TEMPORAL MOVEMENT OF RAINBOW TROUT IN RESERVOIRS

ABSTRACT

by
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The Montana Fish and Game Department and The Washington Water Power Company have been cooperatively investigating the fishery resource of two Company impoundments, Noxon Rapids and Cabinet Gorge reservoirs, since 1952. A sustained sport fishery through liberations of hatchery-reared rainbow trout (Salmo gairdneri) has not been successful in terms of an accepted rate of catch per hour. Flow regimes appear to have an effect on rainbow trout's ability to maintain themselves in the reservoir environment.

A tag and recovery study of rainbow trout conducted in the two reservoirs in 1963 through 1965 showed definite patterns of downstream movement. Tagged fish planted in Noxon Rapids, the uppermost reservoir, were recovered several miles downstream each year of the study. Period of greatest recovery from these areas followed spring runoff and reservoir spilling. A correlation did exist between tag recovery and volume of water discharged from the reservoir. Spills in excess of 40,000 cfs resulted in increased catch rate of tagged fish downstream.

Rainbow trout planted in Noxon Rapids Reservoir in 1964 were from two different brood sources. Part of the tagged fish planted were from commercial brood source and part were from the State of Montana stock. Tag recoveries showed that the commercial fish had less tendency to migrate downstream than the State stock.

INTRODUCTION

The Federal Power Commission in 1955 issued a license to The Washington Water Power Company to construct a 400,000 Kw hydroelectric plant at Noxon Rapids on the Clark Fork River in Western Montana. Noxon Rapids Dam was completed in 1958, and is one of four controlled impoundments on the Clark Fork River within a distance of 60 miles. The reservoir covers 8600 surface acres and at full pool is 38 miles long. Inflows vary from lows of about 4000 cfs to highs of about 120,000 cfs.

A preimpoundment fishery survey was jointly undertaken by the Company and Montana Fish and Game Department starting in 1955. This survey included the section of the Clark Fork River to be inundated, the Company's Cabinet Gorge Reservoir lying directly below the proposed Noxon Rapids Dam, and The Montana Power Company's Thompson Falls Reservoir directly above Noxon Rapids Reservoir (Figure 1). The survey showed that non-game fish, primarily suckers (Catasotmus spp.) and squawfish (Ptychlochelius oregonensis),

comprised about 90 percent of the population. Mountain whitefish (Prosopium williamsoni), cutthroat trout (Salmo clarkii), and Dolly Varden (Salvelinus malma) were the most abundant game fish found. Angler use of the waters and catch rates were low.

Recommendations from the preimpoundment survey included chemical treatment of Thompson Falls Reservoir and the Noxon Rapids impoundment area, followed by planting of large numbers of small rainbow trout (Salmo gairdneri). Rehabilitation was done in the fall of 1958 and planting of hatchery-reared rainbow trout started the same year. Complete findings of the preimpoundment survey, chemical rehabilitation, and research and management efforts on Cabinet Gorge and Noxon Rapids reservoirs since 1953 are given by Gaffney (1956), Gaffney (1959) and Huston (1965). About 2.5 million fingerling rainbow trout were released in Noxon Rapids Reservoir in 1958 through 1960.

Typical of new impoundments, Noxon Rapids Reservoir produced excellent trout fishing during its early years. This was then followed by a rather marked decline. Reasons for this, even after nearly 50 years of study on various types of reservoirs, are still obscure. However, in this particular instance the sudden flooding of a fertile valley with a nutritious water supply followed by the chemical treatment and a substantial stocking of rainbow trout no doubt contributed to the era of good fishing. The reasons for the decline are less clear. Reservoir operations were checked. In the spring of 1961 the operation pattern of the reservoir was changed compared to the pattern of 1958-1960. Reservoir fluctuation in 1958-1960 was from one to two feet daily and not more than 10 feet annually. Increased integration with other hydro and flood control agencies in 1961 required a spring drawdown of at least 35 feet. Following the first large drawdown in 1961 fisherman success declined markedly.

Population sampling by gill netting before and after the 1961 spring drawdown showed a significant reduction in numbers of rainbow trout caught per net-night. No other species showed a significant reduction and one, brown trout (Salmo trutta), showed a significant increase in catch rate. Several thousand fin-clipped rainbow trout had been planted in Noxon Rapids in 1960 and a few of these fish were caught by anglers in Cabinet Gorge Reservoir in 1961. Idaho fishery biologists thought that some of the rainbow trout being caught in the Clark Fork River below Cabinet Gorge Dam bore bruises that might have been caused by passage through turbines or over the spillway.

The decline in numbers of rainbow trout in both harvest and population sampling following the 1961 spring draft, the Idaho reports, and appearance of marked fish in downstream waters were considered evidence of downstream movement of the planted rainbow trout. To check this The Washington Water Power Company and the Montana Fish and Game Department instituted a tagging and recovery program in 1963.

STUDY AREA AND PROGRAM

The study of rainbow trout movement within and out of Noxon Rapids Reservoir included Cabinet Gorge Reservoir, Clark Fork River between Cabinet Gorge Dam and Lake Pend Oreille, Lake Pend Oreille, and Pend Oreille River downstream to Newport, Washington. The latter three waters include 37 miles of river and a lake of 96,000 surface acres. This paper will cover data collected from Noxon Rapids and Cabinet Gorge reservoirs only.

The program called for the planting of large numbers of jaw-tagged, hatchery-reared rainbow trout in Noxon Rapids annually in 1963 and 1964 at the same planting sites used in 1958-1960. Movement information would then be collected from anglers returning tags from fish they had caught. The Department, Company, and area service and sportsmen clubs, cooperated in quarterly drawings for cash and merchandise prizes as inducement to promote maximum return of tags. Information required to qualify a tag for a drawing chance included date and place the fish was caught, plus the return of the tag itself. Extensive publicity about the tagging program was made available through all news media, posters, personal contacts, and public meetings. Anglers could return tags and receive drawing chances at businesses located in seven towns in the project area.

The only measure of angler response was intensive and extensive contacts with anglers and commercial recreation enterprises. Tag return response by the Montana resident angler was excellent in 1963 and 1964, but only fair in 1965. The novelty of the tagging program and desire of anglers to cooperate diminished with the aging of the program. Non-resident anglers in this section of Montana are not numerous and their response was thought to be poor. Much resistance toward returning tags was encountered from Idaho resident anglers. No real explanation can be given other than a common remark given to project personnel. These people's feelings were that the Montana planted rainbow ended up in their waters and that if the extent of fish losses were determined, then Montana would stop planting rainbow trout. Non-resident anglers fishing Idaho waters responded much better than the Idaho resident.

Hatchery-reared, catchable-size rainbow trout from Montana's brood stock and from a commercial source were planted in Noxon Rapids Reservoir. Fish from the Montana brook source were planted in 1963, while fish from both brood sources were used in 1964. The purpose of the two brood sources was to test for any difference between stocks insofar as their residual reaction to the reservoir environment was concerned. Consequently, what was presumed to be the most divergent stocks available were used; the Montana State stock and the commercial stock from Trout Lodge at Soap Lake, Washington. Each fish was tagged with a plastic jaw-tag (pigeon leg-band) using color combinations so that each brood source, general area of planting, and year planted, could be differentiated. Tags were printed "ret. Mont. F&G". The fish were tagged in the hatchery, held 48 hours, then trucked to and released in the reservoir. Mortality from tagging and loss of tags was thought to be minimal.

Numbers of fish planted each year, area of planting (Figure 1), brood source, and tag colors, are given in Table 1.

Table 1. Tagged rainbow trout planted in Noxon Rapids Reservoir, 1963-1964.

Date of Planting	Area Planted	Number	Brood Source	Tag Colors
6/14-7/1, 1963	1	30,755	Montana	green-black
6/14-7/1, 1963	2	43,127	Montana	blue-black
5/22, 1964	1	6,000	Montana	white-brown
5/22, 1964	2	8,975	Montana	white-black
5/23, 1964	1	4,555	Commercial	yellow-brown
5/23, 1964	2	6,315	Commercial	yellow-black

HARVEST AND MOVEMENT OF RAINBOW TROUT PLANTED IN 1963

From June 17 through July 3, 1963, a total of 73,882 jaw-tagged rainbow trout were planted in Noxon Rapids Reservoir. The fish were liberated at nine stocking sites scattered throughout the reservoir with the lowest stocking site eight miles above the dam. All sites were planted within a three-day period and all were planted at least twice during the 17 days required to complete stocking. The reservoir was at or near full pool during planting and total discharges from the dam varied from 40,000 to 50,000 cfs.

Tagged fish started entering the anglers creel within a matter of hours following planting. Table 2 shows the numbers caught by month for the period of June 1963 through December 1965. These data are aligned by water-year; June through May, or high water to high water.

Table 2. Numbers of tagged fish caught from Noxon Rapids Reservoir by month, June 1963 through December 1965.

Month	Number Caught	Month	Number Caught	Month	Number Caught
June 1963	60	June 1964	55	June 1965	0
July	1066	July	10	July	2
August	1041	August	2	August	1
September	163	September	4	September	7
October	116	October	2	October	0
November	151	November	13	November	0
December	95	December	15	December	0

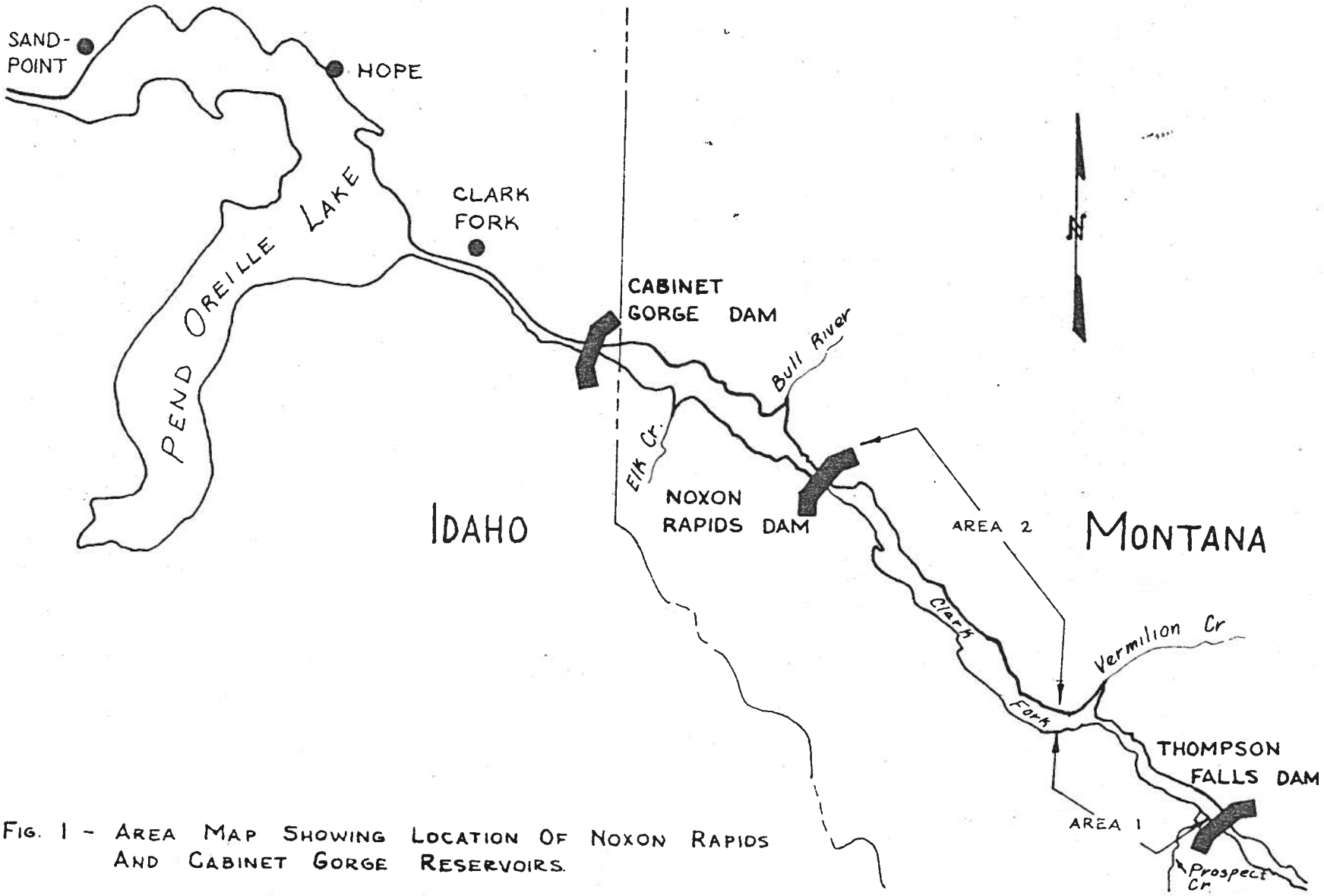

FIG. 1 - AREA MAP SHOWING LOCATION OF NOXON RAPIDS AND CABINET GORGE RESERVOIRS.

Table 2 (Cont'd)

Month	Number Caught	Month	Number Caught	Month	Number Caught
January 1964	122	January 1965	5		
February	416	February	12		
March	307	March	4		
April	142	April	7		
May	131	May	6		

Rate of catch was good for July and August, 1963, with over 1000 fish caught each month. Catch fell to slightly more than 100 fish per month for the months of September, 1963, through January, 1964. A secondary peak harvest experienced during February and March, 1964, was followed by a sharp decline. Angler harvest was insignificant from July, 1964, throughout the remainder of the study.

Many of the fish caught from Noxon Rapids Reservoir during the months of February through June, 1964, were taken in the Noxon Rapids forebay area relatively close to the dam. Only an occasional fish was caught in this small area in other months of the study.

Return of tagged trout from Cabinet Gorge during 1963 was insignificant; only 78 were tallied. Planting of the 1963 stock occurred when Noxon Rapids was at full pool and after peak flood flows had passed. Spill discharge had peaked and was about 20,000 cfs or less during planting (Figure 3). Tagged trout were caught from Cabinet Gorge within ten days after the first stocking of Noxon Rapids. All of the tags returned from fish caught in Cabinet Gorge in 1963 were during the months of June, July, August, and September. No tagged fish were caught after September, 1963, until mid-May, 1964.

A record spring flood was experienced in the Clark Fork River system in 1964. Maximum total discharge of Noxon Rapids was 122,000 cfs occurring in mid-June. Flows through Noxon Rapids Dam in May, June, and July were on the average at least double the flows for the same months in 1963 (Figure 2). Spill discharge from Noxon Rapids started May 6, 1964, and peaked at 97,000 cfs in mid-June.

The first fish taken from Cabinet Gorge from the 1963 Noxon Rapids plant was caught May 16, 1964. Catch rate increased rapidly and peaked at 18 fish June 6, but fell just as rapidly thereafter. The decided drop was at least partially due to greatly decreased fishing pressure during the flood flows. Return of the 1963 Noxon Rapids plant following the peak flows in mid-June was small (Figure 2).

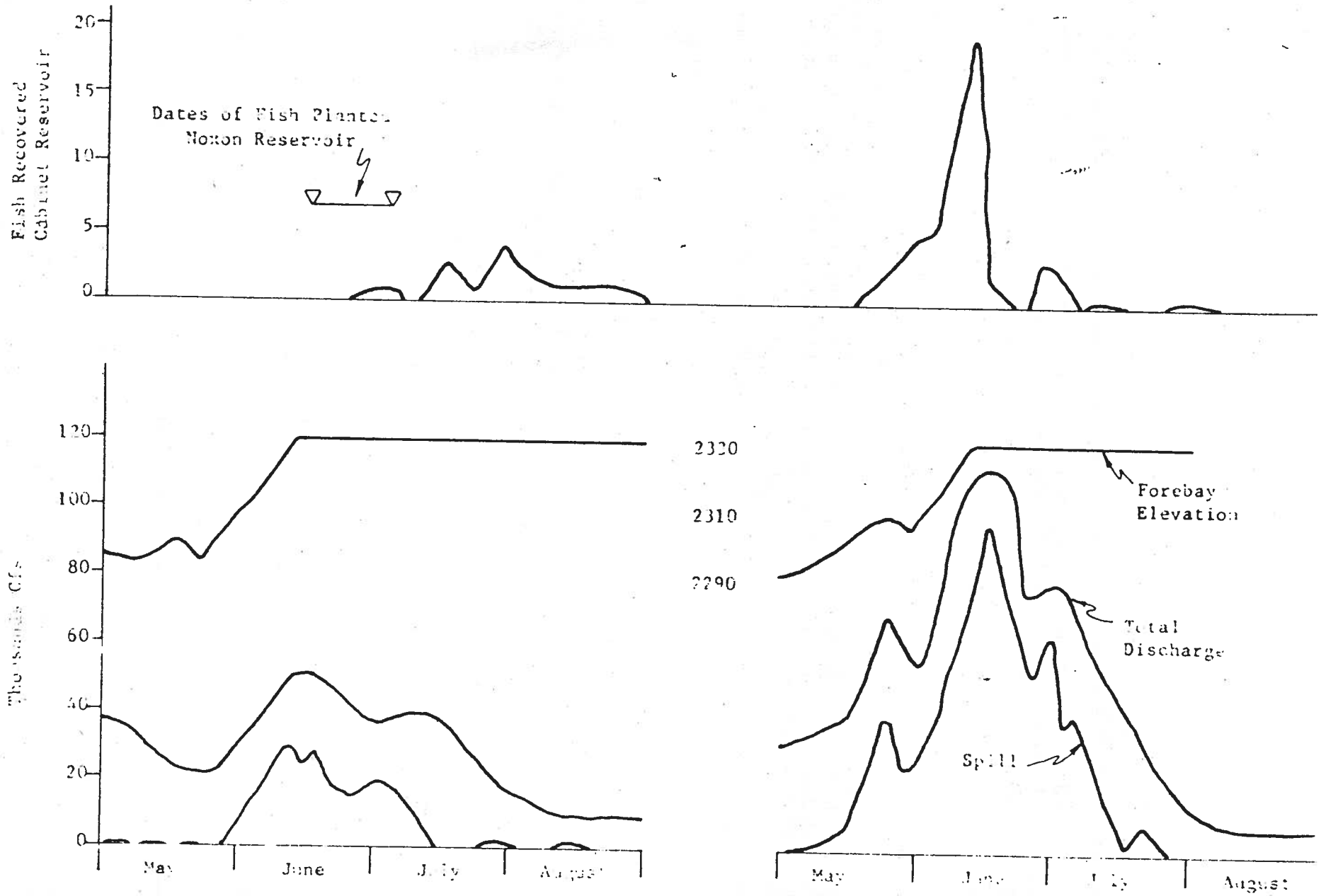

Fig. 2 1961-66 WATER DISCHARGE & FISH RECOVERY PATTERN

Catch information and movement pattern of the 1963 Noxon Rapids plant show four significant points. These are: (1) the high rate of return immediately following planting followed by a sharp decline, (2) the lack of carry-over of the planted fish from year to year, (3) the catch of February-May, 1964, including large numbers of fish taken from the Noxon Rapids forebay area, and (4) the appearance of tagged trout in Cabinet Gorge shortly after spilling started in May, 1964. These data suggest that fish congregated in the Noxon Rapids forebay near the dam prior to spilling and migrated downstream when the spill started. The decided drop in harvest from Cabinet Gorge and Noxon Rapids reservoirs following 1964 flood flows suggests that fish from the 1964 plants were no longer in either impoundment.

Angler harvest of the tagged rainbow trout by reservoir by water-year (June-May) is given in Table 3.

Table 3. Harvest of rainbow trout planted in Noxon Rapids Reservoir in 1963 from Noxon Rapids and Cabinet Gorge reservoirs.

	NUMBERS CAUGHT IN		
Reservoir	6/63-5/64	6/64-5/65	6/65-12/65
Noxon Rapids	3810	131	10
Cabinet Gorge	120	92	4
TOTAL FISH CAUGHT	4167		
PERCENT RETURN	5.6%		

HARVEST AND MOVEMENT OF RAINBOW TROUT PLANTED IN 1964

The appearance of large numbers of tagged trout in the Noxon Rapids forebay area and in Cabinet Gorge during the spring of 1964 raised the possibility that fish from Montana's brood stock might have a downstream migratory tendency. To further test this possibility, rainbow trout from two brood sources were planted in Noxon Rapids Reservoir in 1964. May 20 and 21, 1964, 14,975 tagged rainbow trout from Montana's brood source and 10,870 tagged rainbow trout from a commercial hatchery were planted in Noxon Rapids Reservoir. These fish were distributed between five stocking sites scattered along the reservoir with the lowest site eight miles above the dam. Poor roads, reservoir drawdown, and spring flooding eliminated four stocking sites planted in 1963. At time of planting Noxon Rapids was 23 feet below full pool and total discharge was 60,000 cfs.

Angler catch by month for May 1964 through December 1965 is shown in Table 4. In general the catch pattern for both groups of fish was similar to the 1963 pattern; good return immediately following planting followed by a sharp decline in harvest thereafter. A small increase in harvest of the fish was noted during the spring of 1965 and similar to 1964 most of the fish caught were taken in the Noxon Rapids Reservoir forebay. Neither of the two groups of fish contributed much to the creel after four months. Harvest of the two groups of fish from Noxon Rapids during the study period was very similar to the planting ratio. Planting ratio was one commercial fish to 1.38 Montana fish, while harvest ratio was one commercial fish to 1.44 Montana fish.

Table 4. Numbers of tagged fish caught by month, Noxon Rapids Reservoir, May 1964 through December 1965.

Month	NUMBER CAUGHT Commercial	Montana	Month	NUMBER CAUGHT Commercial	Montana
May 1964	0	8	June 1965	2	4
June	131	169	July	3	3
July	278	352	August	1	1
August	45	81	September	1	1
September	19	39	October	0	1
October	3	17	November	0	0
November	9	14	December	0	0
December	5	10			
January 1965	10	20			
February	9	11			
March	4	4			
April	8	4			
May	6	18			

A notable difference in harvest patterns was apparent between the two groups of fish. Trout from the Montana stock started entering the anglers creel immediately following planting, but trout from the commercial source did not enter the catch until the first of June.

Angler recovery of fish planted in 1964 from Cabinet Gorge Reservoir in 1964 is shown in Figure 3 along with the Noxon Rapids Reservoir operation pattern. Fish from the Montana stock were caught from Cabinet Gorge the day following planting when Noxon Rapid's spill discharge was about 10,000 cfs. No great increase in catch from Cabinet Gorge was noted until spill discharges increased to 40,000 cfs. Catch decreased during the maximum spring flows in mid-June, but this is probably a result of decreased angling pressure during the flood. Catch for the remainder of June and most of July appears to be correlated to the rise and fall of total discharge and spill discharge of Noxon Rapids Reservoir. The only explanation of the peaks of angler returns

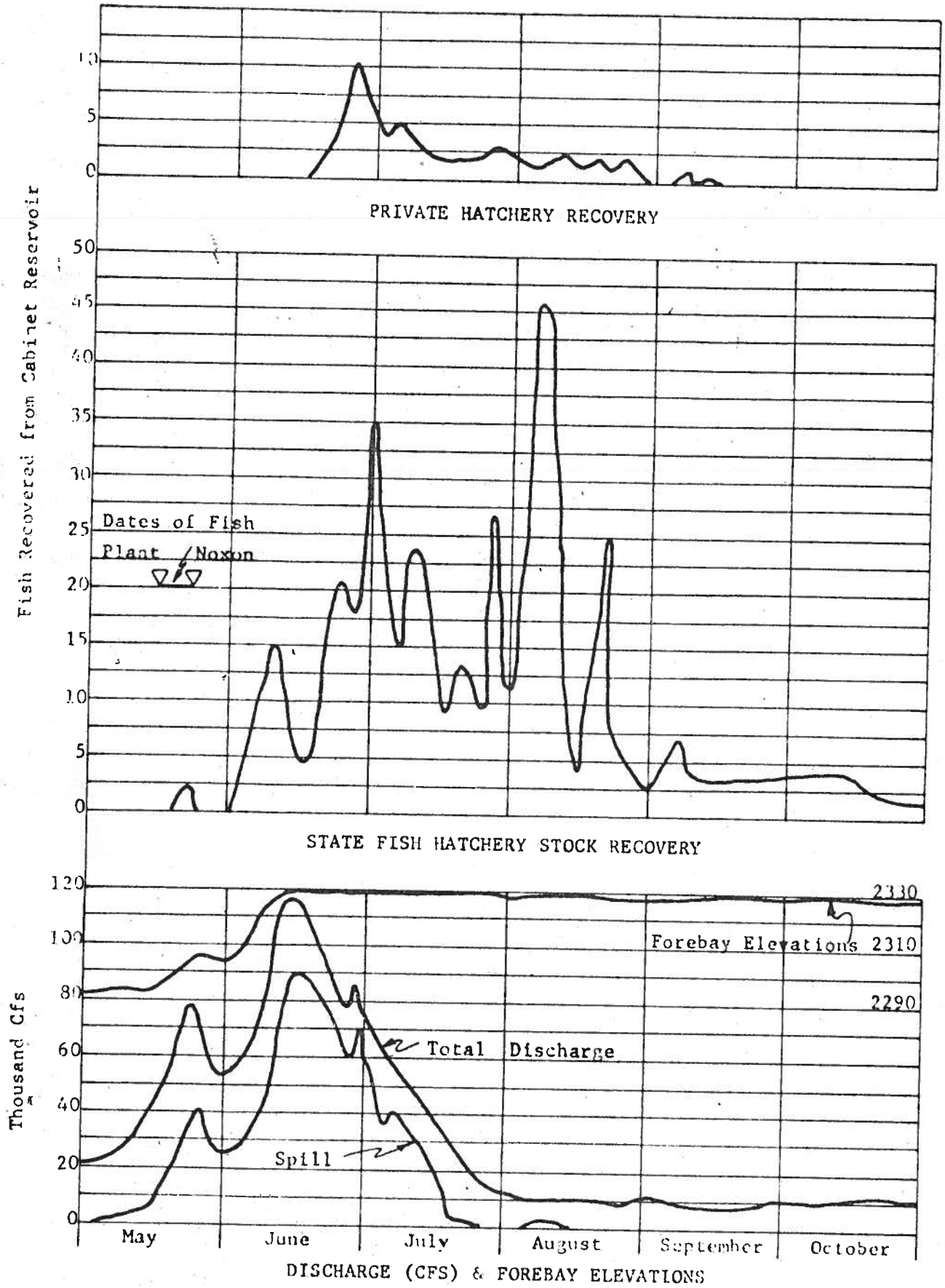

Fig. 3 1964 WATER DISCHARGE & FISH RECOVERY PATTERN

in late July and August is that an unusually large number of non-resident anglers were fishing Cabinet Gorge Reservoir at this time. A small spill discharge in early August of about 3,000 cfs for several days might have triggered some downstream movement.

Fish from the commercial stock behaved differently from the Montana stock (Figure 3). These fish did not show up in the Cabinet Gorge fishery in as large numbers as the Montana fish. They were first caught in mid-June, whereas the Montana fish were caught a day after planting. During the period of May through October 1964, 1271 tags from Montana fish and 165 tags from commercial fish were returned from Cabinet Gorge Reservoir. Ratio of harvest was one commercial fish to 7.7 Montana fish, whereas the planting ratio in Noxon Rapids and catch ratio from Noxon Rapids was one commercial fish to 1.4 Montana fish. Gill net sampling and underwater nightlighting observations of fish populations in both reservoirs showed that the observed ratio of the two groups of fish was very close to the harvest ratio.

The 1963 and 1964 data quite clearly shows a correlation between reservoir water release patterns and downstream movement of rainbow trout planted in Noxon Rapids Reservoir. These data further indicate that spill discharges had more effect on the magnitude of downstream migration than turbine discharge or reservoir drawdown. When spill exceeded 40,000 cfs, a noticeable loss downstream occurred. This quantity appeared to be the breaking point.

COMPARATIVE HARVEST

Catch data for Noxon Rapids Reservoir (Table 4) for 1964 and 1965 show that neither group of fish contributed much to the angler harvest after a few months in the reservoir. Neither did the Montana or commercial fish contribute significant numbers of fish to the Cabinet Gorge fishery in 1965. Only 20 Montana and 12 commercial fish were caught from Cabinet Gorge Reservoir in 1965. It appears then that although the commercial fish did not move out of Noxon Rapids as rapidly as the Montana fish, neither did it contribute to the creel as strongly as the Montana fish. Harvest of the two groups of fishes from the two reservoirs for May 1964 through December 1965 is given in Table 5.

Table 5. Harvest of commercial and Montana rainbow trout from Noxon Rapids and Cabinet Gorge Reservoirs, May 1964-May 1965 and June 1965-December 1965.

	COMMERCIAL FISH		MONTANA FISH	
Reservoir	5/64-5/65	6/65-12/65	5/64-5/65	6/65-12/65
Noxon Rapids	527	7	747	10
Cabinet Gorge	166	12	1,286	20
TOTAL FISH CAUGHT	685	19	2,033	30
PERCENT RETURN	6.6%		13.8%	

MOVEMENT OF THE 1964 PLANT WITHIN NOXON RAPIDS RESERVOIR

Noxon Rapids Reservoir can be divided into two habitat types. The upper area extends from Thompson Falls downstream to about Trout Creek, Montana, and the lower area from Trout Creek downstream to the dam (Figure 1). The upper area closely resembles a slow-moving river with currents noticeable all year. The lower area has more lake characteristics, but has currents visible during spring runoff. The upper area is about 18 miles long and the lower area 20 miles long.

The Montana and commercial groups of fish planted in 1964 were tagged so that each could be identified with the areas in which they were planted. Angler harvest by area of planting, area of catch, and catch from Cabinet Gorge Reservoir is given in Table 6.

Table 6. Angler harvest of fish planted in upper and lower areas of Noxon Rapids Reservoir by area of catch and Cabinet Gorge Reservoir.

Area of Return	UPPER AREA		LOWER AREA	
	C (4555)	* M (6000)	C (6315)	M (8975)
Upper Noxon Rapids	137	330	73	49
Lower Noxon Rapids	65	224	252	155
Cabinet Gorge	57	295	120	1011

* C and M are commercial and Montana fish.
Number in parenthesis is number planted.

The data in Table 6 show that more commercial fish moved upstream from the lower area than did Montana fish, that almost twice as many commercial fish were caught in the area of planting as Montana fish, and that many times less commercial fish moved downstream than Montana fish. A distinction between movements of the Montana and commercial groups is not so clearly demonstrated for the upper area plants. Still, the apparent trend was for more Montana fish to move downstream than commercial fish. The upper area planting ratio was one commercial fish to 1.31 Montana fish. Upper area catch ratio was one commercial fish to 2.4 Montana fish, while the catch ratio in downstream areas was one commercial to 4.2 Montana fish. The lower area downstream catch ratio was one commercial fish to 8.4 Montana fish.

SUMMARY

Movement and harvest of planted catchable-size rainbow trout were determined for Noxon Rapids Reservoir during the years of 1963, 1964, and 1965. Data collected indicated a relationship between reservoir discharge

and numbers of the planted fish moving into downstream. Drawdown per se did not seem to be related to the population decline. Rather, data more closely relates high spring flows and the accompanying spill discharge to downstream movement of rainbow trout. Spill flows of 40,000 cfs or higher appear to precipitate significant downstream movement.

Tests between a commercial stock and Montana's stock indicated that Montana stock moved downstream at a much greater rate than did the commercial stock. Fish planted in the lower part of Noxon Rapids Reservoir moved downstream into Cabinet Gorge Reservoir at greater rates than fish planted in upper Noxon Rapids.

This suggests that even in this meager test where one strain of fish showed a tendency to remain in the waters in which they were planted while another strain did not that genetics should not be overlooked. Perhaps we would do better to look to selective breeding to answer some of the reservoir fishery problems than to continually use selective breeding to produce higher poundage and more eggs.

Data collected finally showed that while the harvest rate of the Montana stock was much better than from the commercial stock, neither made a stable contribution to the sports fishery in Noxon Rapids or Cabinet Gorge Reservoirs. Catch rates of all planted rainbow were good only for about the first two months following planting.

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