

NORTH RIVER SALMON COUNTING TOWER
1972-1973

(From AYK Area Arctic Anadromous Fish Investigations)
Completion Report for July 1, 1972 to June 30, 1974

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North River Counting Tower

In 1972 a counting tower was constructed on the North River just below the bridge on the White Alice access road (Figure 4), which is about 3-1/2 miles upstream from the mouth.

A 12-foot tower was constructed using spruce logs and was placed on a high bank overlooking the river. The river at this point was 3-4 feet deep and about 20 feet across. The location was chosen because at this point the river was swift and the salmon moved rapidly past the tower without milling. A secondary channel formed by a gravel bar in the center of the river was blocked off with a weir constructed of chicken wire and posts.

In 1973 the tower site was moved approximately 1/4 mile upstream from the 1972 site. This move was the result of difficulties encountered with maintaining a weir in swift water. The 1973 tower consisted of a wooden platform erected in a cottonwood tree overlooking the river. The platform was approximately 20 feet from the ground. A temporary deflection weir of metal fence posts and chicken wire was constructed on the river bank opposite the counting tower and projected approximately 30 feet into the river to deflect the passage of salmon towards the counting tower.

For both study years a 1,250 watt generator and a power line with three 400 watt bulbs housed in 18-inch diameter reflectors provided illumination during periods of darkness and overcast.

During 1972 a three-man crew counted salmon on a 24-hour schedule. Each crew member counted salmon for two 4-hour shifts daily. During 1973, due to budgetary limitations on overtime pay, a 3-man crew counted salmon for two 3-hour shifts, from 0000 hours to 0800 hours and from 1400 to 2400 hours daily (18 hours total) with no counting for a 6-hour period (8 a.m. to 2 p.m.). A 24-hour counting schedule was maintained every seventh day (Monday). For both study years hourly counts were totaled daily. Salmon moving downstream were subtracted from the total count. A series of 10-minute counts were made at the beginning of each hour. The purpose was to determine if the 10-minute counts could be used as a basis for estimating hourly migration. The 10-minute counts were expanded by a factor of six to obtain an estimate of daily migration. In 1972 the 10-minute count was conducted only on pink salmon; in 1973 on all three species.

At times it was impossible to make counts of escapement because of storms, rain, generator trouble, etc. These counts were estimated by averaging the last complete hourly/daily count with the next complete hourly/daily count. This average is used for all missing counts.

King salmon length estimates of, less than 50 centimeters, 50-60 centimeters, 60-80 centimeters, and larger than 80 centimeters were made. This was accomplished by placing lengths of galvanized pipe, cut to appropriate length, on the river bottom adjacent to the counting tower. This provided an immediate reference for estimating king salmon total length.

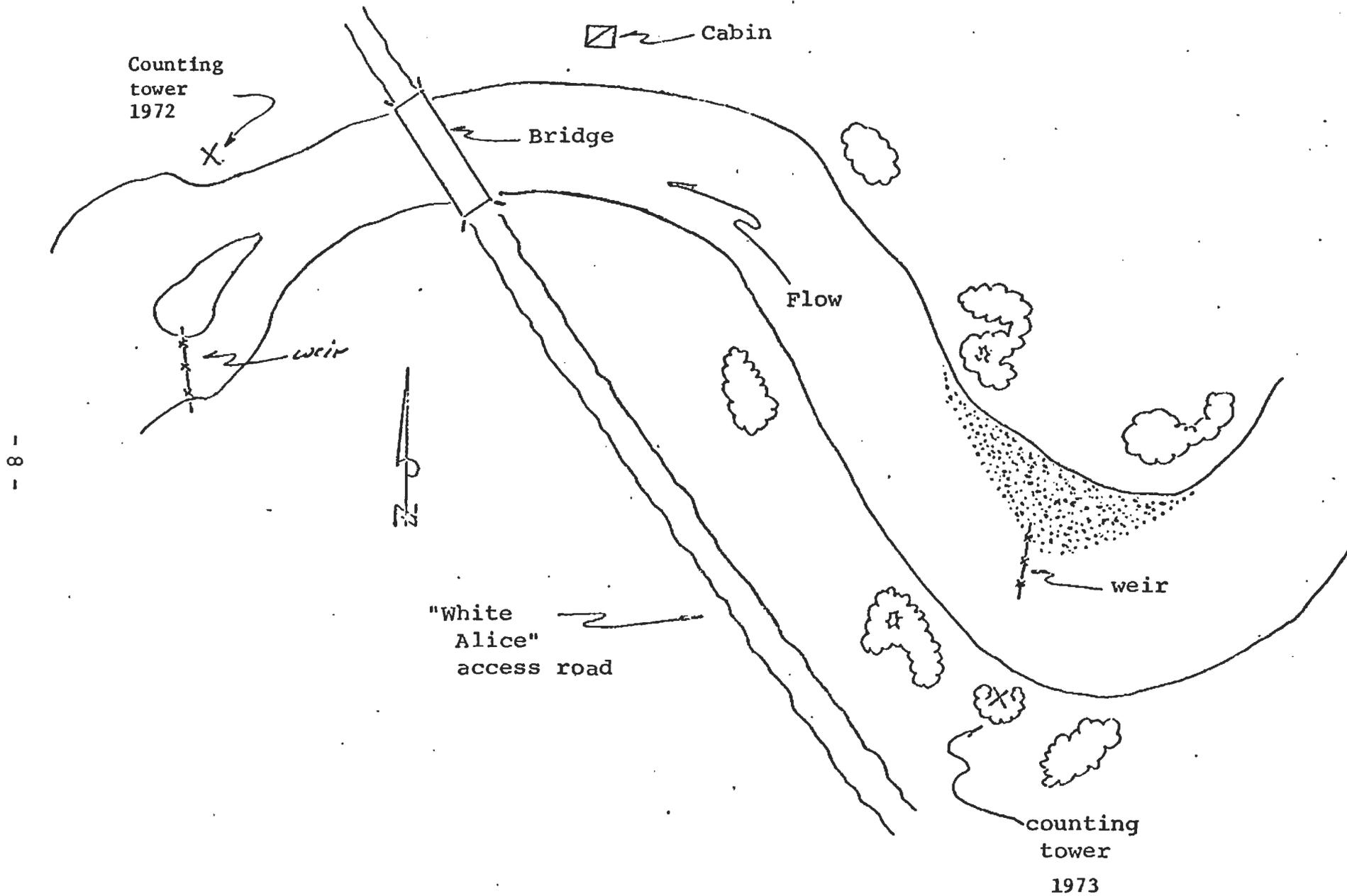


Figure 4. Location of North River salmon counting tower, 1973.

North River Counting Tower 1972

An estimated total (actual count + interpolated counts for missing days) of 561 king, 54,934 pink and 2,332 chum salmon migrated past the North River counting tower during July 7-28, 1972. Estimated daily counts (missing data interpolated) and hourly counts are presented by species in Appendix Tables 3, 4 and 5.

As indicated in Figure 6, peak counts for king and chum salmon occurred later (July 11-17) than for pink salmon (July 7-11).

Diurnal migration patterns were indicated with the peak chum and pink salmon counts occurring from 2100-0200 and 1900-2200 respectively. The king salmon migration was relatively consistent each hour with counts increasing somewhat during 1900-0200 (Figure 7).

A series of 10-minute pink salmon counts were made at the beginning of each hour for 16 days. It was found that the expanded 10-minute counts were 17 percent higher than actual counts during this period (Table 5). It is possible that this difference would have been substantially smaller if 10-minute counts had been made throughout the run.

North River Counting Tower 1973

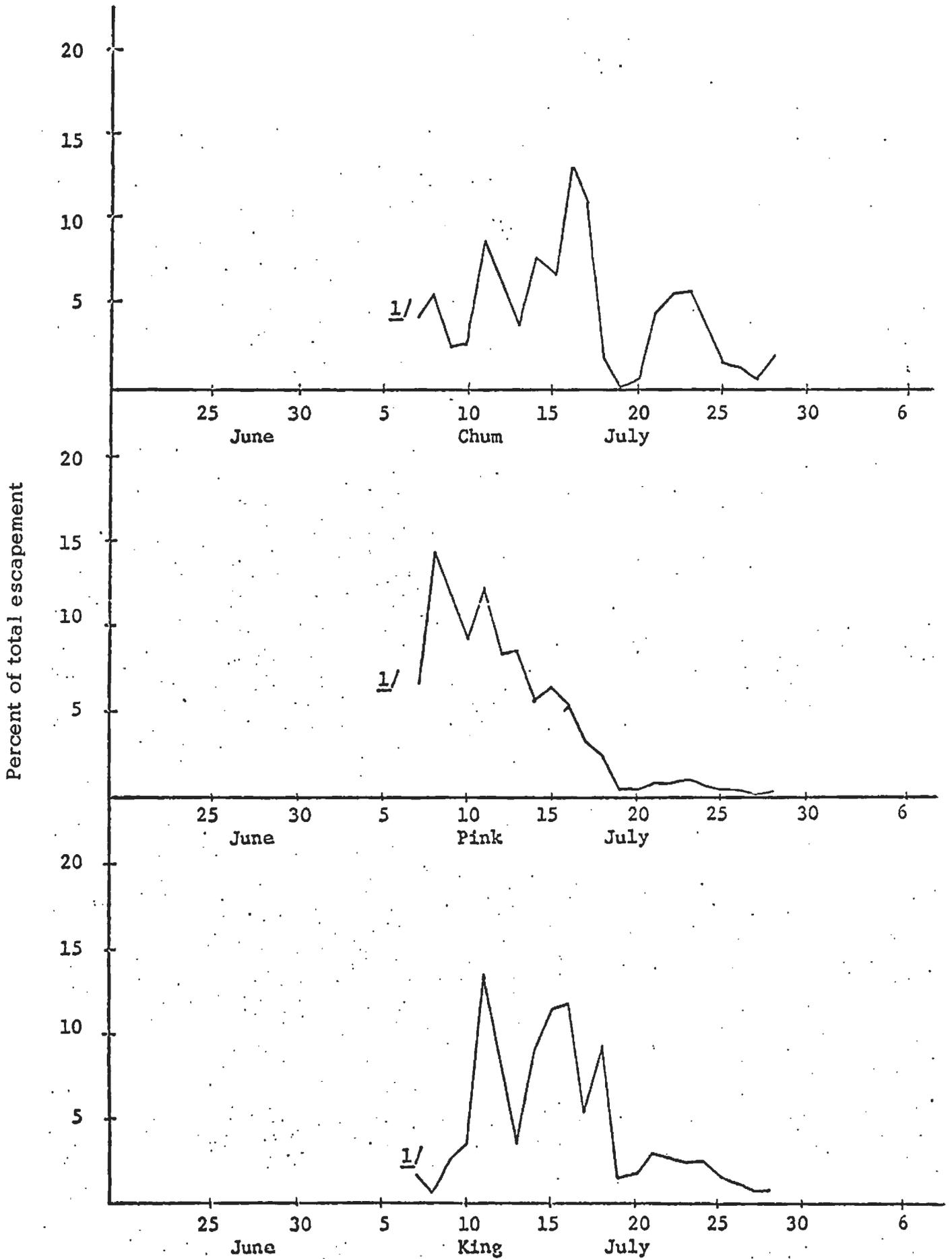
The counting tower began operations on June 29 and continued through July 23 when high, turbid water and poor counting conditions terminated operations. Estimated daily and hourly counts (missing data interpolated) are presented by species in Appendix Tables 6, 7 and 8.

In 1973 an unexpanded 18-hour total of 298 kings, 26,542 pink and 4,334 chum salmon was enumerated past the tower. Discussion of the expansion to 24 hours will be presented in the Discussion section. The main peak of the pink and chum runs occurred during the period of July 11-15. The king salmon demonstrated a peak trend during late July extending from July 17-23 (Figure 8). Chum and pink salmon demonstrated a diurnal migration pattern with peak hourly migration during the early morning hours, while the king salmon did not show a pronounced diurnal pattern (Figure 9).

Ten minute counts resulted in an expanded escapement estimate of 378 king, 23,046 pink and 4,110 chum salmon (Table 6).

An aerial survey of the North River was conducted on July 27 resulting in a count of 267 king, 16,590 pink and 3,644 chum salmon. This represents

Figure 6. Daily expanded salmon counts, North River counting tower, 1972.



1/ 8 hour count.

Figure 7. Hourly salmon migration patterns, North River counting tower, 1972.

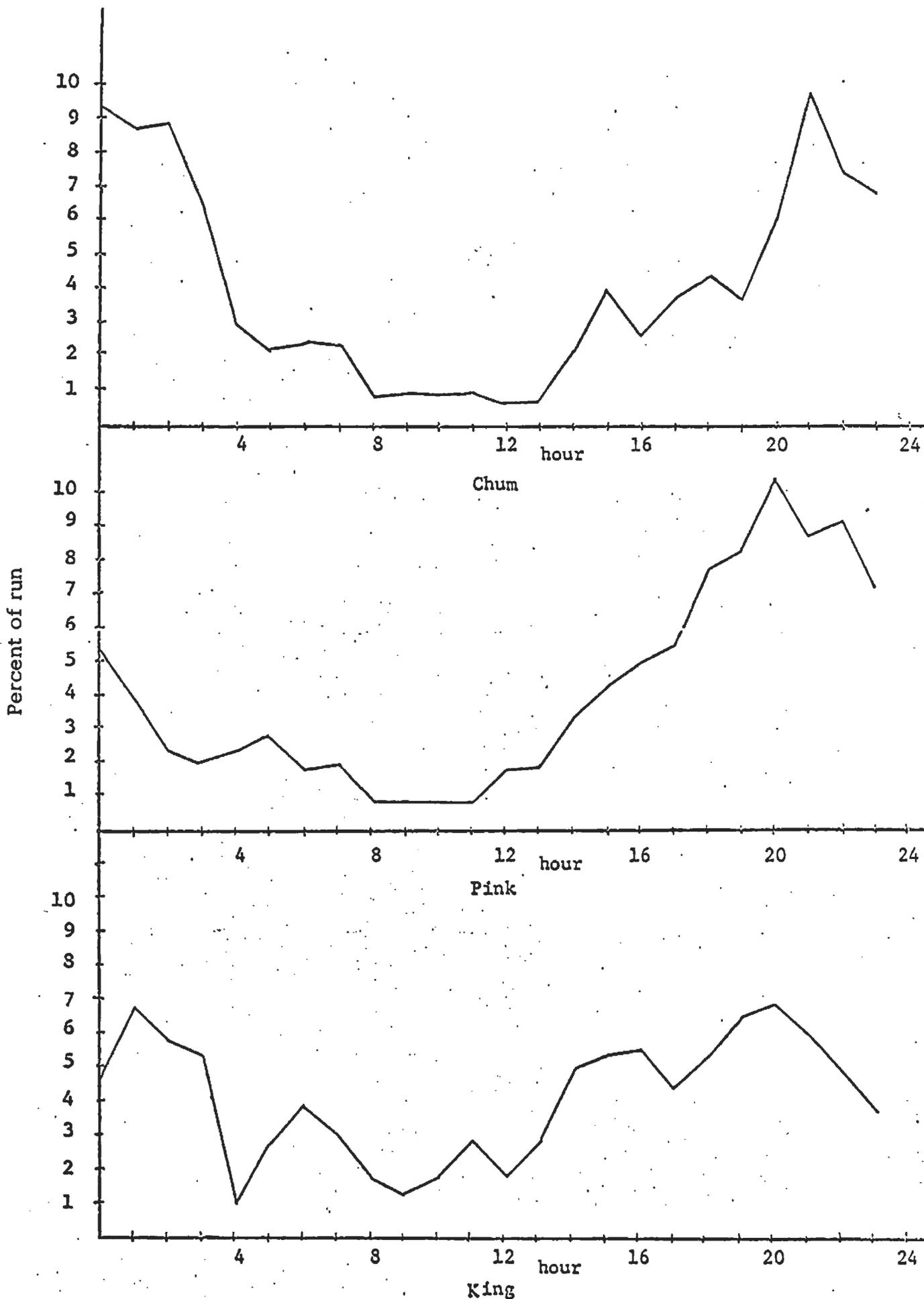


Table 5. Comparison of 10-minute pink salmon counts to hourly counts, North River tower, 1972.

Daily	Daily counts	Hours counted	24 counts/day 10-minute	Expanded
7/12	4,513	24	804	4,824
13	2,791	24	530	3,180
14	3,122	24	522	3,132
15	2,192	24	392	2,352
16	2,582	24	421	2,526
17	1,414	24	250	1,500
19	146	24	60	360
20	180	24	48	288
21	363	24	86	516
22	399	24	146	876
23	556	24	172	1,032
24	355	24	127	762
25	225	24	66	396
26	165	24	72	432
27	53	24	29	174
28	66	24	19	114
	<hr/>	<hr/>	<hr/>	<hr/>
	19,122	384	3,744	22,464

19,122
 - 22,464
 3,342 or 17% error

Figure 8. Daily salmon migration enumerated past North River tower, 1973.

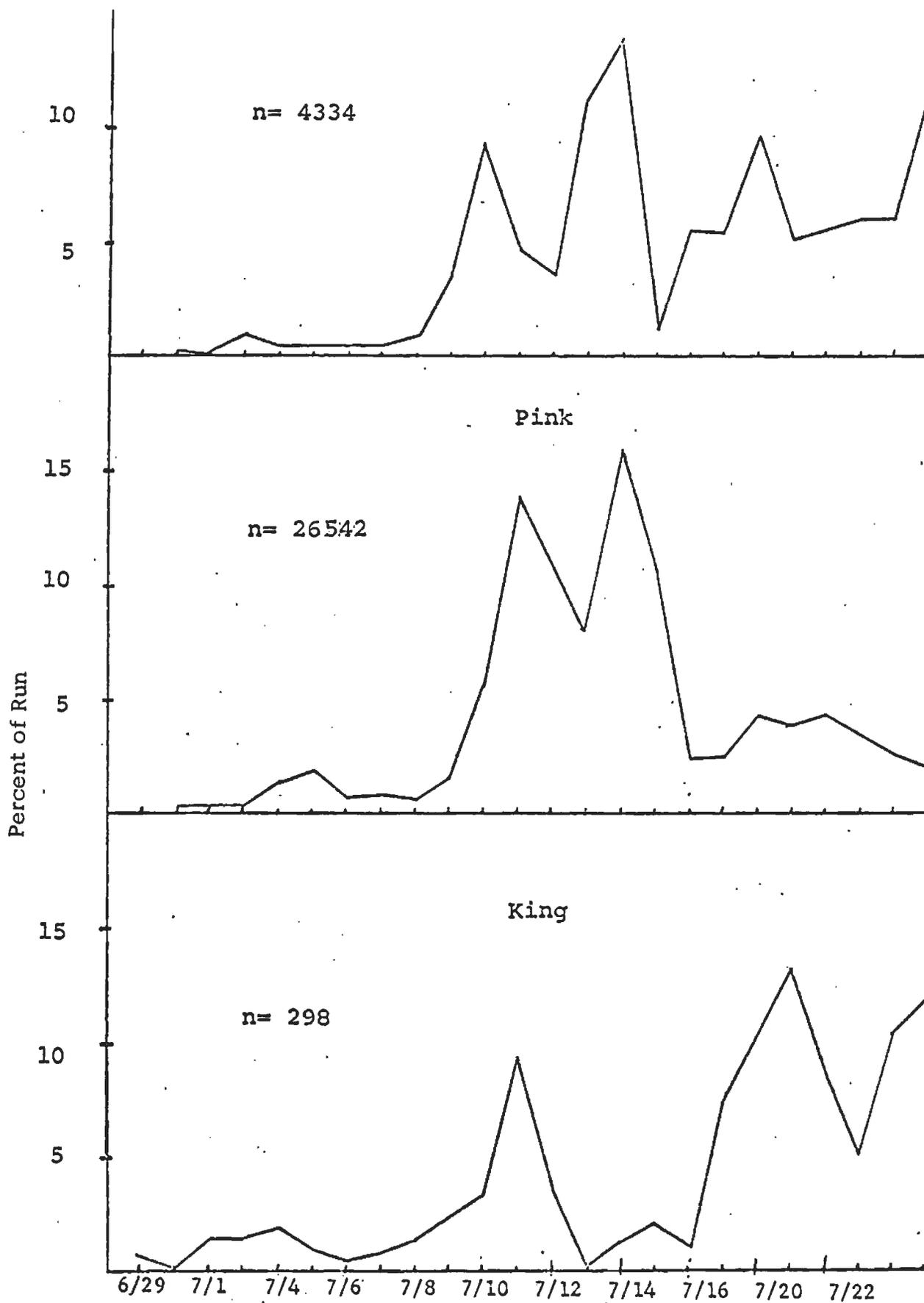


Figure 9. Hourly migration of chum, pink and king salmon, North River tower, 1973.

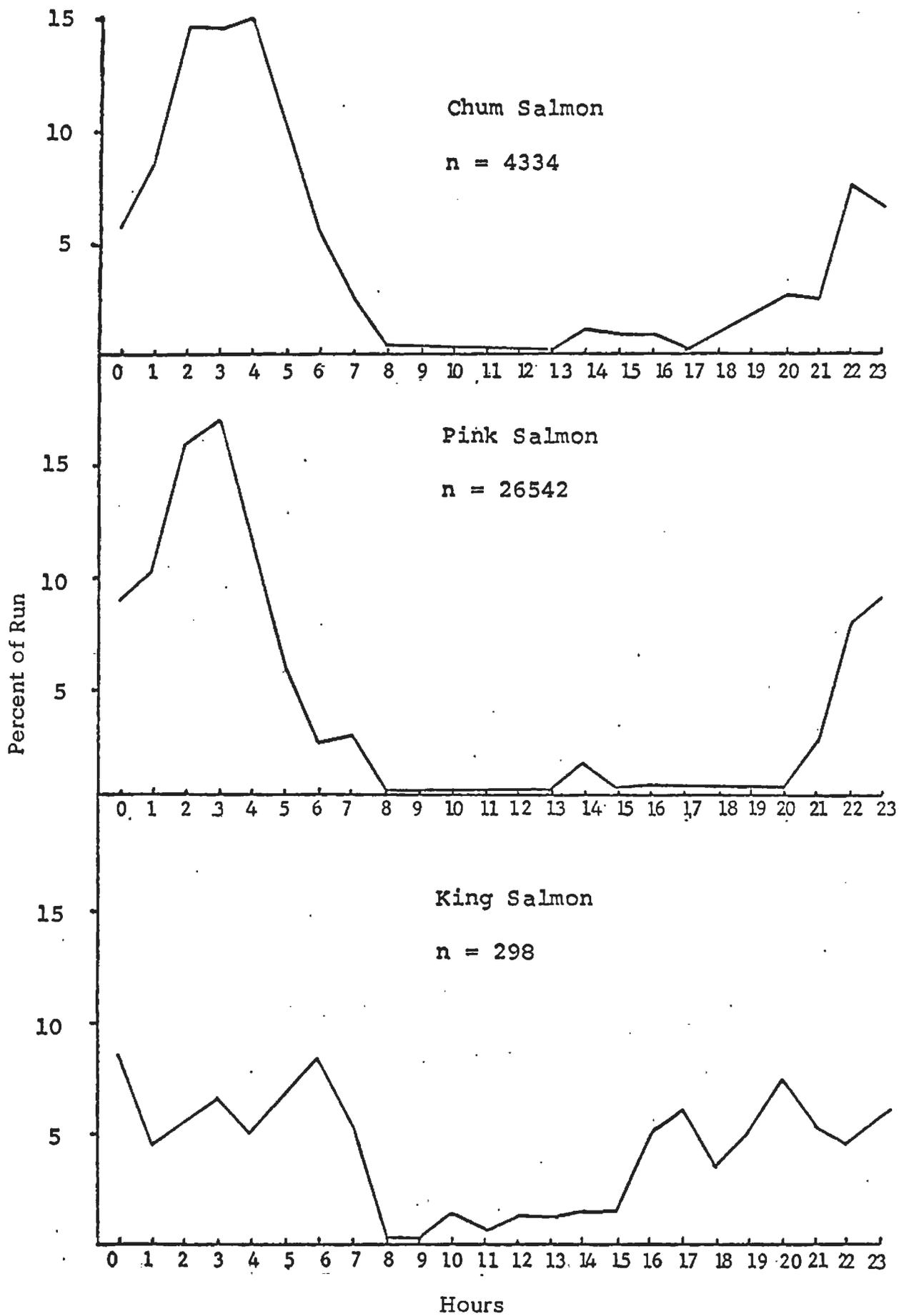


Table 6. Expanded 10-minute counts^{1/} for king, chum and pink salmon enumerated past the North River tower, 1973.

Date	<u>King</u>		<u>Chum</u>		<u>Pink</u>	
	10-min.	Expanded	10-min.	Expanded	10-min.	Expanded
6/29	0	0	0	0	0	0
6/30	0	0	0	0	0	0
7/ 1	0	0	0	0	0	0
7/ 2	2	12	0	0	0	0
7/ 3	0	0	0	0	0	0
7/ 4	3	18	1	6	5	30
7/ 5	1	6	7	42	86	516
7/ 6	1	6	1	6	43	258
7/ 7	1	6	1	6	10	60
7/ 8	0	0	0	0	39	234
7/ 9	1	6	5	30	14	84
7/10	4	24	27	162	28	168
7/11	8	48	101	606	93	558
7/12	1	6	45	270	664	3,984
7/13	0	0	10	60	580	3,480
7/14	0	0	15	90	225	1,350
7/15	1	6	141	846	530	3,180
7/16	0	0	8	48	657	3,942
7/17	6	36	55	330	63	378
7/18	4	24	26	156	112	672
7/19	8	48	67	402	172	1,032
7/20	1	6	32	192	152	912
7/21	7	42	27	162	148	948
7/22	10	60	60	360	112	672
7/23	4	24	56	336	98	588
Total	63	378	685	4,110	3,841	23,046

^{1/} Times factor of 6 for hourly count.

a percent effectiveness compared to the tower count of 89.6; 63.5 and 84.1 respectively.

King salmon passing the North River counting tower were estimated to length as follows: 19 (less than 50 centimeters), 78 (50-60 centimeters), 111 (60-80 centimeters) and 90 (greater than 80 centimeters).

Results of water analysis conducted at the North River tower site during this season is presented in Table 7. No conclusions were made on the first years sampling for water quality.

Table 7. Water analysis, by date, North River, 1973.

Date	pH	D.O.	Ttl Acidity	CO ₂	Hardness	H ₂ O-T°(F)
7/ 8	8.0	12 mg/L	0.66 gm/galCaCO ₃	10 mg/L	6gm/galCaCO ₃	42°
7/11	8.0	12 mg/L	0.60 gm/galCaCO ₃	10 mg/L	6gm/galCaCO ₃	47°
7/13	8.0	12 mg/L	0.80 gm/galCaCO ₃	10 mg/L	6gm/galCaCO ₃	48°
7/21	7.5	12 mg/L	0.60 gm/galCaCO ₃	10 mg/L	8gm/galCaCO ₃	52°
8/ 4	9.0	11 mg/L	0.60 gm/galCaCO ₃	10 mg/L	6gm/galCaCO ₃	50°

DISCUSSION

North River Counting Tower

In 1973, 10-minute tower counts were made at the beginning of each counting hour and expanded to obtain daily estimates of the salmon run. This technique was utilized to determine the validity of using 10-minute counts, as opposed to hourly counts, to estimate the salmon escapement. In 1972, the 10-minute pink salmon counts were 17 percent higher than actual counts. A Chi² (X²) test conducted of the 1973 data indicated there was no statistically significant difference between actual and 10-minute counts for chum and pink salmon. The hypothesis that the 10-minute counts were an acceptable means of estimating the king salmon run was rejected (Table 10). The 1973 expanded 10-minute counts resulted in estimates of 378 king, 23,958 pink and 4,110 chum salmon which represent 126.8%, 88.4% and 94.8%, respectively, of the actual 24-hour counts (Table 11).

Based upon four 24-hour counts obtained in 1973, the king, pink and chum salmon escapement during the non-counted 6 hours from 0800 to 1400 was 33.3%, 0.7% and 1.2% respectively, of the 24-hour total. The 24-hour count total vs. the 6-hour count totals for the four counting days are as follows:

<u>Species</u>	<u>24-hour count</u>	<u>6-hour count</u>	<u>6-hour % of total</u>
King	51	7	13.7
Pink	1,671	12	0.7
Chum	607	7	1.2

Therefore, the 18-hour count escapement estimate (less than the 4 days of 24-hour counts) was expanded by 13.7, 0.7 and 1.2 percent for king, pink and chum salmon respectively to estimate the actual escapement. The expansion is as follows:

	<u>King Salmon</u>	<u>Pink Salmon</u>	<u>Chum Salmon</u>
Estimate of 18-hour escapement	298	26,542	4,334
<u>24-hour counts</u>	<u>-7</u>	<u>-12</u>	<u>-7</u>
Adjusted escapement	291	26,530	4,327

(Cont.)

Table 10. Chi² analysis to test the hypothesis that 10-minute counts are acceptable approximations of hourly king, pink and chum salmon counts, North River tower, 1973.

H₀ = 10-minute counts (observed) are acceptable approximations of hourly (expected) counts of salmon escapement.

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected frequencies})^2}{\text{expected frequencies}}$$

King Salmon:

$$\chi^2 = \sum \frac{(o-e)^2}{e} = \frac{3348}{298} = 11.23$$

χ^2 @ 0.05 significance level = 13.1 for 23 degrees of freedom.

11.23 < 13.1, ∴ reject H₀.

Pink Salmon:

$$\chi^2 = \sum \frac{(o-e)^2}{e} = \frac{4,168,152}{26,592} = 157.04$$

χ^2 @ 0.05 significance level = 11.6 for 21 degrees of freedom.

157.04 > 11.6, ∴ accept H₀.

Chum Salmon:

$$\chi^2 = \sum \frac{(o-e)^2}{e} = \frac{362,914}{4,334} = 83.74$$

χ^2 @ the 0.05 significance level = 11.6 for 21 degrees of freedom.

83.74 > 11.6, ∴ accept H₀.

Table 11. Comparison of expanded 10-minute counts to daily counts for king, chum and pink salmon, North River tower, 1973.

Date	King Salmon		Chum Salmon		Pink Salmon	
	Daily count	Expanded 10-min. count	Daily count	Expanded 10-min. count	Daily count	Expanded 10-min. count
6/29	1	0	-	-	-	-
6/30	0	0	-	-	-	-
7/ 1	0	0	9	0	49	0
7/ 2	5	12	0	0	34	0
7/ 3	4	0	10	0	104	30
7/ 4	6	18	40	6	352	516
7/ 5	3	6	13	42	465	258
7/ 6	1	6	7	6	192	60
7/ 7	2	6	9	6	198	234
7/ 8	4	0	8	0	110	84
7/ 9	7	6	25	30	427	168
7/10	10	24	167	162	1,345	558
7/11	28	48	393	606	3,649	3,984
7/12	11	6	210	270	3,190	3,480
7/13	1	0	150	60	2,150	1,350
7/14	4	0	504	90	4,245	3,180
7/15	7	6	599	846	2,874	3,942
7/16	3	0	46	48	644	378
7/17	22	36	246	330	1,066	672
7/18	31	24	230	156	1,098	1,032
7/19	40	48	421	402	1,013	912
7/20	26	6	223	192	1,118	948
7/21	15	42	236	162	942	912
7/22	31	60	252	360	711	672
7/23	36	24	536	336	566	588
	298	378	4,334	4,110	26,542	23,468

$$\frac{378}{298} \times 100 = 126.8\%$$

$$\frac{4110}{4334} \times 100 = 94.8\%$$

$$\frac{23468}{26542} \times 100 = 88.4\%$$

	<u>King Salmon</u>	<u>Pink Salmon</u>	<u>Chum Salmon</u>
Expansion Coefficient	<u>x13.7%</u>	<u>x0.7%</u>	<u>x1.2%</u>
	40	186	52
	+291	+26,530	+4,327
Expanded estimate of escapement	331	26,716	4,379

There are indications that salmon move promptly upstream after entering the Unalakleet River mouth in 1972. There were good correlation between the commercial catches each period during July and escapements past the North River tower a few days later (Figure 10). This data indicates that the travel time between the commercial fishery and the tower was approximately 3 days for chum and 5-6 days for pink salmon.

Visual estimates of the length of king salmon passing the counting tower in 1973 were used to make estimates of the age and size composition of the run. To determine the validity of these visual estimates, comparison was made with known age and length data collected from the commercial fishery in Unalakleet. A bias may be demonstrated in analyzing the data, due to commercial fishermen using set gill nets with stretched mesh ranging from 6-1/2 - 8-1/2 inches to capture kings. This results in the capture of the larger fish. In addition, visual estimates are of total length, whereas the commercial catch samples were measured for length from mid-eye to fork of tail. Age and size composition of commercial king salmon samples taken at Unalakleet vs. visual size composition of king salmon obtained at the North River counting tower in 1973 is presented in Table 12.

There appeared to be appreciable differences between species compositions in the North River and the main Unalakleet River. For example, in 1972 the North River tower count provided a ratio of 1 chum: 24 pink salmon. Boat survey counts (live and dead fish) of the main river consisted of 1 chum: 5 pinks. Fewer pink salmon were probably recorded for the main river due to the lateness of the survey in relation to the timing of pink salmon spawning and removal of carcasses by predators.

An unknown number of salmon had migrated past the North River counting tower site prior to when counting began on July 7. Counting was delayed because of the time allowed for site selection and tower construction. The pink salmon count was probably most affected due to the earlier run timing indicated for this species.

Figure 10. Comparison of catch per unit effort (3 day period) with escapement past the North River tower, 1972.

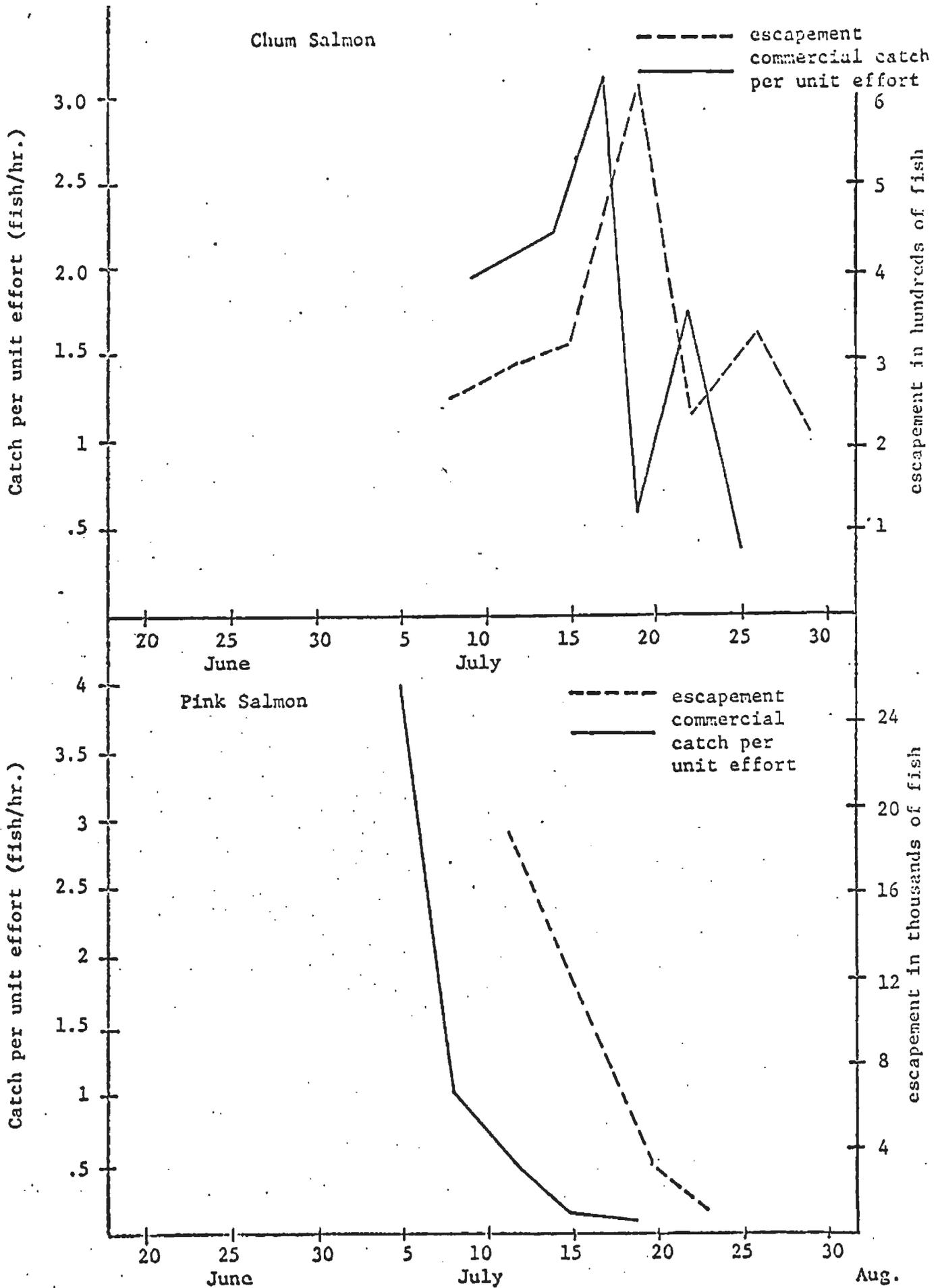


Table 12. Age and size composition of commercial king salmon samples taken at Unalakleet vs. visual size composition of king salmon obtained at the North River counting tower, 1973.

Length (cm.) ^{1/}	Age class ^{2/}	Commercial Sample		Tower Counts	
		#	%	#	%
Less than 50	3 ₂				
	4 ₂	2	100.0	19	100.0
50-60	4 ₂	1	100.0	78	100.0
	5 ₂	-	-	-	-
		<u>1</u>	<u>100.0</u>	<u>78</u>	<u>100.0</u>
60-80	5 ₂	10	56.0	62	56.0
	6 ₂	8	44.0	49	44.0
	7 ₂	-	-	-	-
		<u>18</u>	<u>100.0</u>	<u>111</u>	<u>100.0</u>
Greater than 80	5 ₂	1	3.0	2	3.0
	6 ₂	11	33.0	30	33.0
	7 ₂	21	64.0	58	64.0
	8 ₂	-	-	-	-
		<u>33</u>	<u>100.0</u>	<u>89</u>	<u>100.0</u>
		<u>Summary</u>			
	4 ₂	3	5.6	97	32.5
	5 ₂	11	20.4	64	21.5
	6 ₂	19	35.1	79	26.5
	7 ₂	<u>21</u>	<u>38.9</u>	<u>58</u>	<u>19.4</u>
		54	100.0	298	100.0

^{1/} Commercial samples measured from mid-eye to fork of tail - tower counts were estimates of total length.

^{2/} No 3₂ or 8₂ fish were in the commercial sample.

Using the actual North River tower count and Unalakleet River salmon population estimate for 1973, the North River run was 22.8%, 46.9% and 16.7% of the combined North and Unalakleet River king, pink and chum salmon run respectively.

As means of determining the total salmon run to the Unalakleet River system in 1973, the North River tower count, Unalakleet population estimate and subsistence harvest survey were summed and compared with the commercial harvest as follows:

	<u>King</u>		<u>Pink</u>		<u>Chum</u>		<u>Total</u>	
	#	%	#	%	#	%	#	%
North River tower count	298	(9.7)	26,542	(33.2)	4,334	(7.8)	21,174	(22.4)
Unalakleet River population est.	1,092	(35.7)	31,216	(39.0)	22,193	(39.4)	54,501	(39.1)
Unalakleet River subsistence harvest	<u>273</u>	<u>(8.9)</u>	<u>8,197</u>	<u>(11.1)</u>	<u>4,096</u>	<u>(7.3)</u>	<u>13,286</u>	<u>(9.5)</u>
Subtotal	1,663	(54.3)	66,675	(83.3)	30,623	(54.4)	98,961	(71.0)
Unalakleet subdistrict commercial harvest	<u>1,397</u>	<u>(45.7)</u>	<u>13,335</u>	<u>(16.7)</u>	<u>25,716</u>	<u>(45.6)</u>	<u>40,448</u>	<u>(29.0)</u>
Total	3,060	(100.0)	80,010	(100.0)	56,339	(100.0)	139,409	(100.0)

The estimate of the total run to the Unalakleet River drainage is an approximation, since there is presently no means to accurately separate those commercially caught salmon which are bound for other drainages.

SUMMARY

North River Counting Tower 1972

1. An estimated total of 561 king, 54,934 pink and 2,332 chum salmon migrated past the North River tower in 1972.
2. Pink salmon counts peaked July 7-11; chum and king counts peaked July 11-17.
3. Chum and pink salmon exhibited distinct diurnal migration patterns while king salmon did not.

North River Counting Tower 1973

1. An estimated total of 298 king, 4,334 chum and 26,542 pink salmon were enumerated past the North River tower in 1973.
2. King, chum and pink migration peaks were demonstrated during the periods July 17 to 23, July 11 to 15, and July 11 to 15 respectively.
3. Chum and pink salmon migration peaks demonstrated distinct diurnal migration patterns, while the king salmon did not. Estimates of the size of king salmon passing the tower were made. The breakdown is as follows: 19 less than 50 cm, 78 from 50 to 60 cm, 111 from 60 to 80 cm and 90 greater than 80 cm.
4. The North River king salmon escapement age composition, as a result of comparing estimated length to the age determination of the commercial catch sample was 32.5% 4₂, 21.5% 5₂, 26.5% 6₂, and 19.4% 7₂.
5. The chum salmon escapement samples indicated 33.5% were 3₁; 49.3% were 4₁, and 17.2% were 5₁, age fish.
6. Aerial surveys resulted in a peak count of 267 king, 3,644 chum and 16,590 pink salmon.
7. Carcass surveys resulted in a peak count of 9 king, 120 chum and 2,272 pink salmon.
8. Expanded 10-minute counts resulted in an estimated escapement of 378 king, 410 chum and 23,046 pink salmon.