Volume 18 Study G-II-E

STATE OF ALASKA

Jay S. Hammond, Governor

Completion Report for

RAINBOW TROUT LIFE HISTORY STUDIES IN LOWER TALARIK CREEK - KVICHAK DRAINAGE

by

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Job No. G-II-E
Rainbow Trout Life History Studies in Lower Talarik Creek-Kvichak Drainage

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RESEARCH PROJECT SEGMENT

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ABSTRACT

A sport fishery for rainbow trout, Salmo gairdneri Richardson, has developed during recent years in the Kvichak River drainage of southwestern Alaska. To evaluate the impact of this fishery on the stocks and to provide proper management of the fishery, it became necessary to better understand aspects of the life history of the stocks involved. Thus, the Alaska Department of Fish and Game initiated a rainbow trout life history study in 1971 utilizing the Lower Talarik Creek stock of rainbow trout.

Field investigations were conducted annually through the spring of 1976. They consisted of spawning escapement surveys, migration interception using a weir, tagging studies, age and growth investigations, and creel census.

Spawning occurred in Lower Talarik Creek from late April through mid-June. Spawning surveys (1971-1976) indicated a stable run of approximately 950 rainbows annually. Age groups VII through IX comprised 90% of the spawning population. Most spawners (94%) were 500 mm in length or greater. Females appeared to outnumber males by a ratio of 1.9 to 1. A mean fecundity of 3,431 eggs was obtained from a sample of females examined. Consecutive spawning was documented for 103 (5%) of 2,133 spawners tagged.

Following spawning, spent rainbows migrated out of Lower Talarik Creek and entered Lake Iliamna. They returned to the stream in September. From mid-June through mid-August the stream was inhabited mainly by juvenile rainbows.

From 1971 through 1974 a total of 5,671 Lower Talarik Creek rainbows were captured, measured and tagged with Floy Anchor Tags. A 13% recovery was attained. Ninety-four percent of the recoveries occurred in Lower Talarik Creek. All others occurred elsewhere within the Kvichak drainage.

Age and growth data indicate maximum growth rate for the Lower Talarik Creek stock of rainbows occurs between ages IV and VI. Growth overwinter appears to be minimal for all age groups.

Stomachs of 241 rainbows were examined. Sockeye salmon, Oncorhynchus nerka (Walbaum), eggs, aquatic Dipterans, and Trichoptera larvae were major food items.

The abundance of sockeye salmon spawners may have a direct influence on the fall condition of rainbow trout. Coefficient of condition data for rainbow trout during two years of low salmon abundance yielded a $\bar{k}$ of 0.99. During the ensuing two years of high salmon abundance the $\bar{k}$ increased to 1.12. The difference was significant for age groups III-VI.

Creel censuses conducted at the stream (1971-1976) indicated a mean angler effort of 344 angler days per season (June 8-September 30). The mean annual rainbow trout catch was 1,212 with an average of 178 retained. Present harvest levels do not appear to be adversely affecting the fishery.

BACKGROUND

A rainbow trout life history study was initiated in 1971 at Lower Talarik Creek (Figure 1) by the Alaska Department of Fish and Game. Increased levels of angling effort in the area and a concern for effective management of the rainbow trout stocks in this and other Lake Iliamna streams prompted the Department to undertake an effort to better understand the behavior of these fish. The study was designed to provide information on migration timing, spawning habits, growth, age structure, feeding habits, and dispersal of rainbow trout as well as information on angler effort and harvest. Through better understanding of each of these components, more precise management of the "Trophy" fishery in the Kvichak drainage can be achieved.

The Kvichak River drainage has been popular with sport anglers since the mid 1950's. The spring and fall runs of large, native rainbow trout into Lake Iliamna tributaries have drawn anglers from many parts of the country as well as the state to fish the area. Sport fish guiding operations established at favorable locations throughout the watershed (22 utilized Kvichak drainage streams in 1976) have accomodated most of the nonresident anglers.

In 1968 the Kvichak drainage was designated by the Alaska Board of Fish and Game as a "Trophy Fish Area" in recognition of the quality angling opportunities offered by the uniquely large resident rainbows inhabiting its waters. Restrictive regulations limiting the kill of large rainbow trout were instituted in hope of perpetuating the fishery.

The Lower Talarik Creek stock of rainbow trout was selected for study based on previous years' investigations (Paddock, 1964, 1965, 1968, 1969; Andrews, 1966; Paddock and Whitehead, 1970; Siedelman, 1971). These investigations indicated:

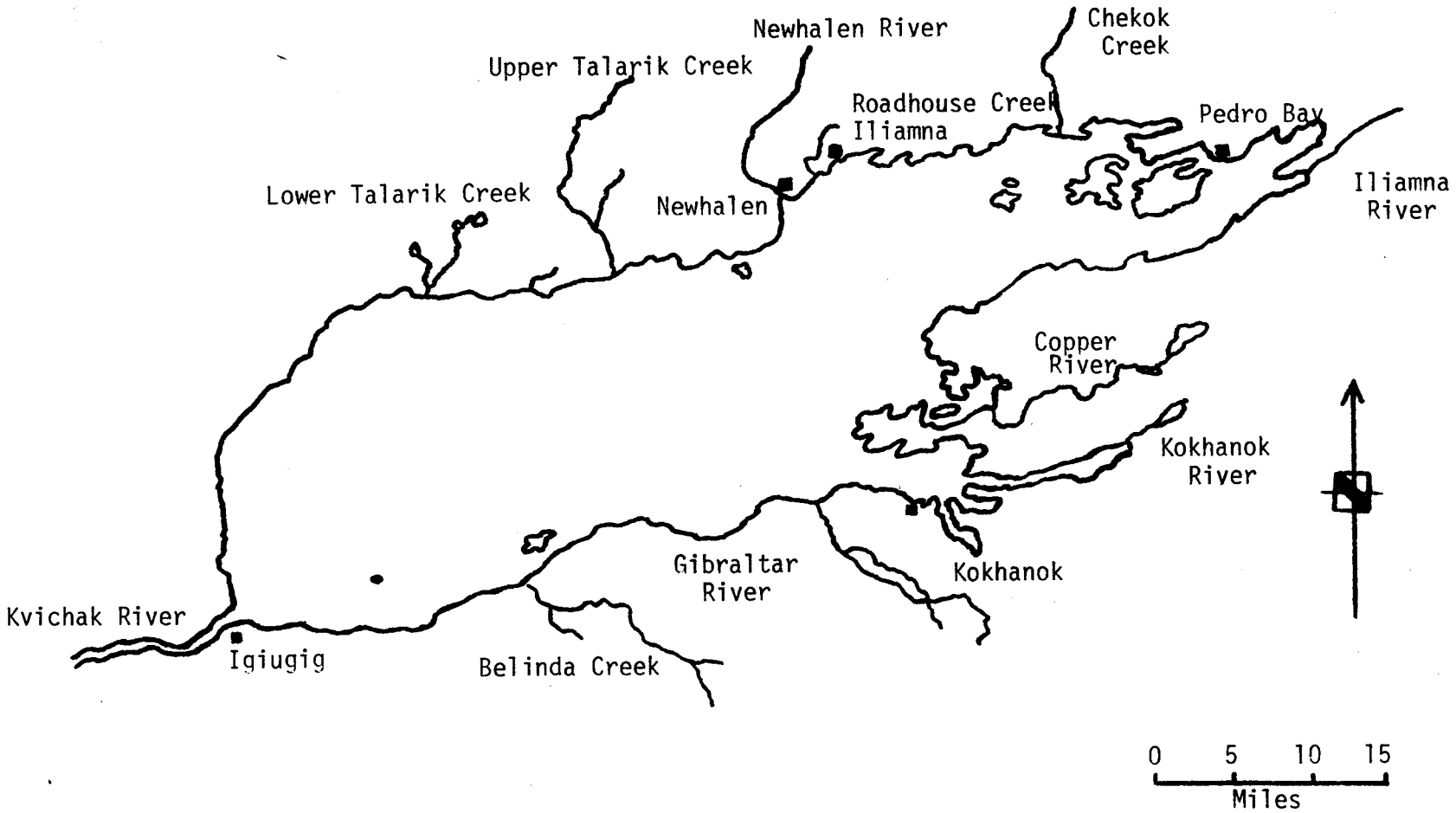

Figure 1. Lake Iliamna

1. The stream had a significant population of large rainbow trout, thought to be similar in size and behavior to other Lake Iliamna stocks.

2. Angling interest in these fish was substantial.

3. The physical character of the stream was similar to other nearby streams.

4. Stream characteristics were suitable for application of available capture methods (weirs, electrofishing).

5. Logistics were suitable for maintaining a crew on site.

Lower Talarik Creek (Figure 2) is a small, clear stream originating in the foothills along the northwest side of Lake Iliamna and drains a watershed of approximately 50 square miles (Demory, Orrell, Heinle, 1964). A number of small lakes are interconnected in its headwaters, stabilizing stream flows somewhat and providing added habitat diversity within the drainage. The stream flows through open rolling lowland tundra. Willows are the dominant streamside vegetation. The summer stream flow, as measured by the Fisheries Research Institute, University of Washington, during August 1961, was 108 c.f.s. (Demory, et al. 1964). There are no obstacles to fish passage along its length.

During 1971 (Siedelman and Cunningham, 1972) a temporary weir was constructed in May on the West Fork of Lower Talarik Creek and upstream migrating rainbow trout spawners were captured and tagged. Surveys were accomplished to determine estimates of the spawning population. Scales and lengths were collected from rainbow trout for age determinations. Angler use and recreational harvest were monitored. Individual angler expenditures relating to the cost of traveling to, and fishing, this rainbow trout stock were also recorded.

Instream migration monitoring was begun in 1972 utilizing a temporary weir in the spring and a permanent weir during the summer and fall. In spite of washouts and design problems that prevented the permanent weir from operating as a complete barrier throughout much of the 1972 summer period, substantial numbers of rainbow trout, representative of the run, were caught at the structure. This weir was operated subsequently during the summer periods, 1973 through 1975. Actual dates of operation were as follows:

1972 - July 21-October 5 (weir only a partial barrier much of this time).

1973 May 4-October 12.

1974 April 30-October 1 (weir inoperative July 21-26).

1975 May 21-September 26.

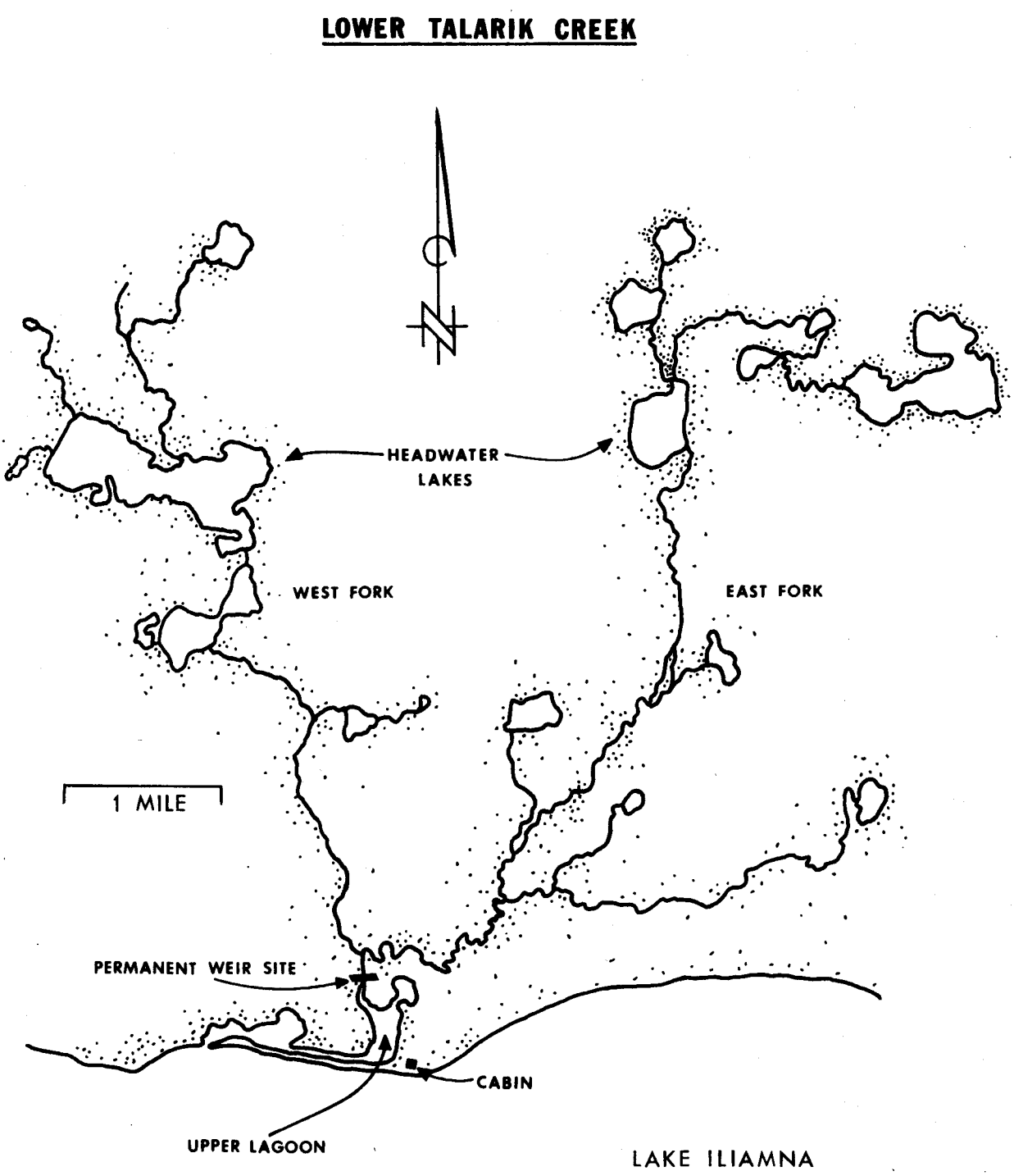

Figure 2. Rainbow Trout Research Site, Lower Talarik Creek.

Data from each of these years were presented in annual progress reports (Siedelman, Cunningham, Russell, 1973; Russell, 1974, 1975, 1976). Concurrently other rainbow trout studies were conducted at Copper River, Gibraltar River, Newhalen River, and the Kvichak River, providing comparative tagging, age-length, and run timing data (Siedelman 1974, Gwartney 1975, 1976).

Following the 1975 field season, the Lower Talarik Creek weir was removed from the stream and a June 1976 creel census constituted the final field work involved in the study.

RECOMMENDATIONS

1. Continue rainbow trout spawning surveys at Lower Talarik Creek on a semi-annual basis to provide necessary information on numbers for management considerations.

2. Continue September sampling of Lower Talarik Creek rainbow trout to provide coefficient of condition data for comparison with magnitude of annual sockeye escapement into Iliamna Lake.

3. Initiate investigations to determine feeding habits of rainbow trout in the Iliamna Lake environment to identify important forage species.

4. Initiate a sonic tagging study to determine October-April movement patterns of Lower Talarik Creek rainbow trout to identify winter concentration areas.

5. Confine any future creel census studies done at Lower Talarik Creek to the June 8-June 30 and September 1-September 30 time periods to intercept a majority of the fishermen.

OBJECTIVES

1. To determine the magnitude of the rainbow trout spawning population in Lower Talarik Creek.

2. To determine recreational angling effort, total rainbow trout harvest, and angler use trends at Lower Talarik Creek.

3. To write a project completion report.

TECHNIQUES USED

Fish capture was accomplished using weirs, a type V backpack electrofisher (Smith-Root Company) and hook and line. Temporary weirs constructed of metal fence posts and hardware cloth 1.6 cm mesh (5/8 inch) were used during the spring of 1971 and 1972. A collapsible 120-foot weir of structural steel construction (Figure 3) was utilized from July 1972

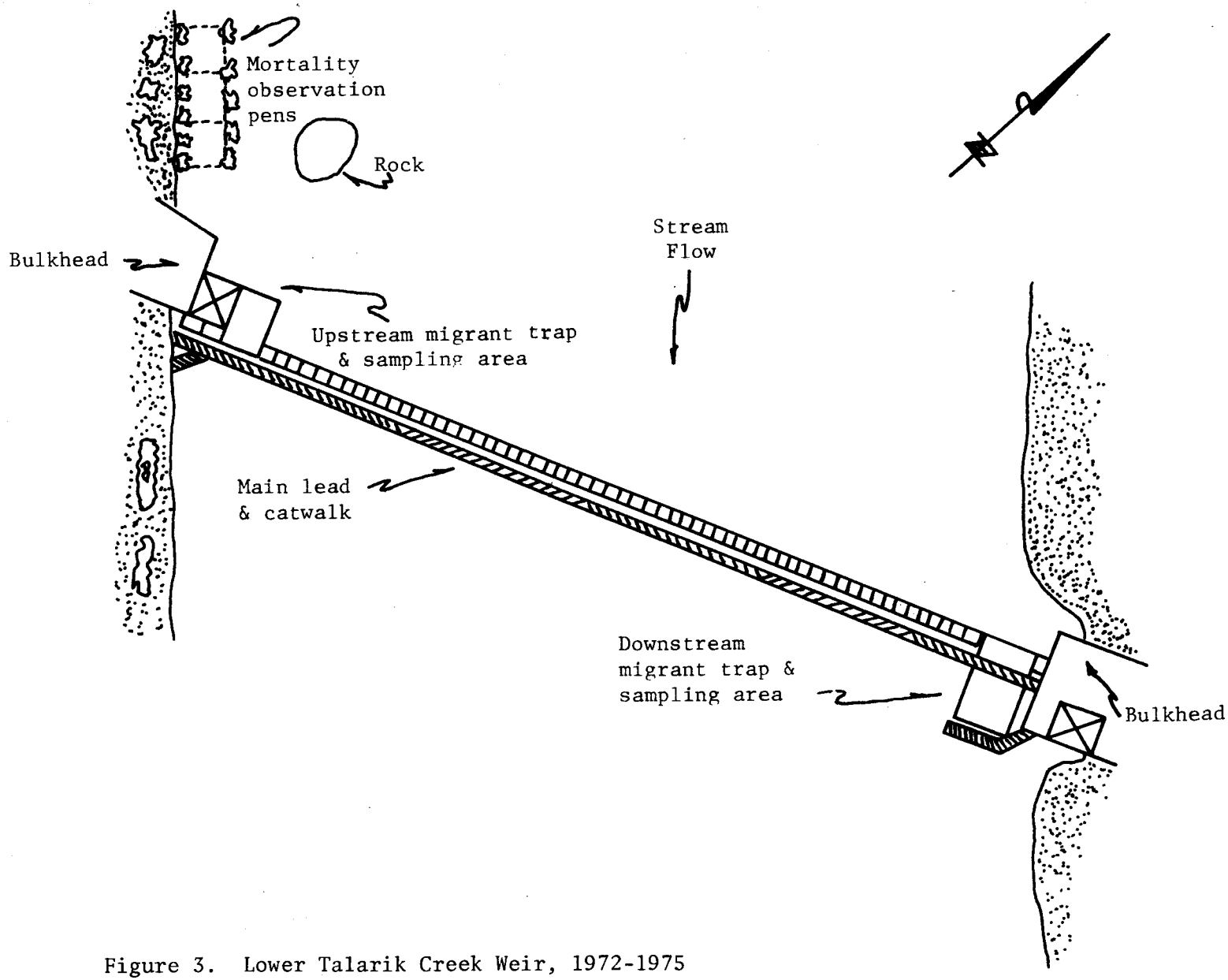

Figure 3. Lower Talarik Creek Weir, 1972-1975

through 1975. It supported two traps: a 6' x 10' "wulf" type trap designed to capture downstream migrants, and a 6' x 10' fyke trap for capturing upstream migrants.

Weir screens were constructed of 1.6 cm (5/8 inch) metal mesh and were reversible to facilitate cleaning. The weirs were assembled in the spring of each year as soon as the stream channel at the weir sites began to open. Water temperatures at the weir site were collected utilizing a Taylor Maximum-Minimum registering thermometer.

Rainbow trout captured were examined for the presence of tags. Fork lengths were recorded to the nearest millimeter. Weights were determined using a Chatillon 9-kilo autopsy scale accurate to 10 grams. Sex and stage of maturity were recorded when identifiable by external characteristics.

During 1971 and 1972 rainbow trout exceeding 150 mm in length were tagged with numbered FD-67 Floy internal anchor tags. In 1973 this procedure was altered and only fish exceeding 300 mm in length were tagged with the FD-67. Smaller fish, exceeding 100 mm in length were tagged with FTF-69 fingerling tags (Floy Tag Company). All FD-67 tags were placed in the dorsal body musculature with the anchor sections lodged between consecutive pterygiophores. Dennison Mark II tagging guns were used. The FTF 69 fingerling tags were placed along the anterior margin of the dorsal fin and secured by inserting a threaded needle (vinyl thread) through the dorsal musculature immediately beneath the fin and then tying the tag with four overhand knots.

Scale smears were taken from the left side of previously non-tagged fish and from the right side of those bearing tags (to minimize selection of regenerate scales). The scales were subsequently cleaned, mounted on numbered gum cards, and impressions made in clear cellulose acetate cards. The impressions were read using a micro projector to determine the age of each fish by counting annular rings. As an alternate aging method, otoliths removed from autopsied fish were cleaned with xylene and studied using a Bausch and Lomb dissecting microscope.

To study feeding habits, stomachs were preserved in 10% formalin and the contents subsequently examined using the dissecting microscope.

Spawning ground escapement counts were obtained by foot surveys.

Coefficient of condition calculations were made utilizing the equation:

$$k = \frac{100{,}000W}{L^3}$$

where:

W = weight in grams
L = fork length in mm

Anglers were interviewed to determine creel information, effort, and gear preference. Those not interviewed were enumerated to provide estimates of total effort. The interview data were expanded to include all anglers enumerated by a ratio proportion formula, thus yielding estimates of "total angler effort" and "total rainbow trout harvested."

Expansions:

$$\text{Angler effort in angler hours} \quad \frac{\text{No. of anglers interviewed}}{\text{No. of angler hrs. fished}} = \frac{\text{Total No. anglers observed}}{X}$$

$$\text{Rainbow trout harvested} \quad \frac{\text{No. of anglers interviewed}}{\text{No. of rainbow trout kept}} \quad \frac{\text{Total No. anglers observed}}{X}$$

The types of gear used by sport fishermen at Lower Talarik Creek were identified and angler success, using different gear types, compared. For purposes of this comparison, flies and lures were defined as follows:

Flies Terminal tackle constructed by methods known as fly tying, including nymphs, dry, wet, and streamer flies.

Lures Terminal tackle other than flies, including spoons, spinners, jigs and plugs.

An angler day was defined as an angler fishing any part of one calendar day.

FINDINGS

Spawning Behavior

Rainbow trout, Salmo gairdneri Richardson, spawning has been observed in Lower Talarik Creek each spring, from 1971 through 1976. Foot surveys were conducted to determine spawning timing, critical spawning habitat, and estimates of the spawning population (Table 1). Using these surveys in conjunction with subsequent weir passage totals, final spawning population estimates were obtained. The mean annual spawning population over the six years studied totalled 950 rainbows.

Spawning occurs throughout much of the stream (Figure 4). Bottom type, water depth, and stream velocity appear to be important factors influencing redd site selection. Redds are dug in gravel bottom areas, generally in water less than two feet deep. Side channels, the tails of pools just above riffles, and areas along the anterior portions of islands seem to be particularly attractive. Demory et al. 1964 have described the bottom composition of the east fork of Lower Talarik Creek as being comprised of 74% materials .32 cm to 7.6 cm (1/8" to 3") in diameter. The west fork bottom composition was descrived as 64% gravel in this size range. Thus ample suitable spawning gravel is present in the stream.

Table 1. Rainbow trout spawning population estimates, Lower Talarik Creek, 1971-1976.

Date	Estimated Spawning Population	Duration of Spawning	Spawning Peak
1971	800	5/14-6/17	5/30
1972	600*	5/25-6/17	6/6
1973	1,000	4/20-5/30	5/10
1974	1,200	4/26-5/30	5/3
1975	1,100	5/15-6/15	5/23
1976	1,000	5/7-6/8	5/17
6-year average	950		

* Based on surveys of the West Fork, expanded to include the entire stream.

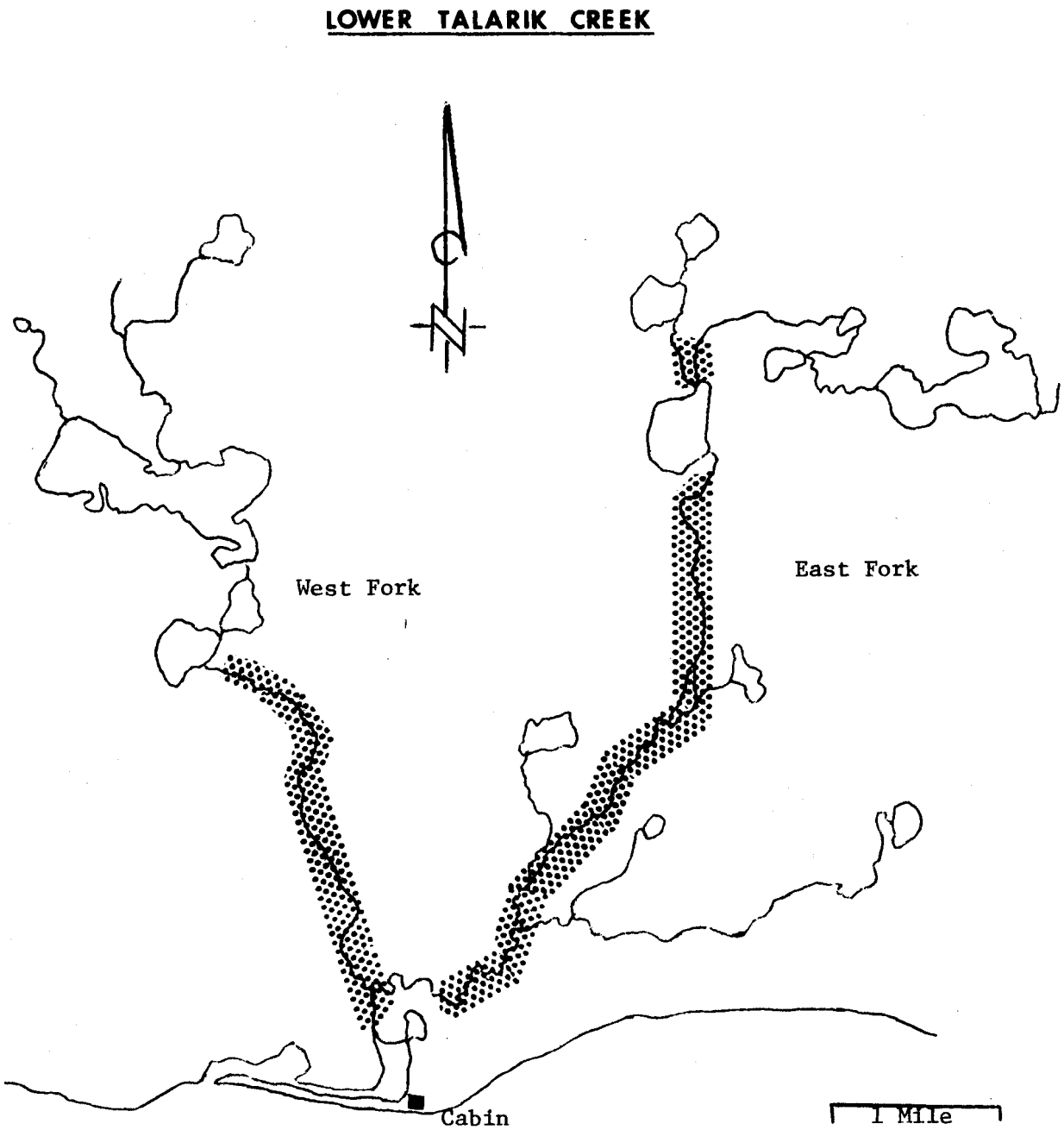

Figure 4. Main Rainbow Trout Spawning Areas, Lower Talarik Creek, 1971-1976

Stream velocity influences the ease with which bottom materials are moved during redd excavation and affects the energy expenditure required of a spawner to maintain position above the redd site. In Lower Talarik Creek, redd sites are generally located in areas where stream velocities are 0.3 to 0.6 m.p.s. (1-2 f.p.s.).

Run timing and subsequent spawning is directly affected by ice cover and stream flows. Lower Talarik Creek freezes over during the fall of the year (generally during October) and remains in this condition until spring break up. Ice depths during March and April can approach 1-1.5 m. The increased day length and warmer air temperatures during April cause the surface ice to begin melting, and the increased flows that occur appear to trigger rainbow trout migration to the spawning grounds. Extended periods of sub-freezing temperatures during the spring of 1971, 1972, and 1975 caused the stream ice to melt relatively late and spawning was delayed. Warmer springs were experienced in 1973 and 1974 and spawning occurred earlier.

Spawning activities appear to be quite closely dependent upon water temperature (Table 2). The onset of spawning appears to occur when stream temperatures reach two to three degrees Centigrade (36°-37°F). Peak activity, as determined by counts of spawners paired on the spawning grounds, occurred at temperatures ranging from five to seven degrees Centigrade (41°-45°F). No spawning was observed at temperatures in excess of 16°C (61°F).

Spawning takes a relatively short time. During the study ninety-seven of a sample of 136 rainbow trout captured at the weir as pre-spawn upmigrants and subsequently recaptured as spent downmigrants spent 15 days or less on the spawning grounds (Table 3). This time span included the remaining upstream migrations necessary to reach spawning areas, mate selection, redd site selection, spawning, and subsequent downstream migration back to the weir. As the weir may have caused a delay in downmigration this time span may be longer than would occur normally. The shortest observed time spent on the spawning grounds was 2 days, while 52 days was the maximum.

Most male rainbow trout were present on the spawning grounds prior to weir installation each spring, thus the number of upstream migrant males captured was small. Females, however, tended to migrate upstream a little later and were intercepted in larger numbers at the weir.

Females appeared to outnumber males in the Lower Talarik Creek spawning population. Downstream migration figures for the years of permanent weir operation, 1973-1975 combined, indicate 1,214 females and 647 males passed downstream following spawning for a female to male ratio of 1.9 to 1 (upmigration totals were not included due to a bias introduced by the earlier male upmigration).

Most post-spawn (spent) rainbow trout leave Lower Talarik Creek during May or early June by migrating downstream and entering Lake Iliamna. A few may continue upstream and enter the headwaters tributary lakes. Very few remain in the stream over summer.

Table 2. Water temperatures associated with rainbow trout spawning, Lower Talarik Creek, 1971-1975.

Year	Stream Temperature °C. Spawning Onset	Spawning Peak	Spawning Termination
1971	2.0 (36°F)	6.0 (43°F)	9.0 (48°F)
1972	3.0 (37°F)	7.0 (45°F)	7.0 (45°F)
1973	2.0 (36°F)	7.0 (45°F)	9.0 (48°F)
1974	2.0 (36°F)	5.0 (41°F)	15.0 (59°F)
1975	4.0 (39°F)	6.0 (43°F)	16.0 (61°F)
5-year average	3.0 (37°F)	6.0 (43°F)	11.0 (52°F)

All temperatures are daily highs.

Table 3. Elapsed time between upmigration (ripe) and downmigration (spent) rainbow trout spawners, Lower Talarik Creek weir, 1973-1974.

No. of Days	Males	Females	Total
1-5	2	5	7
6-10	4	64	68
11-15	3	19	22
16-20	1	10	11
21-25	1	10	11
26-30	1	4	5
31-35	2	1	3
36-40	-	4	4
41-45	-	3	3
46-50	1	-	1
51-55	1	-	1
Total	16	120	136
Range (days)	3-52	2-44	2-52

Many rainbows appear to be in poor physical condition after spawning, with open sores, scratches, lacerations, patches of fungus, eroded fins, and blindness commonly observed. Subsequent survival for many of these fish is doubtful.

The length frequency by sex of rainbow trout spawners, 1971-1975 combined, is presented in Table 4. Of 2,422 spawners examined, 2,282 (94%) were 500 mm (19 1/2") or greater in fork length. Both the largest and smallest spawners were males.

Precocial males were observed on several occasions paired with much larger females on redds. Individual males, 175-200 mm in fork length, were noted paired with females approaching 650-700 mm. In these instances no other males were observed in the immediate area.

Ages have been determined for 1,751 rainbow trout spawners during the study, and age composition figures are presented in Table 5. Age groups III through XII are represented. The youngest male belonged to age group III while the youngest female was a member of age group IV. The age group XII individual was a female. Age groups VII, VIII, and IX comprised 90% of the spawning population (Table 6).

Lower Talarik Creek rainbow trout may spawn several times during their lifetime. Through recoveries of previously tagged fish, some consecutive spawning has been identified. Of 2,133 spawners tagged from 1971 through 1975, a total of 103 (5%) have been recaptured as consecutive spawners and one was recaptured in spawning condition three years in a row. Of those captured as consecutive spawners, 25 were males and 78 were females. Ages for 99 of these were distributed as follows:

Spawned at ages 6 and 7 . . .	8
Spawned at ages 7 and 8 . . .	38
Spawned at ages 8 and 9 . . .	42
Spawned at ages 9 and 10 . . .	10
Spawned at ages 10 and 11 . . .	1
Total	99

Only two fish tagged as spawners one year were recaptured as nonspawners the next year, and only two have been captured as spawners in non-consecutive years (captured as spawners in 1974 and 1976, but not in 1975). Very few fish of spawning size (approximately 500 mm or greater) have been captured instream as nonspawners.

Scale characteristics are often useful in identifying spawning frequency. Andrews (1966) reported that scales collected at Lower Talarik Creek during 1964 had been studied by individuals familiar with steelhead scales at the Fisheries Research Institute, University of Washington. Their findings concluded in part that "spawning marks were not always clear." I also found this to be the case, and for this reason an analysis of frequency of spawning based on scale characteristics has not been completed.

Table 4. Length Frequency, by Sex, Rainbow Trout Spawners, Lower Talarik Creek, 1971-1975 Combined

Length (mm)	Males	Females	Tot
200-224	4	-	4
225-249	-	-	-
250-274	1	-	1
275-299	6	-	6
300-324	2	-	2
325-349	5	3	8
350-374	5	3	8
375-399	8	3	11
400-424	7	8	15
425-449	7	16	23
450-474	10	17	27
475-499	6	29	35
500-524	21	80	101
525-549	29	187	216
550-574	66	278	344
575-599	85	301	386
600-624	98	319	417
625-649	106	190	296
650-674	121	98	219
675-699	81	63	144
700-724	58	17	75
725-749	42	10	52
750-774	15	3	18
775-799	9	1	10
800-824	4	-	4
Total	796	1,626	2,422
Mean Length (mm)	598	591	595

Table 5. Age Composition Rainbow Trout [illegible]

Year	Age Groups III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total	Average Age
1971	-	2	3	4	25	32	11	3	1	-	81	7.6
1972	-	-	3	18	33	15	12	-	1	-	82	7.2
1973	-	1	2	23	202	349	120	19	5	1	722	7.9
1974	-	-	4	37	161	257	168	23	2	-	652	8.0
1975	1	-	3	5	44	117	33	11	-	-	214	7.9
Total	1	3	15	87	465	770	344	56	9	1	1,751	7.9

Table 6. Age Group Percentages, Rainbow Trout Spawning Populations, Lower Talarik Creek, 1971-1975

Year	Age Groups III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
1971	-	2.5	3.7	4.9	30.9	39.5	13.6	3.7	1.2	-	100.0
1972	-	-	3.7	22.0	40.2	18.3	14.6	-	1.2	-	100.0
1973	-	0.1	0.3	3.2	28.0	48.3	16.6	2.6	0.8	0.1	100.0
1974	-	-	0.6	5.7	24.7	39.4	25.8	3.5	0.3	-	100.0
1975	0.5	-	1.4	2.3	20.6	54.7	15.4	5.1	-	-	100.0
Total	0.1	0.2	0.9	5.0	26.6	44.0	19.6	3.2	0.5	0.1	100.0

Fecundity

Sixteen female rainbow trout were sacrificed during the study, yielding fecundity information. These fish ranged in length from 533 to 692 mm (21" to 27"). They ranged in age from seven to nine years. An average of 3,431 eggs was obtained (S.D. = 1,053). Individual counts ranged from 1,416 to 5,484 eggs.

Additionally, egg counts were obtained for 11 females artificially spawned during 1974. These fish had a mean length of 611 mm (24") and were also seven to nine years old. The mean yield per female was 2,970 eggs (S.D. = 594). No estimates of egg retention were obtained as these fish were released alive.

Recognizing the small sample size, it appears that 3,000-3,500 eggs per female is a realistic fecundity estimate for Lower Talarik Creek rainbow trout.

Twelve naturally spent females were examined for egg retention during the study (mean length 604 mm, 23.8", ages seven to nine years). Individual females retained from 11 to 128 eggs, with a mean retention of 38 (S.D. = 34).

Egg diameter measurements were obtained from 25 females, 1971-1975. These fish ranged in age from seven to 10 years and had a mean length of 597 mm. Egg diameters obtained, ranged from 4.5 to 6.6 mm, with a mean diameter of 5.5 mm (S.D. = 0.6).

Weight Loss (Spawning)

One hundred and eighteen females were weighed as upmigrant prespawners and again as downmigrant postspawners at the weir during 1973 and 1974. These fish lost an average of .41 kg (14.4 oz) in weight during the spawning inverval. Weight loss figures were similarly obtained for 15 male spawners during the same period. They lost an average of .18 kg (6.3 oz). During the spawning periods 1973-1975, a total of 39 prespawn males and 287 prespawn females were weighed (Table 7). Males averaged slightly heavier than females, 2.38 kg to 2.24 kg, respectively. Spent males (n = 430) were considerably heavier than spent females (n = 861), 2.28 kg to 1.85 kg. Based on these figures, it appears males lose an average of 0.10 kg (3.5 oz) while females lose 0.39 kg (13.7 oz) during spawning.

Instream Migrations

To identify instream migration trends, rainbow trout passage totals through the weir (1972-1975) were combined and the percentage migration by week is presented, by age groups, in Figures 5 and 6. The Figures indicate both upstream and downstream migrational trends for the lower stream area.

These data indicate that age groups II and III migrate both upstream and downstream in a rather random manner in the lower stream during mid-

Table 7. Mean Weight by Age and Sex, Rainbow Trout Spawners, Lower Talarik Creek Weir, [illegible]

	Age Group									
	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
No. Ripe Males	-	-	2	7	21	9	-	-	-	39
Mean Weight Ripe Males kg (lb)	-	-	-	2.04 (4.5)	2.41 (5.31)	2.95 (6.5)	-	-	-	2.38 (5.25)
No. Spent Males	-	2	16	94	196	110	12	-	-	430
Mean Weight Spent Males kg (lb)	-	-	1.27 (2.8)	1.73 (3.81)	2.35 (5.18)	2.73 (6.02)	3.05 (6.68)	-	-	2.28 (5.03)
No. Ripe Females	-	-	7	81	148	46	4	-	1	287
Mean Weight Ripe Females kg (lb)	-	-	1.59 (3.51)	1.90 (4.19)	2.28 (5.03)	2.64 (5.82)	3.64 (8.03)	-	-	2.24 (4.94)
No. Spent Females	1	2	36	246	377	157	33	8	1	861
Mean Weight Spent Females kg (lb)	-	-	1.26 (2.78)	1.57 (3.46)	1.88 (4.15)	2.16 (4.76)	2.58 (5.69)	3.04 (6.7)	-	1.85 (4.08)

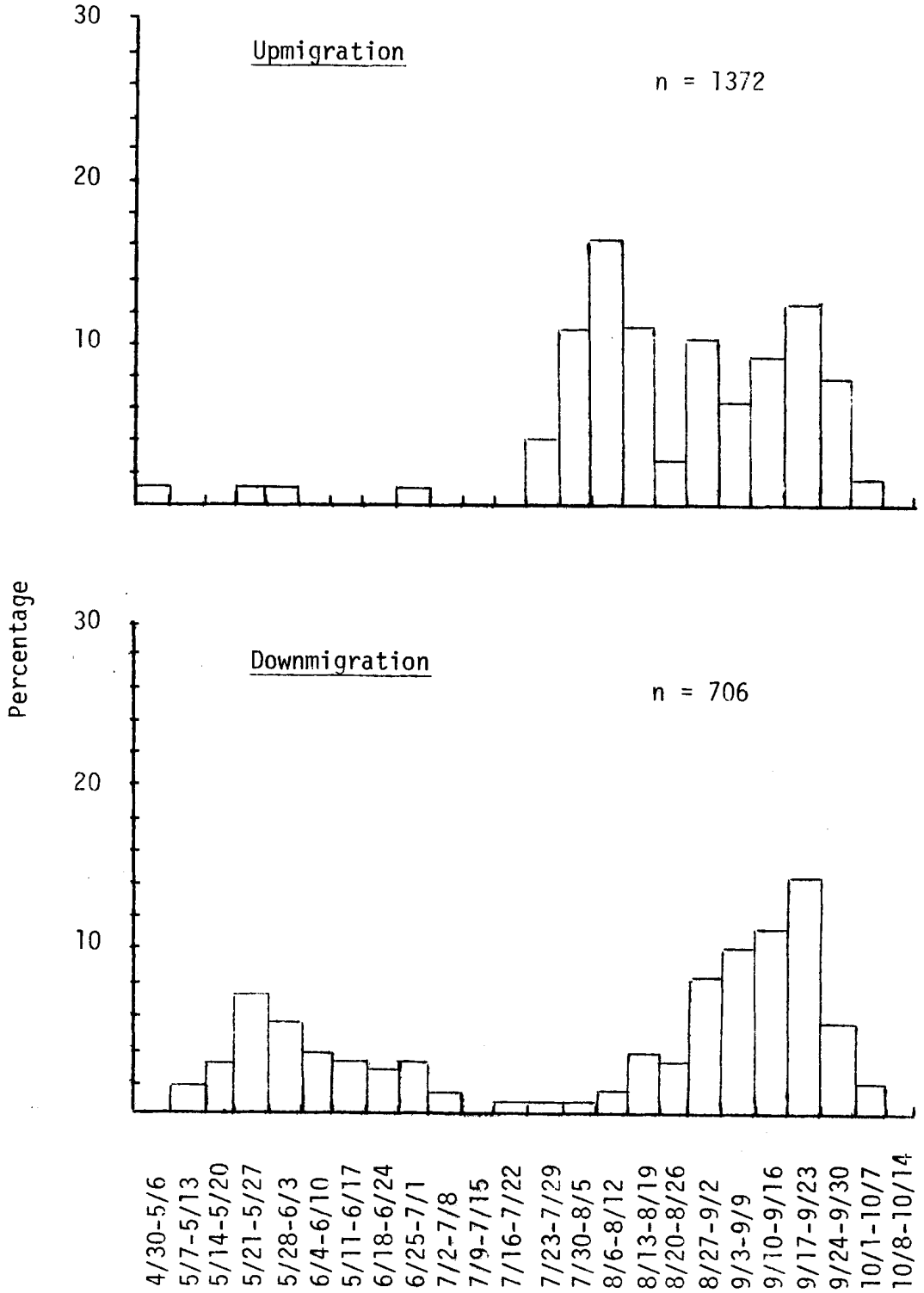

Figure 5. Percentage Migration by Week, Rainbow Trout, Age Groups 0-V, Lower Talarik Creek Weir, 1972-1975 Combined

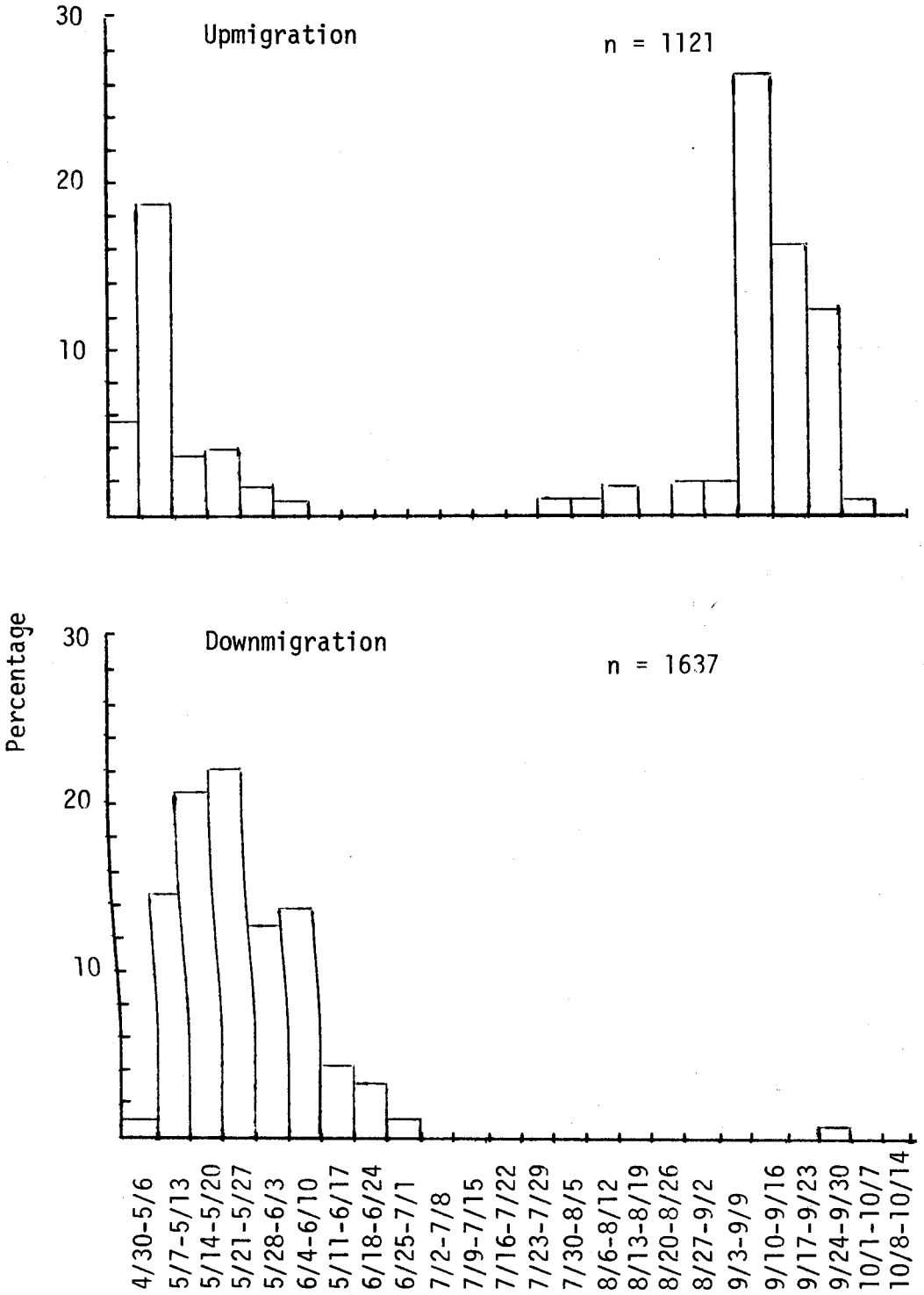

Figure 6. Percentage Migration by Week, Rainbow Trout, Age Groups VI-XI, Lower Talarik Creek Weir, 1972-1975 Combined.

and early fall (July-September). This time span encompasses the sockeye salmon, Oncorhynchus nerka (Walbaum), upmigration and spawning period which may in itself be a major factor influencing juvenile trout movement (food availability, antagonistic behavior, etc). No spring migrations either up or downstream were noted for age group II. Only a few age group III rainbows were captured in the spring, all downstream migrants. Observations made during spring spawning surveys indicate that numbers of these fish were present in the upper stream areas during May and June.

Age group IV rainbows made a spring downstream migration followed by a mid-to-late summer upstream migration, with subsequent milling back and forth. They apparently left the stream and entered Lake Iliamna during May and June and then reentered the stream during the salmon spawning period in August.

Age group V rainbows exhibited a similar pattern. However, this is based on fewer captures than existed for age group IV due to a greater tendency for age group V rainbows to remain in the Lake Iliamna environment over summer.

The spring downmigration of age groups IV and V may indicate these fish overwinter in the upper stream areas or the headwaters lakes.

Age group VI fish, mostly immature individuals, made a spring downstream migration into Lake Iliamna. Spring upstream migration numbers were low; however, the fall upstream migration of this age group was substantial. Most of these fall upstream migrants had maturing gonads (would spawn the following spring).

Age groups VII through X had essentially the same instream migratory timings. There was a spring upstream migration to the spawning grounds. Following spawning, most of these large trout migrated downstream and re-entered Lake Iliamna, where they spent the summer. No further instream movement of these age groups occurred until the maturing fish returned to the stream in mid-to-late September.

During the fall, maturing rainbow trout arrived at the Lower Talarik Creek outlet, generally about the first week in September, and they milled in the vicinity for several days. Then with increasing stream flows, brought about by rains or wind storms, they migrated upstream into the stream proper. Some moved clear to the headwaters, while others remained in the long runs and deeper holes of the lower stream. Most arrived after salmon spawning was completed. Very rarely was anything found in the stomachs of those caught by anglers. Thus, it appears they were not on a feeding migration.

A total of 925 of these fall run fish have been sampled (1971-1975). Of these, 61 (7%) were fish captured as spawners in the stream the previous spring which shows a tendency for redeveloping fish to return to the same stream they spawned in previously. Additionally, 119 (13%) were recaptured as spawners in the stream the following spring, indicating that fall lake-run immigrants comprise at least part of the next year's

spawning population for the stream. These figures are minimal due to problems encountered in capturing the entire upstream spawning runs in the spring. The fate of non-recaptured fall run fish is unknown. Natural winter mortality, mortalities due to the through-the-ice fishermen, and incomplete spring captures could explain part of the difference.

During 1974 and 1975, data were collected indicating the time of day in which rainbow trout entered the weir traps at Lower Talarik Creek (Table 8). These data indicate that migratory movement can occur at any time of day. However, the preferred time for upmigration was during full daylight and the period in which stream temperatures were warmest. Conversely, downmigration was least during this time and greatest during the nighttime hours, or the period in which water temperatures and flows were at daily minimums and the percentage of darkness was greatest.

Tagging and Dispersal

Information regarding both the instream and systemwide dispersal of Lower Talarik Creek rainbow trout has been gathered through the tagging and recovery of individual fish. Tagging operations of varying magnitude have been conducted in the stream each year, 1964-1974, with the exception of 1966. A total of 6,846 rainbows were tagged over this span of years, although most (5,671) were tagged from 1971 through 1974. I have compiled and summarized all the existing tagging data with the following results.

A total of 1,091 recaptures (912 individual fish) have been accomplished from the 6,846 fish tagged, for a 13% recapture rate. Of the 1,091 recaptures, 1,026 (94%) occurred in the stream itself. Other recapture locations (Figure 1) included the Kvichak River (33 recoveries), Newhalen River (17 recoveries), Gibraltar River (6 recoveries), Kakhonak Bay (6 recoveries), Belinda Creek (2 recoveries), and Upper Talarik Creek (1 recovery). The frequency of recoveries at these other locations around Lake Iliamna should not be interpreted as movement pattern indicators, as recovery effort was disproportionate around the lake. The 65 recoveries from outside Lower Talarik Creek proper were predominately from larger fish (only five were 300 mm or less in length at tagging) suggesting that it's the larger and older fish that do most of the interstream movement.

Tag recovery effort was far greater at Lower Talarik Creek than at any other location around Lake Iliamna. However, if interstream movement was very substantial, one would expect that some of the rainbow trout tagged in other Lake Iliamna tributaries in recent years would have been recaptured at Lower Talarik Creek. Only one rainbow of the 1,896 tagged in other streams was recaptured at Lower Talarik Creek. In Table 9, I have presented a summary of all the existing tagging and recovery location data for rainbow trout tagged in the Kvichak drainage. A total of 1,264 of these fish were tagged between 1970 and 1974 and they presumably, had the chance of entering Lower Talarik Creek during the period of weir operation. The fact that only one was recaptured in the stream (tagged at Copper River in 1972) suggests the magnitude of interstream movement was minimal. It is apparent the incidence of recovery area-wide was

Table 8. Time of Day Versus Migration Totals, Rainbow Trout, Lower Tal Creek Weir, 1974-1975 Combined

Month	Upmigration Time of Day 0001-0800	0801-1600	1601-2400	Total
May	52	54	72	178
June	12	19	8	39
July	4	27	18	49
August	11	39	8	58
September	44	298	235	577
Total	123	437	341	901

Month	Downmigration Time of Day 0001-0800	0801-1600	1601-2400	Total
May	296	104	215	615
June	248	116	134	498
July	8	2	1	11
August	4	8	5	17
September	28	97	81	206
Total	584	327	436	1,347

Table 9. Summary of Tagging and Recovery Information, Kvichak Drainage, 1964-1976.

	Lower Talarik Creek	Copper River	Gibraltar River	Iliamna River	Newhalen River	Kvichak River	Tazimina River	Nonvianuk River	Funnel-Moraine Creek	Kulik River	Other	Total
Total tags placed	6,846	697	417	13	195	455	25	31	22	26	15	8,742
Total tags recovered	912	92	51	2	12	34	-	1	2	-	-	1,106
Total recoveries *	1,091	93	53	2	13	34	-	1	2	-	-	1,289
Recovery percentages	13.3	13.2	12.2	15.4	6.2	7.5	-	3.2	9.1	-	-	12.7
Recovery locations:												
Lower Talarik Creek	1,026	1	-	-	-	-	-	-	-	-	-	1,027
Copper River	-	61	1	-	-	-	-	-	-	-	-	62
Gibraltar River	6	3	41	-	-	1	-	-	-	-	-	51
Newhalen River	17	3	1	-	10	-	-	-	-	-	-	31
Kvichak River	33	1	2	-	1	29	-	-	-	-	-	66
Belinda Creek	2	1	1	-	-	1	-	-	-	-	-	5
Northeast Bay	-	-	-	-	-	1	-	-	-	-	-	1
Kakhonak Bay	6	5	6	-	-	-	-	-	-	-	-	17
Intricate Bay	-	15	1	-	-	-	-	-	-	-	-	16
Iliamna River	-	-	-	2	1	-	-	-	-	-	-	3
Pedro Bay	-	1	-	-	-	-	-	-	-	-	-	1
Chekok vicinity	-	2	-	-	1	-	-	-	-	-	-	3
Upper Talarik Creek	1	-	-	-	-	-	-	-	-	-	-	1
Branch River drainage	-	-	-	-	-	-	-	1	2	-	-	3
Elsewhere and unknown	-	-	-	-	-	2**	-	-	-	-	-	2
Total	1,091	93	53	2	13	34	-	1	2	-	-	1,289

* Some tags recovered more than once.

**1 location not recorded, 1 recovery reported for Naknek River??

greatest in the stream of origin (tagging stream). Tag recovery effort in Lake Iliamna was minimal. Anglers and local personal-use net fishermen were responsible for most of the recoveries.

Tag recovery effort was a very seasonal activity. Tags were returned by Department personnel engaged in field investigations, by visiting anglers, and by local personal-use fishermen. The activities of these groups were primarily conducted during the ice-free period, generally May through early October, and the timing of recaptures reflects this. Of 1,091 recaptures of Lower Talarik Creek tags, only 19 were accomplished during the period October 16-April 30. Thus, very little is presently known about the late fall and winter movements of these fish.

Recapture rate varied with the month of tagging (Table 10). It also varied with the size of fish at tagging (Table 11). Rainbow trout tagged in May, June, and September had the highest recapture rates. These were the months in which most of the larger fish were tagged (spawners in May and June, and maturing fish in September). The recovery rate was substantially higher for rainbows in excess of 500 mm in length than for the smaller length groups, averages 23% to 8%, respectively. Factors influencing this recovery rate difference may have included: (1) A greater percentage annual natural mortality among younger and smaller fish, (2) behavior pattern differences between the various age groups, for example spawning age fish were quite predictable in some of their behavior, thus enabling them to be intercepted and captured in fairly large numbers, and (3) possibly a greater handling and tagging-induced mortality among small fish than larger ones.

Most recaptures of Lower Talarik Creek rainbows occurred in the same year as the fish were tagged. Of the 912 fish recaptured, 517 (57%) were recovered in the calendar year they were tagged. A total of 377 were recovered during the second year after tagging. Ten recoveries occurred after three years, five after four years, and one rainbow was recaptured five years after tagging. Several were recaptured more than once in different years.

Tag Loss

Defective tags and some shedding of tags occurred during the tagging studies. A short term tag loss experiment was conducted at the stream during 1972 (Siedelman, et al. 1973) with no tag loss observed for 32 rainbows held in study pens for 14 days. However, over the longer term and under natural conditions some tag loss does occur. No estimate of tag loss over the long term was determined.

Age and Growth

The mean length by age group of 2,208 spring migrant and 1,746 fall migrant rainbow trout (1972-1975) is presented in Figure 7. It appears that the graph of increased length versus age produces a sigmoid curve. The mean annual growth increment, based on the lengths of successive age groups of fall-run fish, is presented in Table 12. While growth rate varies substantially between individuals, the greatest rate of increase

Table 10. Month of Tagging Versus Recapture Rate, Rainbow Trout, Lower Talarik Creek, 1964-1974 Combined

Month	No. Tagged	No. Subsequently Recaptured	Recapture %
March	2	-	-
April	4	1	25.0
May	1,734	427	24.6
June	866	102	11.8
July	446	31	6.9
August	1,444	92	6.4
September	2,106	246	11.7
October	189	9	4.8
November	55	4	7.3
Total	6,846	912	13.3

Table 11. Length at Tagging Versus Recovery Percentage, Lower Talarik Creek Rainbow Trout, 1970-1974 Combined

Length (mm)	No. Tagged	No. Subsequently Recovered	Recovery Percentage
100-149	54	1	1.9
150-199	322	9	2.8
200-249	853	56	6.6
250-299	946	52	5.5
300-349	370	34	9.2
350-399	320	38	11.9
400-449	265	39	14.7
450-499	211	31	14.7
500-549	444	123	27.7
550-599	904	229	25.3
600-649	791	168	21.2
650-699	401	60	14.9
700-749	121	21	17.4
750-799	29	6	20.7
800-849	2	-	-
Not recorded	11	8	72.7
Total	6,044	875	14.5

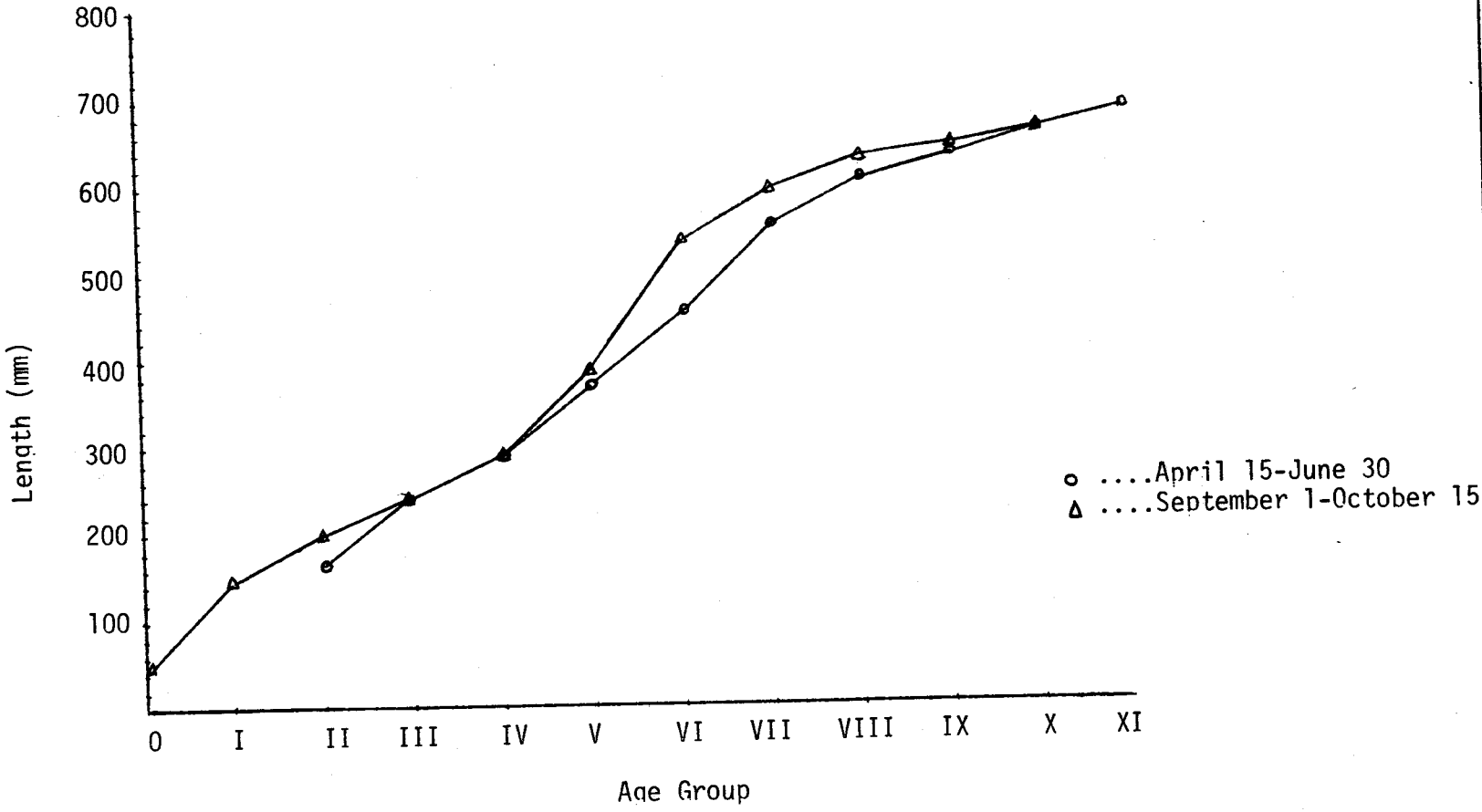

Figure 7. Mean Fork Length by Age Group, Rainbow Trout, Lower Talarik Creek, 1972-1975 Combined

by age group appears to have occurred at ages 0-1 and IV-VI. Length continues to increase throughout the life span, but following attainment of age VI, the rate of increase drops with each additional year. The most rapid increase in length observed was among age group 0 fish. They emerged during mid-to-late July at approximately 28 mm and many nearly doubled their length by late September.

The largest rainbow trout caught during the study was a male with a fork length of 814 mm (32").

By comparing the lengths of fish tagged in the fall with those from the same individuals when they were recaptured the following spring, it is apparent that over-winter growth in length is minimal (Table 13). For 138 fish measured, ranging in age from IV to IX, the mean increase in length over a period of approximately eight months was only 1 millimeter. Tagging these fish in the fall may have had some effect on this, but factors such as water temperature, ice cover, and shifts in the abundance of food items were likely more responsible. The general lack of growth during this eight month coldwater period emphasizes the importance of summer feeding and growth.

Weights were obtained for most rainbows sampled at the weir. For purposes of comparison by age group, weights collected during the fall period (September 1 through October 15) are the most useful (spring weights as mentioned earlier were influenced by spawning). In Table 14 the mean weights by age group of 1,980 fall-run fish (1972-1975 combined) are presented. It is apparent weight increases throughout the life span of the fish and the greatest rate of increase for most occurs between ages IV and VI (the rate of length increase is also greatest between ages IV and VI).

By comparing the weights of fish sampled in the spring with those of the same fish recaptured in the fall, an estimate of over-summer growth in weight was obtained. These data are presented by age group in Table 15.

Dramatic increases in weight were made by the older age groups during this period. The older fish spent most of this time span in Lake Iliamna outside the Lower Talarik Creek environment, so factors that trigger this substantial growth in weight were not observed. Insufficient numbers of juvenile fish were recaptured for valid comparisons.

The heaviest rainbow trout sampled during the program at Lower Talarik Creek was 6.27 kg (13 lb 13 oz).

A regression of length versus weight was computed for a sample (n = 198) of the 1,980 fall-run rainbows weighed (1972-1975). A power curve,

$$Y = 0.000002X^{3.24}$$

was found to best describe the length-weight relationship. The correlation coefficient (r) of this curve is 0.98.

Table 12. Mean Fork Length by Age Group, Fall-run Rainbow Trout, Lower Talarik Creek, 1972-1975 Combined.

Age Group	n	Mean Length (mm)	Mean Annual Growth Increment (mm)
0	43	47	-
I	44	157	110
II	219	199	42
III	424	239	40
IV	243	287	48
V	60	395	108
VI	131	541	146
VII	298	598	57
VIII	213	628	30
IX	65	657	29
X	6	666	9
Total	1,746		

Table 13. Overwinter Growth* by Age, Rainbow Trout, Lower Talarik Cre
1970-1975 Combined.

Age Group (in fall)	No. Recaptured	Mean Length (mm) Fall	Mean Length (mm) Spring	Mean G Grow
IV	4	306	313	
V	6	458	460	
VI	23	559	559	
VII	55	599	599	
VIII	30	645	646	1
IX	4	642	643	1
Unknown	16	603	602	-1
Totals	138	589	590	1

* Based on length comparisons from fish captured in the fall (Aug. 28-Oc
and subsequently recaptured the following spring (March 27-July 8).

Table 14. Mean Weight by Age Group, Fall Run * Rainbow Trout, Lower Talarik Creek, 1972-1975 Combined.

Age Group	No. Weighed	Mean Weight (g)	Mean Annual Weight Increment (g)
I	38	50	-
II	202	80	30
III	417	151	71
IV	227	252	101
V	54	832	580
VI	133	1,925	1,093
VII	298	2,545	620
VIII	208	2,901	356
IX	63	3,494	593
X	6	3,533	39
XI	1	4,550	-
Unknown	333	1,695	-
Total	1,980		

* September 1-October 15

Table 15. Mean Weight Increase Over Summer,* by Age Group, Rainbow Trout, Lower Talarik Creek, 1973-1974 Combined.

Age Group	Males		Females		Total	
	n	Mean Weight Increase (gr.)	n	Mean Weight Increase (gr.)	n	Mean Weight Increase
V	-	-	1	800	1	800
VI	2	1,190	1	300	3	893
VII	3	1,047	15	954	18	969
VIII	5	850	14	1,126	19	1,053
IX	3	1,887	8	1,063	11	1,287
Unknown	4	1,025	7	930	11	965
Total	17	1,149	46	1,004	63	1,043

* These data are based strictly on tag recoveries. Over summer weights were determined by subtracting spring weights (May 7-June 30) from fall weights (September 10-October 7).

Food Habits

Two hundred and forty-one rainbow trout were sampled (1971-1975) at Lower Talarik Creek to determine feeding habits. The food items found and their frequency of occurrence are summarized in Table 16. Sockeye salmon eggs, midges (both larvae and adults), and caddis fly larvae were the most common food items found among the fish sampled. Sockeye salmon eggs were utilized, to some extent, by nearly all size groups of fish sampled. Aquatic diptera, mainly midges, and other small aquatic insects were important among the smaller size groups, especially prior to the onset of salmon spawning. Forage fishes (principally pond smelt) were present in the diet of rainbow trout over 175 mm in length. Data are incomplete on the feeding habits of the larger size groups of rainbows as they spend so much time outside the stream. The bulk of those examined instream had empty stomachs. No information was obtained on winter food habits.

Sockeye salmon produce immediate as well as delayed, impact on the food abundance available to rainbow trout. Salmon eggs and decaying flesh are available as food following each year's run. Nutrients released during decay of salmon carcasses stimulate primary production and, indirectly, affect the invertebrate abundance the following year, producing a delayed impact on rainbow food resources.

Table 17 presents a comparison between the mean coefficient of condition ($\bar{k}$) by age group for rainbows from years of low sockeye escapements with those from years of higher escapements. These data present differences in the length-weight relationships of the fish by age group for the two sets of years. The fish used in this comparison are all from the fall-run (September 1-October 15), so the salmon run for each year would have had direct influence on their condition at the time of sampling. For stream dwelling, stream feeding fish (age groups I-V) the differences in condition between years were significant at the 95% confidence level.

Parasites and Diseases

Spawning rainbows were sampled by personnel from the Alaska Department of Fish and Game, Fish Pathology Laboratory, to determine whether they supported infections of IHN virus. All tests proved negative (Roger Grischkowsky, Fish Pathologist, personal communication). In addition, field examinations have been performed and common forms of internal and external parasites have been discovered. Nematodes and cestodes were very commonly found associated with the viscera and occasionally encysted in the body musculature of fish sampled. Trematodes have been found in the eye, possible *Diplostoma sp.* Acanthocephalans were commonly observed in the intestinal tracts. The only external parasites identified to date were copepods, *Salmincola sp.* (commonly found attached to gill filaments, on internal surfaces of the mouth, and around the fin bases) and the arctic lamprey, *Lampetra japonica* (Martens).

Of 4,402 spring and fall run rainbows examined externally, 107 (2%) bore the scars of previous lamprey attachment. These fish ranged in length from 238 to 760 mm. Some had several lamprey scars...the maximum number

Table 16. Rainbow Trout Food Items, Lower Talarik Creek, 1971-1975

Food Items	Frequency of Occurrence *	% of Total**	Period of Occu
Sockeye salmon eggs	93	39	August 12-April 4
Aquatic Diptera larvae	32	13	June 20-September
Aquatic Diptera adults	30	12	July 11-September
Caddis fly (Trichoptera) larvae	21	9	June 19-September
Unidentified insect matter	14	6	June 12-September
Coleoptera larvae	14	6	July 13-September
Water mites (Hydracarina)	13	5	July 13-September
Mayfly (Ephemeroptera) nymphs	12	5	June 19-September
Unidentified fish remains	11	5	September 1-Septe
Stone fly (Plecoptera) nymphs	10	4	May 3-September 21
Hymenoptera	8	3	July 13-September
Terrestrial Diptera larvae (maggots)	8	3	September 4
Stone fly (Plecoptera) adults	7	3	July 12-September 5
Pond smelt (Hypomesus olidus)	7	3	August 3-September
Caddis fly (Trichoptera) adults	6	2	July 13-September 8
Rainbow trout eggs	5	2	May 3-June 17
Coleoptera adults	4	2	June 26-September
Aquatic Hemiptera	3	1	July 13-September
Aquatic Collembola	2	1	July 13-September
Spiders (Arachnida)	2	1	September 4-Septe
Snails (Gastropoda)	1	-	August 26
Sockeye salmon fry	2	1	June 18-June 20
3-spine stickleback	1	-	August 12
Decaying sockeye salmon flesh	1	-	September 20
Egg skeins of recently cleaned trout	1	-	September 20
Empty stomachs	61	25	April 30-October

* Indicates number of stomachs containing particular food item.

** Based on 241 stomachs sampled.

observed was four. As only one upmigrant rainbow had a lamprey attached at the time of capture, lamprey attachment appears to occur in the lake. The impact of this type of parasitism on Lake Iliamna rainbows is presently not well defined.

Angler Use

Creel census data have been collected at Lower Talarik Creek on a full summer season basis (June 8-September 30) from 1971 through 1975, yielding harvest estimates, catch-release ratios, gear preference information, and other usage parameters. In addition, a partial creel census was conducted during June, 1976.

The timing and magnitude of sport angler use are presented in Table 18. Usage appears to be greatest during June and September (the periods when large rainbows are in the stream). Usage drops to very low levels during July and August. Cumulative percentages by month, 1971 through 1975, of sport fishing effort and catch at Lower Talarik Creek for the period June 8 through September 30 have been distributed as follows:

	Percent of Total Season Effort	Percent of Rainbow Trout Catch
June	27%	35%
July	14%	8%
August	10%	5%
September	49%	52%
	100%	100%

Some October angling and winter through-the-ice fishing also occur, but comparative data are lacking for these time periods. Some effort also takes place on the tributary lakes that feed Talarik Creek, but no monitoring of this use has occurred. The above data reflect the use that occurs in the lower stream area within approximately three miles of the stream outlet.

Comparative rainbow trout catch over this five-year period is summarized in Table 19. The mean annual catch during the 114 day census period was 1,212 rainbow trout. Of these, an average of 177 were retained.

The June, 1976 census (15 days) indicated 791 rainbow trout caught by 69 anglers in 285 angler-hours. Thus, it appears that initial 1976 catch rates were high compared to the previous five-year average.

Fishing regulations in effect during the study period included one limiting anglers to a daily bag and possession limit of five rainbow trout, only one of which could exceed 20 inches (508 mm) in total length. Rainbows in excess of 20 inches are generally members of age groups VI or older and are potential recruits to the succeeding years' spawning population. They are also the fish that draw most of the anglers' attention. In Table 20, rainbow trout retention data are presented with respect to the 20 inch size restriction. These data indicate a mean

Table 18. Number of Angler Days Spent at Lower Talarik Creek, by Month and Year, 1971-1975. *

Month	1971	1972	1973	1974	1975	Total	Average	Anglers/ Day
June	120	144	85	12	103	464	93	4.2
July	125	49	33	19	14	240	48	1.5
August	85	33	38	12	11	179	36	1.2
September	224	80	194	215	126	839	168	5.6
Totals	554	306	350	258	254	1,722	344	3.0

* June 8 through September 30 only (114 days).

Table 19. Comparative Seasons Creel Census Data, Lower Talarik Creek, 1971-1975, (June 8-September 30 only).

Year	Angler Days		Angler Hours		Rainbow Trout Caught		Rainbow Trout Retained		Catch/ Angler Hour
	Checked	Observed	Checked	Total	Checked	Total	Checked	Total	
1971	470	554	2,209	2,604	1,951	2,300	367	433	0.88
1972	226	306	1,269	1,718	616	834	104	141	0.49
1973	205	350	806	1,376	457	780	66	113	0.57
1974	246	258	989	1,037	475	498	70	73	0.48
1975	248	254	1,023	1,048	1,609	1,648	124	127	1.57
Totals	1,395	1,722	6,296	7,783	5,108	6,060	731	887	0.78
5-year Average	279	344	1,259	1,557	1,022	1,212	146	177	0.78

harvest of 65 of these large fish during the average sport fishing season (June 8-September 30) compared to a mean harvest of 113 for fish under 20 inches in length. Some additional harvest, of course, occurs mainly during October after the creel census program ends. However, the total average annual sport fish take of rainbows over 20 inches is not estimated to exceed 100 fish. At these harvest rates the fishery is not being adversely affected by sport angling.

Of the 1,395 angler days for which catch and effort totals were determined by Department personnel during the creel studies, 762 (55%) were expended by non-resident anglers and 633 (45%) by residents.

Gear preference and effectiveness data for 1973 through 1975 are presented in Table 21. It appears, based on the hours fished at the stream, that angling with flies and lures were equally popular. Anglers using both gear types in a single day and those for which gear type was not recorded are included in a "both" category as their catch by gear type could not be separated. While the numbers of hours fished were nearly equal between fly and lure fishermen, the rainbow trout catch rate was considerably greater for fly fishermen, 1.06 per hour to 0.77 per hour. Fly fishermen and lure fishermen retained rainbow trout at practically the same rate, 0.09 and 0.10 per hour.

DISCUSSION

Spawning by Lower Talarik Creek rainbows is similar to that of resident rainbows and steelhead described by other authors in North American watersheds (Hassiner, Hale, and Woods, 1974; Everest, 1973; Kwain, 1971; Dodge and MacCrimmon, 1971; Hartman, Northcote, and Lindsey, 1962). Differences in timing are evident between west coast steelhead stocks and rainbows. However, Hassinger et al. (1974) found that Lake Superior north shore steelhead spawn between mid-April and mid-June, just like Lower Talarik Creek rainbows. No evidence supportive of fall spawning of rainbows (Paddock, 1968) was obtained during the study. Fall-run rainbows noted as maturing in September were captured as spawners the following May. Conditions in the stream do not appear conducive to spawning during the late fall in most years (low flows, surface ice, and anchor ice present). No early emergent rainbow fry have been observed (April-June) which would be indicative of fall spawning. Over-winter survival of fall spawners would be difficult due to the extended winters and harsh conditions. It appears that spring spawning is the normal situation for Lower Talarik Creek.

The age structure of Lower Talarik Creek spawners varies considerably from populations of resident rainbows farther south. Kwain (1971) found rainbows of Lake Superior reaching maturity mostly at ages II through IV. Most Lower Talarik Creek rainbows mature at ages VI and VII. Scott and Crossman (1973) mention a Lake Huron stock spawning at ages III-VI, with most being age V, whereas Talarik rainbows spawn at ages III-XII, with most being age VIII. Overall, ages VI-IX represent approximately 95% of the Lower Talarik Creek spawning population.

Table 20. Rainbow Trout Retention Versus 20 Inch Size Limit, Lower Talarik Creek, 1971-1975*.

Year	Total Rainbow Trout Retained**	No. Actually Measured	No. over 20 Inches		No. Under 20 In	
			Actual	Expanded	Actual	Expa
1971	436	300	67	97	233	33
1972	143	100	29	41	71	10
1973	112	29	27	104	2	
1974	73	61	48	57	13	1
1975	128	94	19	26	75	10
Total	892	584	190	325	394	56
5-year Average	178	117	38	65	79	113

* The yearly period covered is June 8-September 30 only.

** Harvest expanded to include all anglers observed on stream.

Table 21. Comparative Effectiveness of Terminal Gear Used by Anglers, Lower Talarik Creek, 1973-1975 Combined*.

Angler Effort and Catch**	Flies	Lures	Both	Total
Total angler hours	1,279	1,282.0	366.0	2,927
Total rainbow trout caught	1,362	993	164	2,519
Rainbow trout catch/hour	1.06	0.77	0.45	0.86
Total rainbow trout retained	110	132	13	255
Rainbow trout retained/hour	0.09	0.10	0.04	0.09

* Data for the periods June 8-September 30 only.

** Data not expanded to include anglers observed but not interviewed.

Some consecutive spawning was documented in Lower Talarik Creek through tagging studies although the percentage was low (5%). Only one rainbow of 2,133 examined (1972-1975) was observed to spawn three successive years in the stream. Tag recovery data do not support an alternate year spawning pattern. Following an interpretation of spawning marks on the scales of mature fish, a more in-depth discussion of frequency of spawning will be possible.

Lower Talarik Creek rainbow spawners do not tend to remain in the stream long following spawning. Most migrate back downstream to Lake Iliamna. This behavioral trait makes them virtually unavailable to the stream angler over the summer period as winds and a lack of suitable shelter have prevented a troll fishery from developing on Lake Iliamna.

The movements of juvenile rainbow trout proved hard to document as many age group III fish remained upstream in rearing areas during the period of weir operation. Recovery rate of those that were tagged at the weir was quite low. Age groups IV and V spent the early part of the summer in Lake Iliamna but some returned to the stream during the salmon spawning in August. A more intensive instream tagging effort (away from the weir) would have been necessary to fully define juvenile migratory habits.

No evidence of anadromous rainbow trout was found during the study. Post spawn fish tagged at Lower Talarik Creek were recaptured during the summer from other locations around Lake Iliamna and in the Kvichak River, but none were reported captured in the nets of the commercial salmon fishery in Bristol Bay. None of the scales analyzed showed steelhead growth patterns.

While rainbows were recaptured from several locations around Lake Iliamna, the migration routes they chose to reach these locations and their movements within the lake remain uninvestigated.

Each season a substantial number of large, previously non-tagged, rainbows were recaptured at the weir and by anglers at Lower Talarik Creek. Since tags were affixed to each rainbow passing through the weir either upstream or downstream during the study from 1971 to 1975, the origin of these nontagged fish remains an unresolved question. While some may have been tagged in earlier years and subsequently shed tags, I suspect most were fish that outmigrated from the stream during the October through April period when the weir was not in operation, and thus were never tagged. The lack of observed interstream movement mentioned earlier suggests that interstream movement did not account for the untagged fish.

Growth rate of Lower Talarik Creek rainbows proved greatest between ages IV and VI. The factors responsible for the surge in growth at this stage of their life cycle have not been identified. Migration data through the weir indicate these age groups spend much of the summer period in Lake Iliamna. Perhaps forage fishes available in the lake stimulate the increased growth.

The lack of overwinter growth observed for tagged fish is consistent with the findings of other authors. Reimers (1957) found the digestion rate of food items by rainbow trout to be greatly reduced at low temperatures. Chapman and Bjornn (1969) exposed age 0 steelhead to a range of temperatures and found that activity was greatly reduced at temperatures below 2.8° C (37°F). Feeding was observed at temperatures above 5.5° C (42°F). Surface waters at Lower Talarik Creek drop to 0° C (32°F) in early October. Ice breakup generally occurs from mid-April to May. Thus water temperature itself could tend to inhibit both active feeding and digestion. Some feeding must occur under the ice in the lakes, but I suspect the energy is used for body maintenance rather than growth.

As salmon eggs constitute a major food item for juvenile rainbow trout during the late summer, the magnitude of sockeye salmon escapements into the spawning streams may have considerable impact on the well being of trout populations. These rainbows face a six to eight month period in which the streams are at least partially ice covered and growth conditions are apparently adverse, thus it is necessary that they accumulate adequate energy reserves during the May-September time span to insure their survival. Data indicate the condition factor of juvenile rainbows (age groups III through VI) averaged significantly greater following summers of high sockeye escapements than following salmon-poor summers. The availability of large numbers of salmon eggs in the summer and fall may enhance the rainbow's chances for over-winter survival. Present management of sockeye salmon escapements does not place a high priority on perpetuating the survival of other directly dependent species such as rainbow trout. I think future sampling should be conducted to better define the relationship between the two species for the benefit of all user groups.

There is no indication that present levels of sport harvest are adversely affecting the spawning run of large, old aged rainbows. Annual spawning surveys indicate the spawning run is adequately replenishing itself. Guiding firms and anglers primarily seek these larger rainbows as "Trophy" fish. Present bag limit restrictions, closed seasons, and rainbow behavior patterns appear compatible with the continued perpetuation of a healthy population of these fish while allowing an acceptable number for harvest.

The rainbow trout life history studies project ended in 1976. It has provided insight into the behavior and life patterns of rainbow trout near the northern limit of their range, insight that will aid in better management of the existing and potential fisheries.

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