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CUMULATIVE EFFECTS OF MICRO-HYDRO DEVELOPMENT OF THE SWAN RIVER DRAINAGE, MONTANA

II: TECHNICAL INFORMATION

Final Report 1990

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CUMULATIVE EFFECTS OF MICRO-HYDRO DEVELOPMENT ON THE FISHERIES OF THE SWAN RIVER DRAINAGE, MONTANA

II: TECHNICAL INFORMATION

Final Report

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INTRODUCTION

This report is the second in a three-volume series that summarizes the findings of a study to determine the potential cumulative effects of proposed small hydro development on the fisheries of the Swan River drainage. The first volume (Leathe and Enk 1985) is a summary report that presents the major findings and describes the methods used to collect the information gathered during the two and one-half year study. The third volume (Leathe et al. 1985) contains maps and biophysical inventory data gathered on tributary streams in the drainage. Survey sites mentioned in this report can be accurately located using stream maps found in Volume III.

For the most part, this report contains technical information and is a support document for the main report (Leathe and Enk 1985). Consequently, discussion of results was minimized. The sections on fish population monitoring, streambed monitoring, habitat survey comparisons, and water temperature in this document are the only portions that were not discussed in the main report.

TRIBUTARY MONITORING - 1984

Fish Populations

A series of fishpopulationmonitoring sections were established and electrofished during the summer of 1984 in each of the four streams considered "most likely" to have smallhydro developmentoccur. Shocking sections were established above within, and below proposed hydro project areas on each stream (Piper, Cold, Cedar, and Squeezer creeks). Gas-poweredbackpack electrofishing gear was used to obtain mark-recapture estimates for each section. Electrofishing sections were 304 m (1,000 feet) long and were blocked on the lower end with quarter-inch mesh nylon netting. Electrofishing and population estimation techniques were more fully described by Leathe and Enk (1985).

Specific locations of electrofishing sections in relation to proposed small hydro facilities are presented in Table 1 and may be referenced to stream inventory maps in Leathe et al. (1985). Resulting population estimates with 95% confidence intervals are listed in Table 2. Length frequency diagrams for fish captured during these surveys may be found elsewhere in this report (Figures 2 through 11).

Streambed Composition

Gravel samples were collected from the lower ends of bull trout spawning areas during October and November of1984 in three creeks (Goat, Squeezer, and Lion) with proposed small hydro projects. Three transects were established in each stream and four gravel samples were collected from each transect. Samples were collected using a hollow core sampler and collection andanalysis techniques described by Shepard et al. (in press). Sampling locations (stream kilometers from mouth) may be located on stream inventory maps in Leathe et al. (1985), and detailed site description information may be found in MDFWP files. Results of streambed sampling appear in Table 3 and Figure 1.

Table 1. Locations (stream kilometers - from mouth) of proposed mall hydro facilities and fish population monitoring sections established infourtributaries to the Swan River during 1984.

	Locations (Stream kilometers - from mouth)				
creek	Proposed powerhouse	Proposed diversion	Lower shocking section	Middle shocking section	Upper shocking section
Piper	1.8	8.2	1.5	5.4	8.8
Cold	8.5	13.4	8.4	10.8	14.0
Cedar	9.6	13.1	9.0	10.5	13.4
Squeezer	6.1	8.2	2.5 & 5.5	7.0	8.3

Table 2. Mark-recapture population estimates (number of fish 75 mm and longer per 300 m) four tributaries to the Swan River during the summer of 1984. Ninety-five percent confidence intervals are in parenthesis.

Creek	Location (stream km)	Dates of survey	No. of fish ≥75 mm per 300 m (±95%CI) Cutthroat trout	Bull trout	Brook trout
Piper (lower)	1.5	Aug. 1-7	61 (±39%)	66 (±51%)	56 (±39%)
Piper (middle)	5.4	July 27-Aug. 13	60 (±50%)	210 (±55%)	43 (±35%)
Piper (upper)	8.8	Aug. 14-21	389 (±16%)	0 —	0 —
cold (lower)	8.4	Aug. 29-Sept. 6	10 (±30%)	92 (±33%)	250 (±9%)
Cold (middle)	10.8	Aug. 23-28	<10 —	168 (±25%)	0 —
Cold (upper)	14.0	Aug. 22-27	0 —	49 (±31%)	0 —
Cedar (lower)	9.0	Sept. 11-19	128 (±15%)	0 —	436 (±8%)
Cedar (middle)	10.5	Sept. 10-17	233 (±19%)	0 —	0 —
Cedar (upper)	13.4	Sept. 12-18	298 (±14%)	0 —	0 —
Squeezer (lower)	2.5	Sept. 27-Oct. 10	<10 —	140 (±60%)	100 (±20%)
Squeezer (lower)	5.5	Sept. 24-Oct. 9	<10 —	127 (±30%)	<10 —
Squeezer (middle)	7.0	Sept. 20-Oct. 1	0 —	44 (±18%)	0
Squeezer (upper)	8.3	Sept. 27	No Fish		

Table 3. Streambed gravel composition in bull trout spawning areas of three tributaries to the Swan River during October and November, 1984.

Creek	Location (stream km)	Transect No.	Percent composition (dry weight) by size class (mm)						
			<0.063	0.063-2.0	2.0-6.35	6.35-16.0	16-50	50-75	>75
Goat	4.5	1	5.5	10.5	15.3	17.1	25.0	16.9	9.7
		2	2.5	9.1	14.4	17.4	33.4	18.0	5.3
		3	5.6	7.9	9.4	14.5	27.3	17.3	18.0
		combined	4.4	9.2	13.1	16.4	28.9	17.5	10.6
Lion	5.5	1	2.1	12.1	14.9	14.7	32.9	4.5	18.8
		2	3.0	18.2	17.4	19.0	29.9	3.6	9.0
		3	2.6	14.7	17.7	22.2	37.5	5.3	0.0
		combined	2.5	14.8	16.5	18.3	33.4	4.5	10.0
Squeezer	2.5	1	3.0	23.8	20.5	23.8	27.4	1.5	0.0
		2	3.5	17.9	20.6	24.0	31.3	2.6	0.0
		3	6.9	14.1	22.1	20.2	35.6	1.1	0.0
		combined	4.6	18.4	21.1	22.5	31.6	1.7	0.0

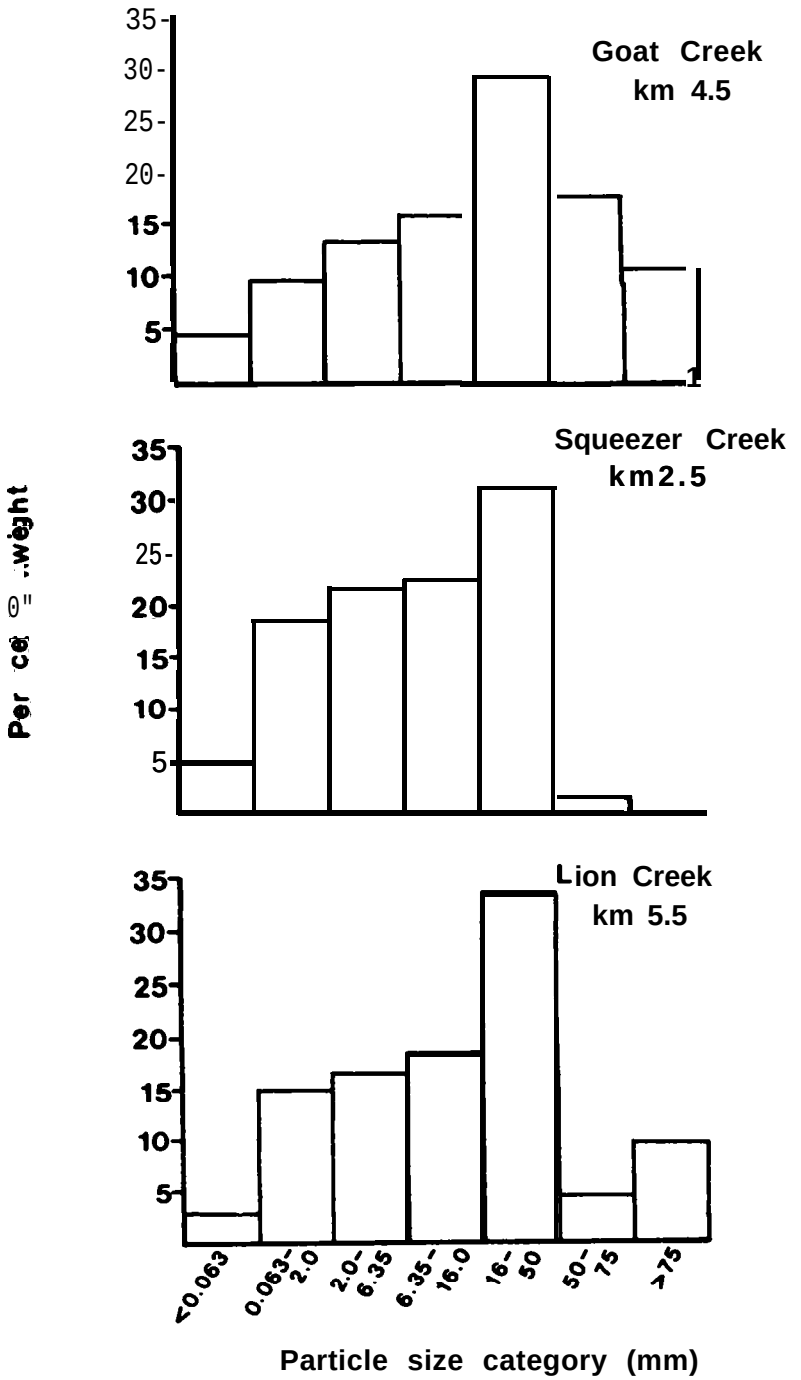


Figure 1. Streambed composition in bull trout spawning areas in three tributaries to the Swan River during fall, 1984.

HABITAT SURVEY COMPARISONS

The precision of cur habitat survey techniques was evaluated during September of 1982 and July of 1983. During the 1982 comparisons, two crews walked 2 km sections of Cold and Lion Creeks and made measurements or estimates at 40 random stops and along transects established at 15 of these stops. The results of the 1982 comparisons were discussed by Leathe and Graham (1983) and are summarized in Table 4. Cold and Lion creeks were relatively large (35 and 56 sq. km) medium gradient streams (5.0 and 5.7% gradient) having flows of 38 and 14 cfs at the time of survey.

Habitat survey comparisons during 1983 involved comparative measurements by three crews an three different tributary reaches. Habitat measurements during the 1983 comparisons were made by all crews at fixed points within each reach to eliminate variation due to sample site locations. Sampling sites were randomly selected by each crew in each reach during 1982, hence, it was unlikely that those measurements (especially line transects) were made at the same locations by each crew.

The 1983 comparisons were made on three reaches of two streams. Reach 1 of Soup Creek was low gradient (2.1%), had a drainage area of 38 square kilometers and a flow of 24 cfs. Reach 2 of Soup Creek was high gradient (11.6%), with a much smaller drainage area (14 square kilometers) and a flow of about 20 cfs. Reach 2 of Piper Creek had a moderate gradient and drainage area (6.2% and 23 square kilometers) and a flow of 59 cfs. Eabitat measurements by each crew were tabulated and average measurement errors for each habitat parameter in each reach were calculated using the method of Beamish and Fournier (1981). Results are presented in Table 5.

Table 4 . Comparison of physical habitat measurements made by two survey crews on two tributaries to the Swan River during early September, 1982.

Parameters	Lion Creek			Cold Creek		
	Crew 1	Crew 2	Mean error	Crew 1	Crew 2	Mean error
Channel Measurements						
Wetted width (m)	8.0	8.5	6%	8.9	8.4	6%
Channel width (m)	12.8	13.0	2%	11.4	11.7	3%
Mean depth (cm)	29	33	13%	32	29	10%
Maximum depth (cm)	145	120	19%	80	89	11%
Channel splitting (%)	0	23	100%	3	10	108%
Channel stability ratlng	56	94	51%	46	65	34%
Substrate Measurements						
Fines (%)	9	13	36%	5	5	0%
Gravel (%)	38	34	11%	20	19	5%
Cobble (%)	26	32	21%	30	44	38%
Boulder-bedrock (%)	27	21	25%	44	32	32%
D-98 (cm)	80	83	4%	81	85	5%
Habitat Measurements						
Feature:						
Pool (%)	30	15	100%	10	15	40%
Rlffle-run (%)	36	65	57%	26	62	82%
Pocketwater-cascade(%)	34	20	52%	64	23	94%
Cover:						
Instream cover (%)	47	29	47%	62	43	36%
logs & debris)	(53%)	(34%)	(43%)	58)	33)	(55%)
boulders)	(47%)	(66%)	(34%)	42)	67)	(46%)
Overhead cover:						
within 1 meter(%)	---	22	---	48	42	13%
undercut bank (%)	---	25	---	33	23	36%
Total overhead(%)	91	87	4%	57	63	10%
Debris (%)	68	60	13%	83	75	10%
Stable debris (%)	89	83	7%	73	90	21%

Table 5. Average percent measurement errors for physical habitat parameters measured by three survey crews in each of three stream reaches in the Swan River drainage during July 1983.

Parameters	Soup Creek Reach 1	Soup Creek Reach 2	Piper Creek Reach 2
Channel Measurements			
Wetted width (m)	3	1	1
Channel width (m)	11	12	10
Mean depth (cm)	3	6	6
Maximum depth (cm)	5	9	3
Channel splitting (%)	31	21	5
Channel stability score	12	14	8
Channel Substrate			
Fines (%)	17	93	26
Gravel (%)	6	21	4
Cobble (%)	33	20	18
Boulder-bedrock (%)	0	17	17
D-90 (cm)	7	20	13
Mean substrate score	6	3	3
Mean embeddedness score	8	3	5
Mean compaction score	3	4	1
Habitat Measurements			
Feature:			
Pool (%)	100	22	0
Riffle & Run (%)	7	41	5
Pocketwater & cascade (%)	0	14	10
Cover:			
Total instream (%)	10	8	10
(logs & debris - %)	10		2
boulder - %)	0	33	17
(turbulence - %)	0	41	120
Total overhead (%)	9	9	8
(within 1 meter - %)	16	21	36
(undercut bank - %)	17	7	10
Debris (%)	4	18	6
Stable debris (%)	12	8	21
Pool Measurements			
No. of class I, II & III pools per km	26	40	18
Pool classification:			
class I (%)	86	34	38
Class II (%)	55	20	30
Class III (%)	34	20	107
Pool substrate:			
Fines (%)	15	111	28
Gravel (a)	9	12	15
Cobble (%)	67	30	8
Boulder-bedrock (%)	0	41	50
Mean substrate score	6	12	10
Mean embeddedness score	11	22	13
Mean pool depth (cm)	17	5	9
Max. pool depth (cm)	8	14	9

CREEL CENSUS

Tables 6 through 24 contain detailed Swan drainage creel census information to supplement that presented by Leathe and Enk (1985). Summaries of creel interview information gathered on other waters in conjunction with the economic evaluation are in Tables 25 through 28. These waters were Ashley Lake, Lake Koocanusa, Hungry Horse Reservoir, Flathead Lake, Thompson River, Kootenai River, Flathead River, and the Bighorn River. Length information on creeled fish in each of these waters may be found in Table 29 while length frequency data for creeled fish from various parts of the Swan drainage as well as most of the other waters surveyed are presented in Figures 19 through 25.

Table 6. Monthly fishing pressure summary (angler-hours) for Swan Lake during the period May 21, 1983 through May 18, 1984. Ninety-five percent confidence intervals are in parenthesis. Ice fishing was classified as "shore" pressure during the iced-in period (mid-December through March).

Month	North Half			South Half			Combined		
	Shore	Boat	Total	Shore	Boat	Total	Shore	Boat	Total
1983	73								
June	210	110	183	249	1499	1748	307	1605	1913 (±604)
July		587	797	237	5558	5794	434	6143	6578 (±1566)
August	76	408	484	89	4571	4660	163	4904	5066 (±1272)
September	30	158	195	19	1500	1519	57	1664	1721 (±697)
October	0	20	20	40	554	593	40	572	612 (±277)
November		0	0	8	164	172	8	175	183 (±161)
December	0	0	0	184	0	184	184	0	184 (±299)
1984									
February	20	0	20	1825	0	1825	1845	0	1845 (±229)
March			0					0	303 (±140)
April	28	0	28	303	879	903	331	1006	1120 (±562)
May (83/84)	0	79	79	26	1917	1943	26	2002	2028 (±932)
TOTAL	456	1360	1816 (±575)	3280	16642	19922 (±2411)	3662 (±584)	18071 (±2474)	21734 (±2540)

Table 7. Estimated monthly harvest of the principal gamefish species in Swan Lake during 1983 and 1984. Ninety-five percent confidence intervals in parenthesis.

Month	Estimated Monthly Harvest				
	Kokanee salmon	Northern pike	Bull trout	Rainbow trout	Cutthroat trout
1983					
June	1165	99	66	66	58
July	4428	109	164	41	68
August	6925	471	49	16	16
September	1455	170	16	40	32
October	90	73	28	107	6
November	0	0	100	0	0
December	7	0	13	0	0
1984					
January	36	0	62	0	0
February	36	0	51	0	
March	0	0	31		8
April	0	48	48	04	0
May (1983 & 1984)	288	267	110	10	57
TOTAL	14430 (±3392)	1237 (±461)	738 (±263)	284 (±182)	237 (±147)

Table 8. Monthly summary of bait types used by fishing parties interviewed on Swan Lake during the period **May** 21, 1983 through May 18, 1984.

Bait type	1983 May	Juno	July	Aug.	Sept.	Oct.	Nov.	Dec.	1984 Jan.	hb.	March	April	TOTAL
Bait	3 (8%)	14(26%)	14(13%)	10(10%)	2 (3%)	2(13%)		5(100%)	30(33%)	22(39%)	7(50%)	3 (8%)	112(19%)
Flies													
Lures	24(65%)	27(50%)	55(51%)	63(61%)	45(65%)	11(74%)	3(100%)		9(10%)	4 (7%)		24(62%)	265(45%)
Snagging													
Combination	10(27%)	13(24%)	39(36%)	29(28%)	2 2 0 2 0	2(13%)			51(57%)	30(54%)	7(50%)	11(28%)	214(36%)
No information				1 (1%)								1 (20	2(<1%)
TOTAL	37	54	108	103	69	15	3	5	90	56	14	39	593

Table 9. Monthly summary of origin of fishing parties interviewed on Swan Lake during the period May 21, 1983 through May 18, 1984.

Party	Origin	1983 May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1984 Jan.	Feb.	March	April	TOTAL
Kalispell		8(22%)	3 (68)	13(12%)	12(12%)	9(13%)	2(13%)		1(20%)	5 (5%)	3 (5%)	1 (7%)	15(38%)	72(12%)
Other Flathead County		7(19%)	10(18%)	8 (7%)	4 (4%)	4 (68)	4(27%)		3(60%)	24(27%)	8(14%)	1 (7%)	5(13%)	78(13%)
Lake County		8(22%)	11(20%)	19(18%)	28(27%)	26(38%)	3(20%)		1(20%)	55(61%)	37(66%)	12(86%)	14(36%)	214(36%)
Missoula County		6(16%)	2 (4%)	9 (8%)	3 (3%)	6 (9%)	4(27%)	3(100%)		4 (5%)	7(13%)		5(13%)	49 (8%)
Montana														
Eastern Montana		2 (5%)	4 (78)	19(X1%)	19(X3%)	10(14%)								54 (1%)
Non-resident (USA)		1 (38)	21(39%)	22(20%)	18(17%)	8(11%)				2 (28)	1 (2%)			73(12%)
Foreign		5(13%)	3 (68)	17(16%)	16(16%)	4 (6%)	2(13%)							47 (8%)
TOTAL		37	54	106	103	69	1s	3	5	90	56	14	39	593

Table 10. Monthly summary of target species sought by fishing parties interviewed on Swan Lake during the period May 21, 1983 through May 18, 1984.

Target Species	1983 May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1984 Jan.	Feb.	March	April	TOTAL
Rainbow trout	1 (3%)			1 (1%)	1 (2%)	2(13%)				1 (2%)			6 (1%)
Cutthroat trout		1 (2%)											1(<1%)
Bull trout	3 (8%)	1 (2%)	4 (4%)	1 (1%)	1 (2%)	5(33%)	3(100%)	5(100%)	83(92%)	49(87%)	14(100%)	11(28%)	180(30%)
Kokanee	5(14%)	17(31%)	46(42%)	49(48%)	32(46%)	4(27%)			2 (2%)	1 (2%)			156(26%)
Trout-general	2 (5%)	6(11%)	6 (6%)	2 (2%)	2 (3%)				1 (1%)				19 (3%)
Trout & Kokanee	1 (3%)	1 (2%)	4 (4%)	1 (1%)									7 (1%)
Trout & pike	3 (8%)	2 (4%)	3 (3%)	4 (48)	5 (7%)					3 (5%)		1 (3%)	21 (4%)
N. Pike	19(51%)	12(22%)	12(11%)	17(16%)	16(23%)	3(20%)						21(54%)	100(17%)
Any fish	2 (5%)	14(26%)	33(30%)	25(24%)	12(17%)	1 (7%)			4 (5%)	2 (4%)		6(15%)	99(17%)
No information	1 (3%)			3 (3%)									4 (1%)
TOTAL	37	54	108	103	69	15	3	5	90	56	14	39	593

Table 11. Monthly bull trout (DV) catch and harvest rate for parties on Swan Lake fishing specifically for bull trout.

Month	No. parties interviewed	Hours fished	No. DV kept	No. DV landed	Harvest rate (DV kept/hr.)	Catch rate (DV landed/hr.)
1983						
May (83/84)	3	11.0	11	13	N.C.[a]	N.C.
June	1	2.0		0	N.C.	N.C.
July	4	19.0	0	1	N.C.	N.C.
August	1	1.5		4	N.C.	N.C.
September	1	1.0	8	0	N.C.	N.C.
October	5	18.5	4	4	N.C.	N.C.
November	3	3.5	2	2	N.C.	N.C.
December	5	28.0	2	3	N.C.	N.C.
1984						
January	83	352.3	19	112	.05	.32
February	49	237.4	16	35	.08	.15
March	14	63.5	6	18	.09	.28
April	11	47.0	11	13	.23	.28
TOTAL	180	784.7	72	205	.09	.26

[a] N.C. = Not calculated due to small sample size (less than 10 interviews)

Table 12. Monthly northern pike (NP) catch and harvest rate for parties on Swan Lake fishing specifically for northern pike.

Month	No. parties interviewed	Hours fished	No. NP kept	No. NP landed	Harvest rate (NP kept/hr.)	Catch rate (NP landed/hr.)
1983						
May (83/84)	19	136.0	28	29	.21	.21
June	12	35.0	11	11	.31	.31
July	12	52.5	8	8	.15	.15
August	17	66.2	21	21	.32	.32
September	16	70.5	21	21	.30	.30
October	3	21.0	12	15	N.C.[a]	N.C.
November						
December	8					
1984						
January	0					
February	0					
March	0					
April	21	137.5	10	10	.07	.07
TOTAL	100	518.7	111	115	.21	.22

[a] N.C. = Not calculated due to small sample size (less than 10 interviews)

Table 13. Monthly kokanee salmon (KOK) catch and harvest rate for parties on Swan Lake fishing specifically for kokanee salmon.

Month	No. parties interviewed	Hours fished	No. KOK kept	No. KOK landed	Harvest rate (KOK kept/hr.)	Catch rate (KOK landed/hr.)
1983						
May (83/84)	5	35.0	44	50	N.C.[a/]	N.C.
June	17	86.5	125	129	1.45	1.49
July	46	172.5	240	266	1.39	1.54
August	49	135.1	304	305	2.25	2.26
September	32	83.5	173	173	2.07	2.07
October	4	22.5	16	16	N.C.	N.C.
November	0					
December	0					
1984						
January	2	4.0	7	7	N.C.	N.C.
February	1	1.0	0	0	N.C.	N.C.
March	0					
April	0					
TOTAL	156	540.1	909	946	1.68	1.75

a/ N.C. = Not calculated due to small sample size (less than 10 interviews)

Table 14. Fishing pressure summary (angler-hours) for three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983. Ninety-five percent confidence intervals in parenthesis.

Time period	Swan L. to Goat Cr.			Goat Cr. to Cold Cr.			Cold Cr. to Cygnet L.	All Sections		
	Shore	Boat	Total	Shore	Boat	Total	Shore only	Shore	Boat	Combined
May 21 - June 30	469	281	750	375	62	437	886	1730	343	2073
July	2203	487	2690	1896	77	1973	1665	5764	564	6328
August	1951	1448	3399	1034	59	1093	975	3960	1507	5467
September	525	567	1092	441	84	525	630	1596	651	2247
Oct. & Nov.	20	163	183	189	0	189	21	230	163	393
TOTAL	5167 (±1404)	2946 (±1275)	8114 (±2203)	3935 (±1070)	282 (±280)	4217 (±1114)	4177 (±1193)	13280 (±2131)	3228 (±1305)	16508 (±2742)

Table 15. Harvest estimates for rainbow trout in three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983. Ninety-five percent confidence intervals are in parenthesis.

Time period	Swan Lake to Goat cr.	Goat Cr. to Cold Cr.	Cold Cr. to Cygnet L.	Sections combined
May 21- June 30	0	0	48	48
July	399	129	10	538
August	479	334	32	845
September	202	90	0	292
Oct. & Nov.	0	42	0	42
TOTAL	1080 (±473)	595 (±474)	90 (±76)	1765 (±674)

Table 16. Harvest estimates for brook trout in three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983. Ninety-five percent confidence intervals are inparenthesis.

Time period	Swan Lake to Goat cr.	Goat Cr. to Cold Cr.	Cold Cr. to Cygnet L.	sections combined
May 21- June 30	54	0	202	256
July	581	184	135	900
August	394	111	512	1017
September	177	48	0	225
Oct. & Nov.	0	0	0	0
TOTAL	1206 (±656)	343 (±276)	849 (±709)	2398 (±1005)

Table 17. Harvest estimates for bull trout in three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983. Ninety-five percent confidence intervals are in parenthesis.

Time period	Swan Lake to Goat Cr.	Goat Cr. to Qld Cr.	Cold Cr. to Cygnet L.	Sections combined
Nay 21- June 30	43	0	48	91
July	182	74	0	256
August	I.39	37	0	176
September	0	42	0	42
Oct. & Nov.	0	0	0	0
TOTAL	364 (±219)	153 (±133)	48 (±63)	565 (±264)

Table 18. Harvest estimates for cutthroat trout in three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983. Ninety-five percent confidence intervals are in parenthesis.

Time period	Swan Lake to Goat cr.	Goat Cr. to Qld Cr.	Cold Cr. to Cygnet L.	Sections combined
my 21- June 30	0	0	83	83
July	11	55	31	97
August	21	19	0	40
September	13	6	0	19
Oct. & Nov.	0	0	0	0
TOTAL	45 (±47)	80 (±89)	114 (±115)	239 (±153)

Table 19. Average harvest rates (fish kept per hour) and catch rates (fish landed per hour; in parenthesis) for four species of fish in three sections of the Swan River between Swan and Lindbergh (Cygnet) lakes during 1983.

Section	Number of interviews	Rainbow trout	Brook trout	Bull trout	cutthroat trout
swan L. to Goat Cr.	130	.14(.28)	.15(.34)	.042(.064)	.006(.036)
Goat Cr. to Cold Cr.	59	.16(.43)	.08(.23)	.044(.078)	.017(.046)
Cold Cr. to Cygnet L.	59	.03(.08)	.21(.42)	.025(.036)	.049(.069)
All sections combined	248	.12(.27)	.15(.33)	.038(.061)	.019(.046)

Table 20. Monthlysummaryof bait types used by fishing parties on the Swan River between 21 May and 30 November, 1983.

Bait type	May	June	July	Aug.	Sept.	Oct.	Nov.	TOTAL
Bait	7(64%)	17(53%)	31(41%)	21(26%)	12(26%)			88(35%)
Flies	3(27%)	5(16%)	16(21%)	29(36%)	18(40%)	2(67%)		73(29%)
Lures		7(22%)	12(16%)	14(17%)	7(16%)	1(33%)		41(17%)
Snagging			1 (1%)					1 (0%)
Combination	1 (9%)	3 (9%)	16(21%)	17(21%)	8(18%)		1(100%)	46(19%)
TOTAL	11	32	76	81	45	3	1	249

Table 21. Monthly summary of origin of fishing parties on the Swan River between 21 Hay and 30 November, 1983.

Party origin	May	June	July	Aug.	Sept.	Oct.	Nov.	TOTAL
Kalispell	5(46%)	4(13%)	26(34%)	27(33%)	14(31%)	1(33%)		77(31%)
Other Flathead County	3(27%)	5(16%)	3 (4%)		2 (4%)			13 (58)
Lake County		1 (3%)	3 (4%)	12(15%)	3 (7%)			19 (8%)
Misoula County	2(18%)	11(34%)	15(20%)	20(25%)	17(38%)	1(33%)	1(100%)	67(27%)
Other Western Montana								0 (0%)
E. Montana	1 (9%)	1 (3%)	10(13%)	3 (4%)				15 (6%)
Non-resident (USA)		9(28%)	19(25%)	19(23%)	8(18%)	1(33%)		56(22%)
Foreign		1 (3%)			1 (2%)			2 (1%)
TOTAL	11	32	76	81	45	3	1	249

Table 22. Monthly summary of target species caught by fishing parties on the Swan River between 21 May and 30 November, 1983.

Party origin	May	June	July	Aug.	Sept.	Oct.	Nov.	TOTAL
Rainbow trout		4(13%)	12(16%)	8(10%)	5(11%)			29(12%)
Cutthroat trout		1 (3%)	5 (7%)	1 (1%)				7 (3%)
Brook trout	2(18%)	4(13%)	5 (7%)	2 (2%)				13 (5%)
Bull trout	3(27%)	3 (9%)	3 (4%)	2 (2%)	3 (7%)			14 (6%)
Trout - general	4(37%)	13(40%)	33(43%)	49(61%)	15(33%)	2(67%)		116(46%)
Any fish		3 (9%)	12(16%)	11(14%)	16(36%)	1(33%)	1(100%)	44(18%)
No Information	2(18%)	4(13%)	6 (8%)	8(10%)	6(13%)			26(10%)
TOTAL	11	32	76	81	45	3	1	249

Table 23. Summary of interview information obtained from parties who fished tributaries in the Swan River drainage between 21 May and 30 November, 1983.

Creek	No. of parties interviewed	Total hours fished	Brook Trout		Cutthroat		Bull Trout		Other fish		
			Kept	Landed	Kept	Landed	Kept	Landed	Species	Kept	Landed
Cedar	7	53.0	20	82	0	3					
Lost	6	25.0	14	17	0	2	1	7	Rb?	4	8
Soup	5	34.0	46	73	2	4	0	1			
Woodward	4	29.5	15	20							
Pony	3	21.0	51	78	0	1					
S.F. Lost	2	6.0			1	3					
Goat	2	10.0	1	4					Rb?	1	2
Cold	2	10.0	18	18	5	5	9	9	Rb?	3	3
Fatty	2	11.0									
Bond	1	3.0	25	25							
Gildart	1	5.0	2	2							
Whitetail	1	12.0	0	4							
Porcupine	1	3.0	2	3							
Cilly	1	4.0	10	10							
Dog	1	4.0	3	8							
Holland	1	1.0							NSQ	0	1
Condon	1	2.0	6	6							
Miscellaneous[a]	9	58.5	72	98	2	2	0	2	Rb?	3	3
TOTAL	50	292.0	285	448	10	20	10	19			

a/ Combination of two or more known and also some unknown streams, all in the Swan River drainage.

Table 24. Characteristics of parties that fished tributaries in the Swan river drainage between 21 May and 30 November, 1983.

Characteristic	No. of parties
Bait type:	
Bait	32 (64%)
Flies	7 (14%)
Lures	2 (4%)
Snagging	0
Combination	9 (18%)
TOTAL	50
Angler origin:	
Kalispell	20 (40%)
Other Flathead County	9 (18%)
Lake County	8 (16%)
Missoula county	5 (10%)
Other Western Montana	1 (2%)
Eastern Montana	1 (2%)
Non-resident (USA)	5 (10%)
Foreign	1 (2%)
TOTAL	50
Target species:	
cutthroat	2 (4%)
Brook trout	21 (42%)
Trout-general	15 (30%)
Any fish	7 (14%)
No information	5 (10%)
TOTAL	50

Table 25. Summary of creel interview information obtained during the summer of 1983 from anglers on 11 different waters in Montana.

	Swan Lake[a/]	Ashley Lake	Lake Koocanusa	Hungry Horse Reservoir	Flathcad Lake	Thompson River	Kootenai River	Flathead River	Bighorn River	Swan tribs.	Swan[a/] River
No. parties interviewed	200	52	05	45	52	05	67	70	101	49	201
Ave. no. anglers per party	2.0	2.2	2.3	2.3	1.9	1.0	2.2	1.0	2.6	2.3	2.2
Total no. anglers interviewed	562	116	190	104	99	156	145	125	261	114	441
Total hours fished	973	346	722	377	215	221	334	324	1405	207	1124
Hours per angler per completed trip	2.4	3.9	4.1	3.7	5.0	2.3	2.5	3.6	5.7	2.0	2.0
No. of completed trips	63	17	48	43	1	10	33	33	90	39	124
No. interviews (and % of total):											
May	---	---	---	---	---	---	---		---	3(6%)	---
June	---	---	---	---	---	---	---		---	9(18%)	
July	108(38%)	5 10%)	1 1%)	17(38%)	a--	9(11%)	52 78%)	34(49%)	9(9%)	22(45%)	77(38%)
August	103(37%)	28 54x)	35 41%)	21 46%)	23 44%)	52 61:)	15 22%)	36(51%)	49 48%)	9(18%)	81(40%)
September	69(25%)	19(36%)	49(58%)	7 16%)	29 56%)	24 28%)	---		43 43:)	5(10%)	43(22%)
October	---	---	---	---	---	---	---		---	1(3%)	

a/ Only includes interview data collected durlng the months of July through Septamber, for comparative purposes.

Table 26. Characteristics of anglers fishing at eleven different waters in Montana as determined from interviews conducted during the summer of 1983.

	Swan Lake[a/]	Ashley Lake	Lake Koocanusa	Hungry Horse Reservoir	Flathead Lake	Thompson River	Kootenai River	Flathead River	Bighorn River	Swan trlbs.	Swan[a/] River
No. parties interviewed	260	52	05	45	52	05	67	70	101	49	201
No. (and %) of parties fishing from boats	276(99%)	51(98%)	81(95%)	39(87%)	51(98.)	0(0%)	8(12%)	19(27%)	84(83%)	--	5(3)
No. (and %) of parties fishing from shore	4(1%)	1(2%)	4(5%)	6(13%)	1(2%)	85(100%)	59(88%)	51(73%)	17(17%)	49(100%)	196(97.)
No. (and %) of parties using:											
Bait	26(9%)	5(10%)	0 10%)	3(7%)	2(4X)	25(29%)	35(52%)	20(29%)	12 12:)	32 65%)	63 31:)
Flies	---	---	2%)	---	---	25(29%)	14(21%)	17(24%	21 21%)	7 15%)	63 31:
Lures	163 59%)	14 27%)	7:1 82%)	33(73%)	10 19:	10(12%)	10(27%)	10(14%	44 3x)	2 4%)	33 17%
Any combination	90 32%)	33 63%)	---	9(20%)	39 75:	25(29%)	---	23(33%)	24 4X)	0 16%)	41 20%)
No. (and %) of parties from:											
Kalispell	34(12%)	26(50%)	14(17%)	17(38%)	3(6%)	19(22%)	3(4%)	36(51%)	---	20(41%)	66(33%)
Other Flathead County	16(6%)	15(29%)	---	18(40%)	26(50%)	5(6%)	2(3%)	14(20%)	---	8(16%)	5(2)
Lah County	73(26%)	1 2%)	---	2(4%)	12(23%)	3(4%)	---	---	---	8(16%)	10 9%
Missoula County	18(6%)	---	---	---	1(2%)	7(8%)	---	1(2%)	---	5(10%)	52(26.)
Other Western Montana	6(2%)	1(2%)	35(41%)	---	---	17(20%)	37(55%)	1(2%)	2(2.)	1(2%)	---
Eastern Montana	48(17%)	---	1(1%)	4(9%)	1(2%)	5(6%)	1(2%)	5(7%)	68(67%)	1(2%)	13 6.)
Non-resident (USA)	48(17%)	7 13X)	34(40%)	4(9%)	8(15%)	27(32%)	23(34%)	11(15%)	31(31%)	5(10%)	46 23%)
Foreign	37(13%)	2 4%)	1(1%)	---	1(2%)	2(2%)	1(2%)	2(3%)	---	1(2%)	1(1%)

a/ Only Includes interview data collectad during the months of July through September, for comparative purposes.

Table 27. Target species summary for parties of anglers fishing 11 different waters in Montana during the summer of 1983.

	Swan Lake[a/]	Ashley Lake	Lake Koocanusa	Hungry Horse Reservoir	Flathead Lake	Thompson River	Kootenr 1 River	Flathead River	Bighorn River	Swan tribs.	Swan[a/] River
No. parties interviewed	280	52	85	45	52	85	67	70	101	49	201
No. (and %) of parties fishing for:											
Rainbow trout	2(1%)	---	10(12%)	---	---	13(15%)	21(31%)	---	3(3%)	---	25(12%)
Cutthroat trout	---	---	---	18(44%)	---	1(1%)	---	16(22%)	---	2(4%)	6(3%)
Brook trout	---			---	---	7(8%)	---	---	---	20(41%)	7(3%)
Brown trout	---	---	---	---	---	---	---	---	4(4%)	---	
Bull trout	6(2%)			---	3(6%)	---	---	2(3%)	---	---	8(4%)
Lake trout	---	---	---	---	3(6%)	---	---	---			---
Kokanee salmon	127(45%)			---	45(86%)	---	---	---	---		---
Trout - general	10(4%)	4(4%)	21(16%)	18(44%)	1(2%)	51(60%)	37(55%)	36(52%)	94(93%)	15(31%)	91(45%)
Trout & Kokanee	5(2%)	24(46%)	4(5%)	---	---	---	---	---	me-	---	---
Trout & Whitefish	---	---	---	2(5%)	---	---	---	2(3%)			
Yellow perch	---	3(6%)	---	---	---	---	---	---			
Northern pike	45(16%)	---	---	---	---	---	---	---	---	---	---
Trout & Pike	12(4%)	---	---	---	---	---	---	---	---	---	
Any fish	70(25%)	4(7%)	35(41%)	3(7%)	---	13(15%)	9(14%)	14(20%)	---	7(14%)	45(22%)
No information	3(1%)		1(1%)	---	---	---	---	---	---	5(10%)	19(10%)

a/ Only includes interview data collected during the months of July through September, for comparative purposes.

Table 28. Summary of harvest rates (fish kept per hour) and catch rates (fish landed per hour; in parentheses) for 11 different waters in Montana during the summer of 1983.

	Swan Lake[a/]	Ashley Lake	Lake Koocanusa	Hungry Horse Reservoir	Flathead Lake	Thompson River	Kootenai River	Flathead River	Bighorn River	Swan tribs.	Swan[a/] River
Total hours fished	973	346	722	377	215	221	334	324	1485	287	1124
Harvest (and catch) rates for:											
Cutthroat trout	.01(.01)	.01(.01)	.05(.07)	.11(.18)	.01(.01)	.02(.03)	.05(.06)	.29(.66)	---	.03(.07)	.02(.05)
Rainbow trout	.01(.01)	---	.15(.15)	.01(.01)	---	.37(.80)	.26(.29)	.06(.11)	.04(.11)	.04(.06)	.13(.30)
Bull trout	.02(.02)	---	---	.01(.01)	0(.01)	.01(.01)	.01(.01)	.01(.02)	---	.03(.07)	.03(.06)
Brook trout	---	---	---	---	---	.22(.60)	---	---	---	.95(1.50)	.14(.35)
Brown trout	---	---	---	---	---	---	---	---	.06(.22)	---	---
Kokanee salmon	.95(1.01)	1.28(1.33)	.01(.01)	---	.28(.28)	---	---	---	---	---	---
Whitefish	.01(.01)	---	---	---	---	.01(.01)	.02(.02)	.01(.07)	---	---	0(.01)
Northern pike	.06(.06)	---	---	---	---	---	---	---	---	---	---
Lake trout	---	---		---	.01(.01)	---	---	---	---	---	---
Rough fish (peamouth, squawfish, suckers)	.02(.03)	.01(.04)	.01(.01)	0(.05)	0	.01(.02)	.01(.01)	.01(.01)	0	.01(0)	.01(.02)

a/ Only includes interview data collected during the months of July through September, for comparative purposes.

Table29 . Length information for fish harvested from ten areas in Montana during 1983 and 1984.

	Ralnbow trout	Cutthroat trout	Brook trout	Bull trout	Kokanee salmon	Other[a] species
Flathead Lake						(LT)
Ave. length (mm)	---	---	---	---	336	508
Range (mm)	---	---	---	---	(257-388)	(435-565)
No. measured	---	---	---	---	61	3
Ashley Lake						(YP)
Ave. length (mm)	---	---	---	---	238	247
Range (mm)	---	---	---	---	(157-270)	(225-280)
No. measured	---	---	---	---	98	6
Lake Koocanusa						
Ave. length (mm)	334	303	---	---	339	---
Range (mm) . .	(190-420)	(220-400)	---	---	(265-440)	---
No. measured	51	24	---	---	7	---
Flathead River						
Ave. length (mm)	281	230	---	453	---	---
Range (mm)	(246-364)	(175-386)	---	(291-710)	---	---
No. measured	11	85	---	3	---	---
Swan River						
Ave. length (mm)	264	226	218	444	---	---
Range (mm)	(163-440)	(192-285)	(160-287)	(220-697)	---	---
No. measured	38	4	26	9	---	---
Thompson River						
Ave. length (mm)	251	249	176	323	---	---
Range (mm)	(164-456)	(199-318)	(134-227)	(280-365)	---	---
No. measured	38	3	21	2	---	---
Kootenal River						
Ave. length (mm)	303	---	---	---	---	---
Range (mm)	(193-390)	---	---	---	---	---
No. measured	42	---	---	---	---	---

Table 29. (Continued).

	Rainbow trout	Cutthroat trout	Brook trout	Bull trout	Kokanee salmon	Other species[a/]
Swan Lake						(NP)
Ave. length (mm)	292	296	300	458	240	613
Range (mm)	(243-328)	(259-352)	(222-378)	(298-708)	(192-309)	(392-891)
No. measured	6	5	2	69	57	65
Swan trfbutarles						
Ave. length (mm)	133	189	207	172	---	---
Range (mm)	(133)	(150-219)	(115-405)	(135-214)	---	---
No. measured	2	3	11	6	---	---
Bighorn River						(LL)
Ave. length (mm)	353	---	---	---	---	396
Range (mm)	(173-709)	---	---	---	---	(157-660)
No. measured	5817	---	---	---	---	3923

a/ LT = Lake trout, YP = Yellow perch, NP = Northern pike, LL = Brown trout.

AGE AND GROWTH - TRIBUTARIES

The following sections describe the growth rates of cutthroat and juvenile bull trout in several tributary streams. A summary of these date may be found in Leathe and Enk (1985). That document also contains growth rate information for rainbow and brook trout from the Swan River and for adult and juvenile hull trout from all parts of thedrainage.

Cutthroat Trout

Age and growth information for cutthroat trout from four tributary streams is presented in Tables 30 through 33. Length at annulus was backcalculated using a body length to scale radius relationship derived from a pooled sample of all tributary cutthroat. The equation for that line (n=339, r=0.89) was:

$$\log(TL) = 0.81 \log(SR) + 1.00$$

where: TL = total body length in millimeters, and
SR= scale radius in millimeters, measured at 71X magnification.

Bull Trout

Age and growth data for juvenile bull trout collected from five tributaries are in Tables 34 through 38. Length at annulus was back calculated us - a body-scale relationship derived from a pooledsampleofa&.lt(fromSwanIakeandtributaryspaw~~rtraps) and juvenile fish. The equation describing the body-scale relationship (n=581, r=0.98) was:

$$\log(TL) = 1.11 \log(SR) + 0.60$$

where : TL = total body length in millimeters, and
SR = scaleradiusin millimeters, measured at 71X magnification.

Table 30. Backcalculated total lengths and length increments for cutthroat trout collected from Cedar Creek during September 1982.

Age	(n)	Length (mm) at annulus I	II	III	Iv	V
1	(11)	50	0		0	0
2	(23)	50	92	8	0	0
3	(31)	50	93	125	0	0
4	(15)	49	84	113	140	0
5	(3)	50	92	126	154	176
Grand mean calculated length		50	91	121	142	176
(n)		(83)	(72)	(49)	(18)	(3)
Length increment		50	41	30	21	34

Table 31. Backcalculated total lengths and length increments for cutthroat trout collected from Groom Creek during August and September 1982.

Age	(n)	Length (mm) at annulus I	II	III	IV
			0		
1	(17)	46	78	0	0
2	(47)	43		0	0
3	(20)	50	85	120	0
4	(5)	49	85	127	160
Grandmean calculated length		45	80	121	160
(n)		(89)	(72)	(25)	(5)
Length increment		45	35	41	39

Table 32. Backcalculated total lengths and length increments for cutthroat trout collected from Soup Creek during August 1982.

Age	(n)	Length (mm) at annulus I	II	III	IV
1	(1)	42	0	0	0
	(48)	45	79		0
3	(56)	49	82	118	0
4	(17)	51	82	118	147
Grand mean calculated length		47	81	118	147
(n)		(122)	(121)	(73)	(17)
Length increment		47	34	37	29

Table 33. Backcalculated total lengths and length increments for cutthroat trout collected from the South Fork of Lost Creek during August and September 1982.

Age	(n)	Length (mm) at annulus I	II	III	IV
1	(8)	43	0	0	0
3	(9)	43	76	0	0
4	(19)	45 47	80 91	139 148	191 0
Grand mean calculated length		44	80	140	191
(n)		(41)	(33)	(24)	(5)
Length increment		44	36	60	51

Table 34. Backcalculated total lengths and length increments for juvenile bull trout collected from Cold Creek during Septenbr 1982.

Age	(n)	Length (mm) at annulus I	II	III
1	(9)	54	0	0
2	(28)	46	93	0
3	(12)	47	88	126
Grand mean calculated length		48	92	126
(n)		(49)	(40)	(12)
Length increment		48	44	34

Table 35. Backcalculated total lengths and length increments for juvenile bull trout collected from Elk Creek during October 1982.

Age	(n)	Length (mm) at annulus I	II
0	(16)	0	0
1	(16)	49	0 109
Grand mean calculated length		56	109
(n)		(95)	(16)
Length increment		56	53

Table 36. Backcalculated total lengths and length increments for juvenile bull trout collected from Lion Creek during September 1982.

Age	(n)	Length (mm) at annulus I	II	III
0	(10)	0	0	0
1	(29)	78	0	0
2	(24)	73	120	0
3	(4)	76	122	175
Grand mean calculated length		76	120	175
(n)		(57)	(28)	(4)
Length increment		76	44	55

Table 37. Backcalculated total lengths and length increments for juvenile bull trout collected from the North Fork of Lost Creek during August 1982.

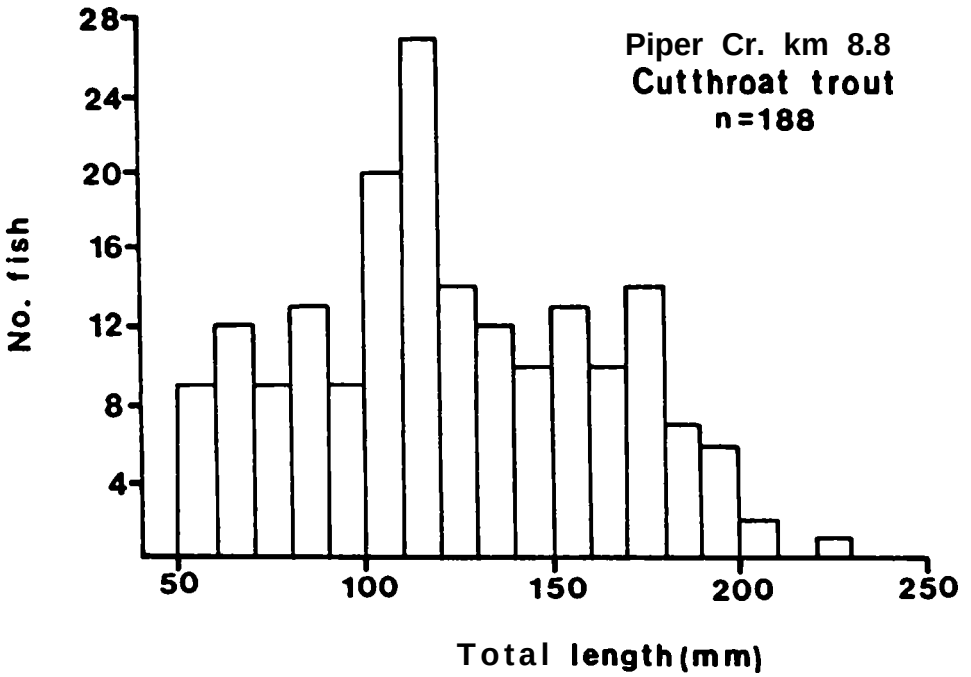
Age	(n)	Length (mm) at annulus I	II	III
0	(4)	0	0	0
1	(20)	72	0	0
2	(3)	67	110	0
3	(3)	69	108	150
Grand mean calculated length		71	109	150
(n)		(26)	(6)	(3)
Length increment		76	38	41

Table 38. Backcalculated total lengths and length increments for juvenile bull trout collected from Squeezer Creek during August and September 1982.

Age	(n)	Length (mm) at annulus I	II	III
2	(30)	50	90	0
3	(2)	75	125	179
Grand mean calculated length		54	99	179
(n)		(51)	(32)	(2)
Length increment		54	45	80

LENGTH FREQUENCY INFORMATION

This section contains example length frequency diagrams for various species in different parts of the Swan drainage. Length distributions of fish captured in tributary population monitoring sections during the summer and fall of 1984 are presented in Figures 2 through 11. Data for fish captured in Swan River electrofishing during the fall of1982 are in Figures 12 through 16. Swan Lake gill netting data are in Figures 17 and 18, while information on creeled fish from various parts of the Swan drainage and from various otherwatersare in Figures 19 through 25.



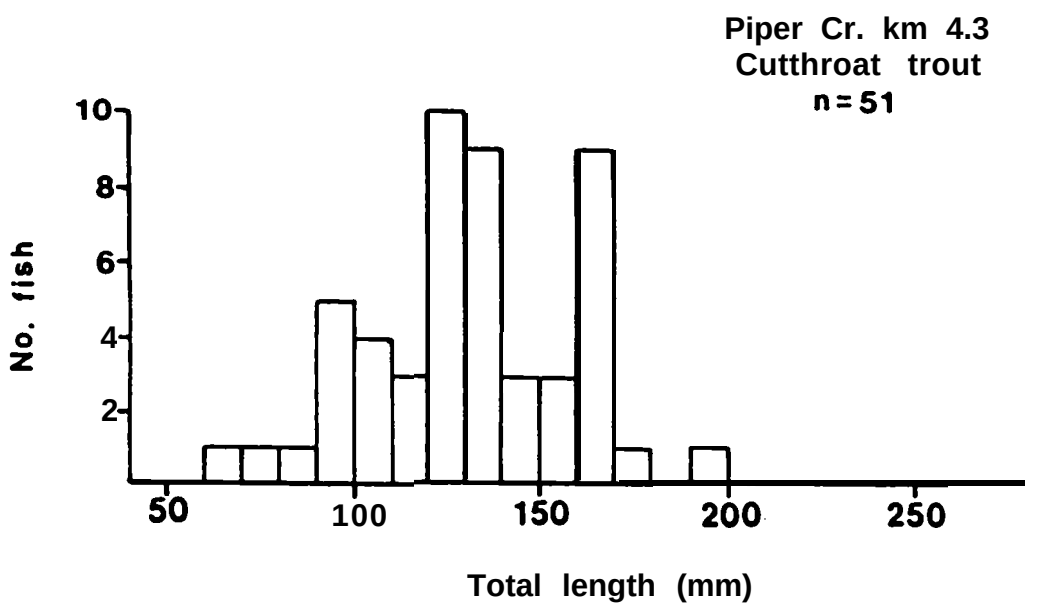


Figure 2. Length frequency diagrams for cutthroat trout captured byelectrofishing in Piper Creek during July and August, 1984.

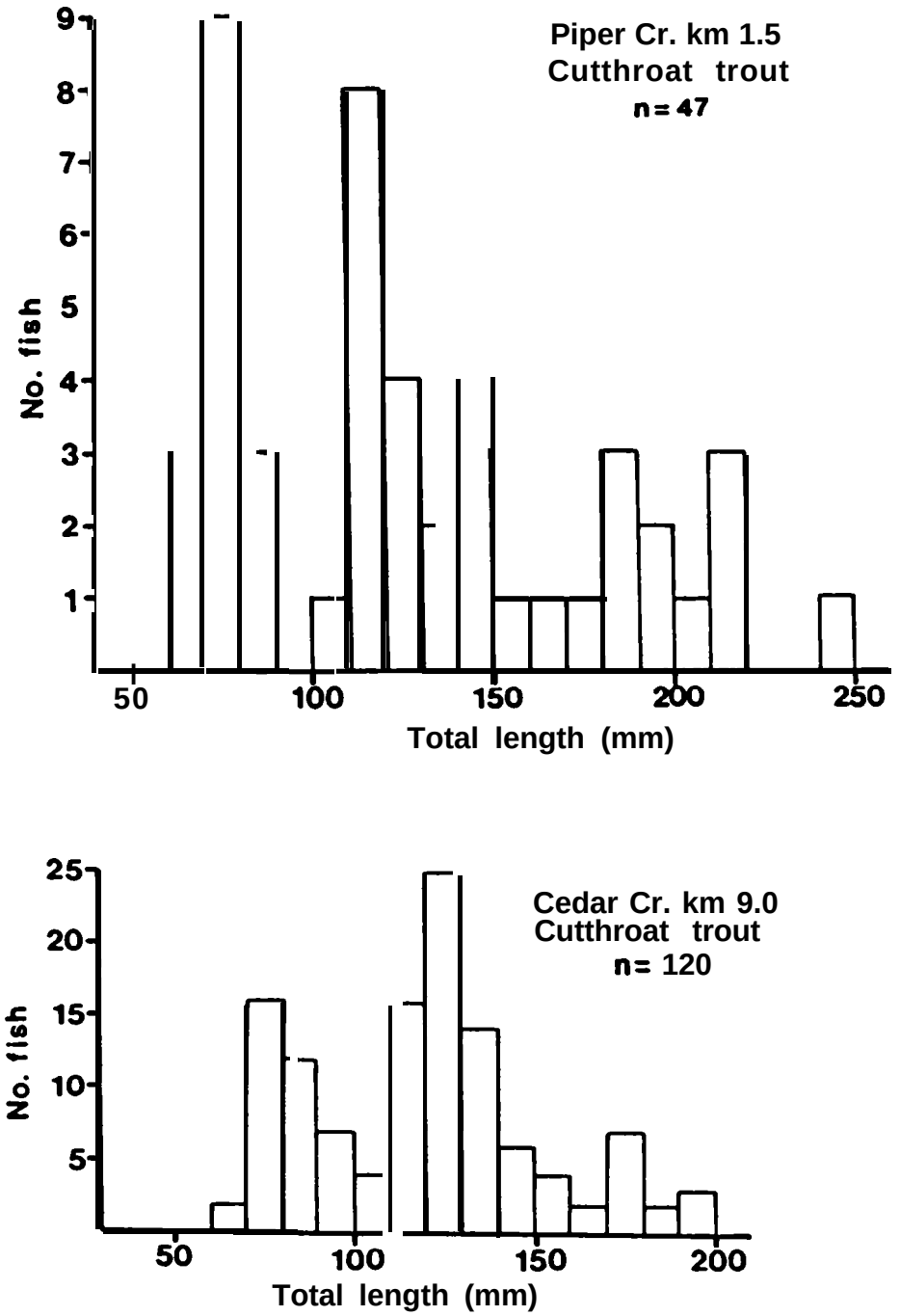
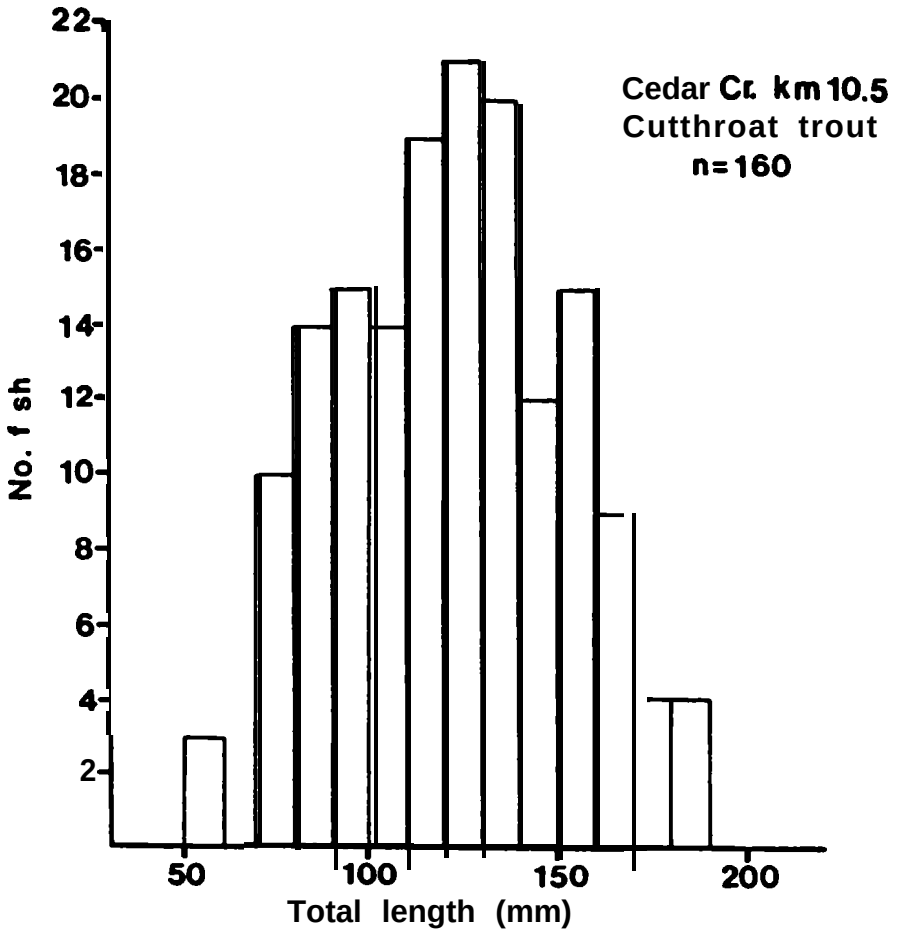


Figure 3. Length frequencydiagrams forcutthroattrout captured by electrofishing in Piper Creek and Cedar Creek during August and September, 1984.



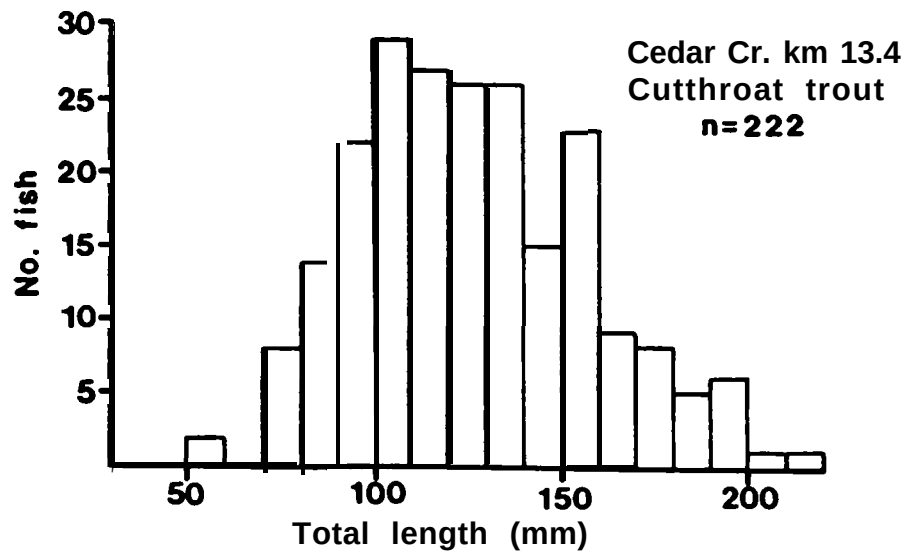
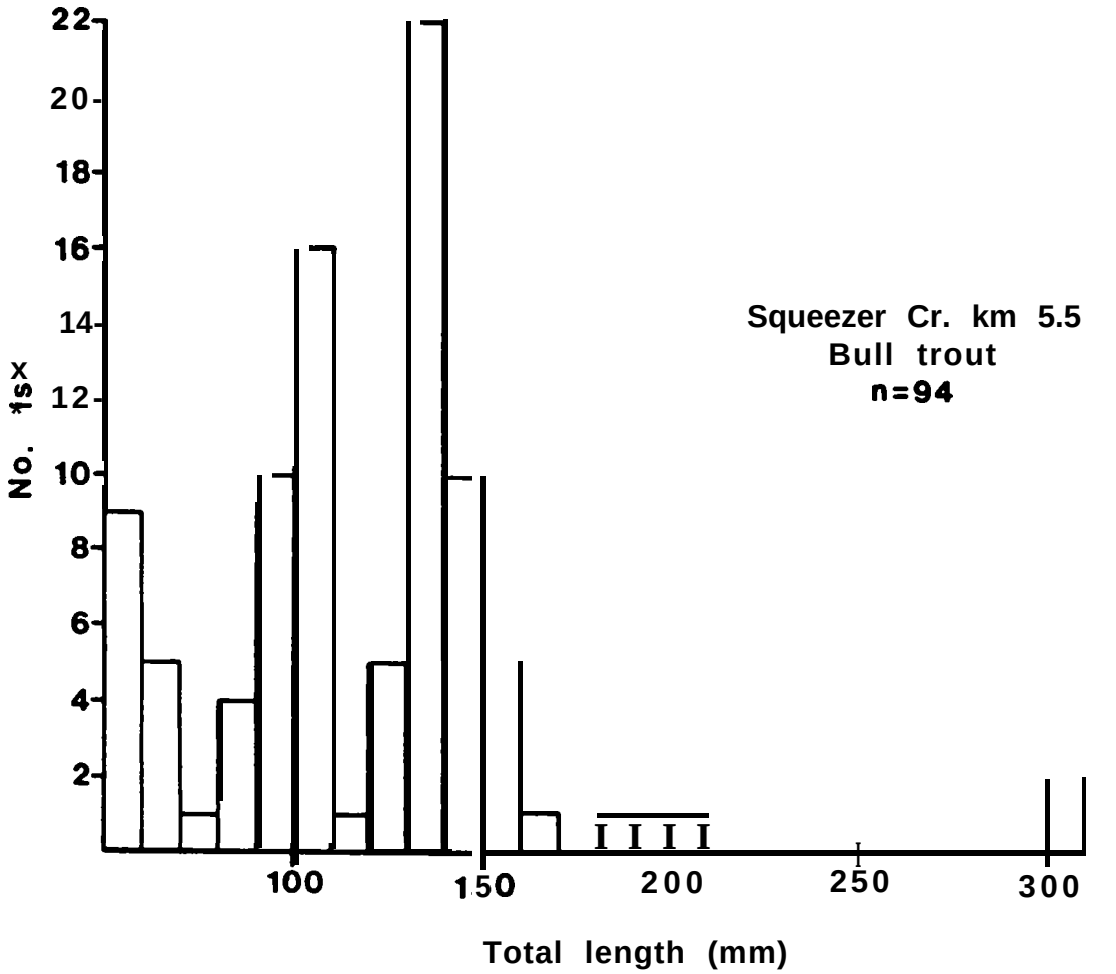


Figure 4. Length frequency diagrams for cutthroat trout captured by electrofishing in Cedar Creek during September, 1984.



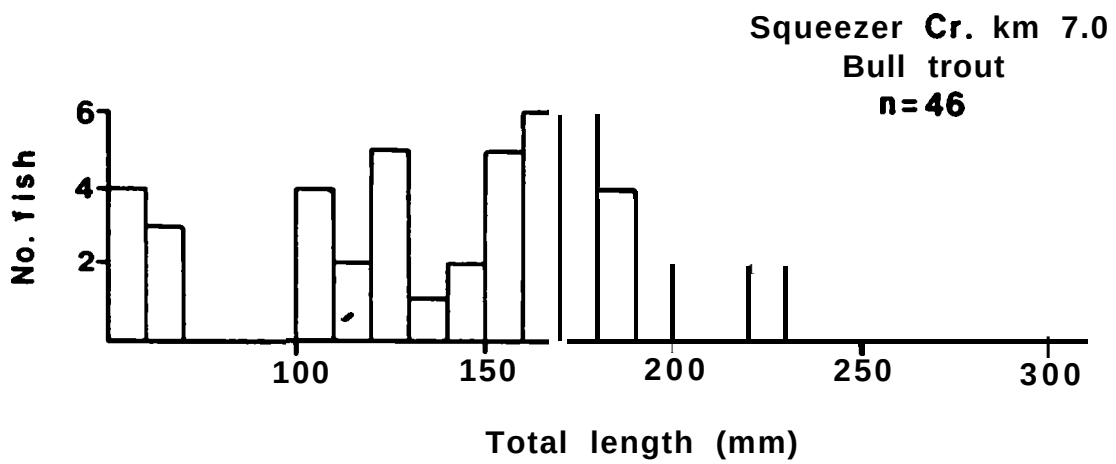
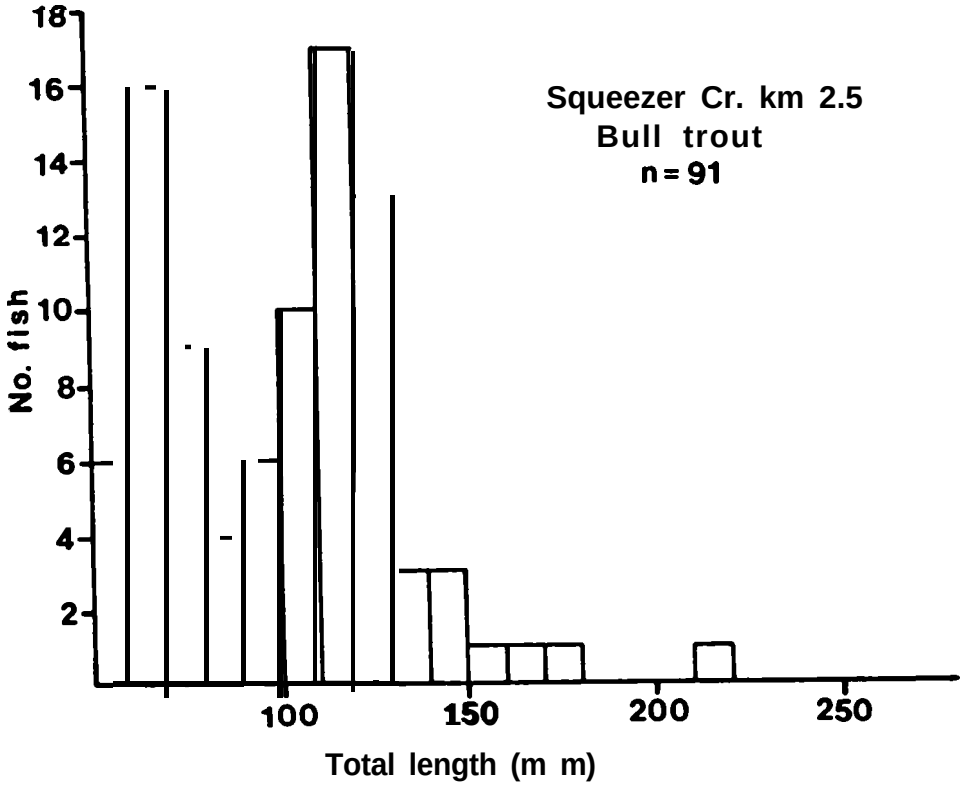


Figure 5. Length frequency diagrams for juvenile bull trout captured by electrofishing in Squeezer Creek during September and October, 1984.



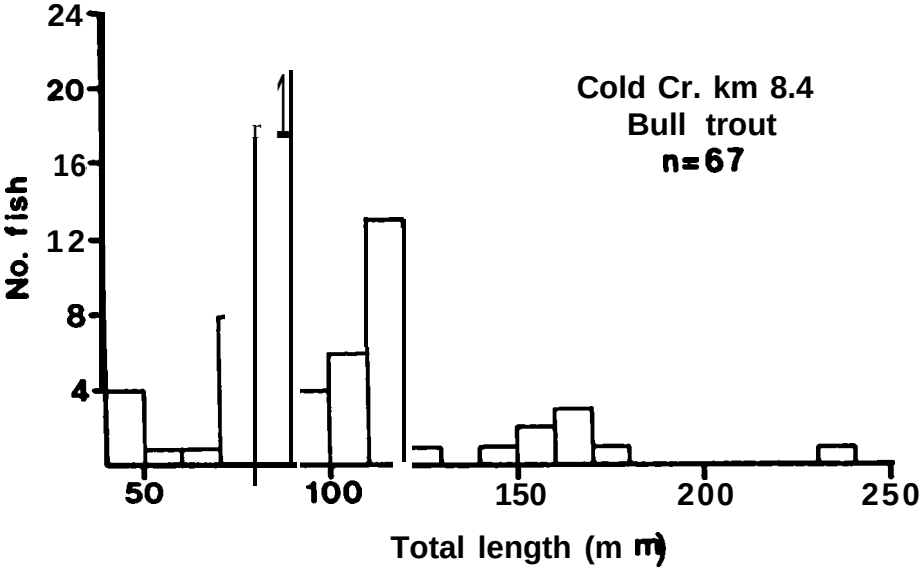
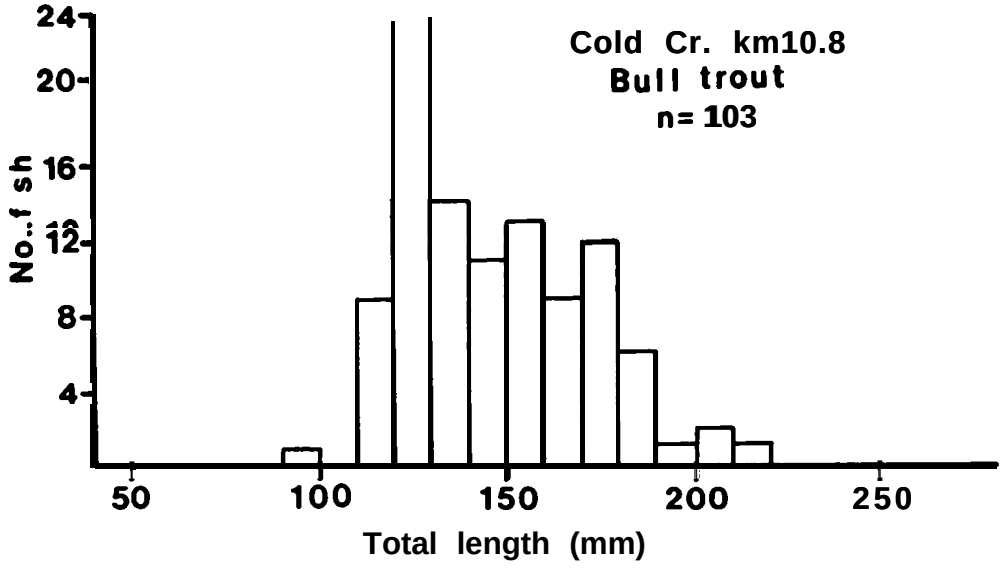


Figure 6. Length frequency diagrams for juvenile bull trout captured by electrofishing in Squeezer Creek and Cold Creek during August, September, and October, 1984.



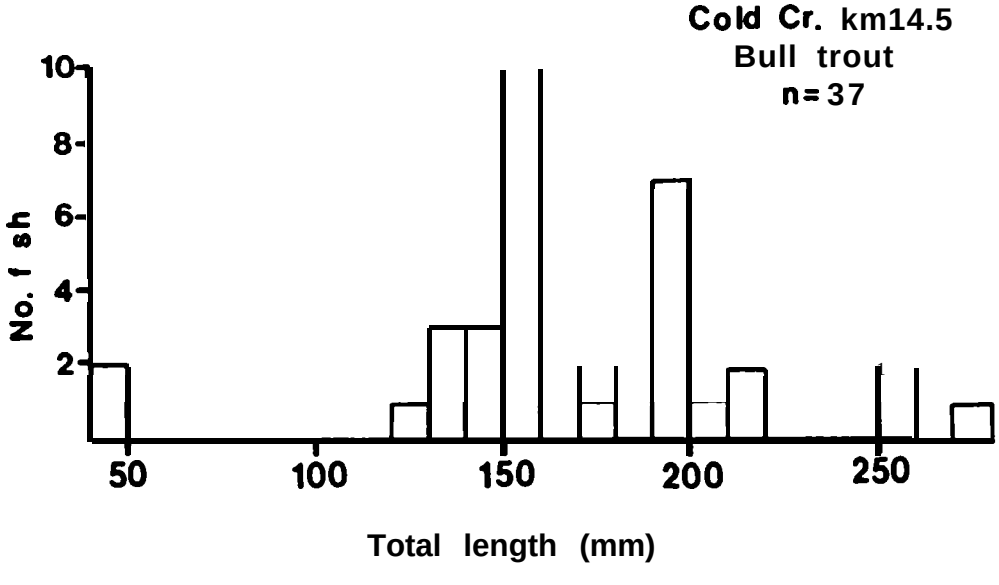
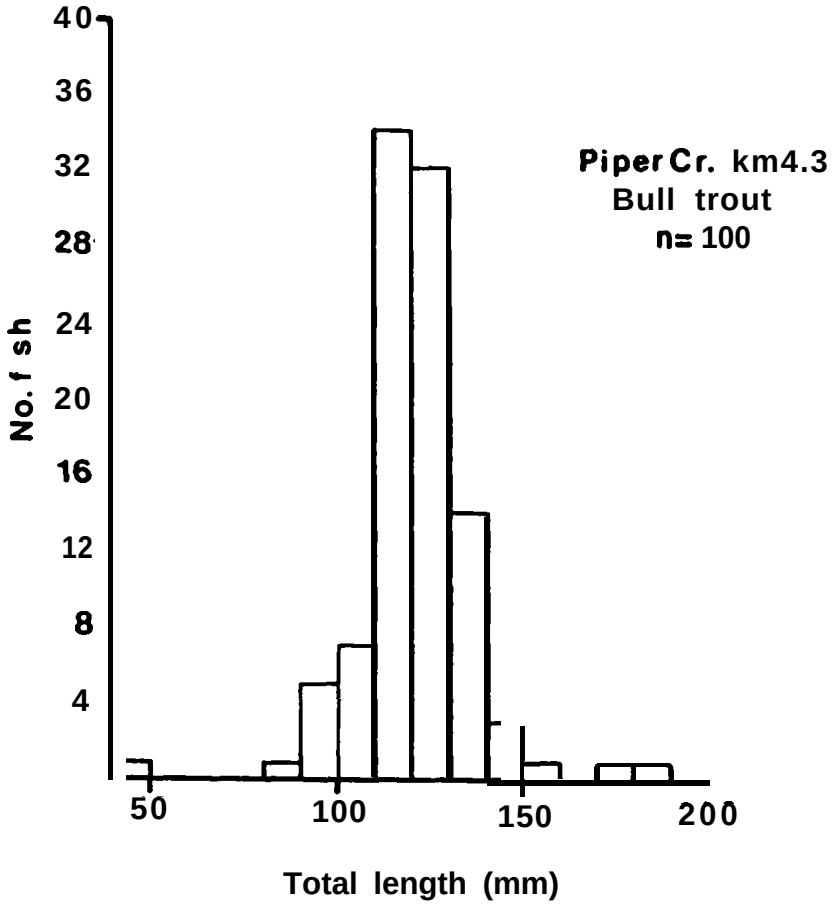


Figure 7. Length frequency diagrams for juvenile bull trout captured by electrofishing in Cold Creek during August, 1984.



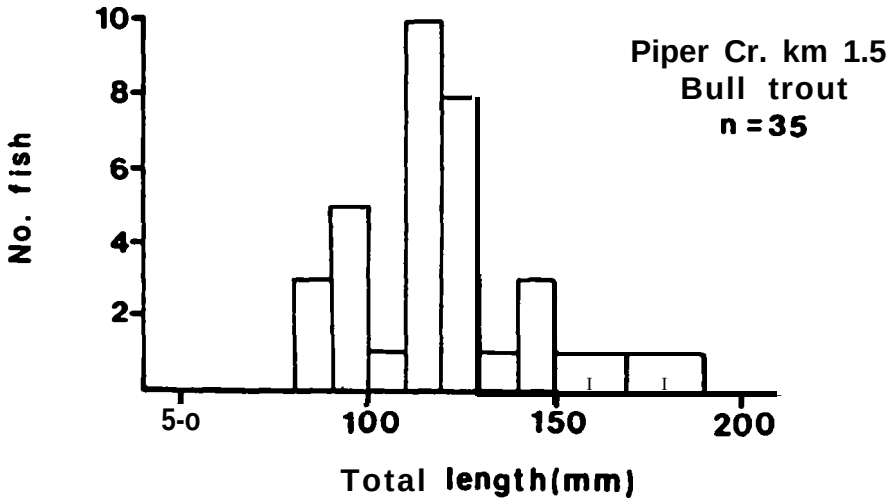


Figure 8. Length frequency diagrams for juvenile bull trout captured by electrofishing in Piper Creek during July and August, 1984.

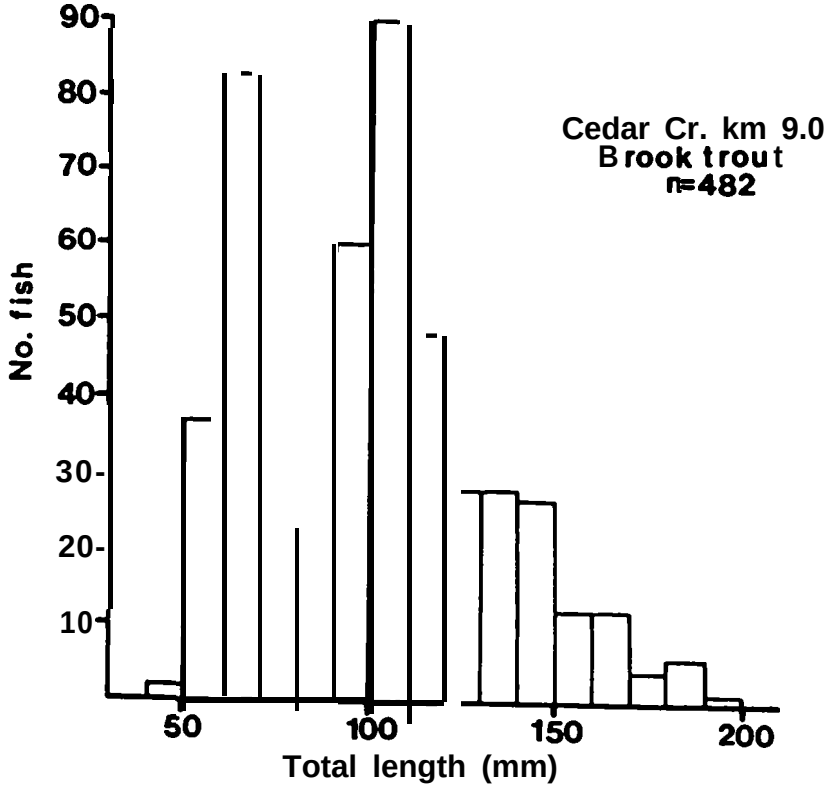
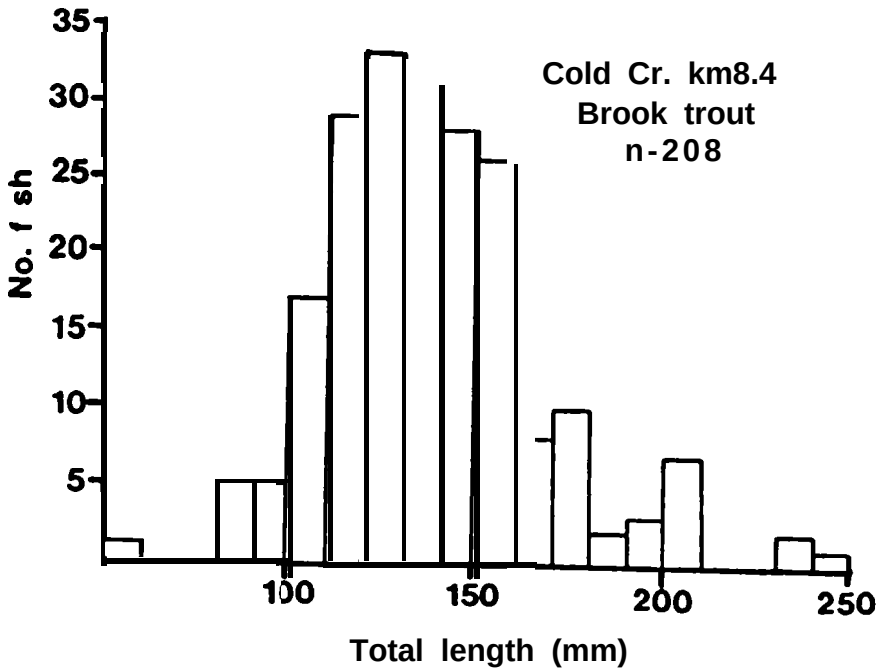


Figure 9. Length frequency diagram for brook trout captured byelectrofishing in Cedar Creek during September, 1984.



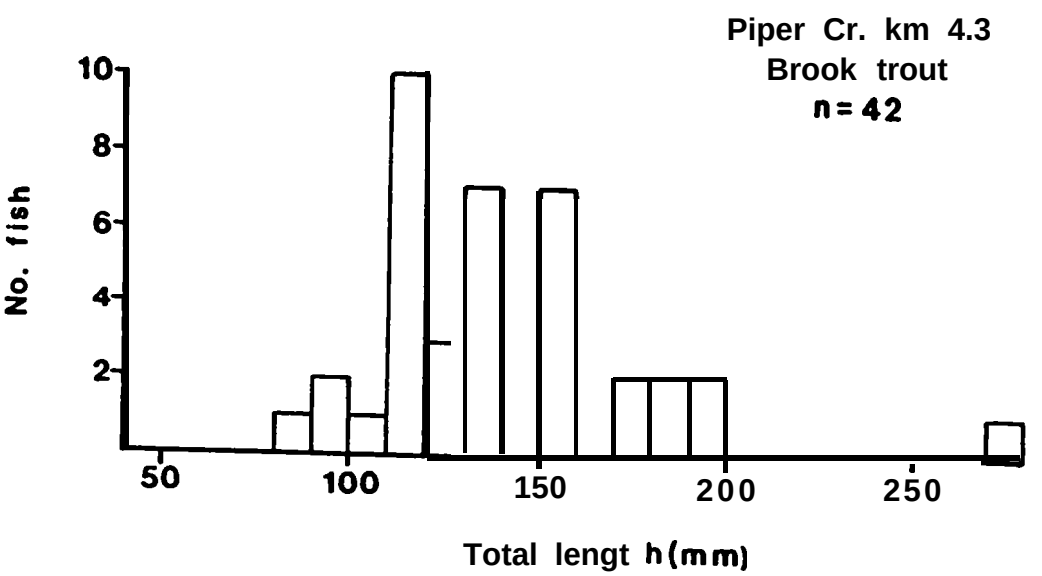
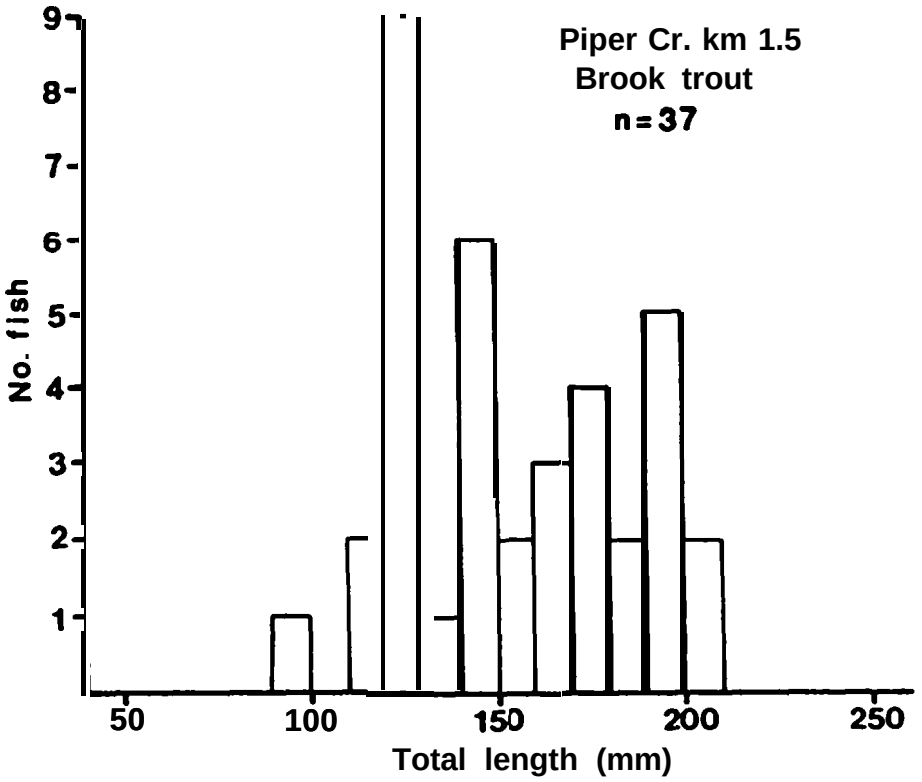


Figure 10. Length frequency diagrams for brook trout captured by electrofishing in Cold Creek and Piper Creekduring July, August, and September, 1984.



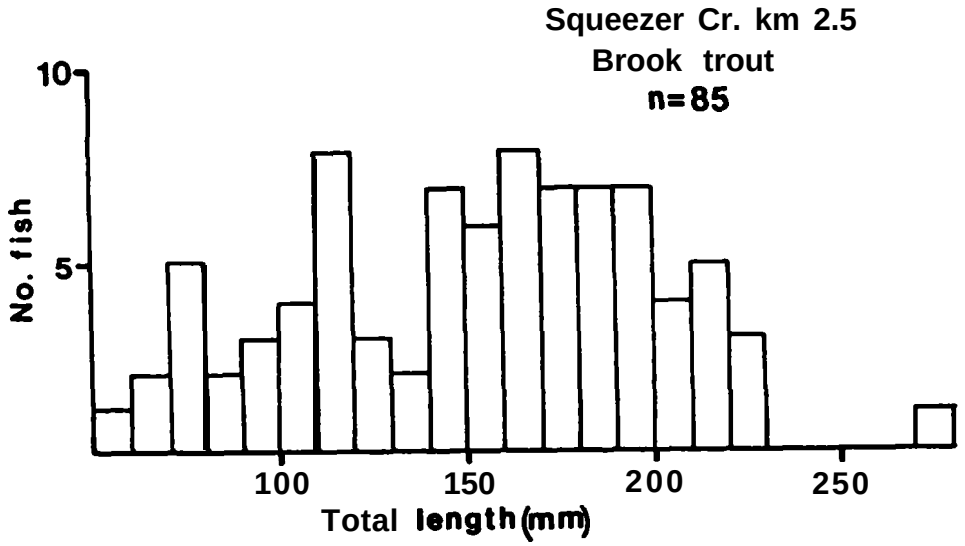


Figure 11. Length frequency diagrams for brook trout captured by electrofishing in Piper Creek and Squeezer Creek during August, September, and October, 1984.

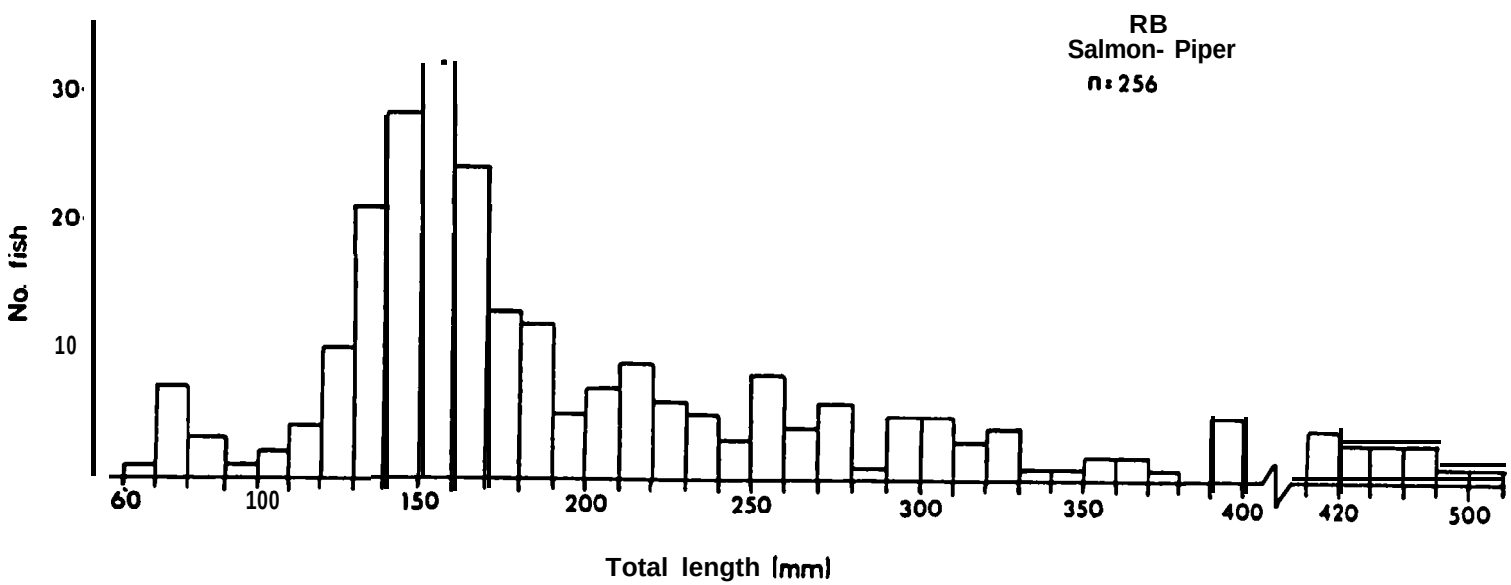


Figure 12. Length frequency diagram for rainbow trout captured by electrofishing during fall 1982 on a section of the middle Swan River between the Salmon Prarie and Piper Creek bridges.

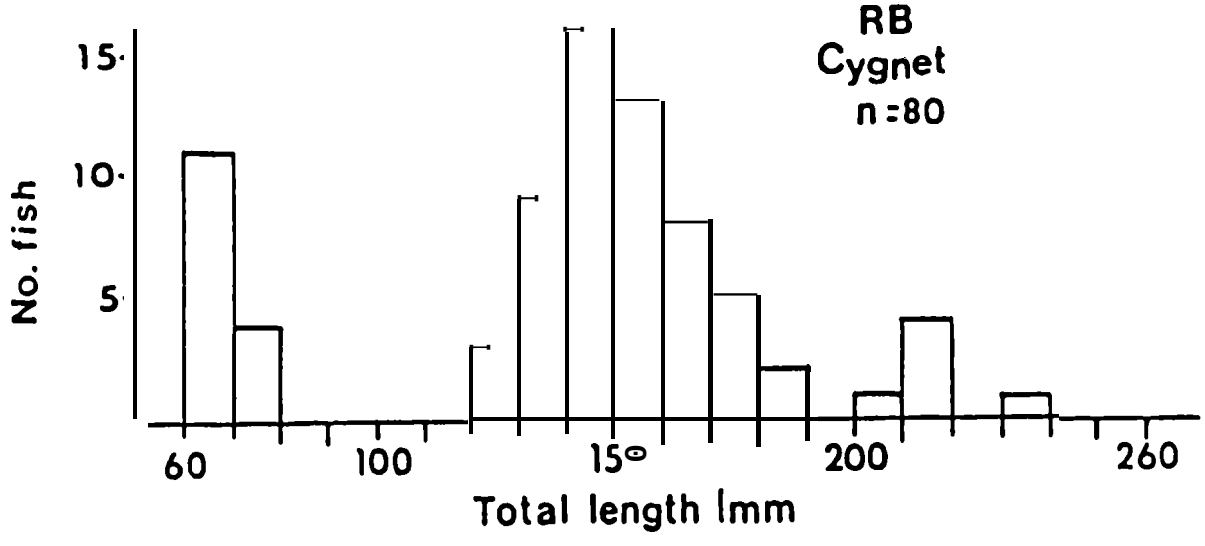
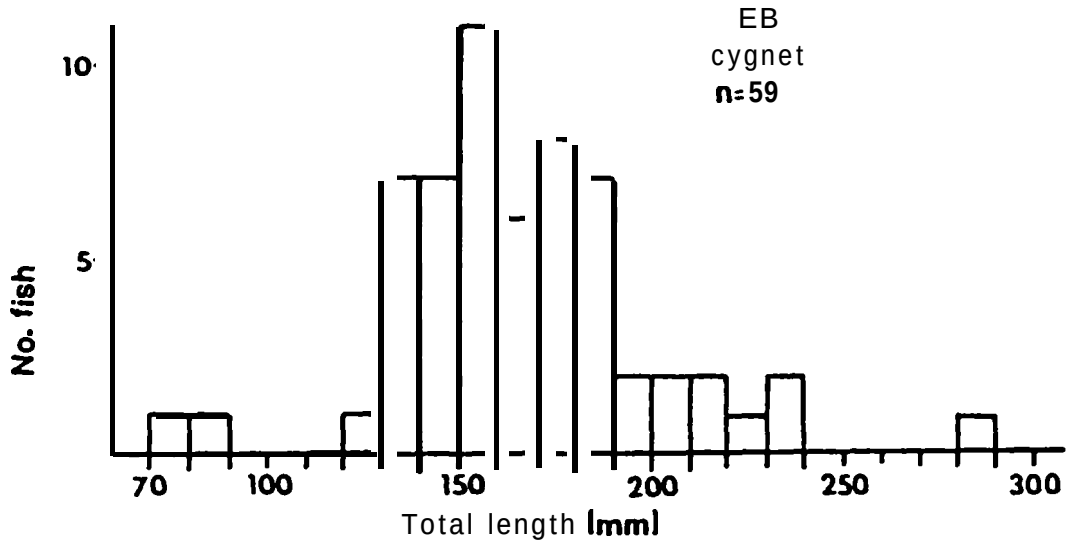


Figure 13. Length frequency diagram for rainbow trout captured during 1982 in an electrofishing section on the upper Swan River below Cygnet Lake.



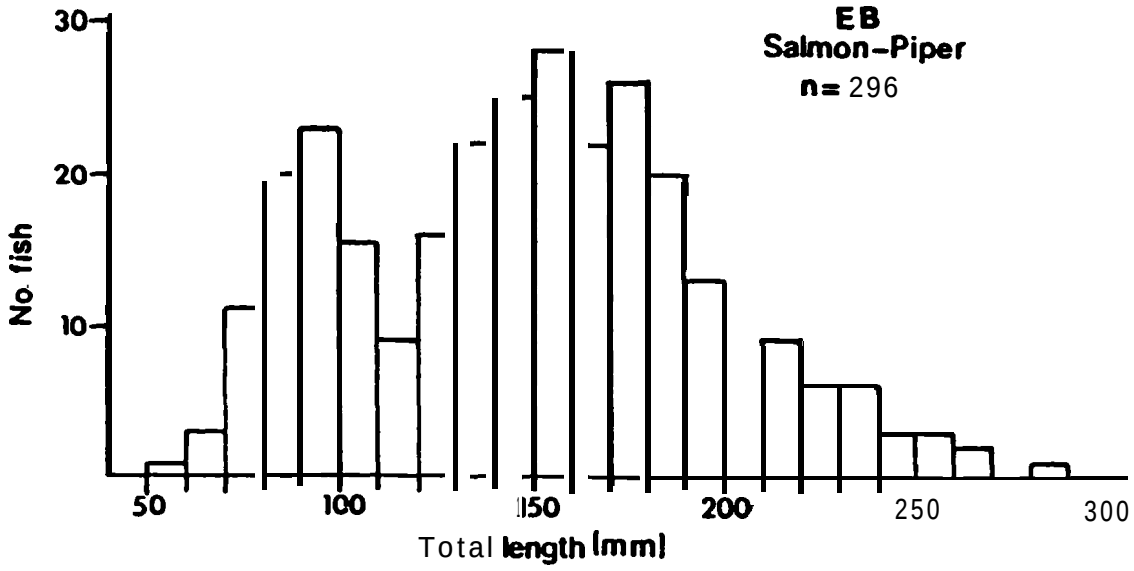


Figure 14. Length frequency diagrams for brook trout captured during 1982 by electrofishing in a section of the upper Swan River below Cygnet Lake and in the middle Swan River between the Salmon Prairie and Piper Creek bridges.

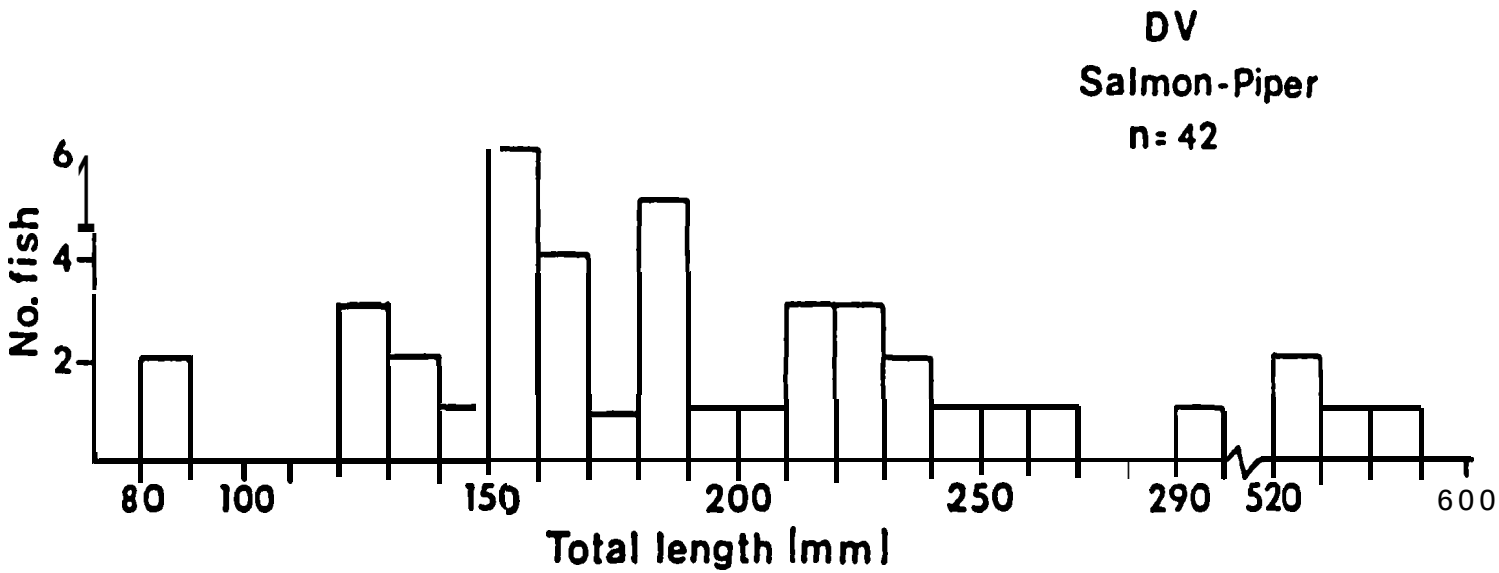


Figure 15. Length frequency diagram for bull trout captured by electrofishing during 1982 in the middle section of the Swan River between the Salmon Prairie and Piper Creek bridges.

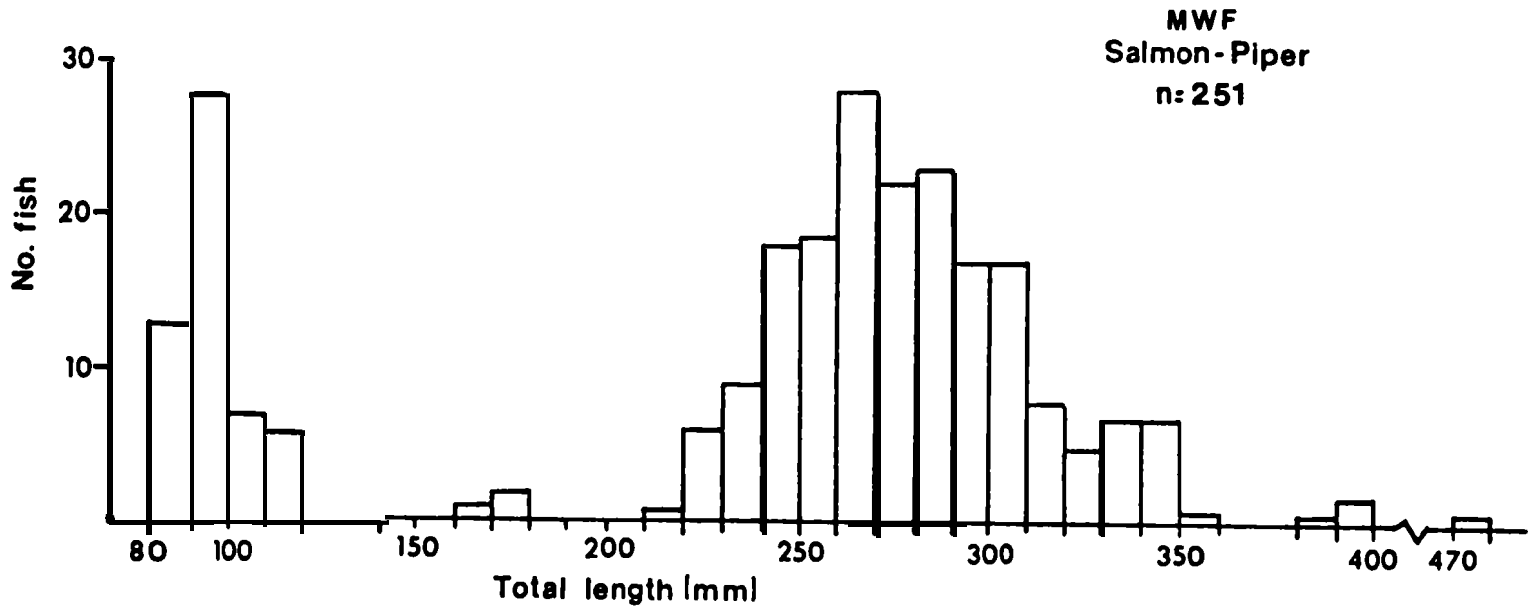
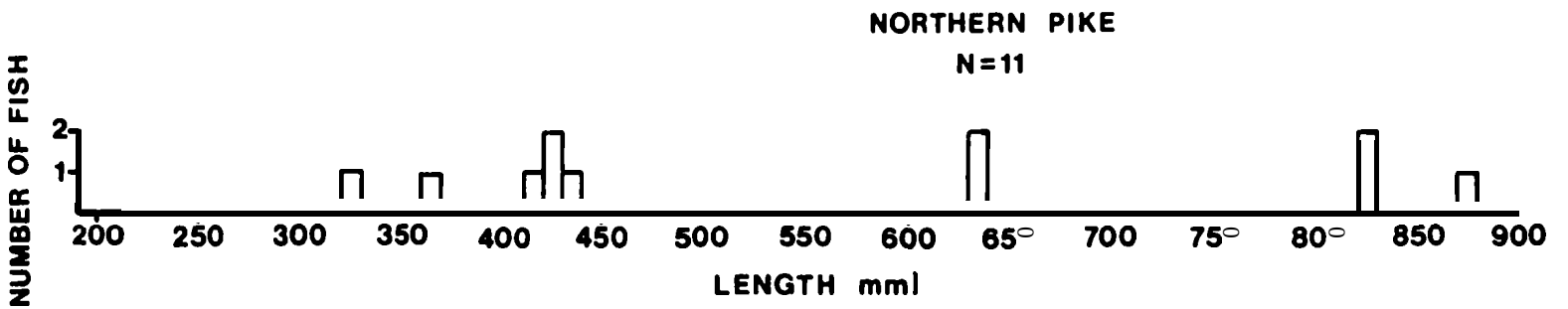


Figure 16. Length frequency diagram for mountain whitefish captured by electrofishing during fall 1982 on the middle section of the Swan River between the Salmon Prairie and Piper Creek bridges.



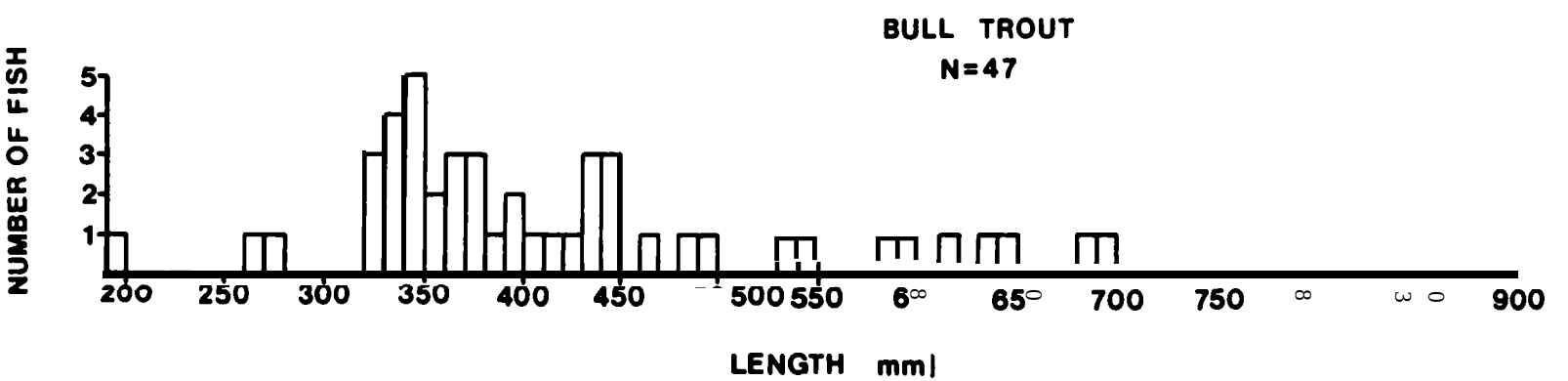
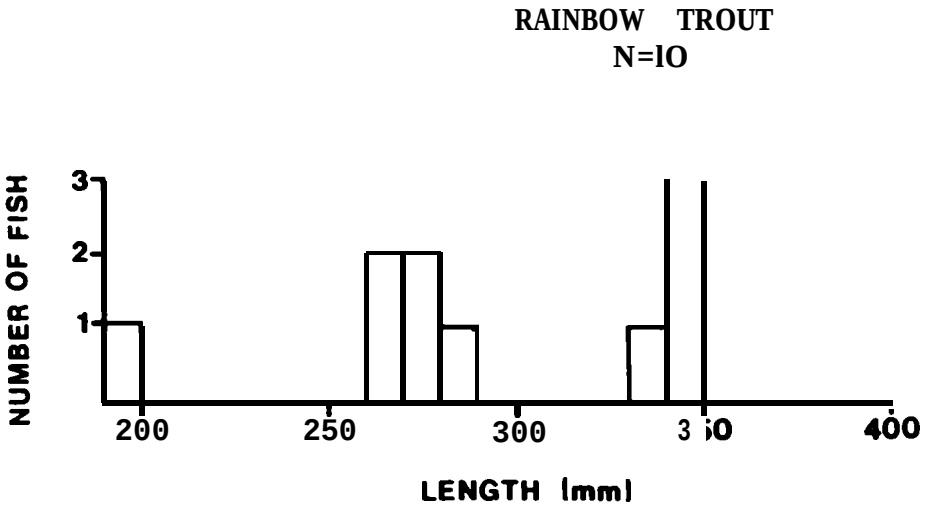


Figure 17. Length frequency diagrams for northern pike and bull tro captured in floating and sinking nets in Swan Lake during April,1983.



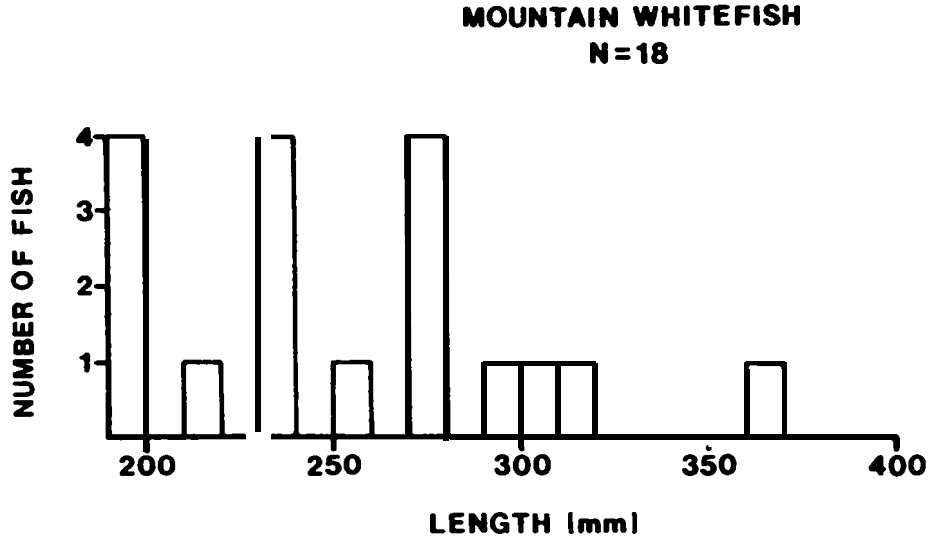


Figure 18. length frequency diagrams for rainbow trout and mountain whitefish captured in floating and sinking gill nets in Swan Lake durinq April, 1983.

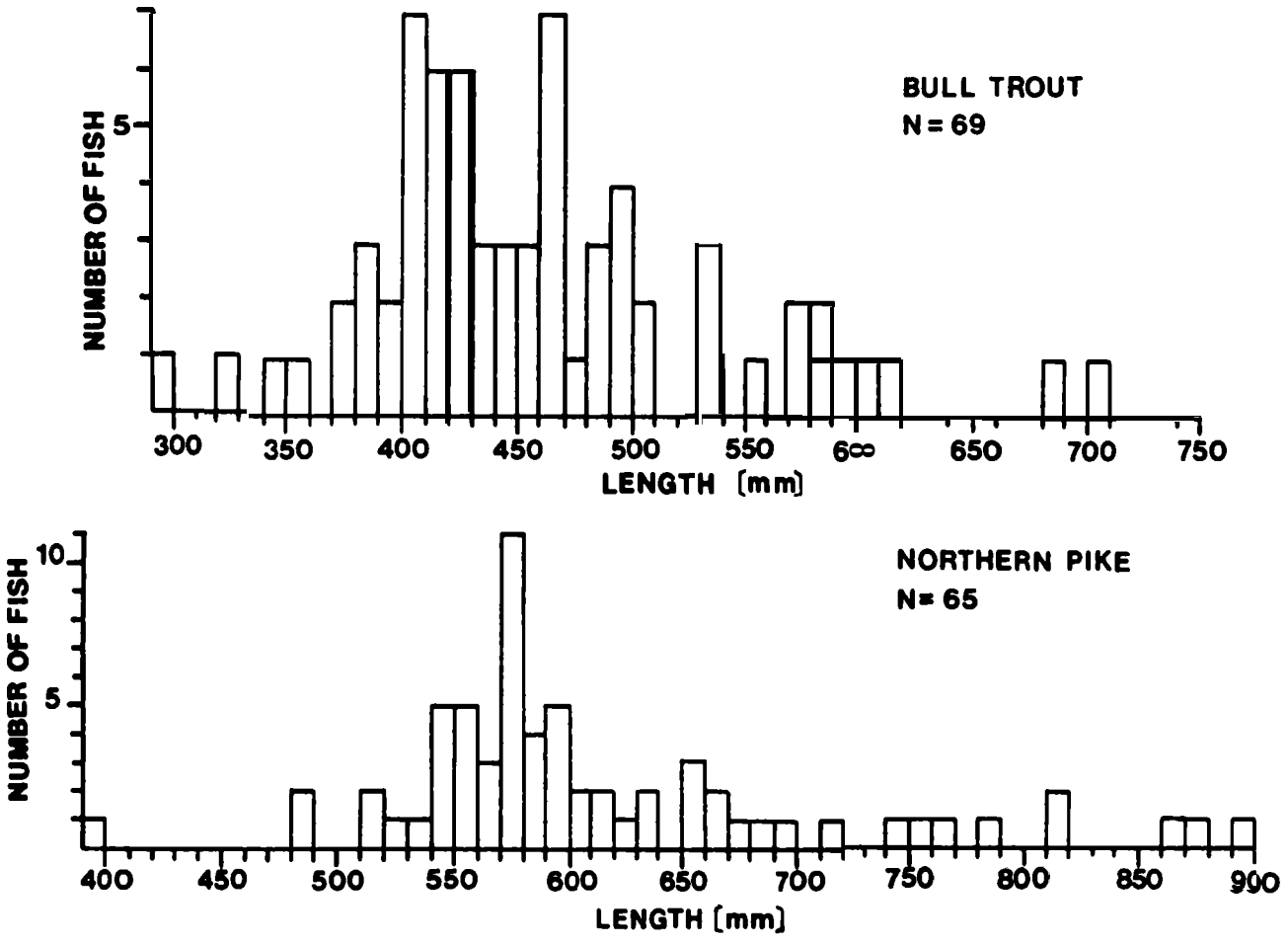


Figure19. Length frequency diagrams for bull trout and northern pike harvested by anglers from Swan Lake during the period May, 1983 through May, 1984.

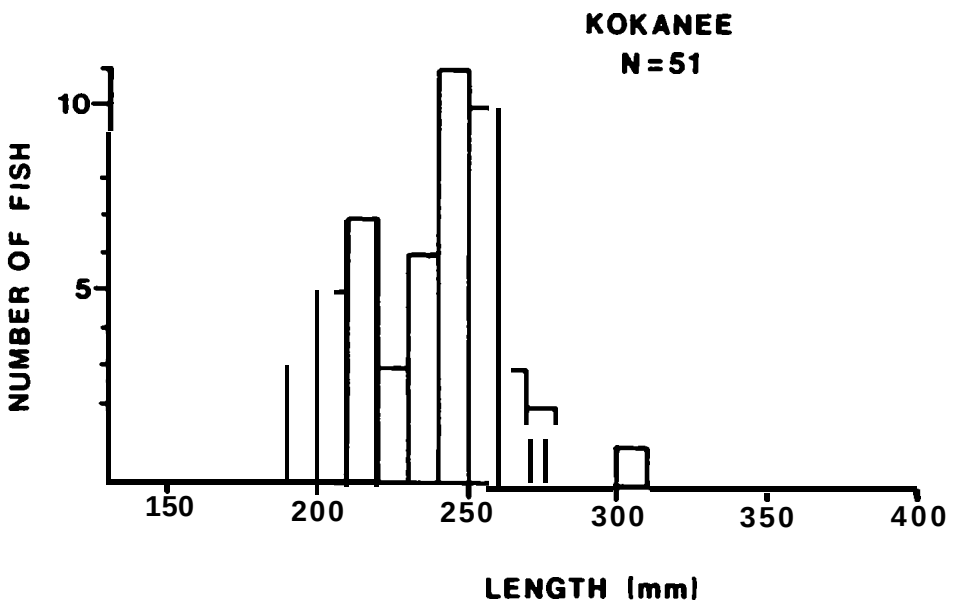
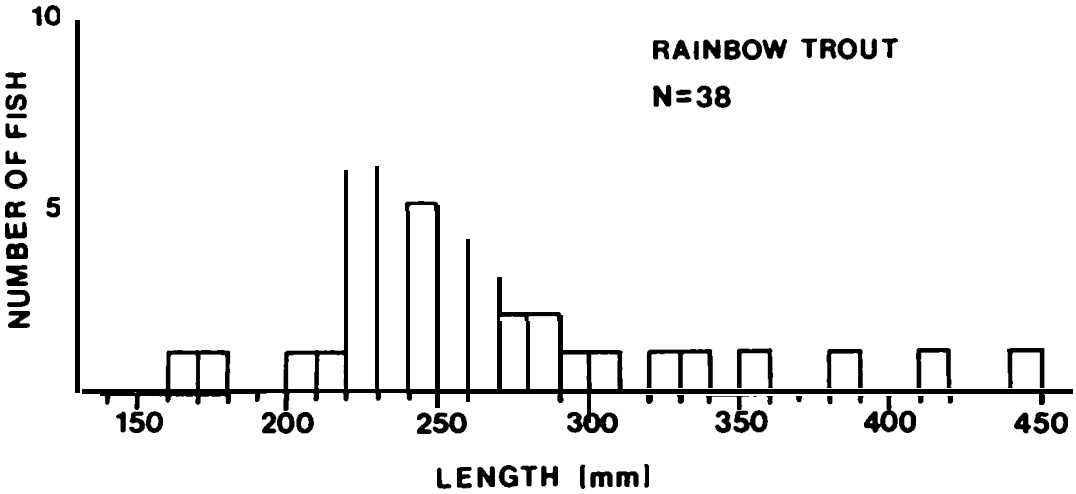


Figure 20. Length frequency diagram for kokanee salmon harvested by anglers from Swan Lake during the summer of 1983.



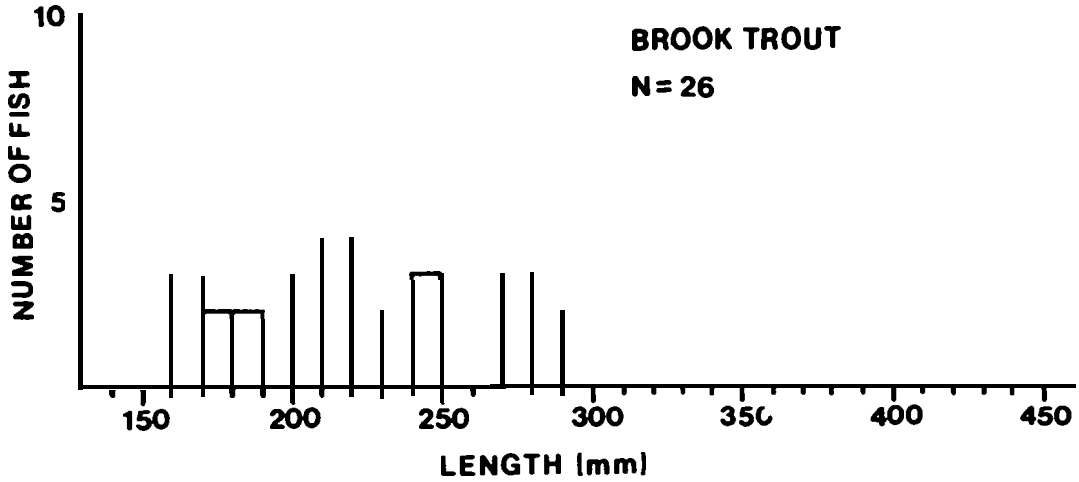
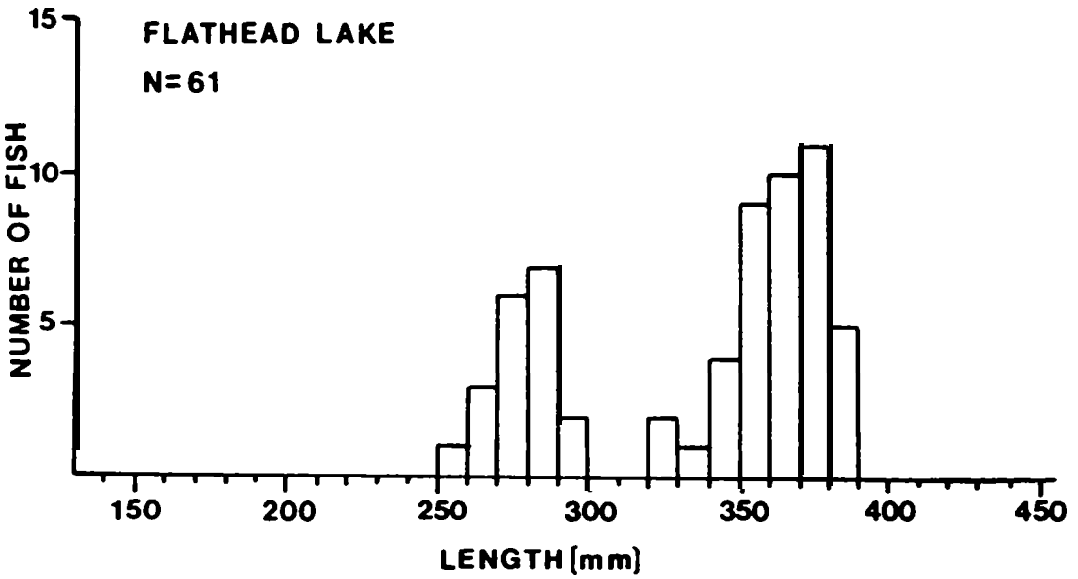


Figure 21. Length frequency diagrams for rainbow trout and brook trout harvested by anglers from the Swan River (upstream from Swan Lake) during the s-r of 1983.



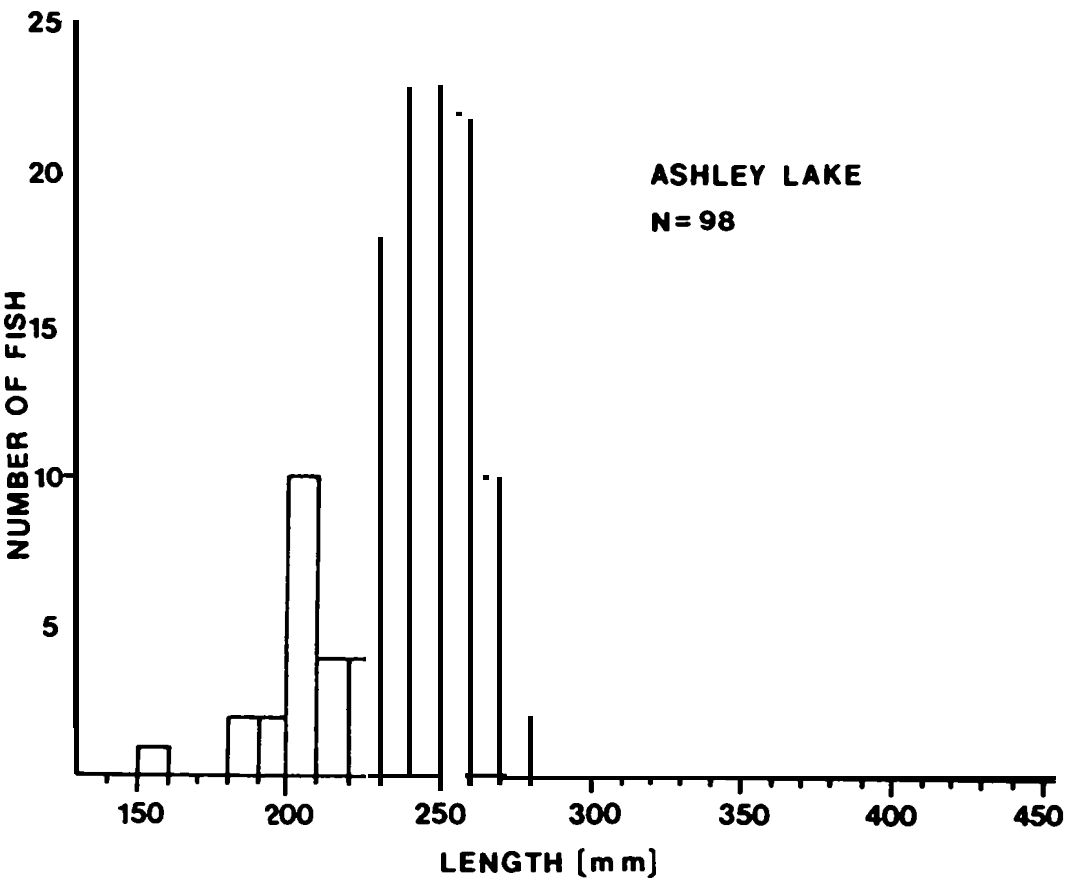
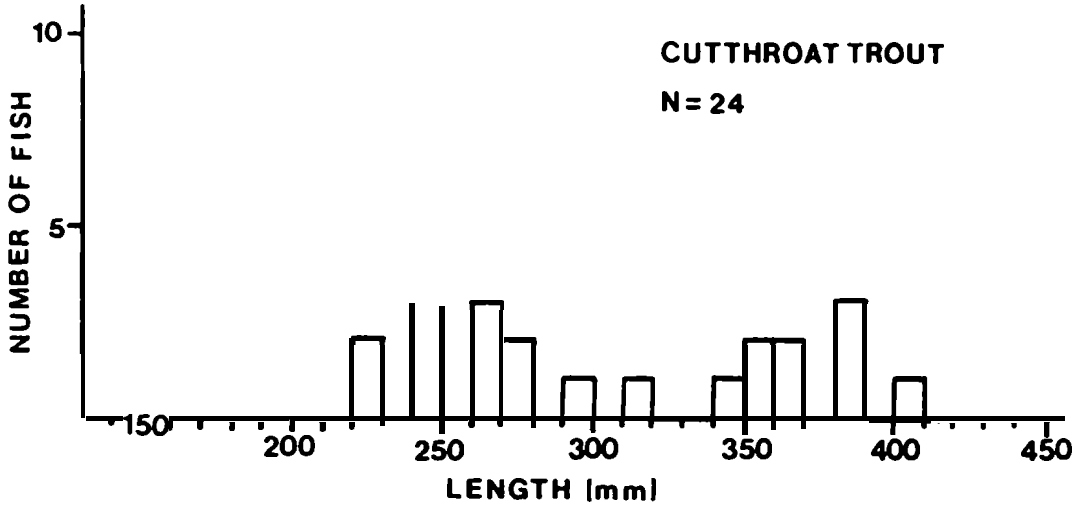


Figure 22. Length frequency diagrams for kokanee salmon harvested from Flathead and Ashley lakes by anglers during the summer of 1983.



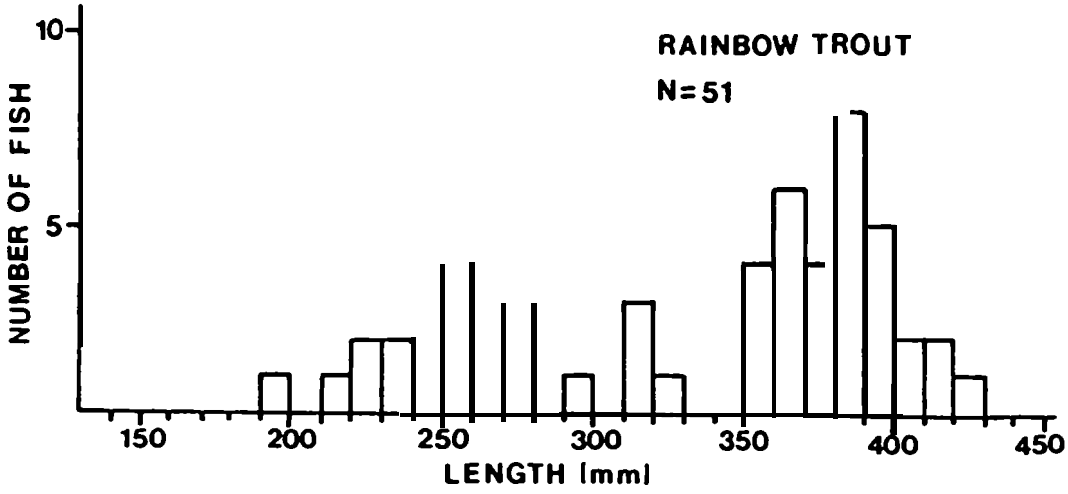
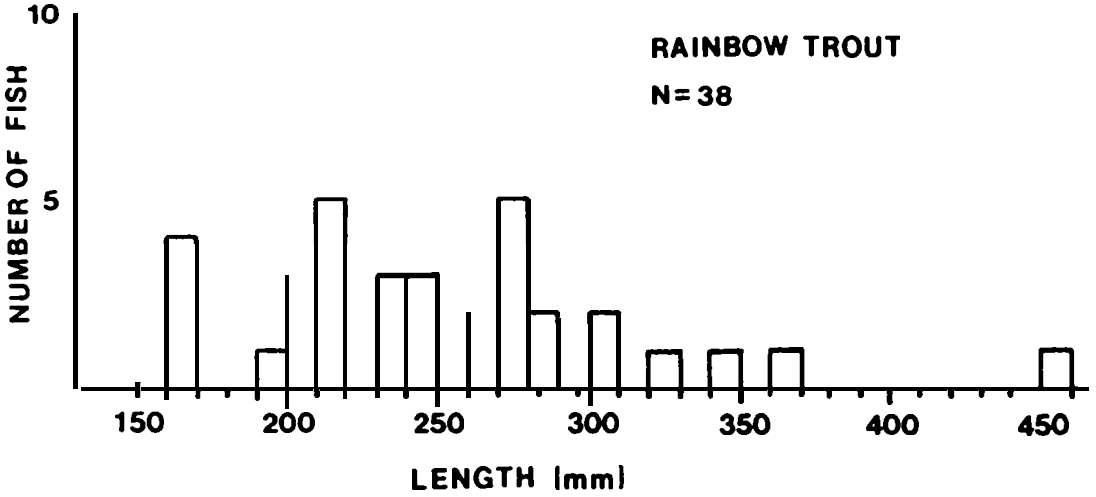


Figure 23. Length frequency diagrams forcutthroatandrainbow trout caught by anglers in Lake Koocanusa during the summer of 1983.



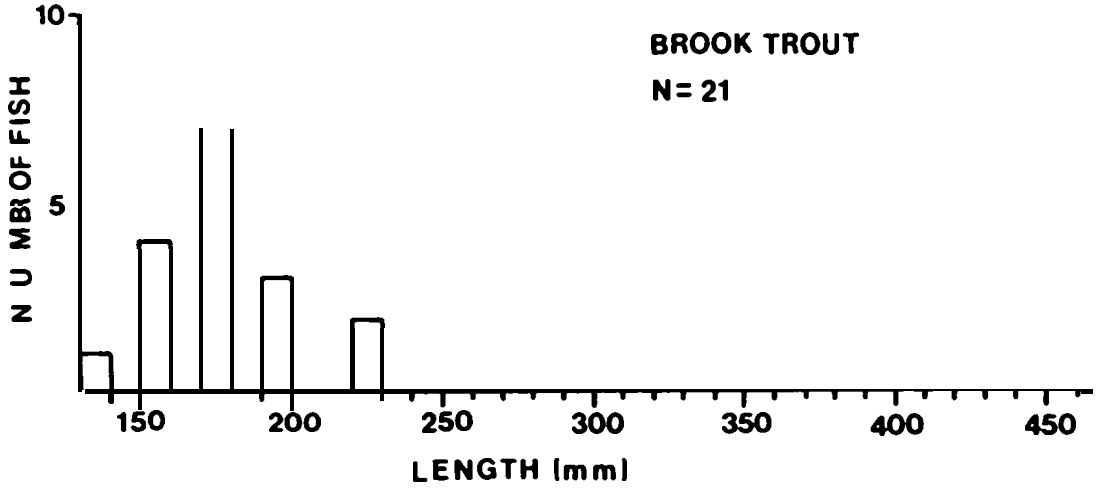
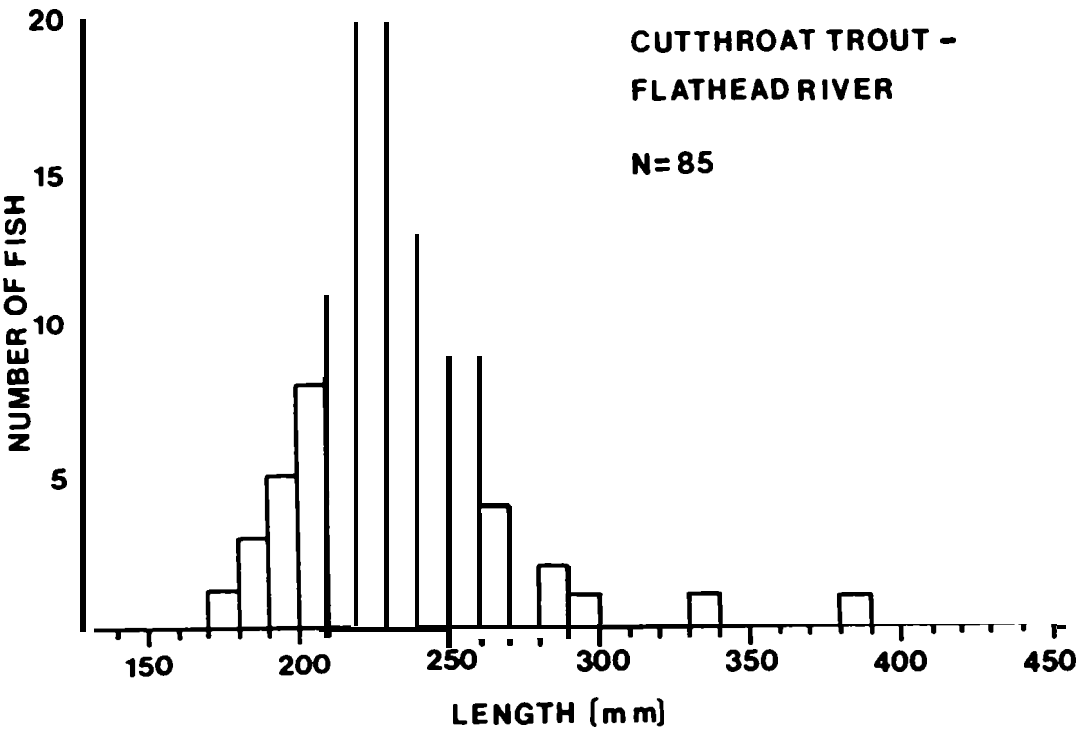


Figure 24 . Length frequency diagrams for rainbow and brook trout harvested by anglers in the Thompson River, Montana during the summer of 1983.



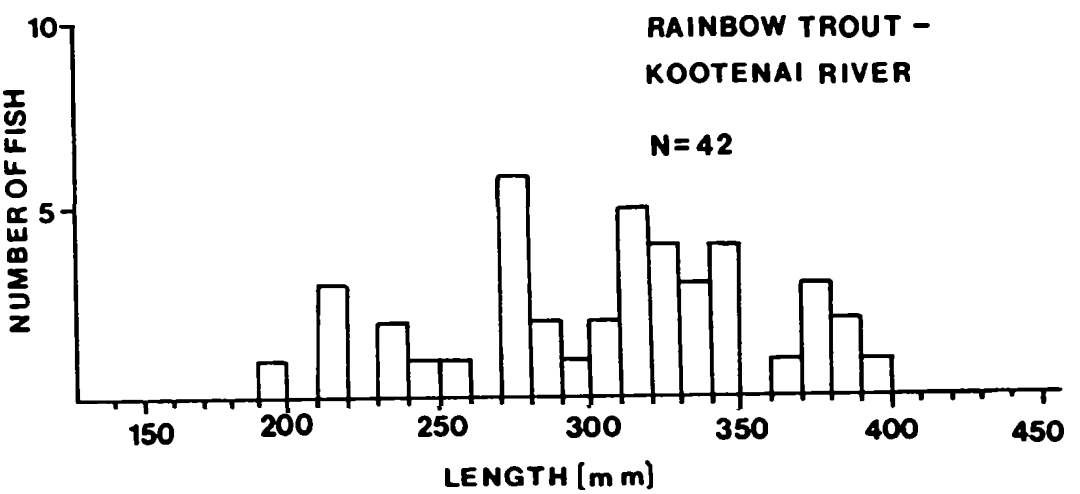


Figure 25. Length frequency diagrams for cutthroat trout harvested from the Flathead River and rainbow trout harvested from the Kootenai River by anglers during the summer of 1983.

INSTREAM FLOW RECOMMENDATIONS - TRIBUTARIES

Composite wetted perimeter -discharge curves for 16 streams surveyed during 1982 through 1984 are presented in Figures 26 through 38. These were generated using the WETP technique and methods described by Leathe and Enk (1985). Recommended minimum flows are indicated on most of the WETP curves. Many of these were agreed upon at an interagency meeting between MDFWP, USFS, and USFWS in early 1983. However, some of the data presented herein were not available at the time. In those cases, recommended flows must be considered preliminary.

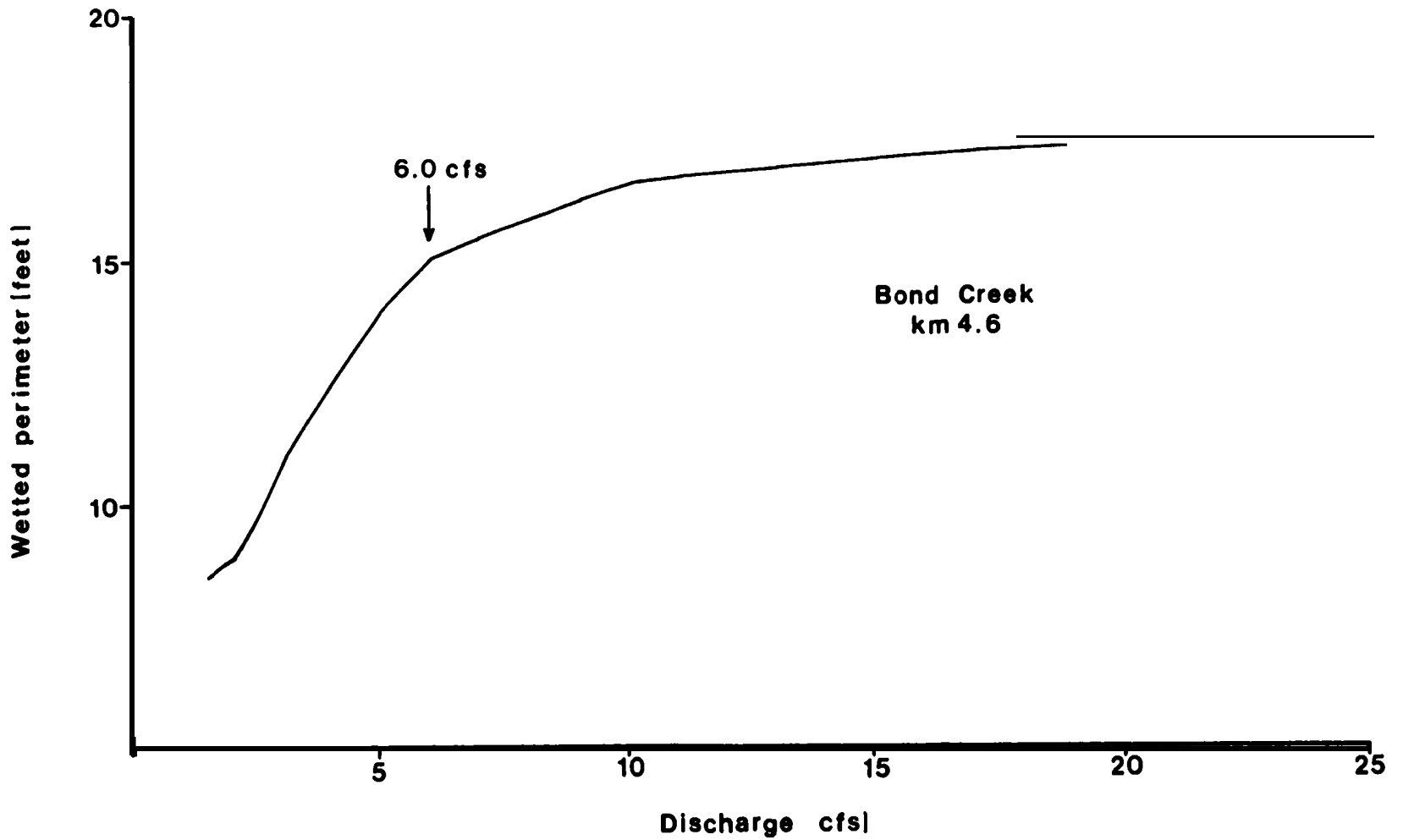


Figure 26. Average wetted perimeter versus discharge with recommended minimum flow (≤.° cfs) for three cross sections on Bond Creek in the Swan River drainage ₀uring 1982.

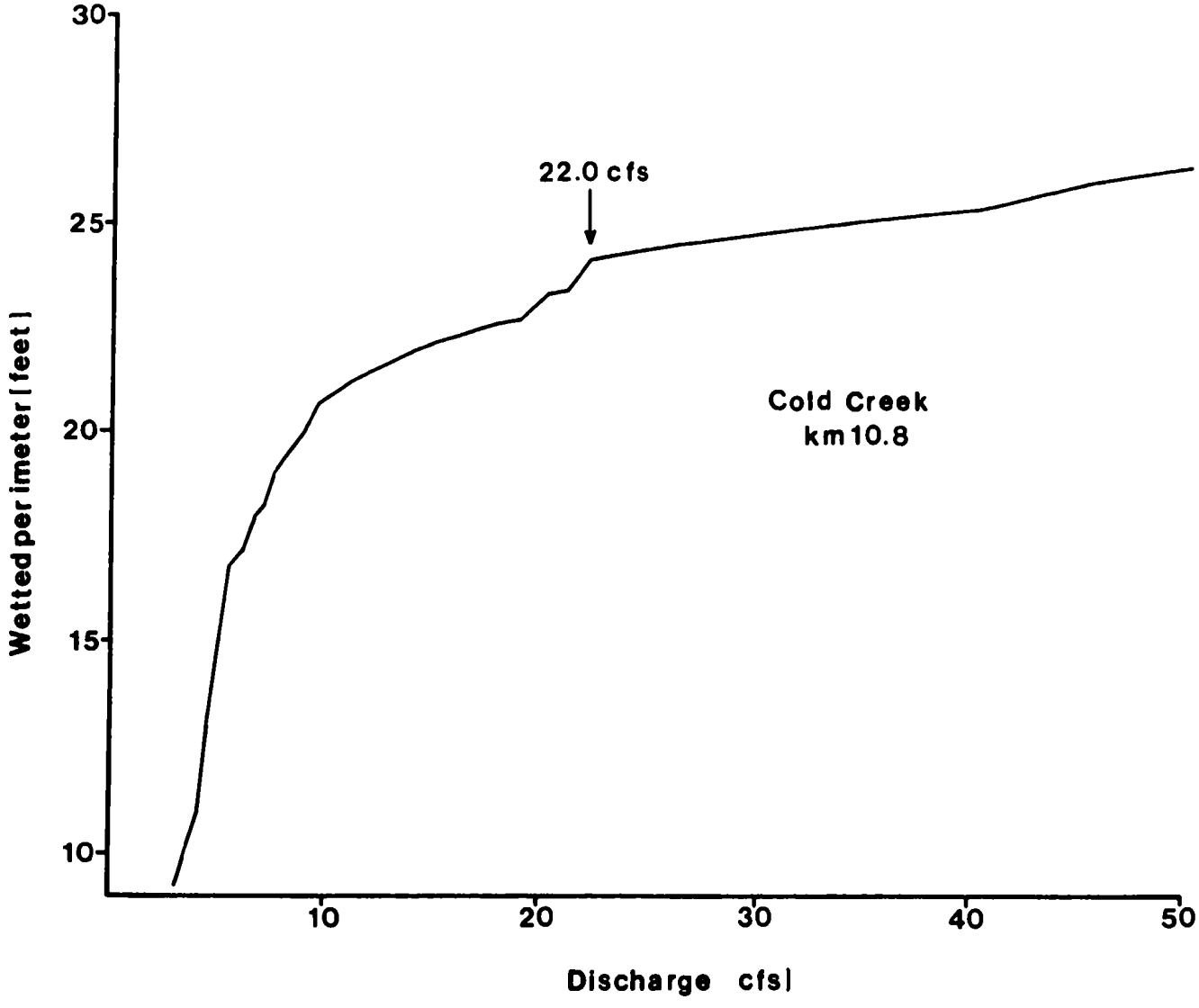


Figure 27. Average wetted perimeter versus discharge with recommended minimum flow (22.0 cfs) for three cross sections on Cold Creek in the Swan River drainage during 1982.

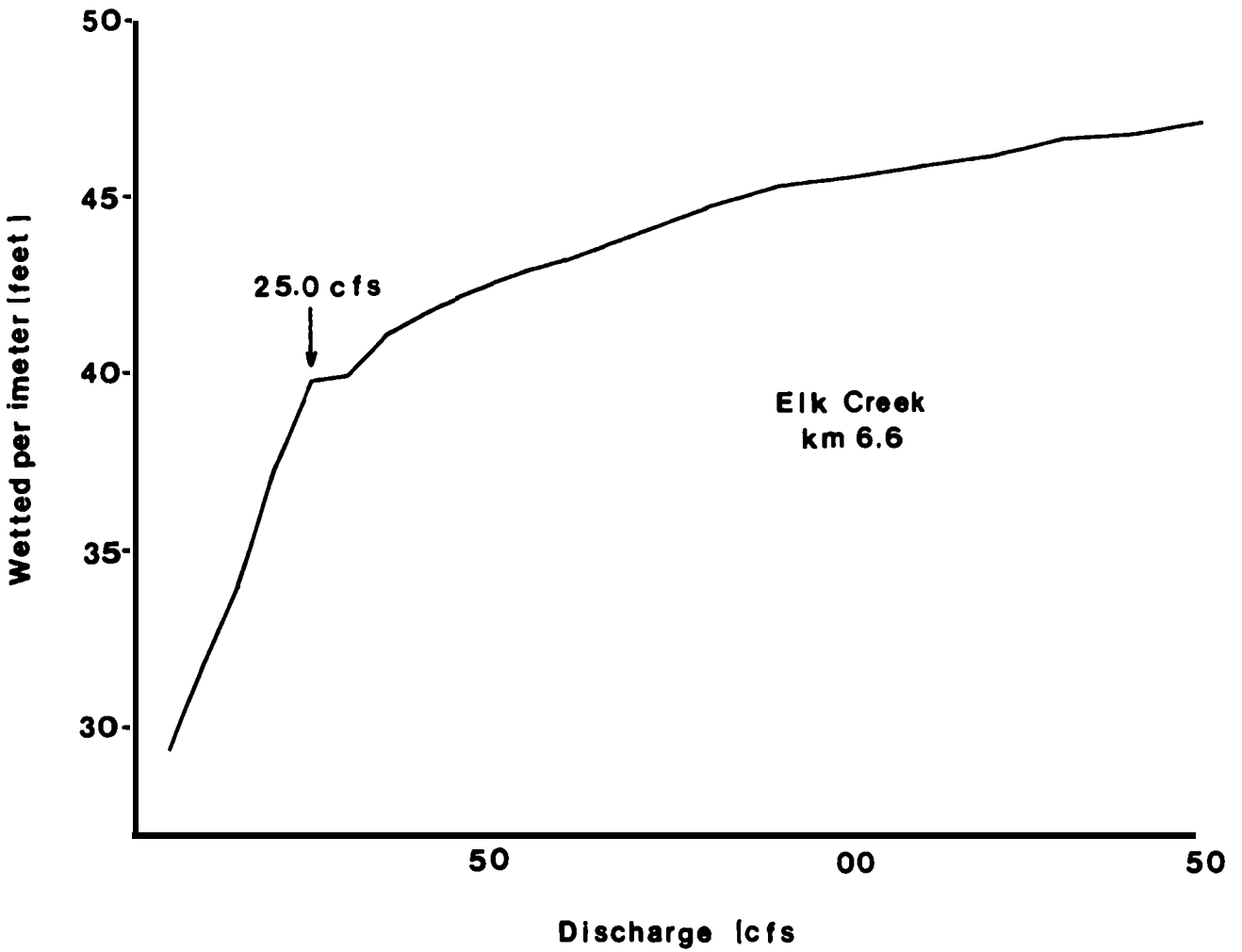


Figure 28. Average wetted perimeter versus discharge with recommended minimum flow (25.0 cfs) for five cross sections on Elk Creek in the Swan River drainage during 1984.

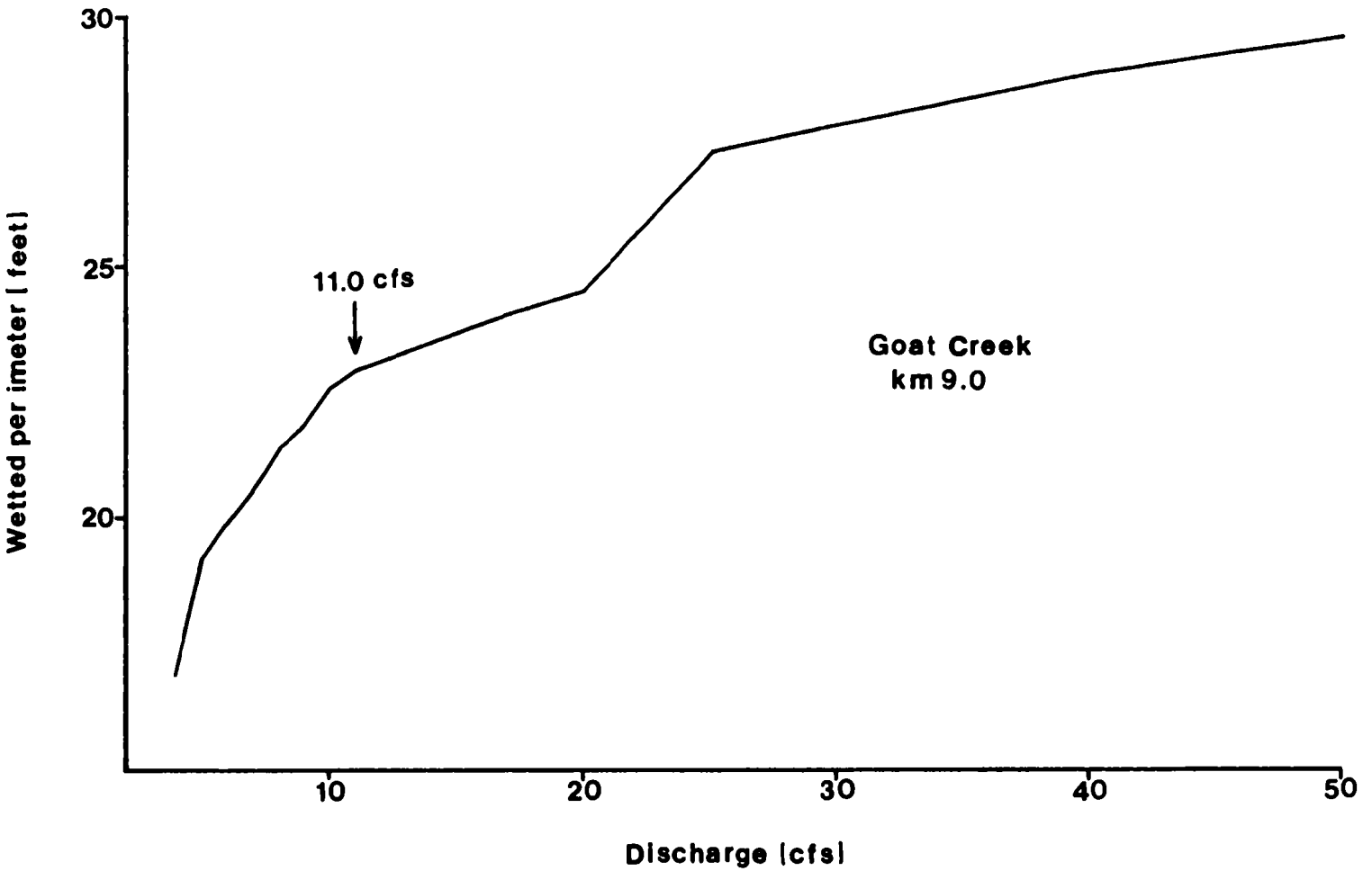


Figure 29. Average wetted perimeter versus discharge with recommended minimum flow (11.0 cfs) for four cross sections on Goat Creek in the Swan River drainage during 1982.

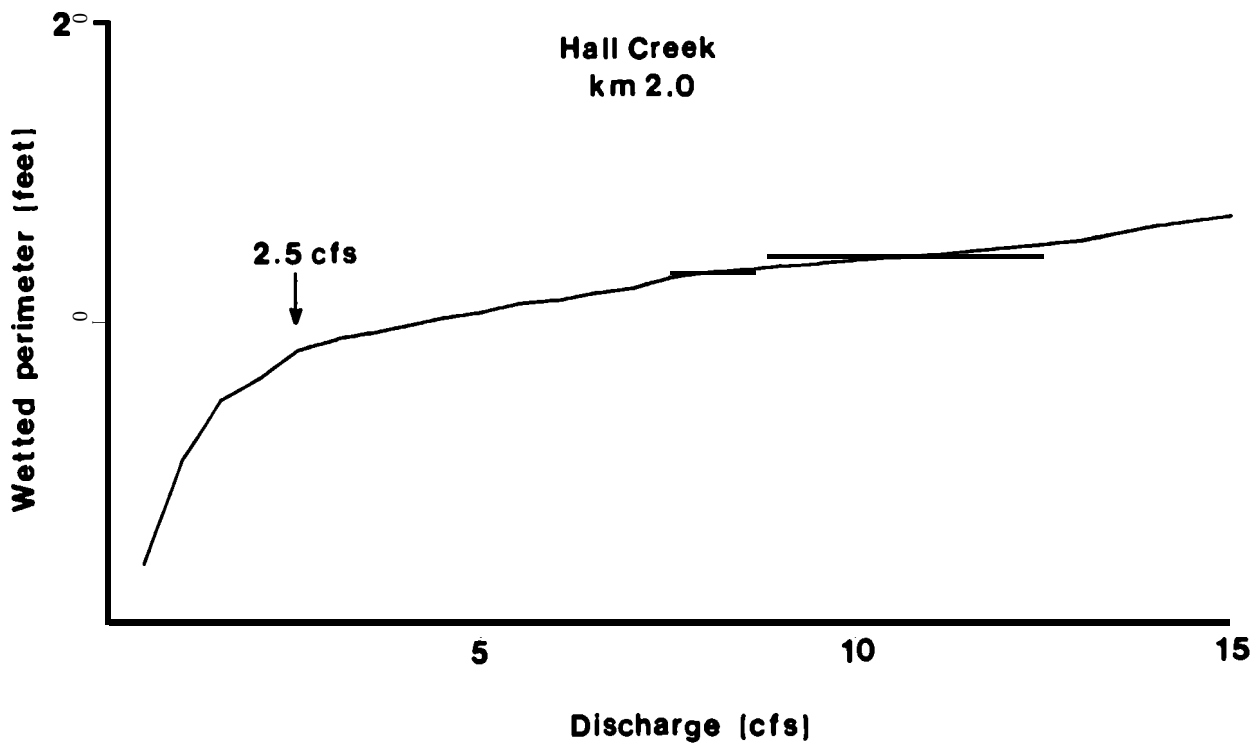


Figure 30. Average wetted per- ter versus discharge with recommended minimum flow (2.5 cfs) for four cross sections on Hall Creek in the Swan River drainage during 1983.

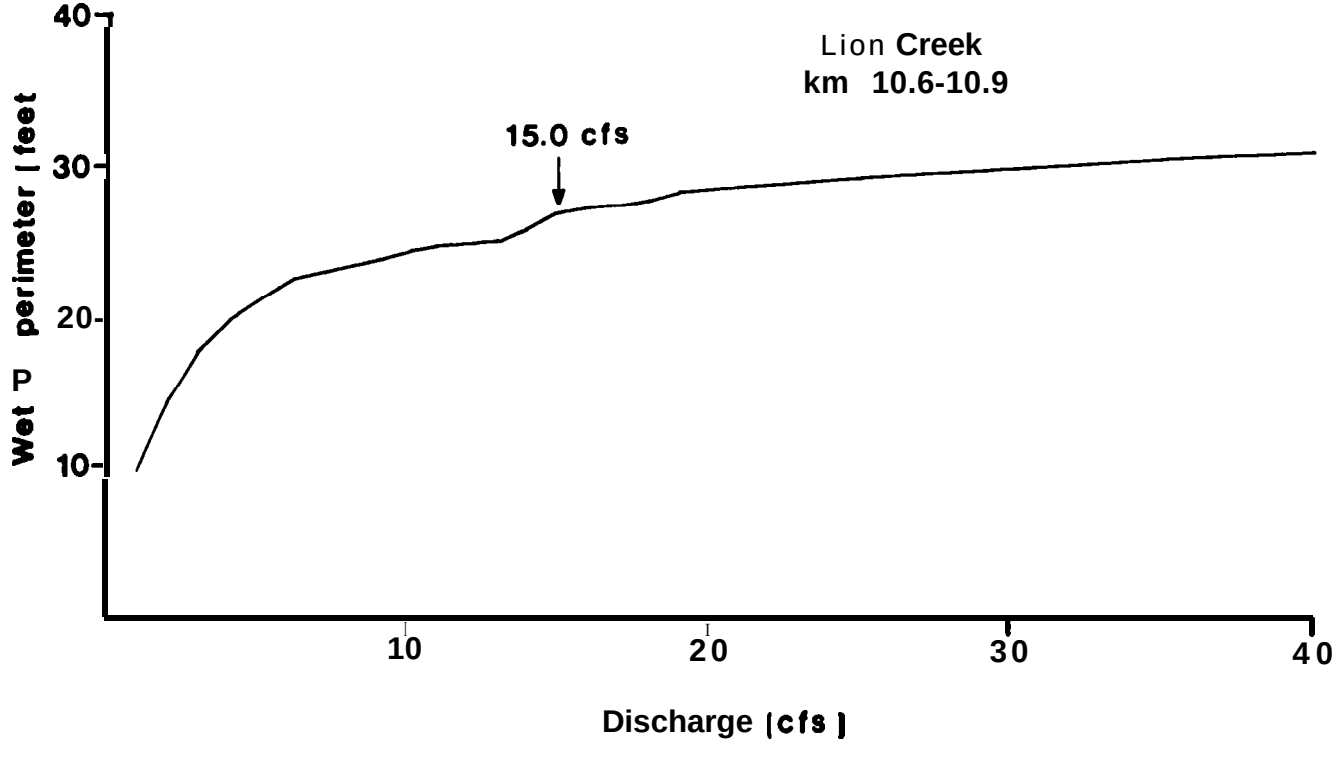


Figure 31. Average wetted perimeter versus discharge with recommended minimum flow (15.0 cfs) for four cross sections on Lion Creek in the Swan River drainage during 1983.

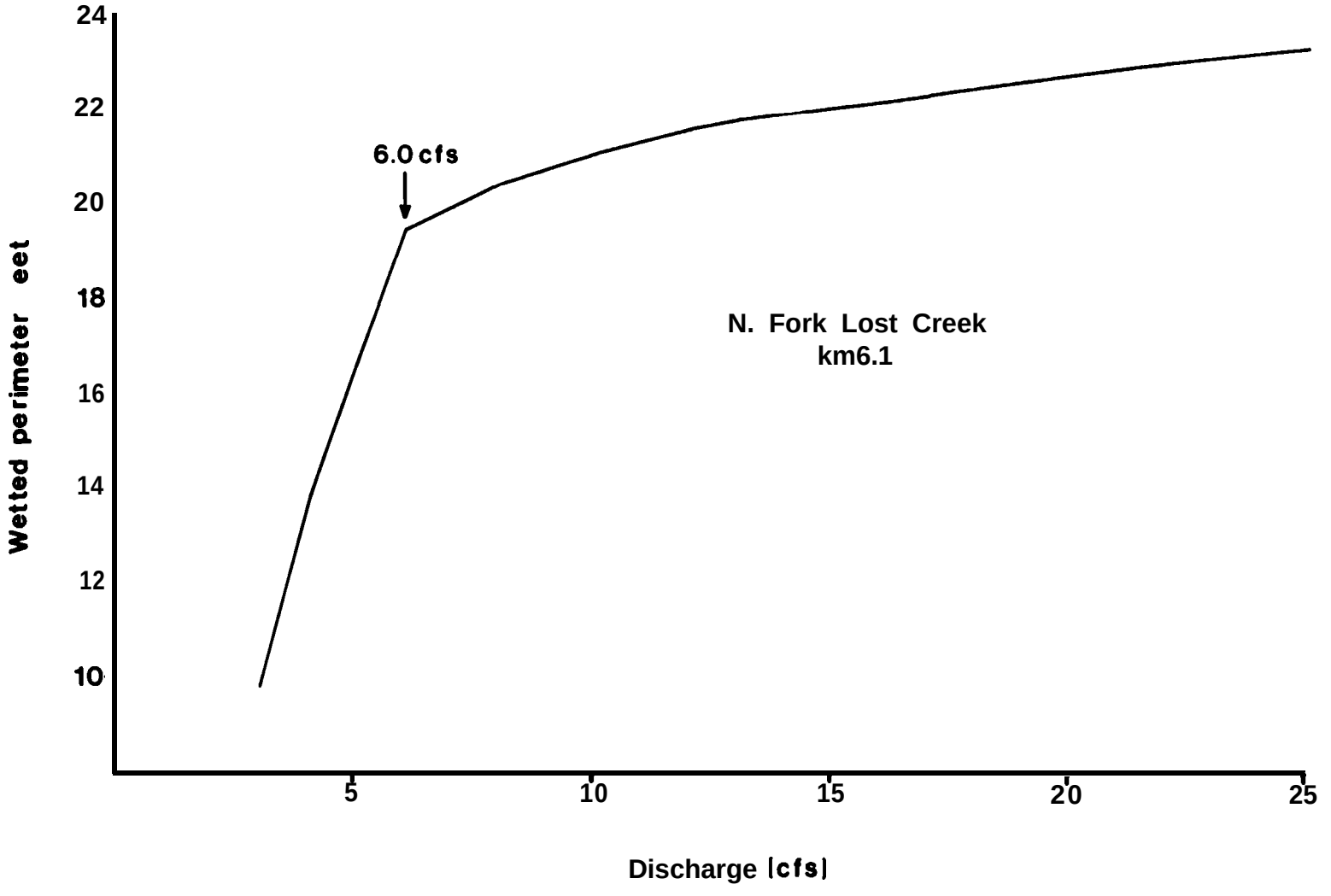


Figure 32. Average wetted perimeter versus discharge with recommended minimum flow (6.0 cfs) for three cross sections on N. Fork Lost Creek in the Swan River drainage during 1982.

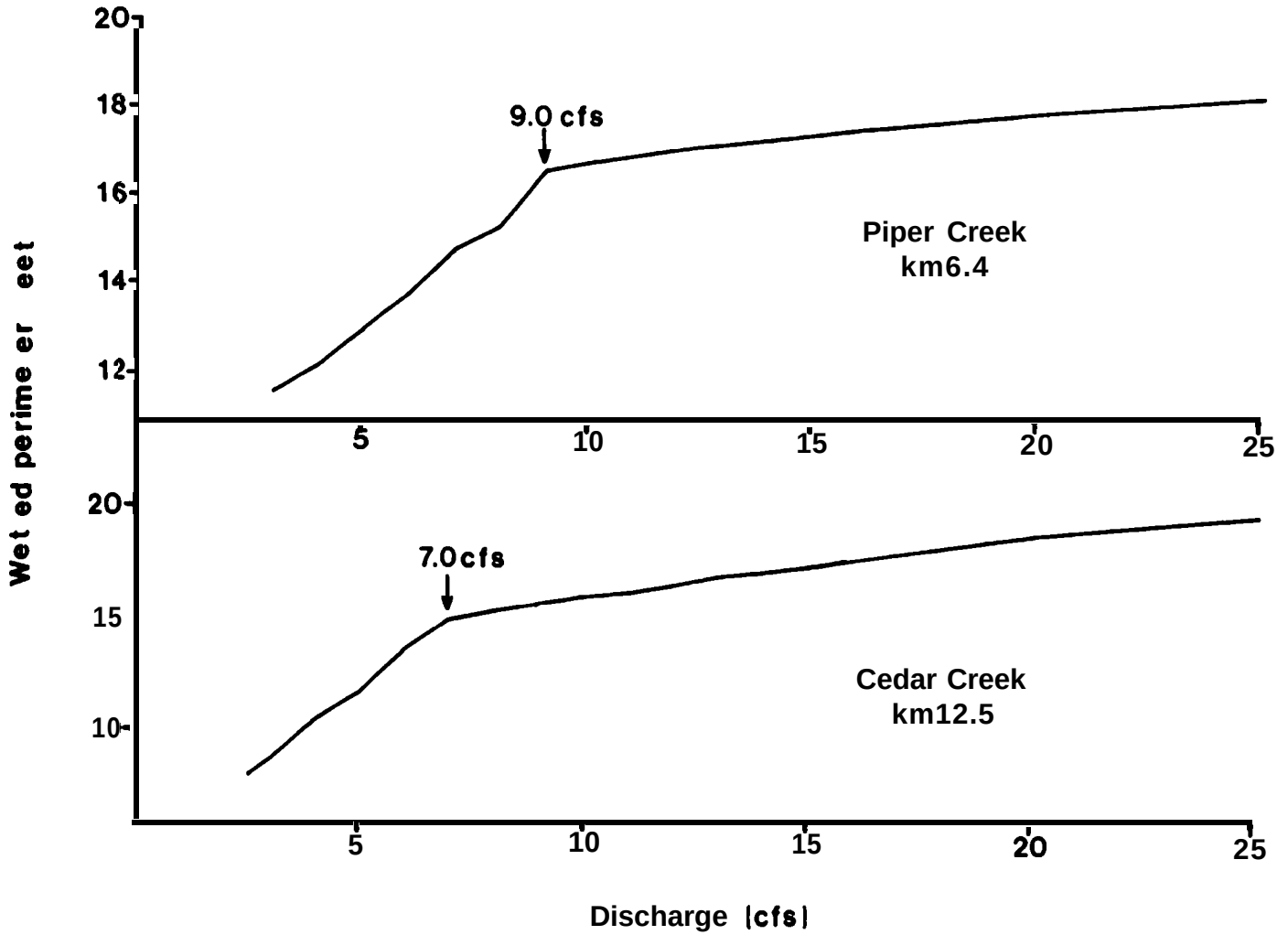
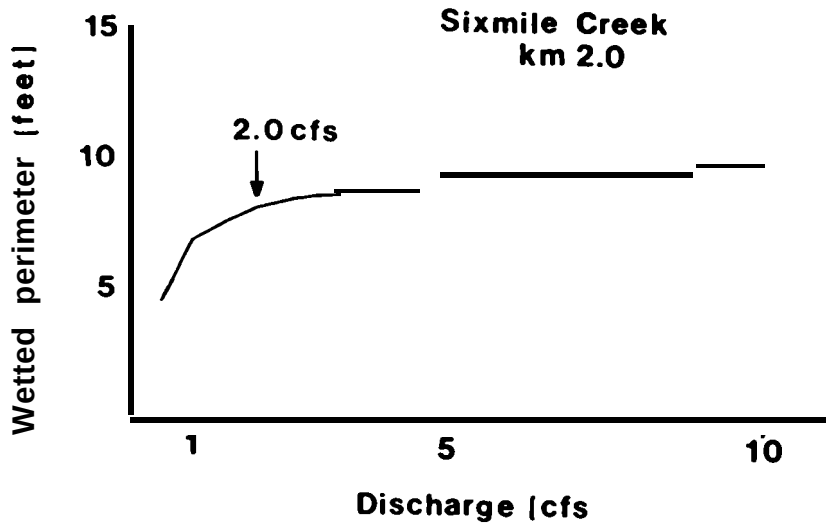


Figure 33. Averagewettedperimterversus discharge with recommended minimum flows (9.0 and 7.0 cfs) for three cross sections on Piper Creek and Cedar Creek in the Swan River drainage during 1982.



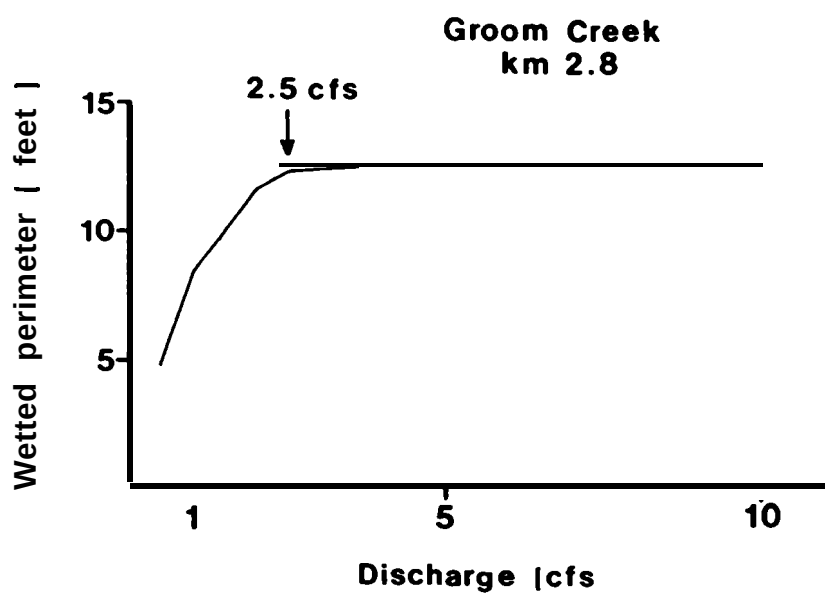


Figure 34. Average wetted perimeter versus discharge with recommended minimum flows (2.0 and 2.5 cfs) for four cross sections on Sixmile Creek and Groom Creek in the Swan River drainage during 1983.

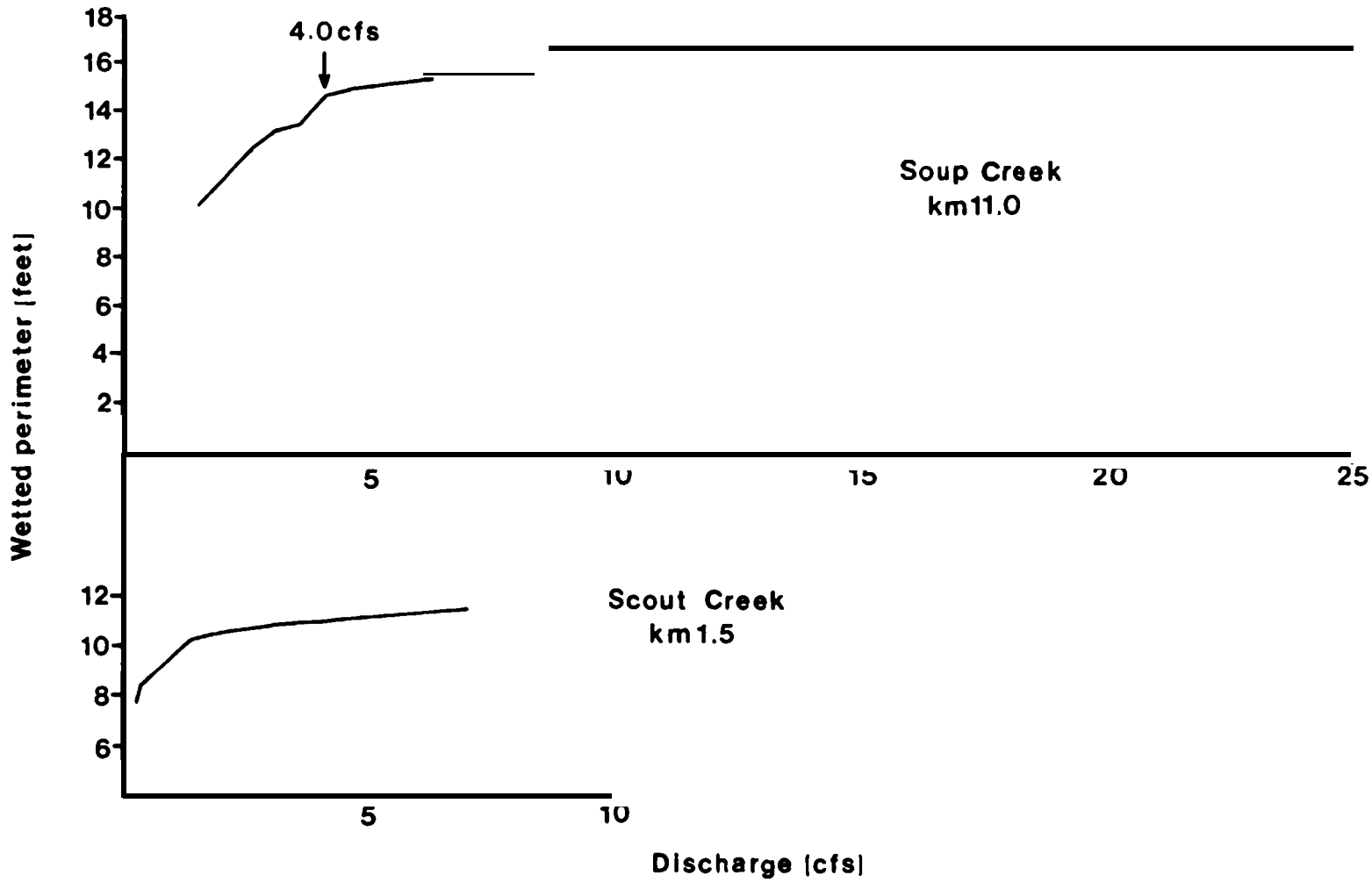


Figure 35. Average wetted perimeter versus discharge with recommended minimum flow (4.0 cfs. Soup Creek) for three and two cross sections on Soup Creek and Scout Creek, respectively in the Swan River drainage during 1982.

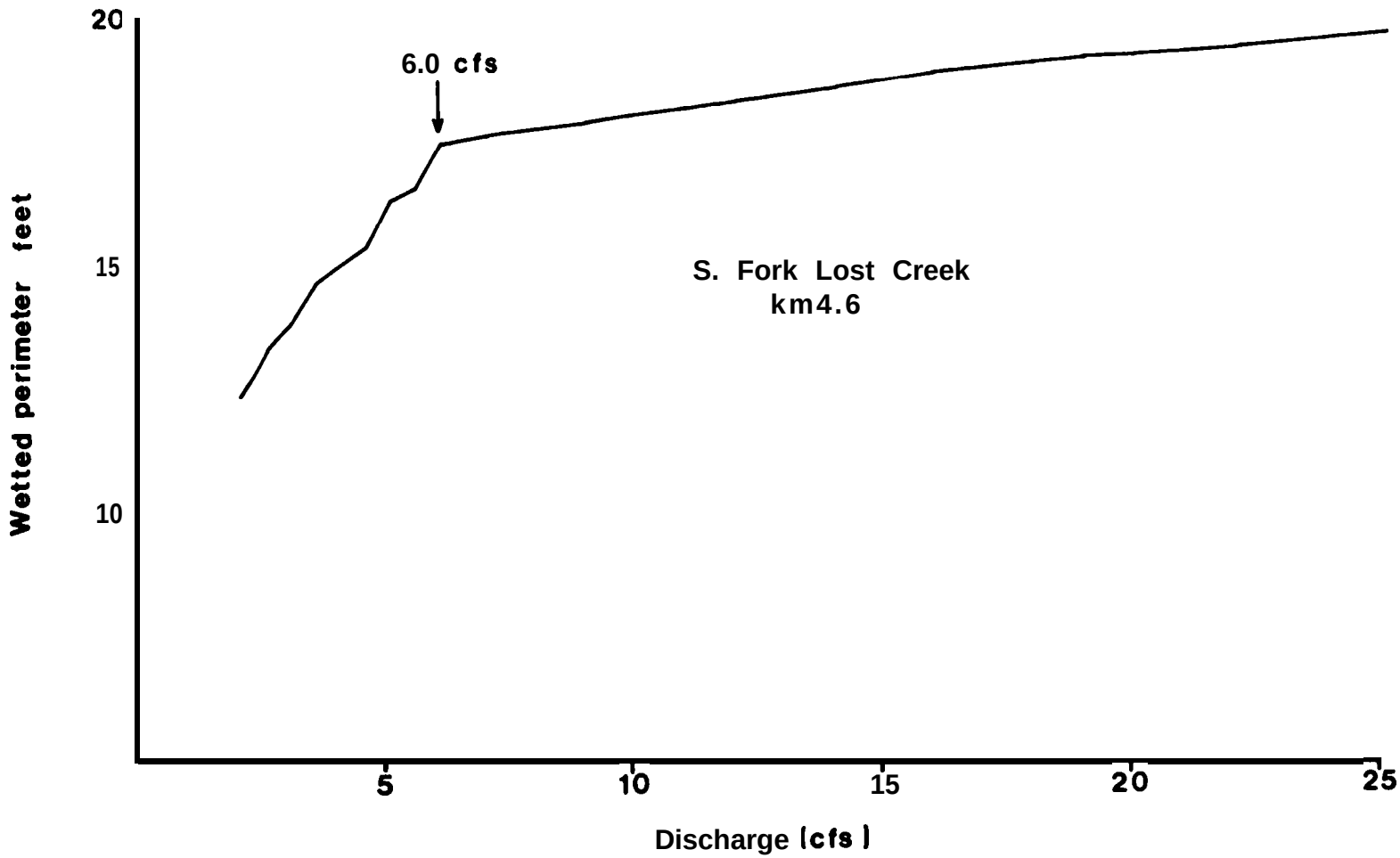


Figure 36. Average wetted perimeter versus discharge with recommended minimum flow (6.0 cfs) for three cross sections on S. Fork Lost Creek in the Swan River drainage during 1982.

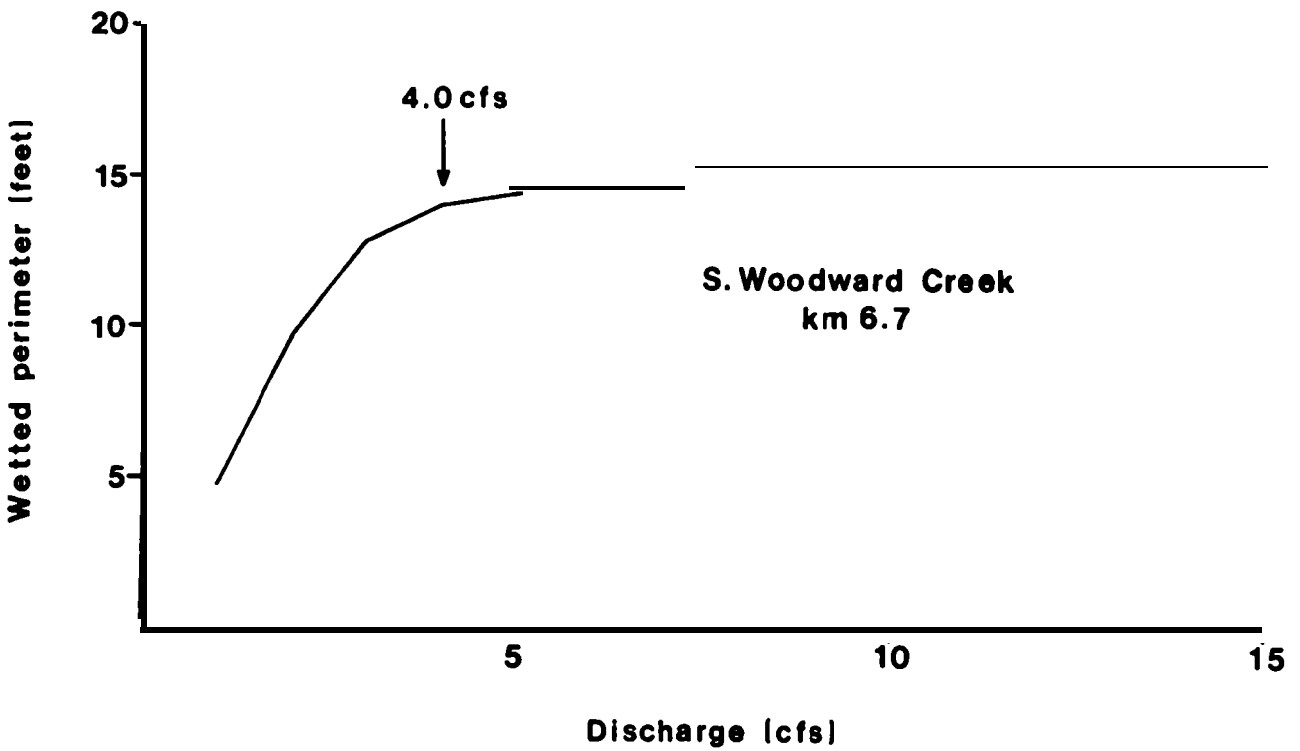


Figure 37. Average wetted perimeter versus discharge with recommended minimum flow (4.0 cfs) for four cross sections on S. Woodward Creek in the Swan River drainage during 1983.

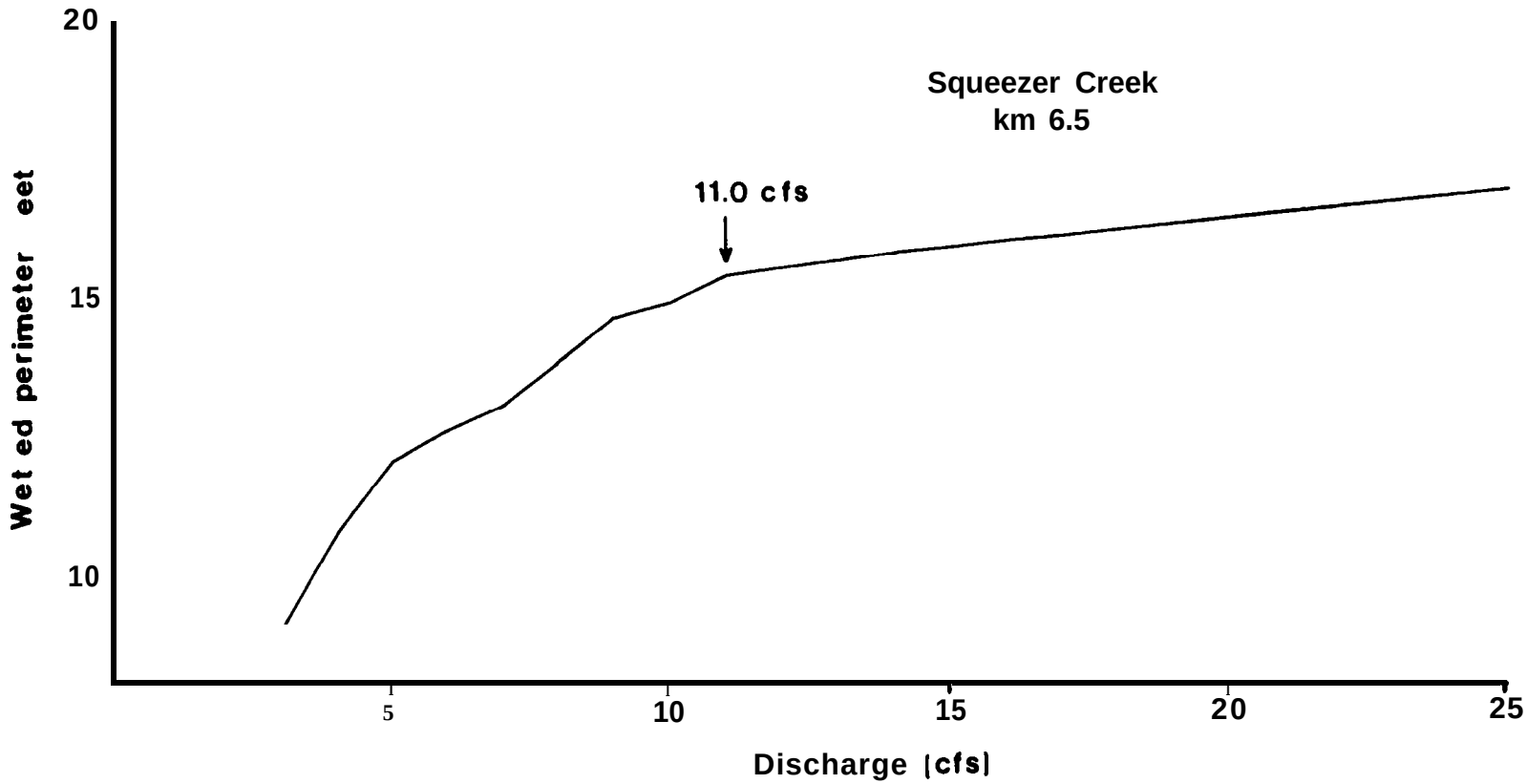


Figure 38. Average wetted perimeter versus discharge with recommended minimum flaw (11.0 cfs) for four cross sections on Squeezer Creek in the Swan River drainage during 1982.

HYDROLOGY - TRIBUTARIES

Tabular summaries of average daily discharges for six Swan River tributaries for the period October 1983 through September 1984 are presented in Tables 39 through 44. Because of problems with maintaining and operating the water level recorder, only monthly flow measurements are available for the South Fork of Lost Creek (Table 43). Graphs of average weekly discharge compared to minimum instream flow recommendations are displayed in Figures 39 through 43. Flow duration curves with recommended minimum flows are in Figures 44 through 40.

Table 39. Average daily discharge (cubic feet per second) in Cold Creek during the period October 1983 through September 1984.

Location: SW¼NE¼S28T21NR17W, (Stream kilometer 8.0)
Drainage Area: 35.2 sq. km (at gaging station)
Period of Record: October 1983 through September 1984
Gage: Water stage recorder
Remarks: Records generally were good with exception of winter months (November through March) where daily flows determined by interpolation from graphs of monthly flow measurements.
Average Discharge: 46.6 cfs
Extremes for year: Maximum: 189.9 cfs June21,22,25-29, 1984
Minimum: 13.0 cfs November 28, 1983

COLD CREEK

Average Daily Discharge (cfs)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	19.4	17.4	13.4	19.1	18.2	19.0	15.6	27.7	SO.5	135.9	107.3	43.8
2	18.7	18.0	13.6	19.4	18.0	19.2	15.6	30.8	SO.5	135.9	103.7	42.3
3	18.7	18.0	13.7	19.6	17.8	19.4	17.4	28.7	90.5	135.9	103.7	40.8
4	20.1	21.6	13.8	19.8	17.7	19.6	18.0	27.7	90.5	135.9	103.7	38.1
5	18.7	21.6	14.0	20.0	17.5	19.7	18.7	26.7	90.5	135.9	103.7	38.1
6	18.7	27.7	14.1	20.3	17.4	20.0	19.4	25.8	131.4	135.9	103.7	35.5
7	18.0	24.9	14.3	20.5	17.2	20.1	18.7	26.7	96.9	114.8	103.7	34.2
8	18.0	24.0	14.4	20.7	17.0	20.3	21.6	27.7	96.9	114.8	103.7	33.0
9	20.8	24.9	14.5	21.0	16.8	20.4	20.1	45.3	81.7	96.9	103.7	31.9
10	20.8	26.7	14.7	21.2	16.7	20.6	20.1	45.3	68.8	127.1	100.2	30.8
11	18.0	38.1	14.8	21.5	16.5	20.8	20.8	48.6	68.8	127.1	96.9	29.7
12	18.0	34.2	14.9	21.3	16.4	20.9	20.1	48.6	68.8	114.8	93.6	27.7
13	18.0	33.0	15.1	21.3	16.2	21.0	19.4	68.8	76.3	114.8	90.5	26.7
14	17.4	31.9	15.2	21.0	15.9	21.2	20.8	68.8	81.7	l14.8	84.5	25.8
15	17.4	30.8	15.4	20.8	16.1	21.4	26.7	84.5	114.8	loo.2	81.5	24.9
16	17.4	31.9	15.6	20.7	16.3	21.5	39.4	68.8	135.9	96.9	78.9	24.0
17	18.7	31.9	15.8	20.5	16.5	21.7	54.0	68.8	135.9	96.9	76.3	23.2
18	18.7	30.8	16.0	20.3	16.6	21.8	59.9	68.8	135.9	96.9	73.7	22.3
19	17.4	29.7	16.3	20.2	16.8	22.0	62.0	81.7	135.9	96.9	71.2	22.3
20	17.4	28.7	16.5	20.0	17.0	22.1	59.9	90.5	155.5	96.9	68.8	29.7
21	17.4	14.4	16.8	19.8	17.2	22.3	57.9	81.7	189.9	96.9	66.4	27.7
22	20.1	14.2	17.0	19.7	17.4	22.4	57.9	81.7	189.9	96.9	64.2	26.7
23	20.8	14.0	17.2	19.5	17.6	22.6	57.9	81.7	160.7	96.9	62.0	25.8
24	18.7	13.8	17.4	19.3	17.7	22.7	48.6	81.7	135.9	96.9	59.9	24.9
25	18.0	13.6	17.7	19.2	17.9	22.9	40.8	81.7	189.9	96.9	57.9	24.9
26	18.0	13.4	17.9	19.0	18.1	23.0	35.5	81.7	189.9	96.9	55.9	24.9
27	18.0	13.2	18.1	18.8	18.3	23.2	33.0	81.7	189.9	107.3	54.0	24.0
28	18.0	13.0	18.4	18.7	18.5	23.3	30.8	81.7	189.9	107.3	52.1	24.0
29	18.0	13.2	18.6	18.5	18.6	23.4	28.7	81.7	189.9	107.3	48.6	24.0
30	18.0	13.3	18.8	18.3		23.6	27.7	90.5	160.7	107.3	47.0	24.0
31	17.4		19.0	18.2		23.7		90.5		107.3	45.3	
Mean	18.5	22.7	15.9	19.9	17.2	21.5	32.9	62.2	127.5	111.1	79.6	29.2
Max	20.8	38.1	19.0	21.5	18.6	23.7	62.0	90.5	189.9	135.9	107.3	43.8
Min	17.4	13.0	13.4	18.2	15.9	19.0	15.6	25.8	68.8	96.9	45.3	22.3
Ac-ft	1135.4	1352.2	977.4	1225.8	991.4	1320.4	1957.2	3820.5	7583.8	6827.8	48S0.8	1736.5

Table 40 . Average daily discharge (cubic feet per second) in Lion Creek during the period October 1983 through September 1984.

Location: NW¼NE¼S13T22NR17W, (Stream kilometer 10.5)
Drainage Area: 55.0 sq. km (at gaging station)
Period of &cord: October 1983 through September 1984
Gage: Waterstagerecorder
Remarks: Records generally good with exception of winter months (Nov. 20, 1983 - April 1, 1984) when daily flows determinedbyinterpolation from graphs of monthly flow measurements. Daily flows during the periods Oct. U-17, 1983, May 26-June 5, 1984, June 20-23, 1984 were estimated by interpolation and comparisons with adjacent drainages.
Average Discharge: 58.9 cfs
Extremes for year: Maximum: 448.6 cfs June 27, 1984
Minimum: 8.0 cfs March 9, 1984

LION CREEK

Average Daily Discharge (cfs)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	16.8	16.8	17.8	25.5	16.1	9.1	13.3	38.8	266.6	243.2	64.6	30.0
2	16.6	17.0	18.0	25.8	15.6	9.0	13.1	36.8	261.2	243.2	75.2	27.1
3	16.5	17.0	18.3	26.1	15.0	8.8	13.0	36.8	226.4	255.9	75.2	25.8
4	16.3	20.2	18.6	26.3	14.5	8.7	13.0	35.0	177.3	231.1	64.6	24.5
5	16.3	26.0	18.8	26.6	14.0	8.6	13.0	33.3	166.7	243.2	58.3	24.5
6	16.0	30.0	19.1	26.8	13.4	8.4	13.1	33.3	166.7	255.9	55.4	25.0
7	16.0	32.9	19.3	27.1	12.9	8.3	13.1	31.6	153.7	219.6	52.6	25.3
8	15.8	33.6	19.6	27.4	12.3	8.2	13.6	30.0	138.8	179.1	45.2	31.3
9	15.8	32.3	19.8	27.6	12.2	8.0	13.7	29.4	125.3	153.7	42.9	40.8
10	15.8	31.3	20.1	27.9	12.0	8.1	14.0	33.3	119.1	146.0	42.9	46.1
11	15.8	33.3	20.4	27.3	11.9	8.2	14.3	35.0	125.3	146.0	40.8	50.5
12	16.0	33.6	20.6	26.7	11.8	8.2	14.6	36.8	146.0	161.7	40.8	53.7
13	16.1	33.3	20.9	26.1	11.6	8.3	14.9	38.8	179.1	161.7	40.8	56.0
14	16.3	31.9	21.2	25.6	11.5	8.4	15.0	55.4	243.2	131.9	38.8	58.3
15	16.5	30.7	21.4	25.1	11.4	8.4	15.2	92.3	313.9	125.3	35.0	60.7
16	17.0	29.7	21.7	24.5	11.2	8.5	15.6	119.1	313.9	125.3	33.3	62.6
17	17.0	29.1	21.9	24.0	11.3	8.6	21.0	107.5	330.3	125.3	33.3	63.9
18	16.6	28.0	22.2	23.4	10.9	8.7	64.6	102.2	330.3	125.3	31.6	65.3
19	17.0	26.8	22.5	22.8	10.8	8.8	83.3	107.5	298.3	119.1	31.6	65.3
20	17.3	27.4	22.7	22.3	10.7	8.8	90.4	170.2	298.3	107.5	30.0	52.1
21	17.5	26.0	23.0	21.7	10.5	8.9	83.3	188.4	384.9	107.5	30.0	39.2
22	17.5	25.8	23.2	21.1	10.4	9.0	77.6	138.8	384.9	104.3	28.5	34.3
23	17.5	24.8	23.3	20.6	10.2	9.1	71.5	125.3	298.3	95.1	27.1	31.3
24	17.3	23.3	23.8	20.0	10.1	9.2	67.9	119.1	269.3	75.2	27.1	29.4
25	17.0	22.2	24.0	19.5	10.0	9.3	61.3	113.1	347.6	83.3	25.8	28.3
26					9.8	9.3	55.4	73.7	405.1	92.3	25.8	27.7
27	17.0	19.4	24.5	18.4	9.7	9.4	50.0	74.5	448.6	97.1	25.3	26.8
28	17.0	17.1	24.8	17.8	9.6	9.5	45.2	76.0	384.9	83.3	25.3	26.3
29	17.0	17.3	25.0	17.2	9.4	9.6	42.9	99.1	365.8	83.3	24.5	25.5
30	17.0	17.6	25.3	16.7		9.6	40.8	156.8	313.9	79.2	24.5	25.5
31	16.8		29.4	16.2		9.7		158.4		67.9	24.5	
Mean	16.7	25.9	21.7	23.3	11.8	8.8	35.9	81.5	266.1	137.1	39.4	39.4
Max	17.5	33.6	25.4	27.9	16.1	9.7	90.4	188.4	448.6	255.9	75.2	65.3
Min	15.8	16.8	17.8	16.2	9.4	8.0	13.0	29.4	119.1	67.9	24.5	24.5
Ac-ft	1023.5	1537.8	1331.5	1433.6	675.7	541.0	2136.9	5009.4	15831.5	8426.7	2422.0	2346.3

Table 41. Average daily discharge (cubic feet per second) in Piper Creek during the period October 1983 through September 1984.

Location: SW¼NE¼S25T22NR18W, (Stream kilometer 6.4)
Drainage Area: 20.4 sq. km (at gaging station)
Period of Record: October 1983 through September 1984
Gage: Water stage recorder
Remarks: Records good with exception of November 20, 1983 to April 1, 1984 when daily flows were estimated by interpolation from graphs of monthly flow measurements.
Average Discharge: 23.5 cfs
Extremes for year: Maximum: 235.0 cfs June 21, 1984
Minimum: 6.0 cfs April 1-14, 1984

PIPER CREEK

Average Daily Discharge (cfs)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	7.0	7.0	9.8	10.0	8.4	6.2	6.0	13.0	108.0			9.0
2	7.0		9.6	10.2	8.2	6.2	6.0	13.0	73.0	97.0	16.0	8.0
3	7.0	8.0	9.5	10.4	8.0	6.2	6.0	13.0	73.0	92.0	15.0	8.0
4	7.5	13.5	9.3	10.6	7.8	6.1	6.0	12.5	73.0			8.0
5	7.0	13.0	9.2	10.7	7.6	6.1	6.0	12.5	82.0	77.0	14.5	8.0
6	7.0	11.0	9.0	10.9	7.4			12.0	73.0	77.0	13.0	8.5
7	7.0	11.0			7.3	6.1	6.0	12.0	74.0	64.0	13.0	8.0
8	7.0	12.5	8.7	11.2	7.1	6.0	6.0	12.0	60.0	52.0	12.0	9.5
9	8.0	11.0	8.5	11.4	6.9	6.0	6.0	12.0	48.0	48.0	12.0	10.0
10	8.5	14.0	8.4	11.6	6.9	6.0	6.0	10.5	44.0	44.0	11.0	8.5
11	8.0	16.0	8.2	11.7	6.9	6.0	6.0	12.5	44.0			8.0
12	8.0	13.5	8.1	11.9	6.8	6			60.0	37.0	11.0	8.0
13	7.0	12.0	7.9	11.7	6.8	6.0	6.0	13.5	73.0	37.0	11.0	8.0
14	7.0	11.5	7.7	11.5	6.8	6.1	6.0	24.0	122.0	34.0	10.5	7.5
15	7.0	11.5	7.6	11.3	6.7	6.1	6.5	34.0	153.0	30.5	10.0	7.0
16	7.0	10.0	7.4	11.2	6.7	6.1	8.0	34.0	186.0	27.0	10.0	7.0
17	7.0	10.0	7.5	11.0	6.7	6.1	11.5	27.0	144.0	27.0	9.5	7.0
18	7.0	9.5	7.7	10.8	6.6	6.1	18.0	27.0	115.0	27.0	9.5	7.0
19	7.0	9.5	7.9	10.6	6.6	6.1	22.5	64.0	108.0	27.0	9.5	7.0
20	7.0	9.4	8.1	10.4	6.6	6.1	33.0	92.0	153.0	24.0	9.0	9.0
21			8.3	10.2	6.5	6.1	28.5	73.0	235.0	26.0	9.0	13.0
22	8.0	9.5	8.4	10.0	6.5	6.2	26.5	48.0	183.0	21.0	8.5	11.0
23	9.0	9.7	8.6	9.9	6.5	6.2	26.0	74.0	115.0	20.0	8.5	9.5
24	8.0	9.8	8.8			6.3	21.5	64.0	129.0	---	8.5	8.5
25	8.0	9.9	8.9	9.5	6.4	6.2	16.5	48.0	173.0	19.5	8.5	8.0
26	7.5	10.0	9.1	9.3	6.4			40.5	173.0		---	8.0
27	7.0	10.1	9.3	9.1	6.4	6.2	13.5	44.0	186.0	21.0	8.5	7.5
28	7.0	10.2	9.5	8.9	6.3	6.2	13.5	48.0	163.0	21.5	8.0	7.5
29	7.0	10.1	9.7	8.8	6.3	6.2	13.5	82.0	144.0	18.5	8.0	7.0
30	7.0	9.9	9.9	8.5		6.3	13.0	198.0	102.0	19.0	8.0	7.0
31			9.9	8.5		6.3		210.0		18.0	11.0	7.5
Mean	7.3	10.7	8.7	10.4	6.9	6.1	12.4	44.8	115.6			8.2
Max	9.0	16.0	9.9	11.9	8.4	6.3	28.5	210.0	235.0	97.0	16.5	13.0
Min	7.0	7.0	7.4	8.5	6.3	6.0	6.0	12.0	44.0	18.0	8.0	7.0
Ac-ft	451.2	673.4	534.2	639.9	397.9	376.8	735.9	2756.4	6877.0	2471.8	658.4	506.5

Table 42. Average daily discharge (cubic feet per second) in Soup Creek during the **period October** 1983 through September 1984.

Location: SW¼NW¼S26T24NR17W, (Stream **kilometer** 11.0)
Drainage Area: 13.5 **sq.** km (at gaging station)
Period of Record: October 1983 through **September** 1984
Gage: Water stage recorder
Remarks: Records good with exception of Nov. 20 through April 1 when daily flows determined by interpolation from graphs of **monthly** flow **measurements.**
Average Discharge: **10.4** cfs
Extremes for year: **Maximum:** **62.2** cfs June 1, 1984
Minimum: 2.4 cfs March 8-10, 1984

SOUP CREEK

Average Daily **Discharge (cfs)**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	3.6	4.3	4.6	4.0	4.0	2.8	3.3	11.2	62.2	21.4	8.1	3.3
2	3.6	4.3	4.5	4.0	4.0	2.8	3.3	10.7	35.1	21.4	8.1	3.3
3	3.6	4.3	4.5	3.9	4.0	2.7	3.3	10.7	28.1	21.4	8.1	3.3
4	3.8	5.8	4.5	3.9	4.0	2.6	3.6	10.3	32.0	21.4	8.1	3.3
5	3.6	5.8	4.5	3.9	4.1	2.6	36	9.8	31.0	17.8	7.7	3.3
6	3.6	7.3	4.5	3.9	4.1	2.5	3.8	9.3	40.6	17.8	7.7	2.9
7	3.6	6.9	4.4	3.9	4.1	2.5	3.8	9.3	38.3	14.6	7.3	3.1
8	3.6	7.3	4.4	3.8	4.1	2.4	4.3	9.3	36.1	14.6	7.3	3.3
9	3.8	6.9	4.4	3.8	4.0	2.4	4.3	10.3	34.0	14.6	5.8	3.1
10	4.3	7.3	4.4	3.8	4.0	2.4	4.3	15.8	31.0	14.6	5.8	3.1
11	3.8	8.1	4.4	3.8	4.0	2.5	4.9	15.3	32.0	12.3	5.8	2.9
12	3.8	8.1	4.3	3.8	3.9	2.6	4.9	17.1	35.1	12.3	5.8	2.9
13	3.8	7.7	4.3	3.8	3.9	2.6	4.6	19.1	38.3	12.3	5.5	2.9
14	3.8	7.7	4.3	3.8	3.8	2.6	4.6	24.6	43.0	12.3	5.5	2.9
15	3.8	7.7	4.3	3.8	3.8	2.7	5.5	33.0	46.8	12.3	5.5	2.9
16	3.6	7.7	4.3	3.9	3.7	2.7	8.1	36.1	56.3	11.8	5.2	2.9
17	3.8	7.3	4.2	3.9	3.6	2.8	12.8	34.0	53.5	11.8	5.2	2.7
18	3.8	6.9	4.2	3.9	3.6	2.8	17.1	33.0	48.1	11.8	4.9	2.7
19	3.8	6.5	4.2	3.9	3.5	2.9	21.4	37.2	44.2	11.8	4.9	2.7
20	3.8	6.5	4.2	3.9	3.5	2.9	23.0	45.5	43.0	11.2	4.9	3.3
21	3.8	4.7	4.2	3.9	3.4	2.9	21.4	45.5	46.8	ll.2	4.9	3.1
22	3.8	4.7	4.1	3.9	3.3	3.0	19.9	40.6	53.5	11.2	3.3	3.1
23	3.8	4.7	4.1	3.9	3.3	3.0	38.3	40.6	40.6	11.2	3.3	2.9
24	3.8	4.6	4.1	3.9	3.2	3.1	17.1	39.5	40.6	11.2	3.3	2.9
25	3.8	4.6	4.1	4.0	3.2	3.1	15.8	53.5	40.6	9.3	3.3	2:s
26	4.3	4.6	4.1	4.0	3.1	3.2	15.2	36.1	40.6	8.9	3.3	2.9
27	4.3	4.6	4.1	4.0	3.0	3.2	14.0	38.3	40.6	8.9	3.3	2.9
28	4.3	4.6	4.0	4.0	3.0	3.3	13.4	34.0	30.0	8.9	3.3	2.7
29	4.3	4.6	4.6	4.0	2:s	3.3	12.2	35.1	25.5	8.5	3.3	2.7
30	4.3	4.6	4.0	4:o		3.3	11.2	53.5	21.4	8.5	3.3	2.7
31	4.3		4.0	4.0		3.3		57.8		8.5	3.8	
Mean	3.9	6.1	4.3	3.9	3.7	2.8	10.8	28.3	39.6	13.1	5.3	3.0
Max	4.3	8.1	4.6	4.0	4.1	3.3	38.3	57.8	62.2	21.4	8.1	3.3
Min	3.6	4.3	4.0	3.8	2.9	2.4	3.3	9.3	21.4	8.5	3.3	2.7
Ac-ft	237.3	358.1	263.1	239.7	210.5	173.4	640.7	1737.2	2357.6	804.7	328.3	177.9

Table 43. Discharge measurements (cubic feet per second) and gage height (feet) at the water level recorder site on the South Fork of Lost Creek (NE1/4 SW1/4 S3 T24N R17W).

Date	Flow (cfs)	Gage ht. (feet)
11-24-82	5.6	730
1-13-83	6.2	7.27
2-15-83	3.6	7.22
3-10-83	10.9	7.37
5-11-83	48.7	7.76
6-8-83	143.5	8.57
7-5-83	80.2	8.07
8-31-83	8.9	7.32
9-27-83	8.2	7.28
10-27-83	8.1	7.36
11-29-83	12.2	7.43
l-lo-84	19.2	7.62
2-9-84	8.9	Broken*
3-8-84	6.3	6.99
4-11-84	15.1	7.12
4-25-84	56.5	7.50
5-10-84	32.4	7.40
5-23-84	148.7	8.20
6-7-84	138.5	8.35
6-25-84	157.7	8.35
7-11-84	35.7	7.61
7-24-84	15.7	7.44
9-24-84	7.8	7.42
10-4-84	7.7	7.24

* New staff gage installed on 10 February 1984 due to tree falling on the old gage.

Table 44. Average daily discharge (cubic feet per second) in **Squeezer Creek** during the period October 1983 through **September 1984.**

Location: SE¼SE¼S27T23NR17W, (Stream kilometer 6.4)
Drainage Area: 21.5 **sq.** km (at gaging station)
Period of Record: October 1983 through **September** 1984
Gage: Water stage recorder
Remarks: Records good with exception of winter months (November through March) which were estimated by interpolation from graphs of monthly **measurements. Daily** flows **during** the periods October 1-19, 1983, May 18-22, 1984, and August 20-21, 1984 were estimated by **interpolation** and **comparisons** with adjacent drainages.

Average Discharge: 20.4 **cfs**
Extremes for year: **Maximum:** 192.3 cfs **May** 31, 1984
Minimum: 3.3 cfs **March** 8-9, 10-11, 1984

SQUEEZER CREEK

Average Daily Discharge (cfs)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	8.0	7.1	8.0	6.2	5.3	3.7	4.2	14.6	122.7	79.6	20.0	8.0
2	7.7	7.1	7.9	6.2	5.3	3.6	4.2	14.2	87.2	72.4	19.3	8.0
3	7.7	7.1	7.7	6.3	5.2	3.5	4.2	13.7	73.8	72.4	18.7	7.4
	7.7	8.0	7.6	6.3	5.1	3.5	4.3	12.4	64.4	63.1	18.2	7.7
3	7.7	8.0	7.4	6.4	5.1	3.4	4.3	10.8	64.4	65.7	16.1	7.7
6	7.7	9:o	7.3	6.4	5.0	3.4	4.4	10.8	64.4	63.1	15.6	8.6
7	7.4	10.0	7.1	6.4	5.0	3.3	4.4	10.8	57:o	53.5	15.1	8.6
8	7.4	8.3	6.9	6.5	4.9	3.3	4.5	10.8	54.7	45.0	14.6	9.3
9	7.4	8.3	6.8	6.5	4.9	3.2	4.5	11.6	51.3	38.3	14.6	9.3
10	7.1	8.3	6.7	6.5	4.8	3.3	4.6	12.0	48.0	38.3	14.2	9.0
11	7.1	10.4	6.5	6.4	4.7	3.3	4.6	12.0	46.0	38.3	14.2	9.0
12	7.1	9.7	6.4	6.4	4.7	3.4	5.7	12.0	52.4	38.3	14.2	9.0
13	7.1	10.0	6.2	6.3	4.6	3.4	5.7	13.3	64.4	38.3	14.2	9.0
14	7.1	9.7	6.0	6.2	4.6	3.5	5.7	18.2	93.6	33.9	13.3	8.6
15	7.1	9.7	5.9	6.2	4.5	3.5	5.7	27.0	122.7	33.9	12.8	8.6
16	7.1	9.0	5.7	6.1	4.5	3.5	6.2	36.5	164.3	33.9	12.4	8.6
17	7.1	9.0	5.7	6.1	4.4	3.6	10.4	41.1	166.8	30.0	12.4	8.3
18	7.1	8.6	5.8	6.0	4.4	3.6	19.3	42.0	132.8	30.0	12.4	8.3
19	6.8	0.3	5.8	6.0	4.3	3.7	25.6	43.0	116.8	30.0	12.4	8.3
20	6.8	8.0	5.8	5.9	4.3	3.7	31.5	43.0	122.7	30.0	11.6	9.0
21	6.8	8.0	5.9	5.9	4.2	3.8	30.7	44.0	166.8	28.4	10.8	9.0
22	6.8	8.1	5.9	5.9	4.1	3.8	20.4	45.0	143.6	27.7	10.0	9:o
23	6.8	8.1	5.9	5.8	4.1	3.9	25.6	46.0	103.9	24.9	10.4	9.0
24	6.8	8.1	6.0	5.8	4.0	3.9	24.2	44.0	103.9	23.6	10.4	9.0
25	6.8	8.2	6.0	5.7	4.0	3.9	21.7	42.0	122.7	22.3	10.0	9.0
26	6.6	8.2	6.0	5.6	3.9	4.0	19.3	41.1	143.6	22.3	9.3	9.0
27	7.1	8.2	6.1	5.6	3.9	4.0	17.7	39.2	143.6	22.3	8.3	8.6
28	7.1	8.3	6.1	5.5	3.8	4.0	16.6	36.5	132.8	22.3	8.3	8.6
29	7.1	8.3	6.1	5.5	3.8	4.1	15.1	42.0	l.32.8	22.3	8.0	8.3
30	7.1	8.3	6.2	5.4		4.1	14.6	72.4	103.9	22.9	9.3	8.3
31	7.1		6.2	5.4		4.1		192.3		21.1		7.7
Mean	7.2	8.5	6.4	6.1	4.5	3.7	12.6	34.0	102.3	38.3	13.0	8.6
Max	8.0	10.4	8.0	6.5	5.3	4.1	31.5	192.3	166.8	79.6	20.0	9.3
Min	6.8	7.1	5.7	5.4	3.8		4.2	10.8	46.0	21.1	8.0	7.4
Ac-ft	441.4	506.3	395.9	371.9	260.5	221::	749.6	2090.7	6084.0	2356.3	775.7	526.8

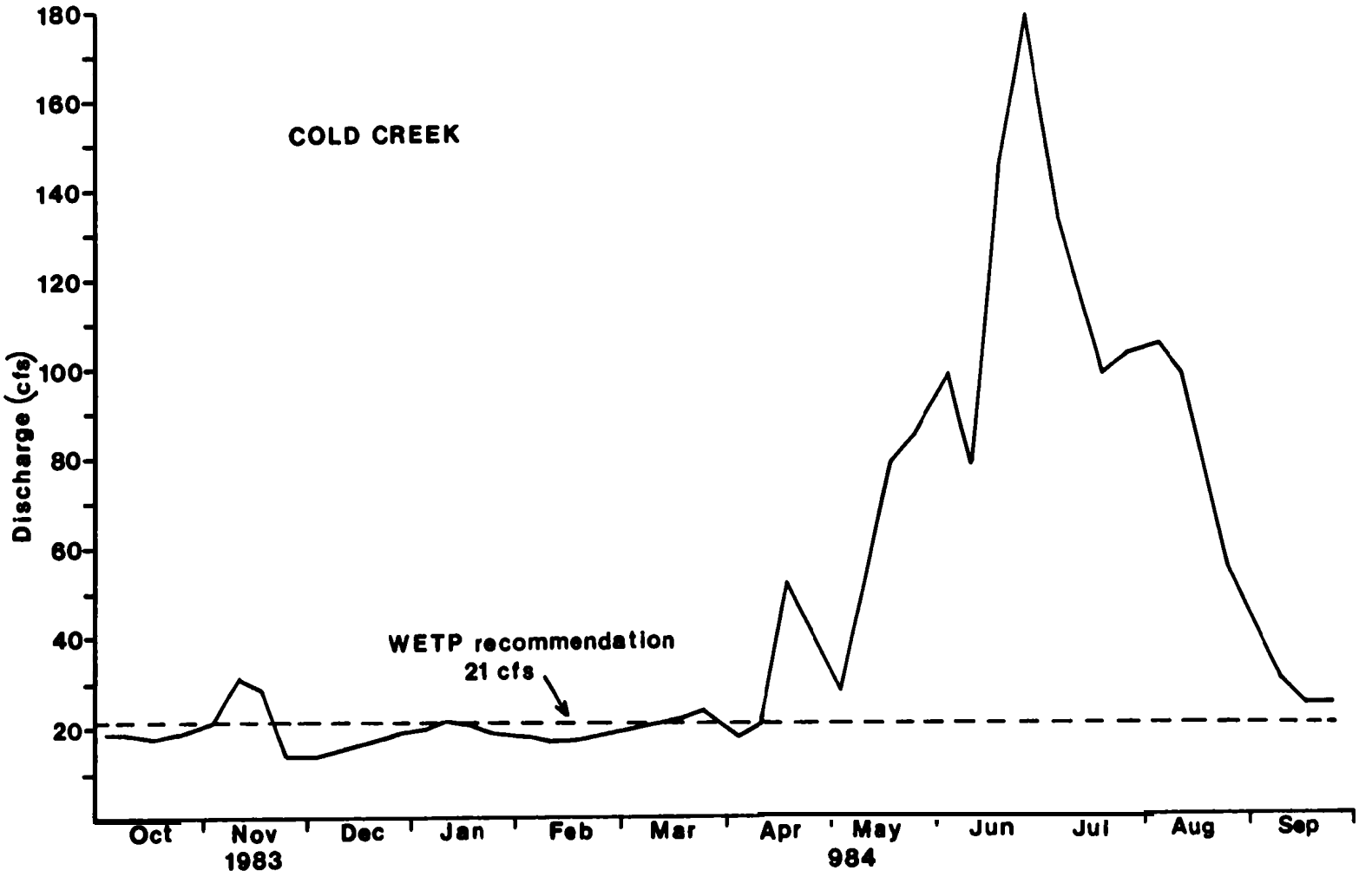


Figure 39. Average weekly discharge and recommended minimum flow (21 cfs) at a gaging point at km 8.0 on Cold Creek in the Swan River drainage during the period October 1983 through September 1984.

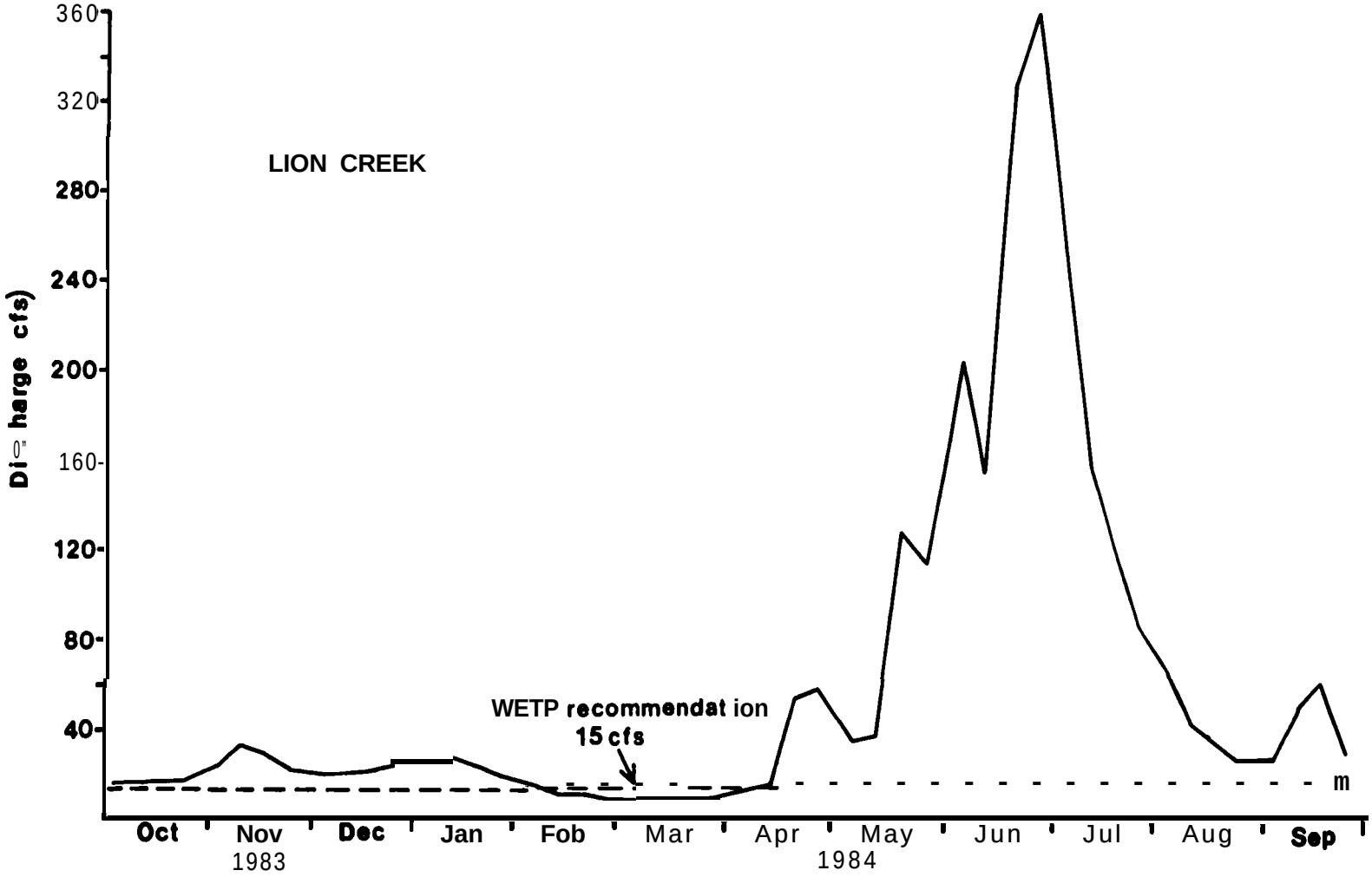


Figure 40. Average weekly discharge and **recommended minimum** flaw (15 **cfs)** at a **gaging point at km 10.5 on Lion Creek** in the **Swan River drainage** during the period October 1983 **through** September 1984.

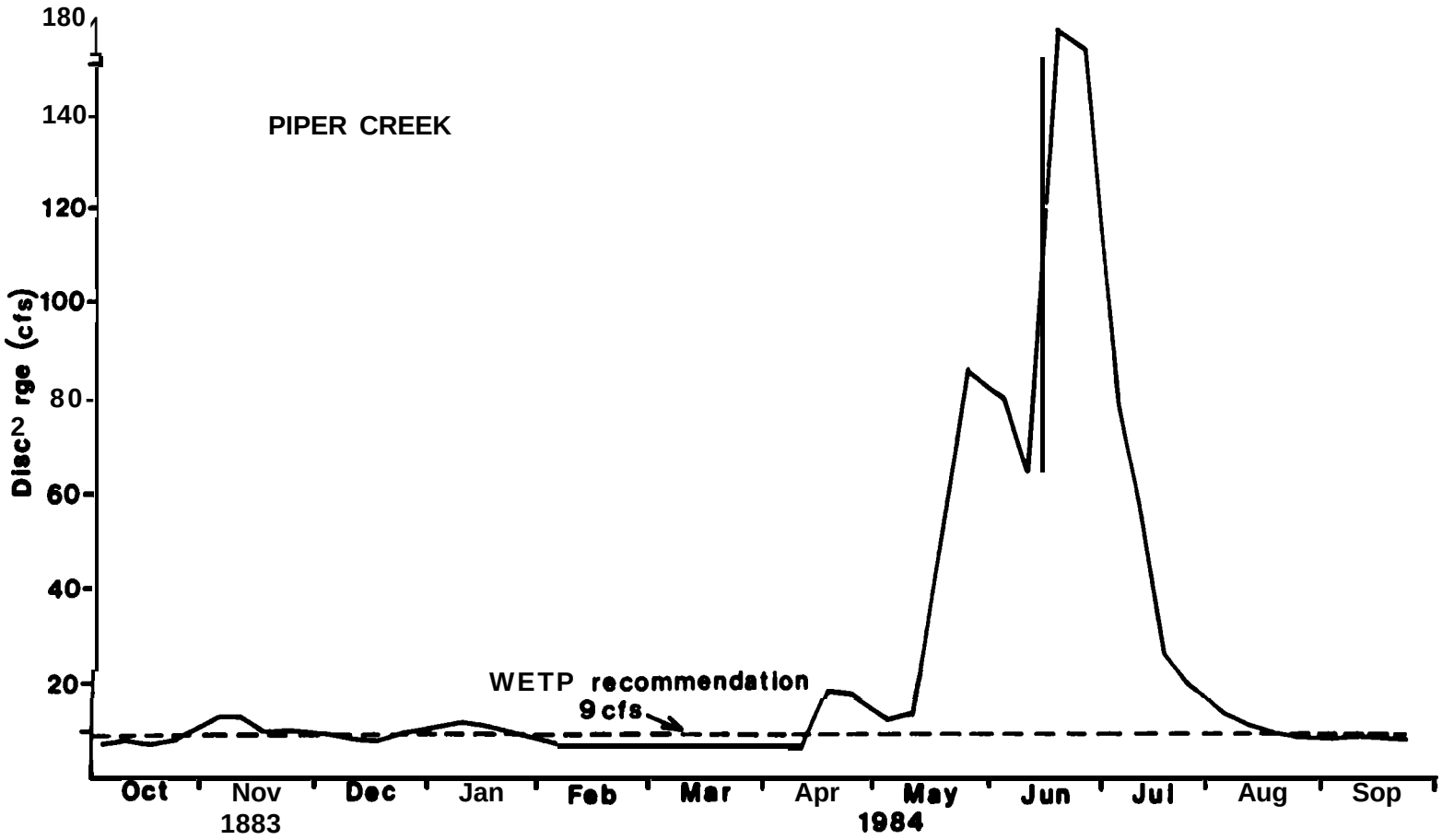


Figure 41. Average weekly discharge and recommended minimum flow (9 cfs) at a gaging point at km 6.4 on Piper Creek in the Swan River drainage during the period October 1983 through September 1984.

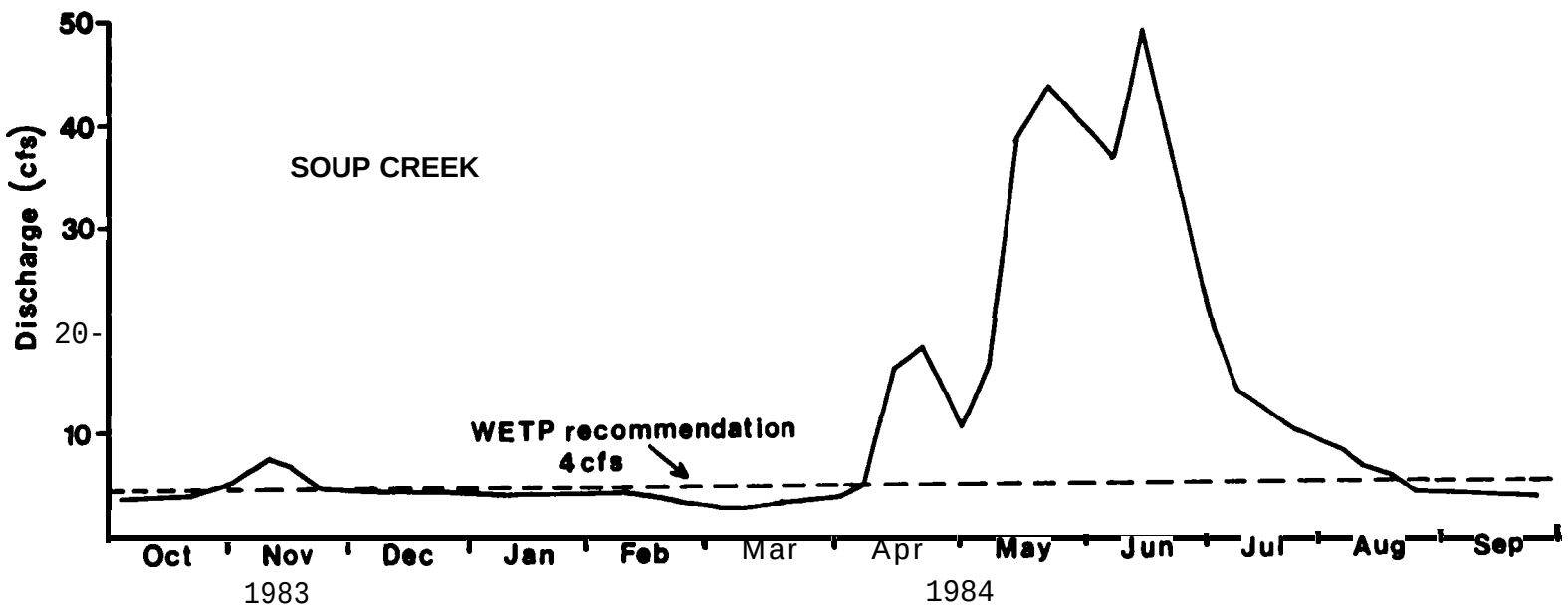


Figure 42. Average weekly discharge and recommended minimum flaw (4 cfs) at a gaging point at km 11 on Soup Creek in the Swan River drainage during the period October 1983 through September 1984.

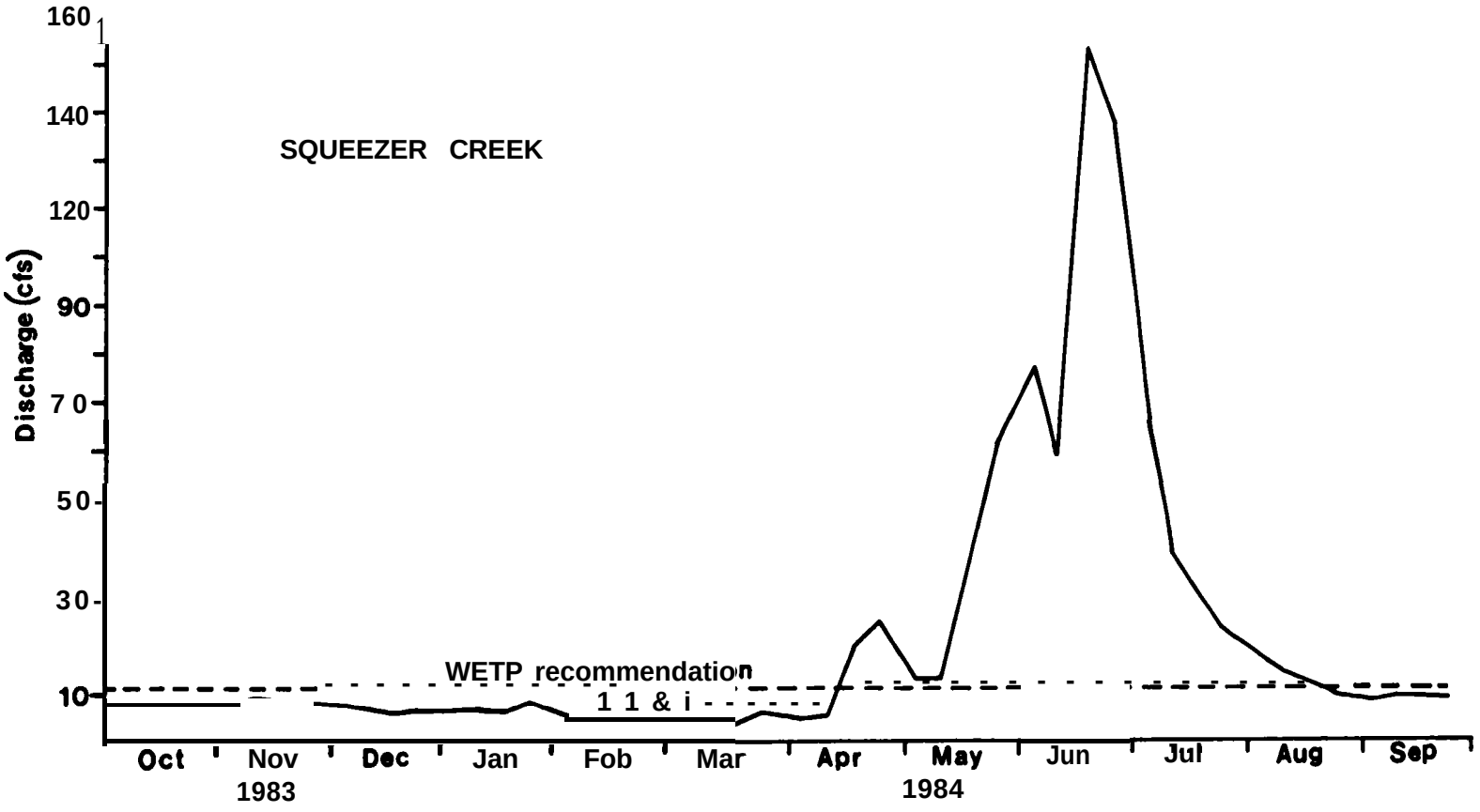


Figure 43. Average weekly discharge and recommended minimum flow (11 cfs) at a gaging point at km 6.5 on Squeezer Creek in the Swan River drainage during the period October 1983 through September 1984.

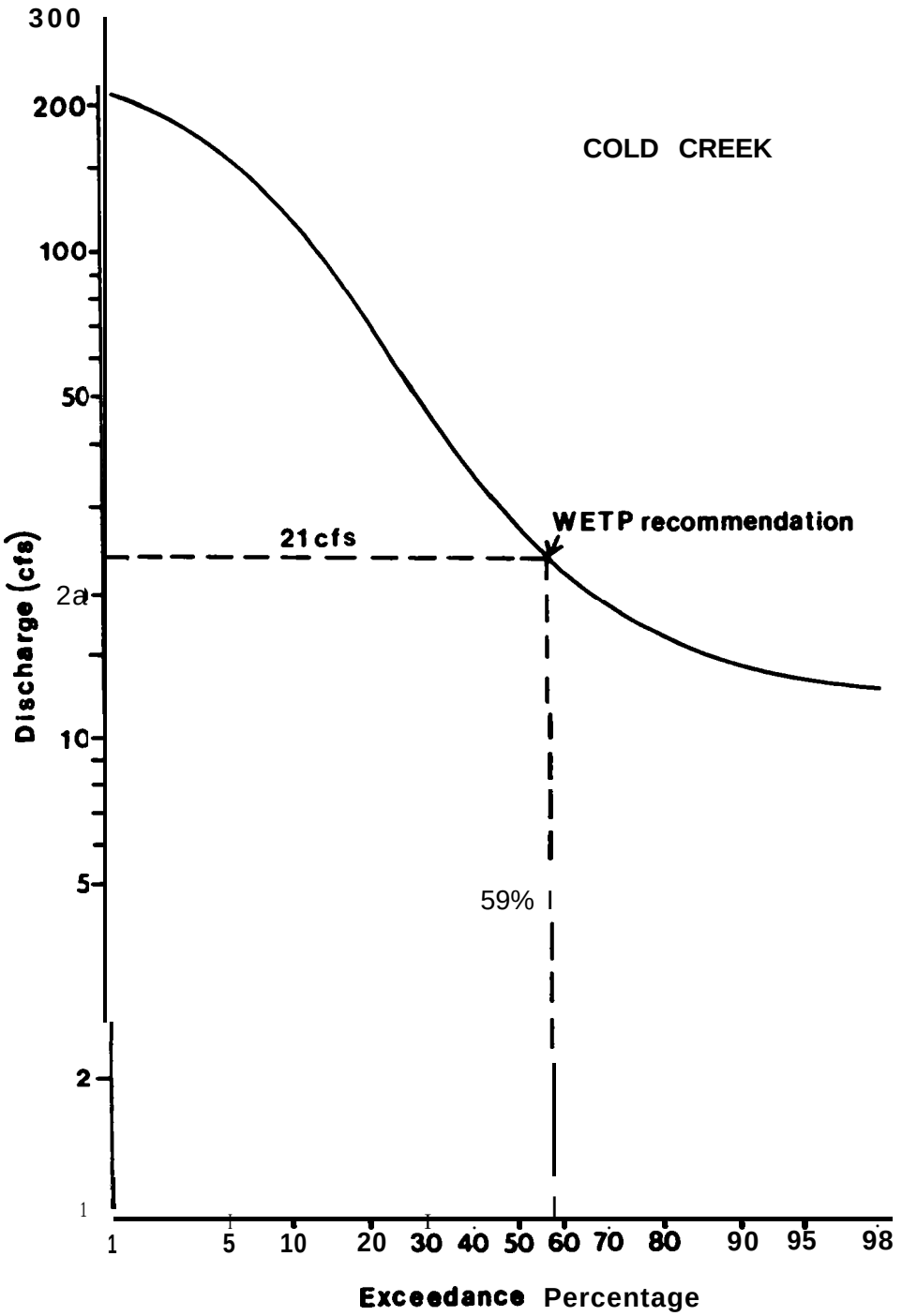


Figure 44. Flow duration at a gaging point at km 8 on Cold Creek in the Swan River drainage during the period October 1983 through September 1984.

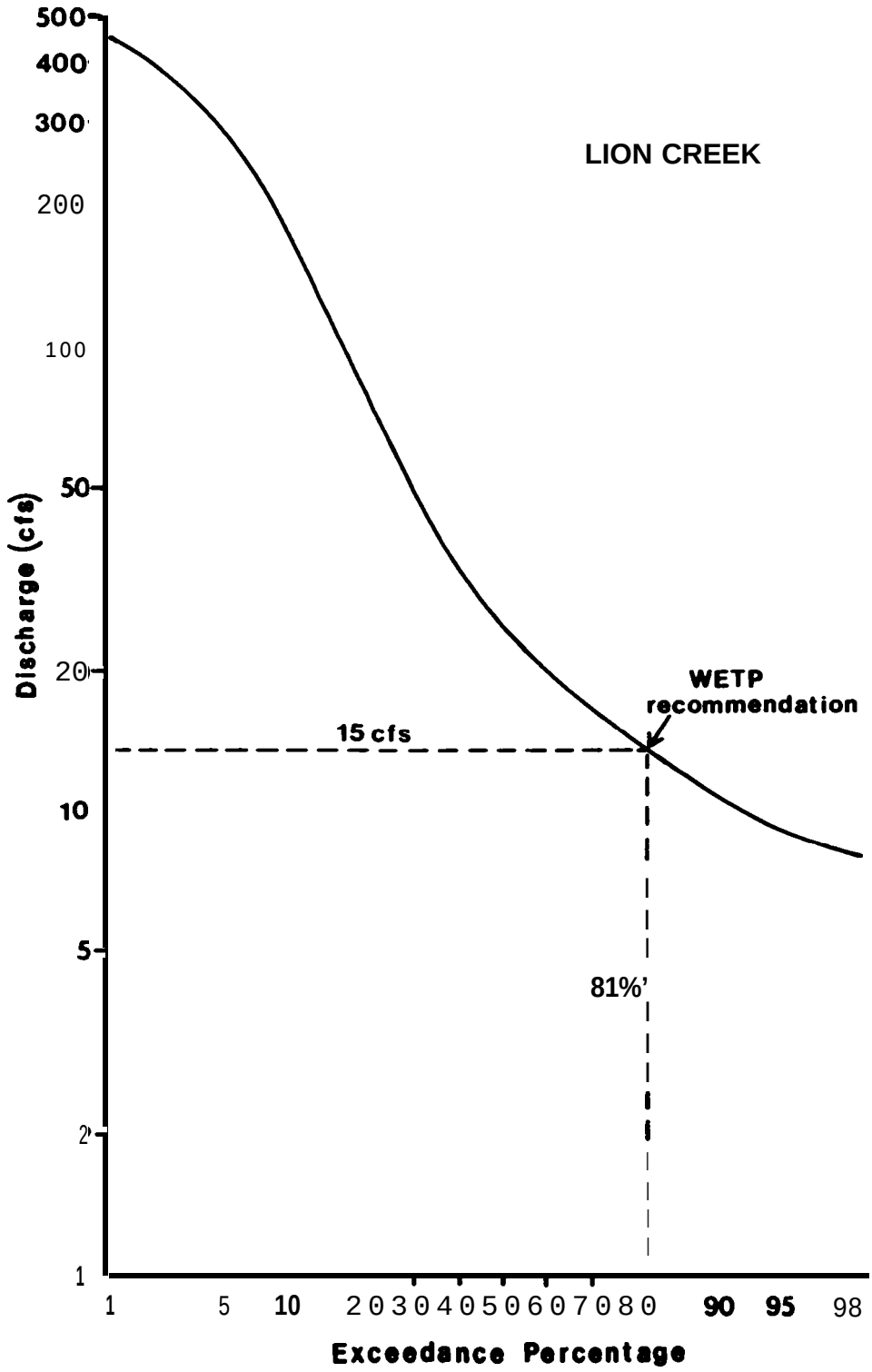


Figure 45. Flaw duration at a gaging point at km 10.5 on Lion Creek in the Swan River drainage during the period October 1983 through September 1984.

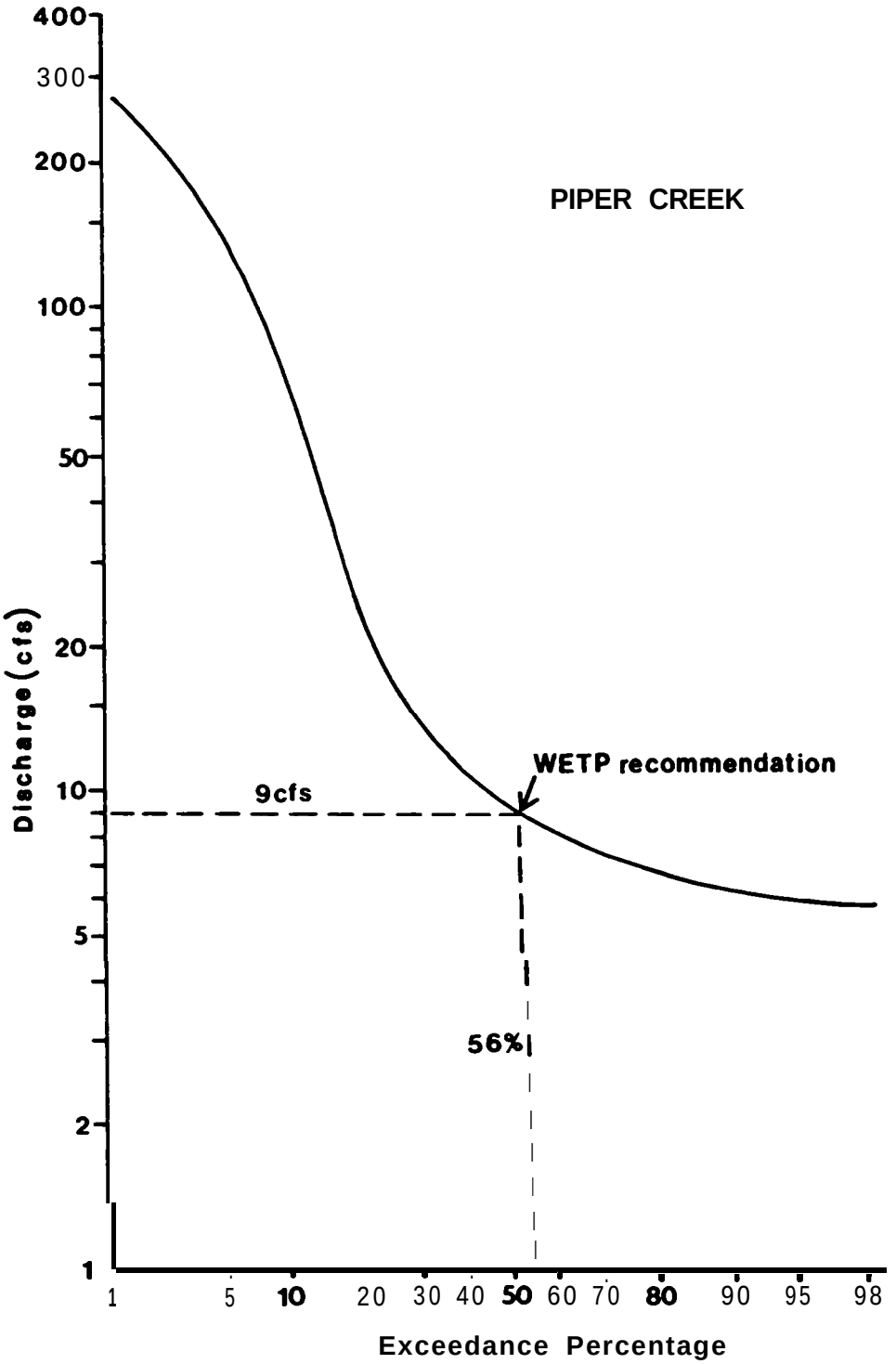


Figure 46. Flow duration at a gaging point at km 6.4 on Piper Creek in the Swan River drainage during the period October 1983 through September 1984.

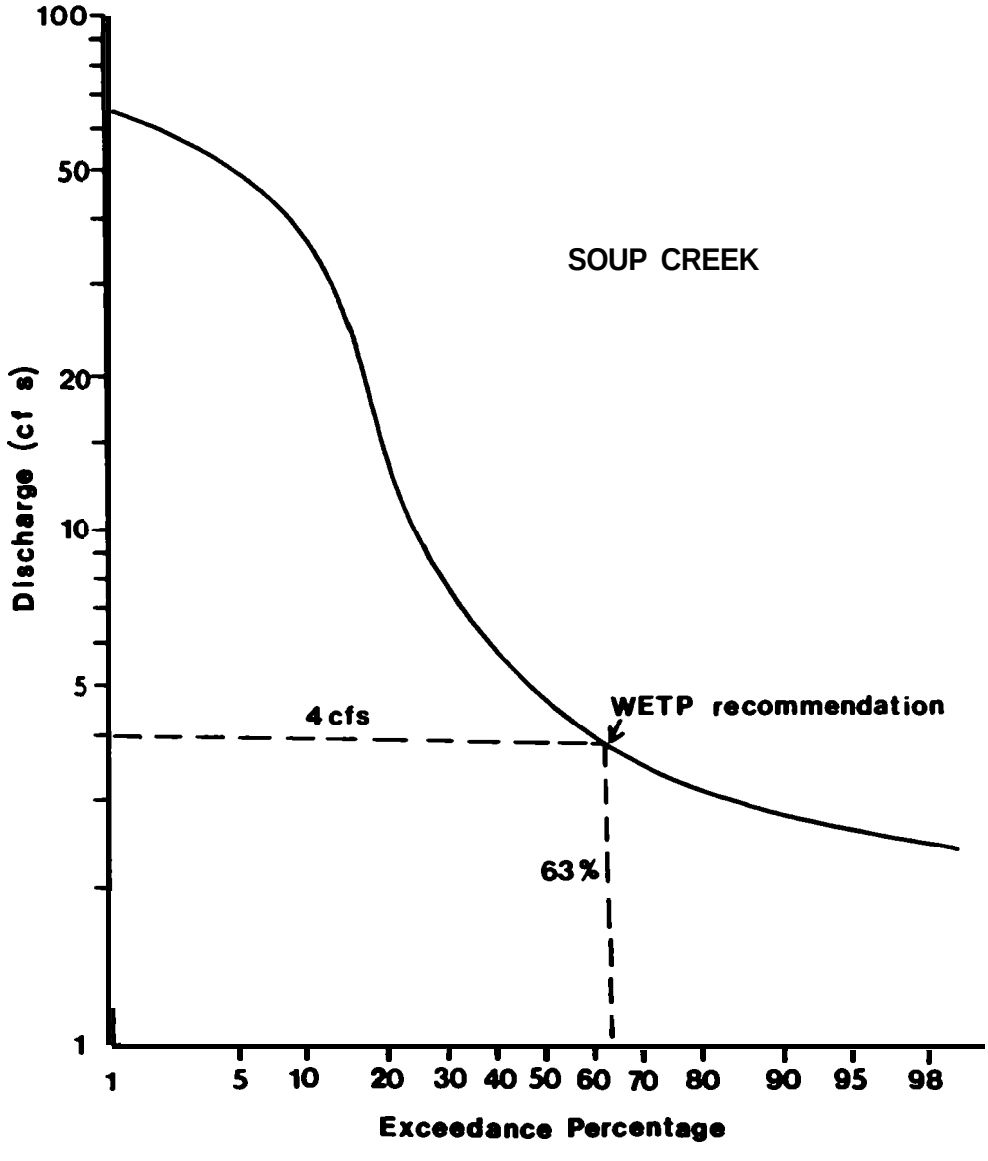


Figure 47. Flawdurationata gaging point at km 11 on Soup Creek in the Swan River drainage during the period October 1983 through September 1984.

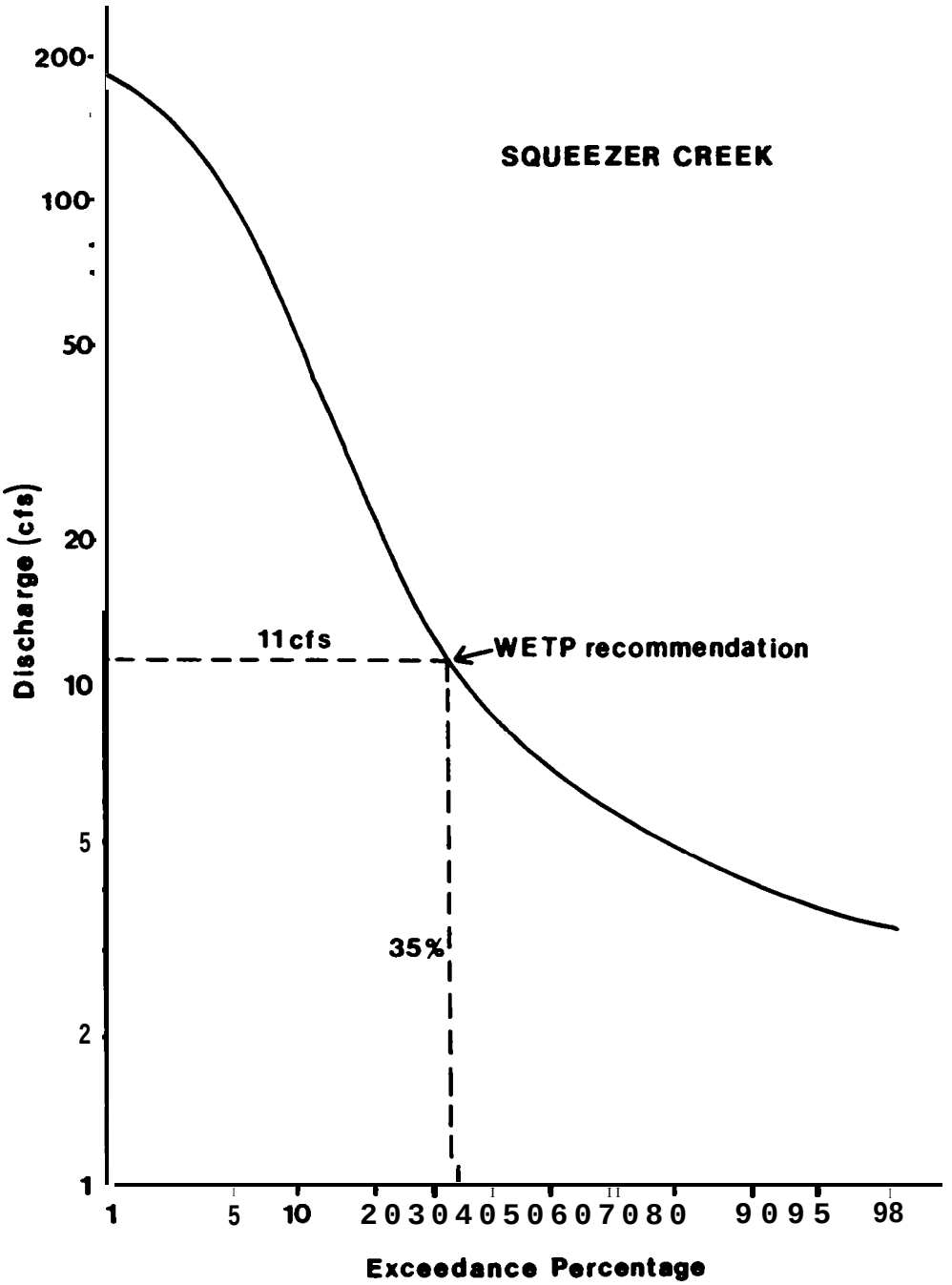
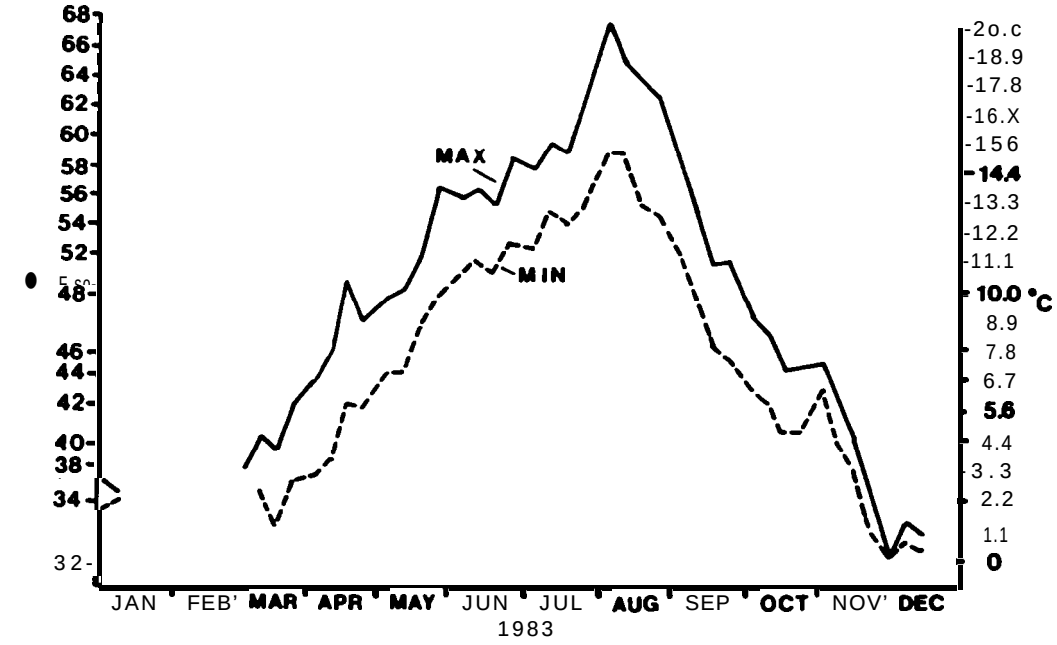


Figure 48. Flaw duration at a gagingpointatkm 6.5 on Squeezer Creek in the Swan River drainage during the period October 1983 through September 1984.

WATER TEMPERATURE

Continuous recording Taylor thermographs were installed in the Swan River (at the Piper Creek road bridge) and in six tributary streams during the study. Average weekly maximum and minimum water temperatures during 1983 and 1984 are in Figures 49 through 55. Tributary thermographs were placed at the same location as water level recorders. Specific locations were described by Leathe et al. (1985).



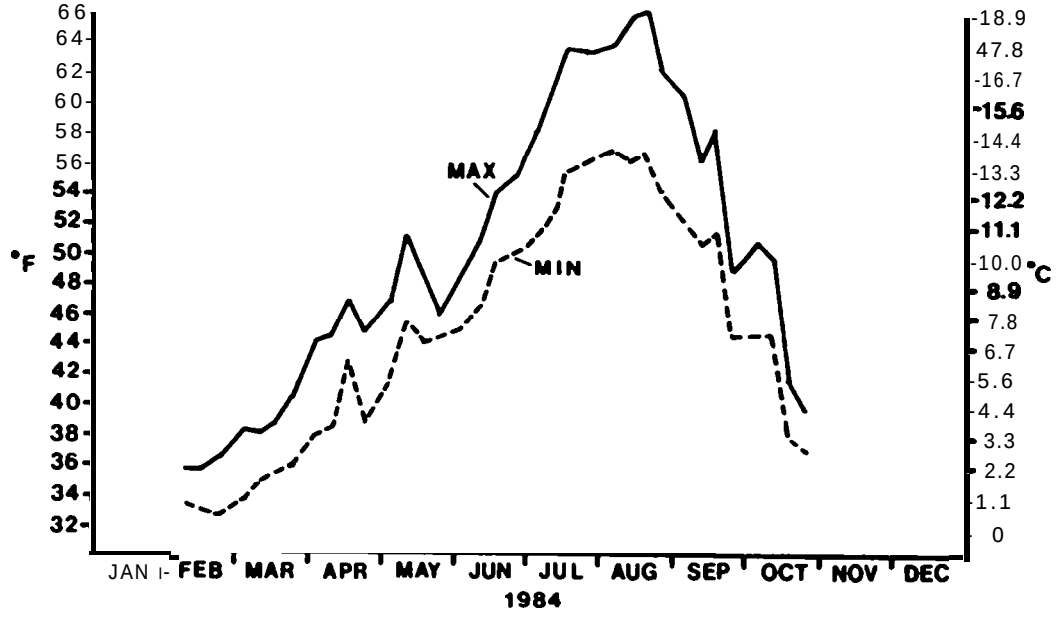
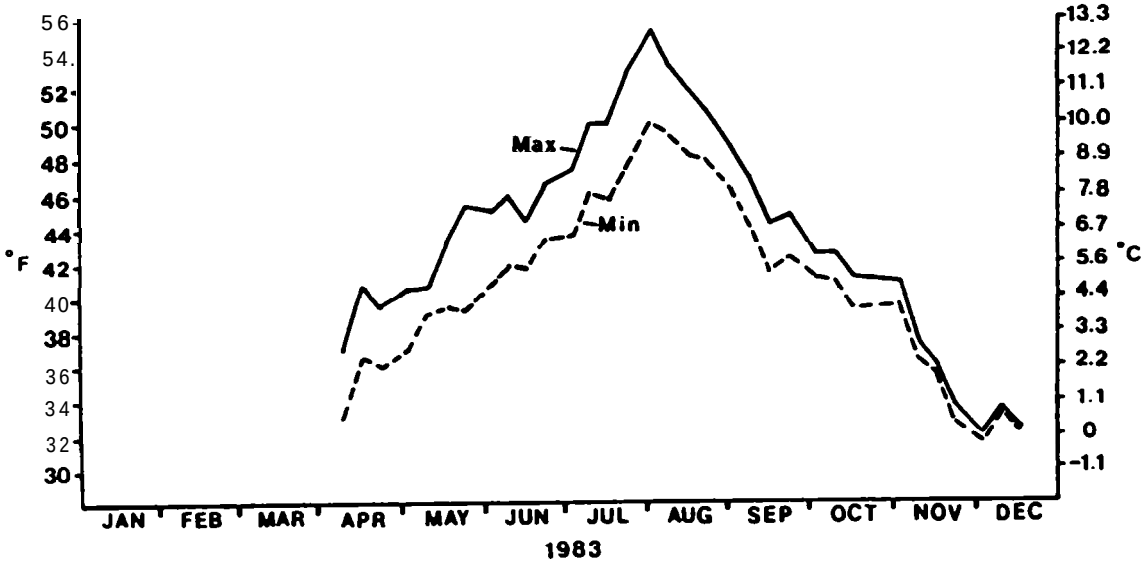


Figure 49. Average weekly maximum and minimum temperatures at the Piper Creek roadbridge on the Swan River during 1983 (upper graph) and 1984 (lower graph).



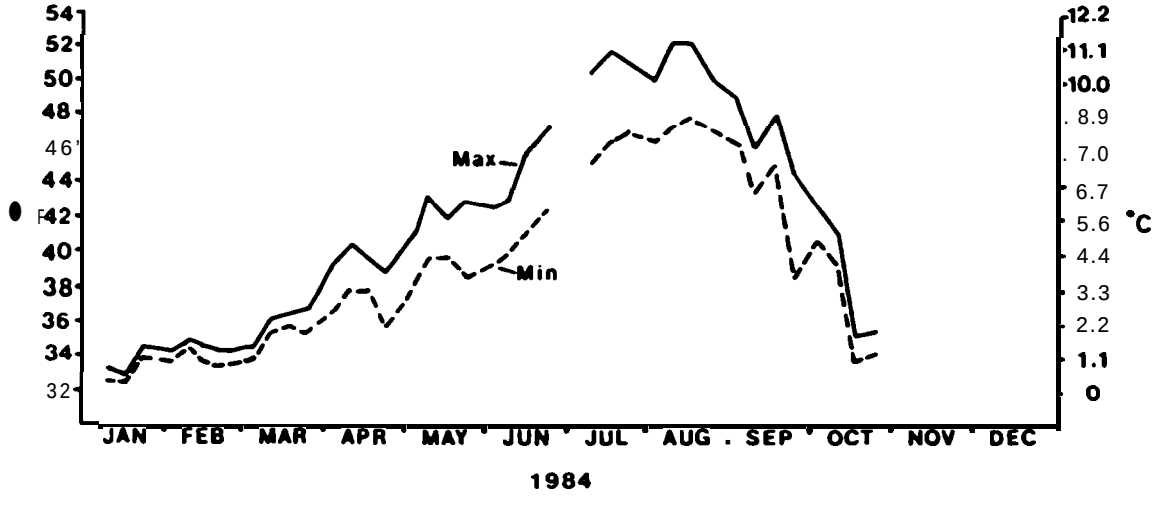
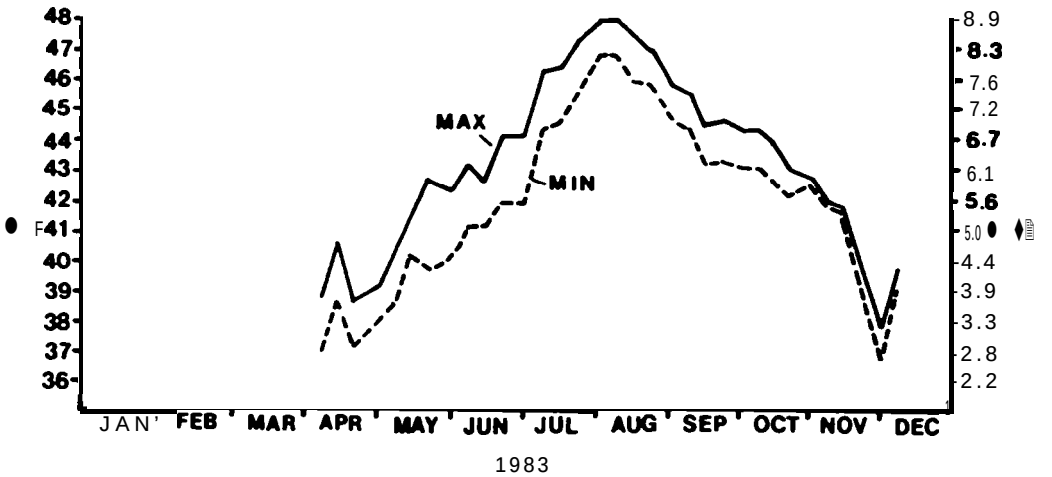


Figure 50. Average weekly maximum and minimum temperatures at km 8 in Cold Creek in the Swan River drainage during 1983 (upper graph) and 1984 (lower graph).



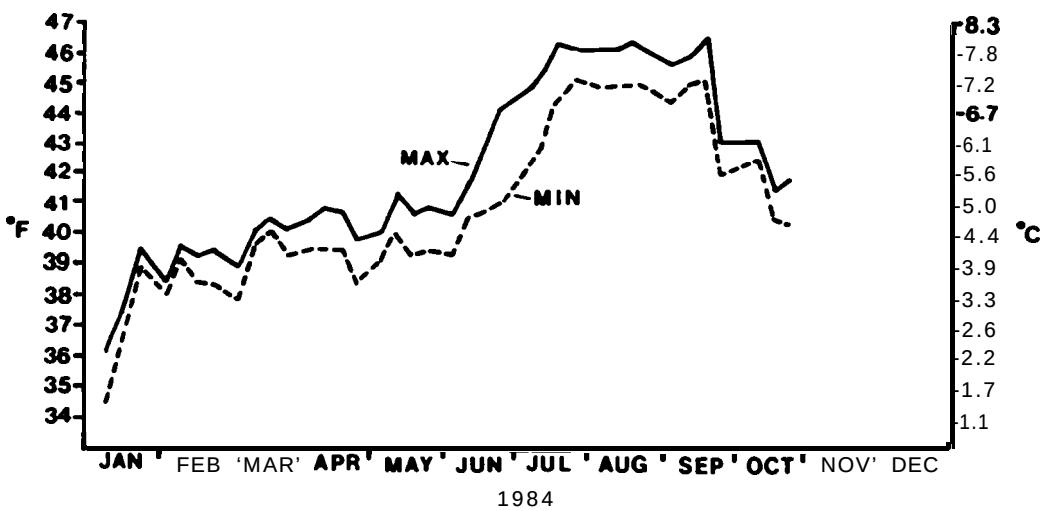
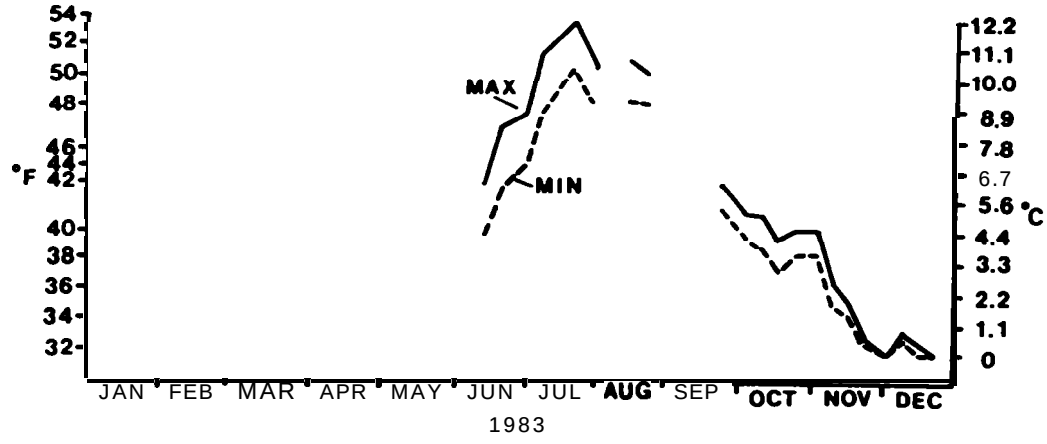


Figure 51. Average weekly maximum and minimum temperatures at km 10.5 in Lion Creek in the Swan River drainage during 1983 (upper graph) and 1984 (lower graph).



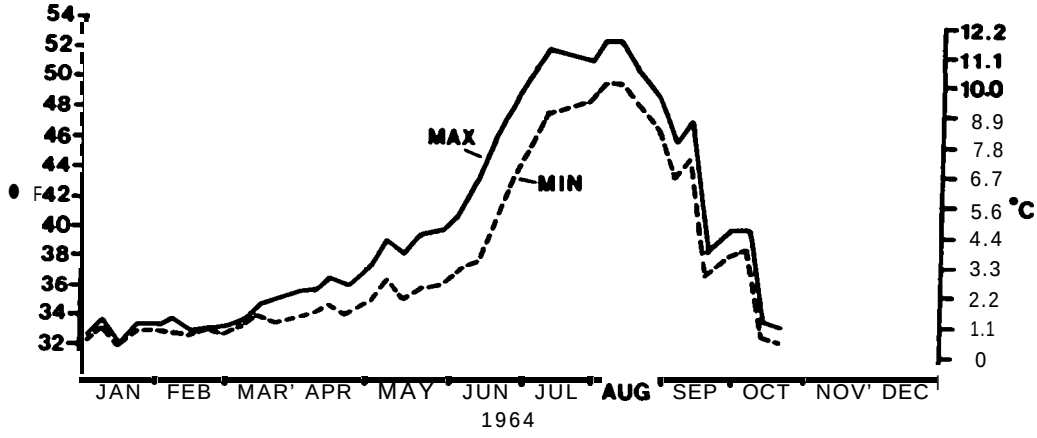
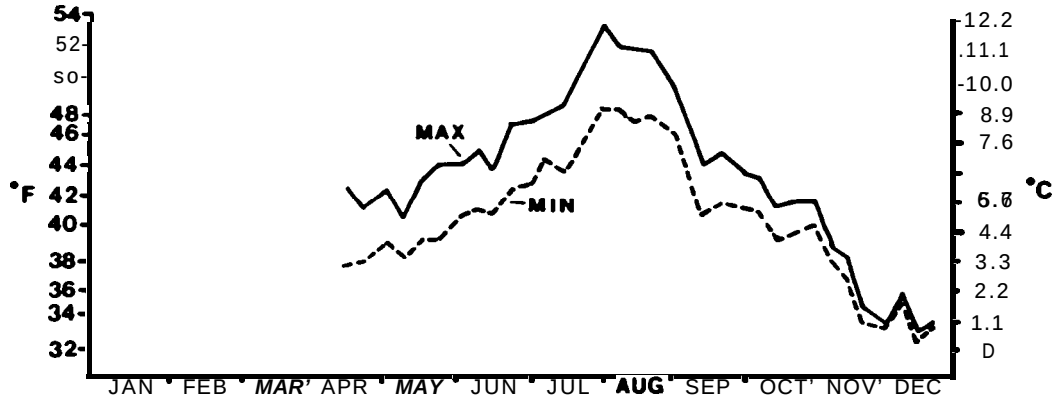
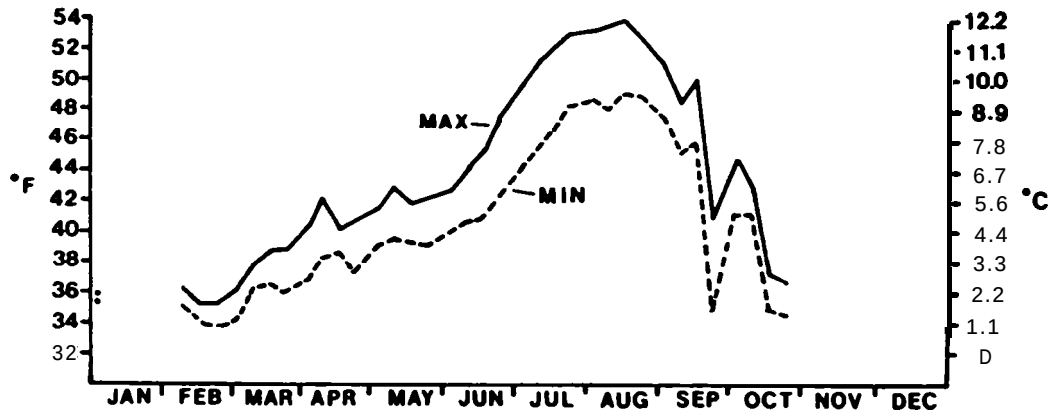


Figure 52. Average weekly maximum and minimum temperatures at km 6.4 in Piper Creek in the Swan River drainage during 1983 (upper graph) and 1984 (lower graph).

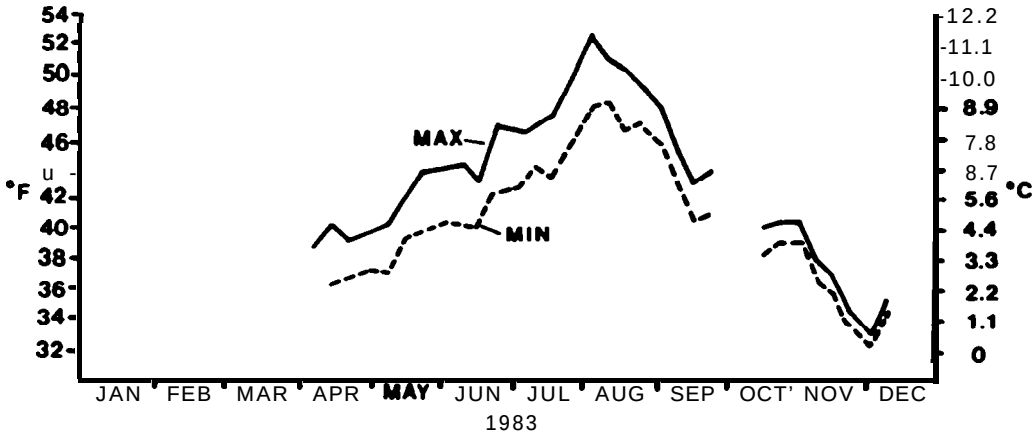


1983



1984

Figure 53. Average weekly maximum and minimum temperatures at km 9.5 in Soup Creek in the Swan River drainage during 1983 (upper graph) and 1984 (lower graph).



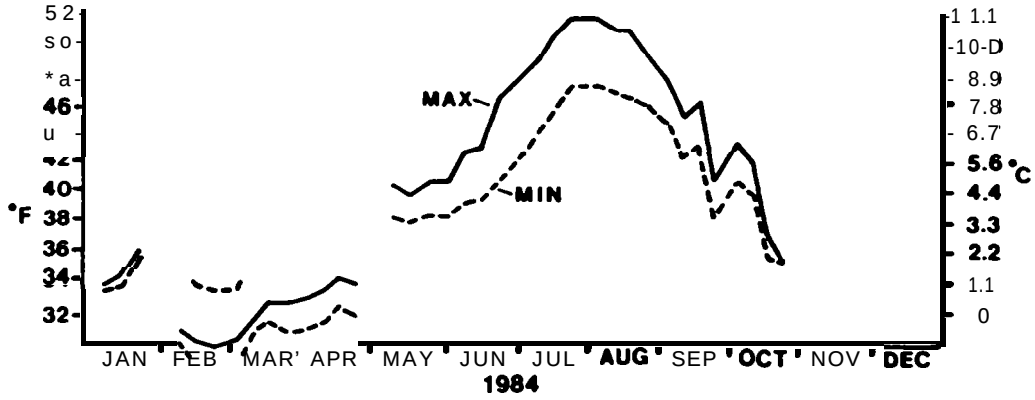
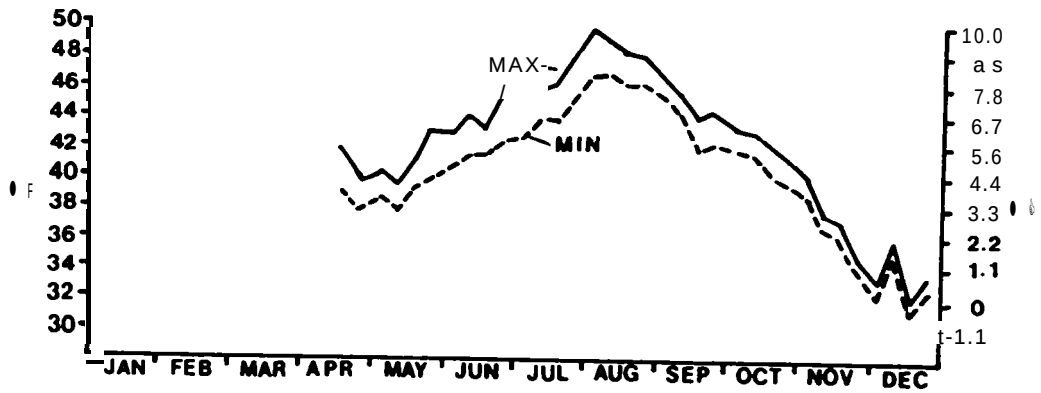


Figure 54. **Average weekly maximum and minimum temperatures at km 5.5 in S. Fork Lost Creek in the Swan River** drainage during 1983 **(upper graph)** and 1984 **(lower** graph).



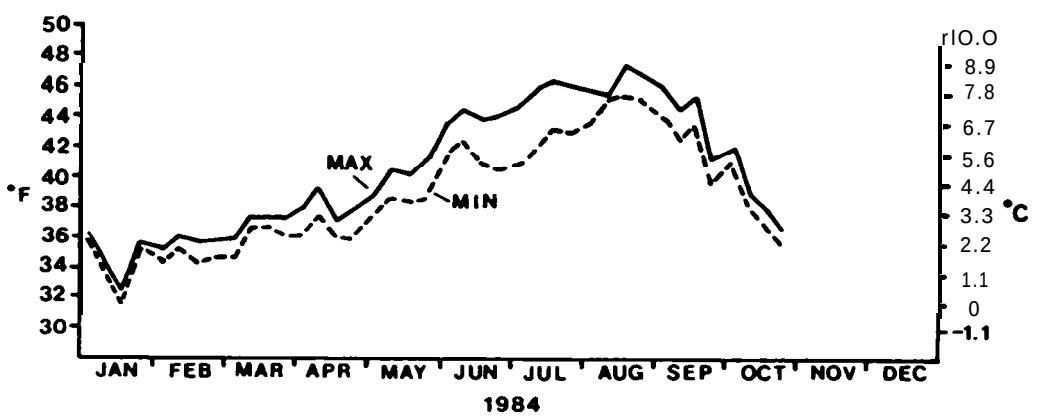


Figure 55. Average weekly maximum and minimum temperatures at km 6.5 in Squeezer Creek in the Swan River drainage during 1983 (upper graph) and 1984 (lower graph).

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