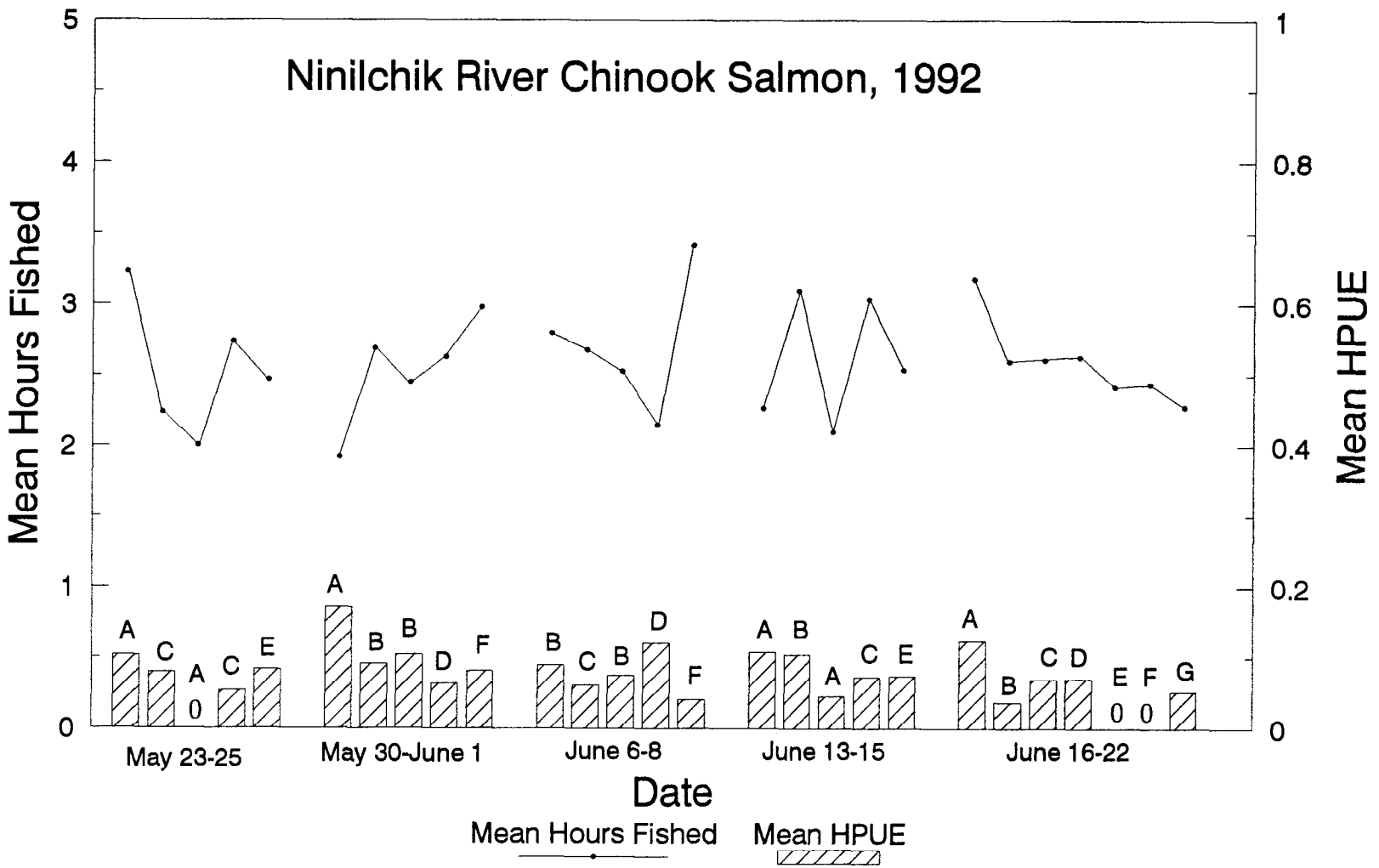

Figure 4. Mean hours fished and HPUE estimated by sample period of the chinook salmon creel survey at the Ninilchik River, 1992.

Table 5. Age composition and mean length-at-age (mm) of chinook salmon sampled at the Ninilchik River, 1992.

	Age						
	1.2	1.3	1.4	2.2	2.3	2.4	Total
No adipose finclip							
Percent	8.5	24.6	38.5	0.8	2.3	3.1	77.7
Mean	587	758	856	855	782	805	791
SE	12.40	11.29	7.69		24.44	21.58	9.98
Sample size	11	32	50	1	3	4	101
Minimum	500	557	690	855	745	760	500
Maximum	635	872	950	855	828	860	950
Adipose finclip							
Percent	1.5	4.6	16.2				22.3
Mean	571	748	843				805
SE	9.00	15.25	7.96				15.42
Sample size	2	6	21				29
Minimum	562	701	754				562
Maximum	580	790	940				940
Total							
Percent	10.0	29.2	54.6	0.8	2.3	3.1	100.0
Mean	584	756	852	855	782	805	794
SE	10.59	9.76	5.92		24.44	21.58	8.47
Sample size	13	38	71	1	3	4	130
Minimum	500	557	690	855	745	760	500
Maximum	635	872	950	855	828	860	950

mean length-at-age between finclipped and unclipped fish among these three age classes. Fish aged 2.2, 2.3, or 2.4 represented 6.2% of the sample. This was the first year that fish exhibiting a freshwater occupancy of 2 years were recovered.

Hatchery Contribution

There were 942 fish examined from the sport harvest for adipose finclips, a sample of 19% of the estimated harvest (Appendix A). Heads were collected from 72 of the 79 fish with an adipose finclip (Table 6). Only 59 tags were recovered from the collected heads, giving a high tag loss rate of 18%. Of the 59 recovered tags, 41 were from the 1988 hatchery smolt release, 13 were from the 1989 release, and 4 were from the 1990 release (Table 6). No tags were recovered from the 1991 release. One tag was recovered from a 1987 Elmendorf Hatchery smolt released into Crooked Creek.

Hatchery contribution was estimated at 2,789 fish and accounted for 57% of the total harvest (Table 7). Age-1.4 fish from the 1988 hatchery smolt release accounted for 1,880 fish, age-1.3 fish from the 1989 hatchery smolt release accounted for 789 fish, while 120 age-1.2 fish were from the 1990 smolt release. Total contribution of hatchery fish to each fishing period ranged from 42% to 75%.

DISCUSSION

The large estimates of total catch, harvest, and hatchery contribution from the creel survey were used as justification to extend the chinook salmon fishing season on the Ninilchik River during 1992. The season extension was the second since the three 3-day fishing regulations were adopted in 1978 (the first was during 1991). An emergency order (EO) was issued on 8 June to extend the fishery from 13 June to 22 June or 10 consecutive days.

The estimated 1992 harvest of 4,896 chinook salmon from the Ninilchik River was the second highest recorded (Mills 1979-1992; Figure 5), exceeded only by the record harvest (5,053) of 1991 (Appendix B). However, the estimated 1992 catch of 12,606 chinook salmon exceeded the estimated record catch (9,718) of 1991. Effort increased from 51,318 hours in 1991 to 60,246 hours in 1992, an increase of 17%. Estimated CPUE and HPUE for the 1991 and 1992 seasons were similar. The estimated harvest of 1,469 naturally spawned salmon during the historic limits of the fishery (Memorial Day weekend and the following two weekends) was the highest on record. The additional contribution of stocked fish to the harvest during this time period (1,876 fish or 56% of the total) provided for a record harvest of 3,345 salmon. The additional harvest realized during the 10 days of extended fishing totaled an additional 1,551 fish of which 59% (913) were stocked fish. During the additional 10 days of fishing time in 1991, nearly twice (2,971) as many fish were harvested. Effort and CPUE were also greater during the extended fishery in 1991, perhaps suggesting a greater number of fish available to the fishery.

The creel survey was modified this year to address problems which occurred in the 1991 survey (Boyle and Alexandersdottir 1992). Specifically, sample period length was increased from 4 hours to 8 hours during the Saturday stratum. The increase in period length appeared to solve the problems of

Table 6. Coded wire tags recovered from chinook salmon each weekend from the Ninilchik River, 1992.

Date	Number Examined	Finclips Observed	n[b]	Tag Code[a]			No Tag
				311762	311830	311735	
5/23-25	150	9	5	3	1	0	1
5/29 - 6/1	246	19	19	10	3	3	3
6/6-8	203	22	21	14	3	0	4
6/13-15	208	17	16	9	4	1	2
6/16-22	135	12	11[c]	5	2	0	3
Total	942	79	72	41	13	4	13

[a] Tag codes released in 1988, 1989 and 1990, respectively.

[b] Number of heads collected.

[c] One recovery was from a 1987 Elmendorf Hatchery smolt release.

Table 7. Estimated contribution (C) and standard error (SE) of hatchery stocked chinook salmon to the Ninilchik River fishery, 1992.

Date	Total Harvest	Tag code[a] 311762 C	311762 SE	311830 C	311830 SE	311735 C	311735 SE	Total[b]	Percent
5/23-25	899	260	138	115	101	0	0	375	42
5/29-6/1	1,436	468	181	186	96	94	56	748	52
6/6-8	1,010	586	181	167	100	0	0	753	75
6/13-15	969	358	127	211	95	26	31	595	61
6/16-22	582	208	110	110	79	0	0	318	55
Total	4,896	1,880	336	789	212	120	64	2,789	57

[a] Tag codes released in 1988, 1989 and 1990, respectively.

[b] Estimated total hatchery contribution to the harvest.

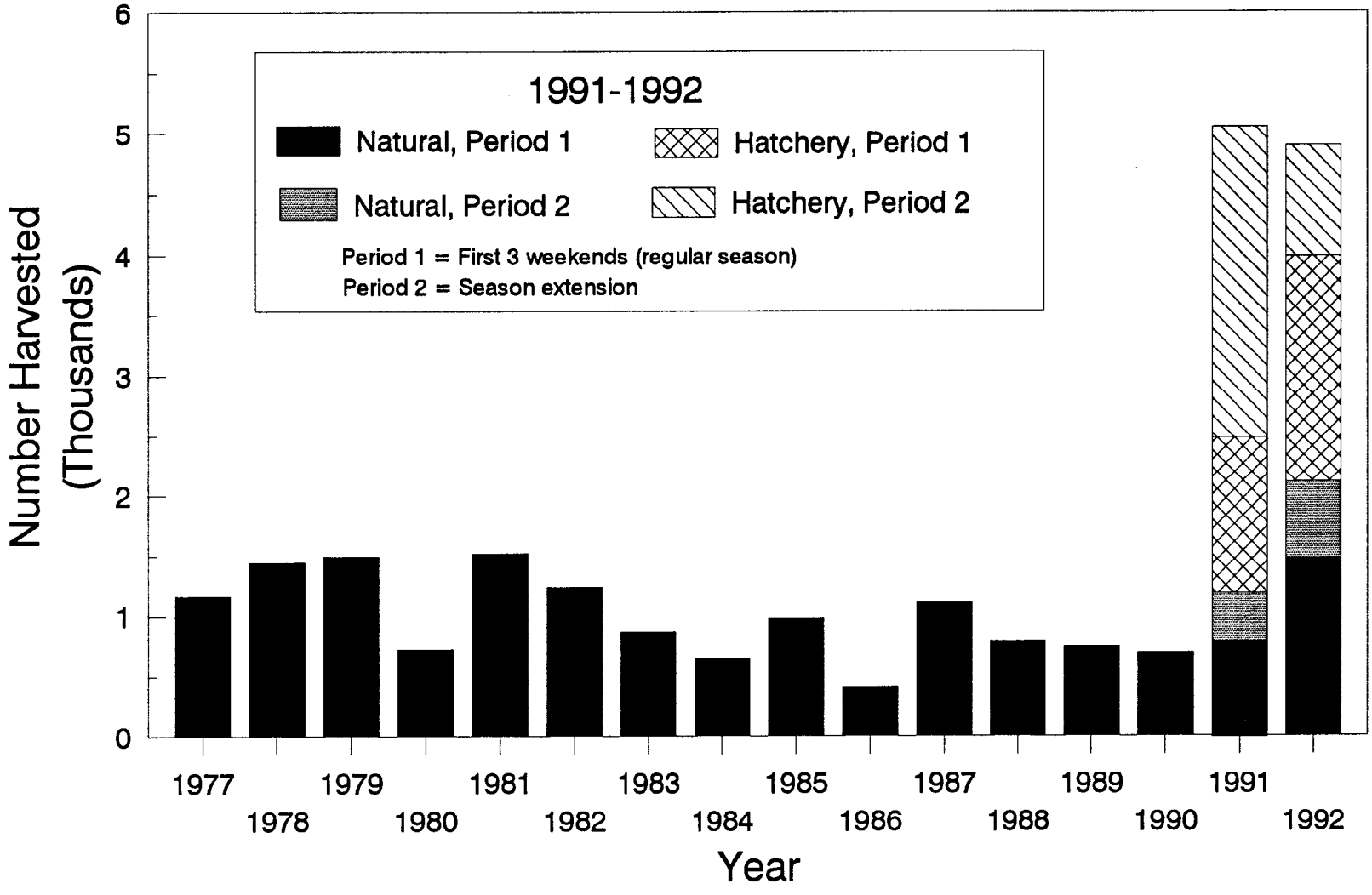

Figure 5. Total estimated harvest of chinook salmon at the Ninilchik River, 1977-1992.

potential sampling bias caused by interviewing anglers who were highly successful in a short time but not interviewing unsuccessful anglers who fished a longer time. It also appeared that decreasing period length during the last week did not compromise accuracy or precision of period estimates while providing for more sampling periods. Sampling more periods should help improve precision of the creel estimates.

No coded wire tags were recovered from the 1991 smolt release group and no age-1.1 chinook salmon were found in the age-length samples. A number of anglers harvested more than one fish, due to anglers retaining fish under 406 mm, so it is possible that age-1.1 fish did return to the Ninilchik River. However, it would appear that the return of the 1991 smolt cohort may be low in future years.

This is the second year of high tag loss from chinook salmon returning to the Ninilchik River. Although the cause of this tag loss problem is unknown, it may be most pronounced in the 1988 smolt release (Boyle and Alexandersdottir 1992, Appendix C).

Complete evaluation of the 1992 fishery will not be possible without an estimate of escapement. In 1991, total effort for the Ninilchik River was a record 19,640 angler-days (Mills 1992); an increase of 8,958 angler-days over the previous 5-year average of 10,682 days (Mills 1987-1991). If sustained, this increase in fishery effort would satisfy the objective of increasing angler effort by 10,000 days. To fully evaluate the stocking program, it will be necessary to estimate spawning escapement and ensure that historic levels of natural spawning are maintained.

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APPENDIX A

Appendix A. Coded wire tag recoveries from chinook salmon, Ninilchik River, 1992.

	Number Examined	Adipose Finclips Observed	Heads Collected	Tag Codes[a]			No Tag
				311762	311830	311735	
May 23	56	5	3	2	1	-	-
24	39	1	0	-	-	-	-
25	55	3	2	1	-	-	1
30	102	6	6	3	1	-	2
31	78	5	5	2	1	1	1
June 1	66	8	8	5	1	2	-
6	95	9	9	6	1	-	2
7	51	7	6	5	1	-	-
8	57	6	6	3	1	-	2
13	114	8	7	5	2	-	-
14	42	4	4	2	-	1	1
15	52	5	5	2	2	-	1
16	22	1	1	1	-	-	-
17[b]	35	3	2	-	-	-	1
18	19	1	1	-	-	-	1
19	14	2	2	2	-	-	-
20	16	1	1	1	-	-	-
21	15	3	3	1	1	-	1
22	14	1	1	-	1	-	-

[a] Tag codes released in 1988, 1989 and 1990, respectively.

[b] One recovery was from a 1987 Elmendorf Hatchery smolt release.

APPENDIX B

Appendix B. Historic harvest and escapement of chinook salmon, Ninilchik River, 1977-1992.

Year	Harvest[a]	Escapement[b]	Exploitation
1977	1,168	1,400	45
1978	1,445	990	59
1979	1,493	1,390	52
1980[c]	723	720	50
1981[c]	1,523	830	65
1982	1,240	1,430	46
1983	871	710	55
1984	648	600	52
1985	983	650	60
1986	420	790	35
1987	1,112	600	65
1988	795	1,080	42
1989	744	400	65
1990	693	840	45
Mean	990	951	53
1991	5,053	827	86
1992	4,896	ND[d]	ND[d]

[a] Harvest estimates for the years 1977-1990 taken from Mills (1979-1992).

[b] Numbers rounded to nearest 10.

[c] Escapement counts considered minimal due to high turbid water during escapement surveys.

[d] No data.

APPENDIX C

Appendix C. Summary of adipose finclipped fish which did not contain a tag, Ninilchik River, 1992.

Head Number	Mid-Eye To Fork Length	Age	Clip Status	Recovery Date
9354	840		Good	5/27/92
9358	810	1.4	Good	5/30/92
9361	903		Good	5/30/92
9365			Good	5/31/92
9376			Good	6/06/92
9383	692		Good	6/06/92
9393	800		Good	6/08/92
9397	824		Good	6/08/92
9412			Good	6/14/92
9414	850		Good	6/15/92
9421	805		Good	6/17/92
9423	810		Good	6/18/92
9429	815	1.4	Good	6/21/92