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Surveys and Investigations
as required by

Federal Aid in Fish Restoration

Fish and Wildlife Service and Alaska Game Commission

1. Title: Game Fish Investigations of Alaska

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Date: January 17, 1956

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SUMMARY: Federal Aid in Fish Restoration - Alaska
December 31, 1955 Quarterly Progress Report - Project F-1-R-5

Spawning Habits of Grayling

The upstream migration occurred two weeks earlier in 1955 than it did in 1954, and is related to the open (ice free) water occurrance at the mouth of the inlet stream.

The peak of migration in 1955 occurred on June 16 with the total migration extending from May 19 to June 19.

Spawning first occurred on June 18 and continued for five days.

The spawning act was observed and the subsequent egg disposition removed from the gravel contained over 200 eggs.

Downstream migration after spawning began on June 20, but some fish remained in the stream longer than two weeks following this date when the work was discontinued.

Artificially spawned and fertilized eggs were well eyed in fourteen days and hatched in eighteen days with water temperatures fluctuating between 43° F and 49° F. Ninety-eight, or 31.2% of the Grayling tagged in 1954 were recovered in the stream where they were tagged.

Experimental Pond Fertilization

Two lakes were selected in the Juneau area in the same drainage system; one of five acres and the other of three acres. Both lakes are shallow with the deepest having a maximum depth of twenty-six feet. Oxygen measured in March was over 7 ppm, and pH of 6.5.

Survey of Barren Waters

Farewell Lake is located in the McGrath area of Alaska. The lake is oligotropic and has an area of 630 acres and a maximum depth of 162 feet. No fish were taken in a 40 hour set of an experimental gill net.

Stocking of lake trout would appear most suitable for this lake.

Work Plan E, Job No. 1 — Spawning Habits of Grayling in Interior Alaska. By George W. Warner

Introduction

Studies of the spawning habits of grayling by the Dingell-Johnson branch of the Fish and Wildlife Service were begun at Fielding Lake in the spring of 1954 and continued to the summer of 1955. The objective of this work has been to obtain a better understanding of the physical environment of spawning grayling and collect information on the actual spawning. The first year of this study was conducted by Mr. Frank Wojcik, and the second year, by the author.

Fielding Lake is located just west of the Richardson Highway approximately sixty miles south of Big Delta. It is a mountain lake at an elevation of just under 3,000 feet with a surface area of approximately 1400 acres. It is fed by several mountain streams which flow considerable water during the spring snow melt, but carry little water in the summer. Fielding Lake itself is normally frozen over from the end of October to the first of June. The species of fish known to inhabit this body of water include grayling, whitefish, lake trout, burbot, and sculpins.

Although grayling are known to ascend at least two of the Fielding Lake tributaries to spawn, this study was confined to the second tributary above the outlet on the south-east side of the lake due to its accessibility. Figure 1 is a chart showing Fielding Lake and the location of this work.

Procedure

In the spring, 1954 and 1955, an observation station was set up at the inlet of Fielding Lake to gather information on the grayling spawning. Both years, a weir was operated in the inlet to obtain data on migration and composition of run. In 1954, the weir was constructed May 24 and operated until June 12. In 1955, the weir was constructed May 20 and was in operation until July 5. Because of the violent nature of this stream during break-up, the weirs operated in 1954 and 1955 were functional only intermittently. In 1955, considerable difficulty was encountered until June 16, after which, the water flucuations and ice flow were not severe enough to prohibit continuous weir operation.

Afternoon temperatures as well as a daily maximum and minimum were taken of the inlet from May 27 through the spawning period in 1955. Also, pH of the stream was recorded every three days.

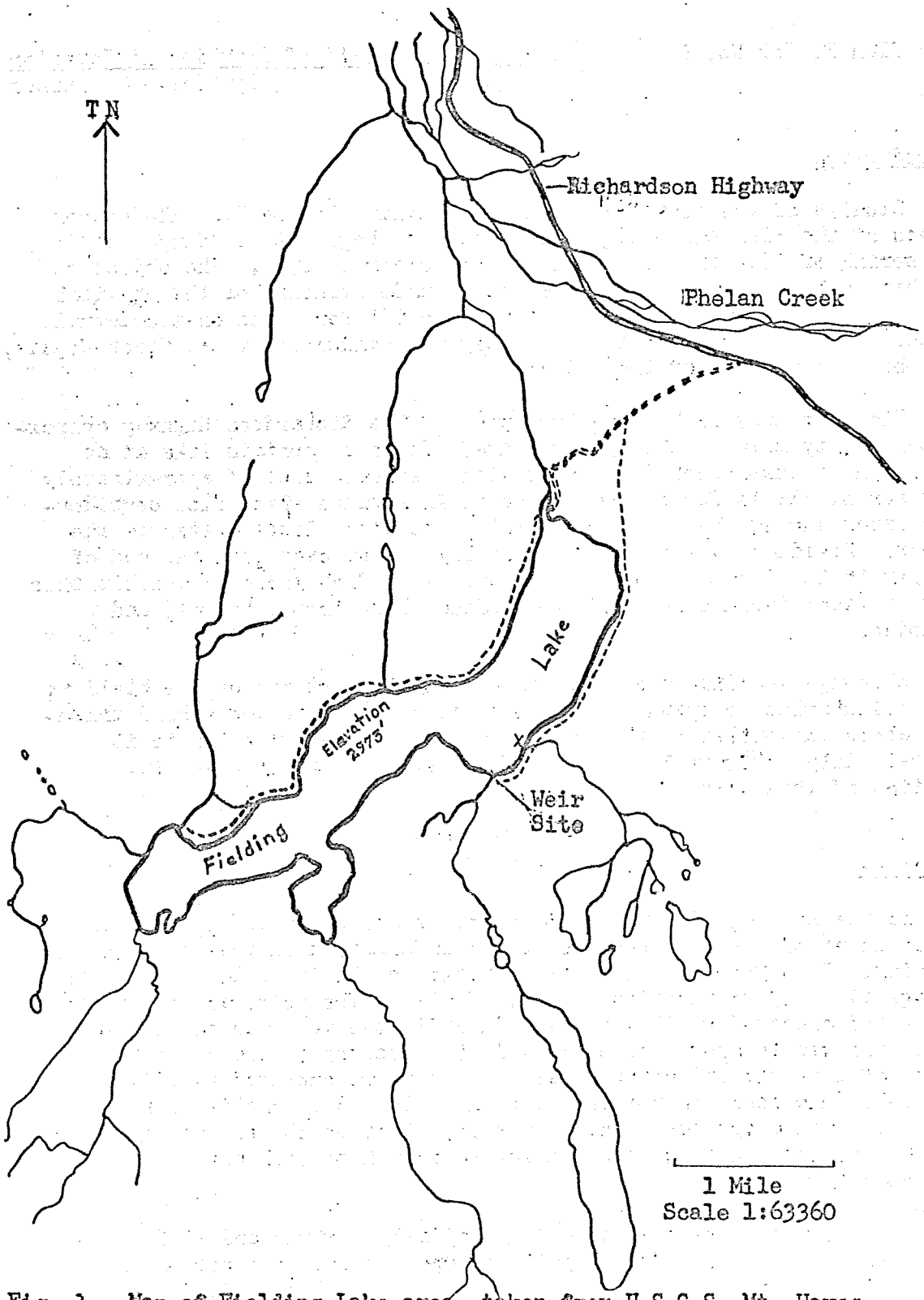


Fig. 1. Map of Fielding Lake area, taken from U.S.G.S. Mt. Hayes (A-4) Quadrangle map.

In 1954, grayling were captured, tagged, and released to trace migration. In this work a white, oval shaped, flutter tags measuring 9/16 inch by 1/4 inch were attached with cadmium wire through the flesh just posterior to the dorsal fin.

In 1955, ovaries were collected from eleven female grayling and used to calculate fecundity. In this work, the ovaries were collected, preserved in formalin, and later dried for counting. The actual calculations were made by weighing several samples of 100 eggs from each fish and then weighing the complete ovaries of each fish. From this, the total number of eggs produced by individual fish was calculated. In this work, all weights were made with a micro-torsion balance.

Spawning Stream. The inlet studied is approximately 1-2/3 miles long and drains another small lake known to contain lake trout and grayling. This stream falls about 300 feet in its length, with most of the drop in the lower 3/4 mile. Through this lower section, the stream bed is composed of rock and gravel. On June 30, 1955, this stream was flowing a volume of approximately 20.3 cubic feet per second. By this date, much of the ice and snow had melted and the stream flow was just a fraction of what it had been during the previous weeks of break-up.

Upstream Migration. The spawning migration of grayling from Fielding Lake into its inlets begins in the spring shortly after open water appears at the stream mouths. In 1955, a pool of water was ice free May 19 at the mouth of the inlet studied. Grayling were first observed at the mouth of the inlet on June 5 when five were taken in a gill net set in the pool of open water. The following day the first fish were observed entering the stream. Grayling continued to migrate into the stream until June 19 with the peak of migration occurring about June 16.

In 1954, an earlier opening of the inlet brought on earlier spawning migration of grayling. This year the migration began about May 15 and continued until June 6. Thus, in 1954 grayling entered the stream at least two weeks earlier than in 1955.

The afternoon water temperature and the daily maximum had begun to rise by the time grayling entered the stream in 1955. On June 5 the afternoon water temperature was 33° F. and June 6 it was two degrees higher. Also, the pH of the water had increased from 6.5 to 6.8 ppm by the time grayling entered the stream.

In 1955, most of the grayling migration occurred at night between the hours of 8:00 p.m. and 4:00 a.m. This was especially true before the peak of the run.

Spawning. In 1955, spawning was first observed June 18, which was fifteen days later than the first observed spawning in 1954. Both years it continued for about five days.

In both 1954 and 1955, spawning occurred while much of the stream was covered with ice and snow. In 1955, approximately 200 yards of the stream just above its mouth was open and above this, the open water was large holes in rotting ice and melting snow.

In the spawning period, the daily flucuations in water level were quite large. During daylight hours, the air temperature was considerably above freezing and much snow would melt causing very high water. The night temperatures dropped to below freezing and the water level would fall to a fraction of the daily high.

Actual spawning was observed in several spots in the stream both in 1954 and 1955. The following is a description of an instance observed June 19, 1955, between 1:20 p.m. and 1:55 p.m. This is believed to be typical of observations made.

The spawning site chosen was a pool of open water a little over fifty feet long. At either end of the pool the stream was covered by ice and six to eight feet of snow. Almost everywhere the banks of the stream were covered by overhanging snow banks so the actual width of the stream was unknown. The opening through the snow was fifteen to twenty feet wide. The water depth varied up to two feet in this open section with the gravel bars approximately 6 inches deep being chosen as preferred spawning sites. The gravel in spawning areas was predominantly quite fine, composed of rocks the size of a pea and larger. The surface current velocity was checked at the time of spawning and found to be 3.9 feet per second. The water temperature was 42° F.

Aggressive males established "territorial rights" and each would defend his area against intruding males. Females spent most of their time in quiet water or under the snow banks. Spawning occurred when a female would leave a resting spot and enter an area occupied by an aggressive male. Then the two fish would press against each other side by side with their heads upstream and vibrate quite violently. This period of vibration which is the period of egg deposition would normally last from five to ten seconds. During this time, frequently an "outside" male would rush into the area and press against either the spawning male or female, presumably also spawning. After each period of egg deposition, the female would return to her resting spot and the "outside" male would depart leaving the aggressive male to his own territory. This activity was observed three times in thirty-five minutes involving the same female and the same aggressive male. After this had been observed three times in the same spot, this gravel was dug up and found to contain over 200 grayling eggs.

There was no indication of the spawning fish digging redds in the gravel and there was no attempt made to cover the spawned eggs with gravel. The eggs were not found to adhere to rocks in the gravel. They seemed to be slightly heavier than the water and would settle among the rocks.

On the afternoon of June 18, 1955, which was the first day spawning was observed, a wire basket made of fine screen and with an opening two feet by two feet square was placed in various spots near the mouth of the stream to detect if grayling eggs were being washed downstream by the current. In this operation, spots were selected where the water was less than one foot deep. In no instance was this net fished in the immediate vicinity of spawning fish. This basket was fished four times for periods of two minutes and the number of grayling eggs captured each time recorded. The maximum catch for two minutes was fourteen eggs and the minimum catch was four eggs. Thus, it appeared that many eggs were being washed down by the current.

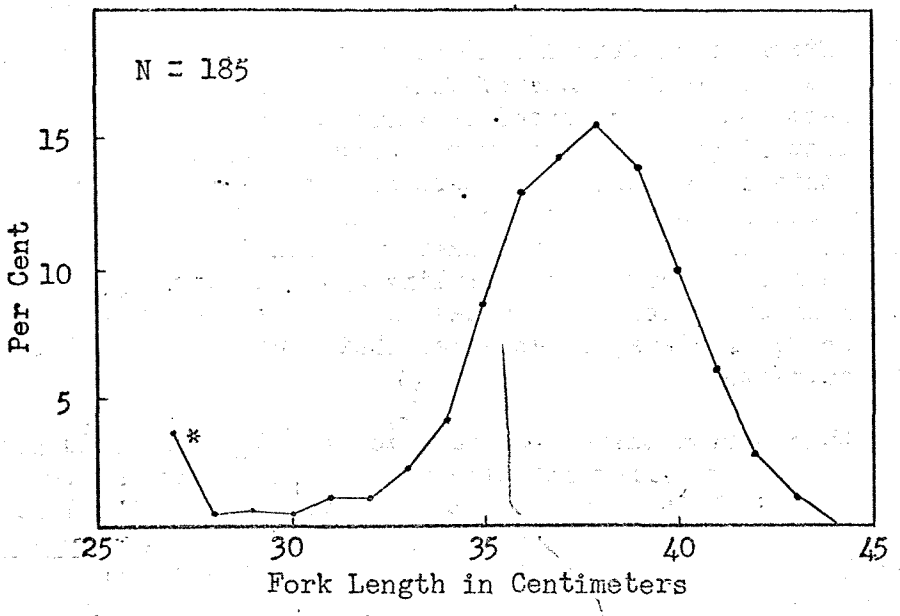
During this period there were data collected which would point to a certain amount of grayling spawning in the lake at the mouth of this inlet. On June 18, 1955, a 60 foot beach seine haul in the lake at the mouth of the inlet yielded many grayling some of which were spawned out and some still spawning. Also, in this seine haul were many whitefish. A stomach analysis of the whitefish disclosed the presence of grayling eggs. At no time were whitefish taken at the weir or observed in the stream.

A gill net was placed along the shore of the lake in a spring fed area, shown by "X" in Fig. 1, to ascertain if spawning grayling were present in this area. This net was fished before and during the time spawning occurred in the inlet. Only immature grayling and whitefish were taken in this net.

Downstream Migration. The downstream migration was first observed in 1955 on June 20, which was two weeks later than in 1954. In 1955, observations were continued for two weeks after the downstream migration began. During this period many fish returned to the lake but at the end of the period, many remained in the stream. A size and age composition was obtained from a sample of 173 of the downstream migrants and believed to be representative of the run. The per cent composition by size for 1954 and 1955 is given in Figures 2 and 3. The per cent composition by age is given for both years in Figure 4. The age given in this graph is the age in number of winters shown on the scale.

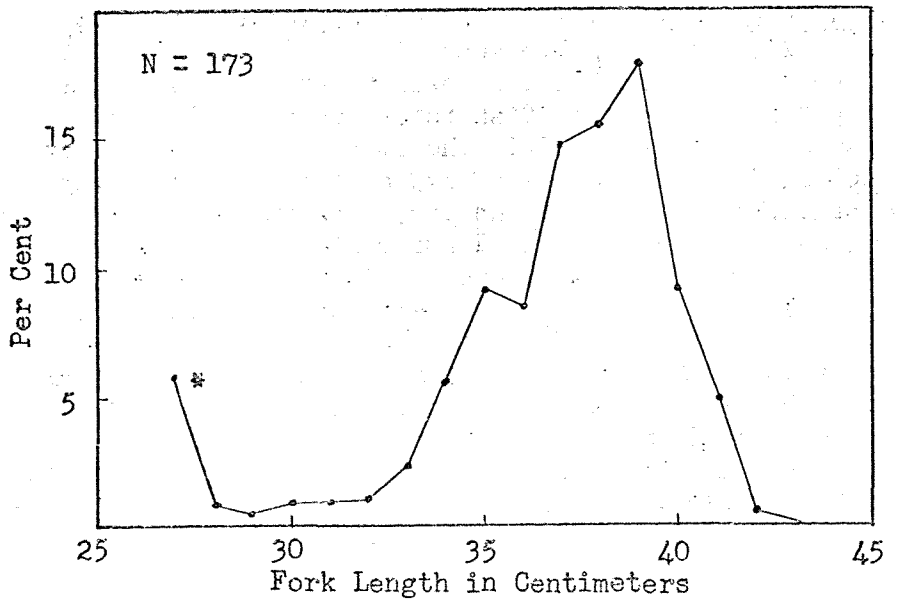
It appears that the size composition of the run was approximately the same for both years. The age composition of the 1955 fish appears more weighted in the six year class than the 1954 fish. This is believed to be caused by the scales being examined by one individual in 1954 and another in 1955. It is not believed to indicate a change in age composition.

Fecundity. Grayling ovaries were collected from eleven spawning females to ascertain the number of eggs produced by fish of various lengths. The fecundity is expressed as a function of fork length in Figure 5. Using the formula $N = FL^X$ in which N is the number of eggs



*All fish with fork length 27 cm. or smaller grouped in this class.

Fig. 2. Size composition of 1954 Fielding Lake spawning run.



*All fish with fork length 27 cm. or smaller grouped in this class.

Fig. 3. Size composition of 1955 Fielding Lake spawning run.

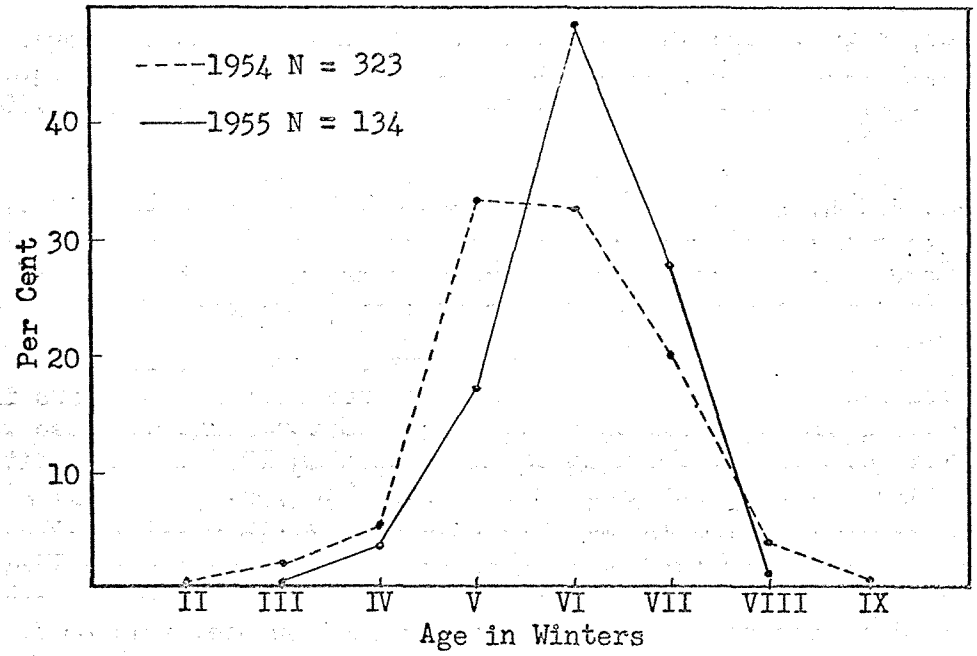


Fig. 4. Age composition of Fielding Lake grayling spawning run, 1954 and 1955.

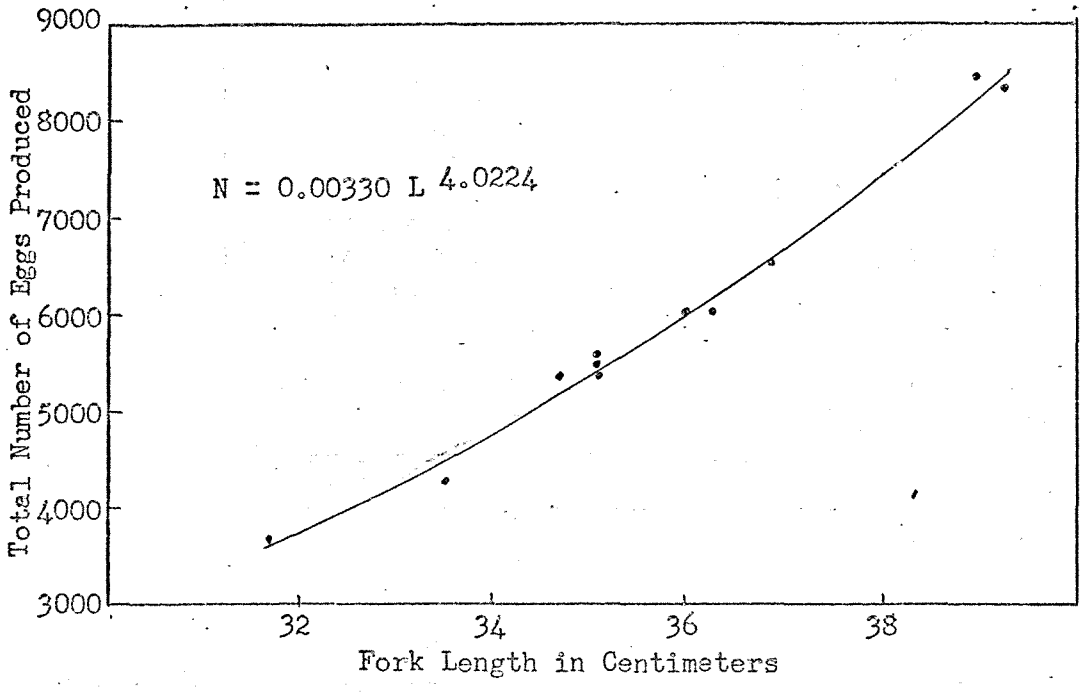


Fig. 5. Egg production of Fielding Lake grayling, 1955.

produced, F is a constant, and L is the fork length to the power x, a line was fitted by the method of least squares. Solving the equation for F and x, it was found that the Number of Eggs produced = 0.0030 X Length 4.0224.

Egg Development. In 1954, approximately 6000 grayling eggs were collected and hatched in the water of the inlet being studied. These were kept at temperatures flucuating from 43° F. to 49° F. These eggs were eyed in fourteen days and hatched in eighteen days.

Tagging. In 1954, 344 grayling were captured and tagged at the inlet studied. Thirty of these fish were recaptured by anglers in 1954 leaving 314 believed to be at large. Sixty-eight of these were taken and released in the upstream migration in 1955 and an additional thirty taken in the downstream migration. Thus, 98 fish or 31.2% of the tagged fish were known to have returned to the inlet to spawn. Age classes four through eight were the only ones in which enough fish were tagged to draw any conclusions. The per cent return of each age class tagged is shown in Figure 6.

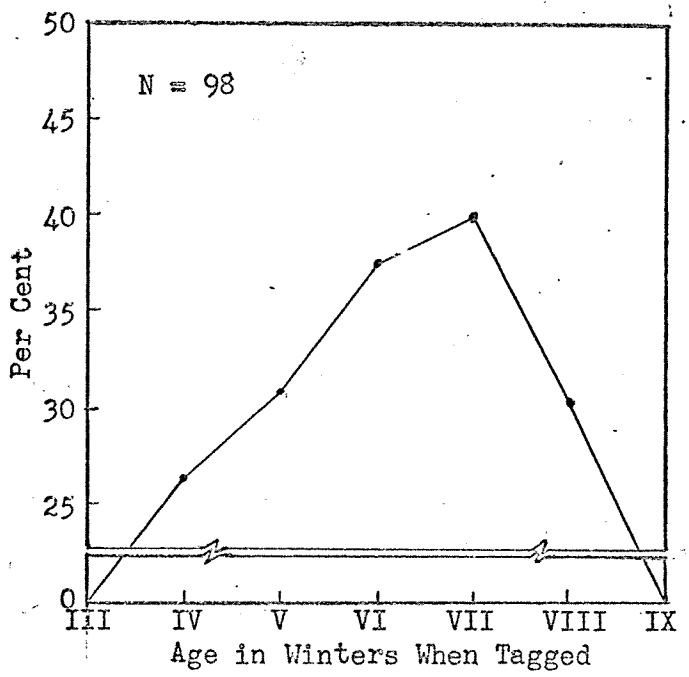


Fig. 6. Per cent tag return of each age class of Fielding Lake grayling tagged during the 1954 spawning run--recaptured during the 1955 spawning run.

It is unfortunate the water conditions prevented the weir from taking every fish in the 1955 spawning run. This would have given a much more complete picture of returning tagged fish. However, a good sample (368 fish) was taken of which 68 fish or 18.5% were bearing tags attached in 1954. In the downstream migration, 273 fish were taken including thirty fish tagged in 1954 and not captured on the upstream migration. From this it is calculated that 907 grayling migrated into the stream. If 18.5% of these were tagged in 1954, this would be a return of 168 fish or 53.5% of the 314 tagged fish at large returning to the spawning stream one year later.

Conclusions

As soon as the water temperatures of the inlets of Fielding Lake begin to rise in the spring, the grayling start their spawning migration. This migration is to a large extent while much of the streams is covered by ice and snow.

Spawning occurs when the maximum daily water temperature reaches approximately 40° F. During this period the pH of the stream is still slightly acid but becoming more neutral.

Spawning appears to take place on shallow gravel bars at a high stage of water. It was observed in 1955 that many of these bars were dry when the water level dropped a few days after spawning. Doubtless, a certain amount of egg mortality resulted.

Although grayling eggs have a slightly higher specific gravity than the water, many were being carried downstream by the current during the 1955 spawning. This probably resulted in some egg mortality.

It appeared in 1955 that many grayling were spawning in the lake at the mouth of the inlet. This may be normal; it may have been caused by a late break-up in the tributary stream; or it might have been caused by the weir blocking their upstream migration. No grayling were found to be spawning in the spring-fed area of the lake shore.

A downstream migration into the lake begins just as soon as the fish have spawned. Not all fish migrate downstream immediately after spawning.

Fecundity appears to have a direct relationship to length of the fish. The number of fish examined in this study was perhaps too few to give significance to the line fitted to the points.

There seems to be a very definate tendency for grayling to return to the same spawning stream year after year. From the tag returns, it is calculated that half of the fish tagged in 1954 returned in 1955.

It is very interesting that the per cent of known tag return for age classes four through eight varied only from 26.7% to 40.0%. It is also noted that per cent recovery when plotted by year class suggests a normal curve. Thus it appears mortality (tagging and natural) follows a definite pattern but is not significantly different among age classes studied.

Work Plan (e), Job Number 1

Experimental
Pond Fertilization
By: Robert T. Baade

Two ponds were selected for the experimental pond fertilization experiment. These ponds lie in the moraine area before the Mendenhall Glacier near Juneau. They are relatively small and easily accessable from the road system. The water exchange is not great in either lake.

The ponds were given names, for clarity, of Glacier and Moraine lakes.

Glacier lake is approximately five acres and has a maximum depth of twenty-six feet. The water is clear and has 7.1 ppm of oxygen at the bottom in late March. There are some shallow weedy areas along the shore line area.

Moraine lake is fed by Glacier lake and is approximately three acres with a maximum depth of fourteen feet and has 7.6 ppm of oxygen at a depth of twelve feet in lake March.

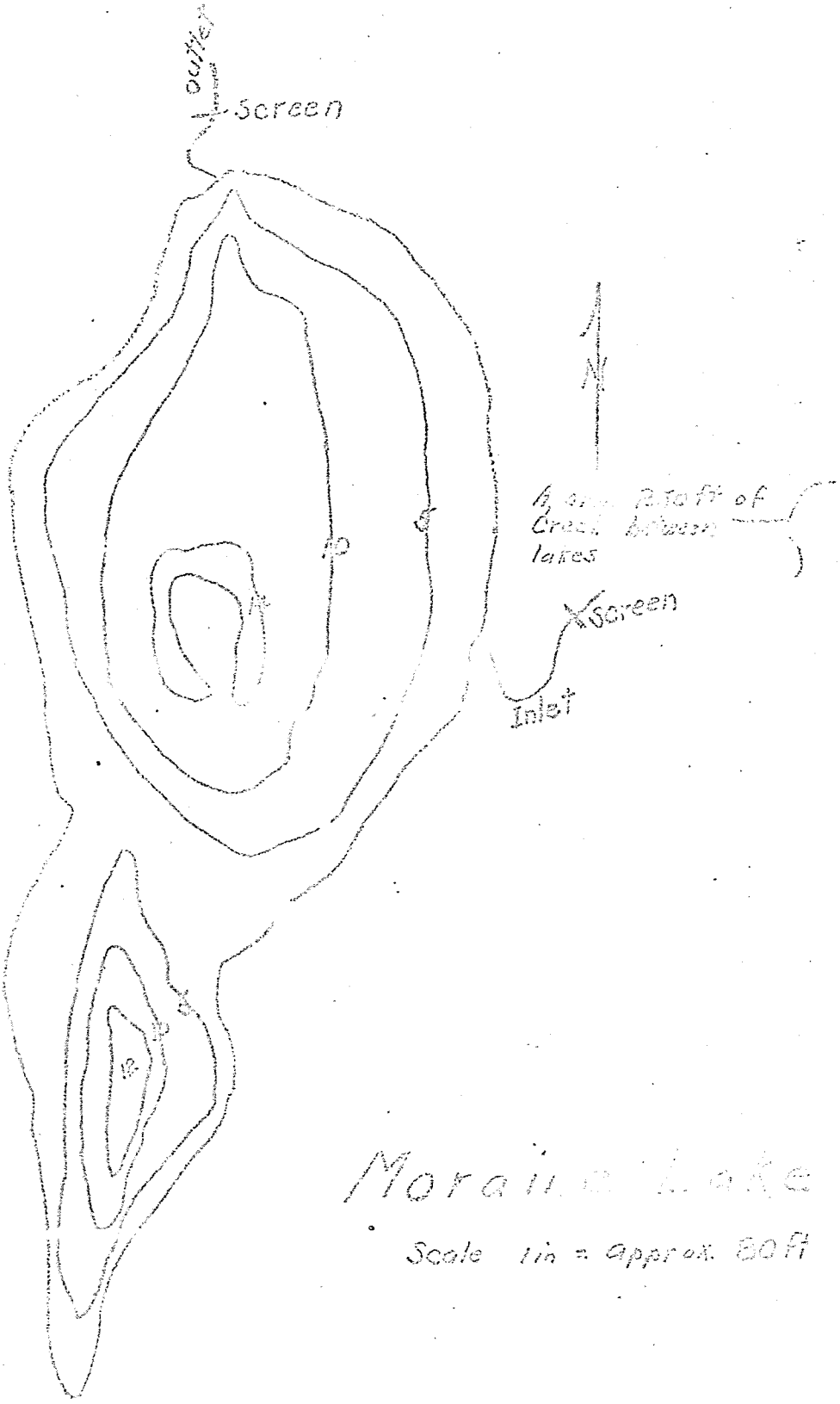
The waters of both lakes have a pH of 6.5, using a LaMotte Color Comparator.

Populations of stickleback and a few juvenile coho salmon are present in the lakes. Both lakes have been planted with a number of rainbow trout fry.

Temporary screens of fine meshed hardware cloth were placed in the outlets of both lakes in July, but were found unsatisfactory as leaves and stickleback made them inoperative. These screens were replaced in October by experimental current-driven rotary screens constructed of plywood.

Glacier Lake

Scale 1 in = approx. 80ft


outlet
screen
N
Creek
lakes
screen
Inlet
Morain Lake
Scale 1in = approx 80 ft

Work Plan (b), Job Number 1

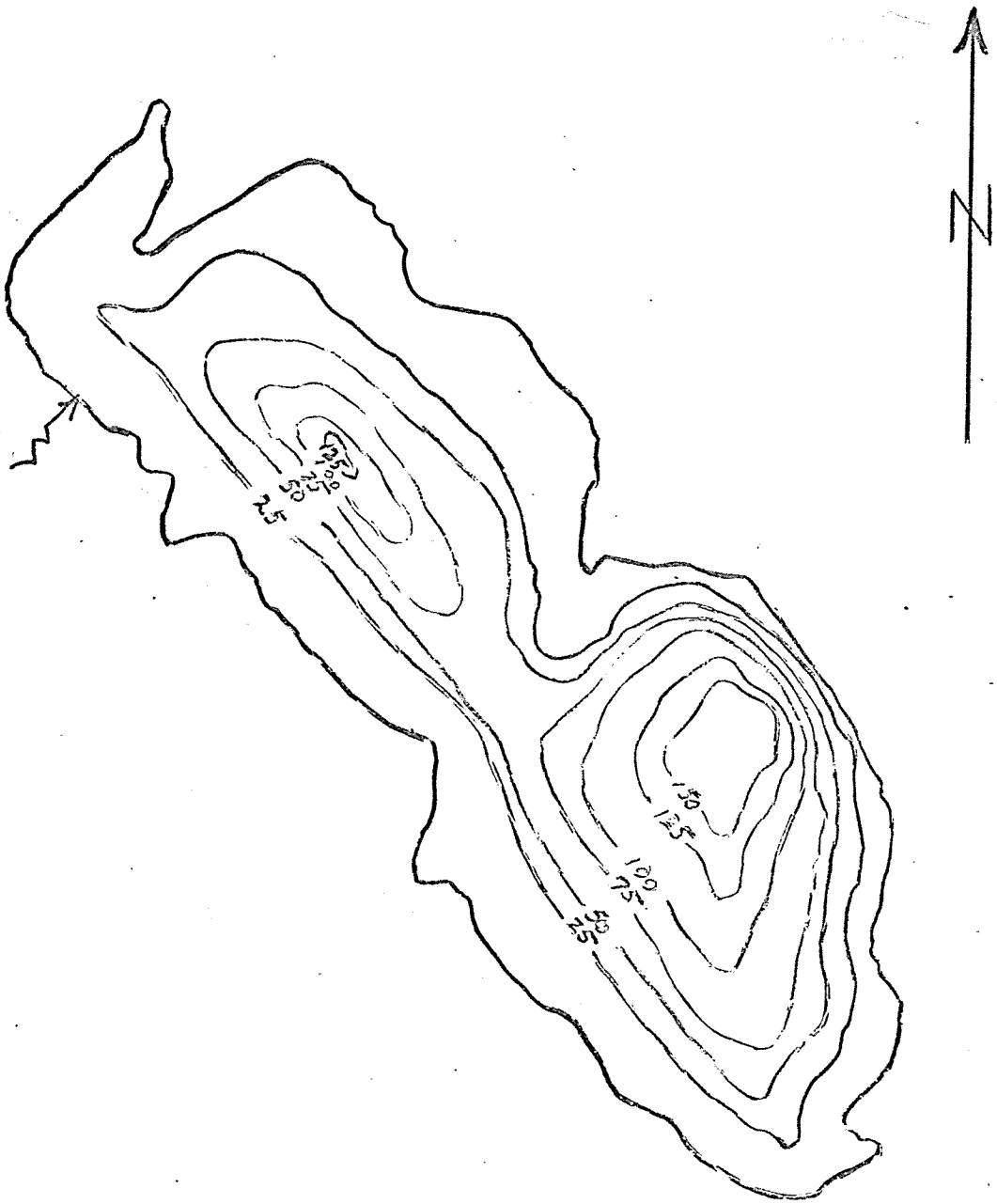
Survey of Barren Waters
Suitable for Stocking
By: Roger N. Allin

Farewell Lake

Elevation	1000 feet msl.
Area	1630 acres
Depth	162 feet
Water	Clear
Bottom	The shore line is composed of rock and boulder which is broken into fine rubble in wind swept shoal areas.
Watershed	The lake lies in a rolling hill watershed of tundra, willow brush and sparce spruce character; draining approximately 4,000 acres.
Aquatic Vegetation	Sparce and composed of pond weeds and stonewort.
Inlets	None Small in. at NE. 75'- small gravel
Outlet	None
Chem-temp.	
Fish	Reported barren. No fish taken in 40 hour set of experimental mesh gillnet.
Critique	An oligotropic lake, deep and with sufficient area. Best defined as lake trout environment with possible introduction of forage fish.

FAREWELL LAKE

Scale = 1 mile



FAREWELL MT.
LANDING FIELD