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STATE OF ALASKA
Keith H. Miller, Governor

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FEDERAL AID IN FISH RESTORATION PROJECT F-9-1

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
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INTRODUCTION

This report of progress involves the findings and work accomplished under the State of Alaska, Federal Aid in Fish Restoration, Project F-9-1, "Sport Fish Investigations of Alaska".

The work conducted during this reporting period constitutes effort on nine separate studies which are crucial in evaluating the sport fishing resources of the State. Recreational demands have necessitated broadening our knowledge of the fishery. All 20 jobs were of continuing nature enabling the Department to keep abreast of present and future impacts on certain fish species. Specifically, the work included work on inventory and cataloging of the sport fish and sport fish waters of the State, sport fishery creel census and access. Special emphasis was given to Dolly Varden, silver salmon, anadromous fish, grayling, salmon, sheefish, pike, and char. The information gathered has provided supporting documentation for better fish management and a basis for necessary future investigations.

The subject matter contained in these reports may be inconclusive. The findings and interpretation are subject to re-evaluation as the work progresses.

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-9-1 Title: Grayling Investigations on Tolsona and Moose Lakes.

Job No: 14-B

Period Covered: July 1, 1968 to June 30, 1969.

ABSTRACT

The number of grayling trapped at Bessie Creek decreased from 3,000 in 1965 to 204 in 1968.

Winter dissolved oxygen concentrations in Tolsona Lake have declined from 4.0 ppm at five feet in 1965 to 1.0 ppm at five feet in 1969.

The majority of grayling in the Tolsona-Moose Lakes system mature at age III; approximately three percent are age II.

In 1967, there was a definite movement of adult grayling from Tolsona Lake into Moose Lake where they assumed residence.

The sex ratio of grayling trapped from Bessie and Our Creeks is approximately 1:1.

Spawning grayling first appear in Our and Bessie Creeks at water temperatures ranging from 34° to 41°F. The single most important factor influencing movement into spawning streams is the disappearance of anchor ice.

Fecundity counts of female grayling ranging in fork lengths from 263 to 316 mm varied from 3,876 to 5,672 eggs.

There have been only slight differences in the fork lengths of grayling trapped in the streams from 1965 through 1968.

Test gill netting indicates grayling populations were increasing from 1960 through 1966. In 1967, sampling indicated a sharp decline in population size and a slight increase in 1968.

RECOMMENDATIONS

One of the purposes of this study was to determine the effects of egg taking on the wild population of grayling in Moose and Tolsona Lakes. It is apparent that this system cannot maintain a fishable population when a million or more eggs are taken each year. Spawning and hatching conditions in Bessie Creek are poor, and natural reproduction is at a minimum. In order to maintain a fishable population of grayling and still allow artificial egg-taking operations to continue, the following is recommended:

1. A minimum of fifty thousand grayling fry should be stocked annually in both Tolsona and Moose Lakes.

2. Effort should be made to maintain the water level of Tolsona Lake. The present maximum depth is only eleven feet. A temporary water-level control structure located at the outlet must be rebuilt. Also, a new outlet has begun to form approximately

75 yards from the present outlet. This newly formed outlet could lower the lake at least one foot if allowed to develop.

3. Because of increased vegetation (emergent and submergent) in Tolsona Lake, dissolved oxygen concentrations are low during the winter months. It is recommended that the use of limited control methods be explored.

OBJECTIVES

1. To determine the number and timing of grayling entering Our and Bessie Creeks for spawning purposes and the factors affecting this movement.

2. To determine the size and age of the spawning grayling.

3. To determine the frequency of spawning.

4. To determine the magnitude of interchange of grayling between the two lakes, if applicable.

5. To determine the composition of the migrant grayling by sex, age and size.

6. To determine the effects of egg taking on the wild population of grayling present in Moose and Tolsona Lakes.

TECHNIQUES USED

1. Traps were installed in Our and Bessie Creeks to capture all migrant grayling from Moose and Tolsona Lakes throughout the spawning migration.

2. All fish were measured to the nearest millimeter, and all lengths are fork lengths.

3. Scale samples were taken for age composition analysis.

4. Ovaries were taken from sample fish to determine fecundity

FINDINGS

A description of the study area and a summary of resident fish populations were made by Williams (1968). Figure 1 presents a map of the Tolsona-Moose complex and study area.

Bessie Creek

Bessie Creek is a small stream (averages four feet wide and less than one foot in depth) which connects Moose and Tolsona Lakes. The stream is 1,500 feet long and almost devoid of any fish cover. The stream banks are sparsely covered with small willows. The stream is manmade, having been built about 1960 to divert water from Moose Lake into Tolsona Lake.

The thawing and initial flowing of Bessie Creek each spring is regulated by the level of Moose Lake. In 1968, the stream did not begin to flow until May 16, which was the latest date since measurements were initiated in 1965.

The first grayling entered the stream on May 17 when the water temperature was 39°F. In 1966 and 1967, grayling first entered the stream when temperatures were 34° to 36°F.

The Bessie Creek weir was operated from May 10 until May 26 with a total of 204 grayling captured. This is the smallest number of fish to be trapped since 1965 when the weir was first operated (Table 1).

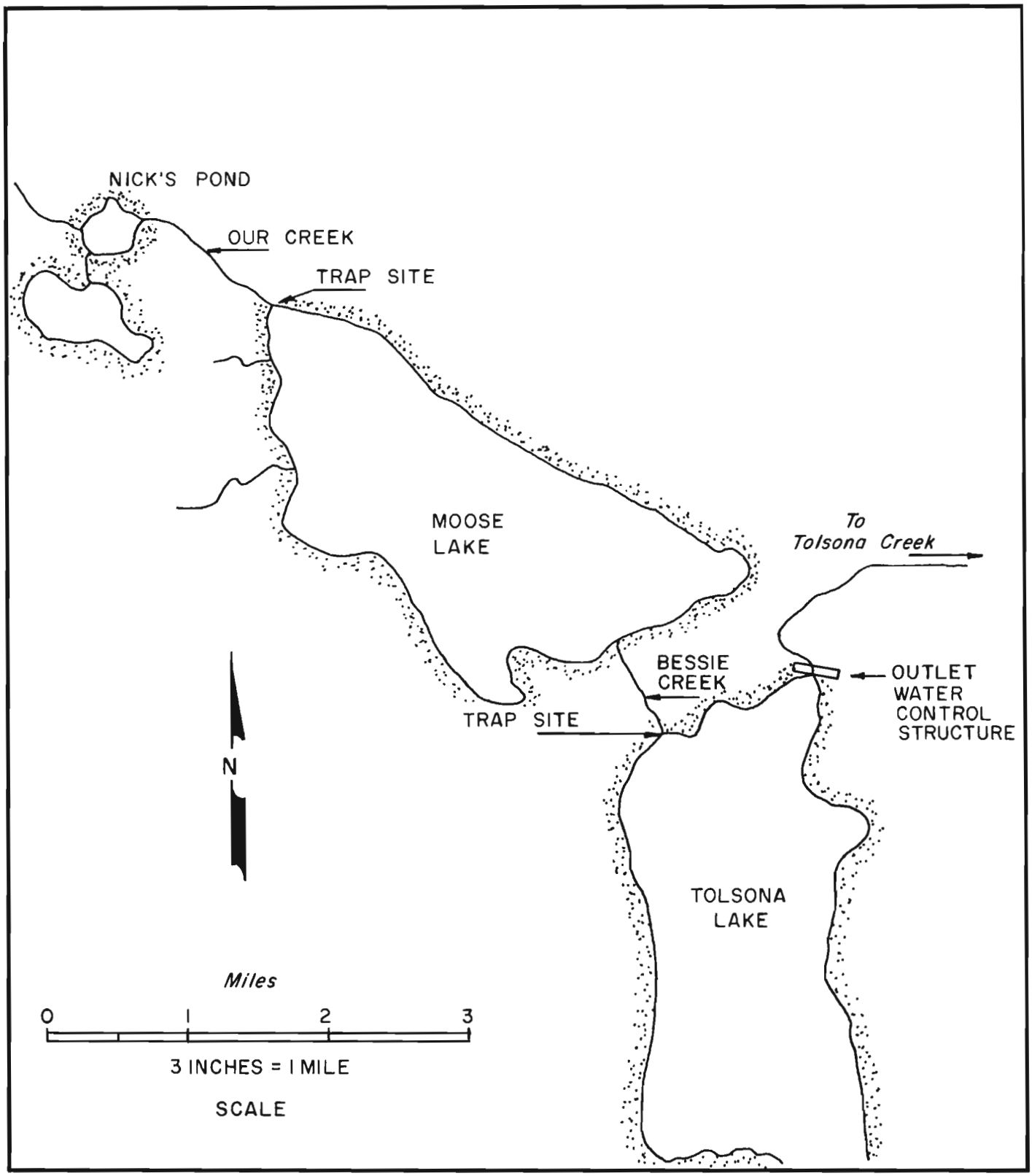

FIGURE 1. MAP OF TOLSONA-MOOSE LAKE SYSTEM.

TABLE 1 - Total Adult Run of Grayling into Bessie Creek from 1965 to 1968.

Year	Total Run
1965	3,000
1966	2,645
1967	671*
1968	204

*Because of severe ice conditions, an unknown number of grayling escaped the trap.

In 1968, it was noted that an estimated 200 grayling spawned in Tolsona Lake at the mouth of Bessie Creek. This spawning had not been observed during past years.

Our Creek

Our Creek is a narrow (maximum of six feet) stream with undercut banks, heavy shoreline vegetation and numerous brush jams. All of these physical features provide excellent cover even during the daylight hours. Fish are to be found in the stream during all hours of the day and night, and upstream migration from the lake is not restricted to the dark hours as is the case in Bessie Creek.

On May 5, 1968, a fish weir was installed just above the mouth of Our Creek. The first grayling entered the stream on May 10. Water temperature was 34°F (Table 5). The weir operated until May 21, and a total of 1,660 grayling were taken. This is a decrease from 1967 when 2,257 fish were caught.

All grayling were checked for tags and fin clips. Tag and fin-clip recovery data for Our Creek is combined with recoveries from Bessie Creek in Table 2.

TABLE 2 - Recovery of Marked Grayling from Bessie Creek and Our Creek, 1967 and 1968.

				Number Recovered			
Mark*	Number Marked	Year Marked	Marking Site	Bessie Creek	Our Creek	Total 1967	Recovery 1968
Adipose	1,154	1966	Bessie	126	46	172 (15%)	
				14	32		46 (4%)
L. Ventral and tag	178	1967	Bessie	4	16		20 (11%)
R. Ventral and tag	551	1967	Bessie	16	33		49 (9%)
L. Pectoral	2,172	1967	Our	1	413		414 (19%)

*Mark - either the fin was removed or fin removed and tagged with subcutaneous tag.

Table 2 also indicates that most tagged grayling entering Bessie Creek from Tolsona Lake in 1967 continued upstream into Moose Lake. It should be noted that those fish marked only by fin removal showed a higher percentage of return in 1968 than did the fish receiving a subcutaneous body tag.

There is an indication of mortality resulting from the addition of the subcutaneous tag.

In 1965, 1966 and 1967, grayling moved downstream from Moose Lake into Bessie Creek and spawned. This movement did not occur in 1968. Since only one fish tagged at Our Creek in 1967 was recovered at the Bessie Creek weir in 1968, nearly the entire Bessie Creek spawning population must have been made up of Tolsona Lake residents.

The reduction in the number of fish trapped at Bessie Creek is attributed to several factors. Table 2 shows that during 1967, after tagging and marking was completed, there was a significant migration of Tolsona Lake grayling (marked at Bessie Creek) into Moose Lake. The 1968 recoveries of Bessie Creek fish were much higher at Our Creek. These grayling moved into Moose Lake sometime prior to freeze-up in the fall of 1967. Most of the grayling migration occurred in May when the interconnecting stream was open, but the lakes were still ice-covered. No return to Tolsona Lake was possible from October, 1967, until after May 16, 1968, because Bessie Creek was frozen to the bottom. Therefore, the grayling did overwinter in Moose Lake. There was a similar movement of grayling in 1966 from Tolsona to Moose Lake.

Environmental conditions are much better in Moose Lake than in Tolsona Lake, but this condition has prevailed for many years (Williams, 1967). Winter dissolved oxygen concentrations in Tolsona Lake have decreased gradually during the past five years. In 1965, concentrations of dissolved oxygen at five feet were 4.0 ppm. In April of 1969, the winter D.O. was 1.0 ppm.

The amount of submergent and emergent vegetation in Tolsona Lake has increased during the past seven years to the extent that it now covers half of the lake surface area.

From the total of 2,172 fish marked at Our Creek in 1967, only one was recovered at Bessie Creek in 1968. Conversely, of 729 grayling marked at Bessie Creek in 1967, 49 were taken at Our Creek in 1968. Although there is some interchange of fish between the two lakes, it appears to be weighted heavily from Tolsona Lake to Moose Lake.

Egg Take

Fifty-three percent of the grayling trapped at Our Creek in 1968 were females. Two hundred sixty-eight of these females were artificially spawned, and a total of 1,087,000 eggs were taken. The average number of eggs per spawned female was 4,056. These females ranged in length from 231 to 335mm and averaged 276 mm.

Fecundity counts were made from six females that ranged in fork length from 271 to 316 mm and averaged 287 mm. The fecundity counts ranged from 3,876 to 5,672 and averaged 4,866 eggs (Table 3).

TABLE 3 - Fecundity of Grayling from Bessie and Our Creeks, 1966 to 1968.

Year	Source	Number	Fork Length Range (mm)	Average Length (mm)	Count Range	Average Count
1966	Bessie	5		299		4,714
1967	Bessie	8	263 - 342	311	3,952-4,812	4,490
1968	Our	6	271 - 316	287	3,876-5,672	4,866

Table 4 shows that there has been only a slight difference in the average lengths of grayling trapped in Our and Bessie Creeks from 1965 through 1968, although there has been a decrease in relative numbers taken by test netting (Table 6) and in weirs (Table 5). This would indicate that a large percentage of the adult population must be able to spawn in order to maintain a high, fishable population in the two lakes.

TABLE 4 - Fork Lengths of Grayling Trapped at Bessie and Our Creeks, 1965 to 1968.

	Female		Male		
Year	Length Range (mm)	Average Length	Length Range (mm)	Average Length	Source
1965	245 - 375	305		312	Bessie
1966	215 - 351	302	229 - 376	279	Bessie
1967	211 - 322	273	215 - 356	301	Bessie
1967	194 - 335	270	182 - 365	279	Our
1968	231 - 335	276	227 - 351	289	Our

Natural Spawning

Very few observations have been made of natural spawning in Bessie and Our Creeks since most of the grayling were taken in weirs. Bessie Creek is a very small, exposed stream. The deposited eggs are subject to severe damage by fishermen who walk up the stream dragging boats to Moose Lake. In addition, because of a lack of cover, the fry are vulnerable to predation by birds and other fishes. Bessie Creek averages less than one foot in depth and is only four feet wide.

Field observations have noted the presence of large numbers of suckers in Bessie Creek that may prey on loose eggs. Large numbers of burbot have been observed in the mouth of Our Creek during the early summer.

Table 5 shows water temperatures at Our Creek and a large number of grayling entering the trap each day. In 1967, when water temperatures dropped from 40° to 36°F, the number of fish entering the trap decreased significantly. The run increased when temperatures increased to a range of 40° to 44°F.

TABLE 5 - Water Temperatures and Trap Catch of Grayling at Our Creek, 1967 and 1968.

	Water Temperatures*		Daily Catch	
Date	1967	1968	1967	1968
May 9	36	34	--	--
May 10	37	34	220	64
May 11	36	36	60	330
May 12	37	37	126	288
May 13	39	37	220	285
May 14	40	39.5	257	4
May 15	40	38	373	--
May 16	36	38	22	161
May 17	36	39	52	277
May 18	40	40	293	92
May 19	40	42	431	124
May 20	40	44	203	35

*Temperatures of the creek were recorded daily on a Farenheit scale at 8 am.

During 1968 the water temperatures rose steadily from 36°F on May 11 to 44°F on May 20. The number of grayling fluctuated considerably each day and during the middle of the trapping period, only four fish were taken in a 48-hour period.

The relationship of water temperatures and the first in-stream movement of grayling is not distinct. In 1968, in Our Creek the first grayling appeared at water temperatures varying from 34° to 39°F. In Bessie Creek the temperatures varied from 35° to 41°F. From observations made at these creeks, it is apparent that grayling are reluctant to move into the streams until most of the anchor ice is gone. This same behavior has been observed in other streams in the work area.

Population Sampling

Figure 2 and Table 6 show the results of gill net sampling of grayling in Tolsona and Moose Lakes. A considerable increase in grayling populations was apparent in both lakes from 1960 through 1966. However, during 1967, relative numbers of grayling dropped sharply in both lakes. The degree of recovery was very similar in both lakes in 1968. The similarity of population trends in the two lakes is not unusual since the waters are connected by only 1,500 feet of stream which is passable to grayling.

The average length ranges of grayling taken from these two lakes during test net sampling has varied somewhat from year to year; however, in 1968, all of the grayling taken from Tolsona Lake were less than 200 mm in fork length and were age I+. The majority of grayling taken by test netting in 1968 from Moose Lake were age II and III. The lack of older grayling in the nets set in Tolsona Lake is paralleled by the small spawning run of 204 adult grayling into Bessie Creek in 1968.

Twenty-four of the 82 net-caught grayling from Moose Lake in 1968 were marked fish. Thirteen (16 percent) were marked at Our Creek in 1967, ten (12 percent) had been marked at Bessie Creek in 1967 and one (1 percent) had been marked in 1966 at Bessie Creek.

TABLE 6 - Population Sampling Results for Grayling from Tolsona and Moose Lakes, 1960 to 1968.

Year	Number	Average Length (mm)	Length Range (mm)	Net Frequency*
Tolsona Lake:				
1960	19	183	140 - 229	.47
1963	20	251	180 - 343	.56
1965	39	315	193 - 399	2.30
1966	162	307	178 - 414	4.27
1967	5	239	176 - 318	.14
1968	17	135	115 - 195	.50
Moose Lake:				
1960	5	203	152 - 254	.21
1961	131	252	150 - 406	1.00
1964	100	236	157 - 312	2.80
1965	54	315	196 - 373	3.09
1966	130	284	178 - 401	5.03
1967	74	273	138 - 365	1.90
1968	82	279	125 - 355	2.40

*Net Frequency - Number of fish taken per net hour.

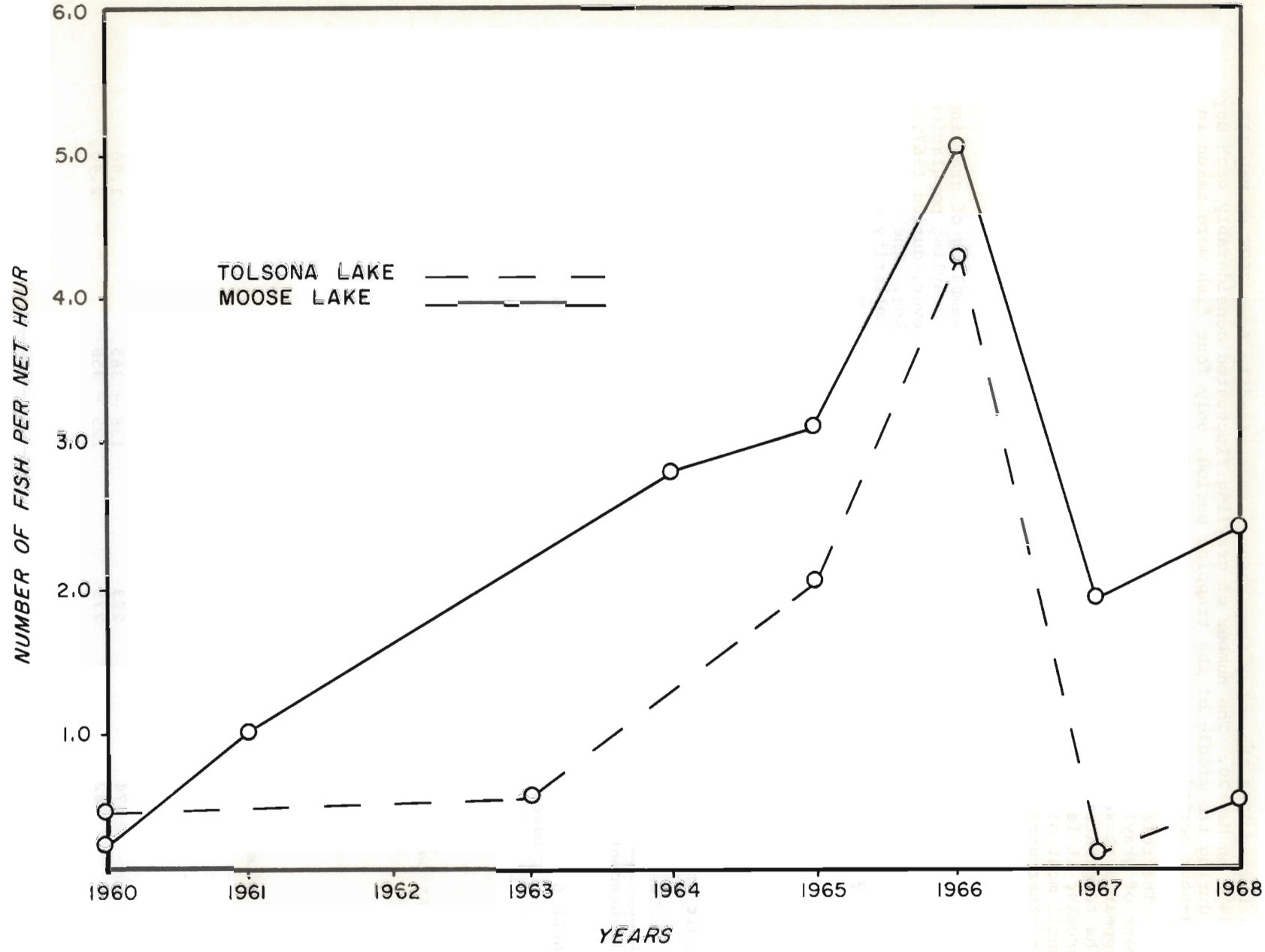

FIGURE 2. TEST NET FREQUENCIES FOR GRAYLING FROM TOLSONA AND MOOSE LAKES, 1960-1968.

Frequency of Spawning

From data collected on returns of tagged and marked fish (Table 2), it is apparent that at least some of the fish do spawn each year. The highest recovery was from the group of grayling marked in 1967 at Our Creek. Ninteen percent of the marked fish returned to the same stream in 1968 and were artificially spawned.

The return of marked fish is considered excellent when such factors as marking and handling mortality, natural mortality and fisherman harvest are considered. It is reasonable to assume that a majority of grayling do spawn each year in this system.

Sex Ratio

The sex ratio of grayling taken in the weirs at Our Creek and Bessie Creek has varied, females to males, from 1.121.0 to 1.0:1.04.

Grayling Populations in Moose and Tolsona Lakes

Data collected in this study show a decline in grayling numbers in both Moose and Tolsona Lakes. In 1965, 17 percent of the mature females taken in the Bessie Creek weir were artificially spawned. In 1966, 26 percent of the females were artificially spawned. In 1967, an unknown number of grayling escaped the trap. During 1968, 16 percent of all mature female grayling taken at Our Creek were artificially spawned. In all cases the remaining females and males were released for natural spawning.

In spite of the relatively large numbers of grayling left to propagate Moose and Tolsona Lakes naturally, it is apparent that this is not sufficient to naturally stock these waters. Spawning conditions vary from good to poor in Bessie Creek and Our Creek because of climatic conditions. Mortality of eggs and fry is probably heavy in Bessie Creek because of a lack of cover and low water.

Although a large percent of the mature females are released from the holding pens in order to spawn naturally, it is probable that the handling of these fish may be detrimental to successful spawning. Females with bloody eggs are not uncommon and are probably a result of rough handling.

A reduction in winter dissolved oxygen concentrations since 1965 and low water conditions in the inlet streams since 1967 have been observed. In addition, fishing pressure has increased, although an accurate measure of this increase is not available.

The number of burbot in these lakes has increased since 1963, and these predators, no doubt, take a heavy toll of grayling in these lakes and streams.

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