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State of California  
The Resources Agency  
Department of Fish and Game

A KING SALMON SPAWNING ESCAPEMENT AND SPAWNING HABITAT SURVEY  
IN THE UPPER TRINITY RIVER AND ITS TRIBUTARIES, 1968 <sup>1</sup>/<sub>1</sub>

by

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SUMMARY

A king salmon Oncorhynchus tshawytscha spawning survey was conducted in 1968 on the Trinity River between its confluence with the North Fork Trinity River and Lewiston Dam. In this 40 mile section of river and five tributaries 3,763 carcasses were counted. These carcasses represent an assumed 14.7 percent recovery from an estimated population of 25,578 fish. Trinity River Hatchery handled an additional 4,772 fish for a total estimated spawning escapement of 30,350 king salmon.

Of the carcasses recovered 91.4 percent were in the 18 mile section between Lewiston Dam and Douglas City.

The carcasses examined were 38.8 percent large males, 10.5 percent small males, 48.4 percent large females, and 2.3 percent small females. Overall spawning success for males and females was 95.4 and 92.4 percent, respectively.

Of 17 major spawning riffles observed, 13 have declined in quality since 1963. The decline of 11 is attributed to the inability of the reduced flows of the Trinity River to transport sediment deposited by tributaries.

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## INTRODUCTION

In 1963, after the completion of Lewiston Dam, a king salmon spawning survey was conducted on the Trinity River (LaFauce 1968). At this time the spawning escapement was estimated at 82,000 fish with 86.4 percent of the natural spawning occurring above Douglas City. Since then, regulated flows with subsequent siltation and encroachment of aquatic plants on the spawning areas have altered the habitat. In view of these changes a second post project survey was conducted.

In order to better manage this species the following information was desired:

1. Estimate the spawning escapement.
2. Define the spawning areas utilized.
3. Composition of the spawning escapement.
4. Determine spawning success.
5. Assess condition of spawning habitat.

## METHODS

The Trinity River between Lewiston Dam and its confluence with the North Fork Trinity River, a distance of 40 miles, was divided into four sections to determine relative use by spawning king salmon (Figure 1). The divisions were the same as those used in previous surveys (Gibbs, 1956 and LaFauce, 1968). The North Fork Trinity River, Rush, Reading, Brown's and Canyon Creeks were also surveyed.

From October 15 to November 27, six survey runs were made in sections four and five, four in section six and two in section seven (Table 1). Two runs were made in Rush and Canyon Creeks, one in Brown's and Reading Creeks and three in the North Fork Trinity River.

The survey was conducted by teams of two men with one man from each team walking along each side of the river. Equipment per man consisted of a gaff, machete, measuring tape, and a water resistant tally card. The first 50 fish tallied each day by each man were measured to the nearest inch, fork length. The remaining fish were recorded by sex as larger or smaller than 23-7/8 inches (the equivalent of the minimum commercial size limit of 26 inches total length) and whether it was spent or ripe. Fish which had deteriorated beyond recognition were recorded as skeletons. After each fish was examined it was cut in half to avoid duplicating data.

Supplemental data on the relative use made of the spawning areas were obtained by an aerial reconnaissance.

Each riffle was also rated on its relative value as a spawning area. The most important riffle, the one behind the town of Lewiston, was given a value of 100 and all others were rated relative to it (LaFauce, unpublished). Riffles were rated on area and their use by salmon.

## RESULTS

The Trinity River and the five tributaries surveyed yielded 3,763 salmon carcasses (Tables 1, 2). Of these 1,580 were males, 1,624 were females, and 559 were skeletons. Percentages of recognizable carcasses recovered were as follows: 38.8 percent large males, 10.5 percent small males, 48.4 percent large females, and 2.3 percent small females.

A total of 1,040 males and 1,061 females was measured. Their mean fork lengths were 28.72 and 29.60 inches, respectively (Table 3, Figure 2).

Between Lewiston Dam and Douglas City, a distance of 18 miles, 91.4 percent of the spawning occurred. The remaining 22 miles from Douglas City to the North Fork received relatively light use, 8.0 percent. The remaining 0.6 percent occurred in the tributaries. Spawning success for females was 92.4 percent and 95.4 percent for males.

Trinity River Hatchery handled 4,772 king salmon of which approximately ten percent were judged, because of their deteriorated condition, to be spring-run fish. No attempt was made to differentiate between spring- and fall-run fish on the spawning grounds.

On November 5 an aerial redd count was made. A total of 1,738 redds were counted between Lewiston Dam and the North Fork (Table 4). Of these 1,229 were counted in sections four and five and 509 in sections six and seven.

Seventeen spawning riffles in the first 19 miles below Lewiston Dam were rated and compared with the values assigned by LaFauce in 1963 and 1967 (Table 6). Every riffle except the one directly below Trinity River Hatchery, Lewiston Riffle, and Hunt's Riffle has declined in relative quality since 1963. The method used is admittedly subjective but does give an indication of changes in the habitat.

## DISCUSSION

Carcass recoveries in 1968 are assumed to be as efficient as those of Gibbs (1956) when a 14.7 percent recovery of tagged fish was made on the spawning grounds. Using this criterion, the 3,763 carcasses recovered in 1968 represent 25,578 fish. An additional 4,772 fish were handled at Trinity River Hatchery for a total estimated spawning population of 30,350 king salmon.

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In 1968 over 34 percent of the spawning was in the two miles of stream between Lewiston Dam and Old Lewiston Bridge as compared with 20.8 percent in 1963. The relative increase in the use of this area may be due to the fish passing up degraded riffles downstream or to their unwillingness to enter the hatchery or they may simply find this area more suitable for spawning. Superimposition of rodds in this area was common.

In 1963, the number of small males entering the hatchery was proportionally greater than in the total population. This also occurred again in 1968 (Table 5). Of all recognizable carcasses recovered, 10.5 percent were small males. In section four, directly below the hatchery, the proportion was 6.1 percent. The proportion entering the hatchery, however, was 18.3 percent. In the areas of high spawning density, the larger males may be chasing the small males to such an extent that the latter move on and go upstream and into the hatchery.

The male to female ratios in 1963 and 1968 were similar, 1.08:1 and 0.97:1 respectively. These ratios are quite different from that of 1955 which was 1.43:1.

The overall spawning success of all males and all females was 95.4 and 92.4 percent respectively, a nonsignificant difference. Small males were noticeably less successful. Only 86.3 percent had spawned compared with 97.9 percent of the large males. A chi square test indicated this to be a significant difference. A similar occurrence was noted for females in 1963 (LaFauce, 1965).

Spawning riffles which have become inundated and weed choked since 1963 are directly above tributaries. Sand and gravel is deposited at the mouths of the tributaries and is forming deltas and partially damming the river. This has occurred at Rush, Grass Valley, and Weaver Creeks. The Weaver Creek Delta has also caused the loss of the Douglas City riffle by covering the riffle with a deep layer of exposed gravel, and thus restricting the flow of the Trinity River and causing an increase in velocity and depth at the site of the riffle.

Another and perhaps more obvious case of riffle degradation is deposition of sand directly upon the riffles. This is occurring on at least several spawning riffles below Grass Valley Creek.

The general degradation of the spawning habitat is a result of the reduced, regulated flow of the Trinity River. Its bedload transport capability has been reduced from an estimated annual capability of 202,000 to 10,000 cubic yards (California, 1970).

An estimated 28 percent of the total spawning area between Lewiston and Douglas City has been lost due to sand deposition from Grass Valley Creek (California, 1970).

Encroachment of aquatic plants on spawning riffles appears to be the result of regulated flows and siltation and is thus a secondary cause of riffle degradation, although once established aquatic plants become effective silt and sand traps. Roots of willows and alders were also observed, even on the three good riffles, extending into the salmon redds nearest the shore.

Apparently because of a lack of other suitable spawning riffles, those remaining in good condition are being overused. This is particularly true for Lewiston Riffle where nearly all redds are superimposed. It has been observed that when the spawning area is inadequate for the number of spawners using it, a reduction in population follows (Washington, 1935).

REFERENCES

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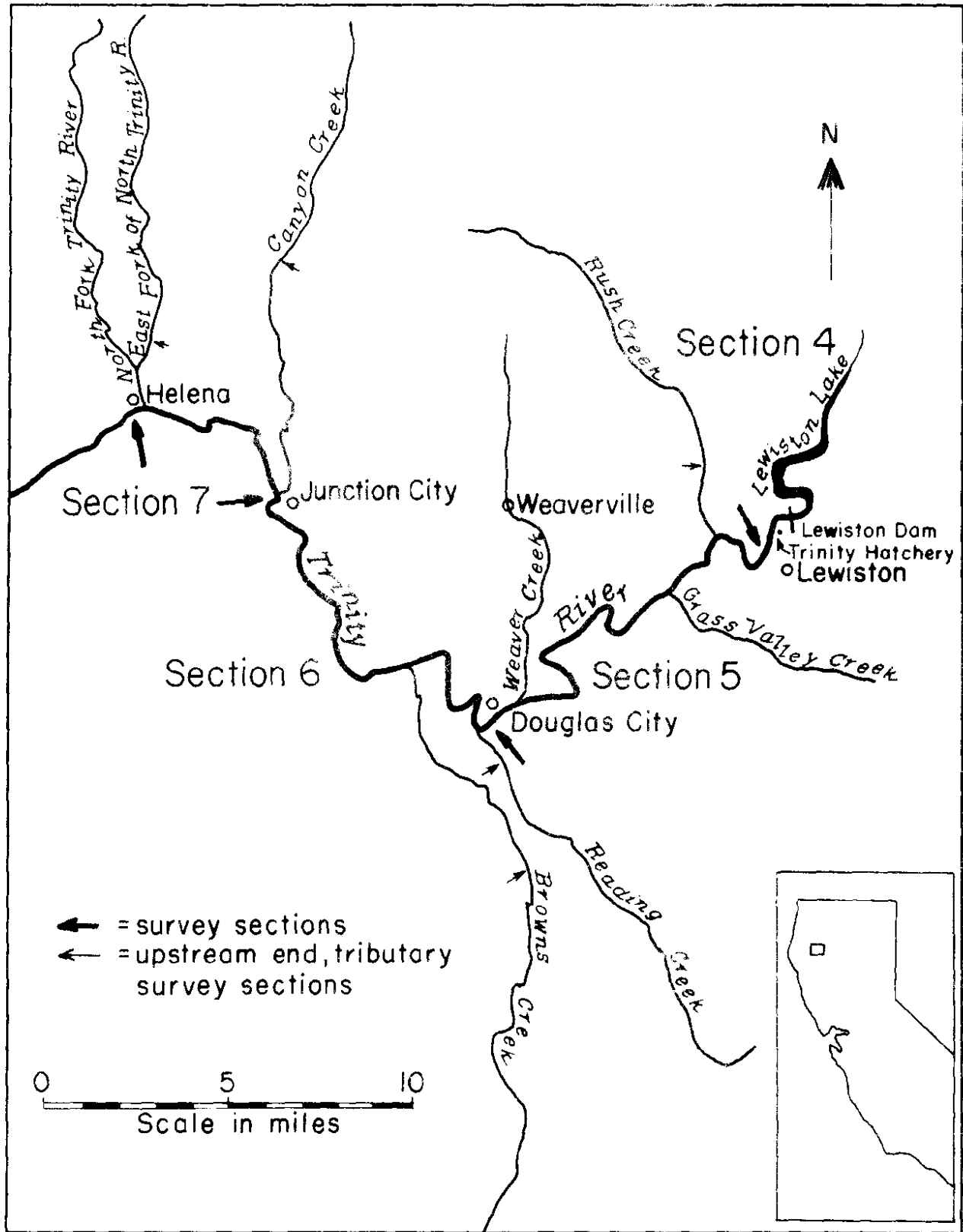


Figure 1. Map showing sections of Trinity River and tributaries surveyed.

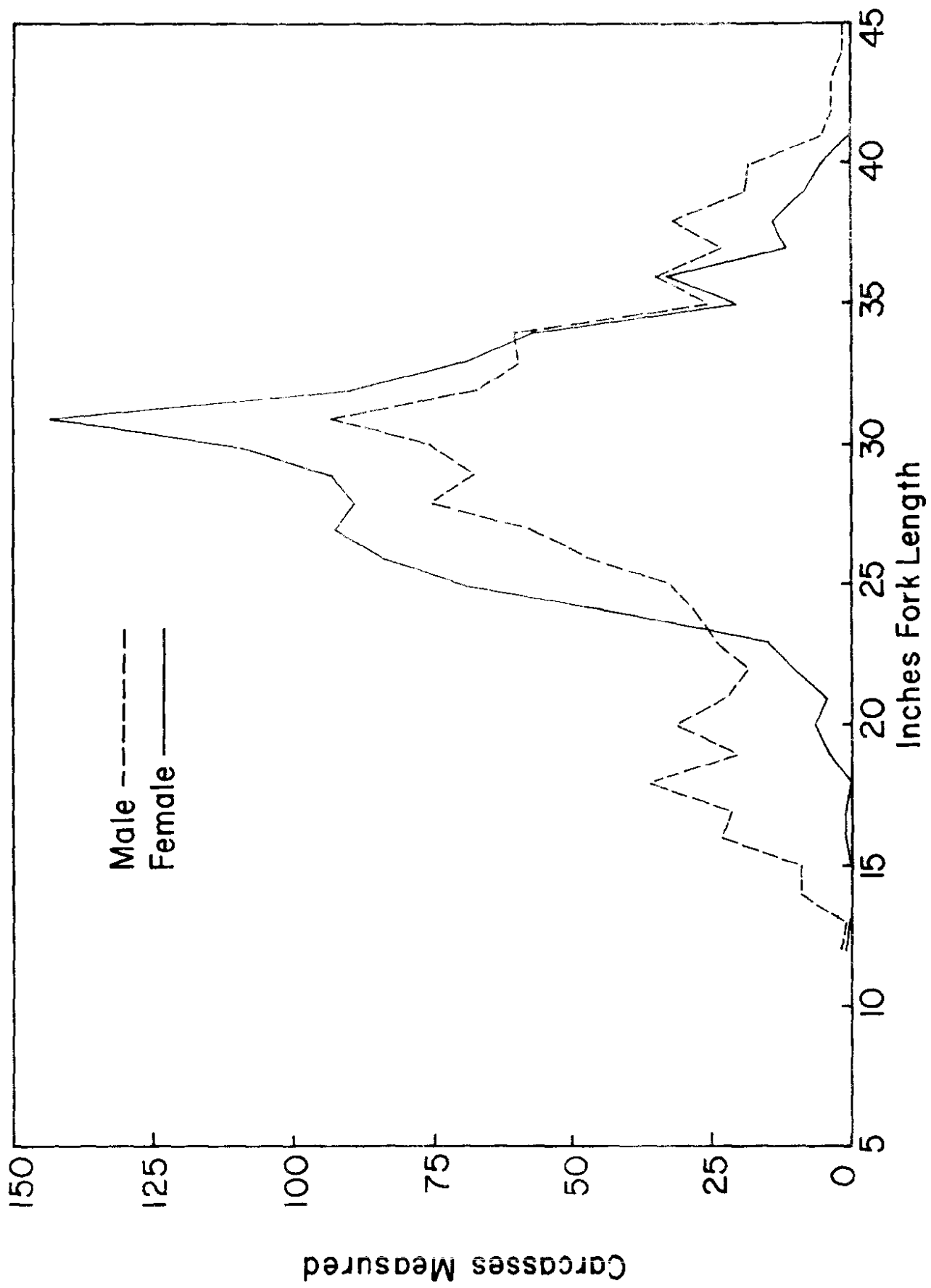


Figure 2. Length frequencies of king salmon recovered during the 1968 spawning season in the Trinity River.



TABLE 1

NUMBER OF SALMON CARCASSES EXAMINED ON THE UPPER TRINITY RIVER AND ITS TRIBUTARIES, 1968

AREA	SECTION	DISTANCE		TIME PERIOD	MALES	FEMALES	SKELETONS	TOTALS
		in MILES						
LEWISTON DAM TO OLD LEWISTON BRIDGE	4 <sup>1/</sup> <sub>6</sub> S <sub>0</sub>	2		Oct. 15 to Nov. 21	489	684	117	1290
LEWISTON BRIDGE TO DOUGLAS CITY BRIDGE	5 6 S <sub>0</sub>	16		Oct. 15 to Nov. 29	959	828	363	2150
DOUGLAS CITY BRIDGE TO CANYON CREEK	6 <sup>4</sup> <sub>4</sub> S <sub>0</sub>	15		Oct. 18 to Nov. 29	110	95	56	261
CANYON CREEK TO TRINITY RIVER NORTH FORK	7 2 S <sub>0</sub>	7		Oct. 21 to Oct. 28	13	11	17	41
	Rush Creek	2		Oct. 15	0	0	0	0
	Reading Creek	1		Oct. 29	0	0	0	0
	Brown's Creek	8		Oct. 22	0	0	1	1
	Canyon Creek	8		Oct. 29 and Nov. 25	8	6	2	16
	North Fork	2		Oct. 21,28 and Nov. 25	1	0	3	4
TOTALS		61			1580	1624	559	3763

<sup>1/</sup> River sections are the same as used in 1963.

TABLE 2

## KING SALMON CARCASSES MEASURED AND EXAMINED FOR SPAWNING SUCCESS, TRINITY RIVER, 1968

Sex	Size	<u>River Sections</u>				Rush Creek	Reading Creek	Brown's Creek	Canyon Creek	North Fork	TOTALS	Percent	
		4	5	6	7								
Male	Over 23-7/8 inches spent	411	722	74	7	0	0	0	3	1	1218	38.8	
		6	16	0	4	0	0	0	0	0	26		
	Under 23-7/8 inches spent	62	195	30	0	0	0	0	3	0	290	10.5	
		10	26	6	2	0	0	0	2	0	46		
	TOTAL MALE		489	959	110	13	0	0	0	8	1	1580	
	Female	Over 23-7/8 inches spent	607	726	86	9	0	0	0	5	0	1433 )	48.4
49			61	6	2	0	0	0	0	0	118 )		
Under 23-7/8 inches spent		23	40	3	0	0	0	0	1	0	67 )	2.3	
		5	1	0	0	0	0	0	0	0	6 )		
TOTAL FEMALE		684	828	95	11	0	0	0	6	0	1624		
Total, Sex Determined		1173	1787	205	24	0	0	0	14	1	3204	100.0	
Skeletons		117	363	56	17	0	0	1	2	3	559		
GRAND TOTALS		1290	2150	261	41	0	1	16	4	4	376		

TABLE 3

## LENGTH FREQUENCIES OF KING SALMON CARCASSES EXAMINED.

UPPER TRINITY RIVER AND ITS TRIBUTARIES, 1968

Fork Length In Inches	Frequency		Total
	Males	Females	
12	2	1	3
13	1	0	1
14	9	0	9
15	9	0	9
16	23	1	24
17	21	1	22
18	36	0	36
19	20	4	24
20	31	6	37
21	22	4	26
22	18	10	28
23	24	15	39
24	27	39	66
25	32	68	100
26	47	83	130
27	57	92	149
28	75	88	163
29	67	93	160
30	75	108	183
31	93	143	236
32	67	89	156
33	59	69	128
34	60	57	117
35	25	20	45
36	35	33	68
37	23	11	34
38	32	14	46
39	19	7	26
40	18	5	23
41	5	0	5
42	3	0	3
43	3	0	3
44	1	0	1
45	1	0	1
Totals	1,040	1,061	2,101
Mean Lengths	28.66	29.56	29

TABLE 4

COMPARISON OF AERIAL REDD COUNT WITH CARCASSES RECOVERED,  
TRINITY RIVER, 1968

River Section	Aerial Count		Carcass Recovery	
	Redds	Percent	Carcasses	Percent
4	320	18.4	1,290	34.5
5	909	52.3	2,150	57.4
6	466	26.8	261	7.0
7	43	2.5	41	1.1
Totals	1,738	100.0	3,742	100.0

TABLE 5

## KING SALMON SPAWNING POPULATION STRUCTURE, UPPER TRINITY RIVER, 1968

	Total		Section 4		Trinity River Hatchery	
	Carcass Recovery Number	Percent	Number	Percent	Number	Percent
Large Males	1,244	38.8	417	35.5	2,102	44.0
Small Males	336	10.5	72	6.1	873	18.3
Females <sup>1/</sup>	1,624	50.7	684	58.3	1,797	37.6
Total	3,204	100.0	1,173	99.9	4,772	99.9

<sup>1/</sup> Trinity River Hatchery does not keep separate records of large and small females, so all females are grouped together.

TABLE 3

RELATIVE VALUES AND CAUSE OF DEGRADATION, TRINITY RIVER RIFFLES

RIFFLE <sup>1/</sup>	Rating			Cause of Degradation
	1963	1967	1968	
Hatchery	25	25	25	Aquatic plants
Lewiston	100	100	100	Aquatic plants
Rush Creek	25	15	1	Inundated
Grass Valley Creek	75	15	10	Inundated-Siltation Aquatic plants
Neo Stott's	25	5	1	Siltation
Below Neo Stott's	15	25 <sup>2/</sup>	20	Siltation
Above End of Steel Bridge Road	15	15	10	Siltation
End of Steel Bridge Road	25	15	15	Siltation
Above Badel Hole <sup>2/</sup>	15	-	5	Siltation
Above Johnson Hole <sup>2/</sup>	15	-	10	Siltation
Above Floyd Jackson <sup>3/</sup>	15	-	0	Siltation-Compaction Aquatic Plants
Indian Creek	15	15	5	Unknown
Hunt's	25	75	50	Aquatic Plants
First Riffle Below Hunt's <sup>4/</sup>	-	25	15	Unknown
Second Riffle below Hunts <sup>4/</sup>	-	25	5	Inundation
Douglas City	25	5	0	Extreme Velocity
Above Reading Creek <sup>3/</sup>	15	-	1	Unknown

<sup>1/</sup> Listed in order going downstream.

<sup>2/</sup> Minor stream changes made in this area increased water velocity and improved riffle.

<sup>3/</sup> These riffles were not observed in 1967.

<sup>4/</sup> These riffles were relatively unimportant in 1963.