

**CALIFORNIA DEPARTMENT OF FISH AND GAME
ENVIRONMENTAL SERVICES DIVISION
STREAM EVALUATION PROGRAM**

**CENTRAL VALLEY ANADROMOUS FISH-HABITAT
EVALUATIONS**

October 1996 through September 1997

**Annual Progress Report
Prepared for
U.S. Fish and Wildlife Service
Central Valley Anadromous Fish Restoration Program**

January 1998

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Funded by the U.S. Fish and Wildlife Service pursuant to the CENTRAL VALLEY PROJECT IMPROVEMENT
ACT to improve anadromous fish habitat in California's Central Valley streams

UPPER SACRAMENTO RIVER EMIGRATION MONITORING

The purpose of this activity is to determine the timing and relative abundance of salmon and rainbow trout (potentially steelhead) emigration relative to precedent conditions of spawning and rearing in the upper natal stream. The results provided in this report are for the period from 1 October 1996 (week 40) through 15 September 1997 (week 38).

Emigrating juvenile salmonids were monitored at sites located near Balls Ferry Bridge (RM 278) and at Deschutes Road Bridge (RM 281). Sampling was conducted using two rotary screw traps at RM 278 and one at RM 281. The upstream trap was first used on 15 March 1997. It was typically fished 2 days/week primarily to determine the efficiency of the downstream traps using a mark-and-recapture approach. No traps were fished from 29 December 1996 to 5 February 1997 due to the very high flow conditions. Sampling ceased on 15 September 1997 due to an unpredicted, large number of winter-run chinook salmon fry which resulted in our achieving the take allotted per our Section 10 research permit earlier than expected.

The traps at RM 278 were normally fished 24 h/day for 7 days/week. Beginning 18 May through 3 July, however, large amounts of algae started to collect on the traps requiring them to be frequently cleaned while they were fishing. In response to this problem, we stratified our sampling to represent a 24 h/day, 7 days/week effort. During these weeks, the traps were fished in 10 hour shifts: either 0130 to 1130 h (dawn shift) or 1400 to 2400 h (dusk shift). Each shift was rotated every 4 days. During each shift, the traps were checked and cleaned each hour. When algae build-up subsided, we resumed fishing the traps 24 h/day, 7 days/week.

Data recorded each time the screw traps were checked included the number of hours fished and the number of juvenile salmonids collected by species and race. (Race for chinook salmon was determined using the length-at-time criteria developed by Frank Fisher of the DFG). All salmon identified as winter run, spring run, and late-fall run were measured and weighed (FL in mm and weight in g). All juvenile rainbow trout were measured. Up to 300 fall-run-sized salmon were randomly selected per trap up to twice daily, then measured and weighed.

Trap efficiency was evaluated using a mark-and-recapture approach. Typically, all captured salmon, except winter-run-sized salmon, were marked and released. Fish captured and marked at the Balls Ferry were transported upstream about 2,500 feet and released. Those marked at Deschutes Road Bridge were released at that site. During the efficiency test, all fish measured at Balls Ferry were checked for marks. Fish were marked using dyes, either by bathing them in Bismark brown (at Balls Ferry) or injecting them with Alcian blue (at Deschutes Road).

Emigration Results

Chinook Salmon

Juvenile salmon were collected every week sampled (Table 10; Figure 42). Mean weekly size ranged from 36.0 mm FL (week 51) to 82.1 mm FL (week 44) (Figure 43). Recently emerged-sized fish (< 35 mm FL) were collected every week that samples were collected except weeks 43 and 44. Larger smolt-sized fish (≥ 70 mm FL) were caught every week except weeks 1 and 38 (Appendix II; Figures 1-12).

Catch rates ranged from 0.15 fish/h (week 20) to 36.04 fish/h (week 9) (Table 10; Figure 42). Weekly mean catch rates were highest during February when fall-run salmon were emigrating and lowest during May, June, July, October, and November. Trap effectiveness, thus catch rates, were likely affected by the large amounts of algae collected on the trap cones during the spring and fall. Trapping efficiency, as measured by the recovery of dye-marked fish, was highest during December 1996 and March 1997 (Table 11).

A combined total of 70,717 chinook salmon was caught by all three rotary screw traps. Peak salmon catches occurred during weeks 8-13 when fall run dominated the catch (Table 10; Figure 43). We caught 1,441 spring-run sized salmon; 54,405 fall-run sized salmon; 3,504 late-fall-run sized salmon; and 11,367 winter-run sized salmon. The spring-run catch peaked in December 1996 (Figure 44). Fall run were caught throughout the year with the peak catch occurring from mid-February 1997 to early March 1997. The late-fall-run catch peaked in June 1997. The peak of the winter run was appeared to be occurring in mid-September 1997 when rotary screw trap sampling was terminated.

Spring-run sized salmon ranged from 25 to 137 mm FL (Figure 45). Fall run ranged from 28 to 160 mm FL; late-fall run ranged from 26 to 254 mm FL; and winter run ranged from 22 to 169 mm FL. Smolt-sized spring run were observed from February 1997 to early June 1997. Smolt-sized fall run were observed from late March 1997 until mid-September 1997. Smolt-sized late-fall run were observed from October through December 1996 and from July to mid-September 1997. Smolt-sized winter run were observed from November 1996 until early May 1997.

Rainbow Trout

Rainbow trout (potentially steelhead) were collected in all but three weeks of the survey (Table 11; Figure 46). Mean weekly size ranged from 32.3 mm FL (week 28) to 134.9 mm FL (week 14). Total catch ranged from 0 (weeks 1, 20, and 38) to 118 (week 31). Catch rate ranged from 0.0 fish/h (weeks 1, 20, and 38) to 0.5 fish/h (week 40) (Figure 47).

Table 10. Summary of chinook salmon catch statistics, upper Sacramento River emigration survey using rotary screw traps, 01 October 1996 - 15 September 1997.

Week	Start Date	Weekly Catch	Catch/h	Size Statistics (FL in mm)			
				Mean	Minimum	Maximum	SD
40	01 Oct	332	5.68	38.3	22	118	15.7
41	06 Oct	113	1.31	44.3	32	140	22.9
42	13 Oct	44	0.80	50.0	30	124	24.4
43	20 Oct	15	0.20	72.9	44	105	20.5
44	27 Oct	41	0.49	82.1	44	135	26.0
45	03 Nov	47	0.26	74.8	25	160	26.2
46	10 Nov	38	0.21	66.3	30	133	29.0
47	17 Nov	41	0.40	69.5	28	115	23.8
48	24 Nov	321	1.60	59.6	29	140	23.7
49	01 Dec	761	2.92	40.4	29	146	17.5
50	08 Dec	234	3.08	36.3	29	123	9.2
51	15 Dec	2,344	7.74	36.0	28	137	8.4
52	22 Dec	2,052	16.82	36.4	30	131	5.9
1	29 Dec	82	10.25	35.9	29	42	2.2
No sampling Weeks 2-5							
6	02 Feb	1,049	10.68	37.6	30	124	8.2
7	09 Feb	2,589	19.95	38.1	29	134	10.9
8	16 Feb	8,699	33.98	37.4	30	130	6.7
9	23 Feb	12,098	36.04	38.9	29	134	12.8
10	02 Mar	6,080	18.10	39.0	30	147	11.8
11	09 Mar	4,826	14.46	38.6	30	160	10.5
12	16 Mar	2,589	8.59	37.8	30	159	7.9
13	23 Mar	4,641	12.06	39.2	29	169	13.3
14	30 Mar	3,594	11.49	40.8	30	203	16.8
15	06 Apr	2,020	5.82	44.3	32	254	21.9

Table 10. (cont.)

Week	Start Date	Weekly Catch	Catch/h	Size Statistics (FL in mm)			
				Mean	Minimum	Maximum	SD
16	13 Apr	543	1.73	60.4	28	150	27.6
17	20 Apr	243	1.19	65.5	31	145	23.1
18	27 Apr	418	1.49	63.3	30	110	16.0
19	04 May	334	1.22	68.7	33	139	13.3
20	11 May	26	0.15	65.8	26	88	6.3
21	18 May	270	2.10	70.5	32	115	20.9
22	25 May	170	0.33	69.0	33	113	22.2
23	01 Jun	508	2.59	50.9	26	137	22.3
24	08 Jun	319	2.11	54.0	32	104	22.6
25	15 Jun	460	2.53	51.1	31	106	22.7
26	22 Jun	436	2.54	46.5	33	103	18.1
27	29 Jun	102	0.94	54.2	26	100	21.6
28	06 Jul	440	1.15	42.3	29	105	13.6
29	13 Jul	742	2.33	41.6	29	122	13.6
30	20 Jul	923	2.88	43.8	31	113	15.0
31	27 Jul	966	2.93	45.0	22	113	17.0
32	03 Aug	1,020	3.05	42.8	30	108	15.6
33	10 Aug	863	3.60	42.6	30	119	16.1
34	17 Aug	1,050	6.27	41.6	30	99	14.1
35	24 Aug	967	5.82	37.0	31	89	7.2
36	31 Aug	1,767	14.14	37.3	30	110	8.1
37	07 Sep	3,498	20.82	36.9	31	107	7.6
38	14 Sep	2	0.36	36.5	36	37	0.5
Total		70,717	7.50	41.7	22	254	15.8

Table 11. Results of rotary screw trap efficiency evaluations conducted with marked chinook salmon during the upper Sacramento River emigration survey, 01 October, 1996 - 15 September, 1997.

Week	Number marked	Number recaptured	Efficiency (%)
40	289	3	1.03
41	99	0	-
42	51	0	-
43	0	0	-
44	0	0	-
45	8	0	-
46	20	0	-
47	8	0	-
48	201	1	0.50
49	326	7	2.15
50	74	1	4.25
51	1,551	40	2.58
52	430	18	4.19
1	0	0	-
No sampling Weeks 2-5			
6	938	0	-
7	1,166	3	0.26
8	6,145	20	0.33
9	10,426	217	2.08
10	4,961	129	2.60
11	2,524	130	5.15
12	2,097	23	1.10
13	2,235	56	2.51
14	2,915	51	1.75
15	1,237	37	2.99
16	383	6	1.57

Table 11. (cont.)

Week	Number marked	Number recaptured	Efficiency (%)
17	139	1	0.72
18	273	3	1.10
19	117	1	0.85
20	2	0	-
21	0	0	-
22	0	0	-
23	235	6	2.55
24	235	6	2.55
25	376	7	1.86
26	367	2	0.54
27	34	1	2.94
28	320	5	1.56
29	398	5	1.26
30	300	1	0.33
31	238	4	1.68
32	142	2	1.41
33	142	3	2.11
34	113	3	2.65
35	10	0	-
36	10	0	-
37	24	0	-
38	0	0	-
Total	41,559	792	1.91

Table 12. Summary of rainbow trout catch statistics, upper Sacramento River emigration survey using rotary screw traps, 01 October, 1996 - 15 September, 1997.

Week	Start Date	Weekly Catch	Catch/h	Size Statistics (FL in mm)			
				Mean	Minimum	Maximum	SD
40	01 Oct	37	0.53	71.1	48	110	13.5
41	06 Oct	6	0.07	74.0	58	89	11.7
42	13 Oct	9	0.16	82.1	55	150	25.4
43	20 Oct	3	0.04	96.7	70	115	19.3
44	27 Oct	10	0.12	89.5	74	150	21.5
45	03 Nov	4	0.02	80.3	75	86	5.3
46	10 Nov	4	0.02	71.5	58	85	9.9
47	17 Nov	16	0.06	93.8	57	120	23.8
48	24 Nov	25	0.12	98.2	79	170	17.9
49	01 Dec	9	0.03	82.1	69	103	9.7
50	08 Dec	1	0.01	95.0	95	95	0
51	15 Dec	6	0.02	103.5	76	178	35.4
52	22 Dec	1	0.01	95.0	95	95	0
1	29 Dec	0	0	-	-	-	-
No sampling Weeks 2-5							
6	02 Feb	6	0.06	58.3	19	160	53.4
7	09 Feb	9	0.07	77.9	24	150	41.2
8	16 Feb	28	0.11	89.2	46	140	20.4
9	23 Feb	39	0.12	100.1	25	200	33.8
10	02 mar	16	0.05	73.5	25	115	35.7
11	09 Mar	13	0.04	77.5	23	200	59.9
12	16 Mar	9	0.03	91.8	27	140	30.1
13	23 Mar	8	0.02	130.7	72	197	41.5
14	30 Mar	17	0.06	134.9	26	290	76.0
15	06 Apr	12	0.03	112.8	45	200	44.6

Table 12. (cont.)

Week	Start Date	Weekly Catch	Catch/h	Size Statistics (FL in mm)			
				Mean	Minimum	Maximum	SD
16	13 Apr	10	0.03	61.8	21	190	50.0
17	20 Apr	15	0.07	40.5	24	84	20.4
18	27 Apr	35	0.12	47.4	24	160	25.4
19	04 May	26	0.09	46.8	25	76	14.4
20	11 May	0	0	-	-	-	-
21	18 May	1	0.01	75.0	75	75	0
22	25 May	4	0.07	60.8	48	77	10.4
23	01 Jun	9	0.05	59.6	35	84	16.8
24	08 Jun	8	0.05	66.0	27	206	55.3
25	15 Jun	19	0.10	44.2	23	74	14.4
26	22 Jun	12	0.07	48.7	25	170	38.4
27	29 Jun	7	0.06	57.7	27	89	19.1
28	06 Jul	98	0.26	32.3	23	90	11.8
29	13 Jul	82	0.26	32.4	22	75	11.5
30	20 Jul	81	0.25	31.2	22	66	9.3
31	27 Jul	118	0.36	43.2	20	236	27.6
32	03 Aug	89	0.27	38.7	21	92	16.1
33	10 Aug	63	0.26	47.2	20	97	16.0
34	17 Aug	41	0.24	56.4	24	96	14.6
35	24 Aug	13	0.08	53.2	40	95	13.8
36	31 Aug	16	0.13	56.6	42	78	9.6
37	07 Sep	37	0.22	55.4	32	95	13.6
38	14 Sep	0	0	-	-	-	-
Total		1,072	0.11	54.7	19	290	34.0

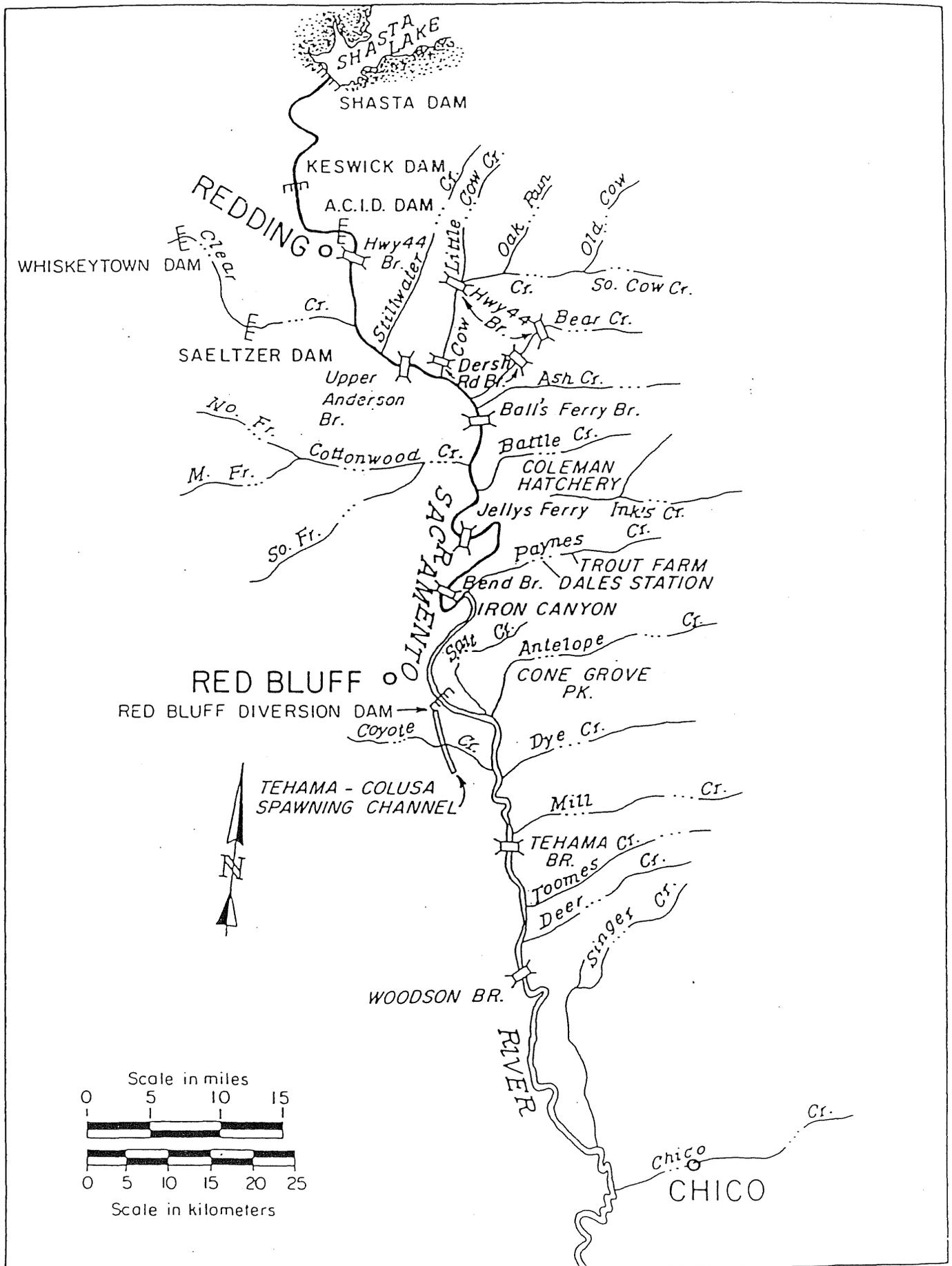


Figure 1. Upper Sacramento River

Upper Sacramento River rotary screw trap, 1996-1997

Effort and chinook salmon catch per hour

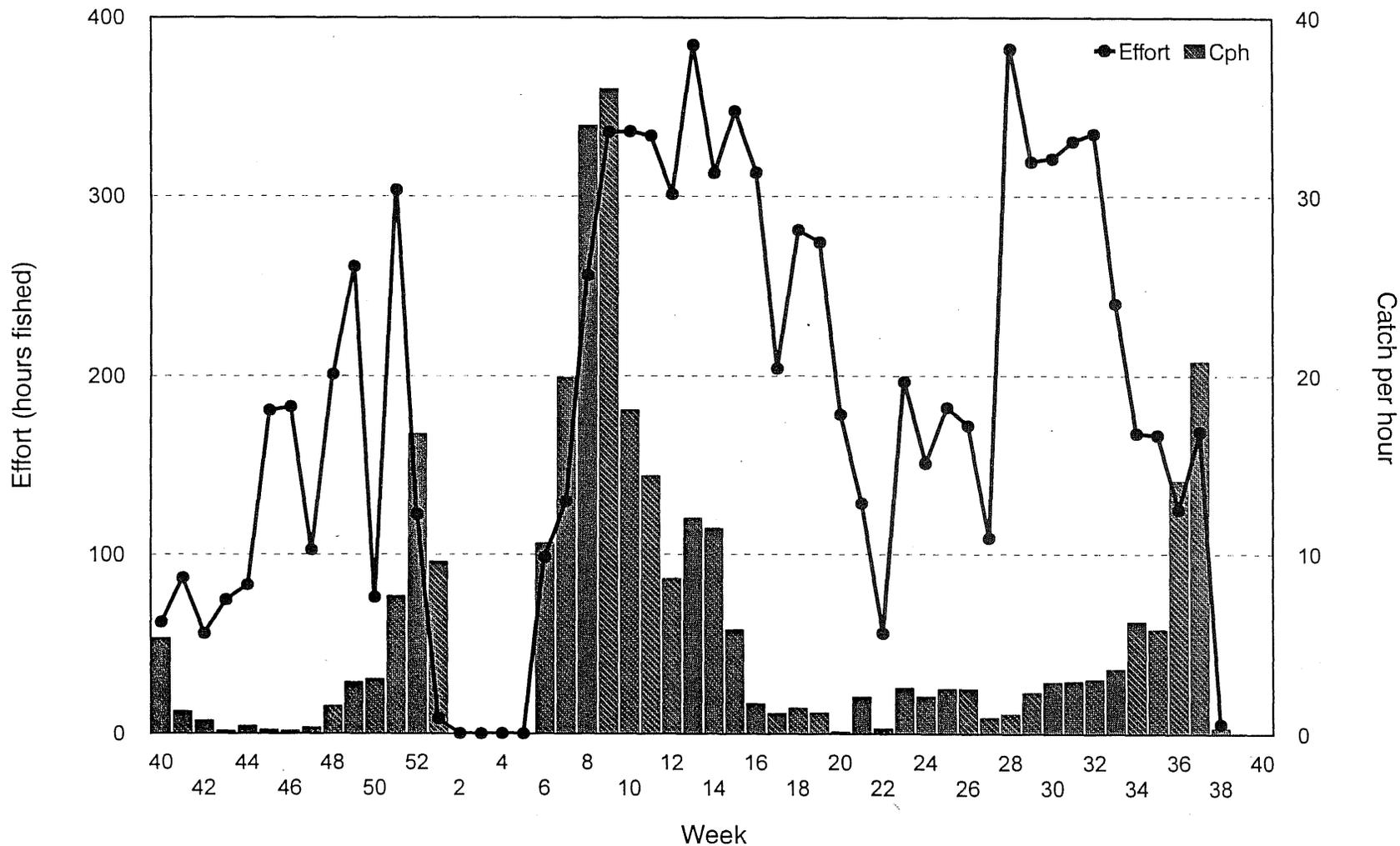


Figure 42. Weekly catch per hour of chinook salmon and hours fished by rotary screw trap in the upper Sacramento River, 01 October 1996 - 15 September 1997.

Upper Sacramento River rotary screw trap, 1996-1997

Chinook salmon size statistics and weekly catch

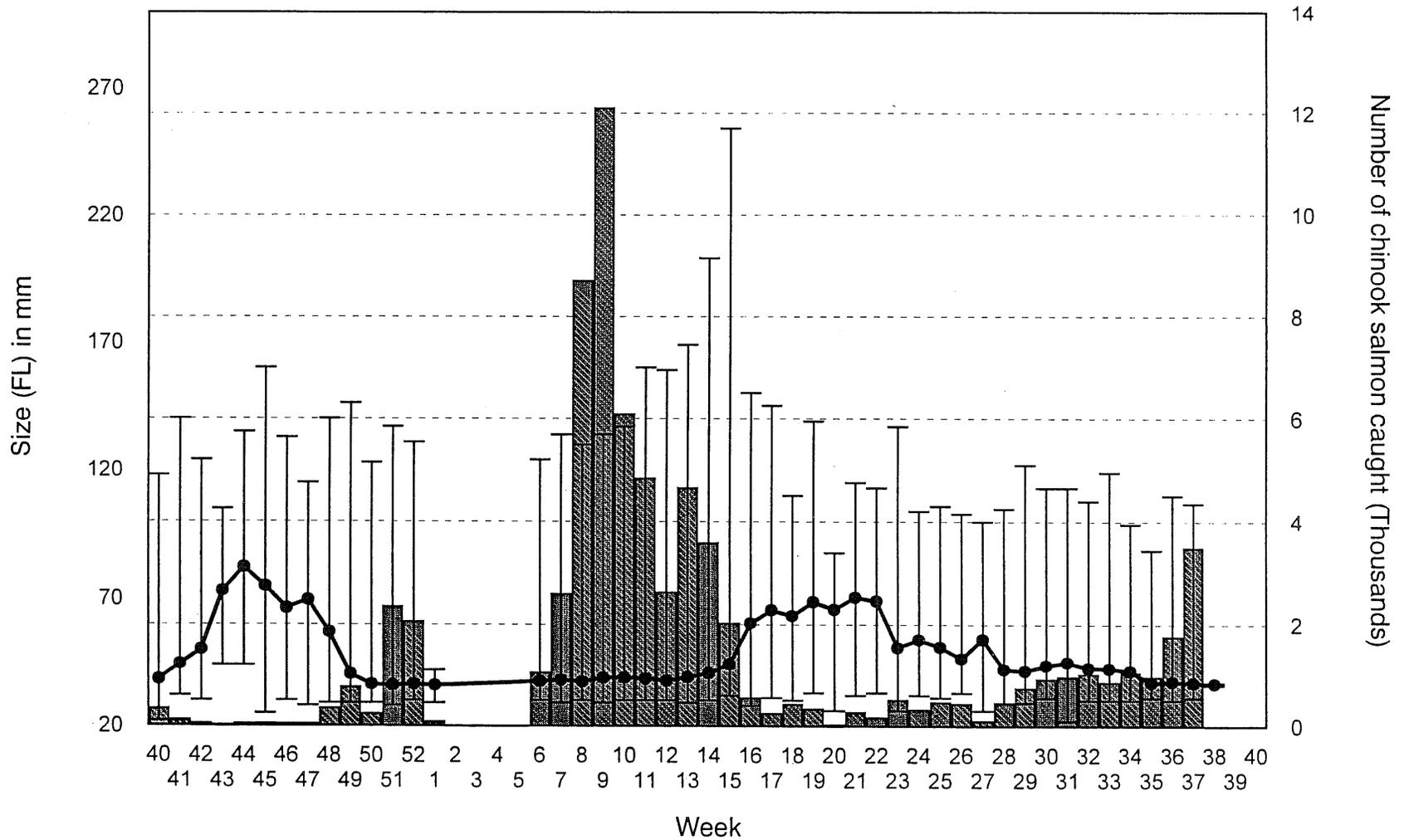


Figure 43. Chinook salmon mean forklengh (minimum and maximum) and total caught by rotary screw trap on a weekly basis in the upper Sacramento River, October 1996 - September 1997.

Upper Sacramento River rotary screw trap survey Chinook salmon catch distribution by race

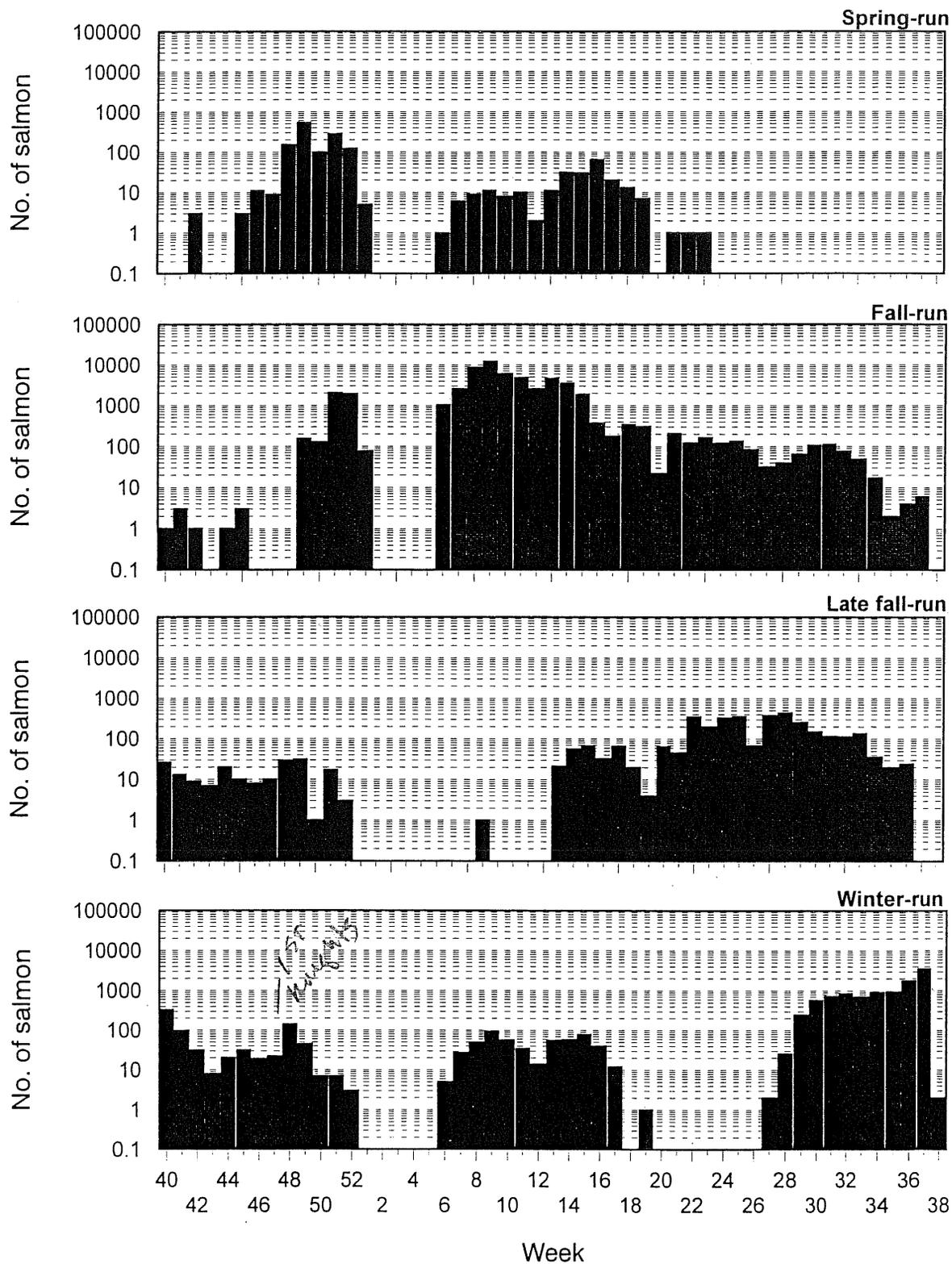


Figure 44. Catch distribution of chinook salmon races collected by rotary screw trap in the upper Sacramento River, 01 October - 15 September 1997.

Upper Sacramento River rotary screw trap survey Chinook salmon catch distribution by race

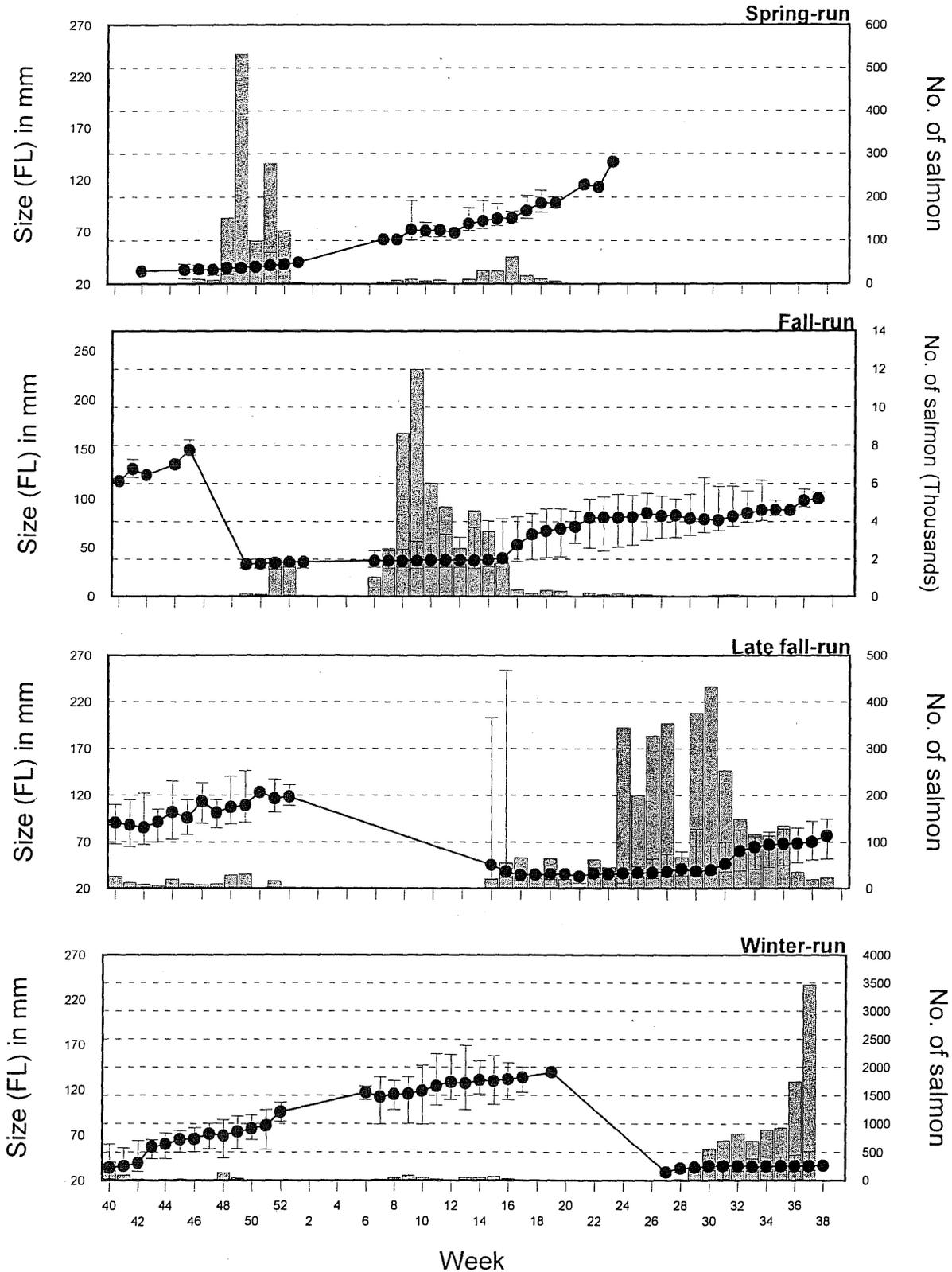


Figure 45. Weekly catch and size statistics for the four races of chinook salmon collected by rotary screw trap in the upper Sacramento River, 01 October - 15 September 1997.

Upper Sacramento River rotary screw trap, 1996-1997

Rainbow trout size statistics and weekly catch

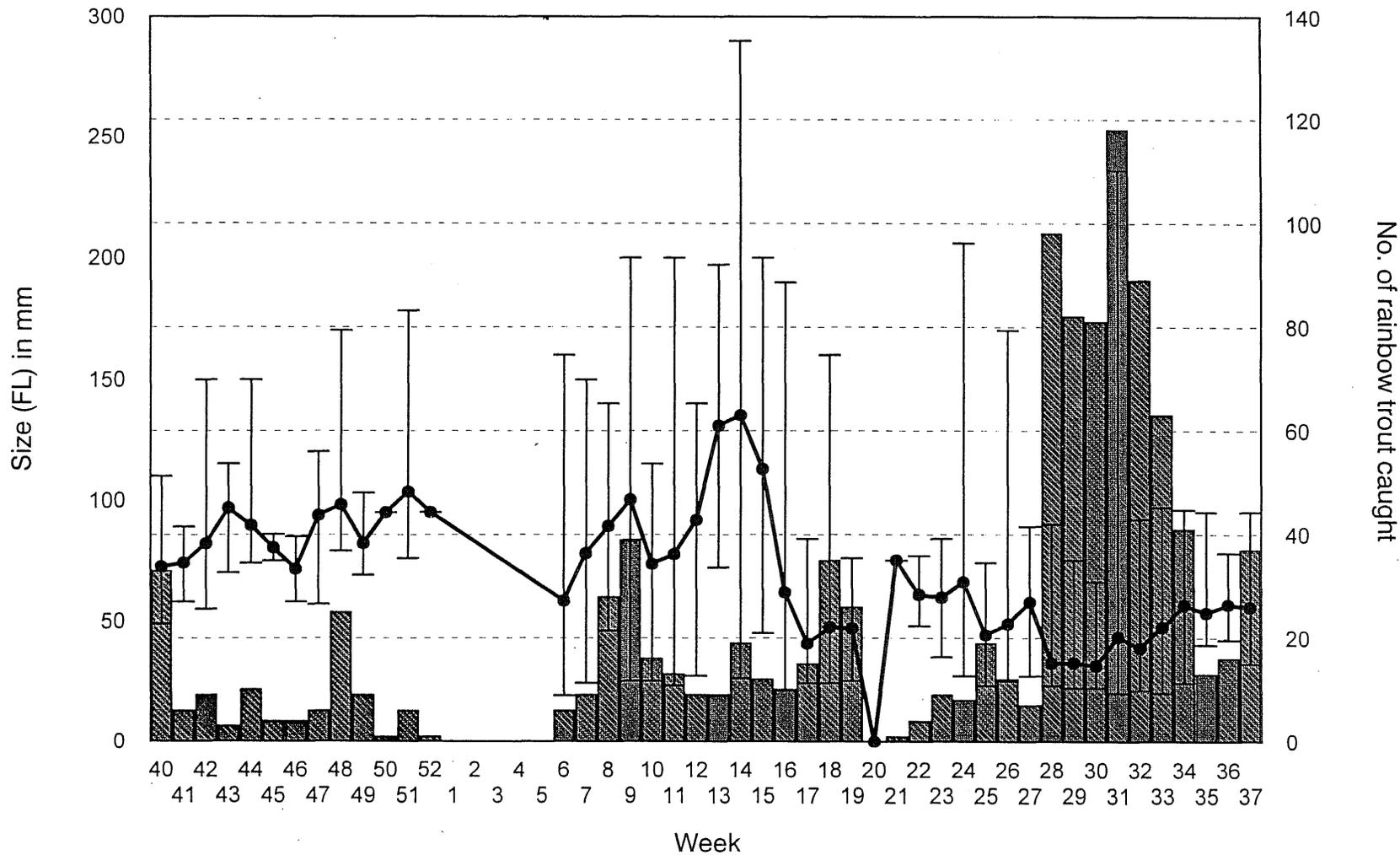


Figure 46. Rainbow trout mean forklengh (minimum and maximum) and total caught by rotary screw trap on a weekly basis in the upper Sacramento River, October 1996 - September 1997.

Upper Sacramento River rotary screw trap, 1996-1997

Effort and rainbow trout catch per hour

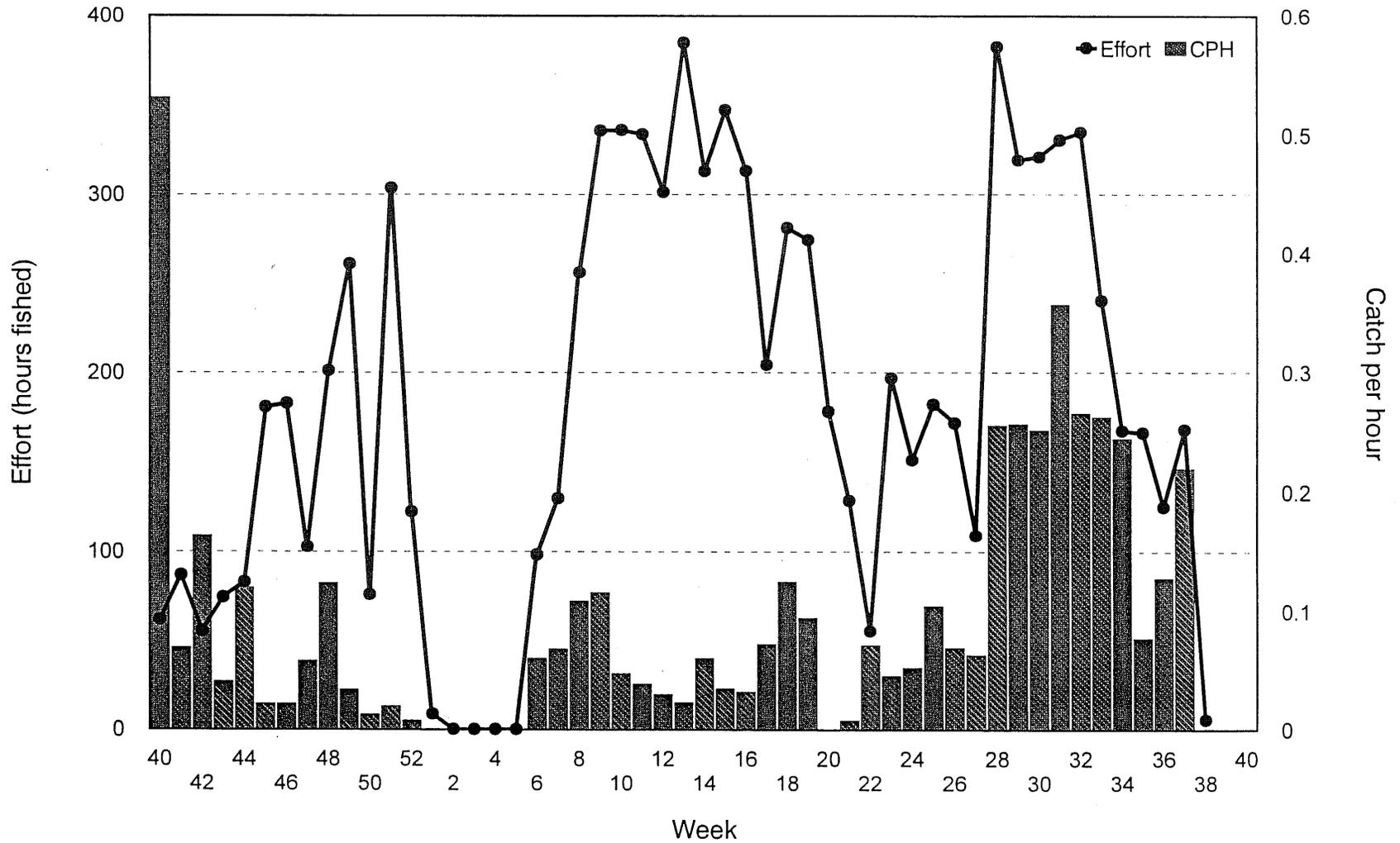


Figure 47. Weekly catch per hour of rainbow trout and hours fished by rotary screw trap in the upper Sacramento River, 01 October 1996 - 15 September 1997.

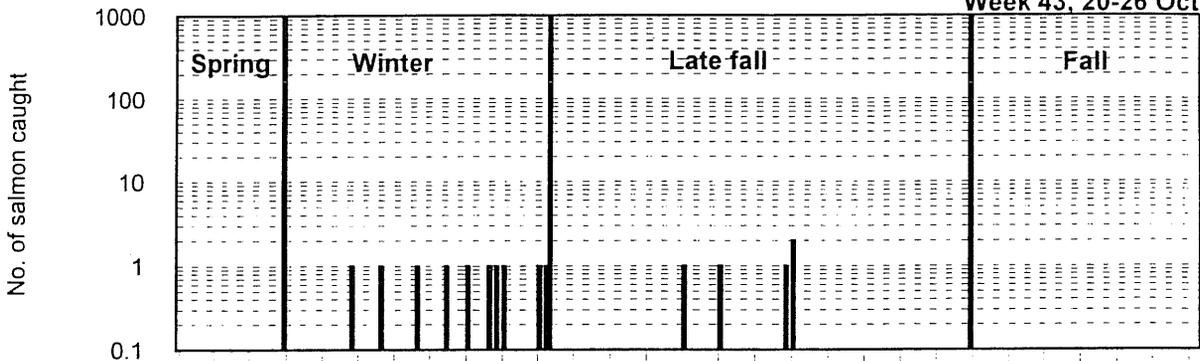
APPENDIX II

**Rotary screw trap catch weekly length distribution
October 1996 - September 1997**

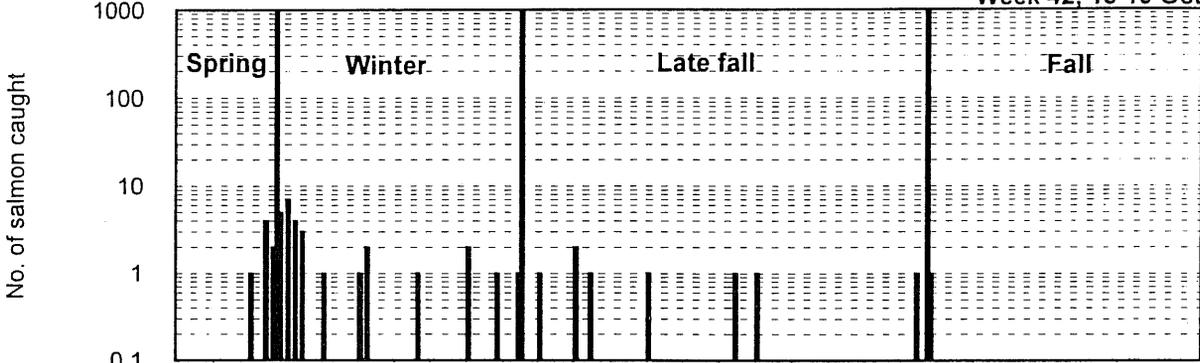
Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap

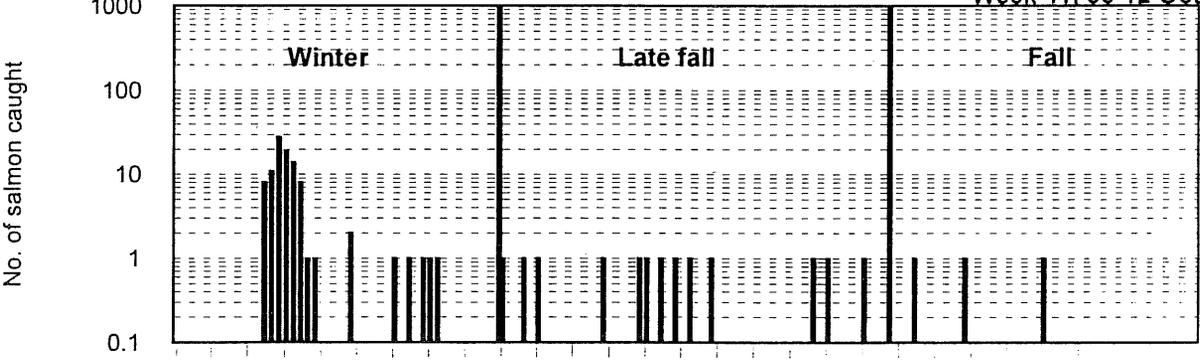
Week 43, 20-26 Oct



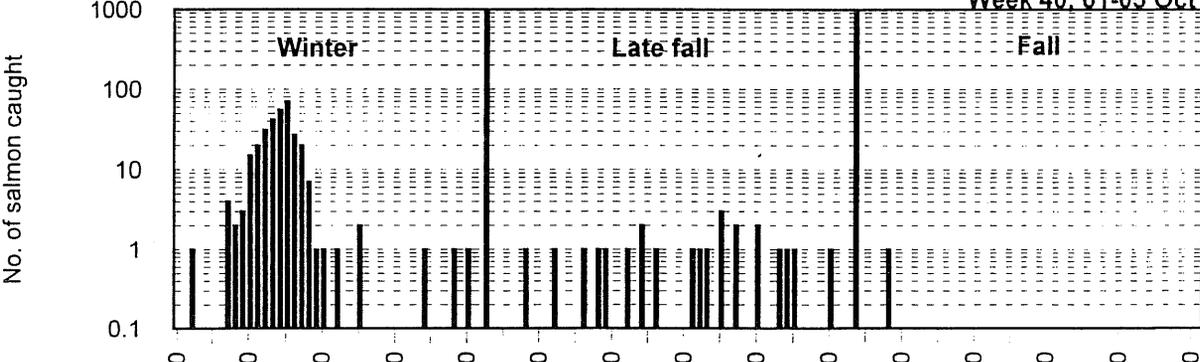
Week 42, 13-19 Oct



Week 41, 06-12 Oct



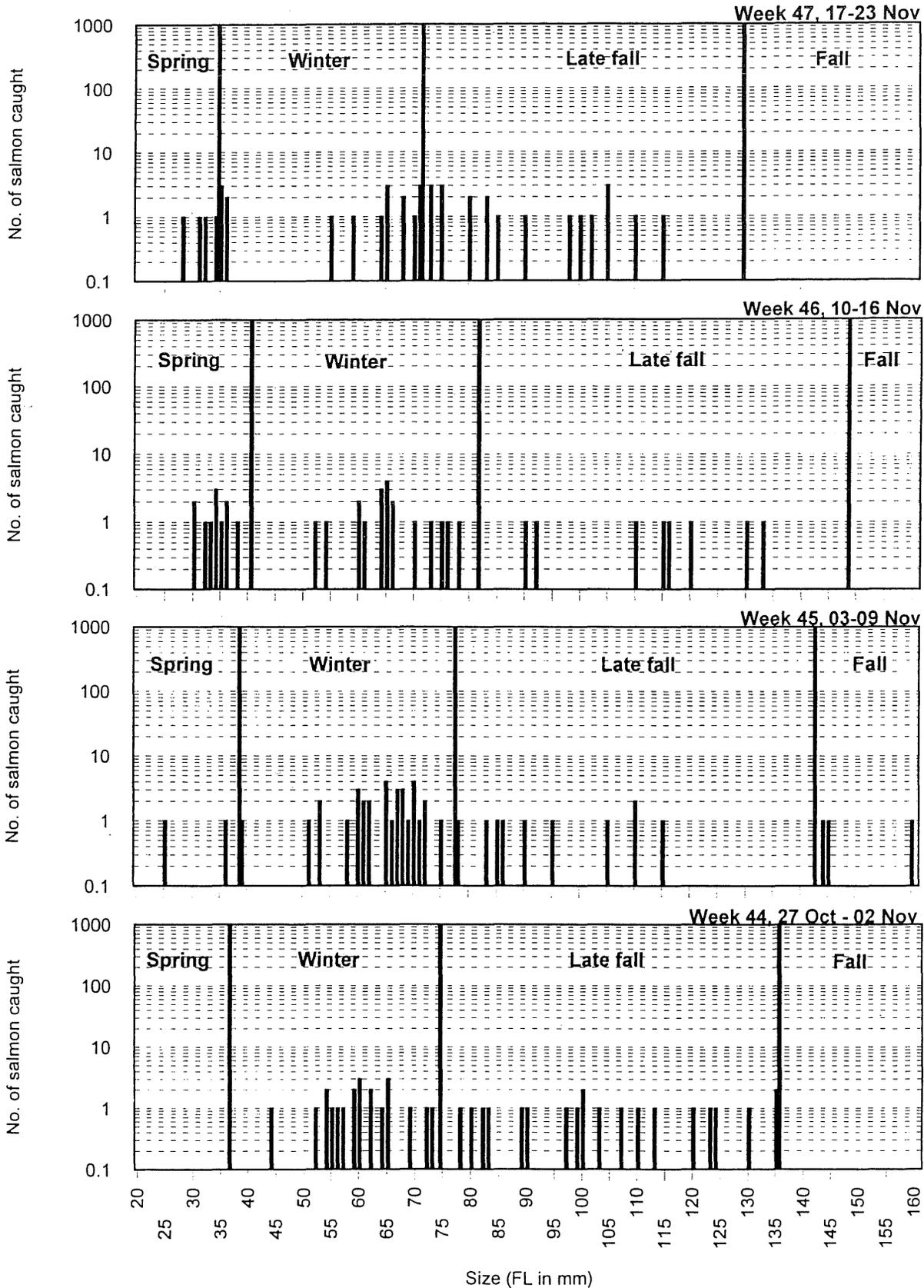
Week 40, 01-05 Oct



Size (FL in mm)

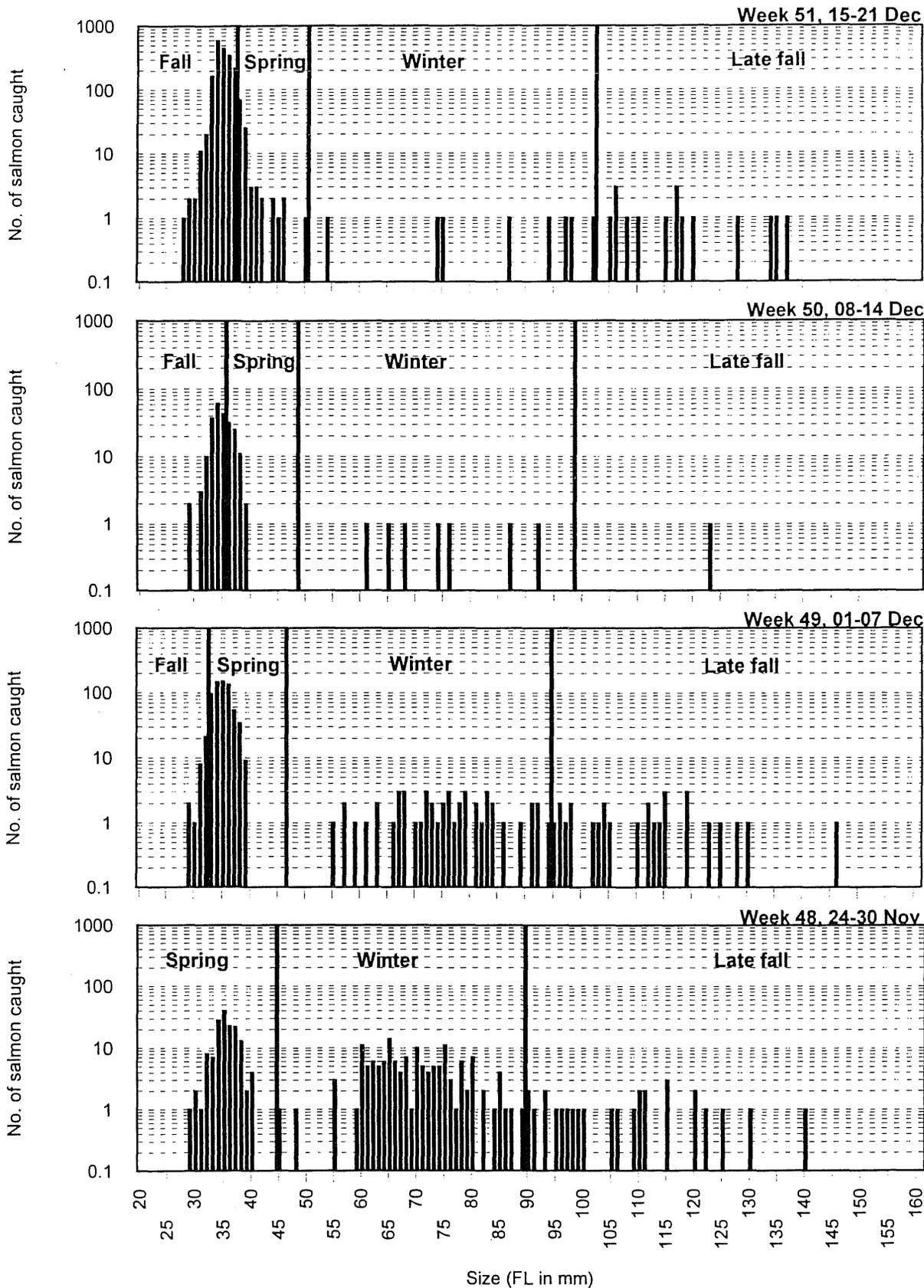
II-1. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 01 October - 26 October 1996.

Chinook Salmon Size Distribution Upper Sacramento River rotary screw trap



II-2. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 27 October - 23 November 1996.

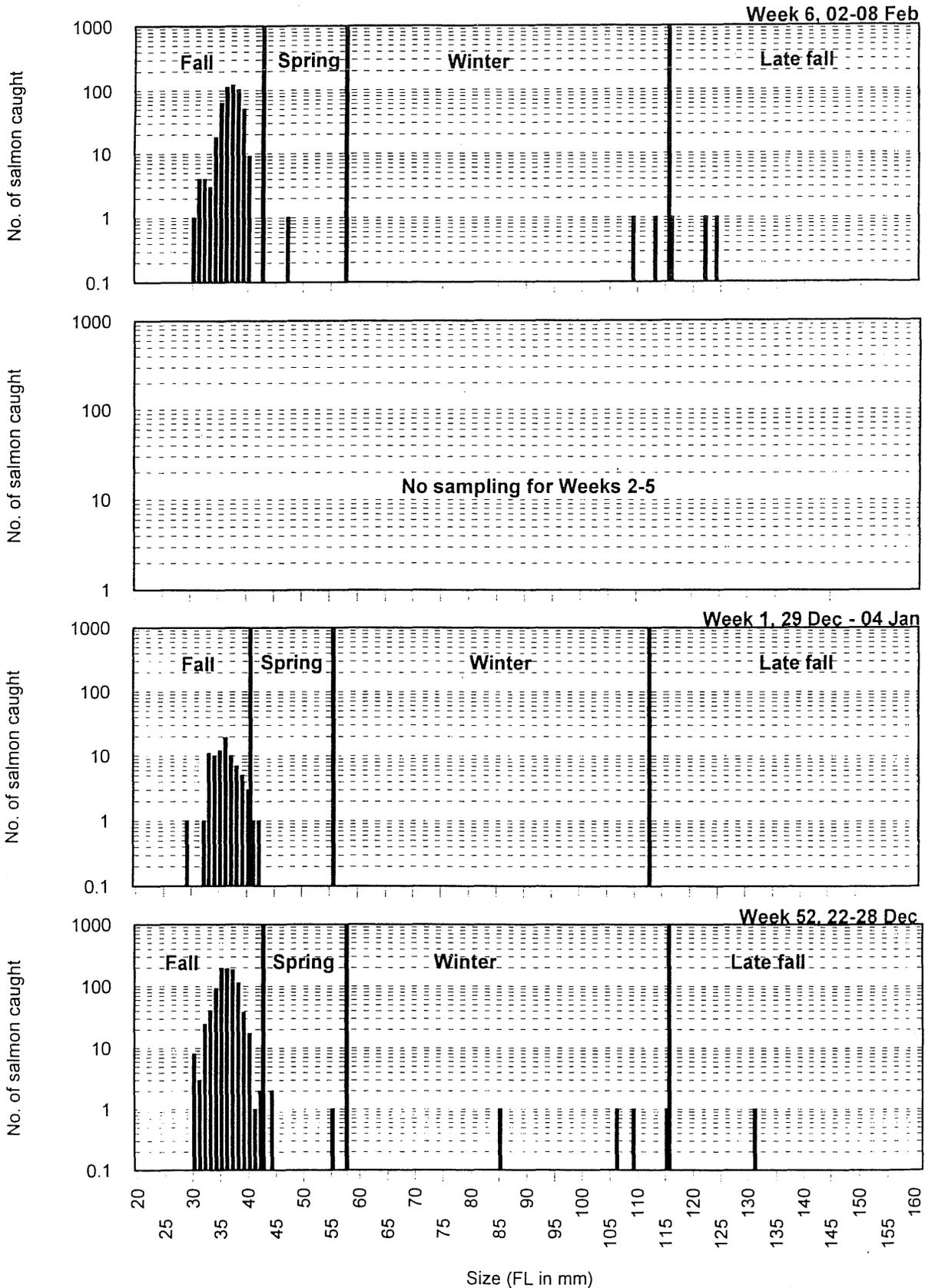
Chinook Salmon Size Distribution Upper Sacramento River rotary screw trap



II-3. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 24 November - 21 December 1996.

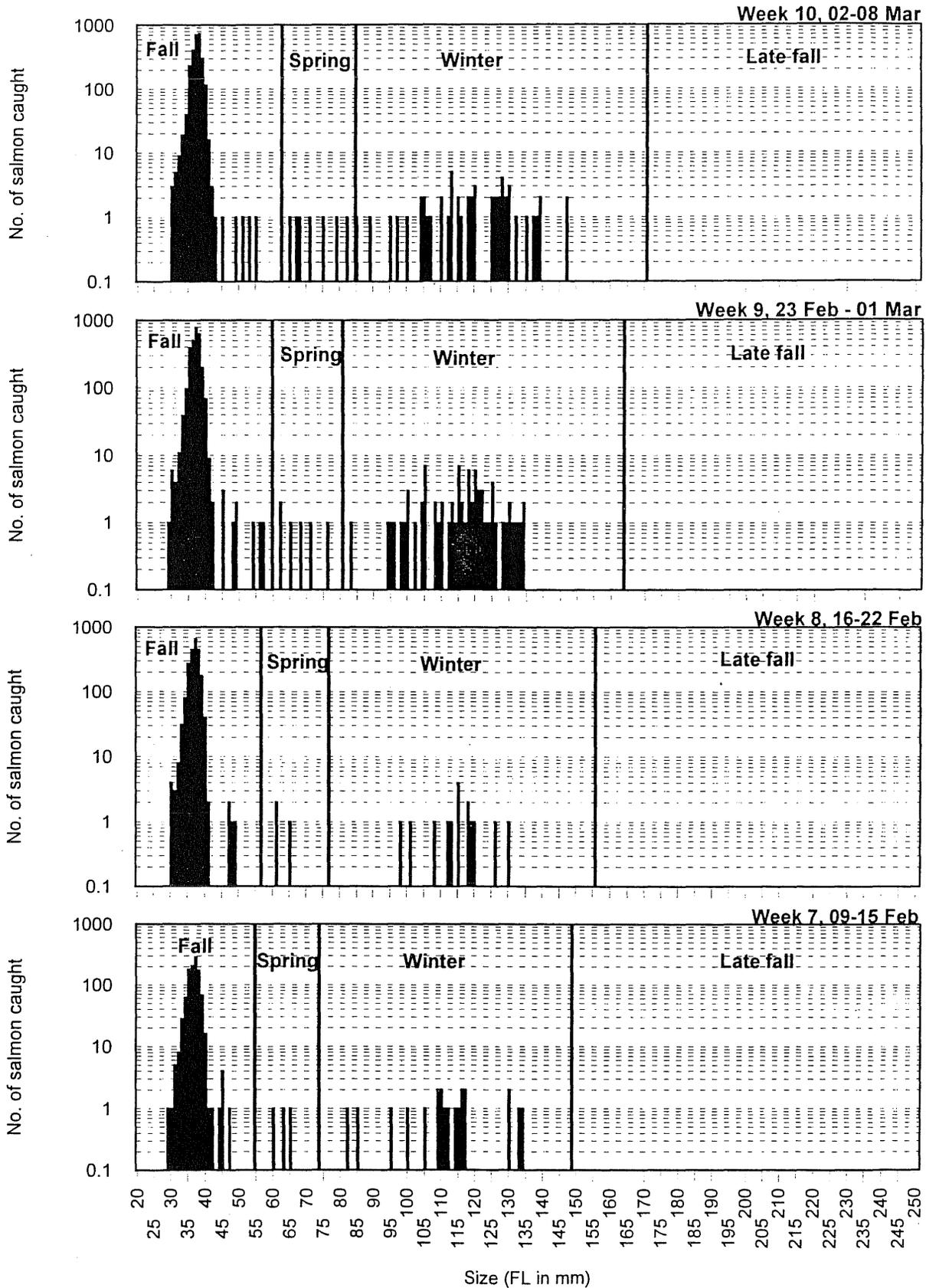
Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap



II-4. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 22 December 1996 - 08 February 1997.

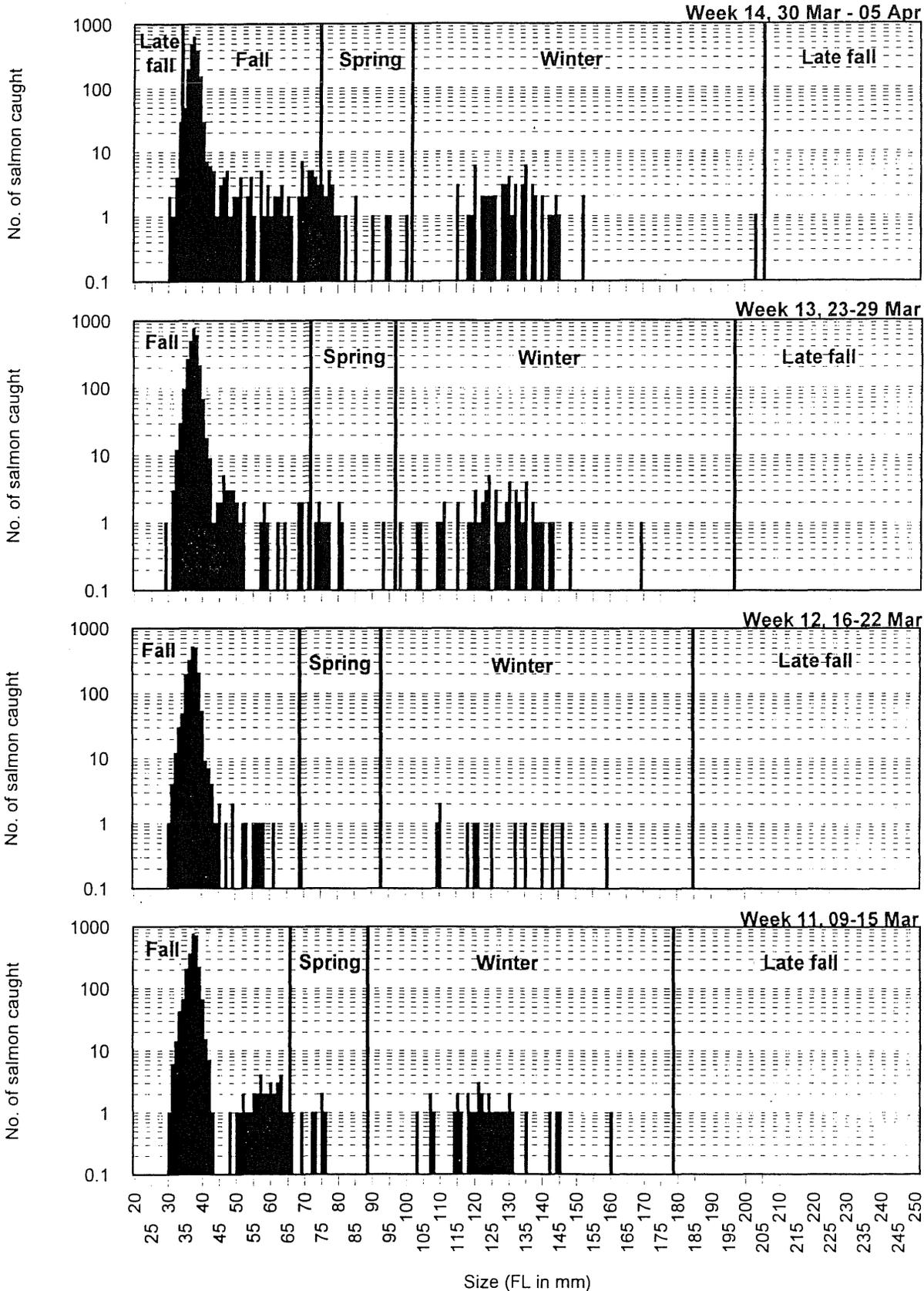
Chinook Salmon Size Distribution Upper Sacramento River rotary screw trap



II-5. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 09 February - 08 March 1997.

Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap

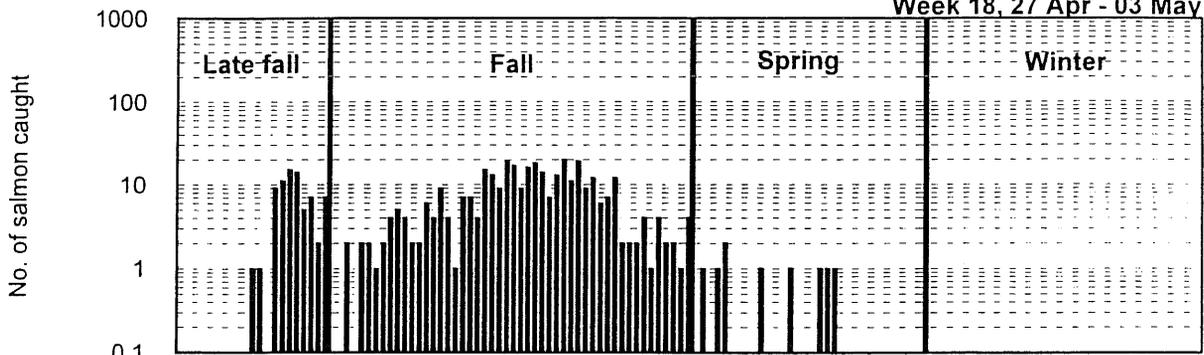


II-6. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 09 March - 05 April 1997.

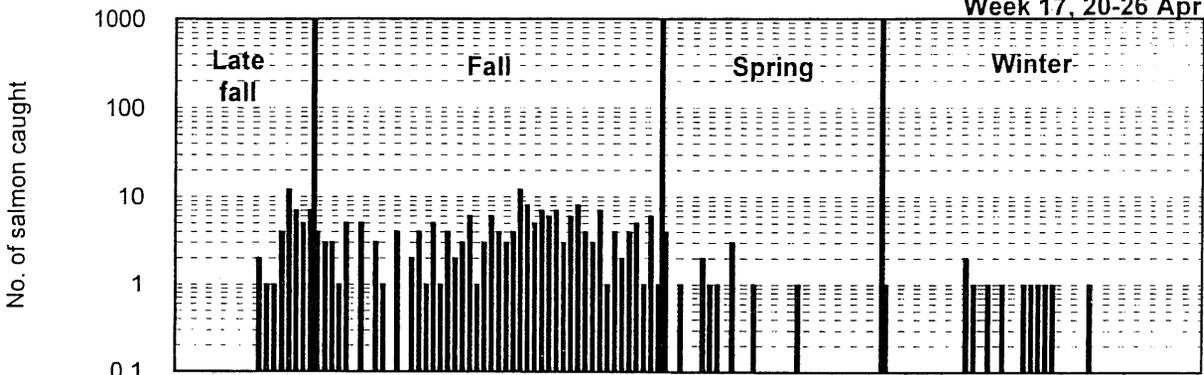
Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap

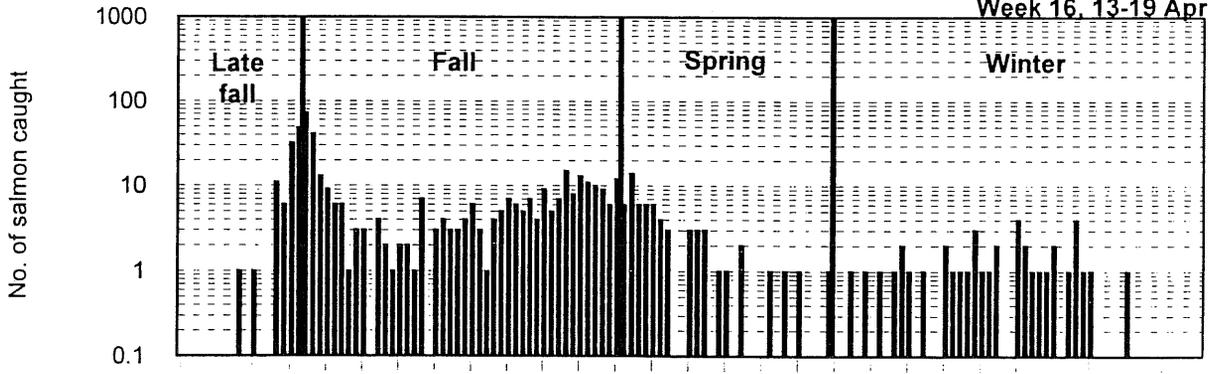
Week 18, 27 Apr - 03 May



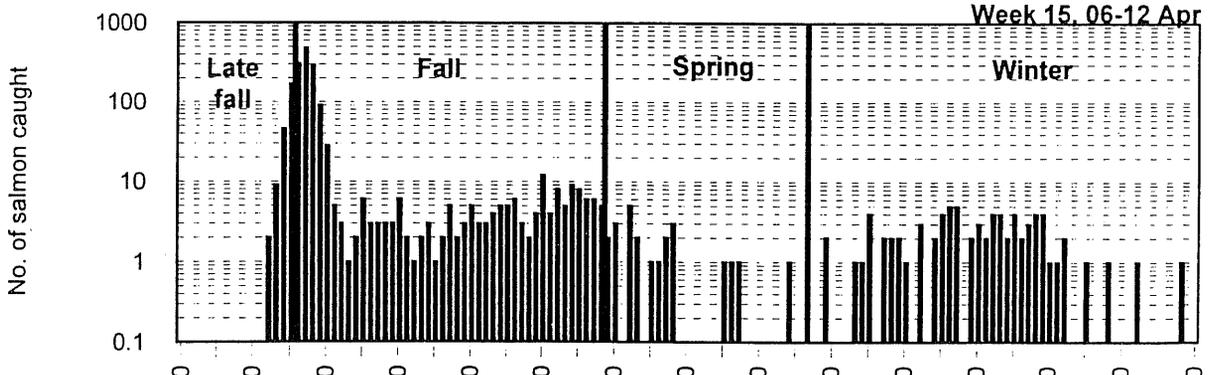
Week 17, 20-26 Apr



Week 16, 13-19 Apr



Week 15, 06-12 Apr



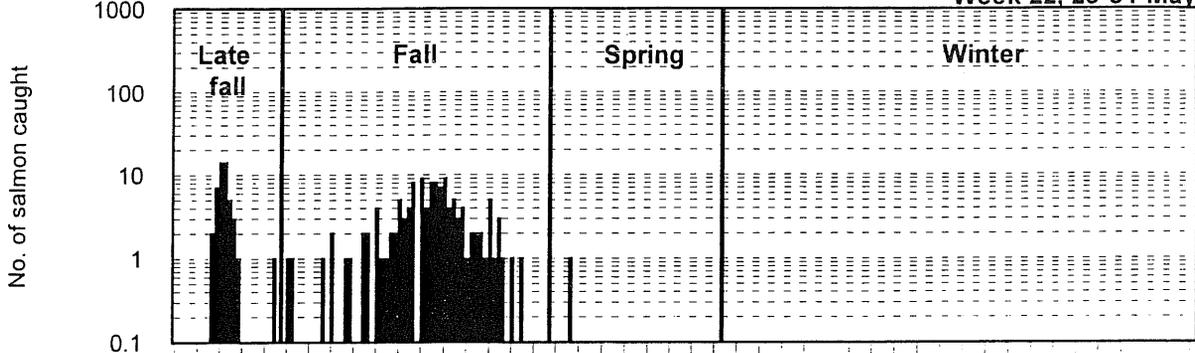
Size (FL in mm)

II-7. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 06 April - 03 May 1997.

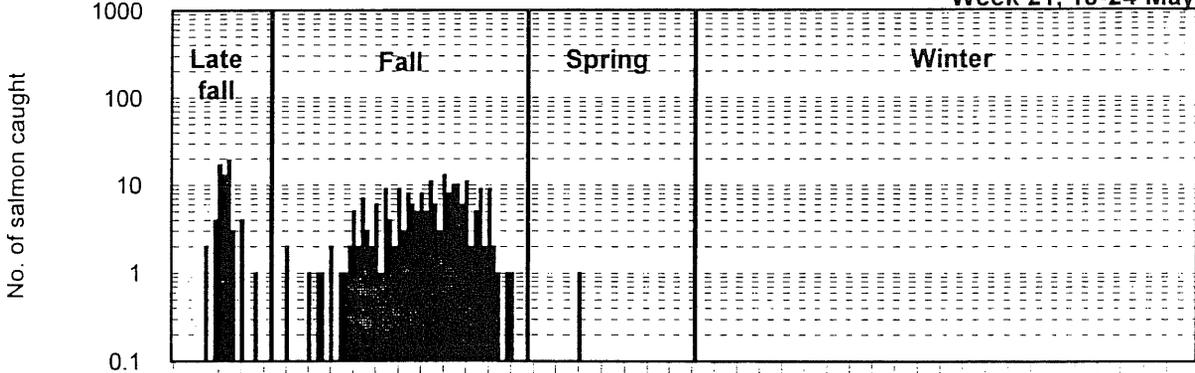
Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap

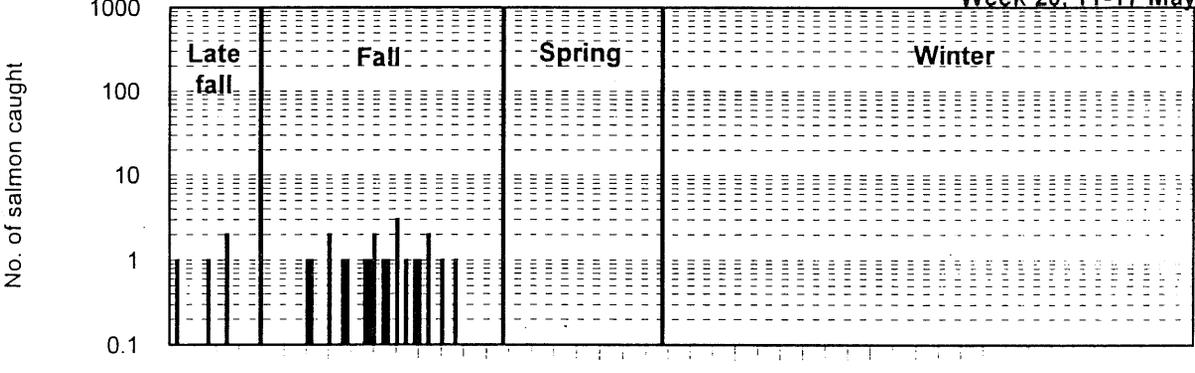
Week 22, 25-31 May



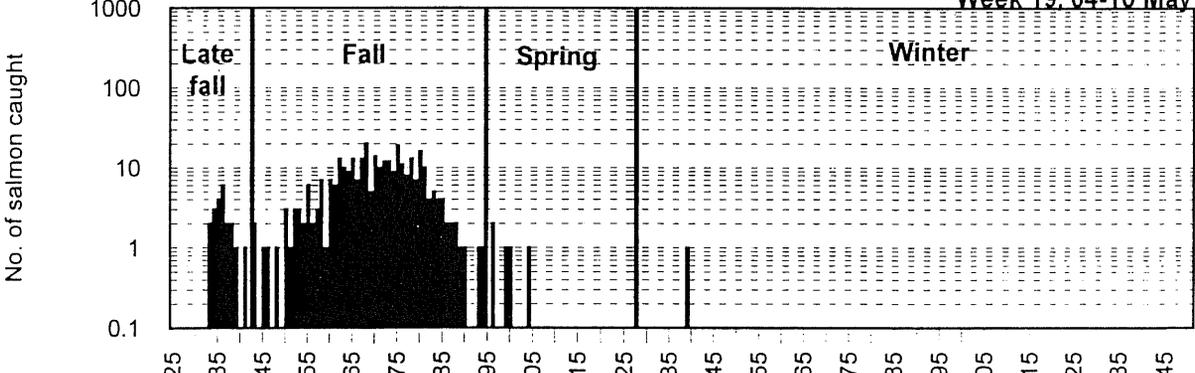
Week 21, 18-24 May



Week 20, 11-17 May



Week 19, 04-10 May

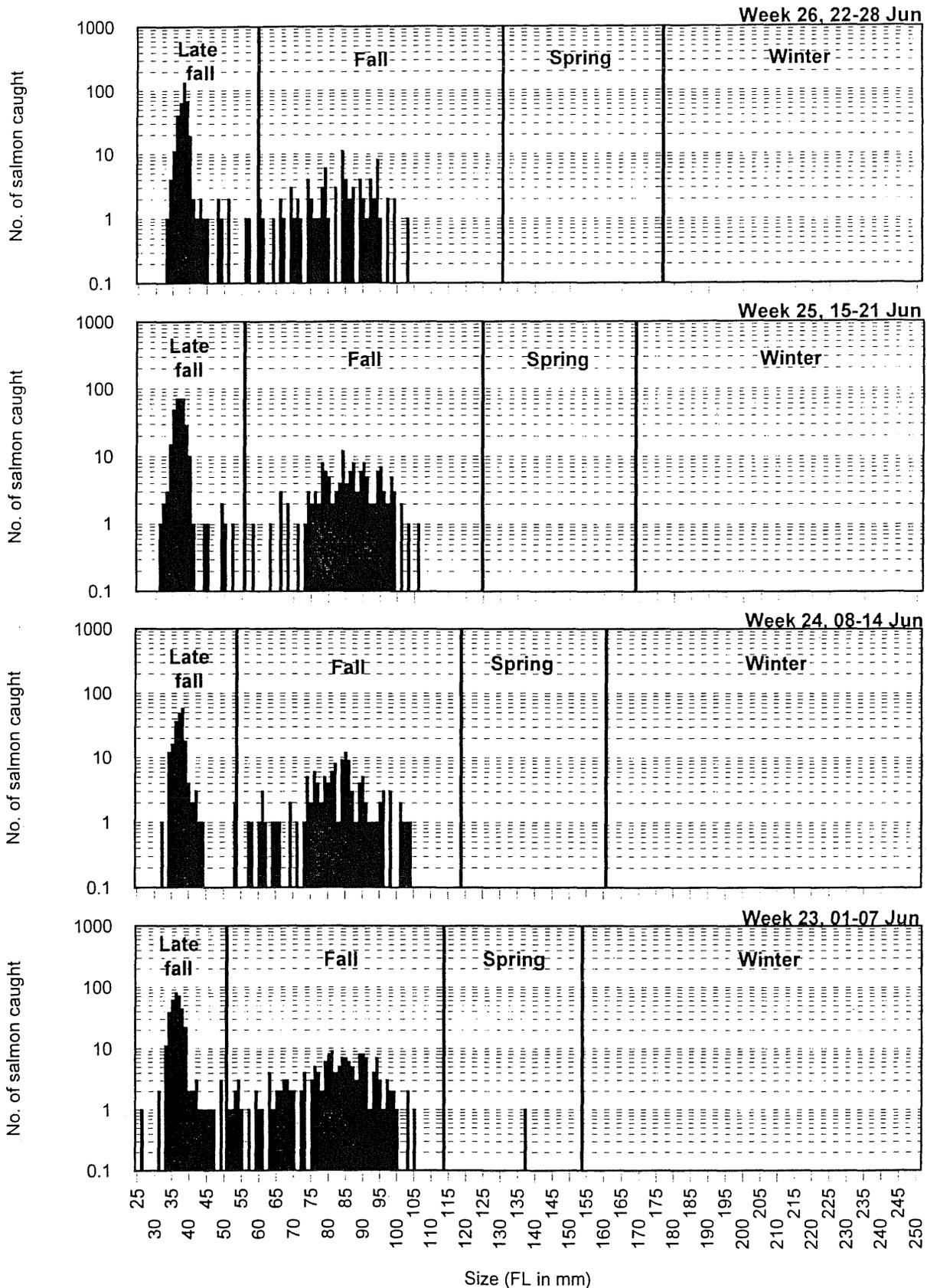


Size (FL in mm)

II-8. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 04-31 May 1997.

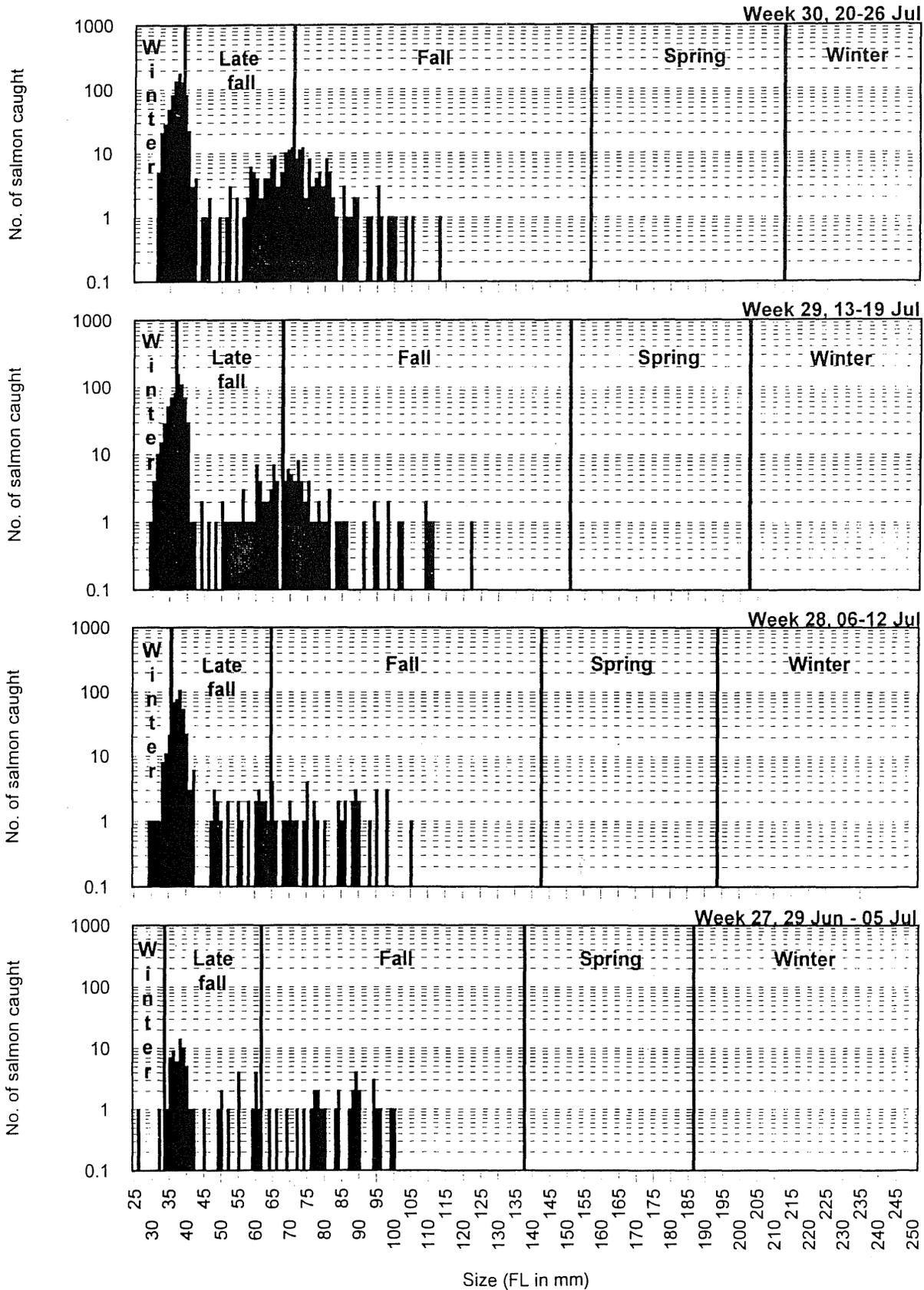
Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap



II-9. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 01-28 June 1997.

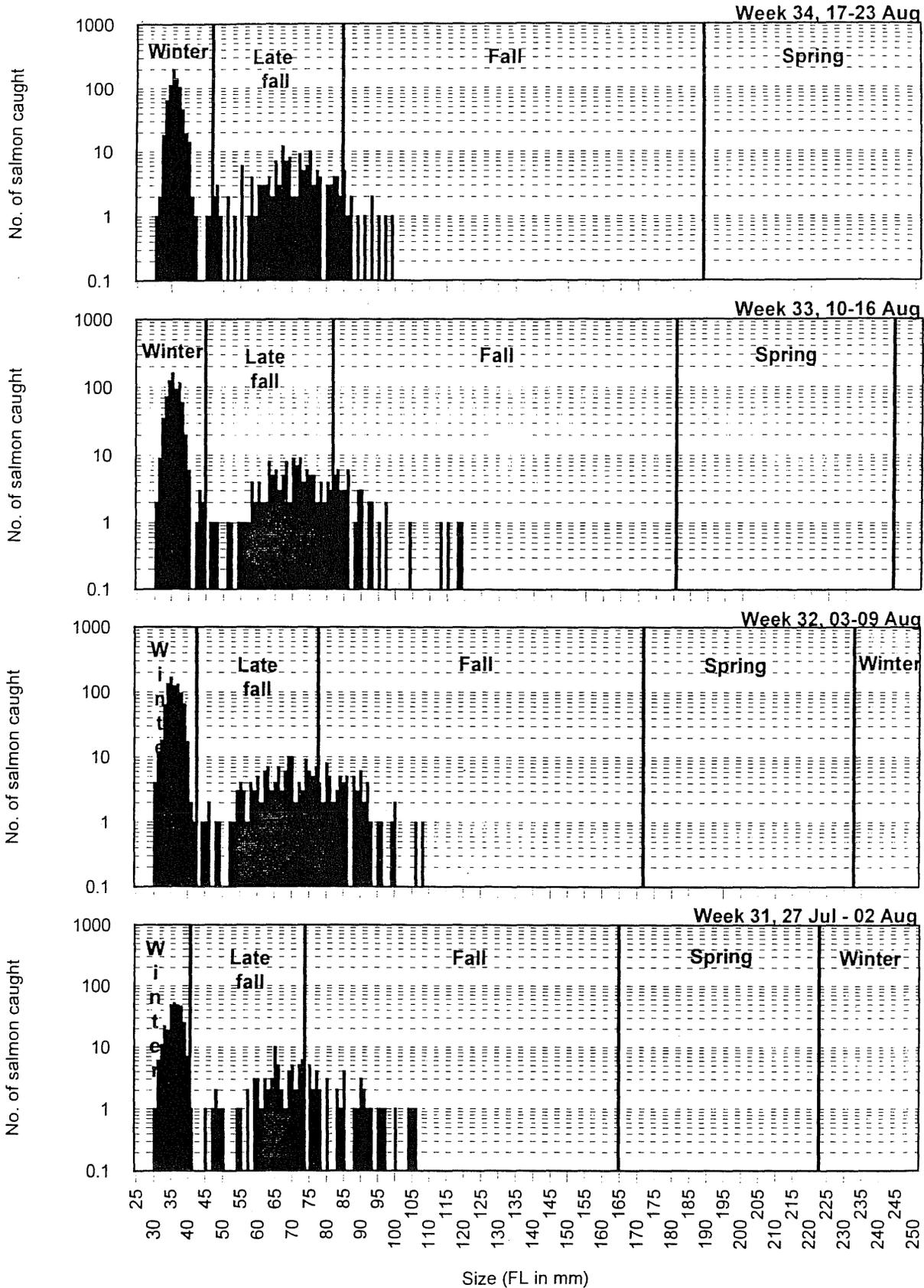
Chinook Salmon Size Distribution Upper Sacramento River rotary screw trap



II-10. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 29 June - 26 July 1997.

Chinook Salmon Size Distribution

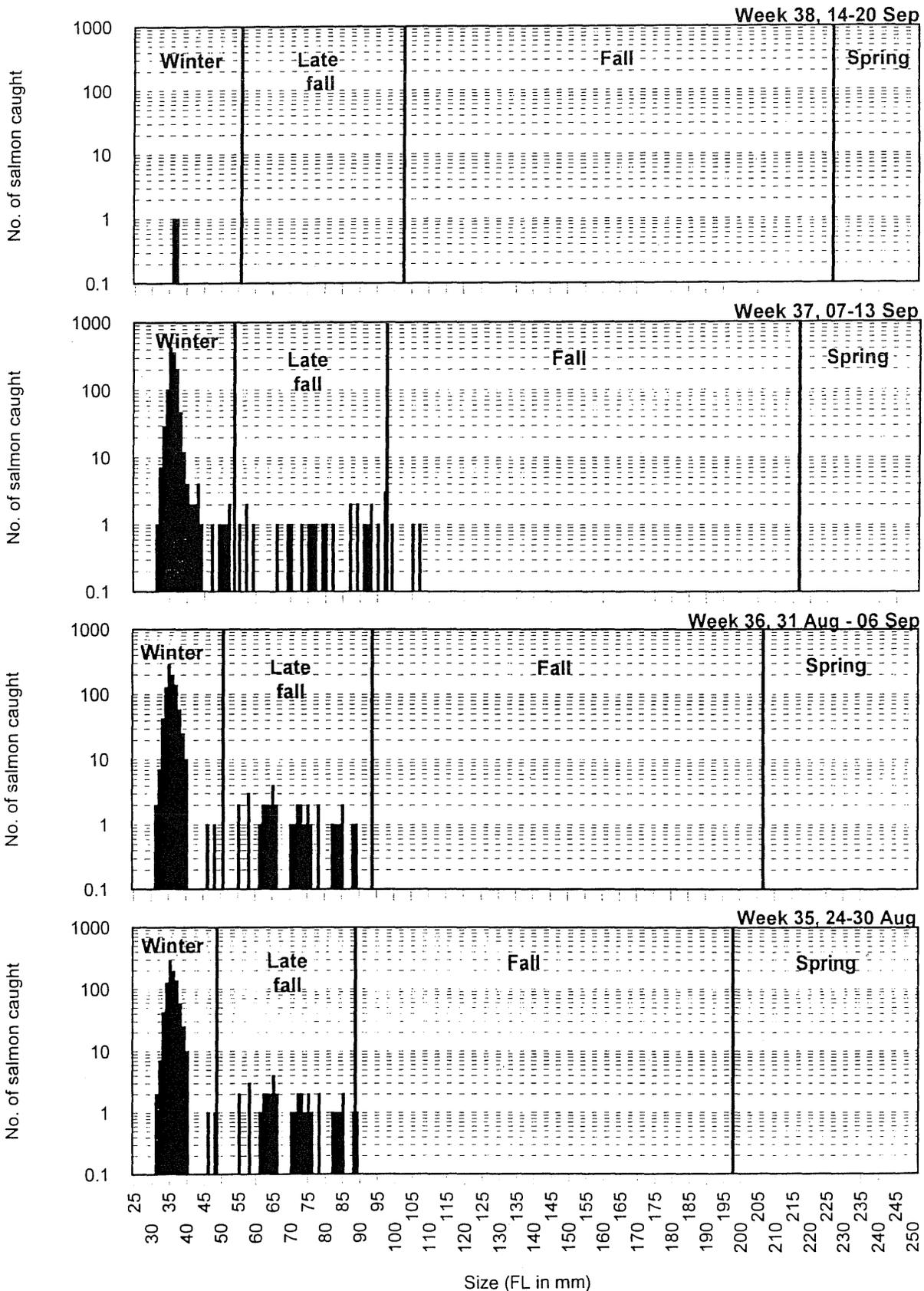
Upper Sacramento River rotary screw trap



II-11. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 27 July - 23 August 1997.

Chinook Salmon Size Distribution

Upper Sacramento River rotary screw trap



II-12. Size distribution of chinook salmon caught by rotary screw traps in the upper Sacramento River, 24 August - 20 September 1997.