STATE OF ALASKA

William A. Egan, Governor

Annual Progress Report for

DISTRIBUTION, ABUNDANCE AND NATURAL HISTORY OF THE ARCTIC GRAYLING IN THE TANANA RIVER DRAINAGE

by

Stephen L. Tack

ALASKA DEPARTMENT OF FISH AND GAME

Wallace H. Noerenberg, Commissioner

DIVISION OF SPORT FISH

Rupert E. Andrews, Director

Howard E. Metsker, Coordinator

RESEARCH PROJECT SEGMENT

State: Alaska

Project No.: F-9-3 *Name:* Sport Fish Investigations of Alaska.

Study No.: R-I *Study Title:* Distribution, Abundance and Natural History of the Arctic Grayling in the Tanana River Drainage.

Period Covered: July 1, 1970 to June 30, 1971.

ABSTRACT

Population estimates of Arctic grayling, Thymallus arcticus, were made in four sections of the Chena River, with means of 2,465, 769, 1,608, and 1,873 grayling per mile. Estimates have increased each year since they were initiated in 1968, suggesting that the population was at a low level in 1968, possibly due to the flood of August, 1967.

Analysis of 907 tag returns since 1967 revealed that most grayling are found in the same area from late May through August, and during this period in succeeding years. Summer movement that does occur appears random and is usually not extensive.

Grayling constituted over 50% of all fish captured throughout the main Chena River.

Analysis of length composition in various river sections indicates that rearing grayling (age I and II) are concentrated in the lower 50 miles of the river and move up during their second and third years of life. By their fourth summer, grayling seem to be distributed quite evenly throughout the main river (i.e., below the union of the North and East Forks).

Grayling that spawn in Mineral Lake outlet mature at age V. The male-to-female sex ratio was 1.2:1. Fecundity and egg size are discussed. Spawning behavior is recorded.

A close relationship was found between length and number of scale circuli in the Chena River grayling fry.

A creel census of the Upper Chena River gave an estimate of 22,500 angler hours and a yield of 12,150 grayling. A total estimate of 6,206 angler hours and 2,669 grayling was found for Badger Slough.

Eight waters were experimentally stocked with grayling fry in 1970.

RECOMMENDATIONS

It is recommended that:

1. Grayling population estimates be continued annually in the Chena River.

2. The length and age composition of grayling be determined in various sections of the Chena River and other tributaries of the Tanana River.

3. The distribution of young-of-the-year grayling be determined in the Chena River.

4. Meristics of grayling from various sections of the Chena River and other tributaries of the Tanana River be compared.

5. Grayling spawning habits be studied at the outlet of Mineral Lake.

6. Experimental stocking be continued to determine conditions necessary for grayling survival and growth in lakes and ponds.

7. The creel census program on the Chena River be continued.

8. Grayling overwintering studies be continued.

TECHNIQUES USED

All grayling for population, tagging, and length composition studies were captured by an Alternating Current shocker boat. This unit was described by Van Hulle (1968) and Roguski and Winslow (1969). Species composition was also determined from shocker boat samples.

Monofilament gill nets, 125' x 6', with five graduated mesh sizes (1/2- to 2 1/2-inch bar measure) and hook-and-line methods were used to sample stocked lakes and ponds.

Numbered FD-67 (Floy Tag Company) internal anchor tags were inserted in the dorsal musculature on grayling over approximately 145 mm. The left pelvic fin was removed from all tagged fish to determine tag loss and from all smaller grayling for population estimation.

Estimation of grayling populations was accomplished by the Schnabel tag-and-recapture technique.

The division of the Chena River into sections as described by Van Hulle (1968, Figure 1), was modified by dividing Sections 2 and 9 into parts a and b (Table 1) to facilitate more detailed analysis in these sections.

TABLE 1 Chena River Study Sections, 1970.

Section No.	Section Name	River Miles	Section Length (Mi.)
1	Mouth to University Avenue	0 - 6	6
2a	University Avenue to Peger Road	6 - 8	2
2b	Peger Road to Wendel Street	8 - 11	3
3	Wendel Street to Wainwright RR Bridge	11 - 14.5	3.5
4	Wainwright RR Bridge to Badger Slough	14.5 - 21.5	7
5	Badger Slough		
6	Badger Slough to Little Chena	21.5 - 25	3.5
7	Little Chena River	25 - 31.5	6.5
8	Little Chena to Nordale Slough		
9a	Nordale Slough to Bluffs	31.5 - 55.5	24
9b	Bluffs to Bailey Bridge	55.5 - 63	7.5
10	Bailey Bridge to Hodgkins Slough	63 - 79	16
11	Hodgkins Slough to 90 Mile Slough	79 - 90	11
12	90 Mile Slough to first bridge	90 - 92	2
13	First bridge to second bridge	92 - 94.5	2.5
14	Second bridge to North Fork	94.5 - 102	7.5
15	North Fork of Chena River		
16	East Fork of Chena River		

Angler use estimates for Badger Slough and Chena Hot Springs Road area of the Chena River were made by a randomized angler count system. Counts were stratified to provide greater sampling during high-use periods. Interviews with completed anglers were used to compute catch statistics.

Dissolved oxygen determinations were made with a Hach OX 2-P drop titration kit.

A Bausch and Lomb microprojector was used for determining age of grayling by scales. All scales were cleaned and mounted between glass slides before being read.

A 25' x 4' monofilament gill net of one-inch bar mesh was used to capture fish under the ice on the Chena River.

Water velocities were determined by the velocity head rod method.

FINDINGS

Job R-I-A *Population Structure, Summer Distribution, and Interspecific Competition in the Chena River and Other Tributaries of the Tanana River.*

Objectives

1. To determine the age composition of grayling in various sections of the Chena River and its tributaries during the summer months.
2. To obtain information on the extent and timing of intrastream movements.
3. To determine relative abundance and distribution of grayling and other fish species inhabiting the Chena River.
4. To investigate food habits of the various fish species in an effort to identify species that may be competing with grayling.
5. To collect sufficient fish specimens between the upper and lower Chena River for comparison of meristic characteristics.
6. To determine effects of tagging practices on growth and survival.
7. As time allows, this study will be expanded to include the Goodpaster and Delta Clearwater rivers.

Population Estimates

The Schnabel method was used to estimate the number of grayling per mile in Sections 2b, 6, 9b, and 10 of the Chena River (Table 1). The equipment, personnel, and method of handling the fish were essentially the same as in 1968 and 1969 (Roguski and Winslow, 1969; Roguski and Tack, 1970). The estimates in Sections 2b and 6 were completed in nine and five days, respectively. Thirty days were required to complete estimates in Sections 9b and 10.

The 1969 calculated estimate of 1,890 grayling per mile in Section 2b increased to 2,465 grayling per mile in 1970 (Table 2). The 1969 estimate is in turn higher than the 1968 estimate, revealing a steady increase in the grayling population for the last three years.

TABLE 2 Grayling Population Estimates, Chena River, 1970.

Section	Date of Estimate	Length of Section (Mi.)	No. Marked	Schnabel Estimates (GR/Mi.)	95% Confidence Limits (GR/Mi.)
2	7/ 2 - 7/10	3	579	2,465	1,852 - 4,075
6	5/26 - 5/30	3	927	769	714 - 841
9b	6/ 8 - 7/ 8	13	1,540	1,608	1,285 - 2,258
10	6/ 7 - 7/ 7	16	867	1,873	1,402 - 3,131

The reason for this increase is not clear, but two possibilities suggest themselves. If the 1967 flood destroyed or dislocated a large part of the population, we may be witnessing the return to pre-flood population levels. If this were the case, a general increase throughout the river would be expected. There was a strong increase in Section 6 (452 - 913 fish per mile) from 1968 to 1969, but in May, 1970, the population was down to 769 fish per mile.

The increase in Section 2 may be the result of enrichment through the introduction of sewage and other wastes. Frey, et. al. (1970), show a high number of invertebrates in the Chena River from University Avenue Bridge to Fort Wainwright (mile 6 to 14). The numbers increase above and below this section. These high numbers are mainly dipterons and oligochaetes which can withstand near zero oxygen levels. If this is the cause of the high population of grayling, we may expect trends in the future population to follow those of the pollution level in the following manner. If pollution decreases, the invertebrates and grayling will probably decrease until the natural carrying capacity of this stretch of river is reached. If pollution increases, the invertebrate fauna will consist of yet fewer species and, to a point, increased numbers, assuming the maximum number has not yet been reached. If pollution is continued, a point will be reached when drastic, probably sudden, changes will occur. The biological oxygen demand may reach a point that would cause anoxic conditions during stress periods such as during the winter. This would result in the destruction or dislocation of grayling from the area. As nearly all of the individual invertebrates present are of only three species (*Tipula* sp., *Prosimulium* sp., and a member of the family Naididae [Frey, et. al., 1970]), any change or disease affecting those species would probably result in a complete collapse of the food chain and death or dislocation of the grayling.

Tagging Program

Grayling over approximately 145 mm fork length, captured by electrofishing during population estimation studies, were tagged with a yellow Floy internal anchor tag. Since initiation of the project in 1967, 6,282 fish have been tagged (Table 3), and 907 recaptures have been reported. In tabulating the results, each recapture was treated as if it were an initial recapture. Recapture reports without data were excluded, and a fish recaptured in the same section of the Chena River as tagged was considered as having not moved at all.

TABLE 3 Number of Grayling Tagged and Recaptured in the Chena River, 1967-1970.

Year Tagged	No. Tagged	No. Recaptured				
		1967	1968	1969	1970	Total
1967	339	13	34	8	2	57
1968	1,078	--	105	36	56	197
1969	1,362	--	--	112	146	258
1970	3,503	--	--	--	395	395
Total	6,282	13	139	156	599	907

In Figure 1, movement of grayling recaptured the same summer they were tagged is analyzed by month tagged and recaptured. In all cases the number of fish showing no movement was several times greater than those exhibiting some up- or downstream movement. More grayling moved upstream than down in June, July, and August; however, movement differences are small and in most cases suggest random movement. Only in the June recaptures of June tagged fish is there a strong indication of a general upstream movement of the population.

Recaptures of grayling that had overwintered at least once since being tagged were analyzed as previously described for the same year recaptures. Figure 2 shows that fish tend to be found in the same section in succeeding summers. The up- and downstream changes are nearly equal in most cases except for fish tagged in May and recaptured in May, June, or July, all of which showed a tendency to move downstream.

Analyzing the returns by length group again shows the general pattern of fish not moving at all and the rest showing nearly equal up- and downstream movement (Table 4).

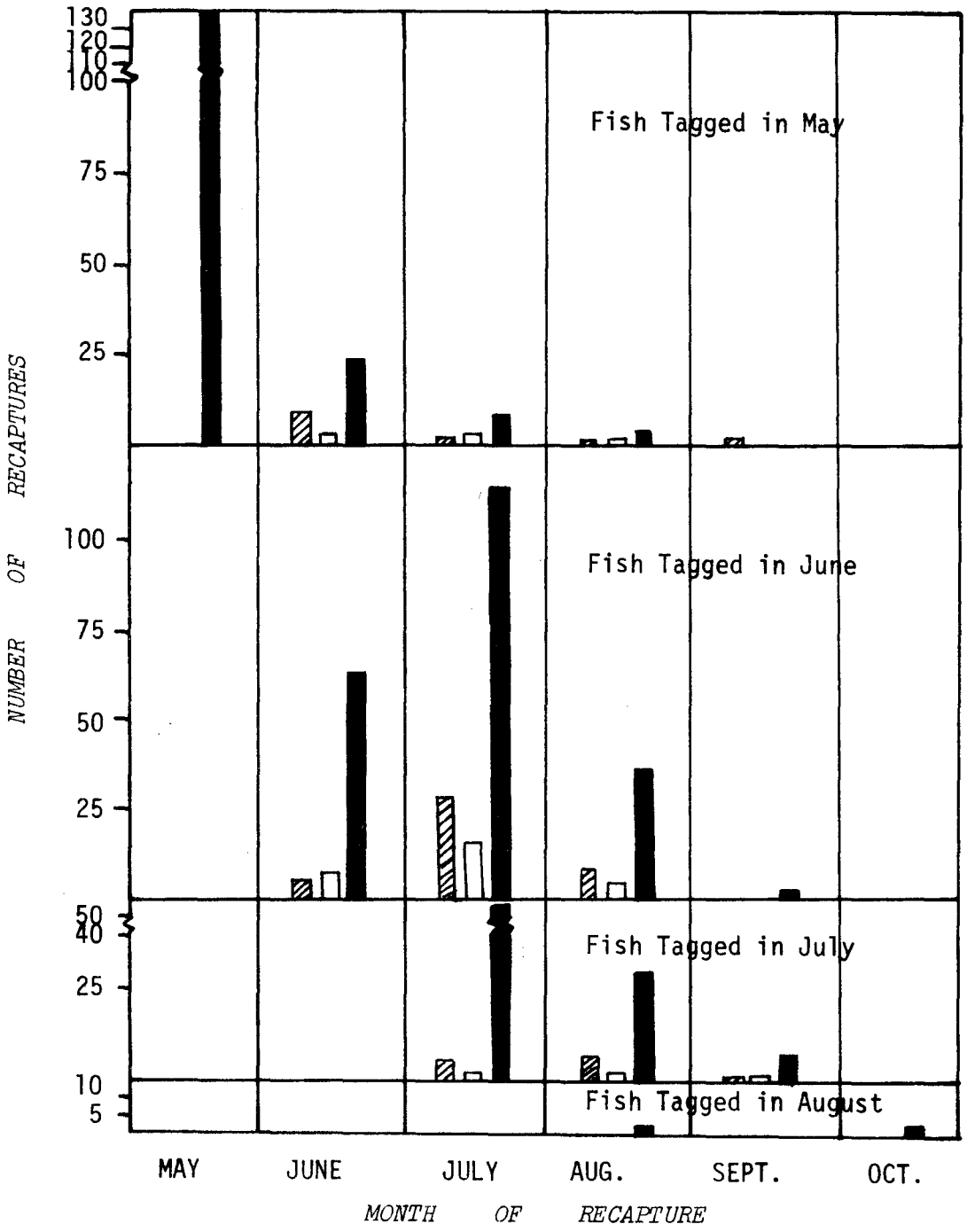


FIGURE 1 NUMBER OF RECAPTURES, BY MONTH, OF CHENA RIVER GRAYLING TAGGED IN THE SAME YEAR, THAT MOVED UP ▨, DOWN □, OR SHOWED NO MOVEMENT ■ FROM 1967 THROUGH 1970.

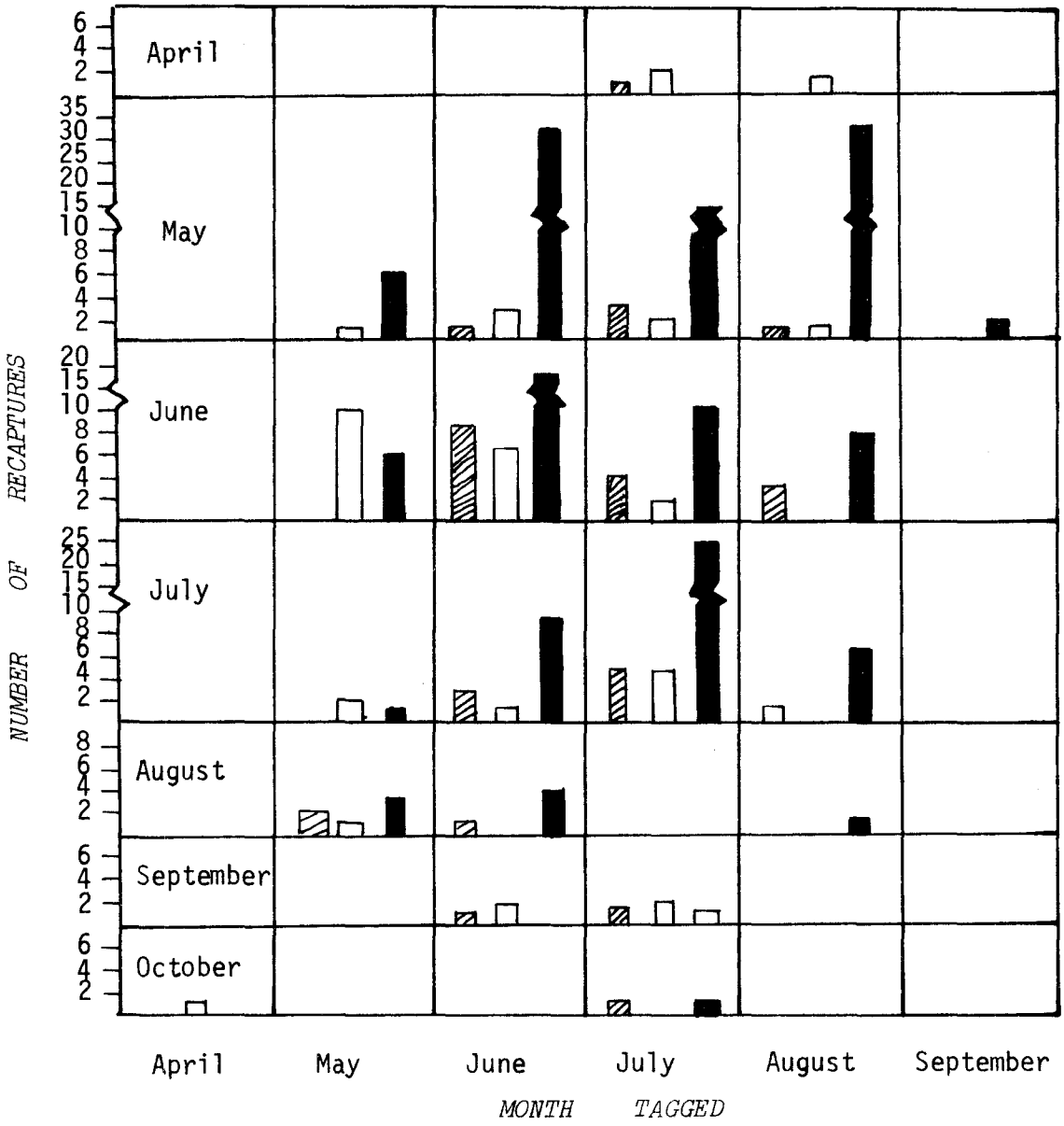


FIGURE 2 THE NUMBER OF CHENA RIVER GRAYLING RECAPTURED FROM 1967 THROUGH 1970 AFTER HAVING OVERWINTERED AT LEAST ONCE SINCE TAGGING, THAT MOVE UP ▨, DOWN □, OR SHOWED NO MOVEMENT ■.

TABLE 4 The Movement of Three Length Groups of Tagged Chena River Grayling, 1970.

	Length Groupings (mm)		
	120 - 189*	190 - 270**	270+***
Number of fish:			
No movement	115	340	56
Upstream movement	10	41	11
Downstream movement	20	54	14

*Approximately age groups I and II.
**Approximately age groups III and IV.
***Most fish sexually mature.

Even though most grayling remain in the area where they are tagged, those that move may move considerable distances. One fish tagged in Section 2 of the Chena River was recaptured 50 miles away at the highway bridge on the Salcha River. One other interstream movement involved a grayling tagged in Section 6 of the Chena River and recaptured 50 miles away in Frenchman Creek on Eielson AFB. Both were caught one year after being tagged.

Intrastream movements were primarily from one section to the next, but several fish moved from 50 - 80 miles up or down the Chena River.

The extent to which the tag returns have been analyzed is not adequate to justify a final conclusion regarding the movement patterns of the Chena River grayling population. Further analysis is planned for next year. Movements related to winter conditions will also be sought in future years.

Age and Growth

Scale samples, collected from a large number of grayling captured in Section 6 of the Chena River on May 26 and 27, were subsampled to represent each 10 mm length group approximately equally. Scales were easily read through age class IV, but became difficult to read in older fish.

Table 5 shows the age-length relationships in the sample. Age class III, the 1967 year class, is strikingly under-represented in the sample. There is no apparent error resulting from sampling and the length groups in the range of age III grayling were well represented. The explanation for the

low number of age III fish may be that this group was distributed in other sections of the river, or that the fry suffered heavy mortality in the August, 1967, flood. The latter explanation is reinforced by the fact that no age II grayling appeared in the 1969 scale samples (Roguski and Tack, 1970). Confirmation of the flood hypothesis will be sought in 1971.

TABLE 5 Length and Age Composition of 183 Chena River Grayling Chosen to Represent Each 10 mm Length Group Approximately Equally, 1970.

Length Group (mm)	Age Class I	II	III	IV	V	VI	VII	Total
70- 79	2							2
80- 89	2							2
90- 99	6							6
100-109	1							1
110-119								0
120-129		5						5
130-139		10						10
140-149		10						10
150-159		9	1					10
160-169		9						9
170-179		7	3					10
180-189		3	2	5				10
190-199			2	10				12
200-209				14				14
210-219				8	1			9
220-229				10	1			11
230-239				9	1			10
240-249				7	3			10
250-259				6	3	1		10
260-269			3	7	1			11
270-279				6	1			7
280-289				3	2	1	1	7
290-299				1				1
300-309				2	2			4
310-319					1	1		2
Totals	11	53	11	88	16	3	1	183
Mean fork length (mm)	89.5	152.4	202.1	230.7	263.5	281.7		

The age III fish were also peculiar in showing a bimodal length distribution. There is no apparent explanation for this.

Capture Rate and Species Composition

Capture Rate:

The capture rate with the shocker boat in each river section sampled during 1970 is shown in Figure 3. The capture rate was calculated using the actual time electricity was flowing. The lower catch rate in upstream sections probably resulted from a combination of fewer fish per mile and less favorable conditions for shocker boat operation.

The capture rate is an indication of abundance, but because it is affected by physical conditions which change considerably from section to section, it should not be used for any more than rough comparisons between sections. It may prove more useful as an index of abundance from year to year in a particular section.

Species Composition:

The summer species composition of samples taken by shocker boat is shown for eight sections of the Chena River in Figure 4. Grayling are the dominant species, with round whitefish, Prosopium cylindraceum, the next most abundant fish. Suckers, Catostomus catostomus, are probably more abundant than indicated because their large size makes them difficult to capture with the small dip nets used for grayling. Pike, Esox lucius, and burbot, Lota lota, are not often encountered and are probably represented fairly. Humpback whitefish, Coregonus pidschian, and least cisco, C. sardinella, are rarely taken and only in the lower river.

Distribution by Length Frequency

Chena River:

The length composition of 15 large samples of grayling taken from eight sections of the Chena River is shown in Figure 5. The samples were further separated into three age groups according to date of capture: late May - early June, mid-June, and July - early August. No samples were taken in late summer.

In general, a 90 mm peak represents age I grayling, and 150 mm peak represents age II fish. A peak present in most samples at about 220 mm probably represents age IV grayling, which had a mean fork length of 230 mm (Table 5). An age group III peak is generally missing, but appears in all three Section 10 samples at about 180 mm. The weak age III length group is further evidence that the 1967 year class was severely affected by the August, 1967, flood.

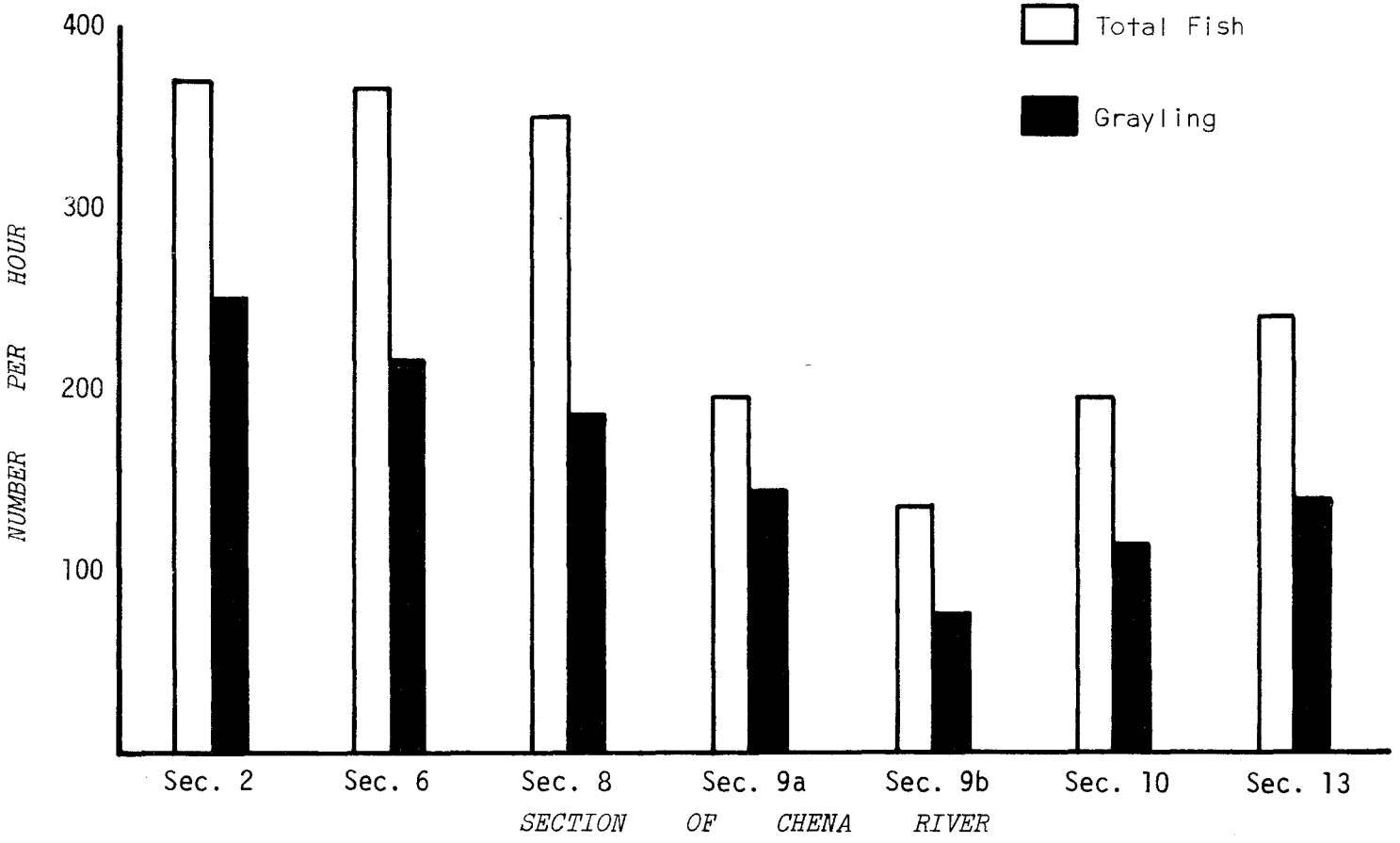


FIGURE 3 RATE OF CAPTURE OF GRAYLING AND TOTAL FISH CAPTURED ELECTROFISHING IN THE CHENA RIVER, 1970.

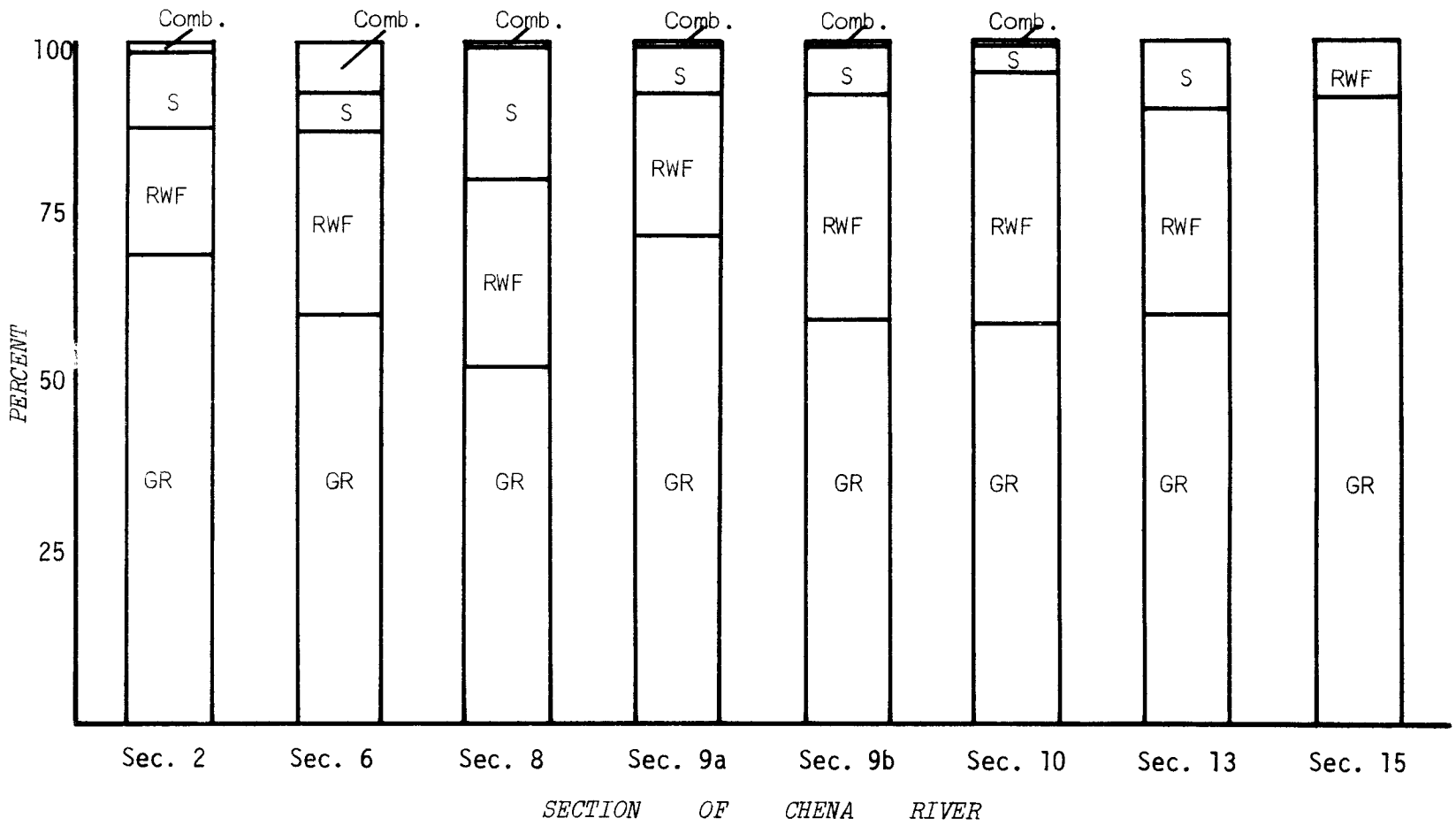


FIGURE 4 THE RELATIVE ABUNDANCE OF GRAYLING (GR), ROUND WHITEFISH (RWF), SUCKERS (S), AND COMBINED HUMPBACK WHITEFISH, LEAST CISCO, BURBOT, AND PIKE (COMB.), IN EIGHT SECTIONS OF THE CHENA RIVER, 1970.

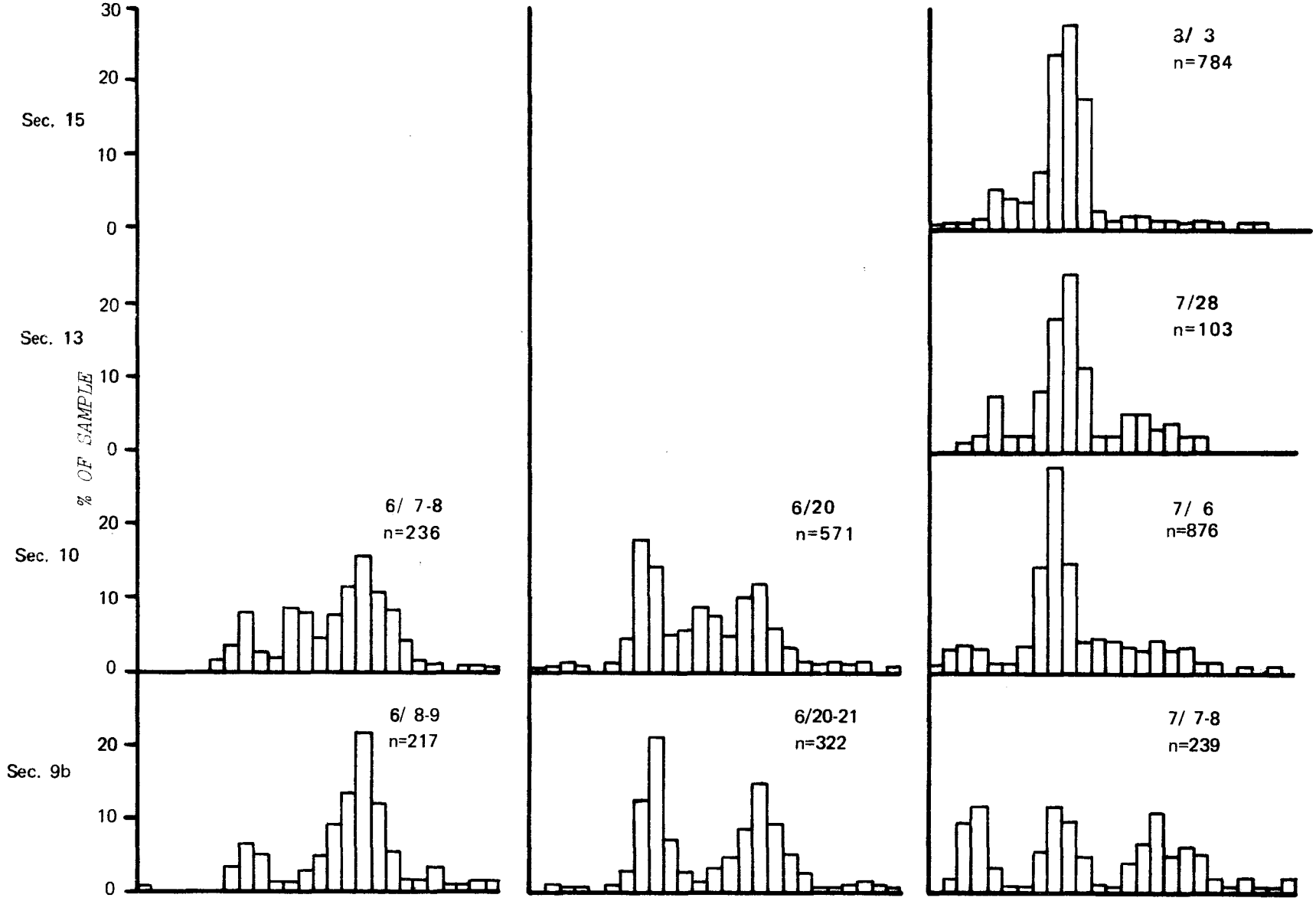
For Sections 6 through 15, there is a slight upward shift in the age II peaks in sections closer to the mouth of the river, indicating faster growth in lower sections of the river. In Section 2, the age II peak is shifted about 30 mm higher than in the upper sections, indicating greatly accelerated growth in this "polluted" (Frey, et. al., 1970) section.

Age I grayling appear predominantly in the lower river from Section 6 through 8 in early summer and begin to appear in upstream sections later in the summer. Age I grayling were not found in Section 2. These results may be biased by the fact that very small grayling are less effectively captured by the methods used than larger grayling. The age II grayling also show a progressive increase in the upper sections and decrease in the lower sections as the summer progresses. This evidence suggests that young-of-the-year grayling use the lower river (below river mile 55) as a rearing area and remain in the lower river during their first winter. During their second summer (age I), they begin to spread upstream and continue to move upstream during the third summer. Tag return data from fish age III and older indicates that these fish are maximally distributed and exhibit only random movements (see section on tagging results in this report).

Grayling mature at about 270 mm in the Chena River (Roguski and Tack, 1970). Only a small percentage of the grayling represented in Figure 5 are over 270 mm, yet as indicated by stable or rising population levels, these few spawners are enough to maintain the population, or as is likely the case, most of the spawners are in the headwaters and were not sampled.

Goodpaster River:

The length frequency of 1,163 grayling captured in the lower 20 miles of the Goodpaster River from August 18 - 21, is depicted in Figure 6. The peak at 60 - 69 mm represents young-of-the-year fish. It appears that early growth is much faster in the Goodpaster River than in the Chena River as shown by Roguski and Tack (1970).


Sec. 15
Sec. 13
Sec. 10
Sec. 9b
% OF SAMPLE
30
20
10
0
6/ 7-8
n=236
6/20
n=571
8/ 3
n=784
7/28
n=103
7/ 6
n=876
6/ 8-9
n=217
6/20-21
n=322
7/ 7-8
n=239

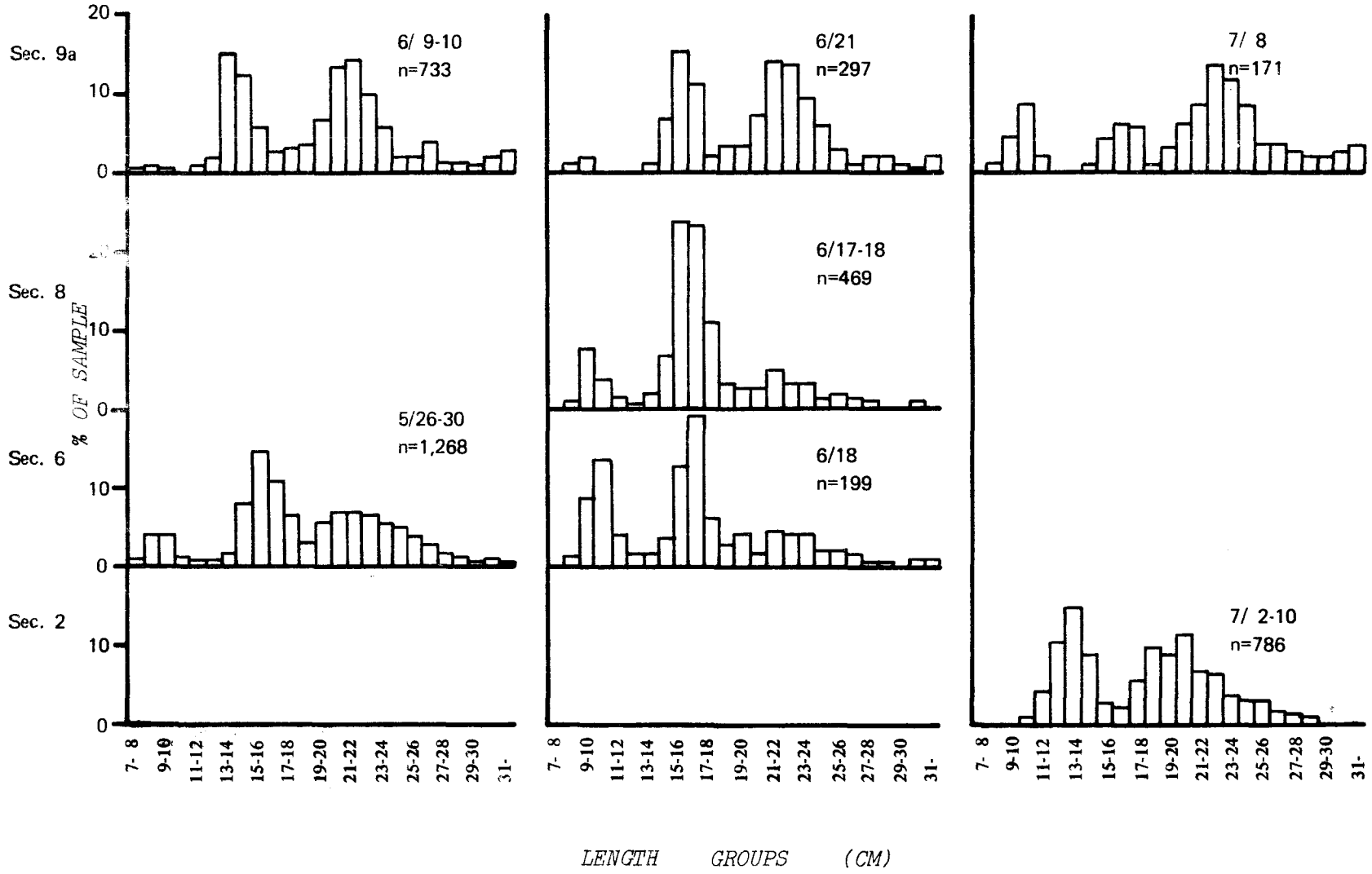


FIGURE 5 LENGTH DISTRIBUTION OF 15 SAMPLES OF GRAYLING TAKEN FROM VARIOUS SECTIONS OF THE CHENA RIVER DURING THREE TIME PERIODS, 1970.

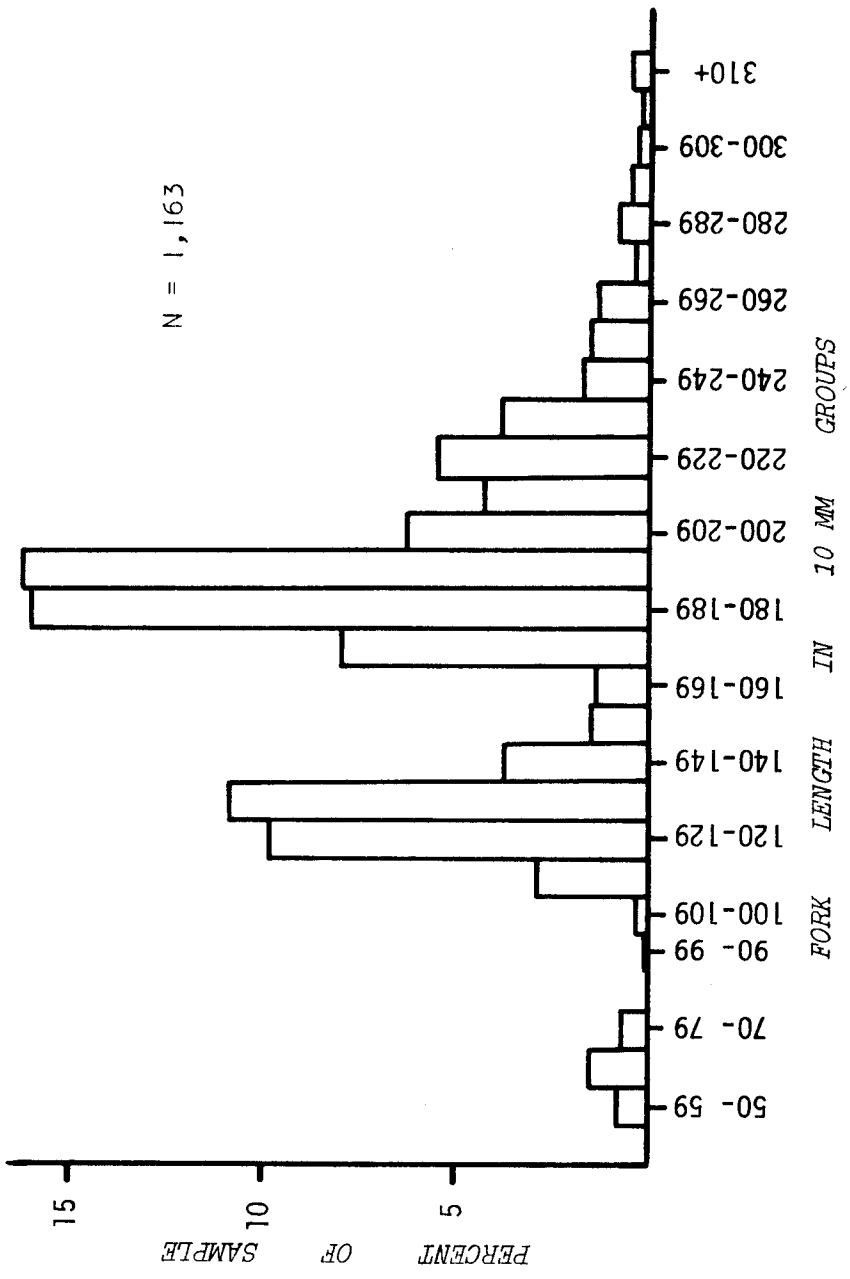


FIGURE 6 LENGTH FREQUENCY OF GRAYLING FROM THE LOWER GOODPASTER RIVER, TAKEN AUGUST 18 TO 21, 1970.