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THE SEAWARD MIGRATION OF ARCTIC CHAR (SALVELINUS ALPINUS)
OUT OF NAUYUK LAKE, KENT PENINSULA, NORTHWEST TERRITORIES

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ABSTRACT

A research program on Arctic char was established on the southwest tip of the Kent Peninsula, Northwest Territories, in May 1974. The seaward migration of this species out of Nauyuk Lake was observed by means of a counting weir established at the head of the river. Large fish tend to precede smaller ones. The whole migratory population is very strongly bimodal. Maturing fish in the migratory group are very rare. In addition to the migration to the ocean there is also a migration of small fish into Nauyuk Lake out of Willow Lake which is the only known spawning and nursery area. Maturing fish apparently ascend to Willow Lake very soon after ice break-up, at the same time as the post-spawners descend to Nauyuk Lake. Post-spawning fish, both males and females, are in an emaciated condition and can be recognized by having a relative condition factor of less than 0.75.

INTRODUCTION

Nauyuk Lake (Nauyuk is Eskimo for seagull) is located on the southwest tip of the Kent Peninsula 140 km (85 miles) west southwest of Cambridge Bay and 720 km (460 miles) north northeast of Yellowknife in latitude $68^{\circ}22'N$ and longitude $107^{\circ}40'W$.

This lake was chosen as the site for a detailed study of the biology and production of Arctic char on account of its relatively undisturbed nature, small size and compactness of the drainage area, in addition to having an abundant population of anadromous char.

Nauyuk Lake (Fig. 1) is approximately 27 km^2 in area; it is shaped like a small letter 'omega' with three arms originating from a common base. The maximum length is 6.5 km and the width across the base of the arms is 6.0 km. The maximum depth is 51.5 m. The lake is fed by several streams which have their origin in small headwater lakes; only one of these, Willow Lake (Fig. 2) is known to have significant fish stocks; this lake has also been found to have great significance in the biology of the char population as it serves as the main spawning and nursery area for this species. Willow Lake is connected to Nauyuk Lake by a short braided stream flowing in deep (60-75 cm), narrow (30-40 cm) channels cut in the peat of the tundra.

Nauyuk Lake connects to Parry Bay by a short river 200 m long which flows from mid June to the end of September; for the remainder of the year it is frozen solid. As thawing of snow on the surrounding land proceeds, the lake level increases in height until water starts to flow on top of the frozen river; this quickly cuts down to the stream bed and allows the first char of the run to pass to the ocean. Prior to the opening of the stream in 1974 a counting fence was erected in the small patch of open water at the head of the river.

The fish species present in Nauyuk Lake are: Arctic char (Salvelinus alpinus L.), lake trout (Salvelinus namaycush (Walbaum)), common, or humpback, whitefish (Coregonus clupeaformis complex), cisco (Coregonus artedii complex), deepwater sculpin (Myoxocephalus quadricornis (Girard)) and stickleback (Pungitius pungitius L.). In Willow Lake only Arctic char, lake trout and sticklebacks were encountered and in Little Nauyuk, which is in an adjacent drainage basin, there are only Arctic char which are non-migratory.

METHODS

Char on the downstream migration were retained in the 'pot' of the counting fence; they were weighed, measured (fork length), tagged and released, or killed for detailed examination of sexual maturity and stomach contents and removal of otoliths for aging or alternatively passed over the weir and merely counted.

Char migrating from Willow Lake to Nauyuk Lake were sampled by rotenone in the first instance and then by a modified minnow trap placed in the creek.

RESULTS

The first char are ready to begin their downstream migration to the sea as soon as a channel opens in the ice. The first fish to move are, in general, the largest; as the season progresses there is a tendency for the fish to get somewhat smaller (Fig. 3), until after the run has been in existence for about five weeks there is a flurry of small fish mainly in the size range 200-220 mm. Very few char below 200 mm were observed in this migration. The weir was destroyed on several occasions due to the passage of ice from the main lake, allowing numbers of fish to escape uncounted, but it was repaired immediately. The two right-hand peaks on the curve in Fig. 4 show the length distribution of the fish migrating to the sea. This curve is adjusted for the number of fish passed through the weir without being weighed or measured, in contrast to the numbers given in Fig. 3 which represent measured fish only.

No fish encountered in the run showed signs of maturing eggs or testes in the current year, and no fish showed signs of spawning coloration. However certain fish were very emaciated and, by the state of their ovaries and testes, had spawned the preceding fall (1973). These 'slinks' or kelts were identified by having a relative condition factor (LeCren 1951) of <0.75 . A good separation appeared to be achieved using this arbitrary figure and using an iterative procedure for the calculation of the length-weight relationship as those fish with relative condition factor less than 0.75 were removed (Fig. 5).

The slinks so eliminated were all of large size (Table 1), but comprised

	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Females	716 mm	779 mm	656 mm
Males	789 mm	832 mm	751 mm

only a segment of the main 'adult' population, with many fish both larger and smaller not apparently in the size range of the spawning population.

Summer fishing in Nauyuk Lake indicated that all fish above 180 mm had left for the sea.

In Willow Creek it was observed that a number of 'slinks' had been stranded in attempting the passage from Willow Lake, but these were only found after Willow Creek had been open for approximately three weeks. At this time one or two large fish were found in the creek but the majority were small fish (50-160 mm) migrating from Willow to Nauyuk Lake. This migration of small fish continued until August 7 (Fig. 6). Stream temperatures at this time were between 8-18°C, the highest observed in the system throughout the summer. The length distribution of this group of migrating char is shown in the left-hand peak in Fig. 4.

Later the counting fence was reversed and 11,233 char (Fig. 7) were observed to return to the lake between August 5 and September 10. No fish were observed to contain maturing eggs and only one fish was found to appear in red spawning coloration. One maturing male was caught in Nauyuk Lake, close to the mouth of Willow Creek in August when no movement had been observed in the river; this fish had recently returned from the sea as its stomach contained capelin (Mallotus villosus).

Maturing fish were caught in Willow Lake during August.

DISCUSSION

It is apparent that the char in the Nauyuk Lake system engage in a feeding migration to the sea; only very rare cases of maturing fish were observed in the run.

The maturing fish apparently stay in Willow Lake throughout the summer, although the time of their arrival there is uncertain; it is presumed that they moved up Willow Creek from Nauyuk Lake at the first possible moment during break-up before a trap could be established in 1974. No char moved up this creek between July 15 and freeze-up in mid September.

That the large fish move down to the sea has previously been observed by Grainger (1953). The movement out of Nauyuk Lake was observed as a trend rather than a definite ordered progression.

The char population is apparently trimodal. The main group of large fish is quite distinct, but it appears that only a segment of this population is of a size capable of spawning, thus there are immature fish (in the sense that they have not yet reached a size at which they can spawn) and there are senile fish (in the sense that they are too large to spawn) in what might be considered the 'adult' group. The sub-adults are a well-defined group between 200-220 mm. The third group shown in Fig. 4 are again quite distinct but

are possibly not completely representative of the non-sea migrating population as many small fish were encountered, both in Willow Lake and Nauyuk Lake, which were not in the process of migrating. The impression is gained that the group as a whole was perhaps somewhat larger than shown. It thus seems possible that the fish migrating out of Willow Lake may have been in response to population pressure rather than due to a migratory urge. This aspect requires further analysis and investigation.

It is of interest to note that the population follows the multimodal model developed by Johnson (1972), even to the suggestion that more than two modes might exist in a relatively stable population.

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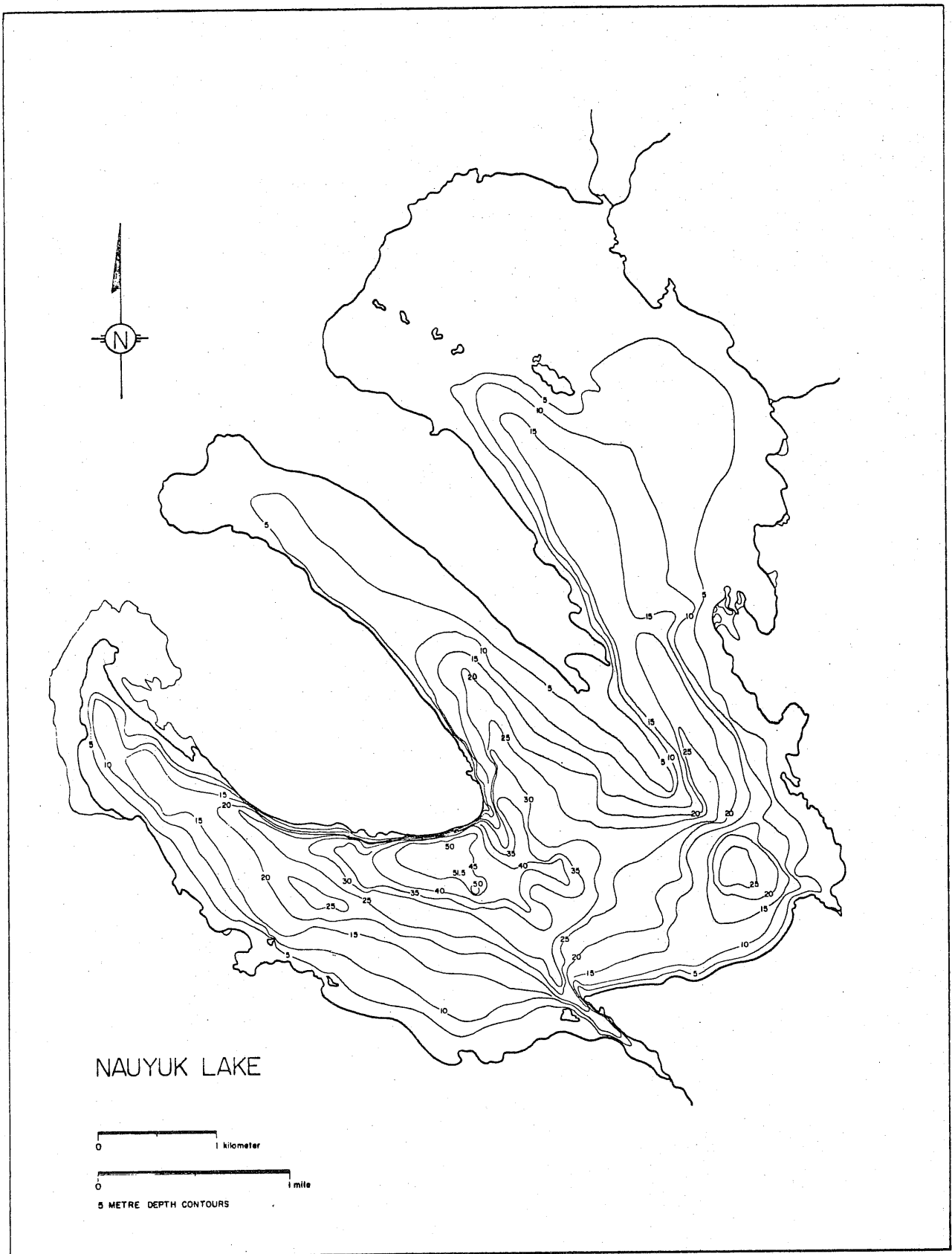


Fig. 1. Map of Nauyuk Lake showing depth contours in meters.

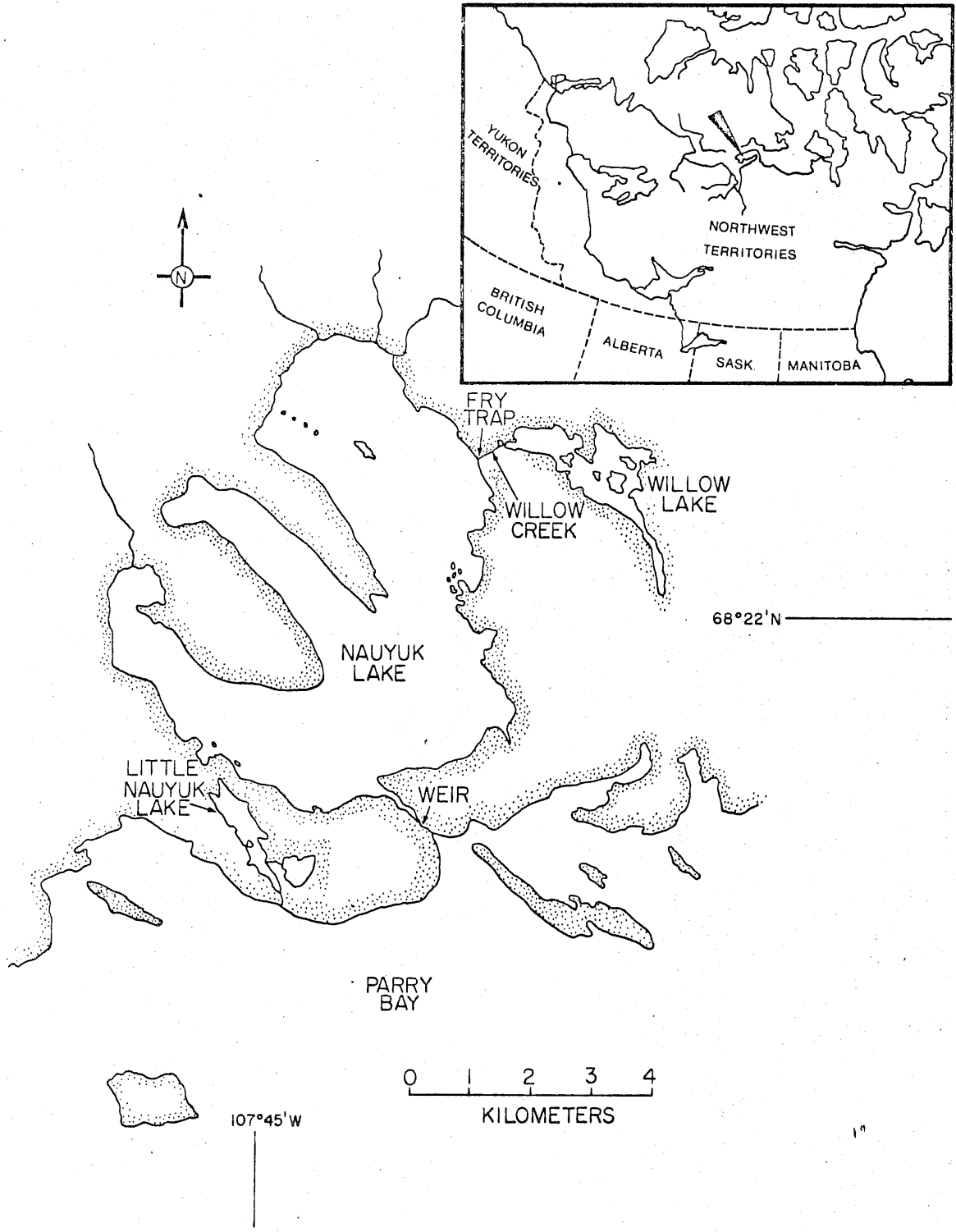


Fig. 2. Map of Nauyuk Lake and its drainage basin. Inset shows location of lake in northern Canada.

DOWNSTREAM MOVEMENT OF ADULT CHAR, NAUYUK LAKE

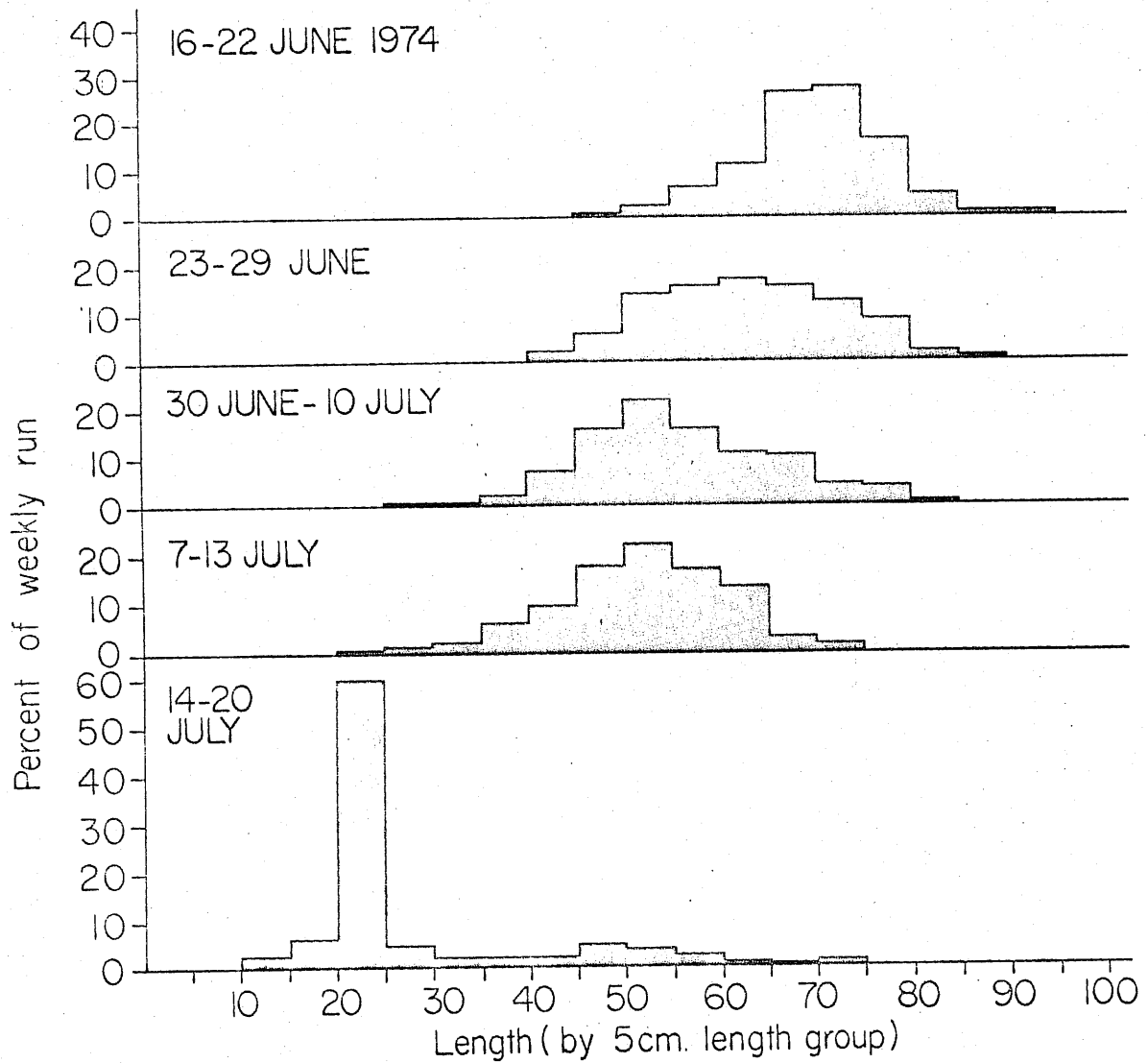


Fig. 3. Downstream movement of Arctic char out of Nauyuk Lake to the sea. There is a tendency for the larger fish to move first and the movement is terminated with a large group in the 200-220 mm length range.

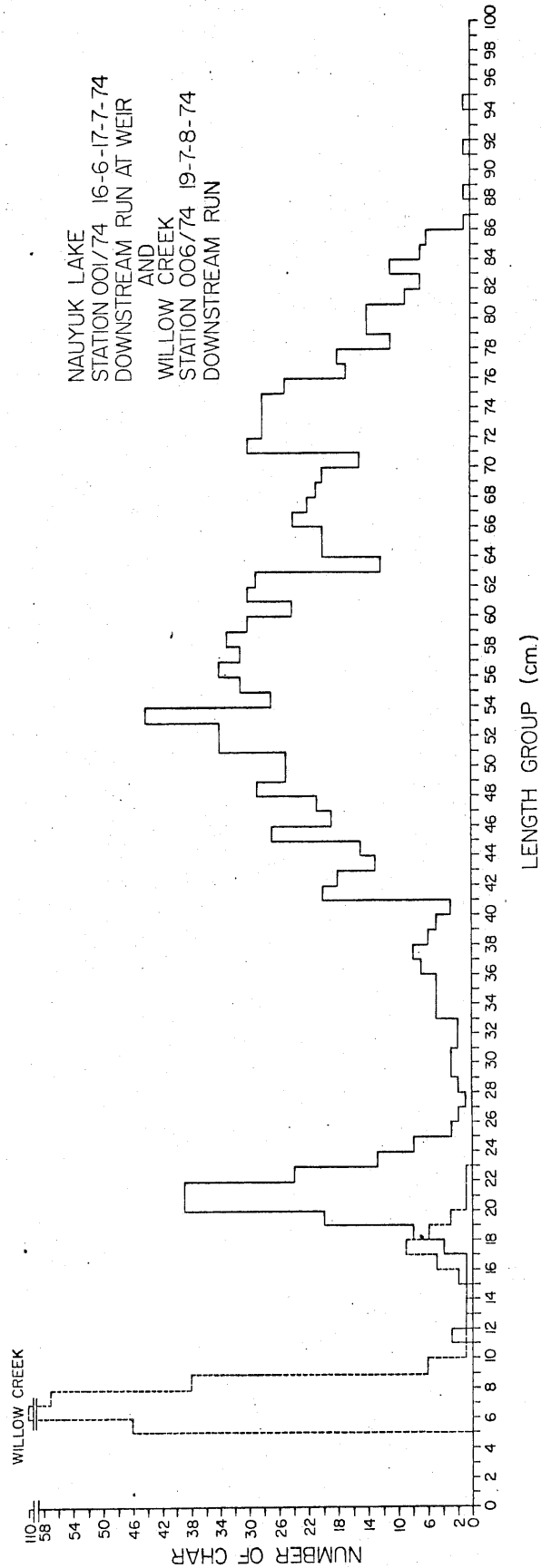


Fig. 4. The two right-hand peaks show the length distribution of Arctic char in the migration to the sea. The left-hand peak is the size distribution of fish moving out of Willow Lake to Nauyuk Lake.

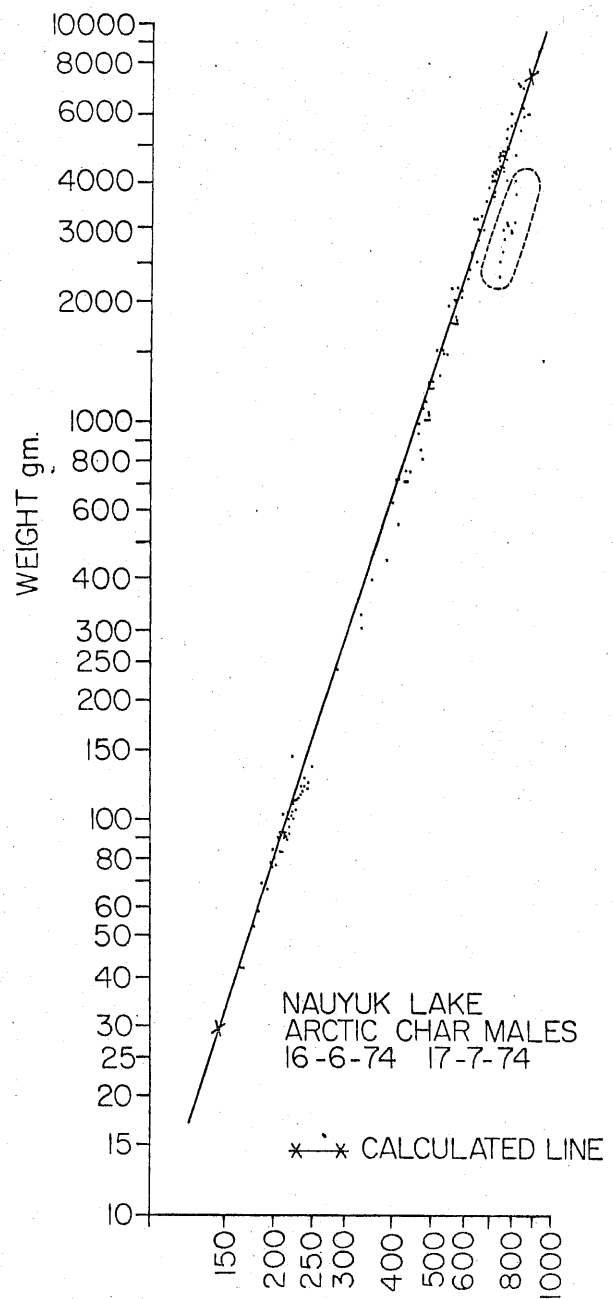
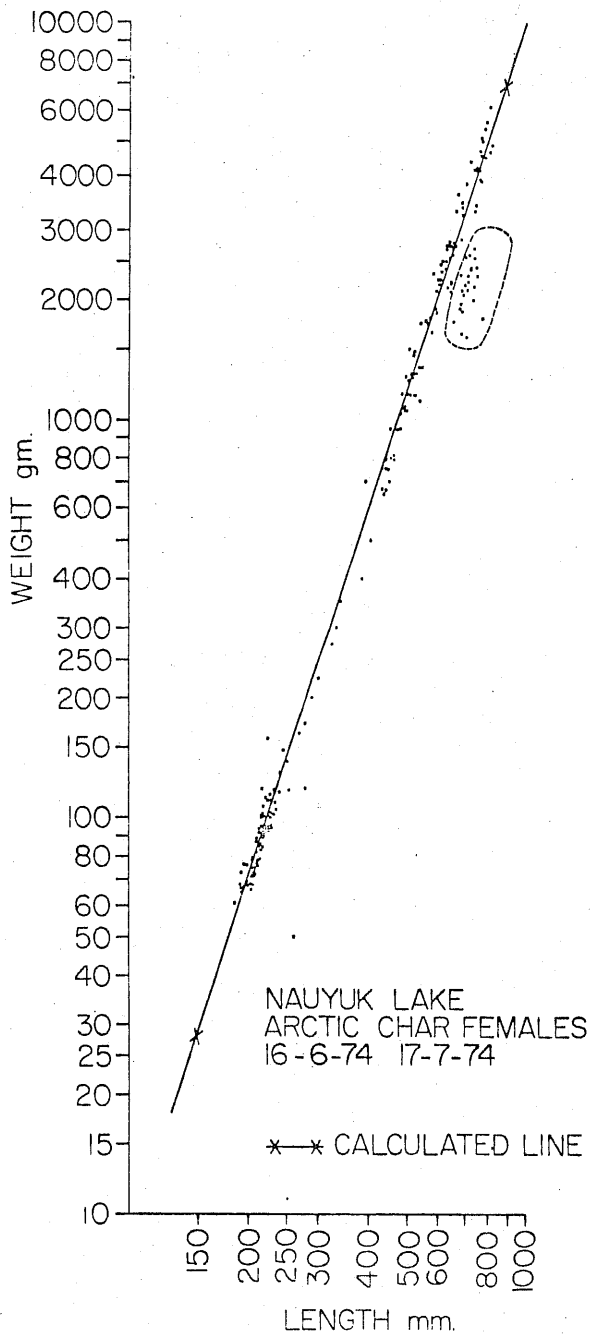
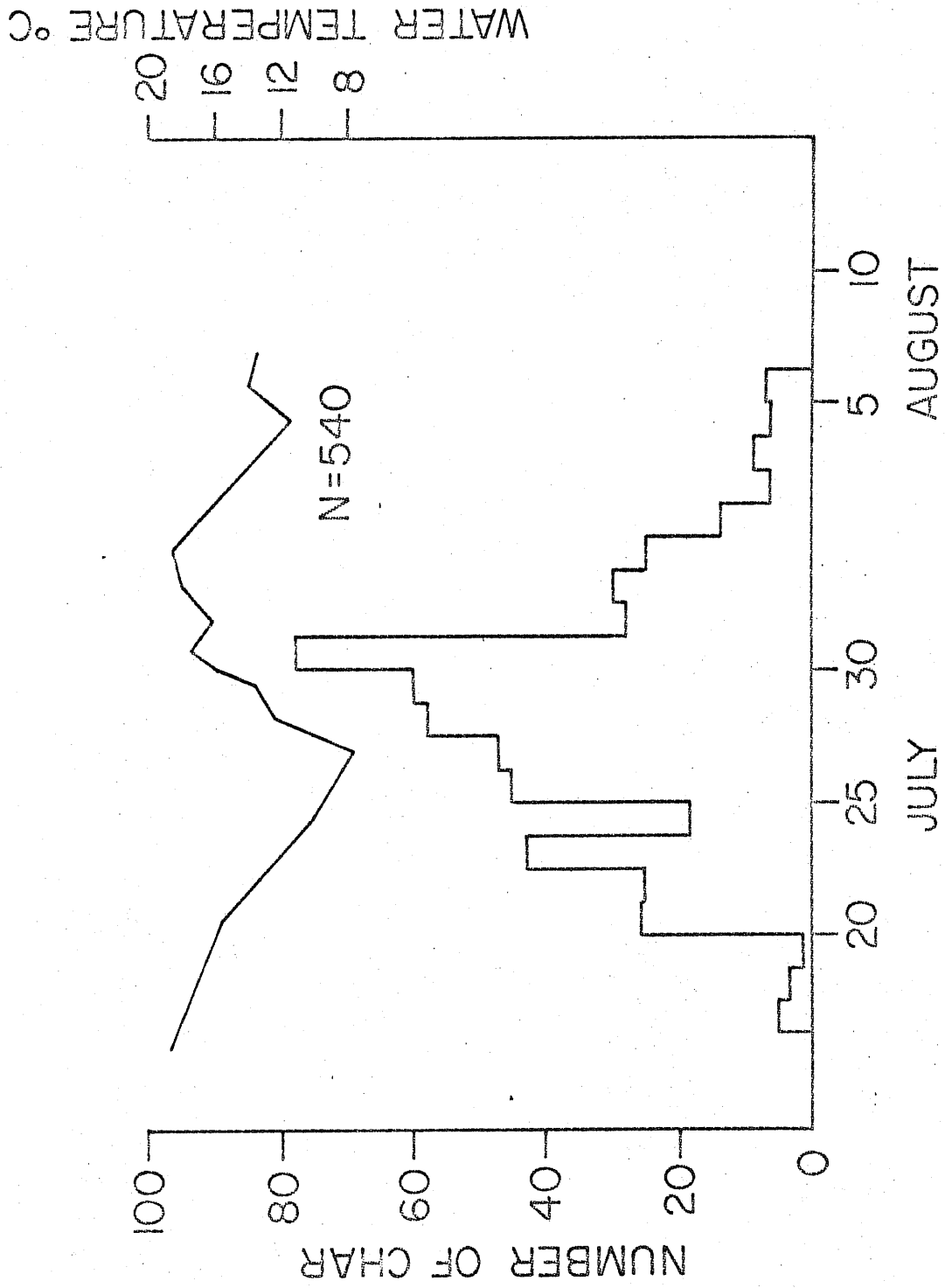


Fig. 5. Length-weight distribution of male and female Arctic char in migration to the sea. The dotted line indicates the separation of post-spawning individuals.

DOWNSTREAM MOVEMENT OF YOUNG CHAR IN WILLOW
CREEK 1974



1974

Fig. 6. Downstream movement of young Arctic char in Willow Creek and the stream temperature during the period of activity.

NAUYUK LAKE 001/74
ARCTIC CHAR
6 AUGUST - 8th SEPTEMBER
UPSTREAM RUN AT WEIR
TOTAL NUMBER 11,223

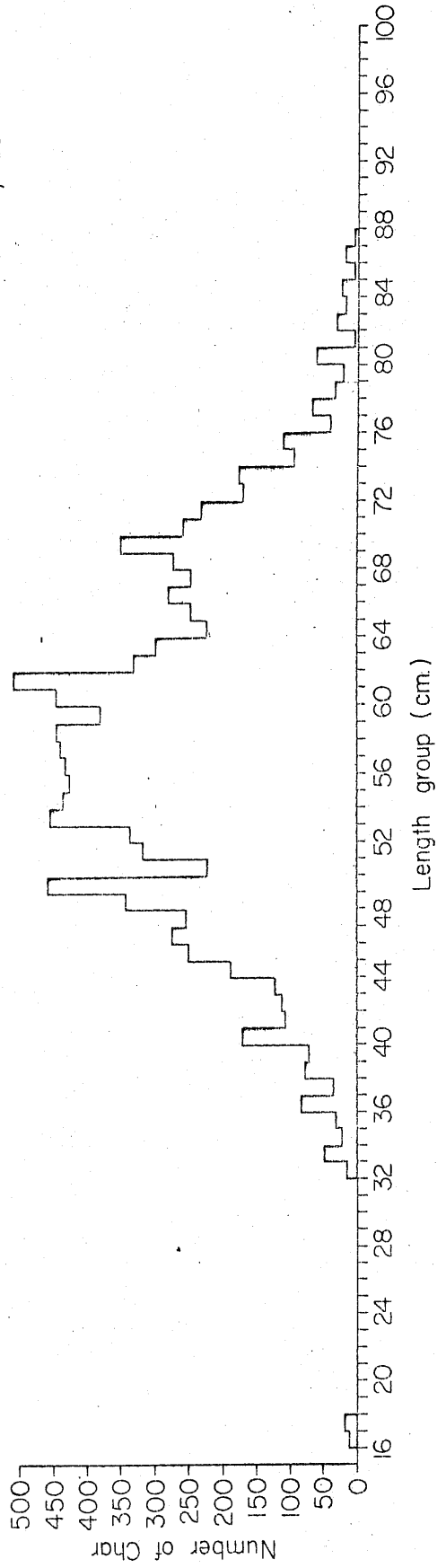


Fig. 7. Length-frequency distribution of Arctic char returning from the sea between August 6 and September 8, 1974.