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STATE OF ALASKA

William A. Egan, Governor

ANNUAL REPORT OF PROGRESS, 1964 - 1965

FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-6

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
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INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-6, "Sport Fish Investigations of Alaska."

The project during this report period is composed of 23 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to pursue the cataloging and inventory of the numerous State waters in an attempt to index the potential recreational fisheries. Four jobs are designed for collection of specific sport fisheries creel census while the remainder of the jobs are more specific in nature. These include independent studies on king salmon, silver salmon, grayling, Dolly Varden, a statewide access evaluation program and an egg take program.

A report concerning the residual effects of toxaphene accumulates the findings of a three-year study. The report presented here terminates this segment and is a final report. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and will assist in the development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

Volume 6 Report No. 16-B

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No.: F-5-R-6 Title: Investigations of the Tanana River Grayling Fisheries, Migratory Study.

Job No. 16-B

Period Covered: June 1, 1964 to June 30, 1965

ABSTRACT

The annual report for 1964-65 will be composed of those sections of data that have been completed during the winter season. In addition to the data presented in this report, large blocks of data encompassing the 1960 through 1964 period were coded for IBM processing or organized for comparison with data sets of other years. This information will become available with the completion of the IBM processing during the next year.

A tag and tag-recovery program was conducted on the Richardson Clearwater, Delta Clearwater, and Goodpaster Rivers in the Big Delta area (4,383 fish were tagged). The growth information and migration patterns are derived from the tag and tag-recovery data. Current analysis indicates a migration trend from the Goodpaster River to the Delta Clearwater and Richardson Clearwater Rivers, a summer upstream movement in the Delta Clearwater, and a random movement during the summer in the Goodpaster. The movements could not be related to size. Comparison of the Delta Clearwater growth rates to those of the Goodpaster show that fish under 9 inches grow faster in the Goodpaster.

A preliminary investigation of current tagging techniques illustrates the effectiveness of the subcutaneous tag. Evaluation of three factors, tag-induced mortality, tag loss, and the detectability of the tagged fish, shows that less than 10 percent loss occurs.

RECOMMENDATIONS

Because of the present lack of knowledge concerning the spawning habits and habital requirements it is recommended that efforts be made to investigate spawning timing, environmental requirements, fecundity and spawning frequency.

In addition, it is recommended that the following objectives be continued:

1. Continue the tag and tag-recovery program to further investigate and document the migration trends and, in addition, continue the determination of growth rate.

2. Initiate efforts to evaluate techniques by which grayling population estimates can be obtained.

3. Continue the evaluation of tagging techniques using these three factors; tagging mortality, tag loss, and tag detectability.

OBJECTIVES

1. To determine the migratory trends of the Arctic grayling in the Tanana River.

2. To determine the ecological factors influencing the migratory behavior of grayling in the study area.

3. To determine the effectiveness of the current tagging techniques.

4. To complete the statistical analyzation of data collected during past segments for incorporation in present evaluation.

   The statistical analyzation of data from past segments was not completed during this work year. While not completed, all of the data from 1960 through 1964 was coded and listed for IBM manipulation and organization. At this time IBM listings have not been analyzed. This phase of the objective will be completed during the next work segment.

TECHNIQUES USED

The fish were captured by using three methods: seine where the stream bottom was smooth and the water less than three feet deep, rod and line in those areas where a seine could not be used, gill net on rare occasions where the river water was deeper than three feet and free of debris.

The seine was 55 feet long, 6 feet deep, with 1/4 inch mesh bag seine. This was the most desirable tool because in restricted areas large numbers of fish could be captured rapidly and with little danger to the fish. It is estimated that approximately one-half of the fish were captured in this manner.

A second tool, rod and line, was utilized to capture approximately one-half of the fish. From the standpoint of time utilized, flyrods and occasionally spinning rods accounted for roughly two-thirds of the total effort. Flyrods with flies accounted for approximately 95 percent of the effort while spinning rods with spinning lures were fished on those occasions when fish could not be taken by flies or the fish could not be reached by flyrods.

Gill netting was used rarely. In most instances, the seine or flyrod and line could be used in the areas. In addition, the fish captured in the gill net were often injured and sometimes killed. Only 17 fish were caught and tagged in this manner.

Once captured, the fish were placed and held in a wire live car (18 inches wide, 2 feet deep and 4 feet long) until a minimum number of fish (25) were collected. The fish were then anesthetized with Tricaine Methanesulphonate (MS-222), tagged ventrally between the pectoral and pelvic fins using a yellow subcutaneous tag, and released at the site of capture. When released, the immobilized fish were placed in a backwater area where water current would not carry them downstream and any immediate mortalities could be observed.

The subcutaneous tags measured 3/16 inch by 7/8 inch. The tags were labeled by 5-digit numbers preceded by an A on one side. The directions "Return ADF&G" were stated on the other.

Each fish captured was tagged and the following information recorded: the tag number, the area the fish was captured, and the fork length of the fish to the closest tenth of an inch.

A scale sample was taken from the fish's left side, lateral and adjacent to the insertion of the dorsal fin. The scales were placed in a coin envelope on which the tag number had been recorded.

All recoveries in this report were crew recoveries. No sportsmen recoveries were integrated into the results because growth rates were calculated from the recoveries and for this purpose sportsmen recoveries are unsuitable. These sportsmen recoveries will be incorporated into the subsequent reports involving movements and migration trends. The recoveries were made incidental to the tagging efforts that continued during the summer.

Richardson Clearwater

The tag recoveries from the Richardson Clearwater illustrate only the tendency to return to the Richardson Clearwater (Table 1). Fish tagged in 1962 and 1963 in the Richardson Clearwater were recovered in 1964 in the Richardson Clearwater. As a result, the magnitude and direction of the movements within the year as well as the timing of the movements are lost.

There is very little possiblity that these fish remained in the Richardson Clearwater during the winter since this would be contrary to the observed over-wintering behavior of the grayling in the Delta Clearwater. Both streams have similar environments; as a result it is anticipated that the fish of the Richardson Clearwater would tend to migrate into the Tanana River as seems to be the case in the Delta Clearwater.

Goodpaster River

As can be seen from Table 2, the majority of the recoveries that were tagged during the 1964 field season show no movement in this system (86 out of 130, or 66 percent). However, both upstream (19 of 130, or 14 percent) and downstream (25 - 19 percent) movements do occur. Table 2 further illustrates and relates the movements to size ranges. Because of the irregularity of the movements it is concluded that the movements cannot be related to size at this time. For example, the 7.0-7.9 group has a tendency to move either downstream or not at all.

However, the adjacent group, 6.0-6.9, exhibits more movements upstream than downstream and the other bordering group, 8.0-8.9, shows movements in both directions. In all cases, except the 10.0-10.9 group, the strongest tendency is to remain in the same area. With these tendencies in mind, the conclusion is made that the movements for this period of this year are random.

The movement data was further broken down into workable time intervals (Table 3). Originally, the intervals were to be two-week periods. However, the great variability of the tag to tag-recovery intervals forced the investigator to set up longer and overlapping intervals to contain both the tag date and the recovery date and yet be able to relate the movements to shorter periods of time than just the summer of 1964.

Adverse weather and high water conditions prevented adequate sampling in June; as a result the movements in June may be larger than Table 3 indicates.

TABLE 1. - Listings of 1964 Grayling Tag Recoveries Showing Years Tagged and River Recovered

River in Which Tagged Fish Were Recovered During 1964	Years in Which Fish Were Tagged					Totals For Each River
	1960	1961	1962	1963	1964	
Richardson Clearwater River	-	-	3	3		6
Goodpaster River	6	-	2	5	174	188*
Delta Clearwater River	7	2	27	20	30	86
Total for Each Year	13	2	32	28	204	
Grand Total for 1964						280

* Includes one unknown (tag number smeared)

TABLE 2. - Correlation of Movement with Size on the Goodpaster River on 1964 Tagged and Recovered Grayling*

Size Range	Up	Down	No Movement
4.0-4.9	1	0	6
5.0-5.9	1	1	5
6.0-6.9	7	2	22
7.0-7.9	0	8	26
8.0-8.9	7	10	21
9.0-9.9	1	1	2
10.0-10.9	2	3	3
11.0-11.9	0	0	1
Total	19	25	86

* This table lists only individuals showing movements greater than 1/4-mile or having been tagged longer than one week at the time of recovery. These restrictions reduce any bias that may enter the analysis. The 1/4-mile limit tends to limit any movement bias due to tagging. The one-week stipulation eliminates the fish that were recovered in the same location several days after tagging, which would bias the no movement group.

TABLE 3. - Grayling Movements Correlated with Time. Fish Tagged and Recovered during these Intervals*

Time Interval	Upstream Movement	No Movement	Downstream Movement
June 1 thru June 30	1	0	0
July 1 thru July 30	2	23	16
July 15 thru Aug. 15	15	51	9
Aug. 1 thru Aug. 30	1	12	0
Total	19	86	25

* The inclusive designation is made to relate movements with specific periods. The overlapping intervals are also designed for this purpose.

The month of July shows slight upstream tendencies and a pronounced downstream movement. The number of downstream migrants may be affected by downstream drift due to the applied anesthetic, Tricaine Methanesulphonate, although efforts were made to eliminate this factor. This element could increase the number of fish participating in downstream movements, but would not influence either the number of fish moving upstream or those showing no movement.

During the mid-July to mid-August period, the upstream movement becomes more pronounced with the downstream tendency diminishing and large numbers of fish exhibiting no movement. By the August 1 though 30 period, few movements occur.

The conclusion is drawn that for the period covered in Table 3, the movements are random. However, it is also concluded that a definite upstream movement occurs prior to this period and that a cycle completing downstream movement appears after the sample interval. Further discussion concerning the movements during the pre- and post-sampling periods will appear in next year's completion report.

Delta Clearwater River

Table 4 shows that the predominant movement is upstream for the sampling period. The tag and recovery dates suggest that the movement begins in June and continues into September. This agrees with the observations made on the river that the number of fish in the river increases about the first of June and decreases in the months of September and October. Fish apparently enter the Delta Clearwater throughout the months of June, July and August and move upstream to the upper reaches of the river where the riffles and deep holes can be found.

TABLE 4. - Intrastream Movement of Grayling in the Delta Clearwater River (1964)

1	Unknown (Tag mutilated)
19	Upstream*
9	No movement**
1	Downstream
30	

* This encompasses tagging dates from June 8 through July 14 and recovery dates from July 13 through September 12.

** All the fish showing no movement were captured less than one week after tagging.

In summary, the fish of the Delta Clearwater move upstream during the sampling period while the Goodpaster fish exhibit both upstream and downstream tendencies with the majority of fish showing no movement. The movements of the Goodpaster fish are considered to be random while the movements of the Delta Clearwater fish are considered directional. Apparently the fish that enter the Delta Clearwater move up the river to establish an area of summer residence. This directional tendency is not noted in the Goodpaster because the upstream migration occurs earlier in the season and is masked by the high water of breakup. By the time water conditions permit adequate sampling, the population has established the area of summer residency. Thus, the sampling period does not encounter the spring migration but does encompass that period when individuals are changing locations, at which time the population per se has established a residency and undergoes little net change by the individual movements.

Interstream Movement

No. of Occurrences	Tagged Area	Recovery Area
7	Goodpaster River	Delta Clearwater R.
4	Clearwater Lake	Delta Clearwater R.
1	Delta Clearwater River	Clearwater Lake

The only interstream system trends that appeared in 1964 were tendencies for the fish to move from the Goodpaster River and the Clearwater Lake area into the Delta Clearwater River. These two movements account for 11 out of the 12 interstream movements; the remaining fish traveled from the Delta Clearwater River into the Clearwater Lake area.

The trend for Goodpaster fish to migrate to the Delta Clearwater has appeared for several years. Further statistical analyzation will follow when the IBM coded data is completed. Very little possibility exists that this movement is occurring randomly. Few Delta Clearwater River tagged fish are recovered in the Goodpaster. If these movements were random, the latter movement should also appear.

This conclusion is supported by spawning location data. To date, no ripe fish or young-of-the-year have been collected in the Delta Clearwater. Fish that have spawned recently have been collected but these fish apparently have spawned in another stream. By contrast, the Goodpaster River supports a large population of spawning fish and large numbers of young-of-the-year are present each year. With the absence of ripe fish and

offspring in the Delta Clearwater, the presence of these two groups in the Goodpaster and a documented Goodpaster emigration and Delta Clearwater immigration, the conclusion may be made that the Goodpaster is supplying the Delta Clearwater with some of its fish.

The possibility exists that the adults spawn in the Goodpaster and move to the Delta Clearwater and Richardson Clearwater Rivers. If this is the case, the Goodpaster River serves as a rearing area for the offspring of the adults that take summer residency in the Delta Clearwater and the Richardson Clearwater Rivers.

All 12 of the recoveries were made the summer following the year in which the fish were tagged. This suggests that the fish may congregate in the Tanana during the winter. In early spring, the collection of fish apparently dissipates with some fish homing to the stream of birth and others entering different streams.

Growth Rates

Numerous ecological factors could affect the migratory behavior of the grayling. One of the most evident is the abundance of food. This study utilizes growth rates as an indicator of food abundance. Two different growth parameters were used to relate growth to size and to particular rivers.

Table 5 relates the inverse relationship of percent of increase to size. As is illustrated, the largest percent of increase (33.61) is shown by the 5.1 through 7.0 group. This rate gradually decreases with increased size until the 13.1 through 14.0 and 14.1 through 15.5 groups average about 3 percent.

The greatest decrease is present between the 8.1-to 9.0-inch group (22.73 percent) with the 9.1-to 10.0-inch division showing a decrease of roughly 9 percent. It is possible that the relatively large decrease is related to sexual maturity and consequent spawning activities which begin to appear in fish of this size. In subsequent years, a large part of the energy intake is probably directed toward reproduction rather than growth.

The fish do show different growth rates in the Delta Clearwater and the Goodpaster Rivers. No samples were collected from the Richardson Clearwater. As Table 6 shows, the sample size from both streams is small. However, a trend can be seen. The Goodpaster River data indicate a growth of .19 inches per week for the 4.1- to 5.0-inch group and the 5.1- to 6.0-inch group, while the 5.1- to 6.0-inch group from the Delta Clearwater shows a growth of .12 inches per week. The growth rate in the Goodpaster system declines until it reaches a rate of .10-inch/week

for the 10.1 to 11.0 group while the Delta Clearwater data seem to hover at about the .10 range. The comparatively high growth increment shown by the small grayling in the Goodpaster may indicate that the Goodpaster River is more suitable for the small grayling than the Delta Clearwater, while the reverse condition may exist for the larger fish (8.1-9.0 and up). The migration patterns seem to suggest this, too.

The growth illustrated here may be affected by a growth-lag factor after tagging. However, if this situation exists, it does not affect the analysis because the samples frmm both rivers would be affected in the same manner. Thus, both groups would be analyzed with the same bias involved. The absolute growth exhibited in the tables would be lower than the growth actually experienced, in which case the percent of increase listing would be a minimal estimate. Since these rates are not being used to calculate or extrapolate annual growth no bias will result.

TABLE 5. - Grayling Growth Rates - Rate of Increase (Percent) by Size Group. Delta Clearwater and Goodpaster Rivers.

Size Range	No. in the Sample	Percent of Increase
5.1 thru 7.0	N= 4	x = 33.61%
7.1 thru 8.0	N= 6	x = 29.01%
8.1 thru 9.0	N=12	x = 22.73%
9.1 thru 10.0	N= 7	x = 13.92%
10.1 thru 11.0	N= 8	x = 12.89%
11.1 thru 12.0	N= 7	x = 6.16%
12.1 thru 13.0	N= 2	x = 4.07%
13.1 thru 14.0	N= 6	x = 2.91%
14.1 thru 15.5	N= 2	x = 3.73%

The tag to tag-recovery interval is greater than 10 months but less than 13 months and encompasses the summer growth interval.

$$\text{Percent of Increase} = \frac{\text{Amt. of Growth}(\text{Recovery Lgth.} - \text{Tag Lgth.})}{\text{Tag Length}}$$

TABLE 6. - Growth of Grayling - Average Rate of Increase (Inches Per Week) by Size Group and River*

Size Range (Inches)	4.1-5.0	5.1-6.0	6.1-7.0	7.1-8.0	8.1-9.0	9.1-10.0	10.1-11.0	11.1-12.0
Goodpaster	.19	.19	.15	.10	.08	.09	-	-
Number in Sample	7	3	24	24	24	4	6	-
Delta Clearwater	-	.12	.10	-	.15	-	-	.07
Number in Sample	-	2	1	-	2	-	-	1

Size Range (Inches)	12.1-13.0	13.1-14.0	14.1-15.0
Goodpaster	-	-	-
Number in Sample	-	-	-
Delta Clearwater	.10	.000	.06
Number in Sample	9	1	2

Richardson Clearwater - No Samples

*These rates have been calculated from fish tagged and recovered during the summer field season of 1964. The week interval is the smallest unit of time that shows measurable growth and, in addition, is a usuable time interval to allow comparison of the sample from the two rivers.

Effectiveness of Tagging Techniques

The effectiveness of current tagging techniques is contingent upon three factors: mortality induced by tagging, retention of the tags and the detection of the tagged fish.

Tag-induced mortality was not tested this season, but controlled experiments were conducted in previous field seasons. In these tests two groups of grayling, tagged and untagged, of all sizes were held under observation for three days. At the end of the test, both groups of 50 fish had suffered no mortality. This test set was administered when the water temperatures ranged from 42° to 48°.[1] Additional observations are available since all tagged and anesthetized fish are released in slow water areas to assure the recovery of the fish and to prevent movement downstream while immobilized. Occasional losses of fish have been recorded and have been attributed to excessive anesthetizing and warm water temperatures. When the water temperature climbs to 55° or warmer, the amount of anesthetic that is used becomes extremely critical. The same amount of anesthetic that kills fish at 55° in less than 10 minutes will not immobilize the fish at 48°. If the water temperature limit is watched, little danger exists and minimal mortality is found. In the 1964 tagging year, 12 fish out of 4,383, or less than 1 percent, were killed while tagging.

The second problem, that of tag retention, was investigated during the 1964 field season. All the fish that were tagged during the year were examined for tag scars that were either recent or from previous years. A total of 3 fish with tag scars was found out of the 4,200 tagged and the 280 recovered. This data was collected from the Delta Clearwater, Richardson Clearwater, Goodpaster Rivers, and the Tangle Lake area. When compared to the number of recoveries, the loss rate is approximately 1 percent. On the Chatanika River, a previous study area, loss was 3 percent. This increase in the rate is attributed to the comparatively large numbers of small grayling (4"-6") that were tagged on the Chatanika.

The tendency of small fish to shed the tags is apparently due to a combination of interrelated factors. On small fish the tag slot (a separation of layers of epidermis in which the tag is placed) occupies the complete ventral surface from the pectoral fins to the pelvic fins. Movement by the fish, with subsequent bending of the body, causes the tag to rub on the tissue. Small amounts of blood may appear shortly after the tagging operation. Apparently the presence of the wound and abrasion by the tag against the weakened tissue causes an agitation that may result in a blister which then ruptures, leaving a tear in the tag slot that allows the tag to slip out.

1 All temperatures given are Fahrenheit.

The third factor affecting the effectiveness of the tagging techniques is the ability to detect the tagged fish. This involves both the tag and recovery crews and the anglers. In most instances the tag is easily discovered by the recovery crews. Some fish, 14 inches and larger, may have great amounts of pigment on the ventral surface which occasionally obscures the tag. However, the heavily pigmented fish represents a small percent of the total and a scar is usually present, so this is not an extremely important factor.

Detections do not apparently pose a serious problem for the recovery crews or anglers. The recovery crews creel censused anglers whenever possible. In most instances the fishermen had detected the tags. Occasionally fishermen were censused that had not discovered the tags (3 fishermen out of 48). While 3 out of 48 fishermen missed tagged fish, the number is insignificant because these 48 fishermen examined approximately 350-400 fish but missed only 3 tagged fish and recovered 63 tagged fish. This results in a loss rate on tagged fish of approximately 5 percent.

In conclusion, the current tagging and recovery techniques are effective. Some mortality appears during tagging, a few tags are lost due to skin ruptures and occasionally tags are not detected when tagged fish are captured. However, the total loss due to these three factors is well below 10 percent, resulting in the conclusion that the current tagging techniques are effective.

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A scenic and relaxing atmosphere as well as fine fishing is provided the Alaska sport fisherman.