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STATE OF ALASKA

Walter J. Hickel, Governor

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FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-8

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
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INTRODUCTION

This report of progress consists of findings and work accomplished under the State of Alaska Federal Aid In Fish Restoration Project F-5-R-8, "Sport Fish Investigations of Alaska."

The project during this report period is composed of 20 separate studies. Some are specific to certain areas, species or fisheries, while others deal with a common need for information. Each job has been developed to meet the needs of various aspects of the State's recreational fishery resource. Seven jobs are designed to pursue the cataloging and inventory of the numerous State waters. These are divided into logical utilization areas and are jobs of a continuing nature. It will be many years before an index of the potential recreational fishing waters is completed. Six jobs are directed toward specific sport fish studies. These include special efforts toward the anadromous Dolly Varden of Southeastern Alaska, silver salmon in Resurrection Bay, king salmon stocks on the lower Kenai Peninsula, king and other salmon stocks in Upper Cook Inlet, and Arctic grayling and sheefish in Interior Alaska. Special reports have been prepared on specific phases of the Dolly Varden life history and appear in the Department's special "Research Report" series.

The Statewide access evaluation remains one of the most important jobs conducted under this Federal Aid Program. It provides the Department with a tool to recommend withdrawal of suitable access sites on potential recreational fisheries throughout the State.

The remaining jobs include creel census efforts on specific fisheries in high use areas of the State, an egg-take program directed toward locating suitable indigenous stocks, perfecting advanced techniques in taking, handling and rearing species that are not normally associated with standard fish cultural practices, and continuation of the evaluation of the Fire Lake System.

The material contained in this report is often fragmentary in nature. The findings, evaluations and interpretations contained herein are subject to re-evaluation as the work progresses and additional data are collected.

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-5-R-8 Title: Investigations of the Tanana River and Tangle Lakes Fisheries: Migratory and Population Study.

Job No: 16-B

Period Covered: July 1, 1966 to June 30, 1967

ABSTRACT

During the 1966 field season 3,779 Arctic grayling were tagged under this project. The majority of these fish, 2,785, were tagged in the Tangle Lakes complex, with lesser numbers tagged in the Delta Clearwater River, Clearwater Lake, Goodpaster River, and the Chena River.

Data from the 1966 tagging program are incorporated into the sections on population trends and interstream migrations.

Population trends of catchable size grayling in the Delta Clearwater River from 1960 through 1966, and in the Tangle Lakes, 1964 through 1966, are presented. No reduction in average size of the grayling in these populations is demonstrated, indicating no excessive angler harvest or other factors adverse to maintenance of these populations. Population estimates, however, were not obtainable from these data.

Interstream migratory trends of grayling in the Tanana River complex, 1960 through 1966, are summarized. The conclusion is made that the Goodpaster River and probably Shaw Creek serve as "nursery" streams for the Delta Clearwater and Richardson Clearwater rivers, providing a substantial portion of the grayling in these clearwater streams.

Growth of grayling in the Tanana River complex was calculated using both summer and winter growth. The former rate is approximately ten times greater than the latter and the yearly growth increment may approach two inches.

Validity of the scale method of aging was determined. This method was found quite reliable for fish up to three years of age, but loses accuracy beyond this age.

A presentation is made of spawning time and temperature for various waters in the Interior. A strong correlation of water temperatures with onset of spawning was noted.

Limited work on the Chena River during 1966 provided little data; however, a full-scale investigation of this river is scheduled for 1967.

RECOMMENDATIONS

It is recommended that this study be continued with emphasis on the following aspects:

1. Efforts be made to incorporate additional collection tools and methods into the study which will permit reliable population estimates to be made of the various waters of the study area. In particular, a trial program to test the efficiency and suitability of various electro-fishing devices should be initiated.

2. The grayling populations of the Goodpaster River, and as time permits, the Tangle Lakes system be further studied emphasizing population estimation, angler utilization and determination of growth rates.

3. Incidental to the above investigation, collect data on timing and area of grayling spawning, and natural movements of grayling within these systems.

4. An extensive pre-impoundment study be initiated on the Chena River to determine population levels and dynamics, and present angler utilization.

OBJECTIVES

1. Obtain population estimates on the Goodpaster, Delta Clearwater, Richardson Clearwater rivers, Shaw Creek and Tangle Lakes.

2. Investigate early life history - spawning areas, spawning dates, fecundity on different streams and systems.

3. Determine the importance of the migrations from Shaw Creek and the Goodpaster River to the Delta Clearwater and the Richardson Clearwater rivers.

4. Determine areas of overwintering in the Tanana River area.

5. Calculate age, growth, and compare scales on large fish from Tanana area to other areas.

6. Investigate the migration trends and the size of the grayling population in the Chena River above and below the proposed flood control dam.

TECHNIQUES USED

Grayling were captured using three tools: seine on streams with relatively smooth bottoms and water depths less than four feet; gill net in deep or dirty water; rod and line in areas of high fish concentration where seining was impracticable.

A bag seine (55 feet long, 6 feet deep, with 1/4-inch mesh) was the most desirable tool, as large numbers of fish could be taken rapidly in restricted areas.

Fly fishing and occasionally spin fishing were employed to capture approximately one-half the total fish and accounted for about two-thirds of the total effort of all tools.

The third tool, a monofilament gill net (125 feet long, 6 feet deep, of one inch bar measure) was used only infrequently as fish captured by this method were often injured or killed.

Fish captured were tagged on the ventral surface between the pelvic and pectoral fins with a yellow subcutaneous plactic tag and released at the site of capture.

The following information was recorded for each fish tagged: tag number, area and date the fish was captured, and fork length to the closest tenth of an inch. A scale sample was taken from the fish's left side, lateral to the insertion of the dorsal fin. The scales were placed in a coin envelope on which the tag number had been recorded.

FINDINGS

Population Trends of the Delta Clearwater River and Tangle Lakes

In the 1966 field season 3,779 Arctic grayling, Thymallus arcticus, were captured, tagged and released. The majority of these fish, 2,785, were from the Tangle Lakes system, while 560 were tagged in the Delta Clearwater River, 183 in Clearwater Lake, 192 in the Goodpaster River and 59 in the Chena River.

Data from 1966 Delta Clearwater River and Tangle Lakes caught grayling are incorporated into Tables 1 and 2. These waters are the most accessible waters of the study area and as such may be most susceptible to angler over-harvest.

Table 1 presents comparative length frequency data for all Delta Clearwater River grayling 6.5 inches and larger, tagged by this project's crew from 1960 through 1966. Although considerable numbers of grayling below this size were captured in several of these years, these smaller fish were excluded from the table for two reasons: (1) Unequal sampling effort was expended from year to year for these smaller fish, which are captured primarily by seine. Variations from 0.6 percent to 42 percent of the total fish captured yearly during this period were 6.4 inches or less in length. Inclusion of these fish would tend to bias the relative percentages of larger fish taken in these years. (2) A minimum length of 6.5 inches more nearly represents the fish available to the angler since fish smaller than this are not usually taken by rod and line and certainlly cannot be considered desirable to the angler.

TABLE 1. Length Frequency of Delta Clearwater Grayling 1960-1966.

Length Class (Inches)	Year 1960 No.	1960 %	1961 No.	1961 %	1962 No.	1962 %	1963 No.	1963 %	1964 No.	1964 %	1965 No.	1965 %	1966 No.	1966 %	Mean Percent 1960-66
6.5-8.4	418	20.0	61	19.1	371	34.2	51	10.4	106	29.3	58	20.6	69	17.9	21.6
8.5-10.4	923	44.1	105	32.8	544	50.1	155	31.6	93	25.7	96	34.2	224	58.0	39.5
10.5-12.4	564	26.9	75	23.4	116	10.7	193	39.3	96	26.5	90	32.0	77	20.0	25.5
12.5-14.4	165	7.9	68	21.3	45	4.1	69	14.1	48	13.3	25	8.9	14	3.6	10.5
14.5-16.4	23	1.1	10	3.1	10	0.9	22	4.5	17	4.7	12	4.3	2	0.5	2.7
17+	1	0.05	1	0.3	--		1	0.2	2	0.6	--		--		0.2
Totals	2,094		320		1,086		491		362		281		386		

While these length frequency data could not be used to give estimates of the total grayling population of the Delta Clearwater River, they do demonstrate that this population has remained relatively stable in the various size classes. Thus it is probable that no overharvest or other adverse conditions are affecting this population.

In five of the seven years, the 8.5-inch to 10.4-inch fish constitute the most numerous size class and average nearly twice as numerous as the next smaller size class (6.5" - 8.4"). The reason for this is unknown but may reflect an in-migration from other streams at this size range. This in-migration tendency is further discussed in the section on interstream migration.

Table 2 presents comparative length frequency data for all 6.5-inch and larger grayling tagged in the Tangle Lakes from 1964 through 1966.

TABLE 2. Length Frequency of Tangle Lakes Grayling 1964 - 1966.

Length Class (Inches)	Year 1964 No.	1964 %	1965 No.	1965 %	1966 No.	1966 %	Mean Percent 1964-66
6.5-8.4	551	60.1	391	42.9	878	57.8	53.6
8.5-10.4	278	30.3	281	30.9	336	22.1	27.8
10.5-12.4	69	7.5	113	12.4	200	13.2	11.0
12.5-14.4	13	1.4	124	13.6	91	6.0	7.0
14.5-16.4	6	0.7	2	0.2	14	0.9	0.6
Totals	917		911		1519		

Sampling effort from year to year was somewhat more consistent than on the Delta Clearwater River; however, fish smaller than 6.5 inches again showed extreme fluctuations in percent of total fish captured - varying from 9.3 to 45 percent of the total fish taken in any year. For this reason, and to allow a more direct comparison with Delta Clearwater length frequency data, only 6.5-inch and larger fish are included in the Table.

In contrast with the Delta Clearwater data, the Tangle Lakes population shows a more normal length frequency distribution with the smallest length class (6.5 - 8.4") nearly twice as numerous as the next larger group. This is to be expected in an isolated system such as the Tangle Lakes, with no possibility of in-migration from other waters.

Percentages of the various size classes are relatively consistent (with the exception of the 12.5" - 14.4" group) and indicate no decline in average fish size over the three-year period. The overly large percentage of 12.5- to 14.4-inch fish in 1965 quite possibly reflects a change in sampling area as water conditions in 1965 permitted more sampling effort in the lower Tangle Lakes area where a somewhat greater number of large grayling are found.

Comparision of Delta Clearwater to Tangle Lakes data is made difficult by the inordinately large class of 8.5- to 10.4-inch fish which seem to immigrate to the Delta Clearwater River each year. However, it is apparent that the Delta Clearwater has a considerably greater percentage of large fish than the Tangle Lakes. This is probably due to the influx of 8.5- to 10.4-inch fish to the Delta Clearwater rather than any pronounced difference in growth rates between the two populations.

The percentages of various size classes in these two waters must not be construed to be a representation of their relative population densities. As stated earlier, the total populations cannot be computed from these data. New tools and sampling methods designed to give reliable population estimates should be incorporated into this study in the future.

Interstream Migration - Tanana River Complex

A compilation of all grayling tagged in the Tanana River Complex and all tag recoveries, both of the grayling project crew and sportsmen from 1960 through 1966 is presented in Table 3. Tagging and recovery totals from the Delta Clearwater River and Clearwater

Lake are combined, as these waters are actually one river-lake system and exhibit quite similar interstream relationships with other waters of the complex. (See spatial relationship of Tanana Complex Waters, Figure 1).

Percentages of the total recoveries (1,524 fish) for any one stream may be somewhat misleading because of unequal sampling effort on the various streams. For example, the Delta Clearwater River has produced the majority of the tag recoveries, but this is due in part to greater efforts here by the grayling project crew and the higher angler utilization of this stream as compared to other streams of the complex.

A more lucid picture of the migration patterns may be gained by examining the area of recoveries for each individual stream. It will be noted that practically the total number of recoveries of fish tagged in the clear-water streams, both the Delta Clearwater (99.2%) and the Richardson Clearwater (96.4%), were made in the same stream, with these fish exhibiting little tendency to out-migrate to other streams following tagging.

In contrast to this, a considerable portion of the fish tagged in the Goodpaster River were recovered in the clear-water streams. This recovery pattern, coupled with the total absence of observations by the grayling crew of spawning grayling or young-of-the-year fish in the clear-water streams, has led to the conclusion that the Goodpaster River serves as a source of supply or "nursery" stream for the clear-water streams.

Although data from Shaw Creek is meager because no work was conducted on this stream since 1961, it was included in Table 3 to illustrate that streams other than the Goodpaster may also produce fish for the clear-water streams. The failure to recover any of the Shaw Creek tagged fish in the Goodpaster River, and vice versa, further indicates that fish outmigrating these nursery streams probably do not take up residence in other "nursery" streams.

TABLE 3. Grayling Tagged and Recovered - Tanana River Complex 1960-1966.

Tagging Area	Number Tagged	Number Recovered	Recovery Areas: Goodpaster No.	Goodpaster %	Delta Clearwater No.	Delta Clearwater %	Richardson Clearwater No.	Richardson Clearwater %	Shaw Creek No.	Shaw Creek %
Goodpaster River	6,097	320	237	75.0	45	14.1	38	11.9	0	0.0
Delta Clearwater River	6,539	836	3	0.5	831	99.2	2	0.3	0	0.0
Richardson Clearwater River	1,812	356	1	0.3	8	2.2	343	96.4	4	1.1
Shaw Creek	213	12	0	0.0	5	41.7	5	41.7	2	16.6
Totals	14,661	1,524	241	15.8	889	25.5	388	25.5	6	0.4

Grayling Growth Determinations

The growth of grayling was calculated using three different time elements; summer growth, winter growth and yearly average.

The growth exhibited in Table 4 is the result of the tag recovery program on 1+ or older fish and may be called summer growth since the change in size appeared from June through September. As shown in Table 4, the growth rate is inversely proportional to fork length, with the smallest fish growing three to four times as fast as the largest fish.

During this summer interval, the rate of growth averaged slightly more than 0.1 inch per week, or approximately 1-1/2 inches in four months. Winter growth rates of the same magnitude are recorded in Table 5, which also indicates that, as the time-out interval approaches 52 weeks, the growth rate increased to a yearly level of 2+ inches. Comparison of the winter growth rates to the summer growth rates indicates that the former rate may be as low as one-tenth of the latter rate.

Figure 1. Spatial Relationship of Tanana River Complex Waters.

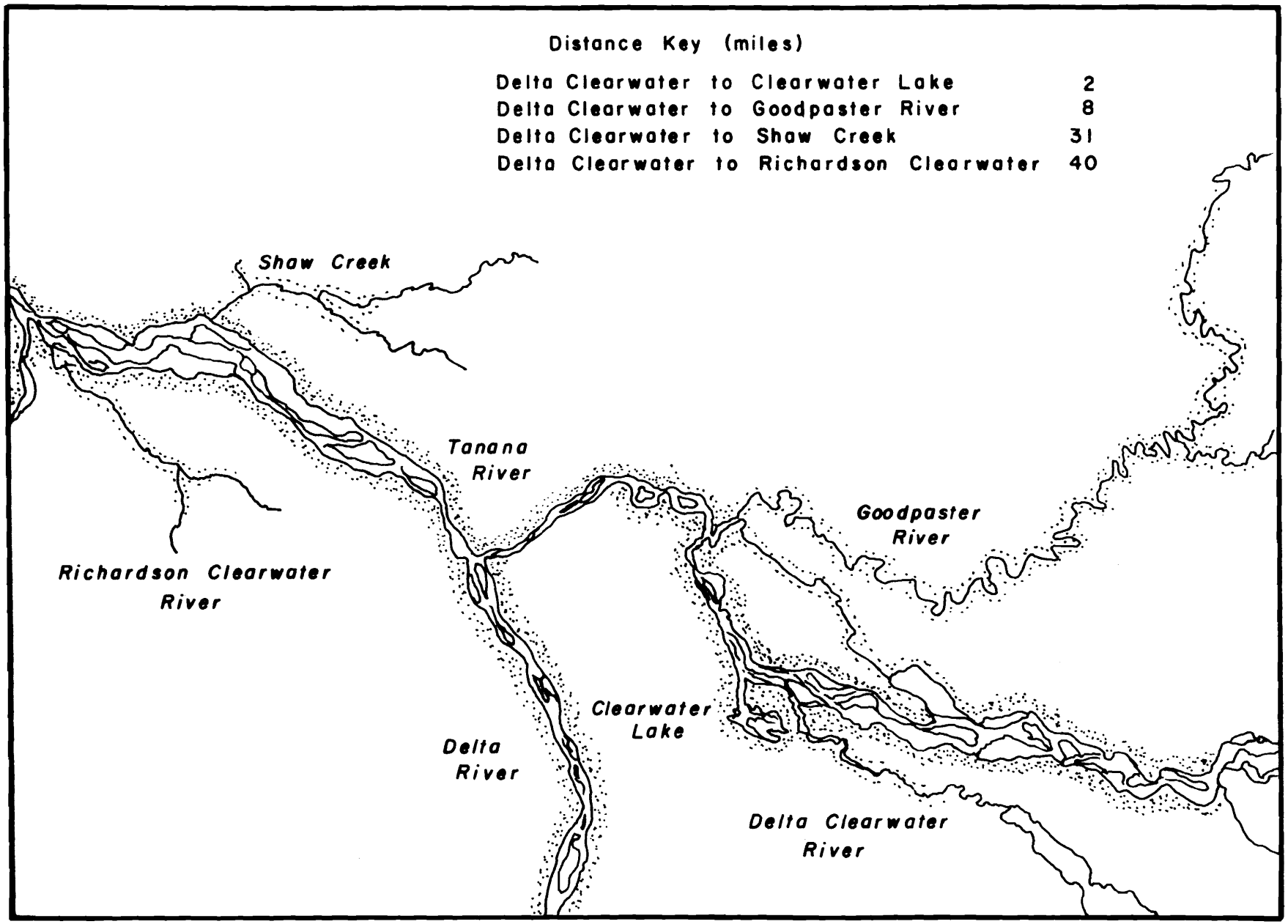

TABLE 4. Summer Growth of Grayling from Streams in the Tanana River Study Area 1960-1966.*

Length in Inches	Number in Sample	Mean Growth Inches Per week
4.0-4.9	11	0.17
5.0-5.9	60	0.11
6.0-6.9	39	0.15
7.0-7.9	59	0.12
8.0-8.9	84	0.096
9.0-9.9	43	0.12
10.0-10.9	38	0.10
11.0-11.9	26	0.11
12.0-12.9	25	0.078
13.0-13.9	12	0.049
14.0-14.9	5	0.053
15.0-15.9	3	0.027

*Summer growth is from fish tagged and recovered June through September of any year.

TABLE 5. Winter Growth of Grayling from Streams in the Tanana River Study Area 1960-1966.*

Weeks Out	Number in Sample	Mean Growth Inches Per Week	Number Of Fish
32	0.00	--	1
33	--	--	--
34	0.30	0.008	1
35	2.40	0.07	4
36	1.57	0.04	3
37	0.37	0.01	6
38	--	--	--
39	0.70	0.02	4
40	0.42	0.01	5
41	0.23	0.005	7
42	0.73	0.02	4
43	0.62	0.01	7
44	1.15	0.03	7
45	1.27	0.03	10
46	1.43	0.03	8
47	1.09	0.02	12
48	1.97	0.04	3
49	1.91	0.04	5
50	1.43	0.03	9
51	--	--	--
52	1.90	0.04	1
53	1.85	0.03	2

*Release Week 31 through 42 - Recaptured August 1 through Mid-October.

Validation of Aging Technique Using Scales

The scales utilized in this study were collected from various streams in the Tanana River Study Area. The scales were removed lateral to the insertion of the dorsal fin. Scale impressions were produced on acetate using an Ann Arbor roller press. A microprojector was used to read the impressions.

The first annulus may be deposited in fall while all subsequent annuli are produced in early spring. Young-of-the-year fish usually produce a grouping of circuli in late fall, September - October, that may be interpreted as an annulus. This occurs when the fish are approximately three months old, 2 to 3-1/2 inches long, and may easily be misinterpreted to be the annulus that is produced in the spring when the fish are nearly one year old. As a result, one-year-old fish may be mistakenly labeled as 2+ fish.

To document that 4- to 5-inch fish captured in June and July were of the 1+ group, approximately 500 young-of-the-year fish were fin clipped. Recovery of nine of these fin clipped fish the next spring showed that these fish had attained the 4- to 5-inch range when approximately 1 year old.

The annulus develops by June and July. In mid-June approximately 15 percent of the fish have developed growth rings outside the last annulus and by mid-July approximately 95 percent have completed annulus formation.

The scale samples of 64 tagged and recaptured fish were used to verify production of annuli. Of the 64 sets of scales that were read and compared to the known age, six fish did not form annuli, one failed to do so in the two to three age range, four fish failed to form annuli in the three to four range, and one fish failed to form an identifiable annulus in the five to seven age range. In the last group, a possibility exists that the annulus was formed but was not discernible since the circuli of the outer edges of the scale on fish of this age are often broken or discontinuous, which does not permit distinguishing one annulus from another.

It has been determined that scale reading is a reliable method of aging grayling, particularly when used on fish in the one- to three-year age range. Once the fish have passed this age range, the scale technique loses some of its reliability.

The set of data that was used to verify the scale technique as a tool for age determination was also used in the growth study. The results have been summarized in Table 6. This table indicates that the grayling growth rate decreases gradually as the fish grow larger. This tendency is not apparent in the 6-7 age class. However, in this group and the 5-6 age class, it is suspected that the problems of reading scales affect the reliability. Thus the fish in these two groups may actually be one or two years older with actual growth rates somewhat less than the table indicates.

TABLE 6. Growth from the Scale Validation Set

Age Class	Number in Sample	Mean Length (Inches)	Yearly Growth Increment (Inches)
1+	13	6.4	6.4
2+	30	8.3	1.9
3+	15	9.8	1.5
4+	15	11.1	1.3
5+	11	12.8	1.7
6+	5	13.5	.7
7+	2	14.9	1.4

Spawning Observations

A correlation of grayling spawning observations with time and water temperature is made in Table 7. These observations were compiled by the grayling project crew on various waters of Interior Alaska during a period from 1960 through 1966. The altitude of the streams ranges from 400 feet elevation a the lower Chatanika River to 3,000 feet at the Tangle Lakes tributaries. Time of spawning on the individual waters ranges from mid-May to early July. In every instance Fahrenheit water temperatures at spawning were in the low 40's, indicating that water temperature rather than photoperiod is responsible for the onset of spawning.

TABLE 7. Grayling Spawning Timing and Temperature.

Area	Number Fish Observed	Time of Observations	Water Temperatures (Degrees F.)
Lower Chatanika River	50-75	Mid-May to early June	39-42
Upper Chatanika River	30-40	Middle to end of June	41-44
Cleary Creek	2	Late May	43
Chena River	3	Early June	39-44
Shaw Creek	Numerous	Mid-May	36-41
Goodpaster River	Numerous	Mid-May	39-41
Fielding Lake Inlet	25-30 pairs	Mid-June to end of June	42, 44-49
Tangle Lakes Area	6-8 pairs	Mid-June to early July	43, 46
Stream at Denali Hwy. Mile 50	Scattered fish	Mid-June to early July	43

Chena River Investigations

During the 1966 field season a total of eight man days was spent on the Chena River. In this period 59 grayling were tagged. Two of these fish were recovered by anglers. While being tagged in July, the fish were recovered in August in practically the same location. With limited results from this year no concrete statements can be made. However, a full scale investigation of the Chena River has been scheduled for 1967 and should provide answers to some of the questions about this river.

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Surveying a Proposed Public Access Site at Lower Ugashik Lake.