SMOLT CONDITION AND TIMING OF ARRIVAL

AT LOWER GRANITE RESERVOIR

Annual Report
for 1985 Operations

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ABSTRACT

This project monitored the daily passage of smolts during the 1985 spring outmigration at three migrant traps, one each on the Snake, Clearwater, and Salmon rivers.

Yearling chinook migration rate between Salmon River release sites and the Salmon RIver scoop trap averaged 23 km per day, about half the migration rate for the same brand groups when migrating from the Salmon River trap to the Snake River trap (48 km/day).

Average migration rates for branded chinook and steelhead between release s l tes and the head of Lower Granite Reservoir were both near 27 km per day.

The yearling chinook migration begins in earnest when Salmon River discharge makes a signif icant rise in early to mid-April. Most year l l ng chinook pass into Lower Granite Reservoir in April fol lowed by passage of steelhead in May. Chinook smol t recapture data from the Snake River trap suggest a strong dependence of migration rate on quantity of Snake and Salmon river discharge.

The ability of the Salmon River trap to catch rearl ing chinook decreased as discharge increased. No correlation between discharge level and efficiency was observed at the Snake or Cl earwater trap for chinook or steelhead smolts.

Daily and seasonal descal ing rates were calculated for each species at each trap. Rates were highest for hatchery steelhead, intermediate for fingerling chinook, and lowest for wild steelhead. Descal ing rates were generally lower in 1985 than in 1984.

When comparing the size of smolts in the Salmon and Clearwater rivers, the former river has smal ler rearl ing chinook and larger hatchery and wild steelhead. Salmon River hatchery steelhead smolts in 1985 averaged 2 cm smaller than in 1983 and were much healthier than in 1983.

INTRODUCTION

This is the third annual report of the Idaho Department of Fish and Game (IDFG) smolt monitoring project. The work is funded by Bonneville Power Administratioin (BPA) pursuant to the Northwest Power Planning Council's Fish and Wildlife Program. Information obtained is sent daily to the Water Budget Center (WBC) and is part of their Columbia River systemwide data base on which they make requests to hydropower project operators for enhancement of the downriver smolt migration. Water storage for hydroelectric generation can severely reduce flows necessary for downstream smolt migration. Thus, the NWPPC proposed a "Water Budge-t" for augmenting spring flows. Additionally, information obtained from this project provides the IDFG with estimates of quantity, quality, and time of passage of hatchery and wild smolt stocks as they leave each of Idaho's major anadromous fish producing drainages.

This project is made possible through the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 46-501), which gives BPA the authority and responsibility to use its resources to "protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of the Federal Columbia River Power System.,,

The water budget in the Columbia's Snake River tributary is 1.19 migration acre-feet of stored water for use between April 15 through June 15 to enhance the smolt migration. To provide information on smolt movement prior to arrival at the lower Snake River reservoirs, the Idaho Department of Fish and Game monitors the daily passage of smolts at the head of Lower Granite Reservoir and 102 miles upriver at Whitebird, Idaho, on the Salmon River. This information allows the Water Budget Center to anticipate river discharge needs into Lower Granite Reservoir and plan for effective passage or collection for transport of smolts arriving at Lower Granite Dam.

Additionally, the IDFG smolt monitoring project collects data on relative species composition, estimated passage, hatchery vs. wild ratios, travel time, migration rate, and smolt condition relative to scale loss. By monitoring smolt passage at the head and at the dam of Lower Granite Reservoir, migration rates under riverine and reservoir conditions can be compared and determined under various environmental conditions. By having monitoring sites on both the Snake and Clearwater arms of Lower Granite Reservoir, the migration timing of smolts from each drainage can be determined individually. Also, the relative composition of hatchery and wild stocks of steelhead can be determined, information useful to document the rebuilding of wild stocks which is being undertaken in other NWPPC and BPA projects.

Within the short life span of the smolt monitoring program, we have yet to encounter a lower than normal spring runoff as occurred in 1973 and 1977. We believe smolt monitoring will be most beneficial under such conditions, as low flows will slow the migration. In such a year, knowledge of when most smolts have left tributaries and entered areas which can be affected by releases of stored waters wil l al low water budget managers to make the most timely use of the limited water budget resource. Perfecting the smolt monitoring technique in years prior to such a low water condition will increase the probability that smolt survival can be maximized through water budget management.

OBJECTIVES

1. Develop a technique to index the relative abundance of smolts entering Lower Granite Reservoir throughout the outmigration season.

2. Establish timing and success of outmigration for the various groups of hatchery-produced and wild chinook salmon and steelhead smolts as they leave the Salmon River drainage.

3. Establish travel time from the Salmon River index site at Whitebird to the index site at the upper end of Lower Granite Reservoir.

4. Correlate travel time with river flows from index sites to Lower Granite Reservoir and dam.

5. Assist in estlmating total fish abundance and collection efficiency at Lower Granite Dam.

6. Determine where, when, and to what extent descal ing occurs to hatchery reared chinook salmon and steelhead smolts released upstream from Lower Granite Dam and develop management alternatives to reduce scale loss.

METHODS

Releases of Hatchery-Produced Smolts

We obtained information from hatcheries which release steelhead and chinook salmon juveniles in the Snake River system upriver from Lower Granlte Dam. The information included species, number, time and location of release, and the identifying freeze brand if used. This al lowed us to anticipate the passage of the various reiease groups and branded f ish at downriver trapping sites.

Smolt Monitoring Traps

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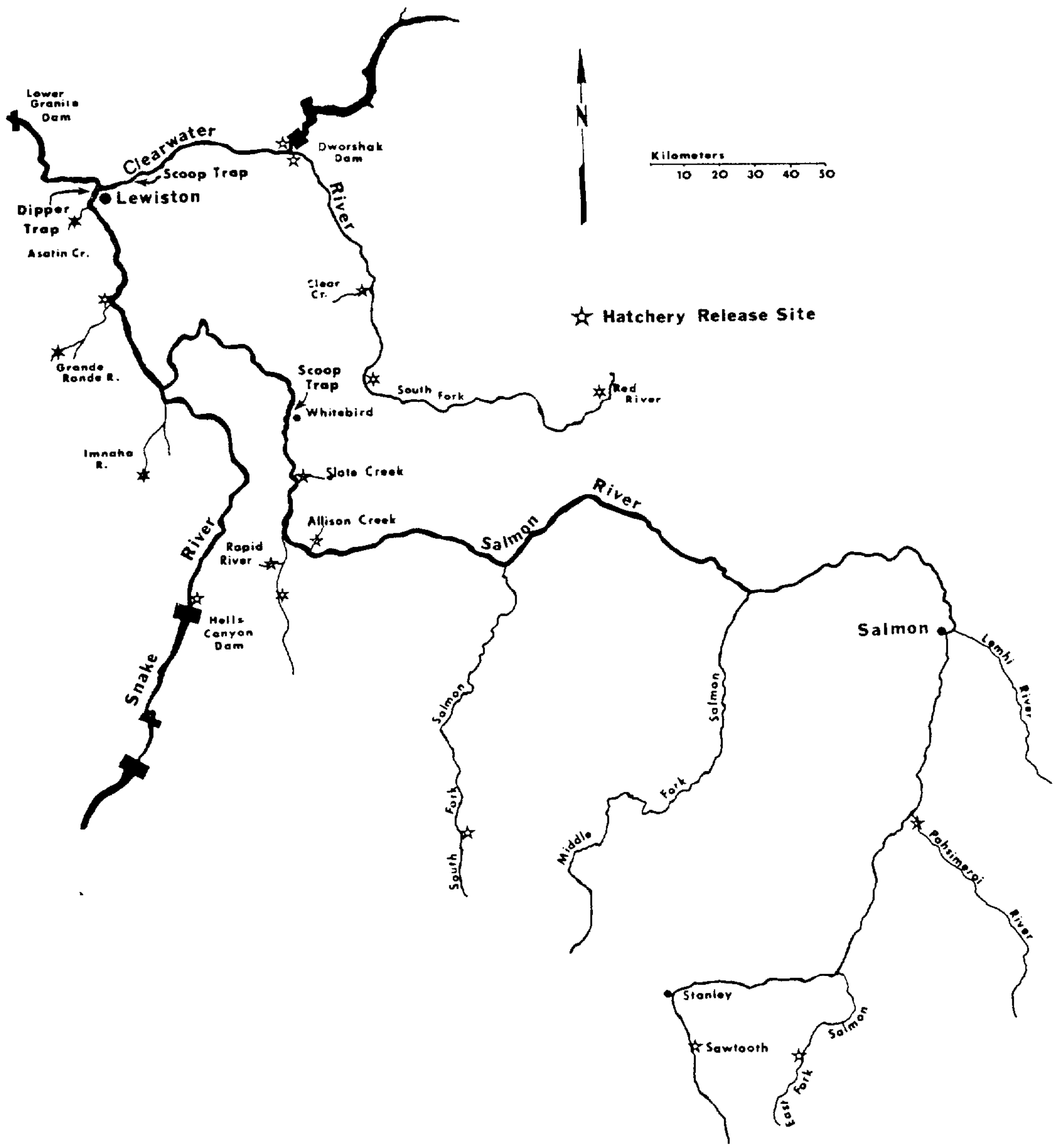

Figure 1. Hatchery release sites, smolt traps, impoundments and river sections relevant to the smolt monitoring project in 1985.

day for scale loss when available. Up to 2,000 smolts were examined daily for hatchery brands, and the remaining catch was then counted by species and released. Only smolts examined for scale loss or brands were anesthetized with tricain methane sulfonate (MS-222). These fish were allowed to recover from anesthesia before being released to the river.

To quantify scale loss, each side of a smolt was separated into five zones and each area was examined, as shown on the juvenile descaling form (Fig. 2). A zone was considered "descaled" if 40% or more of the scales were missing. If at least two zones on one side of a fish were descaled, then the fish was considered descaled. Additionally, beginning in 1985, a fish was also considered to be descaled if a band of scales were missing from at least one side of a fish, and the amount of missing scales was equal to or greater than the loss of 40% or more scales from two areas on a side of a fish as described above. Thus, in 1985 a smolt could be more easily classified as descaled than in previous years. We often refer to such scale loss as "classical" descaling to distinguish it from other types of descaling. A fish was considered to have "scattered" descaling if at least 10% of scales were missing from at least one side of the fish.

At each trap, we recorded water temperature and turbidity each day using a centigrade thermometer and 20 cm Secchi disc. The U.S. Weather Service provided daily information on river discharge. The Snake River trap discharge was measured at the USGS Anatone gage (#13334300). The Clearwater River trap discharge was measured at the USGS Spalding gage (#13342500). The Salmon River trap discharge was obtained from the USGS Whitebird gage (#13317000).

Salmon River Trap

We installed the Salmon River scoop trap one kilometer below the mouth of Whitebird Creek (Rkm 88). The trapping site was located on the outside of a bend in the river immediately downriver from a rock shelf, a location which we believe concentrates downstream migrants both laterally and vertically making them more susceptible to capture. River width at this point is about 70 m, and river depth ranged from 2 m at 6,000 cfs to 5 m at 25,000 cfs. We operated the trap from March 4 until May 20, 1985, when high water forced termination.

We freeze branded (Mighell 1969) and released smolts at the Salmon River trap to estimate travel time from the lower Salmon River to Lower Granite Reservoir. We changed the brand at three-day intervals to document changes in travel time as environmental conditions changed. We branded with 19 unique marks during the 1985 trapping season. We branded up to 1,000 smolts daily when daily catch was less than 3,000, and up to 2,000 per day when catch exceeded 3,000 per day. The remaining catch was counted and returned to the river.

Trap efficiency tests were conducted from late March until early May by releasing marked smolts one kilometer upriver for later recapture at the trap. The ratio of recaptures to marks released is the estimate of trap efficiency, i.e., the fraction of smolts passing the trap which are captured.

TRAP JUVENILE DESCALING FORM (RECORDER ______________________)

DATE __________ SITE ____________ TIME ______________ SECCHI DISC ____________________

H_2O TEMP, ________ DISCHARGE _________ TOTAL CHINOOK __________ TOTAL STEELHEAD ________

TOTAL SOCKEYE __________ TOTAL YOY CHINOOK _________ TRAP DOWNTIME (HRS.) _________

BRAND USED _________ DAILY NO, BRANDED __________ NO, EXAM. FOR HATCHERY BRANDS:

EFFICIENCY: STEELHEAD ________ CHINOOK __________

No, FISH CLIPPED:	No. EXAM. FOR CLIPS:	No. CLIPPED RECAPTURES:
CH ______________	CH ________________	CH ______________________
SH ______________	SH ________________	SH ______________________
SW ______________	SW ________________	SW ______________________

REMARKS ____

RIGHT LEFT

6. SCATTERED 7. EYE/HEAD INJURIES 8. DEAD

	DESCALED CHINOOK					DESCALED STEELHEAD			
	Length	Descal	Length	Descal		Length	Descal	Length	Descal
1					1				
2					2				
3					3				
4					4				
5					5				
6					6				
7					7				
8					8				
9					9				
10					10				
11					11				
12					12				
13					13				
14					14				
15					15				
16					16				
17					17				
18					18				
19					19				
20					20				
21					21				
22					22				
23					23				
24					24				
25					25				

TOTAL FISH SAMPLED _________ TOTAL FISH SAMPLED ________

TOTAL DESCALED ____ % DESCALED ____ TOTAL DESCALED ____ % DESCALED ____

40% DESCALING (ABOVE BELLY) IN ANY SINGLE (1) AREA CONSTITUTES DESCALING.
ANY TWO (2) AREAS ON THE SAME SIDE RESULTS IN FISH CLASSIFIED AS DESCALED.

Figure 2. Form used to record smolt passage and descaling information, Drawings show the five areas on each side of a smolt which are considered independently for scale loss.

Snake River Trap

The Snake River migrant dipper trap was positioned about 40 m downstream from the Interstate Bridge and was attached to bridge piers by steel cables. This is at the head of Lower Granite Reservoir 0.5 km above the confluence of the Snake and Clearwater rivers. River width and depth at this location were approximately 260 m and 12 m, respectively.

Trap operation began March 14, 1985, and terminated on September 15, 1985.

To estimate trap efficiency, fish were marked with a caudal fin clip every fourth day and released 5.5 km above the Snake River trap. Fish examined for brands were also checked for caudal fin clips.

Clearwater River Trap

The Clearwater River scoop trap was installed 10 km upstream from the river mouth, about 4.5 km above the head of Lower Granite Reservoir. The river channel at this location forms a bend and is between 150 and 200 m wide and 4 to 7 m deep, depending on discharge.

Trap operation began March 1, 1985 and continued until May 22, when a small log damaged the traveling screen requiring repair at the factory.

Trap efficiency tests were conducted periodically throughout the season by releasing fin-clipped smolts 7 km upriver from the trap. On several occasions, when not enough fish were captured in the Clearwater trap for marking, fish were caudal fin clipped at the Snake River trap and transported to the Clearwater River release site. All fish captured in the trap were examined for brands and fin clips.

Descaling

Chinook salmon descaling rates were estimated at all six Idaho chinook hatcheries prior to smolt release. Descaling rates were estimated at off-hatchery release sites for Hagerman NFH, McCall, and Rapid River hatcheries. Kooskia NFH, Dworshak NFH, and Pahsimeroi hatcheries release all their smolts directly from the hatchery to a stream.

Steelhead smolt descaling rates were estimated at three Idaho hatcheries and seven release sites just prior to release. Most of Dworshak NFH steelhead smolts were released directly from the hatchery, so there was no post-transport descaling rate sample for these fish.

We examined 100 to 300 smolts from representative groups of chinook salmon and steelhead trout at hatcheries and again at release sites to estimate the percentage of smolts having significant scale loss. The condition of the smolts was compared with that observed at trapping sites along the migration routes.

We examined up to 300 chinook and steelhead smolts daily, when available, at the traps for descaling. We also looked at descaling of flsh by fish length, separating the length frequency data into 20 mm length groups and comparing descaling of the different length groups to see if certain size fish had higher levels of descaling than others.

Trap Efficiency

To estimate the number of smolts passing a trap, it is necessary to know what fraction of the migration is being trapped. Additionally, this fraction, which is the trapping efficiency, may change as river discharge changes. To create an equation which describes the relationship between discharge and efficiency, efficiency must be estimated several times over the range of discharge within which the trap i s operated. A l inear regress l on of efficiency on discharge is then calculated from the data, after which an efficiency can be predicted from a known discharge.

In 1983, the first year of smolt monitoring, we calculated trap efficiency for chinook smolts four times at the Salmon River trap and not at al l at the Snake River trap at Redwol f Bridge. Although four times at the Salmon trap was insufficient to calculate a predicative equation, historical trap efficiency data was available from the National Marine Fisheries Service who fished two scoop traps side by side at Whitebird for several years in the 1960's and 1970's.

Travel Time and Migration Rates

We used the Statistical Analysis System (SAS) computer software at the University of Idaho to do stepwise multiple regressions to select models to describe the influence of several abiotlc factors on the variable migration rate (kilometers per day). We did two sets of regressions, one for hatchery-branded smoi ts migrating between release sites and the Salmon River trap and a second for hatchery-branded smolts migrating between the Salmon River trap and the Snake River trap.

Variables considered in calculating the models were:

Day length (DL) = the average number of hours of daylight per day minus 12 hours during the migration interval. The migratlon interval is the time elapsed between the date that 50% of the migrants passed the beginning location until 50% of the migrants passed the ending location.

Date = the number of days after March 1 that hatchery smolts were released.

Year = 1983, 1984, and 1985 used as -1, 0 and +l, respectively, in the analysis.

For the regressions of migrations between release sites and the Snake River trap, we also included the variables:

Salmon River Discharge (Q) = the average daily discharge in 1,000 cfs at the Whitebird gage during the migration interval.

Salmon River Temperature (T) = the average dai l y water temperature i n degrees C at the Salmon River trap during the migration interval.

Salmon River Transparency (S) = the average dai l y Secch i disc transparency in meters of visibility of the Salmon River at the Salmon Rider trap during the migration interval.

For the regressions of migrations between Salmon River trap and Snake River trap we also included the variables:

Salmon River Discharge (SmnQ) = the average dally discharge in 1,000 cfs at the Salmon River gage during the first half of the migration i nterval .

Salmon River Temperature (SmnT) = the average dai l y water temperature in degrees C at the Salmon River trap during the first half of the migration interval.

Salmon River Transparency (SmnS) = the average daily Secchi disc transparency in meters of visibility of the Salmon River at the Salmon River trap during the first half of the migration interval.

Snake River Discharge (SnkQ) = the average daf ly discharge in 1,000 cfs at the Anatone gage during the last half of the migration interval.

Snake River Temperature (SnkT) = the average daily water temperature in degrees C at the Snake River trap during the last half of the migration period.

Snake River Transparency (SnkS) = the average daily Secchi disc transparency in meters of vis ib i l i ty of the Snake River at the Snake River trap during the last half of the migration period.

Smolt Passage at Migrant Traps

Chinook outmigration was calculated using trap catch divided by trap efficiency for each trap. The Salmon River trap efficiency is dependent on discharge, so a multiple regression equation was used to calculate trap efficiency at a particular discharge. Daily catch was then divided by that calculated efficiency at the Salmon River trap. The Snake and Clearwater River trap efficiency did not vary with discharge, so a constant trap efficiency could be used.

RESULTS AND DISCUSSION

Hatchery Releases

Chinook Salmon

Chinook salmon released into the Snake River drainage above Lower Granite Dam were reared at six locations in Idaho, one in Oregon, and one in Washington. A total of 9,425,010 chinook salmon smolts were released at 13 locations in Idaho, Oregon, and Washington (Table 1).

A large number (44.7%) of spring chinook smolts released above Lower Granite Dam were released in the summer and fall of 1984. Approximately 73% of the smolts released from Rapid River Hatchery into Rapid River left during the fall of 1984 (P. Abbott, Idaho Dept. of Fish and Game, personal communication).

Steelhead Trout

Steelhead were reared at three hatcheries in Idaho, one in Washington, and one in Oregon for release upriver from Lower Granite Dam. A total of 6,194,420 steelhead smolts were released at 18 locations in the Snake River drainage above Lower Granite Dam (Table 2).

Smolt Monitoring Traps

Salmon River Trap Operations

The Salmon River trap operated from March 5 through May 20. Discharge was excessive from April 16 to 21 and May 2 to the end of the season. During these periods, the trap was fished on the east side of the river, an area away from the main channel and of lower river velocity, where we have no efficiency information for the trap. We believe trap efficiency is reduced here and thus the catch, as an index of passage, would be negatively biased.

Total trap catch for the 1985 season was 26,458 chinook, 146 wild steelhead, 989 hatchery steelhead, and 7 sockeye. The total number of chinook captured was lower than in 1983 or 1984 and may reflect the reduced number of Rapid River Hatchery chinook released in the spring, because of the estimated 1.8 million presmolts which left the hatchery during the previous fall. Most of these may have been downriver from the Salmon River trap when we began sampling in March of 1985. The steelhead catch was down 64% from 1984 and 51% from 1983, probably due to the generally high flows during May 1985, which forced us to fish the trap in areas of low trap efficiency. Total length and descaling was determined on 29% of the chinook and 99% of the hatchery and wild steelhead collected.

Table 1. Hatchery chinook salmon released into the Snake River system upriver from Lower Granite Dam, 1985.

Release site (hatchery)	Type	Release date	# released (# branded)	Brand	Remarks
Salmon River					
Sawtooth (McCall)	Spring	3/25&27	420,000 (39,875)	RDR-1	
S.F. Salmon R. (McCall)	Summer	4/1-4	564,400 (25,600)	RDR-3	
Pahsimeroi	Summer	4/3	209,160		
	Spring	4/3	178,780		
Rapid River	Spring	9/1-11/1/84	1,816,730		
		3/27-4/10	674,510 (34,225)	LDR-1	
Drainage Total			3,863,580		
Snake River and non-Idaho Tributaries					
Hells Canyon (Rapid River)	Spring	3/18-3/20	437,360 (35,825)	LDR-3	
Catherine Cr. (Lookingglass)	Spring (presmolts)	6/13-14/84	382,500		
Grande Ronde (Lookingglass)	Spring (presmolts)	6/18/84	159,750		
Lookingglass Creek (Lookingglass)	Spring (presmolts)	7/12-13/84	243,540		
Grande Ronde (Lookingglass)	Spring (presmolts)	7/17/84	191,930		
Big Canyon Cr. (Lookingglass)	Spring	9/11-12/84	171,570		
Lookingglass Creek (Lookingglass)	Spring	9/16/84	112,040		
	Spring	9/16/84	149,890		
	Spring	9/29/84	148,540		

Table 1. Contl nued

Release site (hatchery)	Type	Release date	# released (# branded)	Brand	Remarks
Snake River Continued					
Looklngglass Creek (Looklngglass)	Spring	1l/1/84	731,220		
Look i ngg l ass Creek (Lookingglass)	Spring	4/4/85	920,530		
Imnaha River (Lookingglass)	Sprlng	9/l O/84 3/21/85	56,210 59,580		
Cather I ne Creek (Carson NFH)	Spring	4/l 6/85	100,330		
Grande Ronde (Hagerman)	Fal l	6/4/ 85	45,960	LDR-4 33,850	
Asotin Creek (Hagerman NFH)	Fal l	6/4/85	78,160		
	Drainage Total		3,989,110		
Clearwater River					
Red River, 1.45 miles	Spring	4/l 7/85	80,000		
N.F. Clearwater R. (Dworshak)	Spring	4/3-4/85	1,137,140 (23,100)	RDR-2	night re l ease
N.F. Clearwater R. (Kooskia)	Spring	11/11/84	53,420		
Clear Creek (Koosk i a)	Spring	3/22/85 3/28/85	63,640 238,120		
	Drainage Total		1,572,320		
	Grand Total		9,425,OlO		

Table 2. Hatchery steelhead trout released into the Snake River system upriver from Lower Granite Dam, 1985.

Release site (hatchery)	Type	Release date	# released (# branded)	Brand	Remarks
Salmon River					
Pahsimeroi River (Niagara Springs)	"A"	3/25-4/14	878,530		
Brunos (Niagara Springs)	"A"	4/11-4/13	156,740		
Panther Creek (Niagara Springs)	"A"	5/2-5	237,910		
E.F. Salmon River (Hagerman NFH)	"B"	3/26-4/30	270,210 (31,775)	RDY3	4/17/85 brand released
Little Salmon River Hazard Creek (Hagerman NFH)	"A"	4/15-5/1	308,100		
Sawtooth (Hagerman)	"A"	3/26-4/24	786,190 (35,125)	RDY1	4/9/85 brand released
	Drainage Total		2,637,680		
Snake River and non-Idaho Tributaries					
Hells Canyon (Niagara Springs)	"A"	11/14-16/84	538,200		
	"A"	4/29-5/1	414,710 (30,000)	LDY-1	
Imnaha River (Irrigon)	"A"	4/10,30; 5/1	79,220		
Wallowa River (Irrigon)	"A"	4/27	361,990		
Grande Ronde (Lyons Ferry)	"A"	5/4-15	149,320		
	"A"		(41,030)	RA17-1	
	"A"		(40,210)	RA17-3	

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Table 2. Continued

Release site (hatchery)	Type	Release date	# released (# branded)	Brand,	Remarks
Asotin Creek (Lyons Ferry)	"A"	4/24	31,500		
Wallowa River (Lyons Ferry)	"A" "A"	4/29 4/25-26	284,060 96,040		
	Drainage Total		1,955,040		
Clearwater River					
Clearwater River "B" (Dworshak)	4/29-5/3		1,035,570 (30,625)	LDY-2	4/29 release evening
Eldorado Creek "B" (Dworshak)	4/27-5/1		134,450		
Clear Creek (Dworshak)	"B"	4/30-5/2	145,210		
Newsome Creek "B" (Dworshak)	5/1-2		95,290		
Crooked River "B" (Dworshak)	4/29-5/1		29,070		
American River "B" (Dworshak)	4/29-5/1		162,110		
	Drainage Total		1,601,700		
	Grand Total		6,194,420		

The majority of chinook salmon passed the Salmon River trap during the first half of April **(Fig. 3).** Steelhead began moving in large numbers the last two weeks of Apri l and continued into May (Figs. 4 and 5). Daily catch during May probably underestimates relative smoit passage because the trap was being operated on the east side of the river where trap efficiency Is expected to be much l ess. Of the steelhead examlned, 87% were of hatchery origin and 13% were wild.

Water temperature during most of March was cold, 2-3oC and did not reach 7oC unti l March 31 (F lg. 6). Water temperatures increased to 11oC by mid-Apri l, then dropped back to 6oC the latter part of April. Water temperature did not exceed 1 1oC during the trapping season. Discharge was low when trap operation began and remained low until early April (Fig. 7). In mid-April discharge exceeded 20,000 cfs for five days then receded. On May 2, discharge again reached 20,000 cfs and stayed high unti l trap opera-t ion termi nated May 20. The Salmon River was relatively clear during most of the trapping season. Secch i d isc transparency was l ess than 0.5 m for only 11 days during the season and ranged from 0.4 m to 2.5 m (Fig. 8).

Snake River Trap Operation

We operated the Snake River trap from March 14 unt i l September 15. The trap was operated through the summer to see if signif icant movement of salmon or steelhead smolts occurred then. On September 15 mechanical problems forced us to discontinue trapping.

Trap catch during the 1985 season was 46,737 yearl ing chinook, 1,028 sub-yearling chinook, 1,189 wild steelhead, 8,497 hatchery steelhead, and 90 sockeye. The majority of the chinook (87%) were captured during Apri l (Fig. 9), while 81% of the steelhead were captured during May. Wi ld steel head passed earl ier, 32% in April and 65% in May (Fig. 101, than did hatchery steelhead, 14% in Apri l and 83% in May (Fig. 11). The percent of wild and hatchery steelhead in the catch was 12% and 88%, respectively. Al though some sockeye were trapped the l ast week of March, their passage mostly occurred in May and early June (Fig. 12). **Sub-yearl ing chinook** passage began in mid-May. Release of hatchery reared sub-yearlings the third of June resulted in a peak passage on June 4 (Fig. 13). Less than 0.1% of **all** salmonid smolts captured in the Snake River trap were caught after July 1.

Snake River discharge during March was low, being general ly less than 40,000 cfs (Fig. 14). Discharge increased to a peak of 80,100 cfs on April 17, then receded to 44,000 cfs by the end of the month. Discharge during May remained near 50,000 cfs unt i l l ate in the month when a second peak occurred at 78,000 cfs. Dlscharge gradual ly dropped during June and remained low for the rest of the season.

Water temperature at the beg inn ing of the season was 5oC and increased to 8oC by the end of March (Fig. 15). Temperature climbed steadily and was 19oC by the end **of June.** Maximum water temperatures of 250C occurred in July and August.

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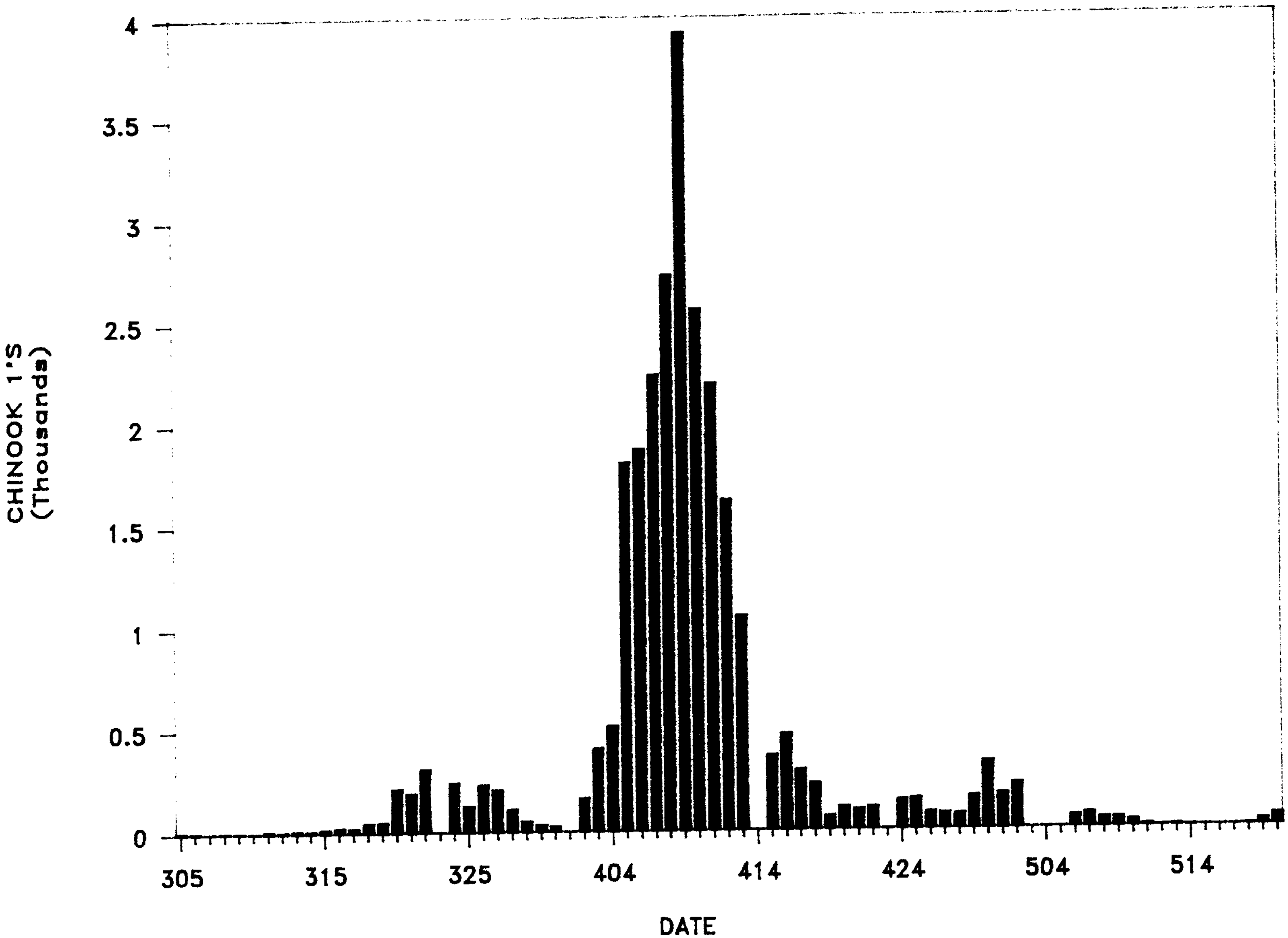

Figure 3. Daily catches of yearling chinook salmon at the Salmon River trap, 1985.

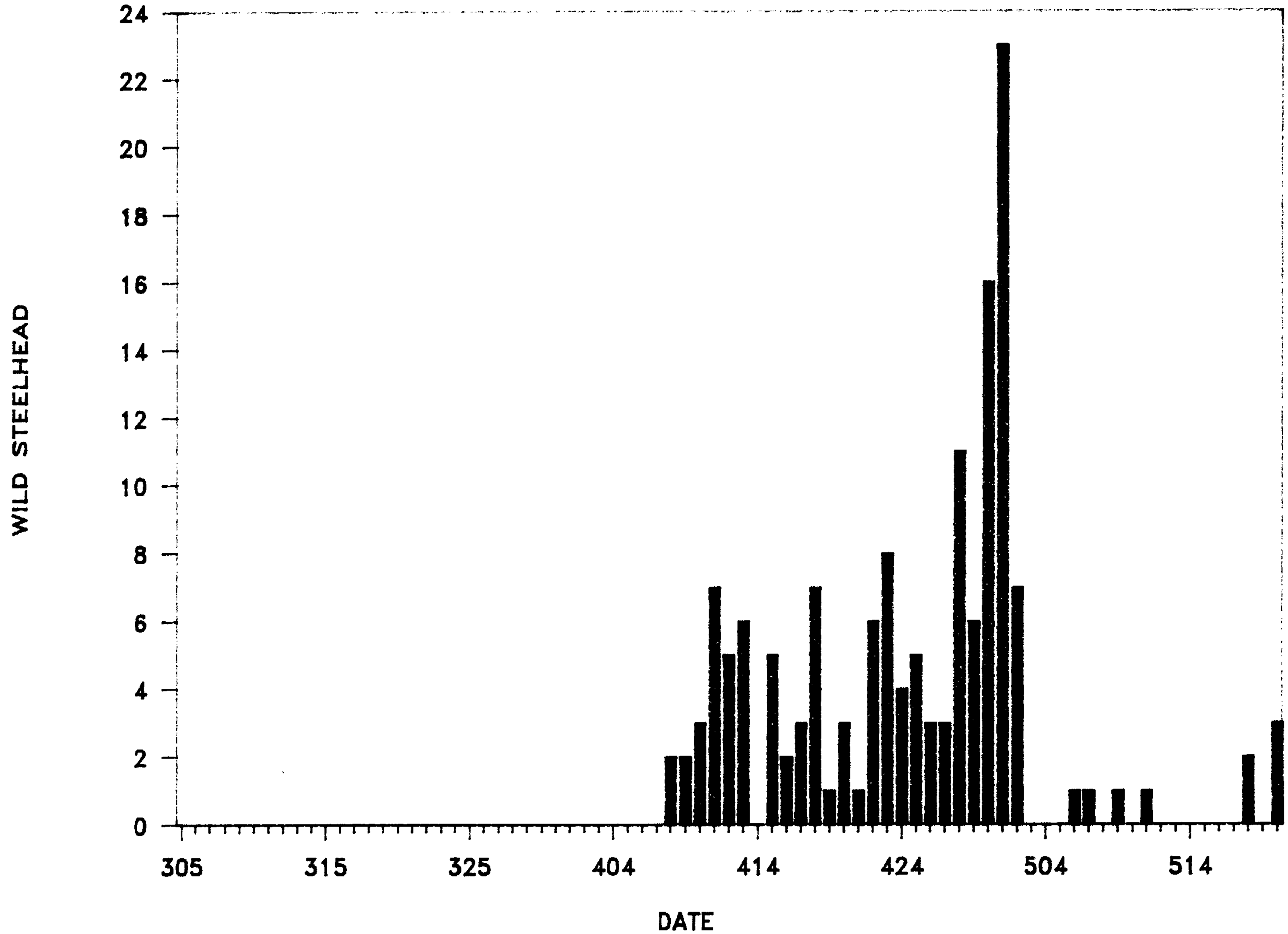

Figure 4. Daily catches of wild steelhead at the Salmon River trap, 1985.

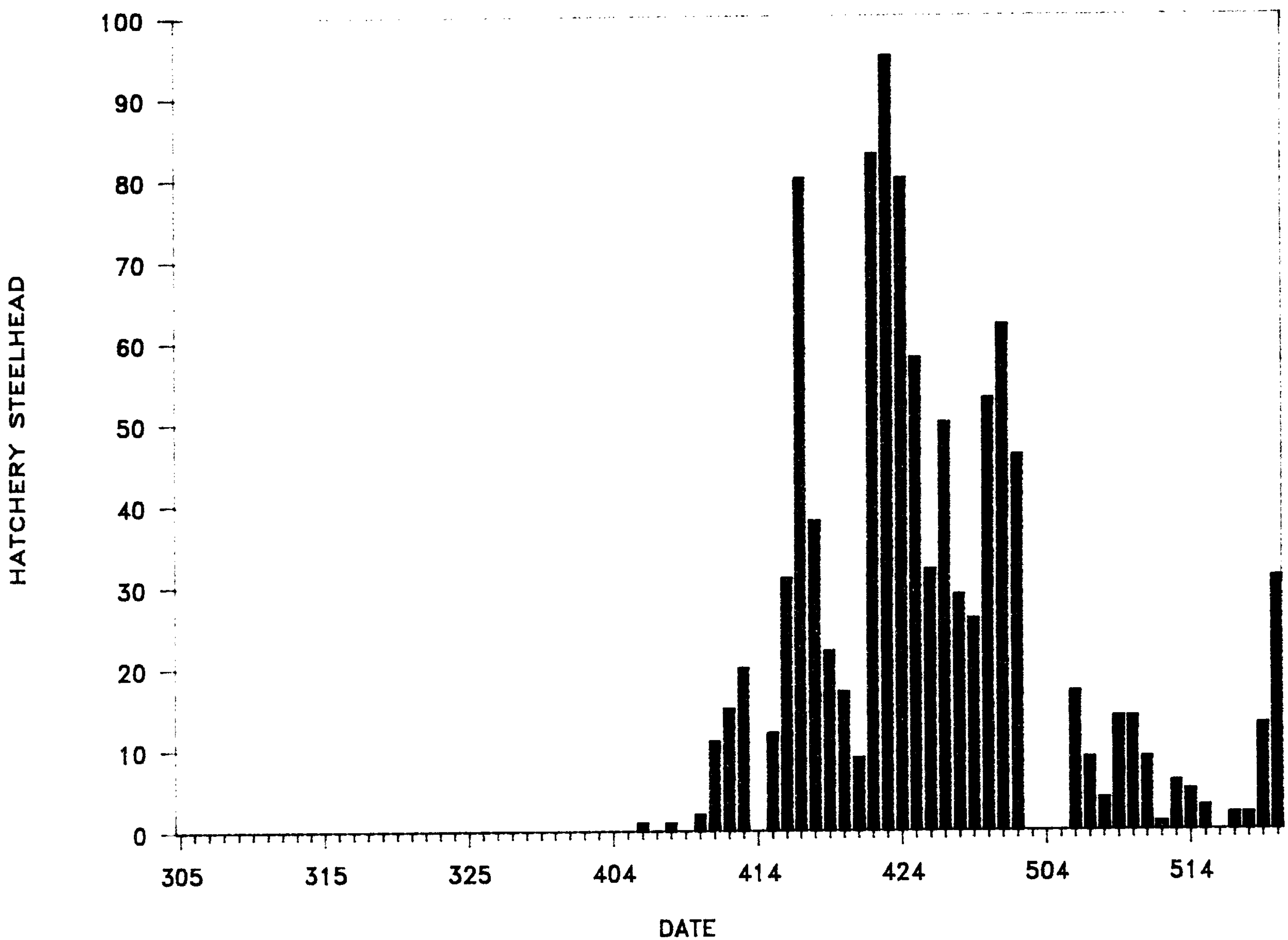

Figure 5. Daily catches of hatchery steelhead at the Salmon River trap, 1985.

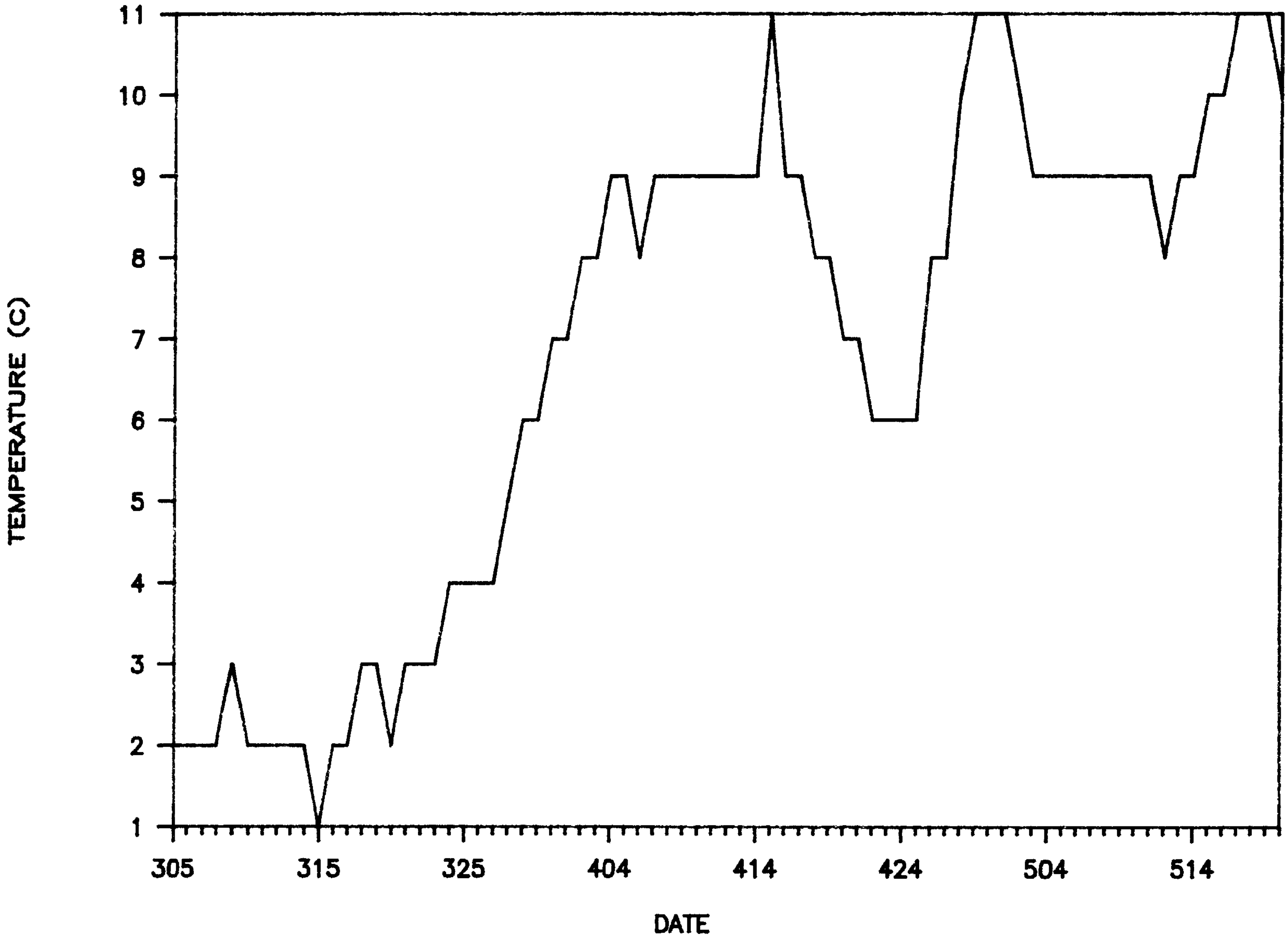

Figure 6. Daily Salmon River water temperature at the Salmon River trap, 1985.

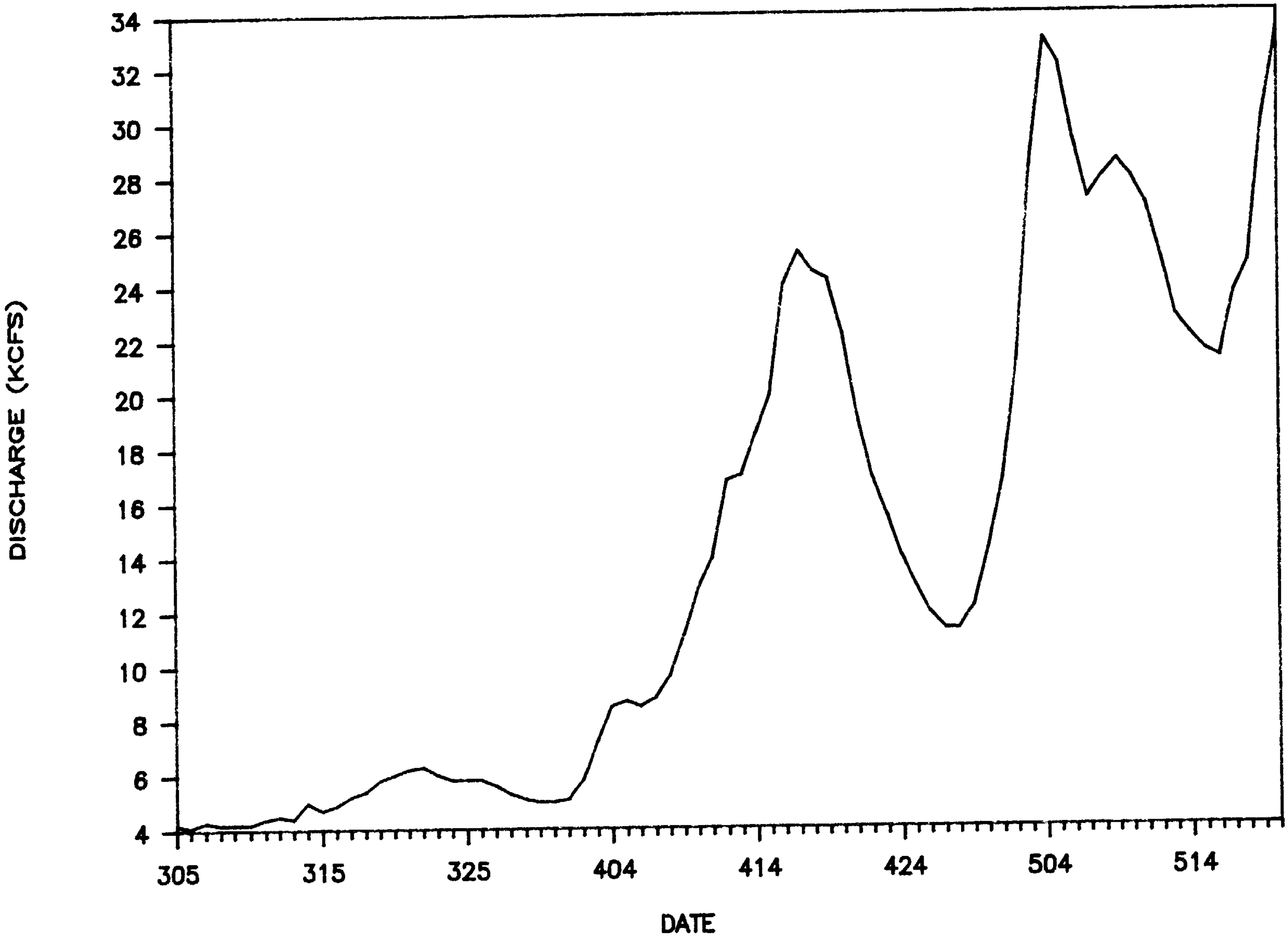

Figure 7. Daily Salmon River discharge at the Whitebird gauge, 1985.

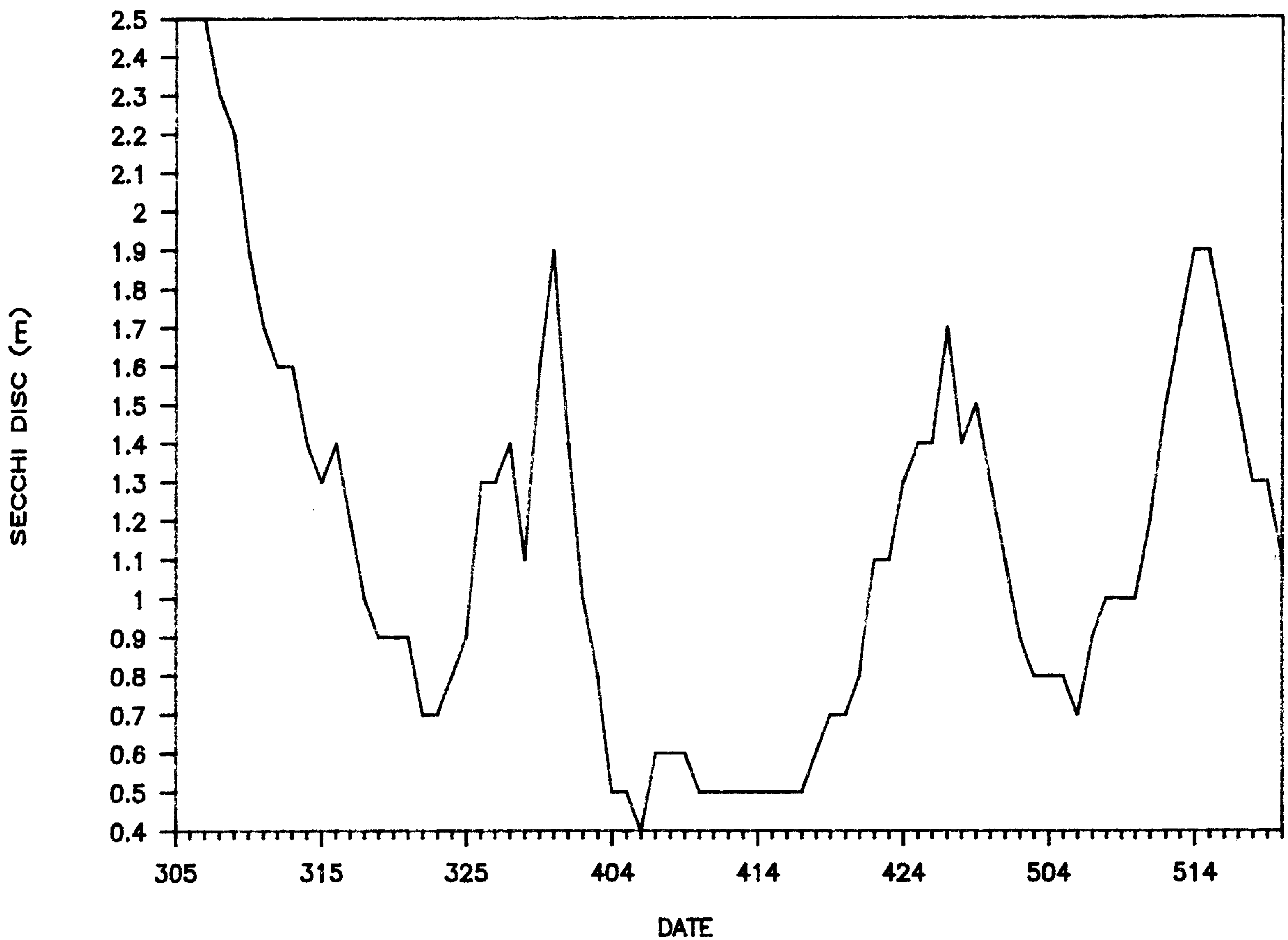

Figure 8. Daily Salmon River visibility at the Salmon River trap, 1985.

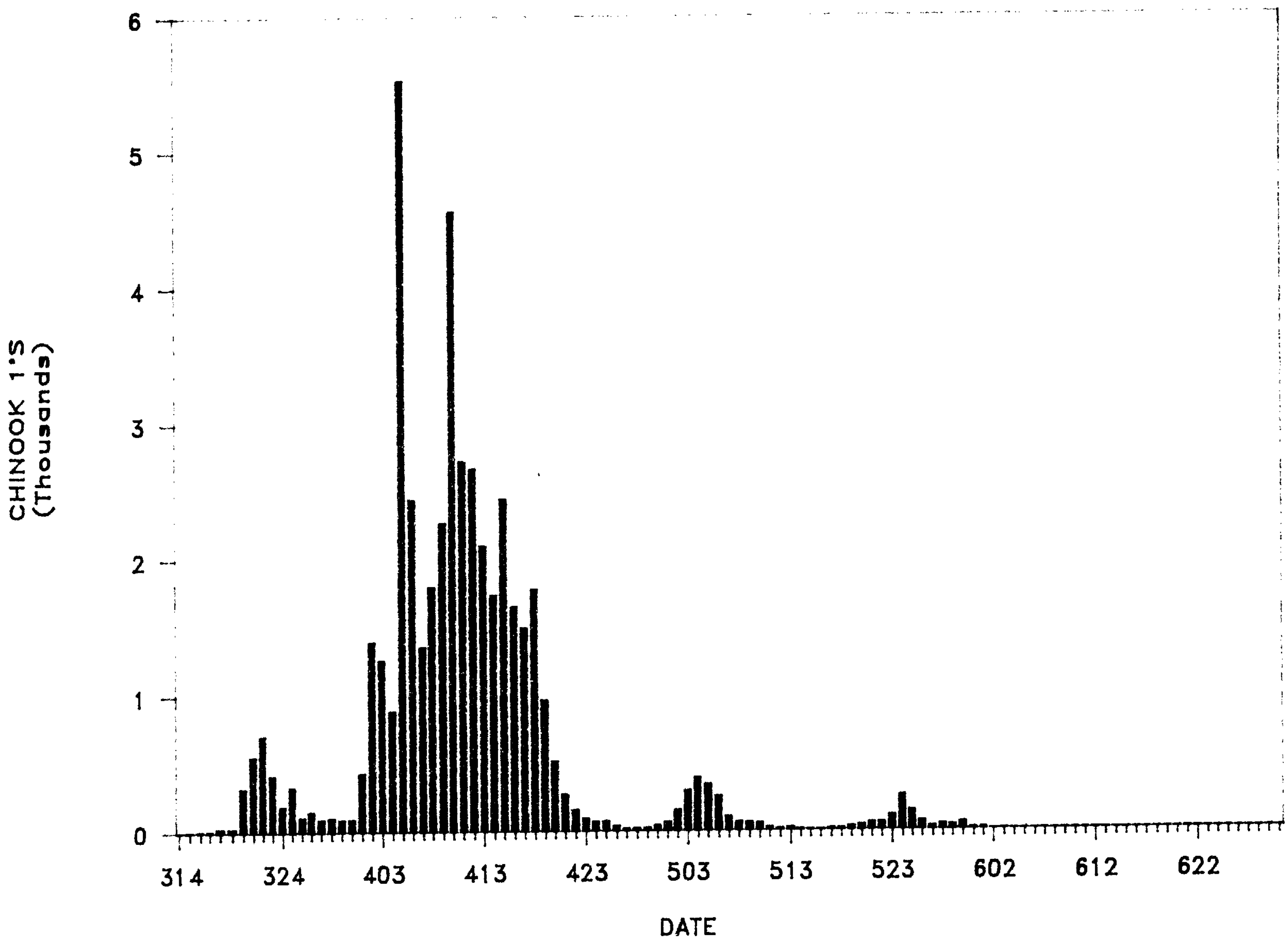

Figure 9. Daily catch of yearling chinook salmon at the Snake River trap, 1985.

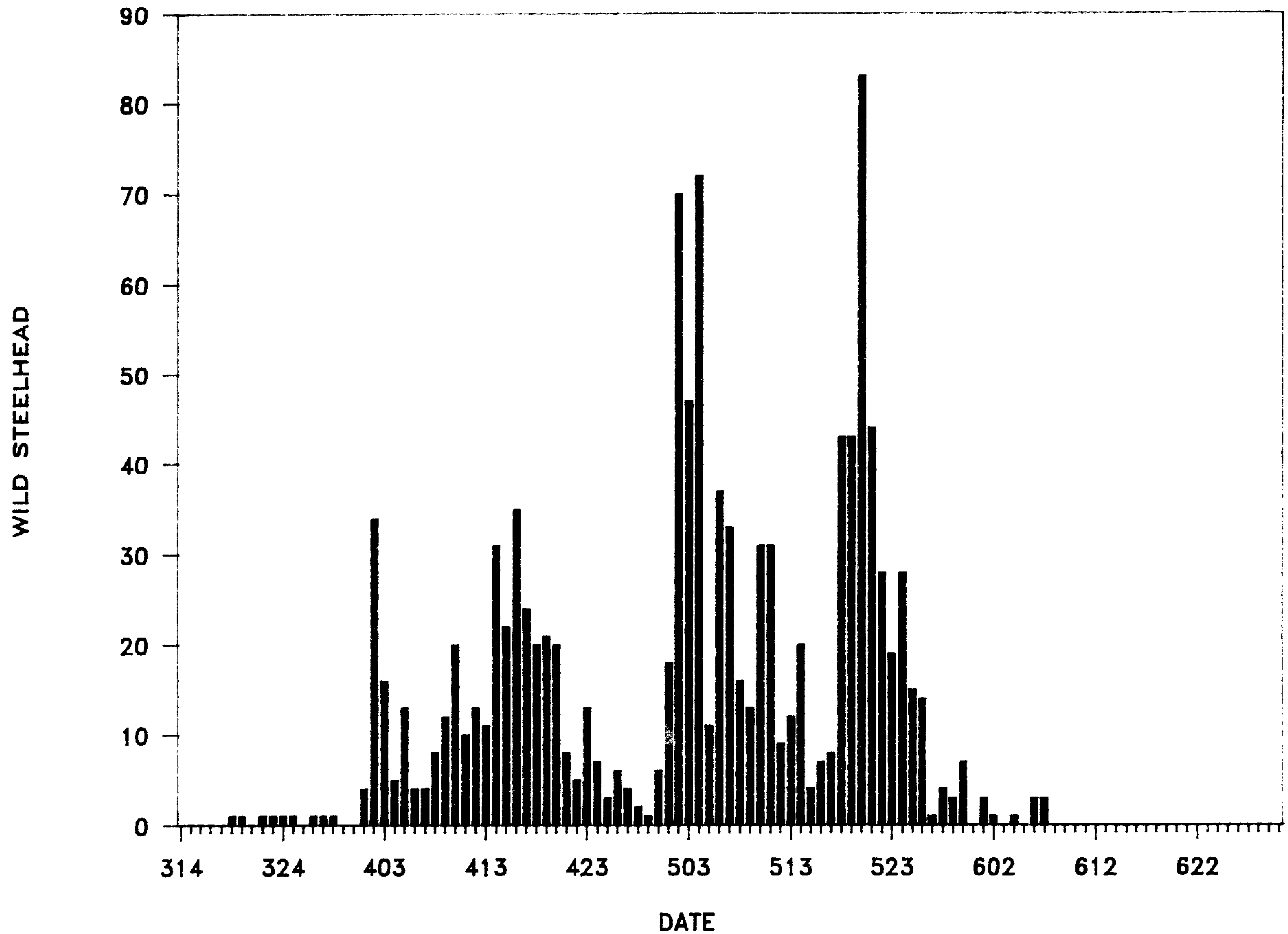

Figure 10. Daily catch of wild steelhead at the Snake River trap, 1985.

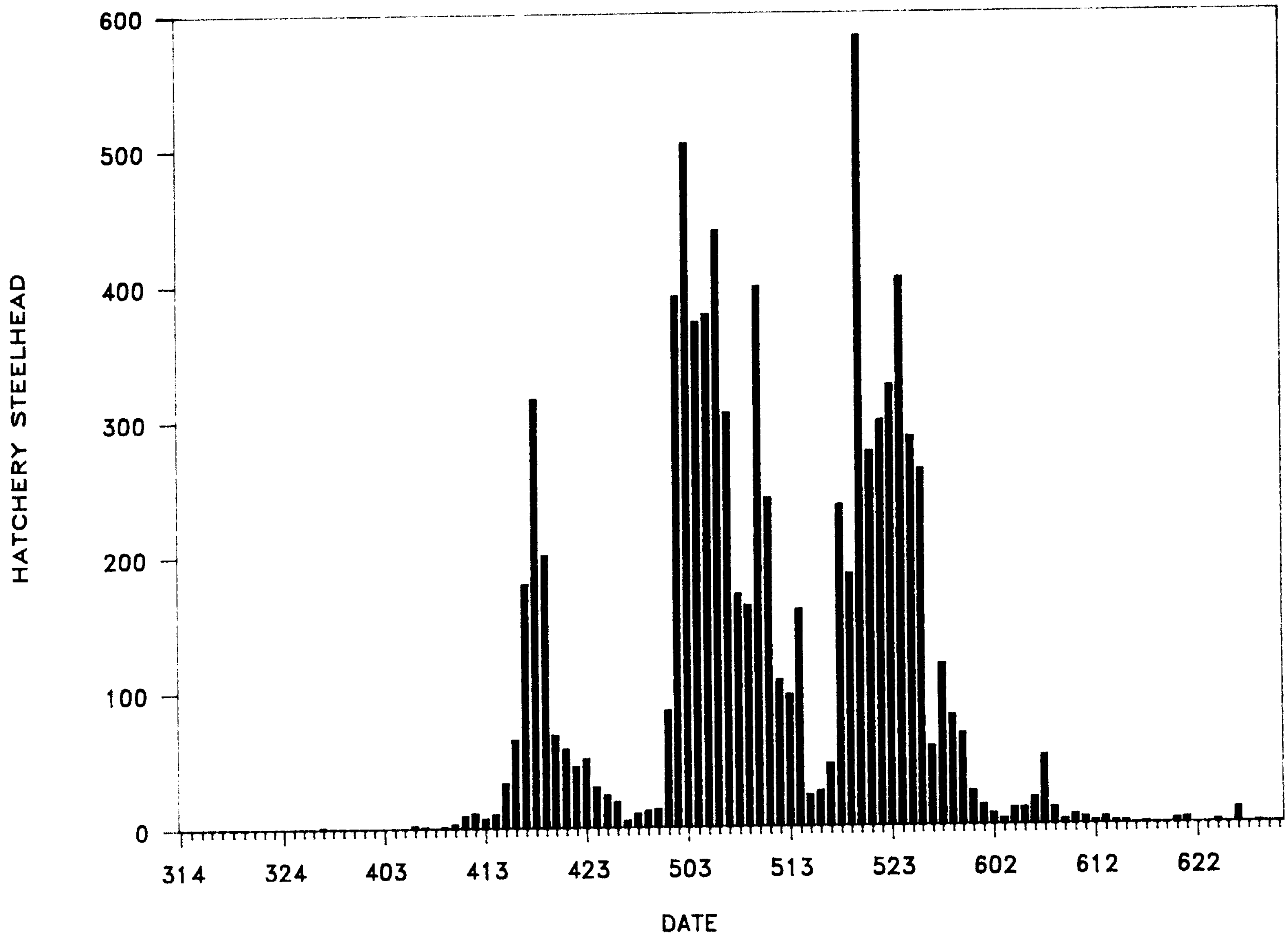

Figure 11. Daily catch of hatchery steelhead at the Snake River trap, 1985.

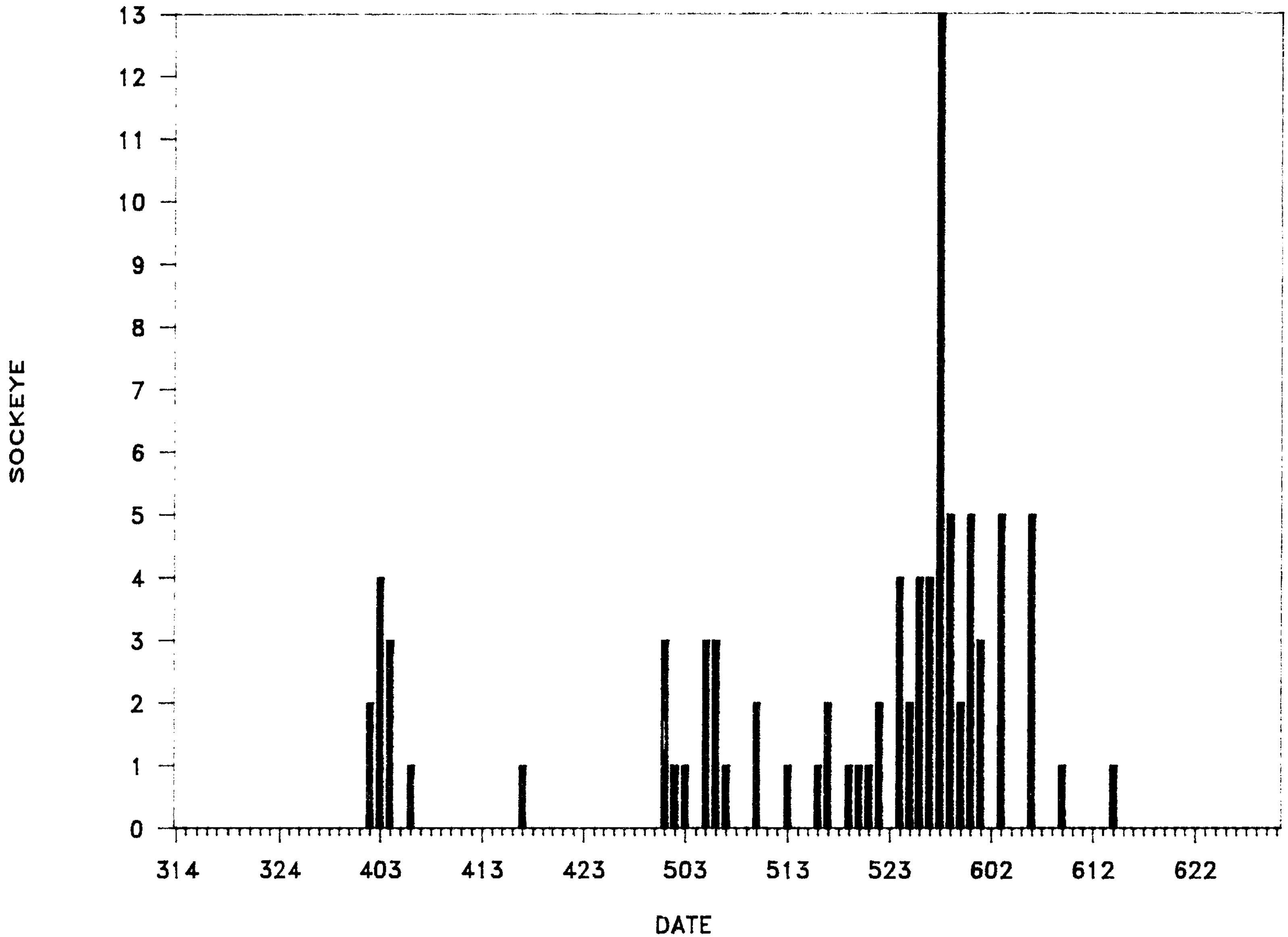

Figure 12. Daily catch of sockeye salmon at the Snake River trap, 1985.

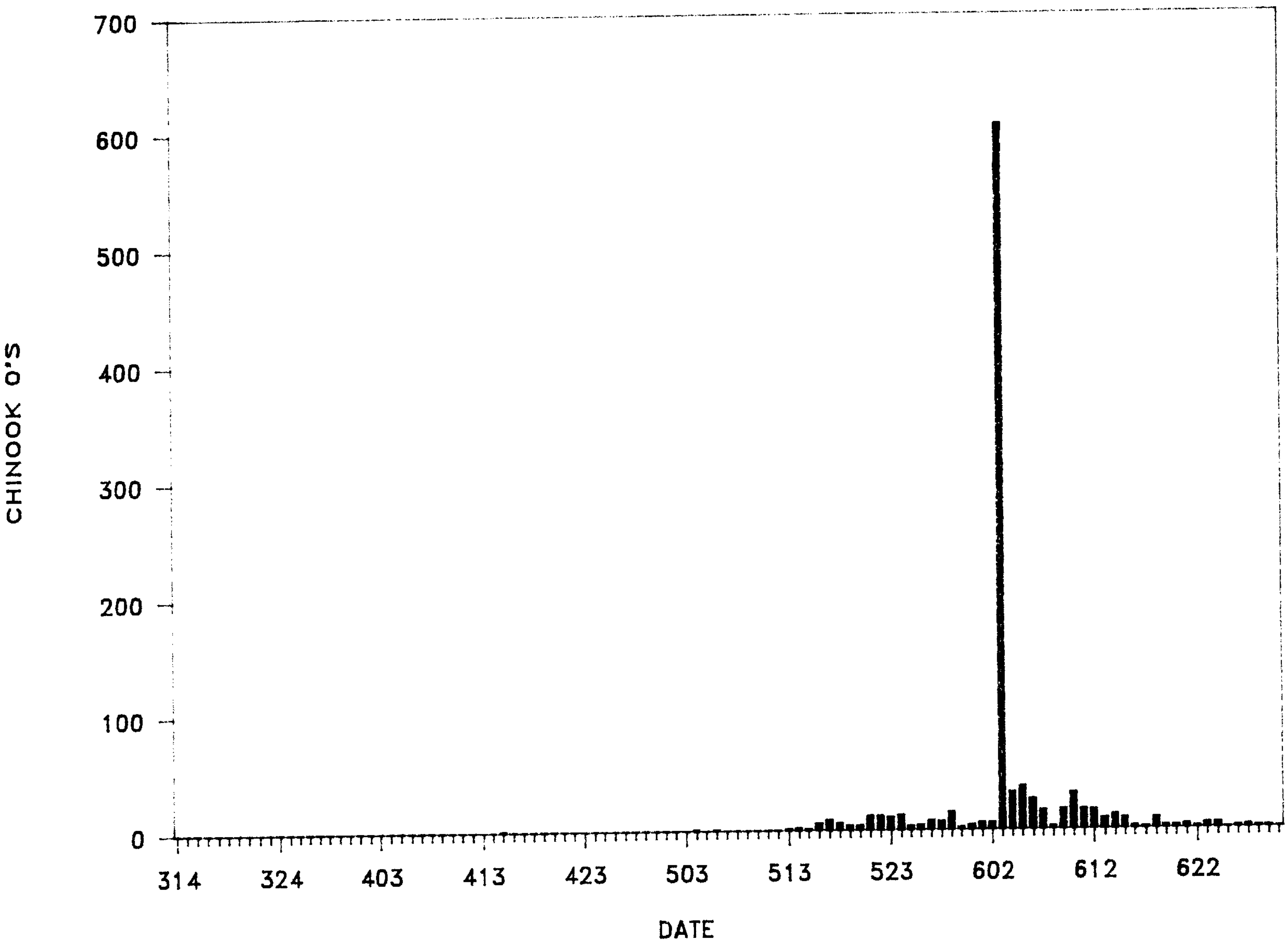

Figure 13. Daily catch of sub-yearling chinook salmon at the Snake River trap, 1985.

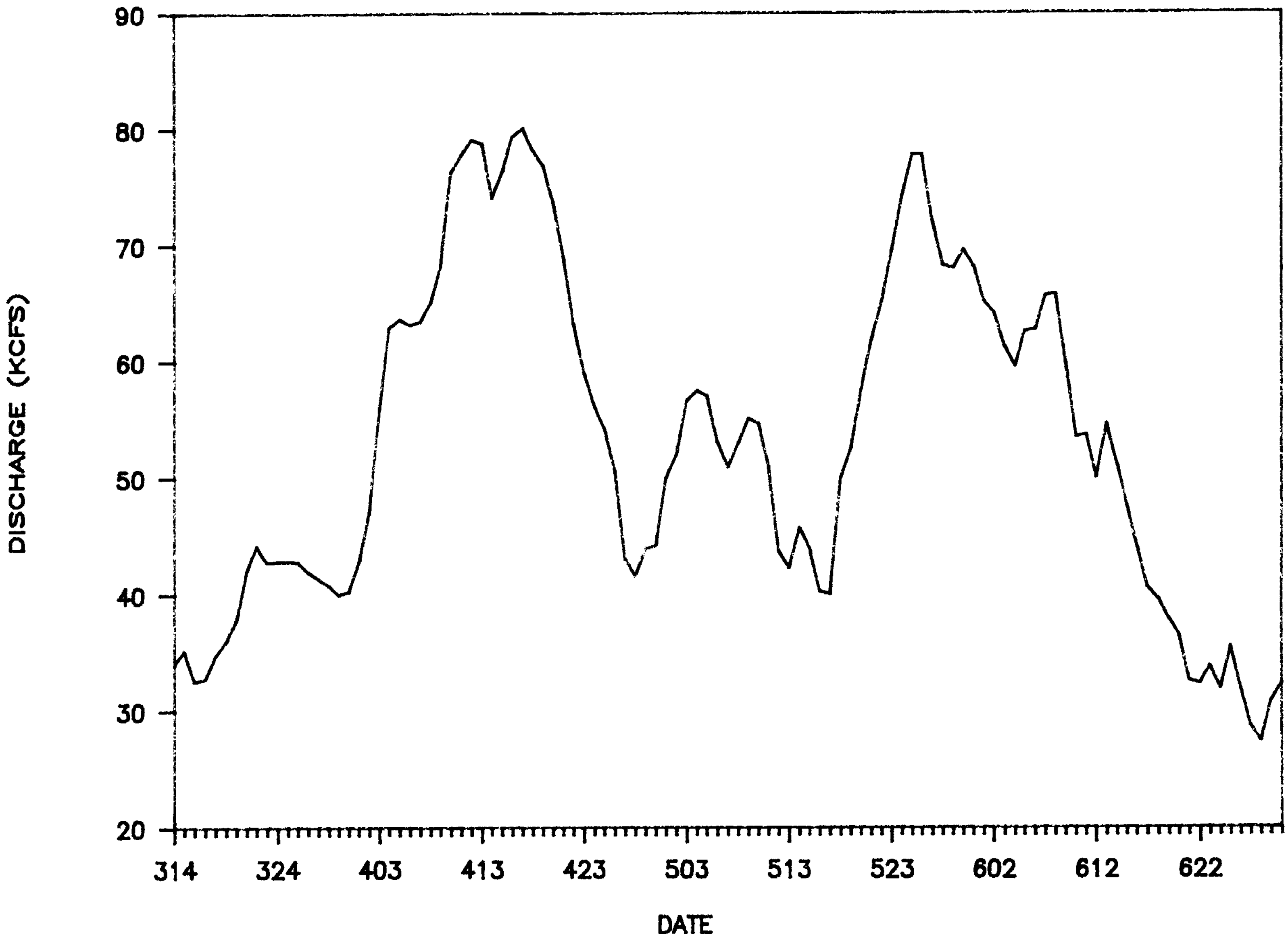

Figure 14. Daily Snake River discharge at the Snake River trap, 1985.

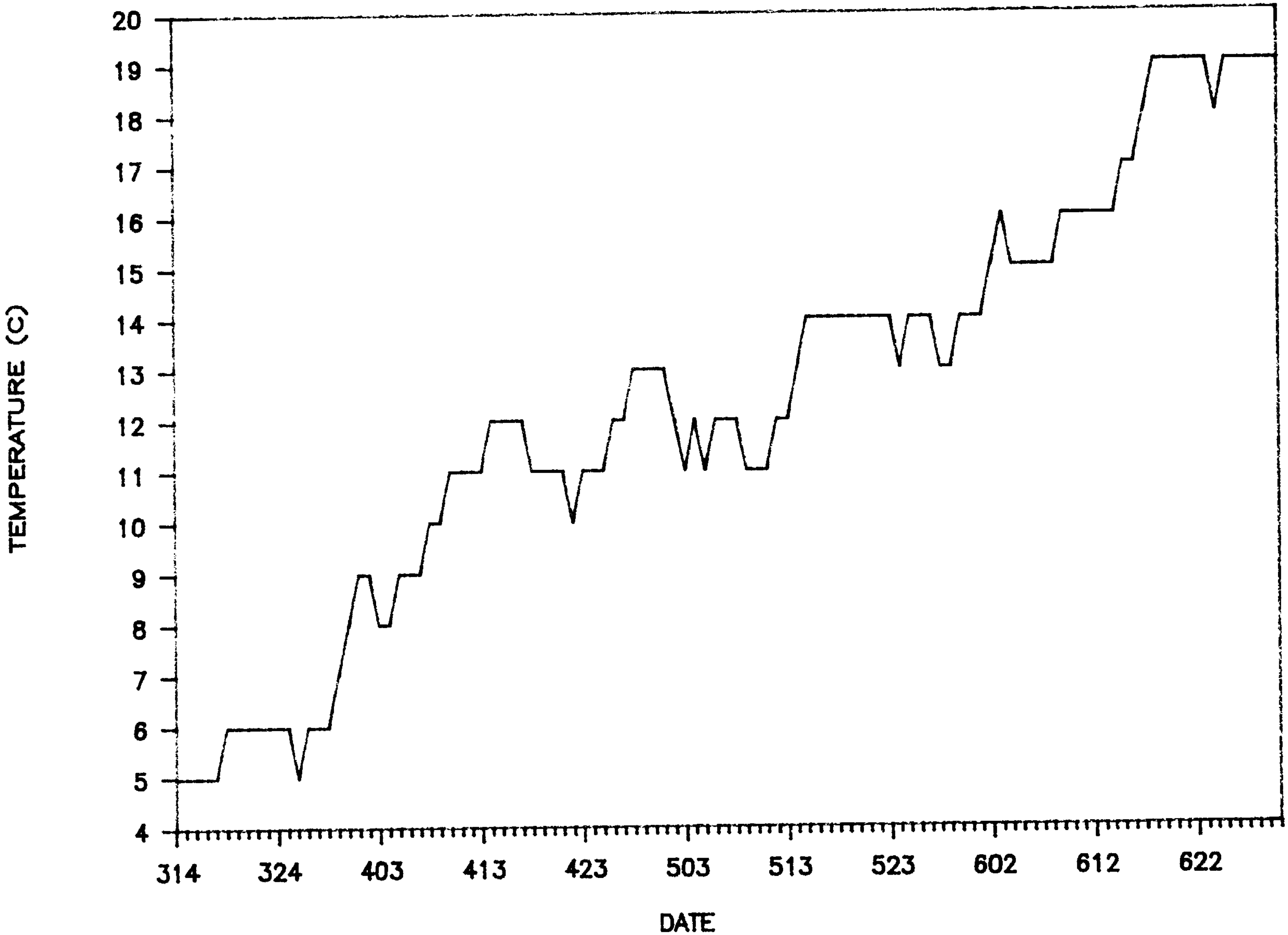

Figure 15. Daily Snake River water temperature at the Snake River trap, 1985.

Secchi disc transparency fluctuated between 0.5 and 1.3 m between March '4 and March 29 (Fig. 16) April 2, transparency reached the seasonal low of 0.3 m. Secchi disc transparency was between 0.4-0.5 m from April 5 to April 18. During the latter part of April, Secchi disc transparercy apprcached 1.0 m. Transparency during May fluctuated mainly between 0.7 and 1.0 m. From June through mid-September transparency was between 1.0-2.5 m.

Clearwater River Trap Operation

The Clearwater River trap operated from March 1 until May 22, when a log damaged the traveling screen beyond our ability to repair it on site. Snowpack and spring runoff were low in the Clearwater River drainage in 1985, and we had few days when high flows and debris prevented trap operation. As flows increased, we moved the trap where water velocities were lower.

The Clearwater River trap captured 13,500 chinook salmon, 1,121 hatchery steelhead, and 115 wild steelhead in 1985. The majority of the chinook passed in late March and early April (Fig. 17). Large numbers of chinook arrived the day following their release at Dworshak National Fish Hatchery, and the majority of the chinook salmon captured were probably of hatchery origin. Approximately 73% of the steelhead captured by the Clearwater trap came in four days, shortly after steelhead were released from Dworshak NFH. Most steelhead, 91%, were of hatchery origin (Figs. 18 and 19).

Water temperature at the Clearwater River trap stayed below 7°C until April 4 (Fig. 20). During mid-April, water temperature was stable at 8oC then dropped to 4-5°C for a week. By the end of April, temperature had risen to 9°C. Again, during the first part of May, there was a cooling trend when water temperature reached 6-7°C for 12 days, but by May 22 temperature was 10°C.

Discharge was low until April 9, when spring runoff began (Fig. 21). The river peaked at 32,700 cfs in mid-April,, then receded. Another peak occurred at 40,000 cfs on May 3, and by the end of the trapping season (May 22) discharge was at 42,400 cfs and increasing.

The Clearwater River was turbid during March and April, when runoff was coming from low elevation rains and snow melt. The Clearwater drainage had a relatively dry spring, and by mid-April, when the low snow was gone, Secchi disc transparency in the Clearwater River exceeded 1 m and increased to 2.8 m by mid-May (Fig. 22).

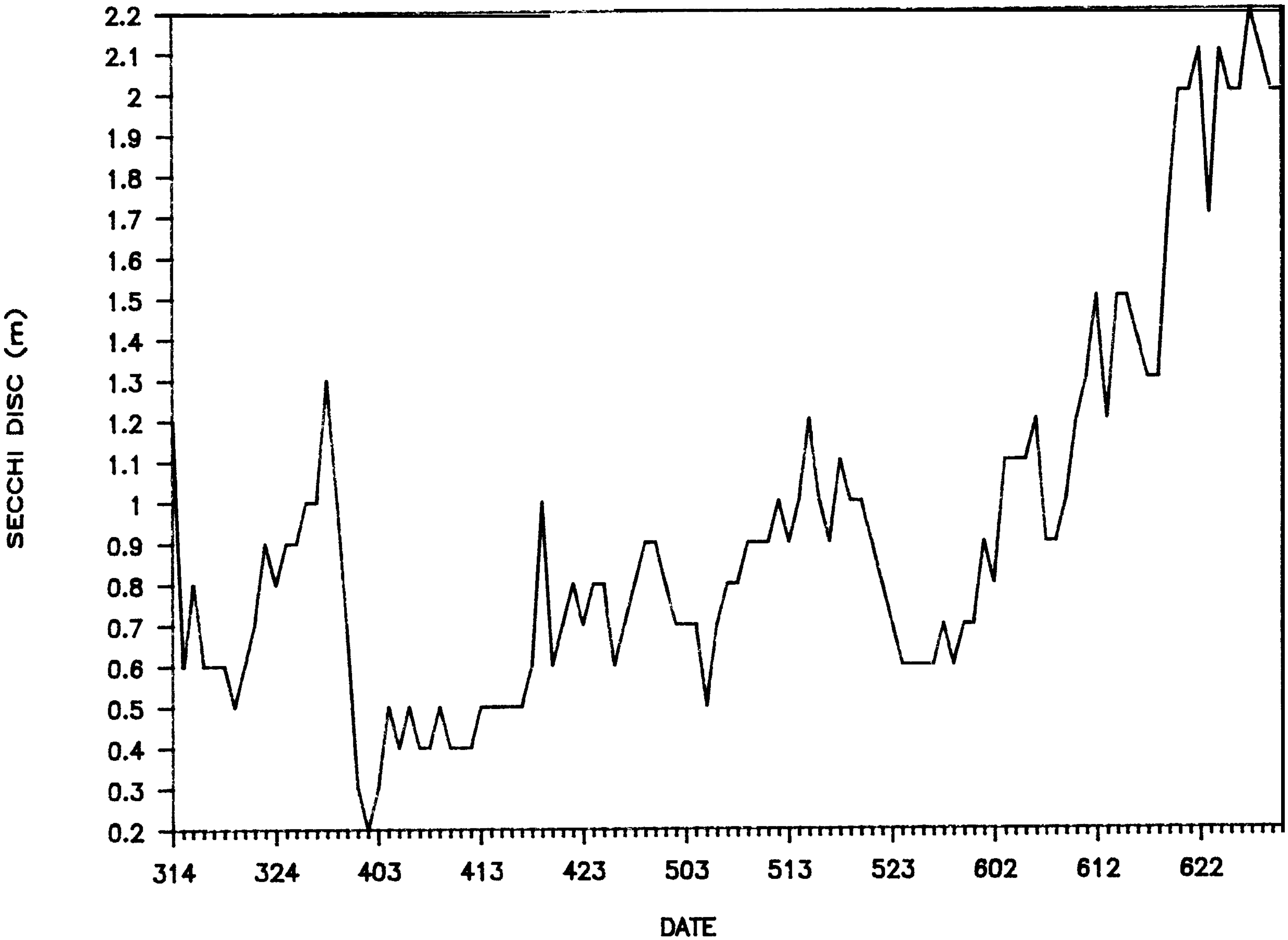

Figure 16. Daily Snake River depth of visibility at the Snake River trap, 1985.

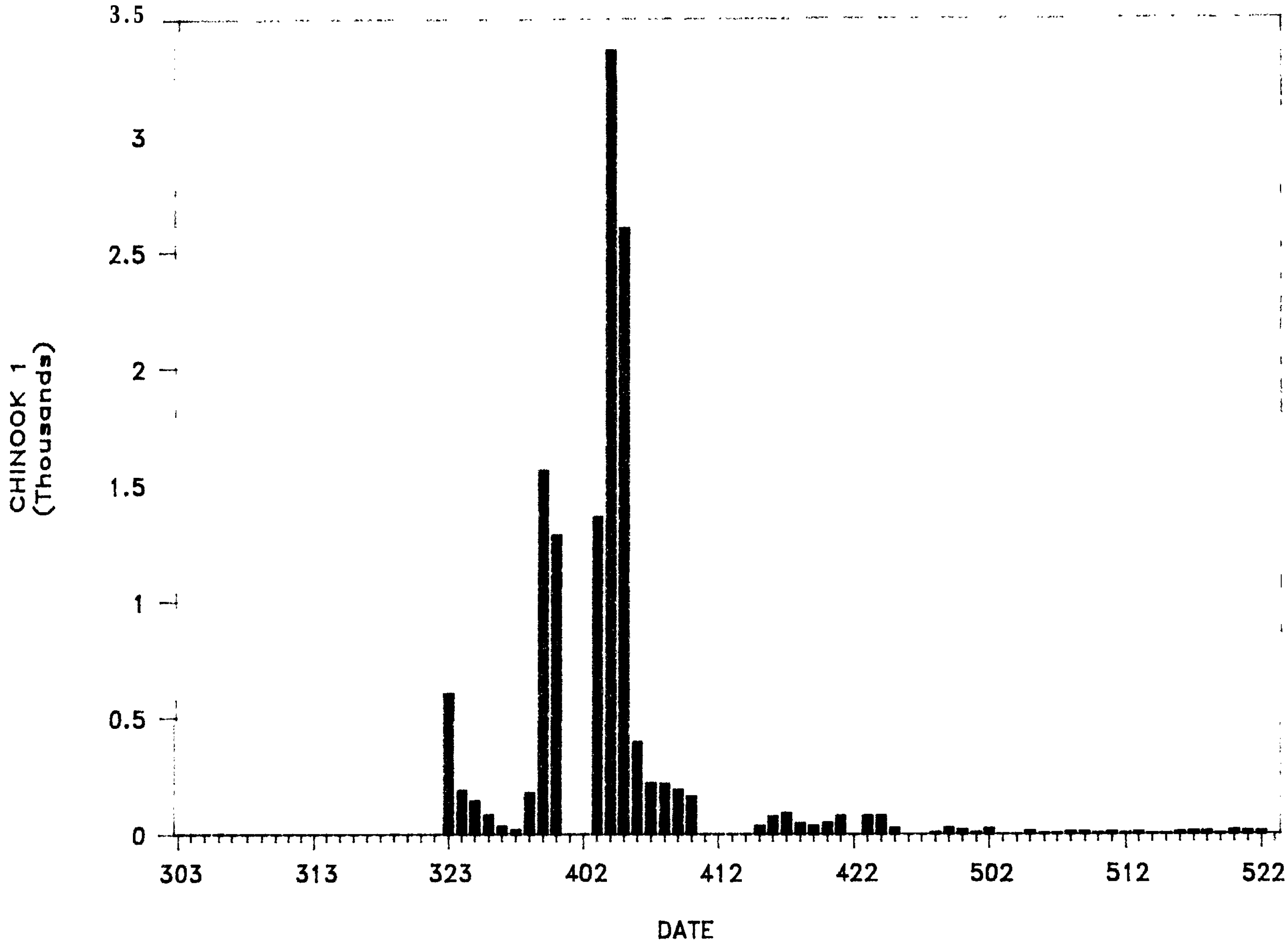

Figure 17. Daily catch of yearling chinook salmon at the Clearwater River trap, 1985.

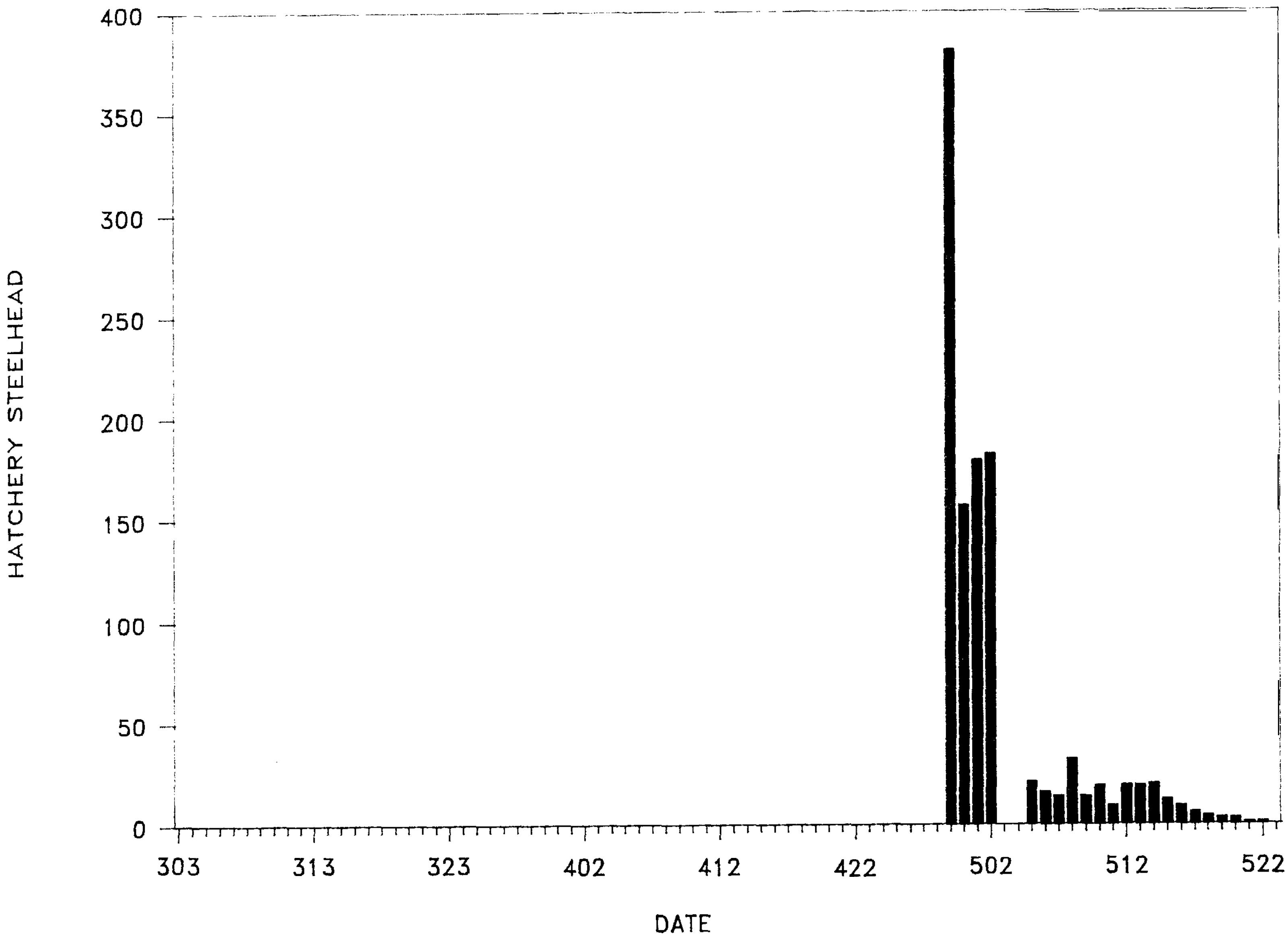

Figure 18. Daily catch of hatchery steelhead at the Clearwater River trap, 1985.

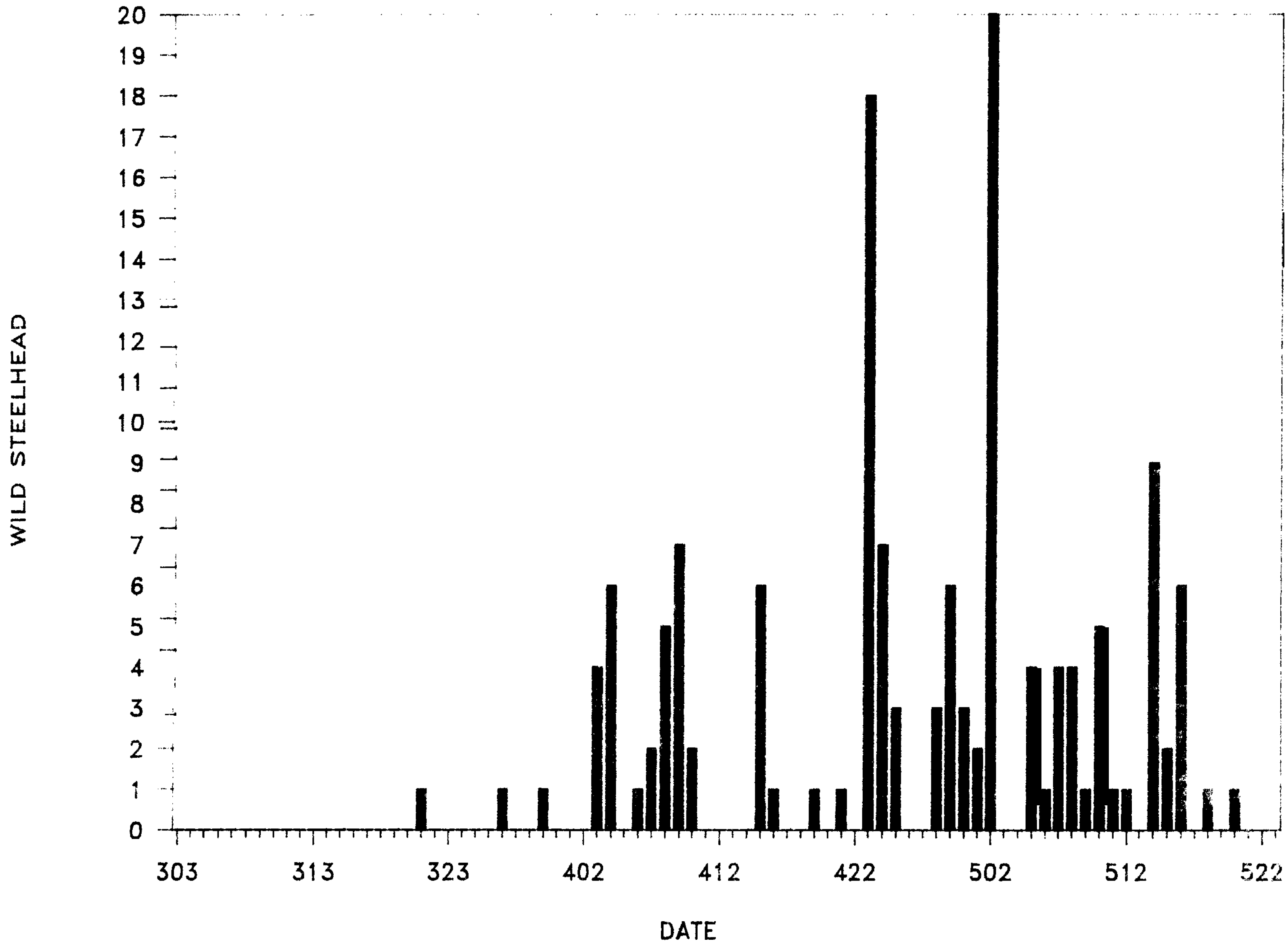

Figure 19. Daily catch of wild steelhead at the Clearwater River trap, 985

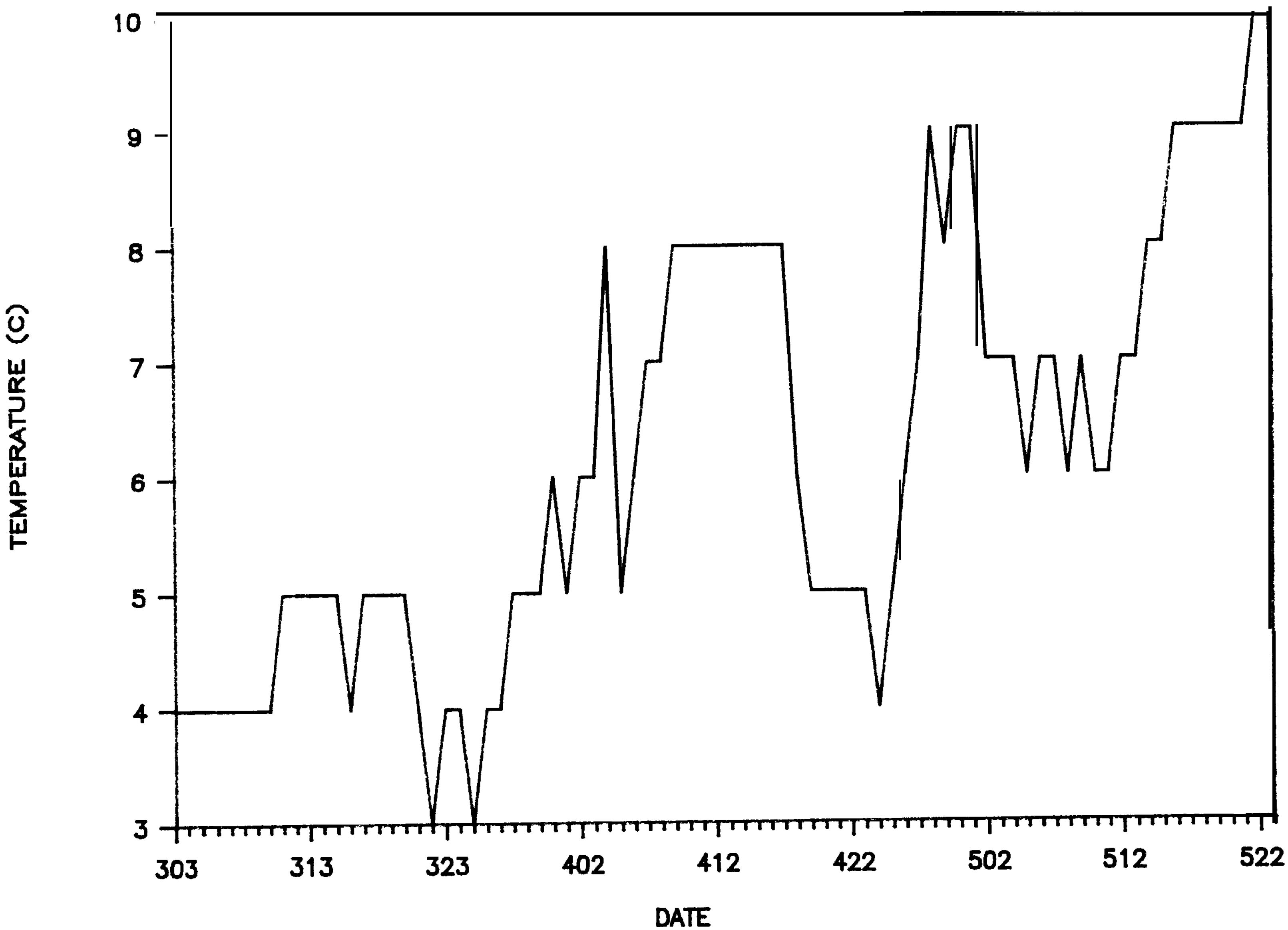

Figure 20. Daily Clearwater River water temperature at the Clearwater River trap, 1985

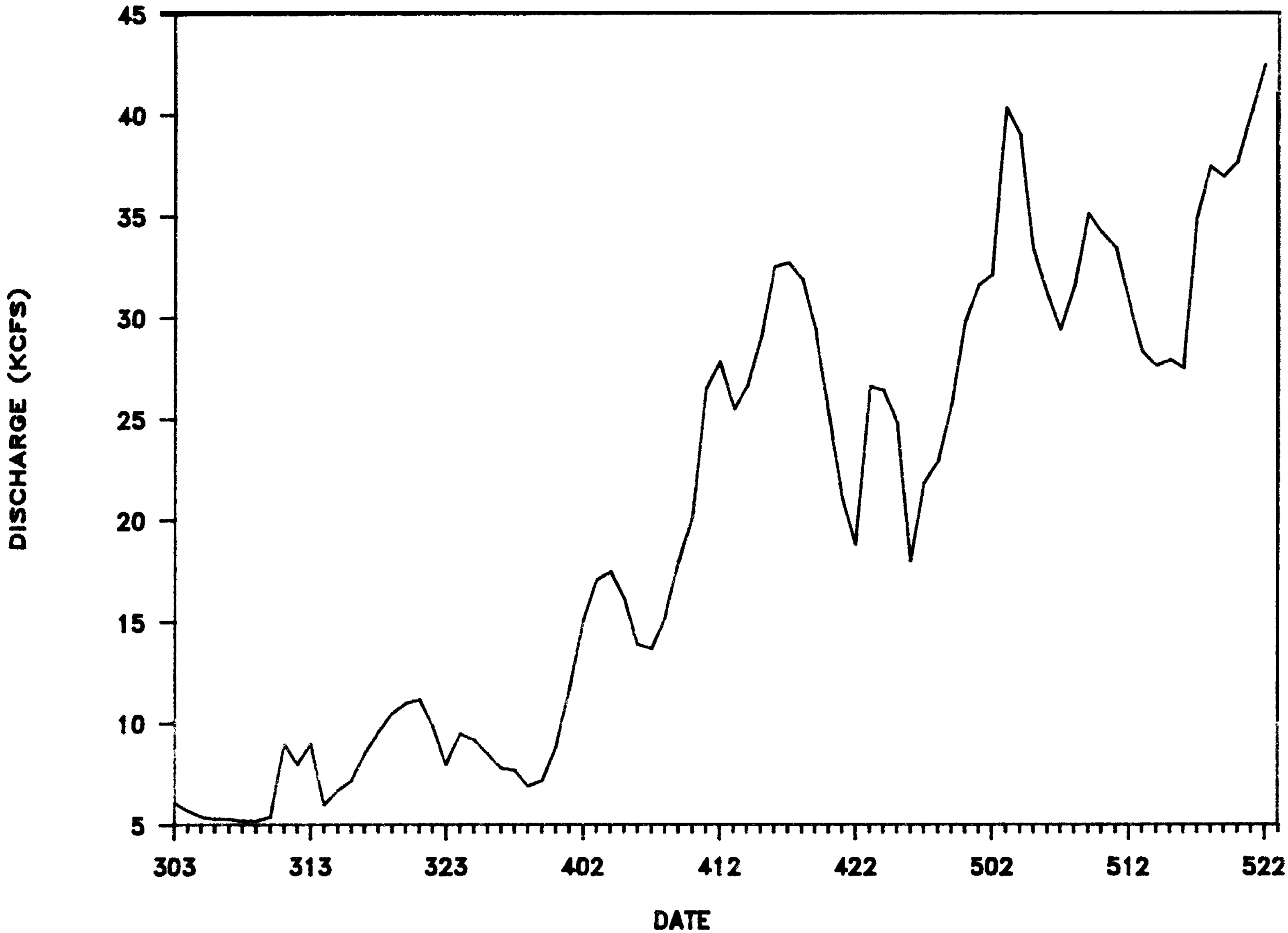

Figure 21. Daily Clearwater River discharge at the Spaulding gauge, 1985.

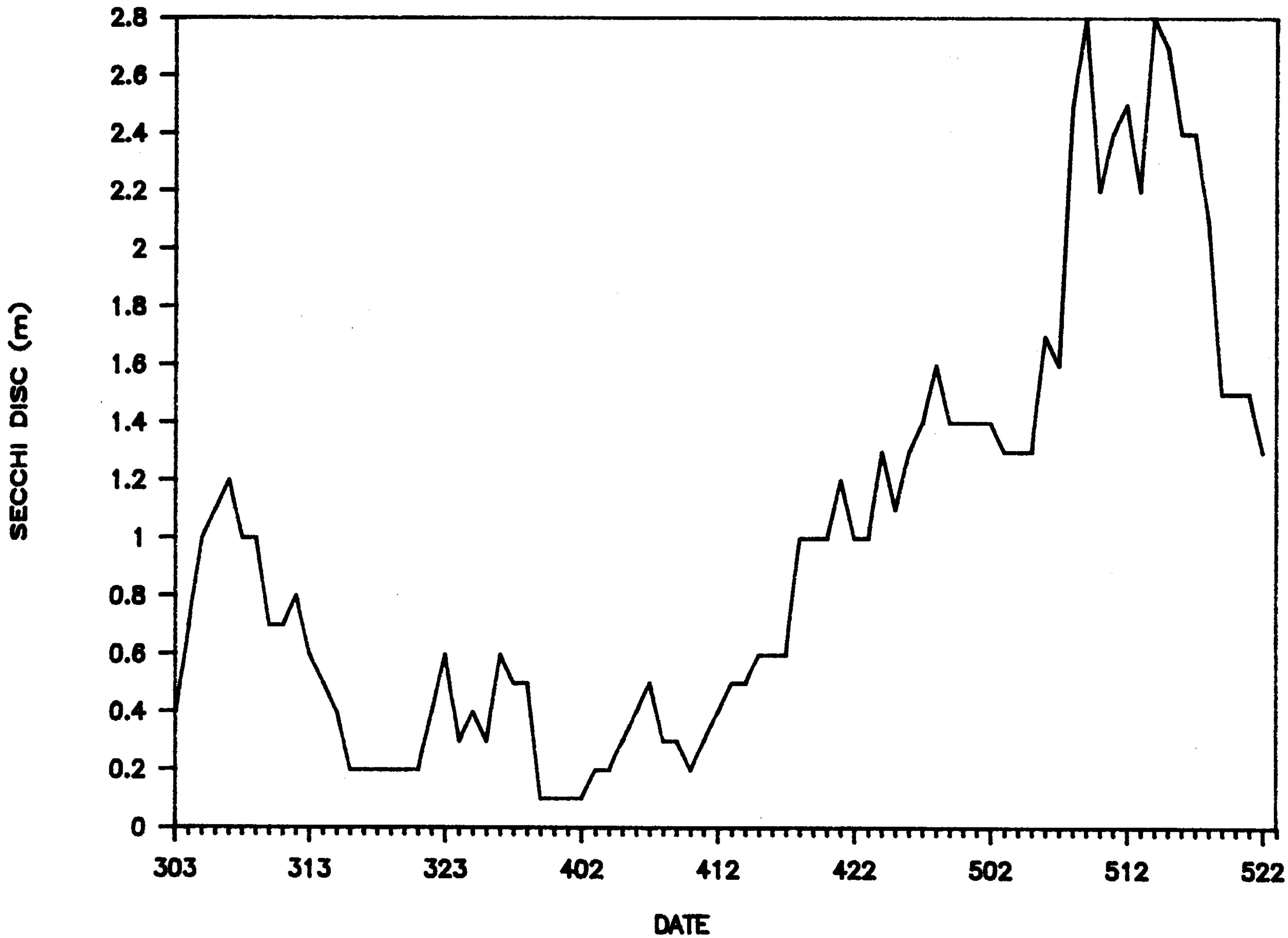

Figure 22. Daily Clearwater River depth of visibility at the Clearwater River trap, 1985.

Descaiing of Chinook Salmon Smolts at Hatcheries and Release Sites

Chinook salmon smolt classical descaling for 1985 showed a slight decl ine from the previous two years. Three of the five chinook hatcheries sampled showed small decreases in classical descaling (Table 3).

Classical descaiing rate at hatcheries ranged from 0 to 2.2% with a mean rate of 0.5%.

Classical descaling of chinook salmon smoits at the three release sites sampled ranged from 0 to 1.1% with a mean of 0.4%. The highest classical descaling occurred at the Hel Is Canyon (Snake River) release site. Descal ing at the release site was si ightl y lower than prior to transport, which is probably due to between-sample variation.

Fish with 10% or more of their scales missing from at least one side in a scattered fashion may be as unhealthy as those which exhibit classical descaling. Chinook salmon “scattered” desca I ing at hatcheries ranged from 0 to 15.8% and averaged 5.3%. Scattered descaiing at three release points ranged from 0 to 12.1% with a mean of 7.5%.

Rapid River Hatchery had the highest classical (2.2%) and highest scattered (15.9%) descal ing rates. Rapid River Hatchery fish also had the highest classical and scattered descaiing at the release site.

Classical descal ing of fail chinook at Hagerman National Fish Hatchery averaged 0.48, and scattered descaiing was 4.8%. After transport, they appeared stressed and were not examined for scale loss prior to release.

Two-area descal ing exists when the sum of the number of the 10 areas (Fig. 2) on a fish which are at least 40% descaled and the number of sides of a fish which exhibit scattered descal ing is at least two. This type of descal ing is probably as detrimental to fish as classical descal ing. Two-area descai ing showed no increase over classical descaling in chinook at the McCall Hatchery, but was five and six times greater at Hagerman National and Rapid River hatcheries, respectively.

Two-area descal ing at release sites showed a similar trend of increase relative to classical descal ing rate. Rapid River fish showed a nine-fold increase of two-area descaling over classical descaling at the Hells Canyon release site.

Two-area descaiing rate was reduced at two hatcheries, unchanged at one, and increased at two compared to rates measured in 1984. Two-area descal ing rates at release sites showed a slight decrease for chinook from McCal I Hatchery and a I arge increase for those from Rapid River Hatchery. The large increase in descaiing rate from the last two years for Rapid River chinook was also seen at the hatchery. Transport of the fish was not responsible for the increase in two-area descaling.

Table 3. Chinook descaling rates at hatcheries and release sites, 1985.

	Classical	Two-area	Scattered
McCall Hatchery Descaling (Percent)			
Summer			
S.F. Salmon	0	0	0
Spring			
Sawtooth	0	0	0
Release Sites			
S.F. Salmon	0	1.3%	1.3%
Sawtooth	0	0	0
Rapid River Hatchery			
Pond #1	2.2%	12.2%	15.6%
Pond #2	2.1%	12.9%	15.9%
Release Site			
Hells Canyon	1.1%	10.3%	12.1%
Kooskia NFH			
Raceway #11	0	0	2.0%
Raceway #10	0	2.7%	8.7%
Raceway #12	0	0	2.0%
Raceway #6	0	4.0%	9.3%
Dworshak NFH			
Lot 3 Lw-2a Raceway #1	0	10.7%	17.3%
Lot 3 Le-2 Raceway #4	0	0	2.0%
Lot 3 Le-2 Raceway #5	0	0	0.7%
Lot 3 (Abernathy feeding trial) Lw-2b Raceway #10	0	0.7%	4.7%
Lot 3 (OMP feeding trial) Lw-2b Raceway #11	0	0	2.7%
Lot 3 (Abernathy-VMP feeding trial) Lw-2b Raceway #15	0	0	0
Hagerman NFH (Fall chinook)			
Freeze branded and CWT			
Raceway #5 and #6	0	0.7%	4.2%
Unmarked #89	0.7%	3.4%	5.5%
Pahsimerol			
Hayden Creek spring chinook	0.7%	No data	No data
Pahsimerol stock summer chinook	0	No data	No data

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Descaiing of Steelhead Trout Smoit at Hatcheries and Release Sites

Classical descaiing rates at hatcheries ranged from 0 to 0.7% and averaged 0.3% (Tab I e 4). The highest rate occurred at Dworshak NFH. Classical descaiing rates at release sites were virtually the same as at hatcheries in contrast to 1983, when release site classical descal ing rate was three times greater than at hatcheries.

The highest classical descaling rate was observed in system 1 at Dworshak National Fish Hatchery (2.0%). Classical descal ing was also 2.0% when these fish were released in American River. Mean classical descai ing rate at release sites was 0.4%.

Scattered descal ing rates at hatcheries ranged from 0.8 to 7.3% with a mean of 3.0%. The severest scattered descaling rate (15%) occurred in system 1 at Dworshak NFH. Both Niagara Springs Fish Hatchery and Hagerman NFH had low scattered descal i ng rates (0.8%). Comparing scattered descaling rates for 1985 with previous years, 1985 mean scattered desca l i ng rate (3.0%) was similar to 1984 (2.6%) and four times less than in 1983 (12.1%).

Scattered descaling rates at release sites ranged from 1.8 to 5.7% with a mean of 3.1%. The highest scattered descaiing rate at a release site was observed on Dworshak NFH steel head smol ts released In American River (8.7%).

Two-area descaiing was eight times greater than classical descaling at hatcheries and seven times greater than ciasslcai descaling at release sites.

Classical descaiing rates of steelhead at hatcheries for the last three years have been about the same at al l hatcheries sampled. Two-area descal i ng was lower in 1985 than during the previous two years. The l argest decrease was a f i ve-fol d decrease over 1983 at Dworshak NFH. Scattered descai ing rate in 1985 was al so the l owest observed dur ing the three years samp l ed. Descaling rates at release sites followed the same trends seen at hatcheries.

Transport of fish causes a si ight increase in descal ing, but normal ly not more than 1%. Most of the descaling is apparent prior to transport but i s not consistent with either hatchery or year. Degree of scale loss is likely associated with illness or other stresses fish have undergone prior to being sampled.

Chinook Salmon Descaiing at Traps

Week l y classical descal i ng rates at the Salmon River trap were general l y near '2% except during the first of Apr i l when the rate rose to near 4% (Fig. 23). Snake River trap chinook descaiing rates were generally higher than those at the Salmon River trap, the opposite of what occurred in 1984. Descai i ng rates at Snake River trap peaked near 5% in

Table 4. Steelhead descaling rates at hatcheries and release sites, 1985.

	Classical	Two-area	Scattered
Dworshak Descaling			
System 1	2.0%	14.0%	15.0%
System 2	0	2.7%	4.3%
System 3	0	0.7%	2.7%
$\bar{x}$	0.7%	5.8%	7.3%
Release sites for Dworshak fish			
Eldorado Creek	0	2.7%	2.7%
American River	2.0%	4	8.7%
$\bar{x}$	1.0%	3.7%	5.7%
Niagara			
Hatchery	0.1%	0.6%	0.8%
Pahsimeroi release site	0	1.8%	1.6%
Hells Canyon release site	0	3.3%	2.0%
$\bar{x}$	0	2.[illegible]%	1.8%
Hagerman NFH			
Hatchery	0	0.8%	0.8%
Pahsimeroi release site	0	2.0%	2.0%
Sawtooth release site	0.3%	0.7%	1.3%
E.F. Salmon release site	0	2.7%	2.0%
Hazard Creek release site	0	2.78	2.0%
$\bar{x}$	0.1%	2.0%	1.8%

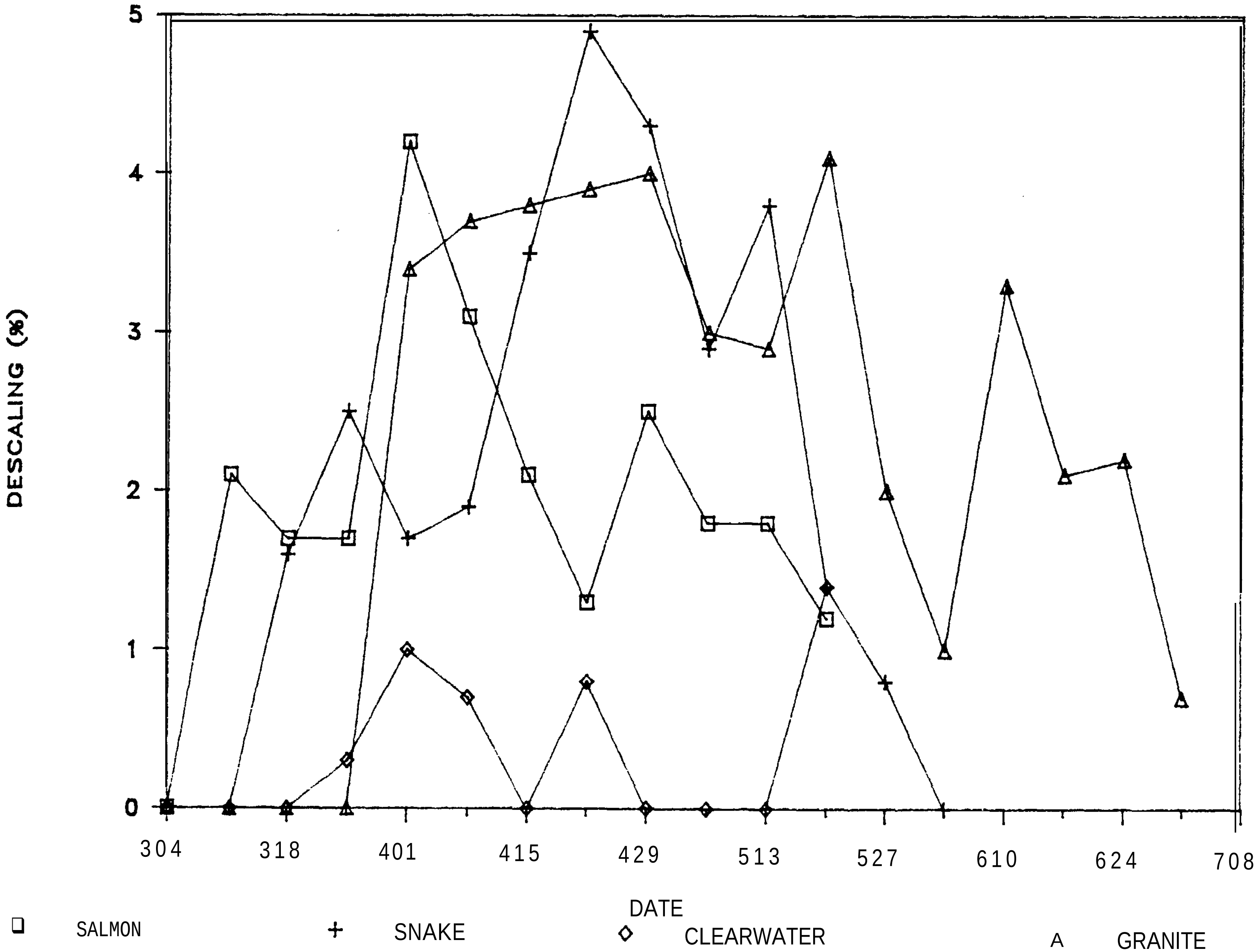

Figure 23. **Mean weekly descaling rates for yearling chinook salmon at the Salmon, Snake and Clearwater river traps and at Lower Granite Dam, 1985.**

mid-April, but were generally less than 4%. Descaling rates at Clearwater River trap were lowest, weekly averages being generally less than 1%. Seasonal averages in 1985 at Salmon River, Snake River, and Clearwater River traps were 2.4%, 2.68, and 0.6% (Table 5). Descaling rates at Lower Granite Dam were higher than at the Salmon River or Clearwater River trap, but similar to those at the Snake River trap.

Wild Steelhead Trout Descaling at Traps

Classical descaling rate at the Salmon River trap (Fig. 24) was very low, generally zero on a weekly basis, considerably less than in 1984 when it averaged near 2%. Snake River trap descaling rate was generally between zero and 2.5%, peaking in mid-May. Descaling rate at the Clearwater River trap was generally zero with one peak of 3.5% in mid-April. Seasonal averages in 1985 at the Salmon River, Snake River, and Clearwater River traps were 0.7%, 0.88, and 0.7%. Descaling at Lower Granite Dam ranged between 0.5% and 1.5% most of the season, rising to near 2% in late May.

Hatchery Steelhead Trout Descaling at Trap

Weekly classical descaling rate at the Salmon River trap (Fig. 25) was generally less than 10%, but rose to 37% in early May. Descaling rate at the Snake River trap was generally less than 5%, but rose to near 10% the first part of June. Descaling rate at the Clearwater River trap rose from near 1% to 10% from late April to mid-May. Descaling rate at Lower Granite Dam stayed near 5% throughout the season.

This is the first season when a smolt could be considered classically descaled if scales were missing in a longitudinal band as well as when two or more areas on one side of a fish were classified as descaled. At the Snake River trap, this new criterion added 3.1%, 0.3%, and 0.8% to hatchery steelhead, wild steelhead, and yearling chinook descaling rates, respectively.

Descaling Rate, by Length Interval

Classical descaling rates of smolts separated into 20 mm length intervals indicate that yearling chinook 140 mm and larger have higher descaling rates than smaller individuals. This phenomenon was also observed in 1983 and 1984. Zero percent descaling rates among large sizes (Table 6) generally is associated with small samples.

Neither hatchery nor wild steelhead showed obvious descaling rate relationships with size intervals in 1985. This is consistent with 1984 data, but differs from 1983 when larger hatchery steelhead suffered high descaling rates at the Salmon River trap.

Table 5. Seasonal mean descaling rates for yearling chinook, hatchery steelhead, and wild steelhead at Clearwater River, Snake River, and Salmon River traps In 1984 and 1985.

		Salmon River	Snake River	Clearwater River
Yearling chinook	1984	4.5	2.5	1.5
	1985	2.4	2.6	0.6
Hatchery steelhead	1984	8.7	5.5	4.1
	1985	10.1	6.2	2.1
Wild steelhead	1984	2.1	1.4	0.4
	1985	0.7	0.8	0.7

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Table 6. Classical descaling rates by 20 mm length intervals for yearling chinook salmon and hatchery and wild steelhead at Clearwater River (CW), Snake River (Sn R), and Salmon (SR) traps, 1985.

Length interval	Yearling chinook salmon			Steelhead					
				Hatchery			Wild		
	CW	Sn R	SR	CW	Sn R	SR	CW	Sn R	SR
81-100	0	0	0.8						
101-120	0.5	0.9	0.6						
121-140	0.4	2.9	3.2						
141-160	0.7	2.9	3.4	0	2.8		0	2.4	0
161-180	0.4	1.0	2.8	3.1	3.5	11.8	1.7	0	0
181-200	4.4	0	14.0	0	6.4	7.5	0	0.9	1.9
201-220	0			2.7	5.5	11.8	0	1.0	0
221-240	0			1.5	5.9	12.0		0	0
241-260				1.0	3.3	6.3		0	0
261-280				11.0	2.4	5.8			
281-300				0	6.5	0			
301-320					0	0			
N	3,868	7,925	7,855	791	3,283	987	129	708	152

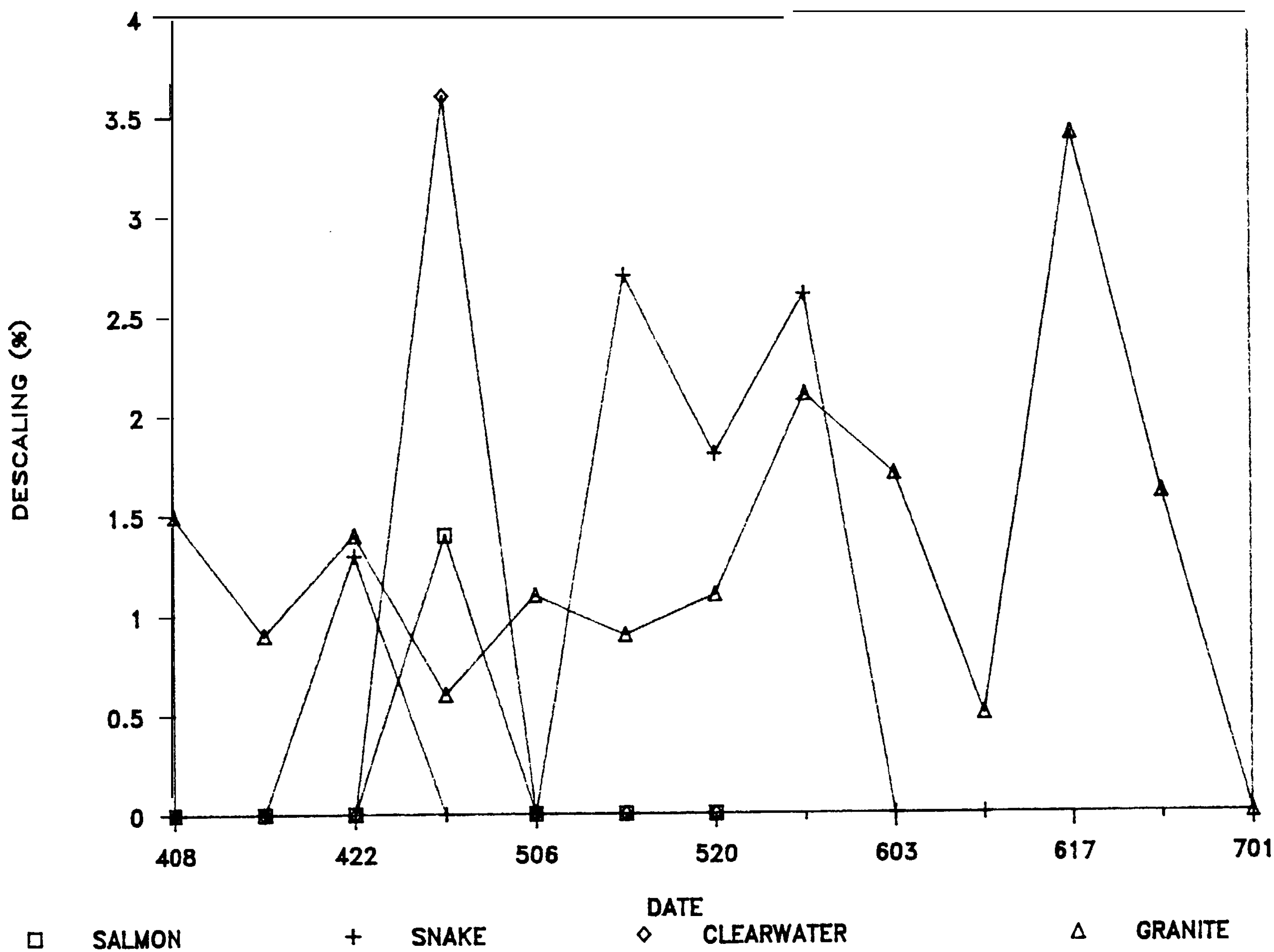

Figure 24. Mean weekly descaling rates of wild steelhead smolts at the Salmon, Snake and Clearwater river traps and at Lower Granite Dam, 1985.

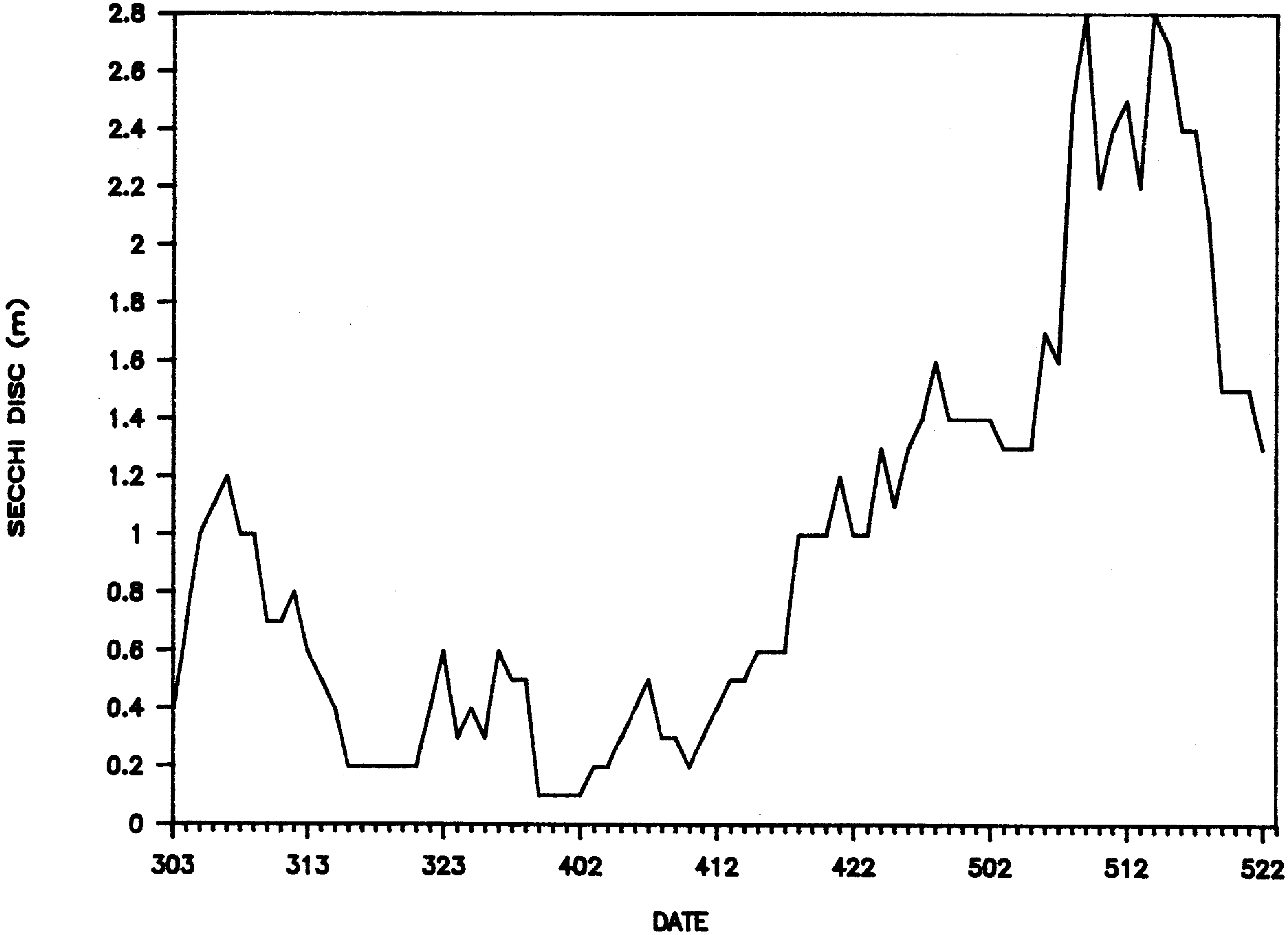

Figure 22. Daily Clearwater River depth of visibility at the Clearwater River trap, 1985.

Trap Efficiency

Salmon River Trap

In 1984 we estimated chinook trapping efficiency ten times and in 1985 five times within a discharge range from 5,800 to 19,000 cfs (Table 7). The latter discharge is near the upper limit at which the trap can be fished in the preferred location. A regression of the combined 1984 and 1985 data produced the equation:

$$LnE = -3.501 - 0.085\ Q$$

Where LnE = natural logarithm of the efficiency decimal, and Q = discharge divided by 1000 cfs.

The coefficient of determination is 0.536 and the slope is highly significant, F = 15.0 (Fig. 26).

Snake River Trap

This trap should provide low variance estimates of efficiency and clearly define the relationship between efficiency and discharge. The trap fishes almost continually through the season; it is always in the same location and the fish which enter the live well have no chance of being washed from it as is occasionally possible with scoop traps. It appears that no relationship exists between discharge and trap efficiency (Fig. 27). Average efficiency for yearling chinook is near 1.4% and the range in estimates is from near zero (0.2%) to 2.5% (Table 8). The 95% confidence limits on the mean estimate are near 15% of the estimate:

$$(\bar{x} \pm c.l. = 0.0137 \pm 0.002).$$

Although river velocity at the trap ranges from near 1 fps to near 4 fps within the range of discharge that efficiency was tested, the river width changes very little, and the trap is always in current which is not much less than that of the main channel. Perhaps for these reasons, there is no obvious relationship between discharge and chinook trapping efficiency.

Mean chinook trapping efficiency in 1984 was 1.6% and in 1985 was 1.2%. Efficiency tests in 1984 were done when discharge ranged from 74,000 to 103,000 cfs (x = 87,000) and in 1985 when discharge ranged from 42,000 to 80,000 ($\bar{x}$ = 63,000). A t-test on the mean values from the two years, however, revealed no significant difference (t = 1.731, thus we pooled 1984 and 1985 data for the best estimate of trap efficiency for chinook (1.37%).

Table 7. Salmon River trap efficiency tests for yearling chinook smoits in 1984 and 1985.

Year	Dates	R/M	Trapping efficiency	Mean river discharge in 1000 cfs at Whitebird
1984	3/21-23	2/227	0.0088	9.6
	4/3-5	3/195	0.0154	7.9
	4/6-7	4/314	0.0127	9.2
	4/10-11	22/1270	0.0173	9.8
	4/13-17	11/1374	0.0080	10.8
1985	3/20-21	3/194	0.0155	6.1
	3/25-26	2/88	0.0227	5.8
	4/2-3	3/163	0.0184	6.5
	4/4-5	7/423	0.0165	8.6
	4/7-9	23/1168	0.0197	9.8
	4/10-11	20/1288	0.0155	13.4
	4/22-23	1/07	0.0093	16.2
	4/24-25	1/141	0.0071	13.5
	4/28-30	4/538	0.0074	12.3
	5/1-2	1/166	0.0060	19.0

Table 8. Snake RIver trap efficiency tests for chinook salmon smolts in 1984 and 1985.

Release	date	R/M	Efficiency	Discharge (1,000 cfs)
1984	3/24	26/1388	0.0187	a4
	3/28	10/545	0.0183	75
	4/8	3/589	0.0051	77
	4/12	7/309	0.0227	al
	4/16	9/806	0.0112	92
	4/19	23/1061	0.0217	104
	4/24	8/812	0.0098	101
	4/28	5/267	0.0187	86
	5/4	4/179	0.0223	81
	5/9	2/95	0.0211	93
1985	3/22	11/1124	0.0098	43
	4/2	31/840	0.0250	56
	4/6	7/1092	0.0064	64
	4/10	4/1490	0.0027	79
	4/12	15/1276	0.0118	77
	4/16	12/915	0.0131	80
	5/5	4/338	0.0118	42
		181/13126		

Overall efficiency and 95% confidence limits:
0.0137 + 0.0020
Limit as % of estimate = 15%

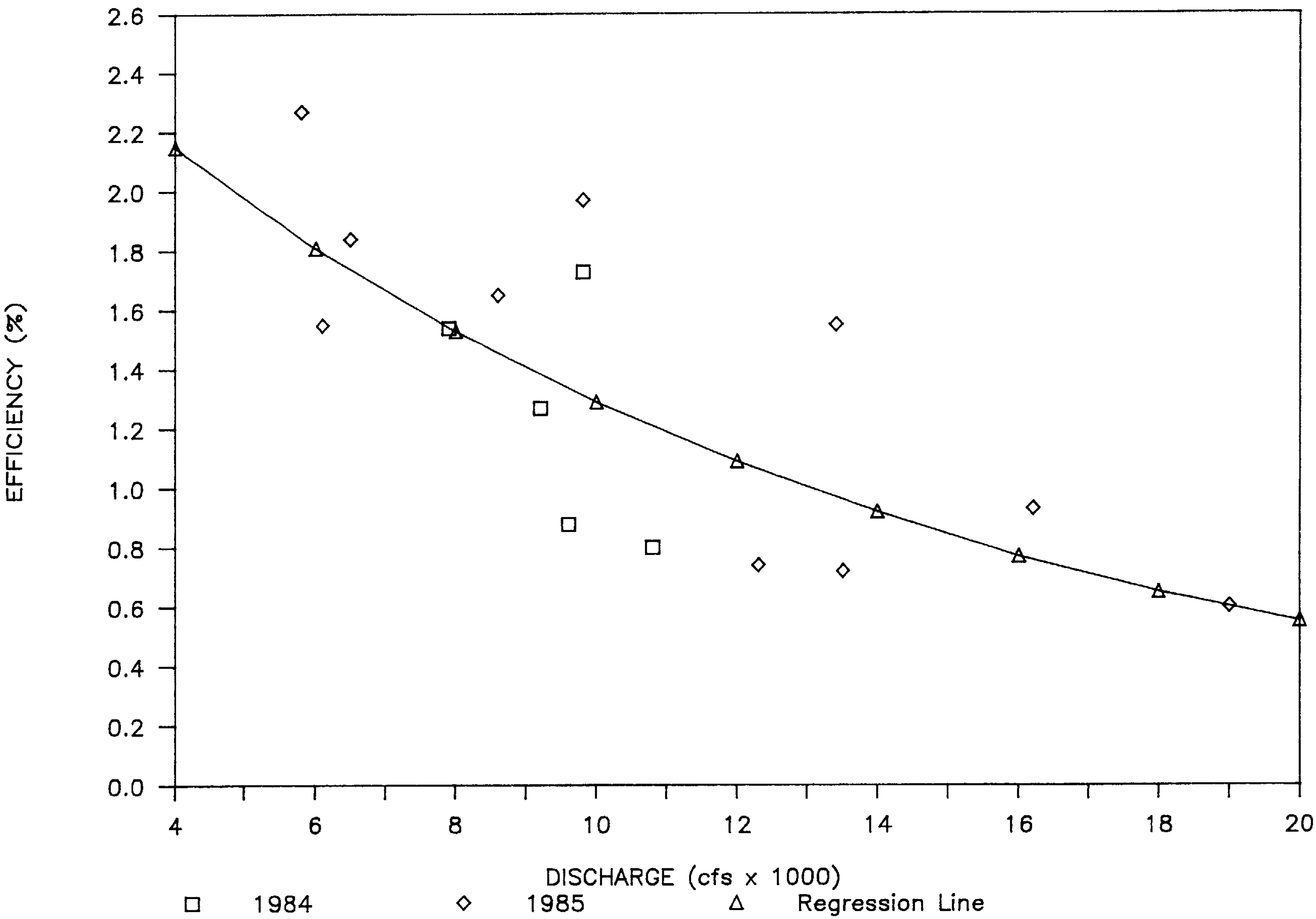

Figure 26. Relationship of Salmon River discharge and Salmon River trap efficiency for 1984 and 1985.

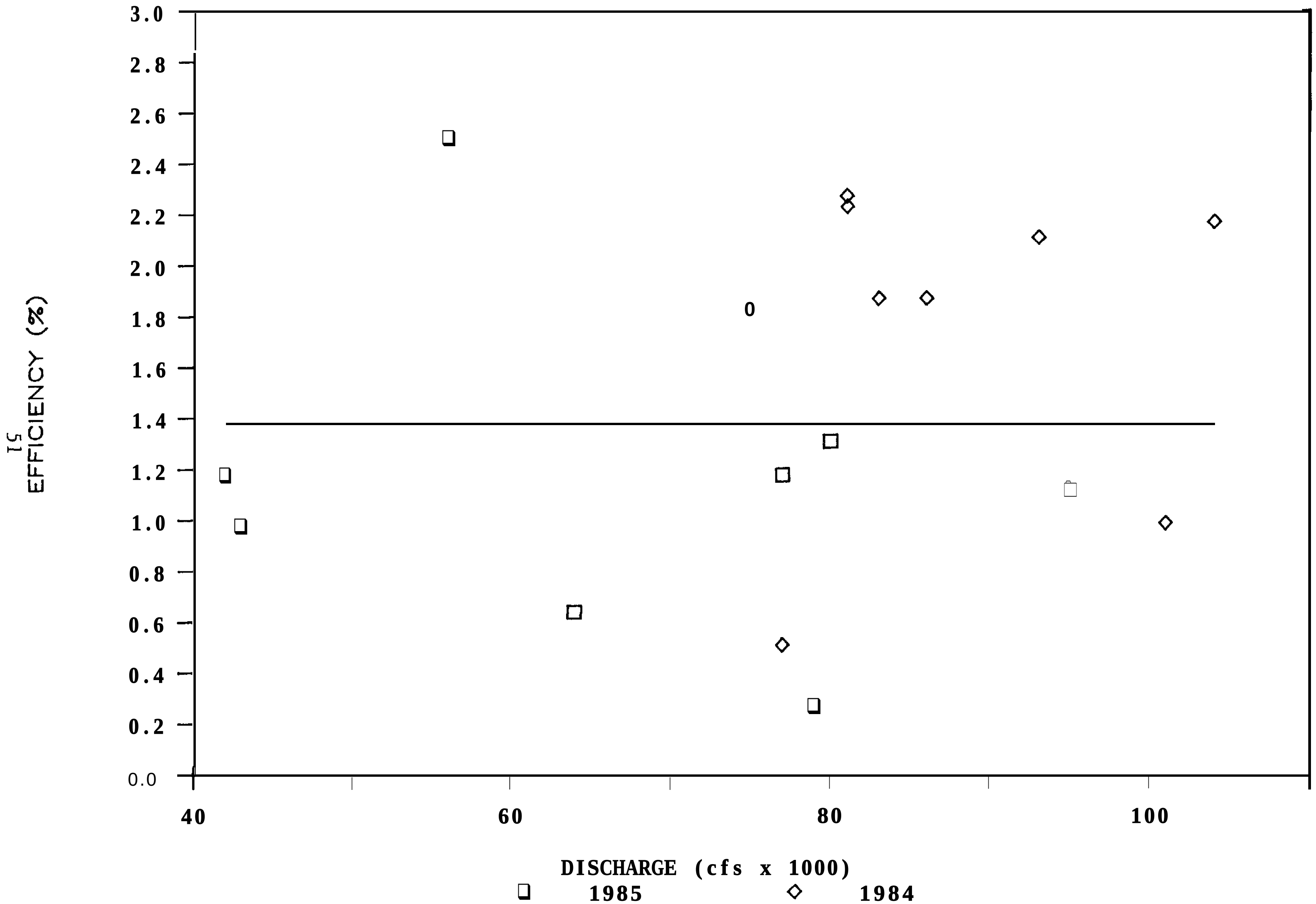

Figure 27. Scatter diagram showing Snake River trap efficiencies over a wide range of Snake River discharges, 1984 and 1985.

The first year we captured enough steelhead to make meanlngful trap efficiency tests was 1985. The range in discharge during the tests was 47,000 to 68,000 cfs, and there was no obvious correlation between efficiency and discharge (Table 9). The average steelhead trapping efficiency is 0.0051, and the 95% conf idence interval is 58% of the estlmate.

Clearwater River Trap

We tested trapping efficiency for yearling chinook salmon five times in 1984 and six times in 1985 (Table 10). Tests done in 1984 were within a discharge range from 21,000 to 33,000 cfs and in 1985 within a range from 9,100 to 31,000 cfs. There is no obvious relationship between the variables. Efficiency estimates range from 0.0021 at 14,800 cfs to 0.0309 at 24,000 cfs. We marked 7,457 chinook and recaptured 112 in the 11 tests for an average trap ef f iciency of 0.0150. We wil I continue to estimate trap efficiency, but unless we obtain a signif icant correlation with discharge, we will use the overal I average efficiency value when estimating the number of chinook passing the trap. There were insufficient steelhead available to conduct reliable tests for their trap efficiency. In five tests, we released 1,564 steelhead and recaptured only four. From these data, steelhead trapping efficiency would be 0.0023 and 95% confidence limits would be 100% of the estimate (Table 11).

Travel Time and Migration Rates

Release Sites to Salmon River Trap

Three groups of branded chinook salmon, containing from 26,000 to 40,000 smolts each and two groups of branded steelhead of 32,000 and 35,000 were released upriver from the Salmon River trap (Tables 1 and 2). The Salmon River trap captured 645 branded chinook salmon and 4 branded steelhead trout.

Median release dates for branded chinook salmon at the Sawtooth Hatchery (Salmon River) and South Fork Salmon River were March 25-29 and Aprl I 1-4, respectively. Branded chinook were a I lowed to voluntarily leave Rapid River Hatchery beginning March 27 with April 2 the median release date. Distances upriver from the Salmon River trap for these three release sites are 332, 154, and 40 mi les for Sawtooth Hatchery, South Fork Salmon River, and Rapid River releases, respectively. Branded chinook from Rapid River began arriving April 3, fol lowed by Sawtooth chinook on Apr i I 5 and South Fork chinook on Apr i I 10. Median passage dates were April 9, April 11, and April 12 for Rapid River, Sawtooth and South Fork branded chinook, respectively. For each of these groupsl 95% confidence Intervals around median passage dates were less than + 2 days, and two-thirds of each group

Table 9. Snake River trap efficiency tests for steelhead smolts in 1985.

Release dates	R/M	Efficiency	Discharge (1000 cfs)
5/4	8/811	0.0099	55
5/8	1/185	0.0054	54
5/10	0/535	0	47
5/18	1/492	0.002	50
5/21	2/314	0.0064	68

Overall efficiency and 95% confidence limits:
0.00513 + 0.00296
Limit as % of estimate = 58%

Table 10. Clearwater River trap efficiency tests for chinook salmon smolts in 1984 and 1985.

Release date		R/M	Efficiency	Discharge (1,000 CfS)
1984	4/5	4/418	0.0096	21
	4/21	13/806	0.0161	33
	4/25	3/489	0.0061	31
	5/2	3/183	0.0164	24
	5/6	I/42	0.0238	24
	5/10	14/453	0.0309	24
1985	3/25	14/607	0.0230	9
	3/30	45/1511	0.0298	9
	4/5	6/1079	0.0056	18
	4/9	2/940	0.0021	15
	4/16	7/929	0.0075	33
		112/7457		

Overall efficiency and 95% confidence limits:

0.01502 $\pm$ 0.00282

Limit as % of estimate = 19%

Table 11. Clearwater River trap efficiency for steelhead smolts in 1985.

Release dates	R/M	Efficiency	Discharge (1000 cfs)
5/7	2/464	0.0043	
5/8	O/338	--	
5/11	I/384	0.0026	
5/12	O/272	- -	
5/14	I/106	0.0094	

Overall efficiency and 95% confidence limits:
0.00256 + 0.00256
Limit as % of estimate = 100%

passed the Salmon River trap wlthin 8-16 day intervals; i.e., standard deviation ranged from 3.7 for Rapid River chinook to 8.0 days for South Fork chinook.

Migration was most rapid for the Sawtooth chinook, 36.8 km/day, and least for Rapid River chinook, 8.5 km/day. Considering migratlon rates relative to average Salmon River Discharge, there appears to be no obvious relationship when the three years of data are compared. The high water year of 1984 did not result in uniformly rapid migration rates compared to the years of less runoff (Table 12).

Upriver (Sawtooth Hatchery and South Fork Salmon River) chinook smolts migrated at about the same rate, averaging 24.7 + 7 km/day (95% confidence Interval) over the years 1983 to 1985. Smoits migrating from Rapid River to the Salmon River trap traveled much slower, averaging 7.2 + 3 km/day. Hatchery-reared smolts may not migrate immediately after release. The effect of this would be to decrease our calculated value of migration rate and the effect would be greatest for shorter migration intervals such as Rapid River to the Salmon River trap.

Multiple Regression Analysis - Hatcheries to the Salmon River Trap

We used stepwise multiple regression analyses to determine the relative influence of several abiotic factors on migration rate. We considered average day length, date when smolts were released, water temperature, discharge, and transparency at the Salmon River trap. The regression procedure selected date of release (a negatlve relationship) as the most important factor when 1985 data were considered alone. Smolts are released later at Rapid River Hatchery than at the South Fork Salmon River and Sawtooth Hatchery because Rapid River smolts do not have to migrate as far as those from the upper Salmon River, and as discussed earlier, Rapid River smolts migrate much slower to the Salmon River trap than uprlver smolts. The second variable entered into the model was discharge, a parameter which has been significant during each year of the project.

When considering data from the ten observations for 1983-1985 combined the best predictive equation includes year, discharge, and secchi disc transparency. As discharge, secchi disc transparency, and chronological year increase, migration rate increases:

$$\text{Rate} = 38.19S + 4.72\,Q \; t \; 17.38\,Y - 71.49$$

$$n = 10, \; R^2 = 0.77$$

Where S = Secchi disc transparency
Q = is Salmon River discharge
Y = is chronological year

Table 12. Migration statistics for branded chinook salmon released at three sites on the Salmon River and migrating past the Salmon River trap in 1983, 1984 and 1985.

Release site	Dates: Release	Dates: Arrival	Miles	Migration rate Mi/day	Number brands in trap	Discharge at Whitebird (1000 cfs)
South Fork Salmon River						
	4/05/83	4/23/83	154	8.5	134	7.0
	4/10/84	4/19/84	154	17.1	108	12.6
	4/02/85	4/12/85	154	15.4	70	10.2
				x = 13.7		
Sawtooth Hatchery						
	3/29/83	4/29/83	332	10.7	57	9.5
	3/28/84	4/19/84	332	15.1	124	10.2
	3/27/85	4/11/85	332	22.1	123	7.9
				x = 16.0		
Rapid River						
	3/25/83	4/04/83	40	4.4	149	7.2
	4/01/84	4/13/84	40	3.3	286	8.8
	4/02/85	4/09/85	40	5.1	453	8.5
				x = 4.3		

Average migration rates for brand groups from Rapid River, Sawtooth Hatchery, and South Fork Salmon River were 13.2 km/day in 1983, 19.7 km/day in 1984, and 23.7 km/day in 1985.

Prior to this study, we assumed that discharge would be the major factor influencing migration rate, and those collecting data at the traps have observed increased numbers of smolts in the trap as discharge increases. There is a cause and effect, but it is difficult to quantify through correlation and regression analyses. By plotting the 1985 daily frequencies of each brand group of chinook on the same graph and overlaying the river discharge hydrograph, a better picture of the migration rate and river discharge relationship emerges (Fig. 28).

All chinook brand groups in 1985 passed the Salmon River trap about the same time, when river discharge began its first significant rise after the smolts were released. Although the increase in discharge continued for several days, the majority of smolts passed quickly, such that their numbers at the trap soon decreased even though discharge was still increasing. Subsequent rises in discharge appeared to "dislodge" the remaining smolts, but no large passage occurred because most of the smolts had passed the Salmon River trap already.

Average discharge during the migration of Sawtooth smolts to the Salmon River trap (March 27 - April 11) was low because discharge did not rise significantly until April 4. Probably most of the migration of these smolts occurred in the days between April 4 and April 11 when discharge had risen. Rapid River smolts came from a much shorter distance and were released later than the Sawtooth chinook, so average discharge was greater, but migration rate was slower, probably because little movement occurs in the first day or two after release. All smolts were probably moving at a uniformly rapid rate after April 4.

Salmon River Trap, Hells Canyon, and Grande Ronde River to Snake River Trap

We trapped 1,138 branded yearling chinook salmon from four release groups and 156 branded steelhead smolts from five release groups at the Snake River trap. About half (544) of the branded chinook came from the Hells Canyon release, the remainder from the three Salmon River releases listed above. Branded steelhead came from two sites on the Salmon River (East Fork Salmon River and Sawtooth Hatchery) two sites on the Grande Ronde River, and one site immediately below Hells Canyon Dam on the Snake River.

Travel times for branded chinook salmon from the Salmon River trap to the head of Lower Granite Reservoir (Snake River trap) averaged 49.2 km/day in 1985, twice that of the rate upriver from Whitebird (23.7 km/day). This is a phenomenon consistent in all three years of the project. Smolts move faster in the lower river section, probably because they are fully smolted in mid-migration and generally are riding a crest of rising discharge when they begin their lower river

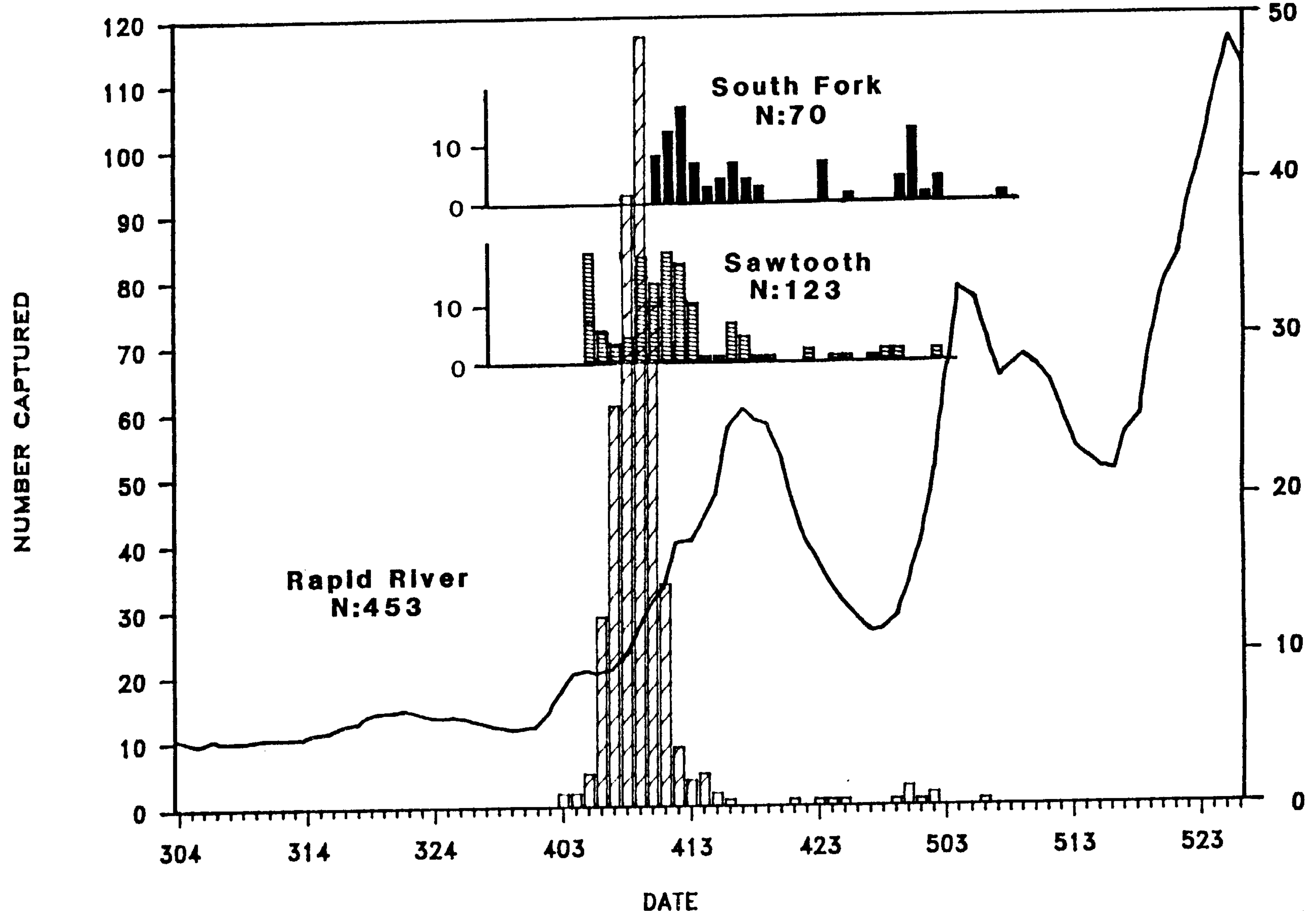

Figure 28. Daily Salmon River recaptures of three branded yearling chinook salmon groups overlayed by the Salmon River hydrograph, 1985.

migration at Whitebird. Migration rate from Hells Canyon Dam to the Snake River trap was much slower, 11.8 km/day, similar to the 20 km/day rate for branded chinook migrating between Hells Canyon Dam and the Snake River trap in 1984 (Table 13).

Because only four branded steelhead were captured at the Salmon River trap, we did not estimate travel time and migration rate for steelhead between the Salmon River and Snake River traps.

Migration rates for steelhead from release sites to the Snake River trap averaged 27 km/day (N = 5, standard deviation = 12.4). Steel head smolts migrating from the Grande Ronde RIver were the slowest migrators (8 to 10 km/day) and Hells Canyon smolts were the most rapid (60 km/day).

Median migration rates for yearling chinook salmon smolts from release sites to the Snake River trap averaged 26 km/day (N = 4, standard deviation = 7.041. Branded sub-yearling chinook released in the Snake River at the mouth of the Grande Ronde River, 48 kilometers upriver from the Snake River trap, passed the trap (median passage date) the following day. Chinook smolts released at Hells Canyon were the slowest migrators (12 km/day). They were released early, when discharge was low, to allow these smolts to move downriver from Hells Canyon Dam when percent saturation of dissolved gases below Hells Canyon Dam is low.

We did stepwise multiple regression analysis on the combined ten branded chinook groups migrating between Salmon River and Snake River traps In 1983, 1984, and 1985. The only significant parameters were day length (DL) and year (Y), resulting in the following equation:

$$\text{Rate} = 16.8\ \text{DL} + 7.0\ \text{year}$$

$$R^2 = 0.90$$

This indicates that the later the chinook are released, the faster they migrate, at least within the time range of the available data. The equation also indicates that average migration rate has increased each year from 1983 to 1985. Looking at average discharge during the migration intervals of the branded chinook groups, average discharge and migration rate increased significantly between 1983 and 1984, but in 1985 migration rates and discharge actually decreased (Table 14). The change in migration rate between 1984 and 1985 was only slight, however. The wide range of migration rates within each year probably kept the regression procedure from finding a significant relationship between migration rate and river discharge. The data in Table 13, however, indicate that on the average, migration rate does correlate positively with changes in discharge.

We graphed the daily frequencies of chinook smolts captured at the Snake River trap in 1985 for each of the four branded chinook groups and overlayed the figure with Snake River discharge (Fig. 29). It appears that the Hells Canyon chinook release on March 19 coincided with a slight rise in river discharge. A large pulse in chinook catch

Table 13. Migration statistics for branded chinook salmon traveling from the Salmon River trap or Hells Canyon Dam to the Snake River trap in 1984 and 1985.

Migration release group	Median passage dates at traps: Salmon River	Hells Canyon	Snake River	Distance in km	Travel time in days	Rate in km/day
1985						
Sawtooth Hat.	4/11	--	4/14	170	3	56.7
S. Fk. Salmon	4/12	--	4/17	170	5	34.0
Rapid River	4/09	- -	4/12	170	3	56.7
Hells Canyon	- -	3/19	4/3	178	15	11.8
1984						
Sawtooth Hat.	4/19	- -	4/21	170	2	85.0
S. Fk. Salmon	4/19	- -	4/24	170	5	34.0
Rapid River	4/14	- -	4/18	170	4	42.5
Hells Canyon	- -	3/20	3/29	178	9	20.2

Table 14. Average Salmon River discharge for the first half of the migration between Salmon RIver trap and the Snake River trap, average Snake River discharge for the second half of the migration and average and range of migration rates for chinook salmon smolts. Data are for branded groups released at Sawtooth, South Fork Salmon, and Rapid River in each of 1983, 1984, and 1985 and a group released at Pahsimeroi in 1983.

Year	Salmon River discharge (1000 cfs)	Snake River discharge (1000 cfs)	No. of release groups	Migration (km/day)	
				Rate	Rate range
1983	11.5	66.1	4	30.5	12-58
1984	17.3	99.8	3	53.5	33-83
1985	14.9	77.9	3	49.0	33-57

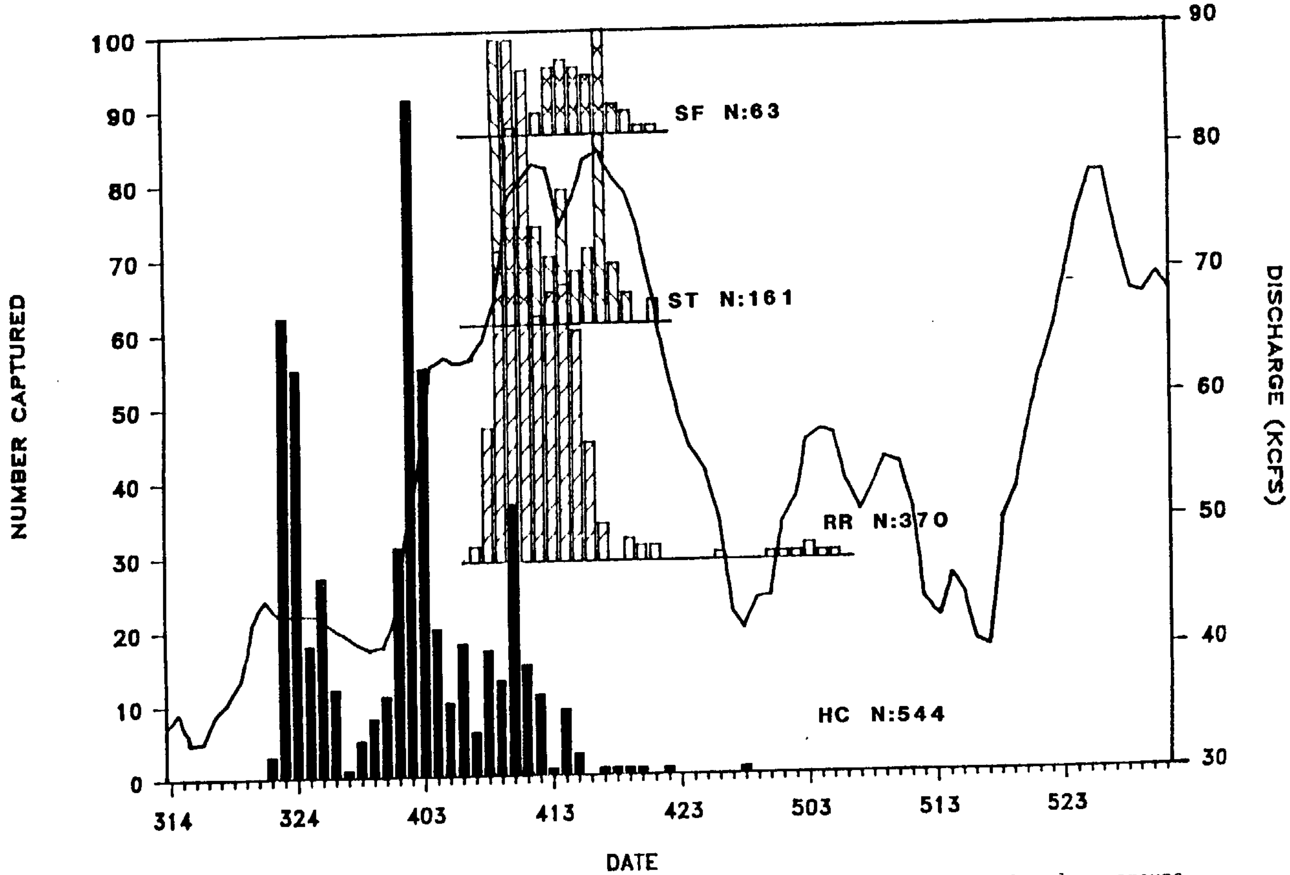

Figure 29. Daily Snake River trap recaptures of four branded yearling chinook salmon groups overlayed by the Snake River hydrograph, 1985. Branded smolt groups were released at South Fork Salmon River (SF), Sawtooth Hatchery (ST), Rapid River (RR), and Hells Canyon (HC).

occurred four to five days later, but numbers soon decreased corresponding to a decrease in discharge. Discharge increased again on April 1, and dal l y passage of the Hel l s Canyon smol ts peaked on Apr i l 3. Although discharge stayed high and stable, the numbers of Hells Canyon smolts passing the Snake River trap decreased. On Apri l 9, the Snake River began a major rise, and the remaining Hel ls Canyon smolts passed during this time. Simultaneously, a major pu l se in passage of al l three Salmon River branded chinook groups occurred. Their median passage dates occurred from April 12 for Rapid River brands to April 17 for South Fork Salmon River brands. After this pulse in passage, discharge decreased dramatically as did the capture of all branded chinook smolts. A minor rlse in discharge began on May 2 and with this, the remaining few chinook brands were captured at the Snake River trap. Al though another major rise in discharge occurred in late May, there appeared to be no more branded chinook upriver from the Snake River trap.

Branded chinook smolts migrating between the Salmon River and Snake River trap averaged 54 km/day in 1984 and 49.2 km/day in 1985. Migration rates for chinook smolts migrating from Hel ls Canyon Dam to the Snake River trap during those years traveled at 20.2 and 11 .8 km/day, respectively. The distances migrated are nearly the same, i.e., 170 kilometers from the Salmon River trap and 174 kilometers from Hells Canyon Dam.

During 1985 we captured enough branded steelhead (N=156) to document their time of arrival at the Snake River trap (Fig. 30). This compares with zero branded steelhead captured in 1984 and nine in 1983. No travel time information for steelhead between the Salmon River and Snake River traps is available, however, because only four branded steel head were captured at the Salmon River trap. Travel time and migration rates from release sites to the Snake River trap are shown in Table 15.

The steelhead brand groups comlng from the upper Salmon River migrated when the Salmon River at Whitebird averaged near 20,000 cfs, about twice the discharge that occurred during the yearling chinook migration one month earlier. Chinook from Sawtooth Hatchery, however, migrated at 42 km/day to the Snake River trap while steelhead migrated the same distance at 25.8 km/day. Possibly, the steelhead were not ready to migrate when released, or steelhead do not actively migrate until later in the spring.

Migration rate, once steel head reached the Snake River, was probably rapid, based on brand returns from steelhead released below Hel l s Canyon Dam which migrated at 60 km/day. Branded steel head released In the Grande Ronde River migrated slowly, averaging 9.3 km/day to the Snake River trap. Perhaps most of their migrating time was spent in the Grande Ronde River. However, Snake Rl ver discharge was relatively low during the week (May 12 to 18) prior to the median passage of the Grande Ronde steelhead at the Snake River trap.

Table 15. Travel times and migration rates for brand groups of steelhead migrating between release sites and the Snake River trap, 1985.

Release site	Distance travelled (km)	Dates Released	Dates 50% passage	Travel time (days)	Migration rate (km/day)	Brand
Sawtooth Hat.	722	4/9	5/7	28	25.8	RDY-1
E. Fk. Salmon R.	685	4/17	5/9	22	31.2	RDY-3
Hells Canyon	178	40/30	5/3	3	59.5	LDY-1
Grande Ronde-1	97	5/9	5/20	11	8.8	RA17-1
Grande Ronde-2	97	5/9	5/19	10	9.7	RA17-3

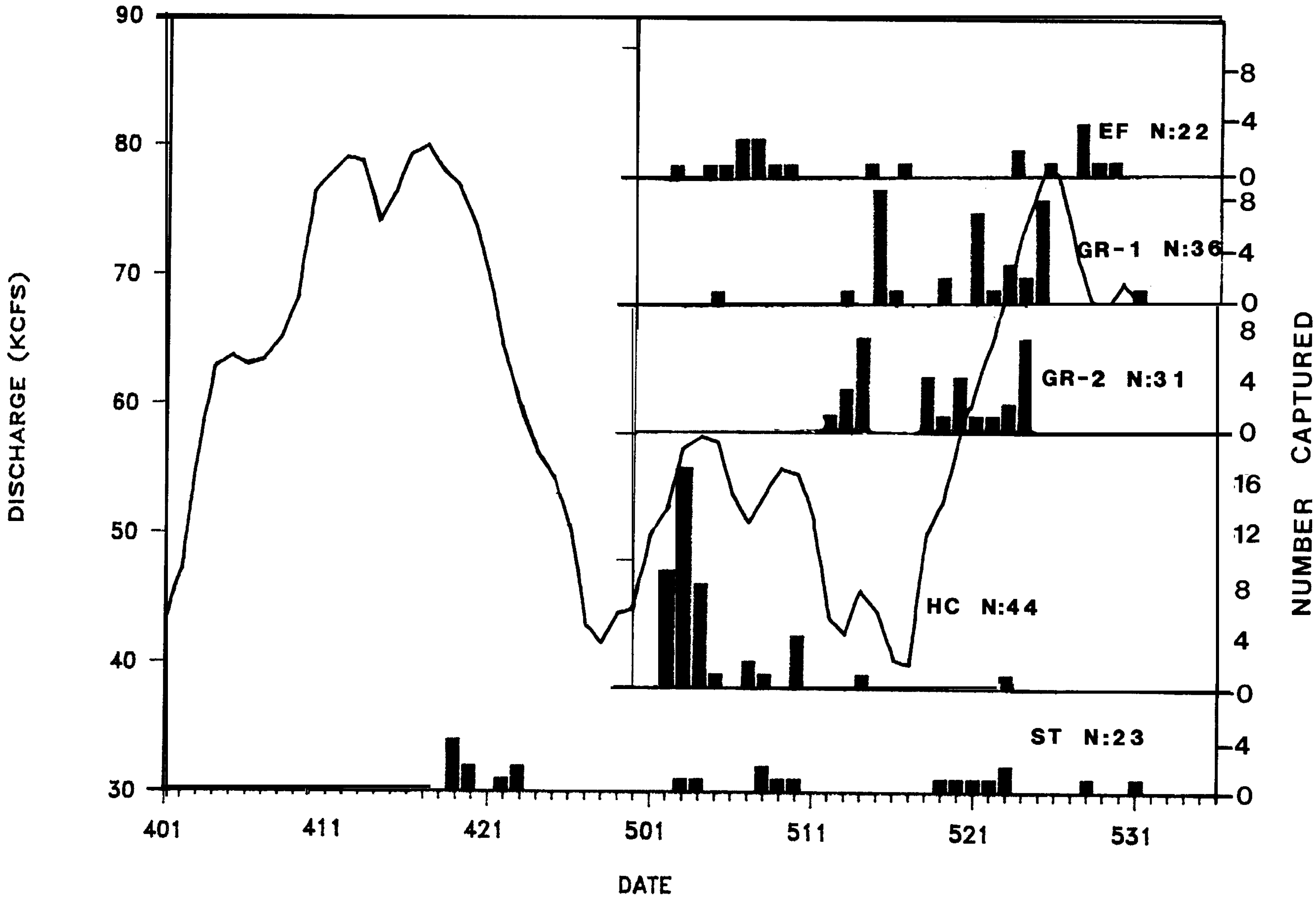

Figure 30. Daily Snake River trap recapture of five branded steelhead smolt groups overlayed by the Snake River hydrograph, 1985. Branded smolts were released at East Fork Salmon River (EF), Grande Ronde River (GR1 + GR2), Sawtooth Hatchery (ST), and Hells Canyon (HC).

Except for an early pulse of Sawtooth Hatchery branded steelhead (Fig. 30), there was little temporal overlap in the passage of branded yearling chinook and steelhead smolts at the Snake River trap, with most chinook passing in April and most steelhead in May. Passage of steelhead did not appear as dependent on rises in discharge as was seen with chinook.

In 1985, we released 20,528 branded chinook and 1,076 branded steelhead at the Salmon River trap for recapture at the Snake River trap and Lower Granite Dam. We recaptured 32 Salmon River trap branded chinook and zero steelhead at the Snake River trap. Based on the average Snake River trap efficiency (1.37%), for chinook, 2,336 (11.3%) of the Salmon River trap branded chinook passed the Snake River trap. However, the "passage index" for these branded chinook at Lower Granite Dam, 53 kilometers down reservoir from the Snake River trap was 3,801 smolts. This index would be 18.5% of the number released at the Salmon River trap, very similar to the 20.9% passage index for the five hatchery brand groups of chinook released upriver from Lower Granite Dam in 1985.

Thus, we may be observing no more than 61% of the Salmon River trap brands which enter the Snake River trap, assuming the passage index is probably less than actual passage (Sims, et al. 19841. This cou Id be due to the newness of the brands which become darker during the first few days after branding. The number of brands we recovered is marginal for documenting travel time for any of the brand groups (Table 16).

The limited data do indicate, however, that there is a relationship between river discharge and chinook salmon migration rate. There were seven release groups from which two or more branded smolts were recaptured, and from these, we calculated median migration rates (Table 17). It appears that chinook smolts migrated slowly in mid-March when Salmon and Snake River discharges were low (Figs. 8 and 16). In mid-April, smolts moved rapidly, coinciding with peaks in river discharge. When river discharge decreased near April 20, migration rate dropped dramatically. Migration rate was high again in early May, again corresponding with a rise in discharge.

In 1984 we branded 31,411 chinook at the Salmon River trap and recaptured 156 of them at the Snake River trap. From these returns, we calculated migration rates for 17 brand groups released between March 21 and May 7. Figure 31 depicts the migration rates and travel times of each brand group and is overlayed wlth the corresponding hydrographs of the Salmon River and the Snake River. It is apparent in this figure that migration rate and travel time are highly correlated with river discharge. Migration rates were slowest (and travel times longest) when discharge was least and fastest when discharge was greatest. Chinook migration rates between the Salmon River and Snake River traps ranged from near 8.3 km/day during the low water period of late March to near 83.3 km/day during the high water period in mid- to late-April. Migration rates rose and fell throughout the season In an apparent reaction to change in discharge.

Table 16. Statistics of chinook salmon smolts marked and released at Salmon River trap and recaptured at the Snake River trap in 1984 and 1985.

	Released	Recaptured	% returned	% of return expected[a]
Chinook				
1984	31,411	156	0.50	36
1985	20,528	32	0.16	11
Steelhead				
1984	3,066	4	0.13	26
1985	1,076	1	0.09	18

[a]Percent of expected return is the percent of return divided by trap efficiency where trap efficiency at the Snake River trap for chinook equals 0.0137 and for steelhead equals 0.0051.

Table 17. Mark end recapture statistics for chinook salmon smolts released at Whf tebf rd end recaptured et Sneke River trep end Lower Grsnfte Dam, 1985.

Median release date	Brand	Chf nook released	At Snake River trap: Number caught	At Snake River trap: Median passage	Rate	At Lower Granf te Dam: Est. passage	At Lower Granf te Dam: Median passage	Whf tebi rd to Lower Greni te Dam: Migration rete (mi Lea/day]	Whf tebi rd to Lower Greni te Dam: Travel time (days)
3-I 6	RDK-1	48	0		-			-	
3-22	LDK-4	306	4	411	5.1				
3-24	RDK-4	436	1	5-4	-	39	418	9.0	25
3-27	RAK-1	538	4	4-8	8.5	87	4-26	7.5	30
3-30	RAK-2	63	0						
4 3	RAK-3	566	1	4-16	-	278	4-20	13.2	17
4-6	RAK-4	3,350	0		-	186	418	18.7	12
4-8	LAK-1	6,056	8	4-I 1	34.1	887	4-22	16.0	14
4-11	LAK-2	4,527	3	414	34.1	871	4-25	16.0	14
4-14	LAK-3	1,635	0		-	530	5-03	11.8	18
4-17	LAK-4	828	2	4-18	102.2	59	5-02	15.0	15
4-20	ROM	273	4	5-3	7.8	109	5-04	16.0	14
4-23	RDE-2	420	1	5-3		294	5-10	13.2	17
4-26	RDE-3	303	1	5-7	-	93	5-07	20.3	11
4-30	RDE-4	538	1	5-2	-	31	512	18.7	12
5-2	RAE-1	380	2	5-4	51.1	48	5-I 5	17.2	13
5-7	RAE-3	172	0		-	16	5-22	15.0	15
5-9	RAE-4	86	0		-	16	5-22	17.2	13
5-12	LAE-1	3	0		-	——	-		
		20,528	32			3,604			

At Snake River trap: estimated passage = 32 - .0137[a] = 2338 = 11.4% of release

At Lower Granite Dam: 3,604 = 17.6%[b] of release

"Snake River trap efficiency for chinook smolts (1984 and 1985 average) is 1.37%.

[b]This survive1 estimate is increased to 18.5% by adding the incorrectly marked or read E and K brands ssen at Lower Granite Dam.

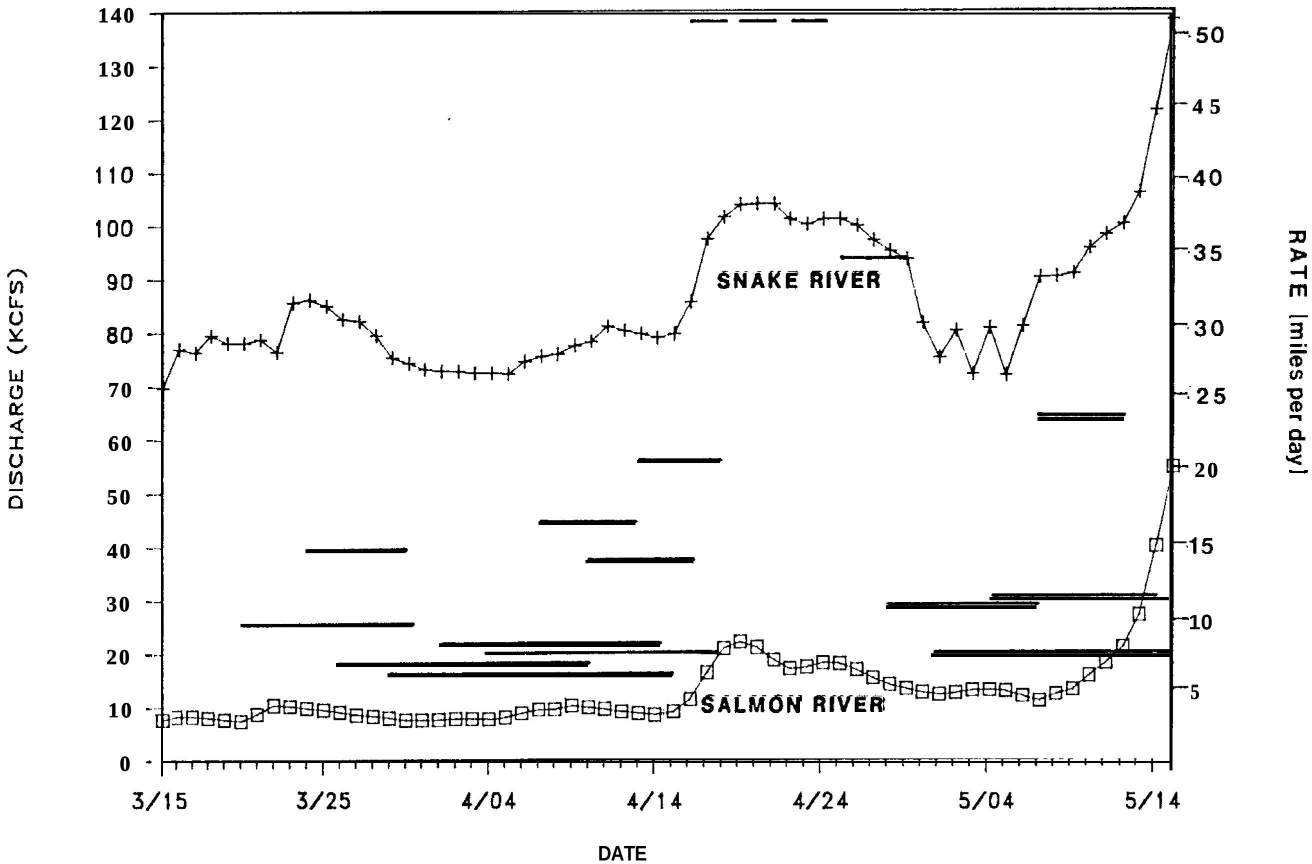

Figure 31. Relationship between migration rate and river discharge for 17 unique groups of branded yearling chinook salmon released at the Salmon River trap and recaptured at the Snake River trap in 1984. Line segments represent unique brand groups. Continuous lines are Snake and Salmon river hydrographs. Each line segment describes migration rate (vertical placement) and travel time (length of line).

If there had been 100% survival of the Salmon River trap branded chinook to the Snake River trap in 1985, we would have seen about 281 brands (20528 x 0.0138). With 100% survival and observance of all brands, we would have to brand about 700 smolts with an individual brand to expect to recapture 10 brands. More realistically, we would have to brand three to nine times that many if estimated survival to the Snake River trap is between the 34% of 1984 and the 11% of 1985. Thus, to assure a reasonable return from a brand group released at the Salmon River trap, it should contain at least 2,000 smolts. Of the 19 chinook release groups in 1985, only three contained greater than 2,000 smolts. It will be difficult to document, with precision, travel time for chinook from the Salmon River trap to the Snake River trap except during the peak of the chinook migration in mid-April.

We branded 1,076 steelhead at the Salmon River trap; the largest individual release group containing 274 smolts. In order to have adequate recaptures of steelhead smolts at the Snake River trap for travel time evaluation, the same argument for increased sample size as is given above for chinook applies except that for steelhead the sample size needs to be 2.7 times greater (or 5,400 fish) to compensate for the reduced trap efficiency at the Snake River trap (0.0051) which occurs for steelhead.

Although we captured none of the Salmon River trap branded steelhead at the Snake River trap, the Water Budget Center estimated that 179 or 16.6% of the Salmon River trap branded steelhead passed (passage index) Lower Granite Dam (Table 18). This is similar to the 18.4% mean passage value for the six hatchery branded groups of steelhead recorded at Lower Granite Dam in 1985.

Yearling chinook move out of the Salmon River in mass with the first significant rise in discharge in mid-April and complete their passage in small pulses associated with subsequent rises in discharge in late April and early May. Chinook enter Lower Granite Reservoir with the initiation of rising discharge in mid- to late-April. Heavy passage lasts five to ten days then decreases. Small pulses in chinook passage occur with subsequent increases in discharge. Discharge has only to increase sharply but not necessarily to high levels to cause major movement of chinook.

Clearwater River Trap

There was one group of branded chinook salmon released April 3 and 4 and one of branded steelhead released April 29 - May 3 in the Clearwater River in 1985. Both were released at Dworshak Hatchery, 57 kilometers upriver from the Clearwater trap. Median passage at the Clearwater trap was the day following release for each group (Fig. 32). River discharges for the chinook and steelhead groups were 17,300 cfs and 25,700 cfs, respectively. The Corps of Engineers increased discharge from Dworshak Reservoir to facilitate the rapid movement of the chinook group. Steelhead were also released when discharge was increasing.

Table 18. Steelhead marked and released at the Salmon River trap and their estimated passage at Lower Granite Dam, 1985.

Release dates	Brand	# released	Recapture date	Estimated passage
4/06	RAK-4	3		
4/08	LAK-1	6		
4/11	LAK-2	50		
4/14	LAK-3	40		
4/17	LAK-4	156	5/6	28
4/20	RDE-1	53		
4/23	RDE-2	274	5/6	116
4/26	RDE-3	149		
4/30	RDE-4	139		
5/02	RAE-l	136	5/9	35
5/07	RAE-3	31		
5/09	RAE-4	38		
5/12	LAE-1	1		
		1,076		179=16.6% survival

R9FS199JW

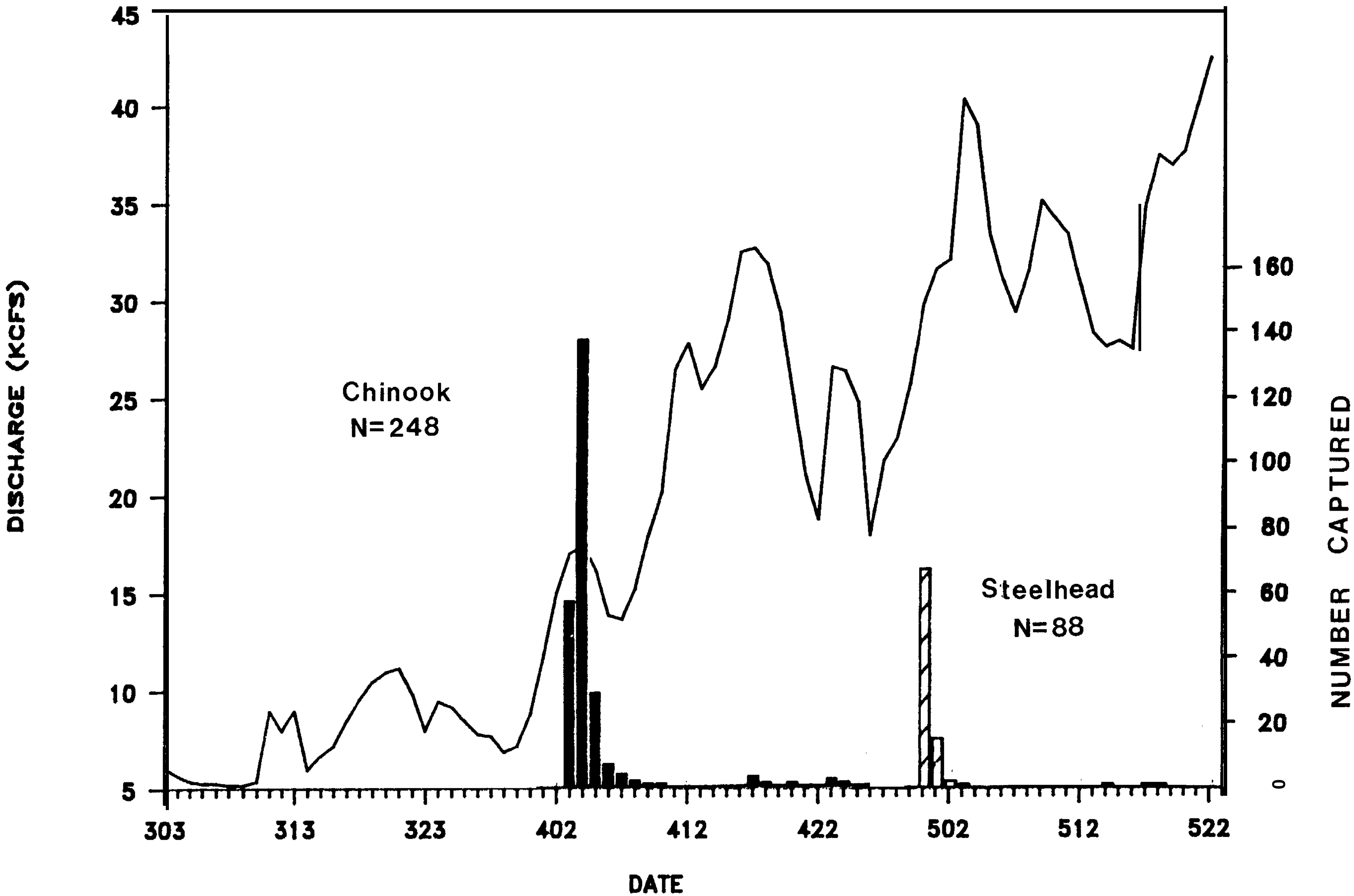

Figure 32. Daily Clearwater River trap recaptures of one branded yearling chinook salmon and one steelhead smolt group overlayed by the Clearwater River hydrograph at the Spaulding gauge.

Smolt Passage at Migrant Traps

Salmon River Trap

Based on the chinook salmon trap efficiency equation discussed in a previous section, we calculated that 2,713,800 yearling chinook smolts passed the Salmon **River** trap during the period of trap operation. This is a minimum passage **estimate** because there were days during the trapping season when the trap was down for repairs or moved out of the main channel due to excessive discharge, and the season was ended when **chinook were still passing the trap.**

Total release of hatchery-produced chinook upriver from the Salmon River was 3,863,580, but 47% of these were believed to have voluntarily left Rapid River Hatchery during the previous fal l, and many may have passed downriver from the Salmon River trap prior to spring.

We have no trapping efficiency estimate for steelhead at the Salmon River trap and thus, no estimate of steelhead passage.

Snake River Trap

We estimate that 3,409,000 yearling chinook and 1,666,000 hatchery steelhead passed the Snake River trap; 44% and 36% of hatchery releases, respectively. Some of the yearl ing chinook were wild, but it is assumed the wild component is a small part of the total migration.

We estimated that 233,000 wild steelhead passed the Snake River trap. if we assume the trapping efficiency for sub-yearling chinook and sockeye salmon are similar to that for yearl ing chinook, then 75,000 and 6,565 of these two groups, respectively, would have passed the trap.

Clearwater River Trap

We used average efficiencies calculated at this trap to estimate the number of smol ts passing during the period of trap operation. The trap was inoperable for **eight days in** April and two days in May prior to the end of sampling, so the estimate Is low. We estimated that **925,000 yearling chinook (hatchery and wild) and 402,000 hatchery steel** head passed the trap, 59% and 25% of hatchery releases, respectively. We also estimated that 41,071 wi ld steel head passed the trap.

SUMMARY

In addition to wild salmon and steelhead production, 9,425,000 chinook salmon and 6,194,000 steelhead smolts were reared at hatcheries in Idaho and in eastern Oregon and Washington for release upriver from Lower Granite Reservoir for the 1985 outmigration. Of these, 192,475 chinook and 208,765 steelhead smolts (2.3% and 3.4% of the total release, respectively) were freeze branded and released in six unique groups per species.

The Salmon River trap operated March 5 to May 20 and captured 26,458 yearling chinook, 146 wild steelhead, 989 hatchery-reared steelhead, and 7 sockeye. The Snake River trap operated March 14 until September 15 and caught 46,737 yearling chinook, 1,028 sub-yearling chinook, 1,189 wild steelhead, 8,497 hatchery steelhead, and 90 sockeye. The Clearwater River trap operated from March 1 until May 22 and captured 13,500 yearling chinook, 1,121 hatchery steelhead, and 115 wild steelhead. Percent of steelhead which were wild at these three traps were 12.9, 12.3, and 9.3%, respectively.

Of the 99,700 branded chinook and 66,900 branded steelhead released in the Salmon River, 645 (0.65%) and 4 (0.006%), respectively, were captured at the Salmon River trap. Chinook salmon migration rates to the Salmon River trap from the distant release sites of Sawtooth Hatchery and South Fork Salmon River, 553 kilometers and 257 kilometers above the trap, respectively, were similar and averaged 24.7 km/day over the three seasons of 1983, 1984, and 1985. Average migration rate for this period for chinook traveling from Rapid River Hatchery to the Salmon River trap (67 km) was 7.2 km/day. Average migration rate for branded chinook salmon between release sites on the Salmon River and the Salmon River trap increased each year from 1983 to 1985. The migration rate appears to be affected by how early the first rapid rise in Salmon River discharge occurs.

We trapped 1,138 branded chinook salmon and 156 branded steelhead smolts at the Snake River trap. Migration rate for branded chinook salmon migrating from the Salmon River trap to the head of the Snake River trap averaged 49.2 km/day in 1985, twice the rate upriver from the Salmon River trap (23.7 km/day). Smolts moving through this lower river stretch are in mid-migration and are generally riding a crest of rising discharge.

Because only four branded steelhead were caught at the Salmon River trap, we could not estimate travel time and migration rate for steelhead between the Salmon and Snake River traps. Average migration rate for steelhead between release sites and Snake River trap was 27 km/day; for yearling chinook the rate was 26 km/day. The relation between migration rate and discharge at the Snake River trap is difficult to quantify, but graphically, it appears that chinook smolts pass rapidly with the rises in discharge which occur in early to mid-April. Chinook smolts coming from Hells Canyon Dam were in the Snake River earlier and migrated much slower than those coming from the Salmon River.

There was little temporal overlap in the passage of branded yearling chinook and steelhead smolts at the Snake River trap, with most chinook passing in April and most steelhead passing in May.

We branded and released 20,528 yearling chinook and 1,076 steelhead for recapture at the Snake River trap and Lower Granite Dam. We recaptured 32 chinook and zero steelhead at the Snake River trap. Based on a passage index at Lower Granite Dam, we observed no more than 60% of the brands which entered the Snake River trap. Although data were few, migration rates for yearling chinook do appear to be influenced by Salmon and Snake River discharges. Rates range from 11.7 to 83.3 km/day with corresponding discharge from 8,000 to 20,000 cfs in the Salmon River and 75,000 to 105,000 cfs in the Snake River.

Median passage dates at the Clearwater trap for branded yearling chinook and steelhead smolts released at Dworshak NFH were the day following release (56.7 km/day).

The Salmon River trap efficiency for yearling chinook is affected by river discharge. An estimate of efficiency can be calculated based on the existing level of discharge at the Whitebird gage using the regression:

$$LnE = -3.501 - 0.085Q$$

Where: LnE=natural logarithm of the efficiency decimal; and Q=dishcarge divided by 1,000 cfs.

We had insufficient data to estimate efficiency for steelhead.

We could detect no correlation between discharge and trap efficiency at either the Snake or Clearwater River traps. Mean efficiencies for yearling chinook and steelhead at the Snake River trap were 0.0137 and 0.0051 and at the Clearwater River trap were 0.0146 and 0.0028, respectively.

We estimate that 2,713,800 yearling chinook passed the Salmon River trap, but we have no estimate of steelhead passage. At the Snake River trap, estimated passage was 3,409,000 yearling chinook, 1,666,000 hatchery steelhead, 233,000 wild steelhead, 75,000 sub-yearling chinook, and 6,565 sockeye. Passage of the latter two groups is based on the yearling chinook efficiency which may be similar for the three groups as they are all fish of small size.

We estimated that 925,000 yearling chinook, 402,000 hatchery steelhead, and 41,071 wild steelhead passed the Clearwater trap. Estimates at the Salmon River and Clearwater traps are undoubtedly low because they could not be operated continuously throughout the migration season due to high water velocities and trap breakdowns. The Snake River trap operated continuously through the season.

Average descaling rates for yearling chinook were 2.4, 2.6, and 0.6% at the Salmon River, Snake River, and Clearwater River traps, respectively. This differs from 1984 when yearling chinook descaling rate was much higher at the Salmon River trap than at the other two traps. Average descaling rates for wild steelhead smolts were 0.7, 0.8, and 0.7% at the Salmon River, Snake River, and Clearwater River traps, respectively, generally lower than in 1984. Average descaling rates for hatchery steelhead at the Salmon River, Snake River, and Clearwater River traps were 10.1, 6.2, and 2.1%. Descaling rate of hatchery steelhead at the Clearwater River trap decreased considerably from 1984, when the average rate was 4.1%.

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