STATE OF IDAHO
FISH AND GAME DEPARTMENT

John R. Woodworth, Director

Annual Progress Report

EVALUATION OF TRANSPLANTING MID-SNAKE SPRING CHINOOK SALMON TO RAPID RIVER HATCHERY

May, 1964 to May, 1966

By
Melvin Reingold
Fishery Biologist

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INTRODUCTION

Studies conducted at Brownlee and Oxbow Dams on the Snake River provided evidence that downstream migrant chinook salmon and steelhead trout were not passing through the reservoirs in sufficient numbers to maintain the runs. As a result of this information, a program was initiated to rear the offspring from the chinook salmon and steelhead trout entering the trapping facilities at Oxbow and Hells Canyon Dams in artificial propagation facilities. Idaho Power Company constructed at Rapid River artificial propagation and trapping facilities to handle the mid-Snake River spring chinook run.

In 1964 and 1965, chinook salmon and a part of the steelhead trout adults were taken from the trapping facilities at Oxbow Dam and hauled by tank truck to a holding pond located on Rapid River, a tributary to the Little Salmon River near Riggins, Idaho. These fish were held until ripe, spawned, and the eggs placed in incubators. The resulting juveniles were placed in raceways, reared to downstream migrant size and then released into the Salmon River via Rapid River. The 1964 brood-year juvenile salmon and steelhead were released in the spring of 1966.

An evaluation program was initiated to determine the success of rearing these fish in a hatchery and perpetuating the runs by releasing the smolts into Rapid River.

This report covers the period from May 13, 1964 to May 1, 1966.

FACILITIES

The initial construction of the Rapid River Hatchery facilities was completed in the summer of 1964. An upstream migrant velocity barrier and trapping facilities in Rapid River to be used in the evaluation were completed during the winter of 1964-65. The main hatchery facilities consist of the hatchery building, raceways, holding pond, storage shed, public toilet facilities, and two dwellings for hatchery personnel (Figure 1).

Hatchery Building

The main hatchery building is 23 feet wide by 60 feet long and contains a garage, freezer room, incubator room, workshop, and laboratory and office facilities (Figure 2). The freezer room has a capacity of 40,000 pounds of fish feed.

The incubator room presently contains 10 Heath upright incubators which have a capacity of 1,300,000 salmon eggs. There is room and hookups for four more stacks.

Raceways

Rearing facilities consist of 12 concrete raceways 100 feet long by 6 feet wide by 4 feet deep (Figure 3) with a capacity of approximately 30,000 pounds of fish or approximately 800,000 juvenile salmon. Water level in the raceways was varied from 14 to 38 inches depending on the size of the fish. Lower levels were used for feeding small fry.

Adult Holding Pond

A concrete pool, 25 by 80 by 6 feet (8,800 cu. ft.) is used to hold fish prior to taking eggs (Figure 4). It has a capacity for holding approximately 800 adult salmon. River water enters the holding pond from three sources: two

Figure 1. Rapid River Hatchery. Facilities also include picnic area with two picnic benches and public toilets. Upper buildings are dwellings.

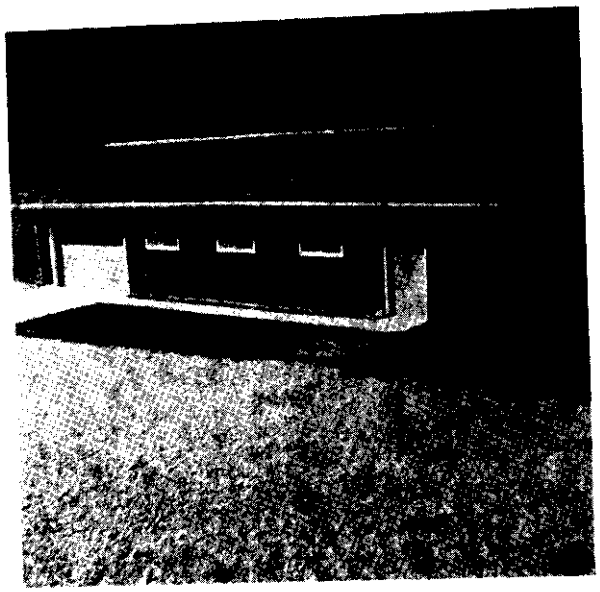


Figure 2. The 23 by 60 foot hatchery building contains a garage, a 40,000-pound freezer room, incubator room, workshop, laboratory, and office.

Figure 3. Concrete raceways at the Rapid River Hatchery.

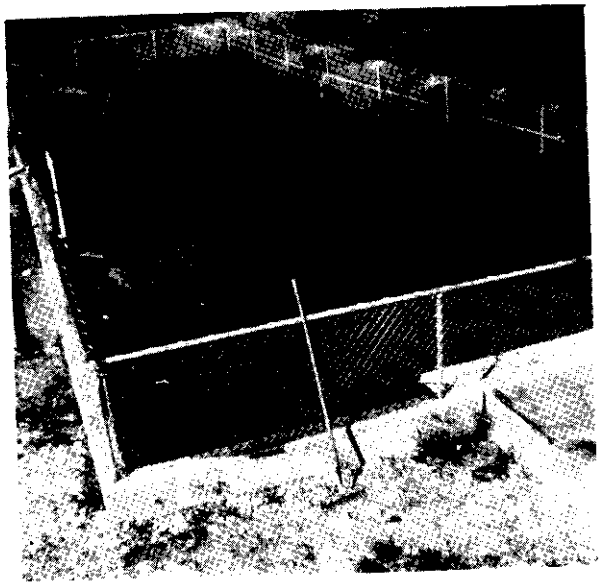


Figure 4. The adult holding pond at Rapid River Hatchery. The water spray is used for oxygenation and to create cover by breaking up the surface of the pond.

wall inlets and a floor diffuser. When adult salmon are in the pond, most of the water is piped through the floor diffuser. This effectively prevents the fish from leaping at the wall inlets and injuring themselves.

Water Supply Systems

Water for hatchery operations is taken directly from Rapid River. Flows to the raceways and holding pond enter a 30-inch intake pipe approximately 100 yards upstream from the hatchery. A rotary screen mechanism prevents trash and debris from entering the pipe.

The water supply for the incubators is drawn from Rapid River through a buried perforated six-inch pipe approximately 300 yards upstream from the hatchery. A compressed air tank is hooked into the six-inch line through a series of pipes and valves and is used periodically to clear the line of accumulated silt by reversing the flow in the pipe. In June of 1965, the first pipe laid was broken by flood waters and land slides. A new stronger pipe was laid in the summer of 1965.

The Rapid River Hatchery also has a well system which provides water for domestic use and as an emergency supply for the incubators in case of the failure of the normal supply. Temperature of this water is 51° F. Dissolved oxygen content is 5 ppm which is marginal for hatchery use.

Rapid River temperatures range from 32.5° F. during the winter to a recorded high of 55.5° F. during the summer months. In 1965, the minimum recorded flow was 85 cfs on December 16 (Table 1) and the maximum recorded flow was 1,065 cfs on June 16. This latter flow level is higher than the normal spring runoff flow levels and caused considerable damage at the hatchery and evaluation facilities.

Table 1. Gage board readings at Rapid River fish evaluation velocity barrier, April through December, 1965.

Day	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1		2.00	2.45	1.80	1.20				0.70
2			2.40	1.80	1.20	0.95		0.80	0.70
3		1.80	2.50		1.20				
4		1.60	2.70	1.80	1.30	0.95			
5			2.75		1.25			0.80	0.70
6		1.45	2.90	1.80	1.20	0.95		0.80	0.70
7		1.40	2.90	1.80	1.15			0.80	
8		1.30		1.80	1.15	0.90	0.85		
9				1.80	1.15			0.80	0.70
10		1.30		1.70	1.15	0.90		0.80	0.70
11		1.30	flood	1.70			0.80		
12					1.15		0.80	0.80	
13		1.55			1.10				0.70
14		1.70							
15		1.75		1.55	1.10	0.90		0.80	0.65
16		2.00	3.30	1.50				0.80	
17		2.00	2.40	1.50	1.10				
18		1.90	2.40	1.50			0.80		
19		1.85		1.50	1.00		0.80		
20	1.40			1.45			0.80		
21	1.50		2.40		1.00		0.80		
22	1.35			1.40			0.80	0.75	
23		1.85	2.30	1.40	1.00			0.75	
24		1.85	2.30	1.40	1.00				
25		1.80	2.30	1.35			0.80	0.75	
26		1.80		1.35	1.00		0.80	0.75	
27		1.75	2.00	1.30			0.80		
28	1.50	1.85		1.30	1.00		0.80		
29	1.70		1.90	1.30				0.70	
30		2.40		1.25	1.00			0.70	0.65
31				1.20	1.00				

Refer to gage conversion table to interpret gage readings to cubic feet per second (Appendix Table 1).

Velocity Barrier

The velocity barrier and its associated facilities (Figure 5) are located approximately two miles downstream from the hatchery site. The velocity barrier consists of a wooden dam four feet high with a sloping floor immediately downstream. The velocity of the water over the floor is sufficient to prevent any upstream migration of fish (approximately 25 feet per second depending on flows). A few feet downstream from the barrier is the entrance to the bypass channel around the barrier. Fish entering the bypass channel swim into the upstream migrant trap.

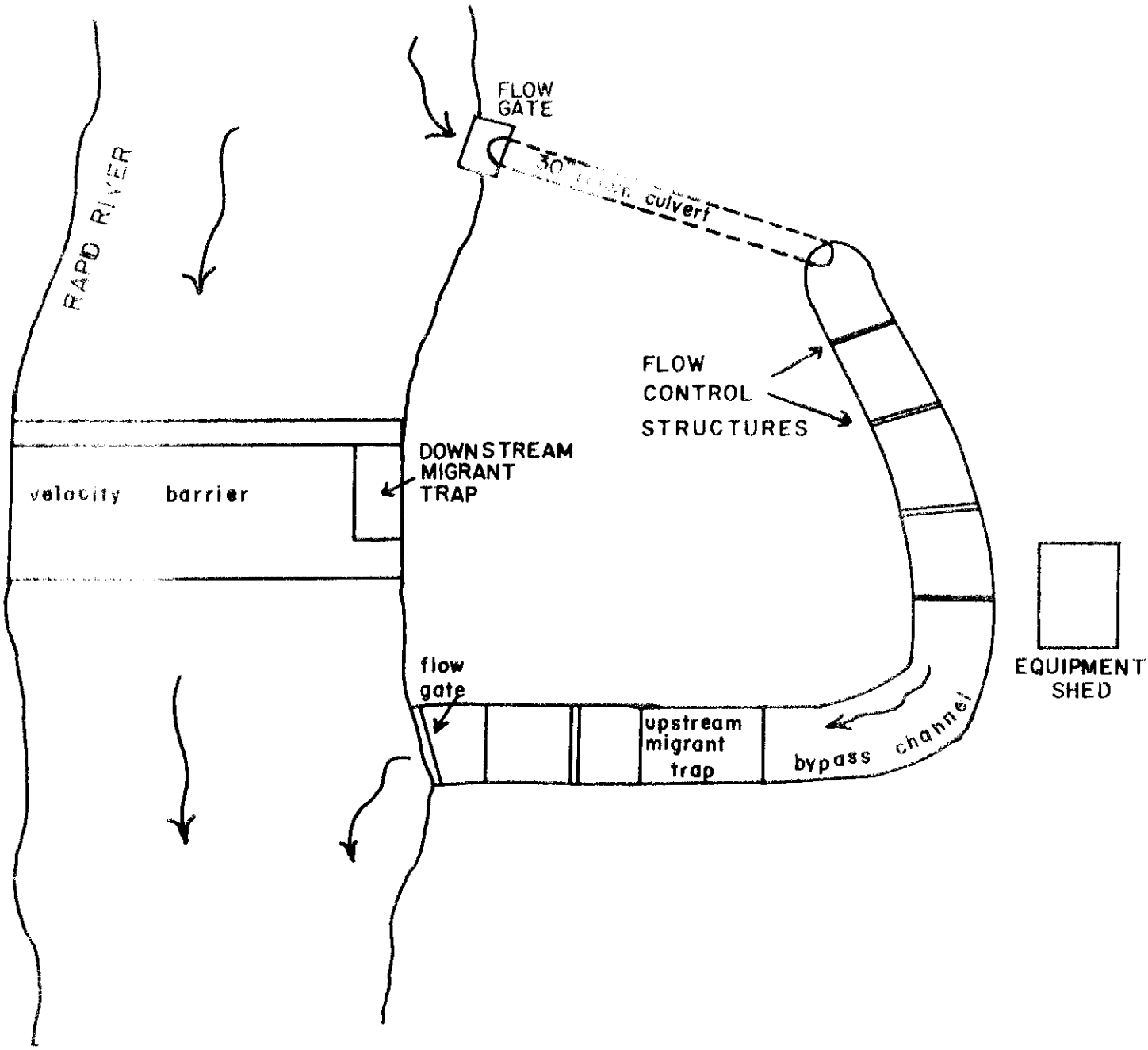
Upstream Migrant Trap

The upstream migrant trap consists of a wood box structure approximately 10 by 15 feet. A finger weir prevents fish from returning downstream. A false floor made of steel angle iron and aluminum hurricane fencing can be hand cranked up from the floor to raise the fish into view. The fish are released through a sliding headgate, counted and measured as they pass through a marked trough. They are then free to return to the river via the bypass channel and return culvert (Figure 5).

The only major problem encountered at the upstream trapping facilities was that of adult salmon and steelhead getting under the false floor through excess space along the sides. This problem was effectively solved by the addition of rubber belting around the edge of the floor.

Downstream Migrant Trap

The downstream migrant trap is located on the north side of the velocity barrier (Figure 5). It is basically an inclined screen type trap. It can be raised or lowered with hand cranks and adjusted to fit water flows. It



RAPID RIVER FISH ENUMERATION FACILITIES (LAYOUT)

Figure 5. Schematic representation of Rapid River velocity barrier and fish enumeration facilities. Upstream migrants, unable to negotiate the velocity barrier, enter the bypass channel and upstream migrant trap.

is fished on the crest of the velocity barrier.

The original downstream migrant trap installed in the spring of 1965 was damaged during the June 1965 flood and was replaced in October of 1965. The original trap was mounted on two 8 by 8 timbers jutting out at right angles from the north wall across the floor of the velocity barrier. Drifting logs snapped these outrights off during the flood and the base of the trap was damaged beyond repair. The replacement trap was mounted flush to the side of the velocity barrier. Adjustment is by a hand-cranked gate valve adapted for that purpose and mounted to the side of the barrier. It is presently working satisfactorily.

Bypass Channel

The bypass channel constitutes a route around the velocity barrier that can be negotiated by fish. Water control structures consisting of wooden 2 by 6 gate boards in slots create a series of seven pools. There was no problem with adult salmon and steelhead failing to move through this channel and the return culvert (Figure 5) back into Rapid River.

The only major problem encountered with this system was the excessive deposition of sand and gravel in the pools. Deposition occurred mainly during high-water periods. In time the pool structure below each flow control gate would be filled with sand and gravel (Figure 5). It also settled in the upstream trap. Periodically the gravel and sand was removed with a backhoe and the upstream trap washed out with a high pressure pump and hose.

METHODS

Adults

Adult salmon and steelhead were both handled at Rapid River Hatchery in 1964 and 1965. Normal procedure was to hold the adult fish in the holding

pond until eggs were ripe. Ripeness was determined by physical inspection of each fish. The fish were normally checked for ripeness three times each week (Figure 6).

Eggs were taken from adult steelhead by stripping the body. The fish were first anesthetized with Tricaine Methanesulphonate - MS_{222}. After taking eggs, the steelhead were released alive in Rapid River.

Ripe female salmon were killed by a blow on the head and the artery was severed at the caudal peduncle to prevent bleeding into the egg-taking bucket (Figure 7). An incision was made from the vent at the base of the pectoral fins and the eggs were shaken into a container (Figure 8). Milt was then added to the eggs (Figure 9). Normally the milt of two males was used to fertilize the eggs of five females. The fertilized eggs were then washed of excess milt, counted by the displacement method, and placed in the incubators.

To inhibit the growth of parasitic fungi on adult salmon, the holding pond was treated with one ppm of Victoria green solution for one hour daily.

Juveniles

Buttoned-up fry were taken from the incubators and placed in the outdoor raceways. They were fed Oregon moist pellets. The amounts and number of times fed was determined from a precalculated feeding chart and depended upon the size and poundage of fish and temperature of the water.

Newly-hatched fry were placed in 14 inches of water in the raceways, approximately 100,000 per raceway. They were fed generally six times per day. As the fish grew and learned to accept the feed, the water level was increased and the numbers of fish in each raceway reduced. As the fish approached smolt size, each raceway held approximately 50,000 fish in 38 inches of water. The fish were fed three times each day. Size of the feed ranged from 1/32 to 1/8

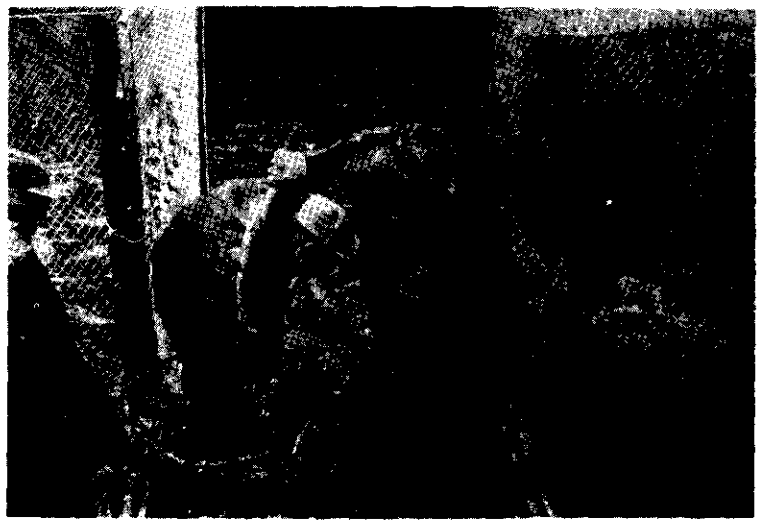


Figure 6. Adult mid-Snake spring chinook being sorted for ripeness at Rapid River Hatchery.

Figure 7. Ripe salmon were killed with a blow on the head and the artery was severed at the caudal peduncle to prevent bleeding into the egg bucket. A special knife is used to incise the fish from the vent to the pectoral fins. The eggs are then shaken out.

Figure 8. Ripe salmon eggs are shaken from the ovaries of an incised spring chinook.

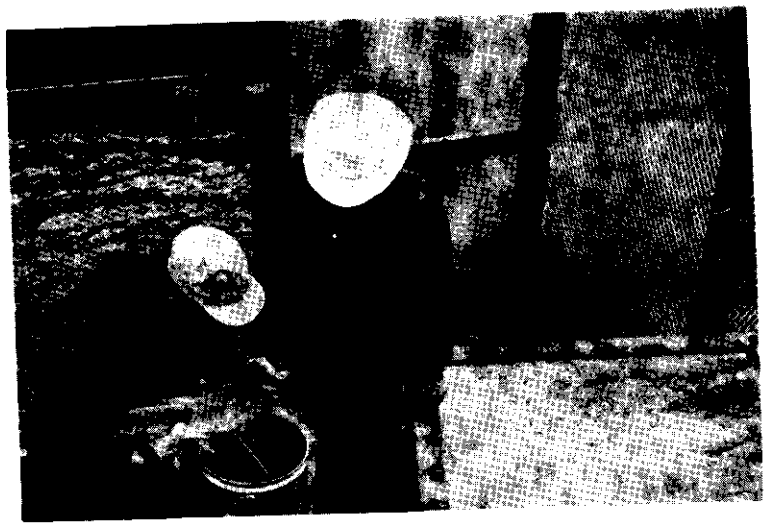


Figure 9. Milt from a ripe male salmon is added to the eggs. The fertilized eggs are then stirred, rinsed of excess milt and placed in incubators.

inch in diameter and was varied according to the size of the fish.

There was some loss of juvenile salmon and steelhead due to flooding of Rapid River. During the latter part of December, 1964, an unseasonal flood caused the loss of approximately 12,000 chinook fry and 3,200 steelhead fingerling. The loss of the salmon was from suffocation from loss of water supply; they were in a holding trough in the incubator room. Loss of the steelhead was caused by raceway screens bursting from extreme amounts of trash and debris being brought down by the river. The rotary screens were unable to cope with the high flows and had to be raised to prevent complete loss of the water supply to the hatchery.

Extreme flooding in June of 1965 caused severe damage at the hatchery and evaluation facilities (Figures 10-15). Approximately 100,000 salmon fingerlings were lost during this period. Observation of these fish indicate they were mostly substandard scrubs and pinheads that were weak fish and not capable of withstanding the high turbidity of the water. Experience indicates that these fish would most likely have been lost to natural mortalities in event the flood had not occurred.

FISH HANDLED AT HATCHERY

Spring Chinook Salmon

1. Adults

A. 1964 Brood-year

Two hundred fifteen female and 134 male spring chinook salmon were handled at Rapid River Hatchery in 1964. Approximately 25 percent of the males were jack salmon, age 3_2. Eighteen females (8 percent) and 39 males (29 percent) died prior to being spawned. Mortality appeared to be directly connected with fin deterioration and consequent invasion of parasitic fungi. The holding

The amount of food to feed rainbow trout per day, in per cent of body weight, for different size groups, held in water of different temperatures.

NUMBER OF RAINBOW TROUT PER POUND

Water Temp. (F.)	-2542	2542-304	304-88.3	88.3-37.8	37.8-19.7	19.7-11.6	11.6-7.35	7.35-4.94	4.94-3.47	3.47-2.53	2.53-
	APPROXIMATE SIZE IN INCHES										
	-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-
36	2.7	2.2	1.8	1.3	1.0	0.8	0.7	0.6	0.5	0.45	0.4
37	2.8	2.3	1.9	1.4	1.1	0.9	0.7	0.6	0.5	0.45	0.4
38	2.9	2.4	2.0	1.5	1.1	0.9	0.7	0.6	0.6	0.5	0.5
39	3.0	2.5	2.0	1.5	1.2	0.9	0.8	0.7	0.6	0.5	0.5
40	3.2	2.6	2.1	1.6	1.3	1.0	0.8	0.7	0.6	0.5	0.5
41	3.3	2.8	2.2	1.7	1.3	1.0	0.9	0.7	0.6	0.6	0.5
42	3.5	2.9	2.3	1.8	1.3	1.1	0.9	0.8	0.7	0.6	0.5
43	3.6	3.0	2.4	1.8	1.4	1.2	0.9	0.8	0.7	0.6	0.6
44	3.8	3.1	2.5	1.9	1.4	1.2	1.0	0.9	0.7	0.7	0.6
45	4.0	3.3	2.7	2.0	1.5	1.2	1.0	0.9	0.8	0.7	0.6
46	4.1	3.4	2.8	2.1	1.6	1.3	1.1	0.9	0.8	0.7	0.6
47	4.3	3.6	2.9	2.2	1.6	1.3	1.1	0.9	0.8	0.7	0.7
48	4.5	3.8	3.0	2.3	1.7	1.4	1.2	1.0	0.9	0.8	0.7
49	4.7	3.9	3.2	2.4	1.8	1.4	1.2	1.0	1.0	0.8	0.7
50	5.0	4.2	3.3	2.5	1.9	1.5	1.3	1.1	1.0	0.8	0.8
51	5.2	4.3	3.4	2.6	1.9	1.6	1.3	1.1	1.0	0.8	0.8
52	5.4	4.5	3.6	2.7	2.0	1.6	1.4	1.2	1.0	0.9	0.8
53	5.6	4.7	3.8	2.8	2.1	1.7	1.4	1.2	1.1	1.0	0.9
54	5.8	4.9	3.9	2.9	2.2	1.8	1.5	1.3	1.1	1.0	0.9
55	6.1	5.2	4.1	3.1	2.3	1.9	1.5	1.3	1.2	1.0	0.9
56	6.4	5.3	4.3	3.2	2.4	1.9	1.6	1.4	1.2	1.1	1.0
57	6.7	5.5	4.5	3.4	2.5	2.0	1.7	1.4	1.3	1.1	1.0
58	7.0	5.8	4.7	3.5	2.6	2.1	1.8	1.5	1.3	1.2	1.1
59	7.3	6.0	4.9	3.6	2.7	2.2	1.8	1.6	1.4	1.2	1.1
60	7.6	6.3	5.1	3.8	2.8	2.3	1.9	1.6	1.4	1.3	1.2
61	7.9	6.5	5.3	4.0	3.0	2.4	2.0	1.7	1.5	1.4	1.3
62	8.2	6.7	5.5	4.2	3.2	2.5	2.1	1.7	1.6	1.4	1.3
63	8.5	7.0	5.7	4.4	3.4	2.6	2.1	1.8	1.6	1.5	1.4
64	8.8	7.2	5.9	4.6	3.5	2.7	2.2	1.9	1.7	1.5	1.4
65	9.1	7.5	6.1	4.8	3.6	2.8	2.2	2.0	1.7	1.6	1.5

Data from the Feeding Charts were used in compiling the above table. The values given are probably not perfect. However, the table may serve as a very useful guide in the hatchery daily feeding practice.

Figure 10. Rapid River during flood, June, 1965. Approximately 1,065 cfs.

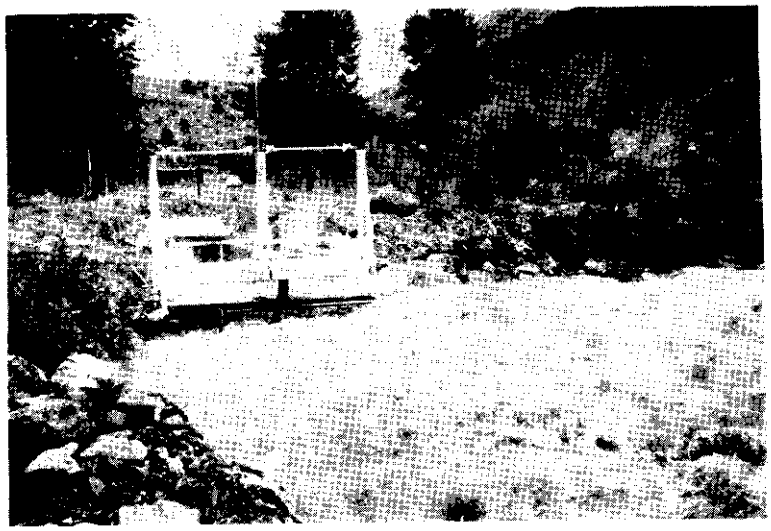


Figure 11. Screened intake system was rendered inoperable during flood. Rapid River Hatchery, June, 1965. Additional trash racks have been added since.

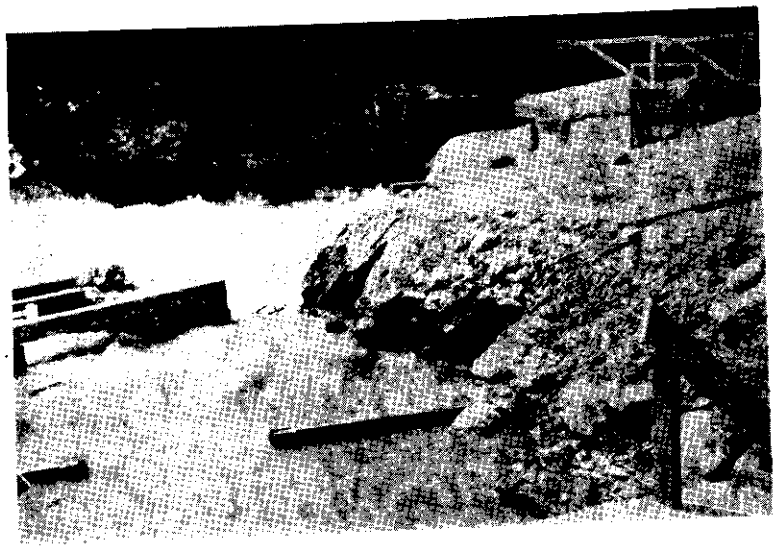


Figure 12. Right side of bypass channel entrance was washed out by extreme flow of Rapid River. June, 1965.

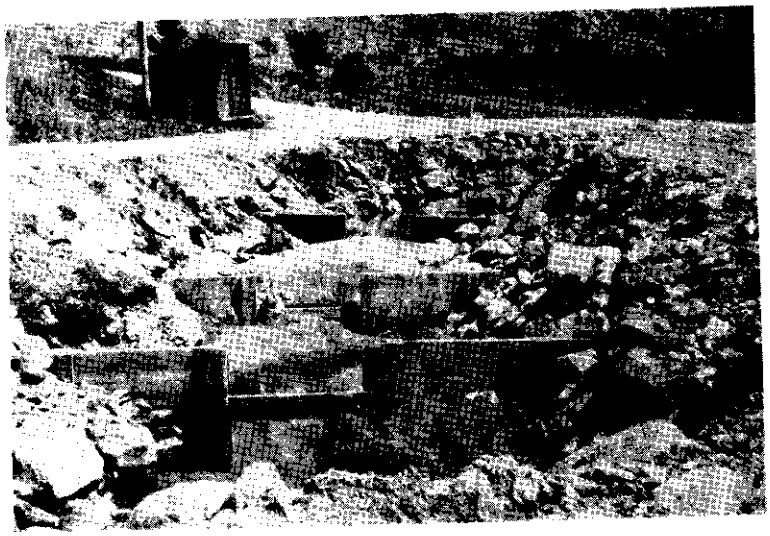


Figure 13. High Rapid River flows deposited large amounts of sand and gravel in bypass channel pools. A backhoe was used to remove debris.

Figure 14. Flood waters in June, 1965, cut access road to Rapid River Hatchery and came within 18 inches of flooding hatchery facilities.

Figure 15. Velocity barrier showing flow of over 1,000 cfs during flood. Damaged downstream migrant trap is hanging from upright winch stands. Entrance to bypass channel is seen at lower right.

pond was treated daily with one ppm Victoria green for one hour.

The 197 remaining females yielded an estimated (von Bayer method) 887,616 eggs. This was an average of 4,505 eggs per female.

B. 1965 Brood-year

In 1965, 408 spring chinook adults were handled at Rapid River. Of these fish, 178 were females and 230 were males. Approximately 25 percent of the males were jacks. There was a prespawning mortality of 45 females (25 percent) and 57 males (24 percent).

The remaining 133 females yielded 603,800 eggs for an average of 4,540 eggs per female.

II. Juveniles

A. 1964 Brood-year

Approximately 92 percent of the 887,616 eggs taken from 1964 year class spring chinook survived to the eyed egg stage. Survival to the fry stage was 85.5 percent (Table 2). An estimated 588,000 smolt-size fish were released in the spring of 1966 for a survival from egg to smolt of 66.2 percent.

Growth rates for 1964 brood-year spring chinook salmon are presented in Figure 16. Due to the low water temperatures of Rapid River, growth rates were low compared to some other hatchery installations with warmer water. The 1964 brood-year chinook grew an average of 81 millimeters in 15 months of rearing at Rapid River Hatchery.

In March, 1966, 51,180 1964 brood-year chinook (approximately 10 percent of the entire lot of these fish at the hatchery) were marked by removing the left pectoral fin. These fish were released beginning on March 31.

To determine the proper time of release of these chinook, a simple screen trap was built and installed at the foot of one raceway containing

Table 2. Summary of details on adult steelhead and chinook salmon and their progeny handled at the Rapid River Hatchery, May 12 to December 31, 1964.

		Steelhead	Spring chinook	Fall chinook
1.	Number of fish received from Oxbow fish trap	10F 3M	349 - 215F 134M	57 - 12F 45M
2.	Transportation loss	none	1 2/	none
3.	Total number of days in holding pond	(5/13-5/29 16	(5/12-9/14) 115	(9/27-11/16) 51
4.	Holding pond loss	none	57 - 18F - 39M	14 - 4F 10M
5.	First female spawned	5-21-64	8-26-64	10-28-64
6.	Last females spawned	5-29-64	9-14-64	11-16-64
7.	Number of eggs taken	21,165 est.	887,616 est.3/	25,644 est.
8.	Percent survival to eye-up	95	92	89
9.	Percent survival to fry stage	79.5	85.5	4/
10.	Natural loss (disease, parasites, etc.)	7,079	276,444	
11.	Other loss (flood damage, etc.) 1/	3,205	12,000	
12.	Number of progeny on hand (December 31, 1964)	4,814 est.	599,172 est.	

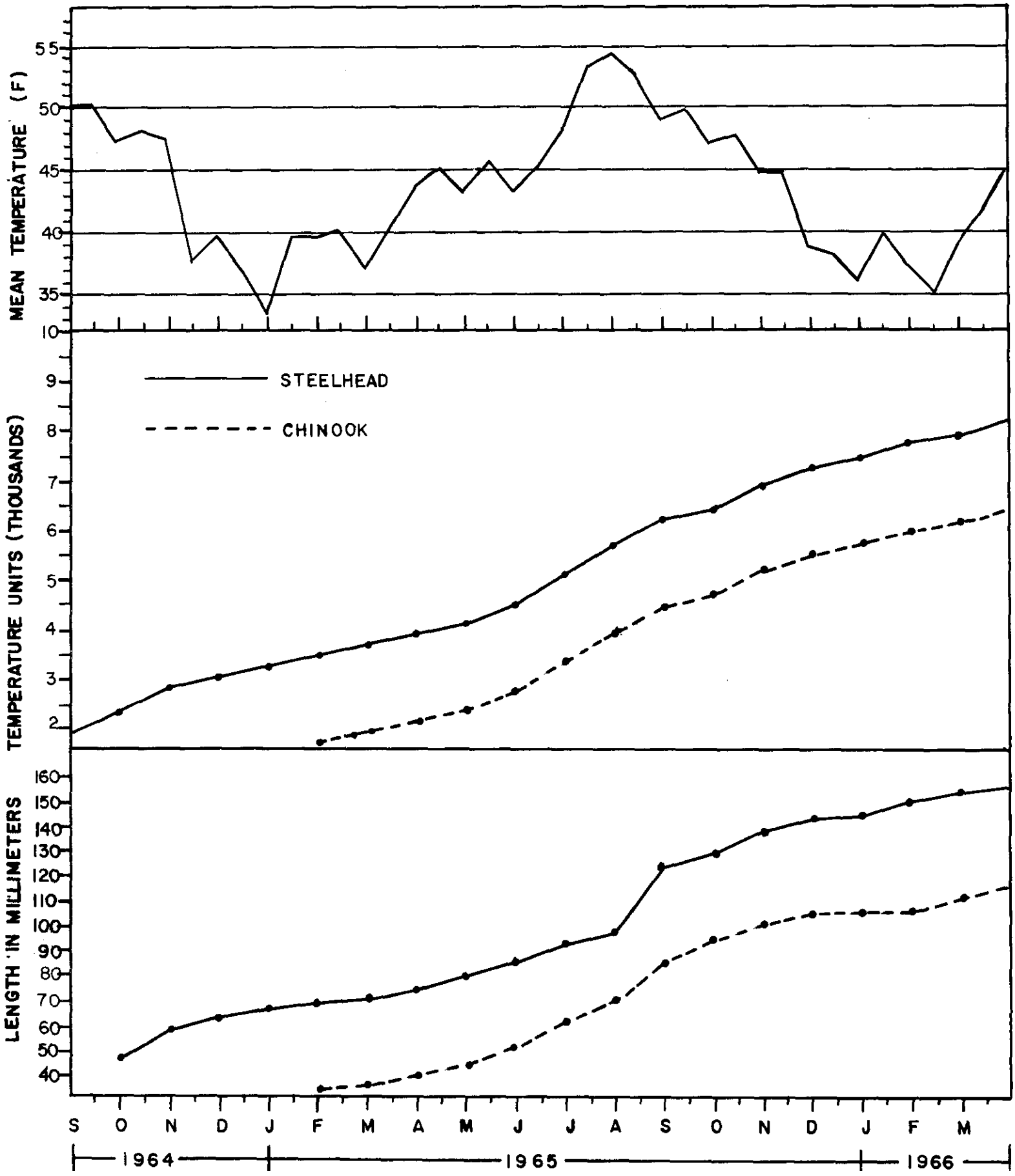
1/ About 25 percent of the fish lost from the hatchery during damaging floods were not killed, but escaped from the hatchery raceways and troughs.

2/ This one chinook salmon was transported to the hatchery in a normally unused small tank on the bed of a pickup truck. This was the only transportation fatality. The rest of the chinook were brought to the hatchery in the large Brownlee fish transportation trucks and there was no loss.

3/ Estimates of egg numbers were obtained with the use of a von Bayer egg measuring trough.

4/ The eyed-up fall chinook eggs were delivered to Oxbow Hatchery.

Figure 16. Length in millimeters, accrued temperature units, and mean water temperatures during growth of juvenile steelhead and chinook salmon at Rapid River Hatchery, September, 1964 through March, 1966.



approximately 50,000 smolts. The raceway screen was removed and fish were allowed to leave the raceway at will. Movement occurred only at night. During the first half of March, catches averaged around 50 fish a night except for a burst of fish on March 11. On March 29 catches suddenly increased to about 500 for three consecutive nights and the trap was removed (Figure 17). Outlet screens on all raceways were then removed and the smolts allowed to leave when they desired.

The downstream migrant trap at the velocity barrier was operated prior to and during the release of the 1964 brood-year salmon smolts. Trap catches increased from catches of wild fish of less than 30 per night to over 4,000 hatchery-reared smolts per night. Catches remained high throughout April as the hatchery-reared smolts left the raceways and diminished steadily through the month of May until the trap was removed from operation on May 20 due to high water. Hatchery-reared salmon were captured at the downstream migrant trap the same day they were released.

B. 1965 Brood-year

Of the 603,800 eggs taken from the 1965 brood-year adult spring salmon at Rapid River Hatchery, 94 percent survived to eye-up (Table 3). From eye-up to fry stage, survival was 93 percent. As of May 1, 1966, there was an estimated 560,000 1965 brood-year chinook salmon fingerlings at Rapid River Hatchery. Present plans are to release these as smolts in the spring of 1967.

Fall Chinook Salmon

1. Adults

In September, 1964, 57 fall chinook salmon were brought from Oxbow Dam and put in the Rapid River holding pond. Attempts to hold and

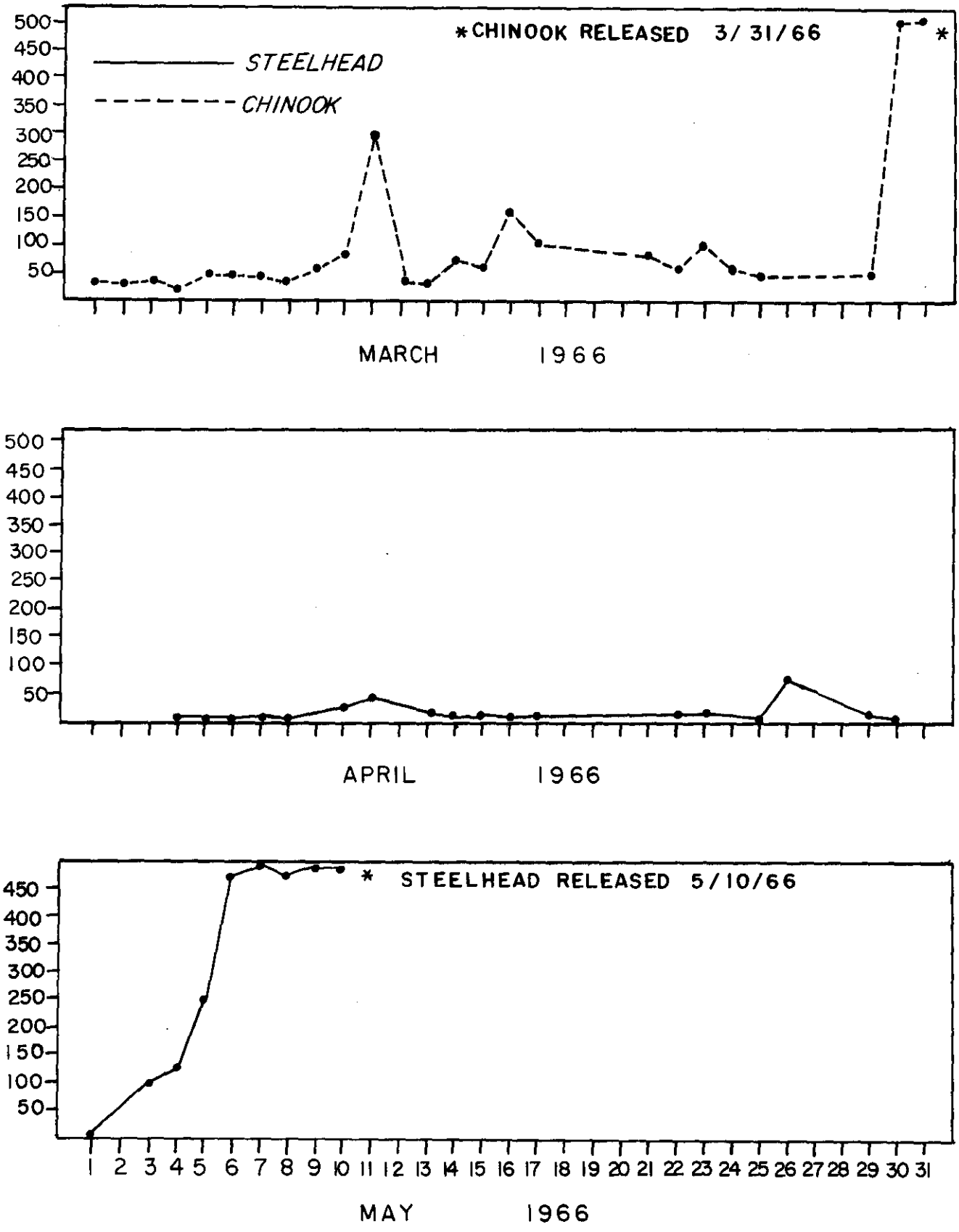


Figure 17. Rapid River raceway trap catches of 1964 brood-year mid-Snake steelhead and spring chinook. The fish were released when sustained increases in trap catches indicated their desire to migrate. The steelhead were released forty days later than the salmon.

Table 3. Summary of details on adult steelhead and chinook salmon and their progeny handled at the Rapid River Hatchery, January 1 to December 31, 1965 and January 1 to April 1, 1966.

		Fall-run steelhead	Spring-run steelhead	Spring chinook
1.	Number of fish received from Oxbow fish trap	57 1/	162 - 82F 80M	408 - 178F 230M
2.	Transportation loss	none	none	none
3.	Total number of days in holding pond	(9/26/64-6/8/65) 255 days	(4/12-6/8) 57 days	(5/13-9/13) 124 days
4.	Holding pond loss	57	none	102 - 45F 57M
5.	First female spawned	--	(4/27/65)	(8/20/65)
6.	Last female spawned	--	(6/8/65)	(9/13/65)
7.	Number of eggs taken	--	217,020	603,800 est.
8.	Percent survival to eye-up		92	94
9.	Percent survival to fry stage (December 31, 1965)		2/	93
10.	No. fish on hand (May 1, 1966)			560,000 est.

1/ The fall-run steelhead held at Rapid River Hatchery over the winter of 1964 - 65 failed to mature and produce viable eggs or milt. The majority of these fish died in the holding pond and the remainder were released into Rapid River.

2/ The 1965 brood year eyed-up steelhead eggs were sent to Hagerman Fish Hatchery.

artificially spawn these fish were not successful. Thirty-three percent of the females and 37 percent of the males (excluding jacks) died prior to spawning. The cause of mortality did not appear to be any excess of deterioration or fungus infestation. Most of the deceased fish appeared to be in relatively good physical shape.

Upon taking eggs from what appeared to be ripe females, it was found that approximately one-quarter of all the eggs in each female salmon failed to ripen and a large number of dried-out eggs appeared scattered throughout the ovaries. It is believed that the large difference in water temperatures between Rapid River where these fish were held and the Snake River where they normally would spawn may be the cause of this holding mortality and loss of eggs. An average of only 2,137 viable eggs were obtained from each fall chinook female.

The fall chinook were held at Rapid River for 51 days. During this period, they accumulated 676 temperature units. Had these fish remained in the Snake River during this same period, they would have accrued 1,439 temperature units (Figure 18). These fish received less than half the number of temperature units at Rapid River than if they had been in the Snake River during this length of time.

On the basis of these findings, it was decided that fall chinook would not be handled at Rapid River in the future. All fall chinook would be handled at the Oxbow Hatchery located on the Snake River near Oxbow Dam.

Steelhead Trout

The steelhead trout that spawn in Idaho enter the lower Columbia in July-September as "summer steelhead." The first part of that run enters Idaho in the fall months. During the winter months, very little upstream move-

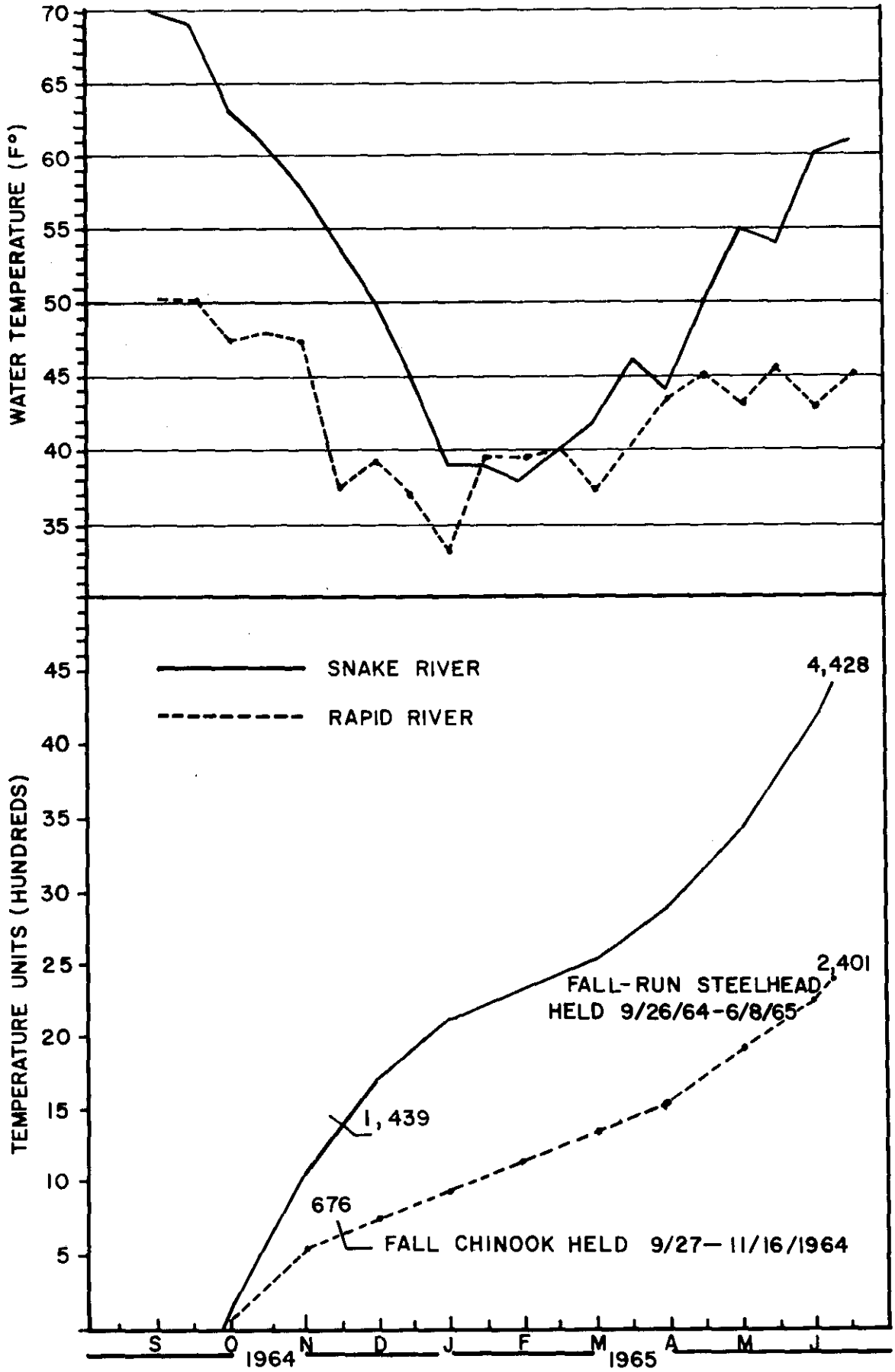


Figure 18. Temperatures and accrued temperature units of Rapid River and the Snake River at Oxbow Dam from September, 1964 through June 15, 1965. Snake River fall chinook salmon and fall-run steelhead trout held at Rapid River Hatchery during this period did not mature normally.

ment of steelhead trout into Idaho takes place. The fish remain in the lower Snake River until spring thaws increase water temperatures. These fish then resume their migration into Idaho and spawning takes place primarily in May. For the purpose of clarity, these two separate movements of steelhead are referred to as spring-run and fall-run steelhead.

Spring-run Steelhead Trout

I. Adults

A. 1964 Brood-year

Only 13 spring-run steelhead were trapped at Oxbow Dam and transported to Rapid River Hatchery in 1964. The hatchery holding pond facilities were not completed early enough to receive the major part of the steelhead run at Oxbow Dam. There was no holding pond mortality.

There were ten females and three males. Each female produced an average of 2,116 eggs. The eggs were placed in incubators and the resulting progeny were put in the raceways for rearing.

B. 1965 Brood-year

One hundred sixty-two spring-run steelhead were handled at Rapid River Hatchery in 1965; 82 females and 80 males. There was no holding pond loss during the 57 days these fish were held at the hatchery.

Each female produced an average of 2,646 eggs. The eggs were placed in the incubators at Rapid River and held to the eyed stage. Survival was 92 percent. After the eggs reached the eyed stage, they were shipped to Hagerman Hatchery for further rearing.

II. Juveniles

A. 1964 Brood-year

Growth rates for 1964 brood-year steelhead trout are presented in Figure 16. Low water temperatures appear to hold growth rates

down at Rapid River Hatchery. It requires approximately 24 months to rear steelhead at the hatchery to the desired release size of 150 to 200 millimeters. In comparison, the warm (59° F.) year-round temperatures of Hagerman Hatchery allow steelhead to reach smolt size in about half the time (Figure 19).

Steelhead of the 1964 year class reared at Hagerman Hatchery had accumulated 6,215 temperature units by February 1, 1965 and a mean length of approximately 130 millimeters. Steelhead of the same year class reared at Rapid River Hatchery had not accumulated 6,215 temperature units until about September 1, 1965 and they averaged 120 millimeters in length, 10 millimeters less than the Hagerman-reared fish with the same number of temperature units (Figure 19).

On the basis of these findings, it was decided that all steelhead from mid-Snake stocks would be raised at a new facility now being constructed in the Hagerman Valley at Niagara Springs.

In March, 1966, 4,306 1964 brood-year steelhead were on hand at Rapid River Hatchery. These were marked by removing the left pelvic fin. The fish were released into Rapid River on May 10 when raceway trap catches indicated that these fish had a desire to leave the raceway (Figure 17). These steelhead grew an average of 106 millimeters in 19 months. Average size upon release was 153 millimeters.

A. 1965 Brood-year

Two hundred seventeen thousand twenty eggs were taken from the year 1965 brood-year adult steelhead at Rapid River Hatchery. Of this number, 92 percent survived to eye-up. After reaching this stage, the eggs were shipped to Hagerman Hatchery for further development and rearing. This was done to achieve better growth rates on these fish. The resulting smolts were planted in the Lemhi and Pahsimeroi Rivers in the spring of 1966.

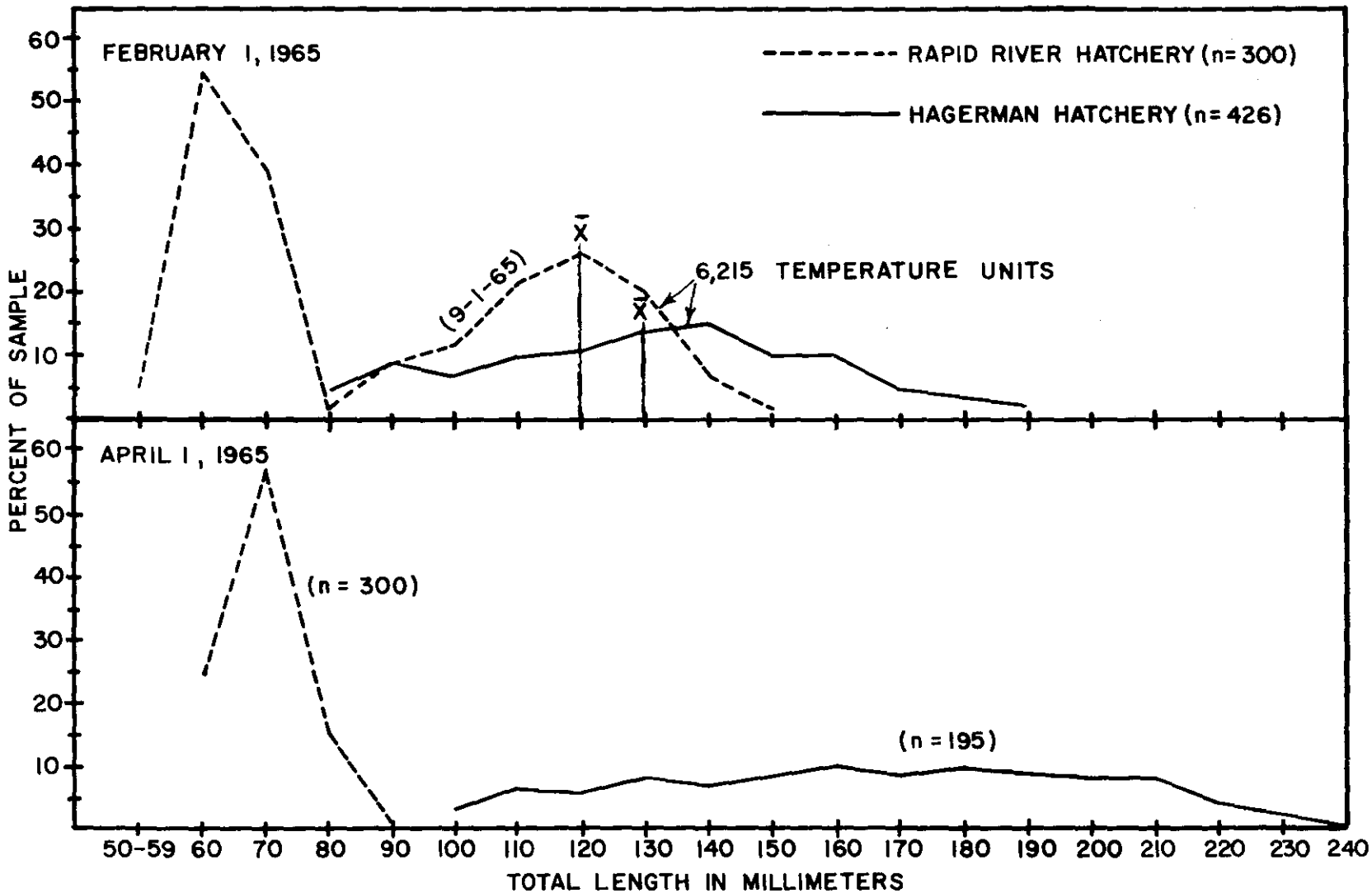


Figure 19. Comparison of growth rates at the same date and at the same accrued temperature units of 1964 brood-year juvenile steelhead at Rapid River and Hagerman fish hatcheries. Smaller size range spread accompanies slower growth rate at Rapid River.

Fall-run Steelhead Trout

1. Adults

Fifty-seven fall-run steelhead from Oxbow Dam were delivered to Rapid River Hatchery by tank truck on September 26, 1964. These fish were held for 255 days until June 8, 1965.

As near as could be determined, none of these fish produced viable eggs and nearly 100 percent died prior to becoming ripe. Inspection of dead and live females in the spring of 1965 disclosed the eggs still clustered and in an unripe condition. The spring-run steelhead held and spawned at Rapid River that same spring (total time in pond 57 days) had been spawned and released while none of the fall-run fish had yet ripened. It is believed, as with the fall chinook salmon, that temperatures were the cause of this condition. Had the fish remained in the Snake River over the winter, they would have accrued approximately twice as many temperature units as they received at Rapid River (Figure 18). On the basis of these findings, it was decided that no fall-run steelhead would be handled at Rapid River Hatchery in the future.

FISH ENUMERATED AT VELOCITY BARRIER

Chinook Salmon

1. Adults

The upstream trapping facilities were put into operation in March, 1965. The first chinook salmon entered the trap on July 1. Four hundred thirty-seven salmon were counted through the facilities from July 1 to September 15 (Figure 20).

The chinook salmon were counted through a marked trough at the release gate of the upstream trap. Salmon less than 24 inches fork length were considered to be 3_2 fish (jack salmon). Salmon between 24 and 33 inches were

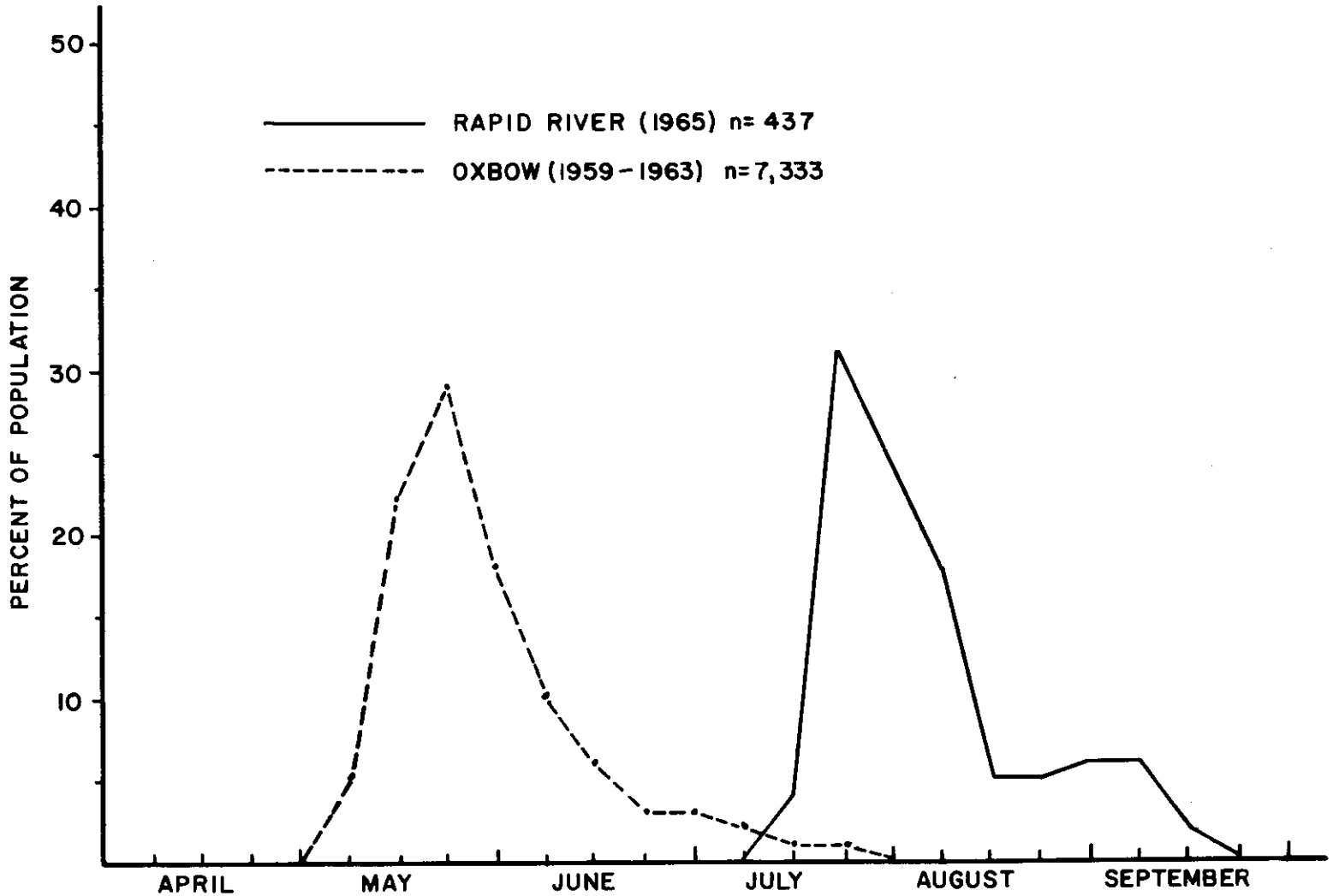


Figure 20. Times of arrival of spring chinook salmon at the Oxbow Dam fish trap on the Snake River and summer chinook salmon at the upstream trapping facilities on Rapid River. River distances are close to the same from the mouth of the Salmon River. Adult returns to Rapid River of artificially propagated Snake River spring chinook are expected to be similar in timing to Oxbow above.

considered as 4_2 fish (two years in the ocean) and salmon over 33 inches fork length were counted as 5_2 or 3-year ocean fish. The numbers and percentages for each age class for the entire 1965 run are presented in Table 4.

Indications are the chinook salmon run now existing in Rapid River consist of summer chinook salmon. The peak of the run occurred around the first of August (Figure 20). The peak arrival of mid-Snake spring chinook salmon at Oxbow Dam for the years 1959 through 1963 occurred around the first of June. River distances to Oxbow Dam and Rapid River from the mouth of the Salmon River are close to the same. Adult returns to Rapid River of artificially propagated Snake River spring-run chinook are expected to be similar in timing to fish returning to Oxbow.

The first returning Rapid River raised mid-Snake spring chinook are expected to show up at the Rapid River evaluation facilities in May, 1967 as jacks. The first run of adult 4_2 fish should arrive in May, 1968.

II. Juveniles

Downstream migrant trapping facilities were installed at the Rapid River fish velocity barrier in late February, 1965. The trap was operated periodically from March 1 to May 27, 1965 on an experimental basis. During this period the trap was operated for 231 hours and collected six chinook salmon juveniles and one rainbow-steelhead. This trap was partially destroyed by floods in June, 1965 and was replaced with a new system on October 8, 1965.

The new trap was operated periodically for 632 hours from October 8 through December 31, 1965. Numbers of chinook salmon collected, catch per hour, timing, and sizes are shown on Figures 21 and 22.

During the fall months from the first part of October to the first part of November, falling and drifting leaves caused operational problems with the downstream trap by clogging the screen and trap basket. During windy periods,

Table 4. Chinook salmon counted through the upstream trap at Rapid River in 1965.

	NUMBERS			PERCENT		
	3_2	4_2	5_2	3_2	4_2	5_2
July	157	88	16	60	34	6
August	47	77	18	33	54	13
September	19	12	3	56	35	9
SUBTOTALS	223	177	37	61	40	9
TOTAL 437						

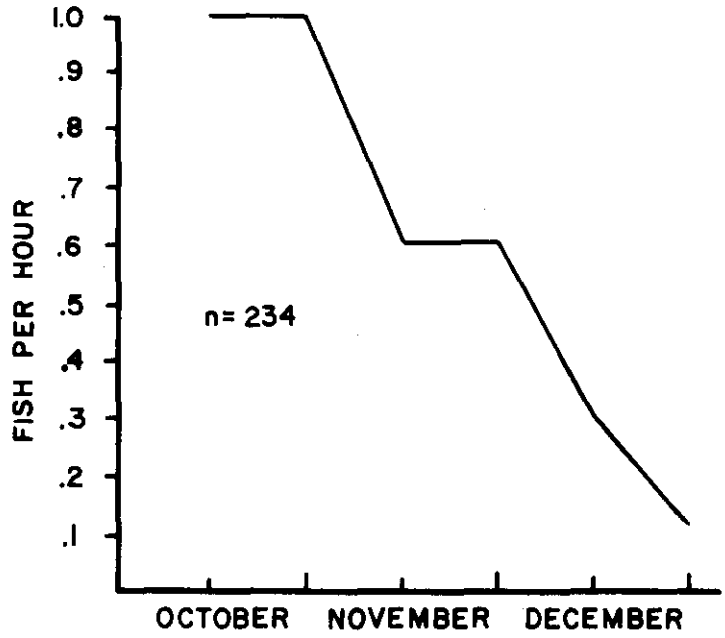


Figure 21. Catch per hour of wild juvenile chinook salmon in Rapid River downstream trapping facilities. Rate is based on a twelve hour operating period, from 6 pm (dusk) to 6 am (daylight). The trap was installed on October 8, 1965.

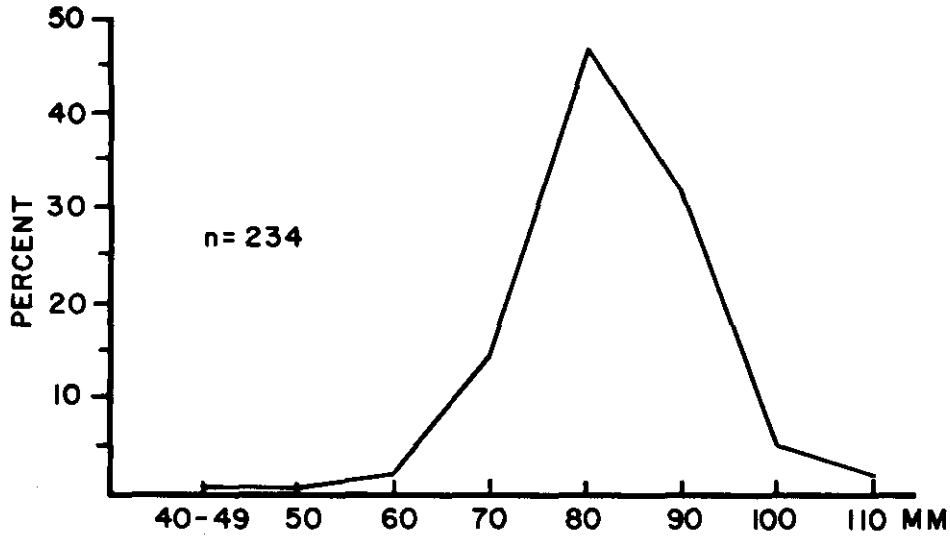


Figure 22. Length frequency of wild juvenile chinook salmon captured in the Rapid River downstream migrant trapping facilities, October through December, 1965.

it was necessary to clean the trap every 15 minutes. A few fish were lost by becoming stranded in the piled leaves.

Steelhead Trout

I. Adults

One hundred fifteen steelhead trout were counted through the upstream trapping facilities from April 8 to July 5, 1965 (Figure 23). The peak occurred in the latter part of May. Each steelhead was taken from the trap with a net, measured, and sexed and scale samples were taken for future study. They were then released above the trap to spawn naturally in Rapid River.

Adult steelhead collected at the upstream migrant trap consisted of fish which had spent two or three years in the ocean (Figure 24). Those fish which had spent two years in the ocean averaged 26 inches in length while those which had spent three years averaged 32-33 inches. Most of the males returned after spending two years in the ocean while a majority of the females spent three years.

A marking study indicated that approximately eight percent of the total run of steelhead to enter the trap returned downstream after release and entered the upstream trap for a second time. The mark used consisted of punching a small hole in the opercle of the steelhead with a conductor's punch.

II. Juveniles

During the fall operating period, the downstream migrant trap collected 29 rainbow-steelhead trout. Thirteen of the rainbow-steelhead appeared to be young-of-the-year fish from 40 to 80 millimeters total length. Fourteen rainbow-steelhead ranged from 160 to 220 millimeters total length. Scales from these fish all showed two annuli present, an indication that these may be downstream migrant steelhead smolts that had spent three growing seasons

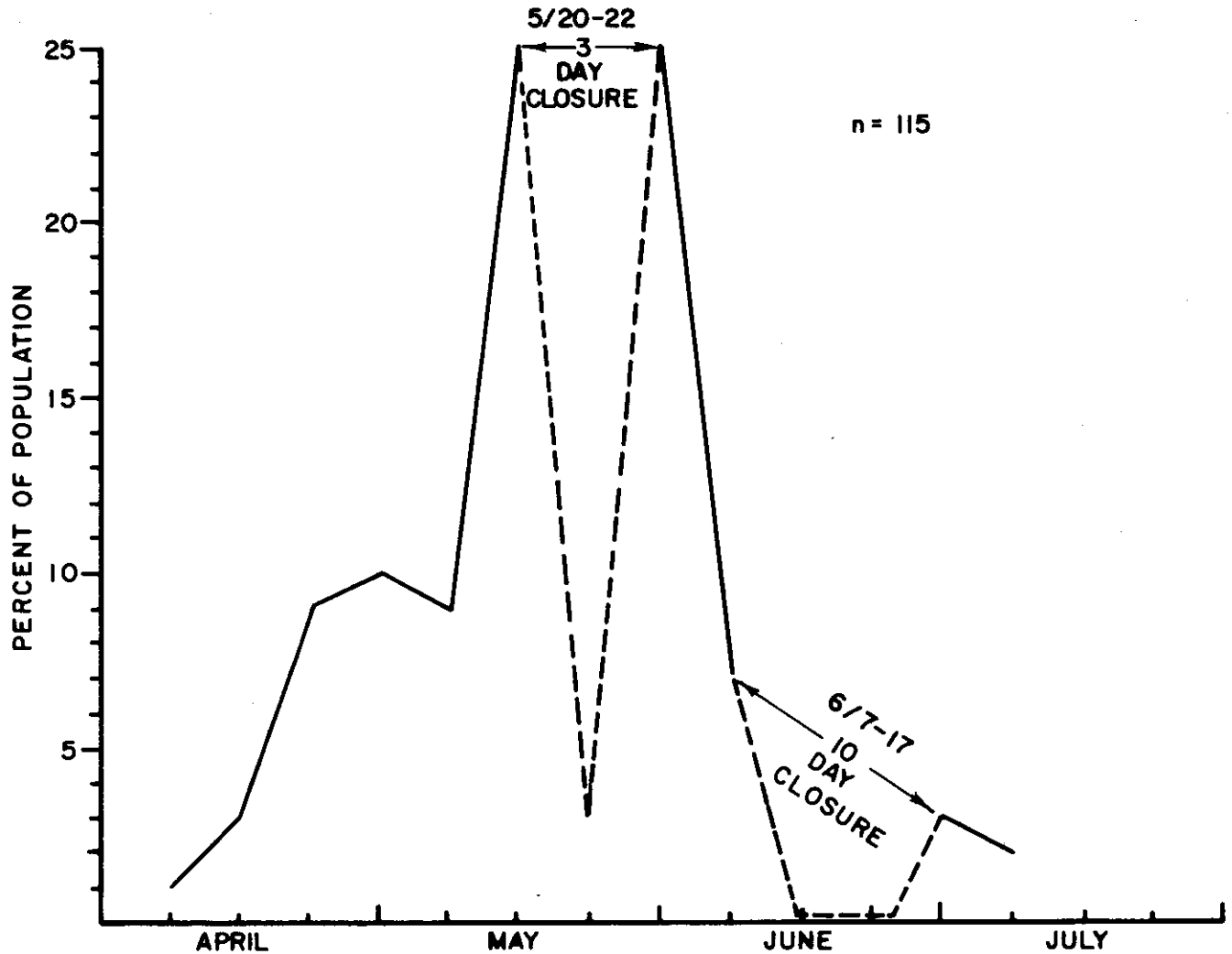


Figure 23. Time of arrival of adult steelhead trout at Rapid River upstream trapping facilities, 1965. The trap was closed down for three days for repairs and for a ten day period during flooding conditions. Time of arrival of Rapid River steelhead is similar to time of arrival of Snake River steelhead at Oxbow Dam. There is no movement of steelhead into Rapid River in the fall months.

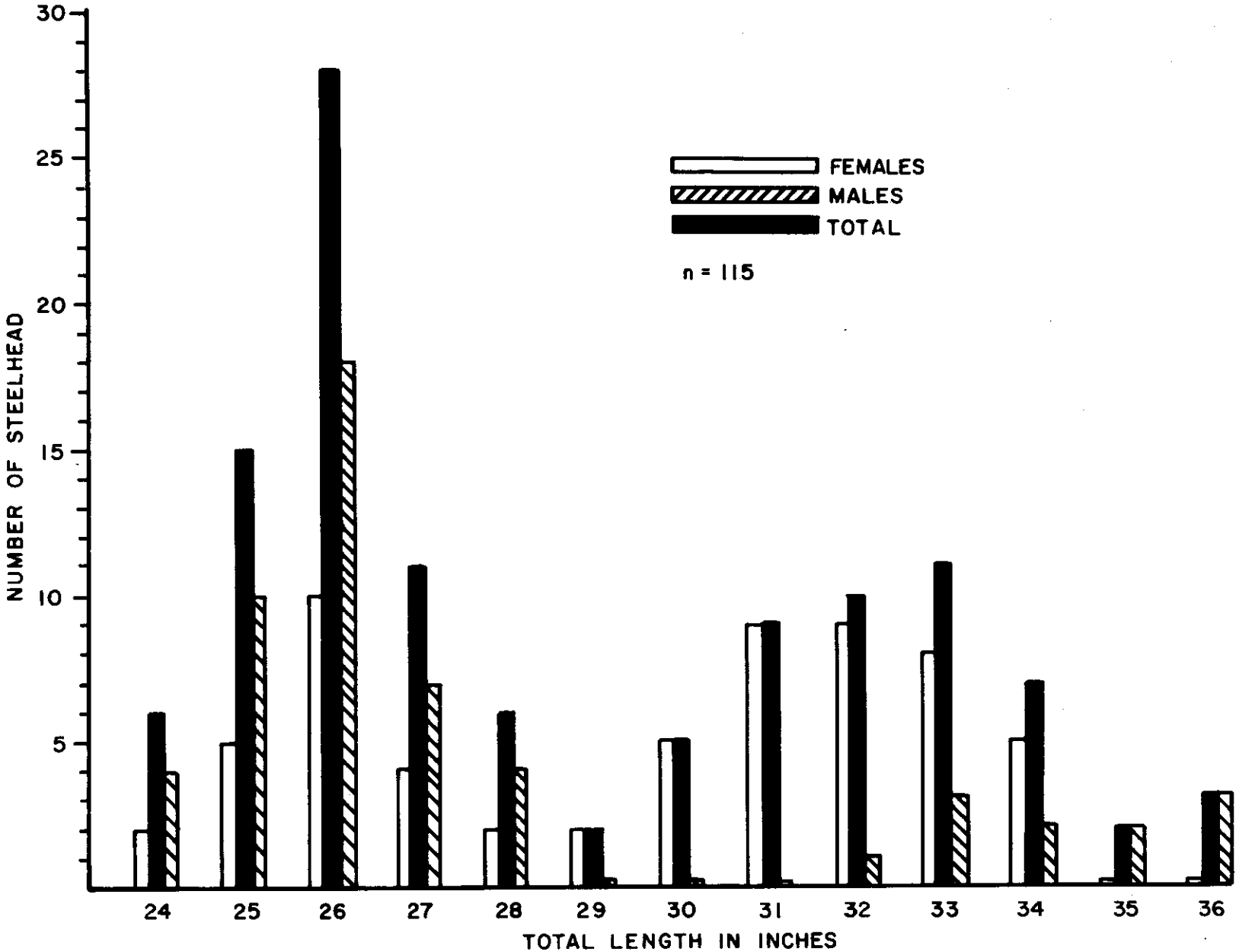


Figure 24. Length frequency of adult steelhead handled at the Rapid River upstream trapping facilities for the year 1965.

in Rapid River. Two other rainbow collected were 265 and 280 millimeters total length and were believed to be resident rainbow trout.

Other Species

I. Upstream Migrant Trap

From April 9 to July 30, 1965, twenty-five Dolly Varden trout were counted through the upstream trap. These fish ranged from 16 to 25 inches total length.

Whitefish were seen in the trap during the entire period of operation from March 15 to September 15, 1965. Any fish less than about 16 inches in length can swim through the bars of the trap.

Small numbers of resident rainbow were observed periodically in the upstream trap and bypass channel. Hatchery-reared rainbow planted in the Little Salmon River approximately two miles downstream from the trapping facilities were also observed on occasion in the trap and channel.

II. Downstream Migrant Trap

Twenty-one Dolly Varden, two cutthroat trout, and three whitefish were collected in the downstream migrant trap during the total time it was operated.

OTHER INFORMATION

Diseases

An outbreak of what was identified as an infestation of the protozoan parasite Octomitus salmonis occurred in part of the 1964 brood-year steelhead at Rapid River Hatchery. After the fish were removed from the incubators in the summer of 1964, they were placed in two lots in identical fiber glass hatchery troughs located in the incubator room. The troughs were fed by the

same water supply through the same piping system. The steelhead fry in one of the troughs became infested with the parasite. The fish in the adjoining trough never contacted the disease.

The affected fish had a high mortality, were thinner, and did not feed as well as the noninfected group. Measurements were kept on the growth of the two groups. During the infection, August through September, 1964, the non-infected group of steelhead grew slightly faster than the infected group. Average size at the end of September was 43 millimeters total length for the infected group and 47 millimeters for the noninfected group. On December 28, the difference was still approximately four millimeters. The infected group had been treated during this period from September to December with periodic additions to the feed of Carbarsone in a proportion of two percent. Periodic examinations indicated that the infestation of Octomitus salmonis had been effectively controlled.

It had been planned to keep comparative records on the growth rate of this group of fish. However, it was this group that was lost in the late December flooding at Rapid River Hatchery.

In the eggs from the 1965 brood-year adult salmon, the condition known as "Blue-sac" was observed in a large number of alevins. This condition is attributed primarily to crowded conditions causing excesses of metabolic waste substances in the hatchery water supply. The flow of water into the incubators was increased and losses from this phenomenon became negligible.

Some fungus was noted occasionally on salmon and steelhead juveniles in the raceways. Periodically, the fish were treated by introducing 25 pounds of noniodized salt at the head of each raceway. This was also done immediately after the marking program on the 1964 brood-year salmon and steelhead. Fungus was never a serious problem at the hatchery.

Redd Counts

Salmon redd counts were conducted in the fall of 1964 and 1965. On September 3, 1964, twenty-five redds were counted from the hatchery to the mouth of Rapid River. On September 4 in Rapid River near the mouth of Hall Creek, approximately 10 river miles upstream from the hatchery, 13 redds were observed.

On September 10, 1965, from the hatchery to the mouth of Rapid River, 28 redds were counted. A check was made in the Hall Creek area near this same time and no redds were found in 1965.

ACKNOWLEDGMENTS

During my work at Rapid River, many people contributed their efforts and knowledge to the evaluation study. I would like to extend thanks to Bob Quidor, Rapid River Hatchery Superintendent, during the study and to Rex Spackman and Bud Ainsworth, Jr., Rapid River Hatchery Fish Culturists.

I would also like to extend my appreciation of their cooperation and help to Paul Cuplin, Idaho Fish and Game Department Fish Hatchery Supervisor and to Richard Moore, Idaho Power Company official in charge of the Idaho Power Fisheries Program and Wendell Smith, Idaho Power Company Fishery Biologist.

Special appreciation goes to Ted Bjornn, Idaho Fish and Game Department Fishery Research Supervisor, who contributed to this project in a supervisory capacity and reviewed the preparation of this report.

Melvin Reingold

A P P E N D I X

Appendix Table 1. The following table is an approximation of the flow (in cubic feet per second) over the Rapid River velocity barrier for various depths of flow over the crest gage board.

Depth of Flow (ft.)	Flow (cfs)	Depth of Flow (ft.)	Flow (cfs)
0.0	0	2.6	720
0.1	5	2.7	760
0.2	14	2.8	810
0.3	25	2.9	860
0.4	42	3.0	908
0.5	60	3.1	965
0.6	76	3.2	1,015
0.7	95	3.3	1,065
0.8	116	3.4	1,120
0.9	139	3.5	1,175
1.0	160	3.6	1,225
1.1	185	3.7	1,275
1.2	210	3.8	1,325
1.3	240	3.9	1,380
1.4	268	4.0	1,435
1.5	300	4.1	1,490
1.6	330	4.2	1,550
1.7	365	4.3	1,615
1.8	400	4.4	1,675
1.9	435	4.5	1,735
2.0	475	4.6	1,795
2.1	510	4.7	1,855
2.2	550	4.8	1,915
2.3	590	4.9	1,989
2.4	630	5.0	2,060
2.5	675		