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NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT

No. 7

Yellow-eyed Mullet

Aldrichetta Forsteri

Cuvier and Valenciennes in Lake Ellesmere

T. B. S. Gorman

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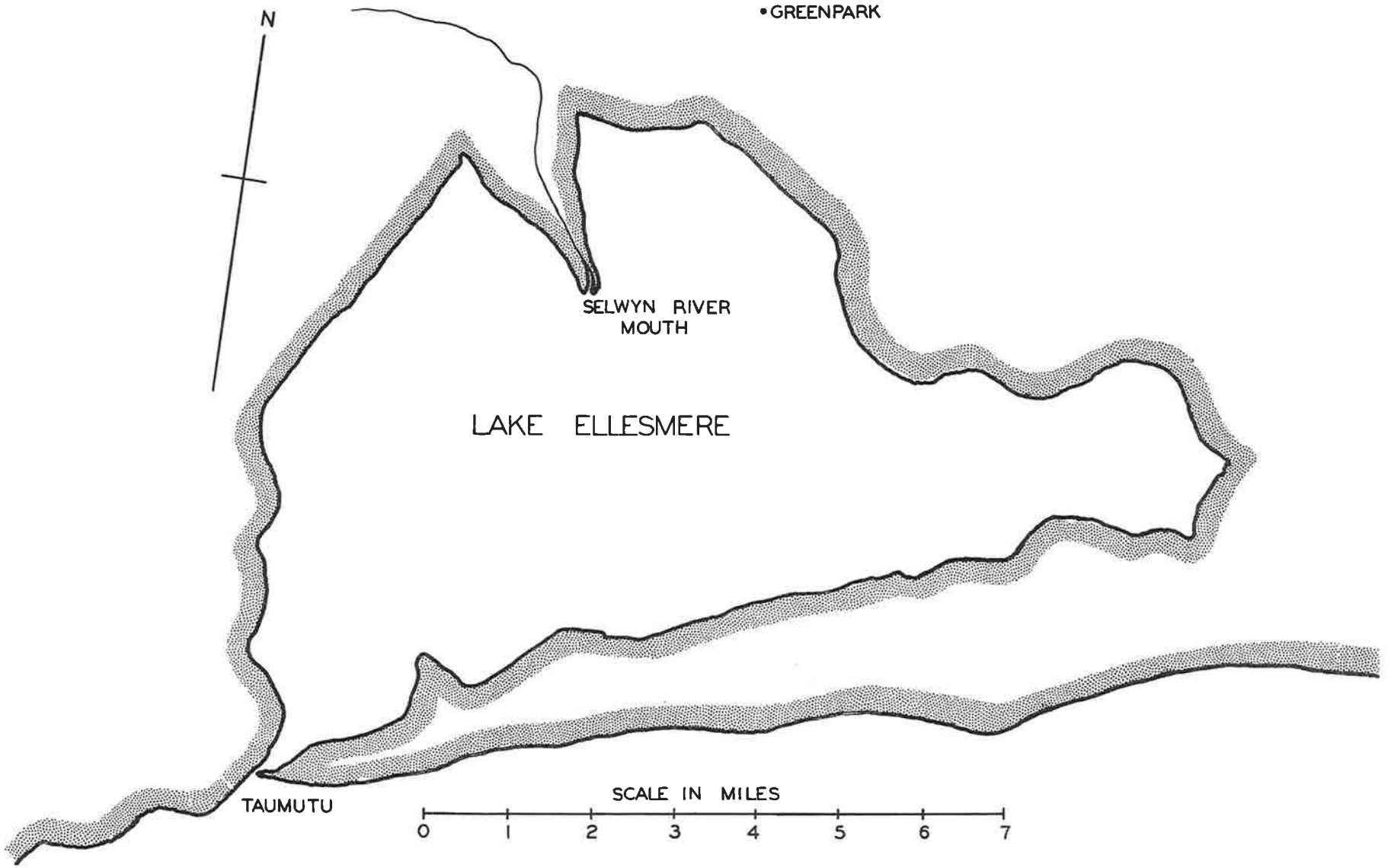

N
• GREENPARK
SELWYN RIVER
MOUTH
LAKE ELLESMERE
TAUMUTU
SCALE IN MILES
0 1 2 3 4 5 6 7

YELLOW-EYED MULLET, ALDRICHETTA FORSTERI (CUVIER AND VALENCIENNES) IN LAKE ELLESMERE

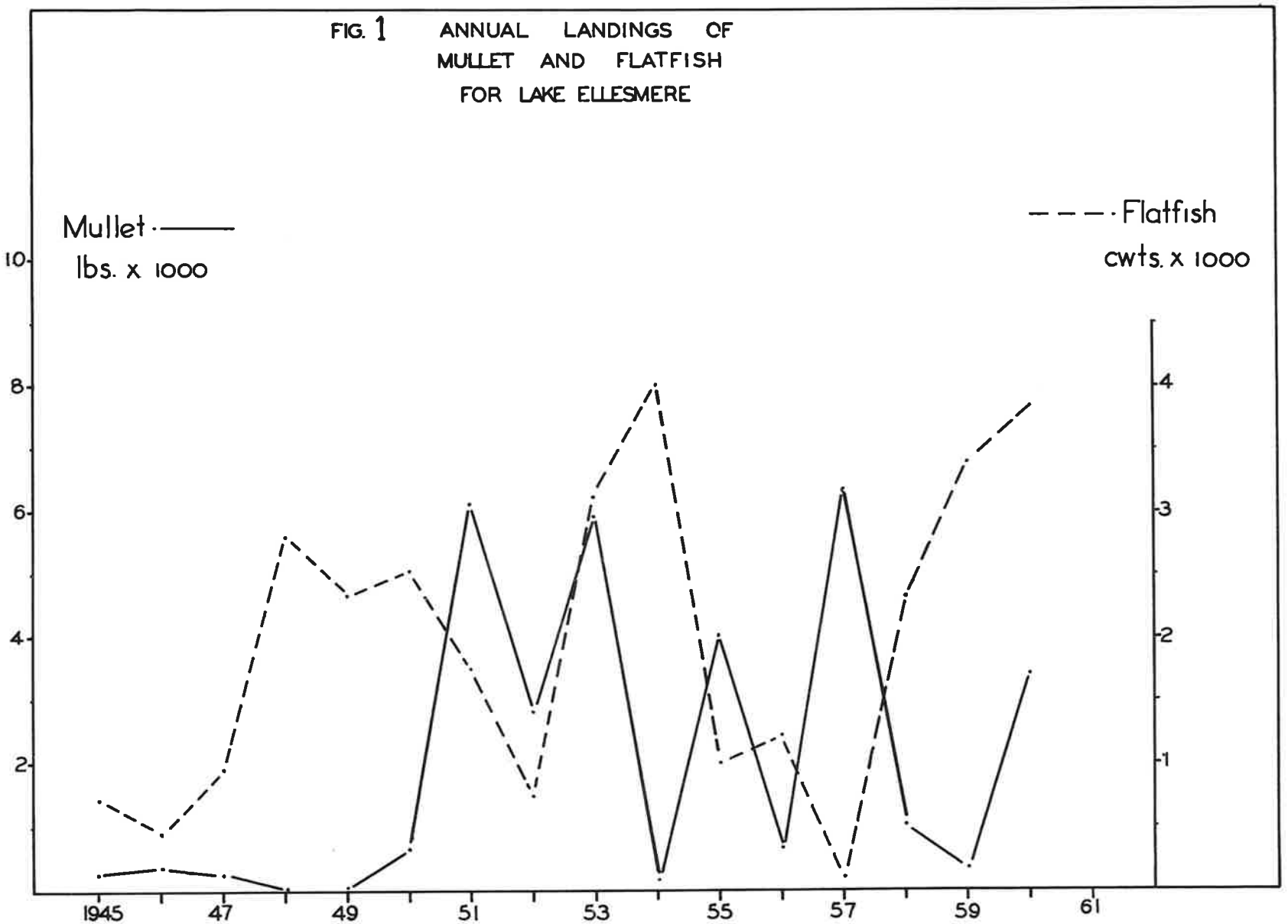
T.B.S. Gorman

PART I. THE YELLOW-EYED MULLET FISHERY IN RELATION TO TROUT AND TO MESH SIZE REGULATIONS

Introduction

Yellow-eyed mullet are taken in small quantities throughout New Zealand, more particularly in the northern part of the North Island, with some coming from the Sounds. Due probably to the small average size of the fish, the market was strictly limited, so that the total catch between the years 1945 and 1960 inclusive, amounted to only 11,288 cwt of which Lake Ellesmere contributed 278 cwt. In 1961, however, the total catch in the lake rose to 403 cwt with a value of £1,182, this remarkable increase being due to the development of a new method of processing. In that year a Christchurch wholesaler became interested in kippering mullet and the venture has proved so successful that the Company concerned is willing to accept as much mullet as can be produced from the lake. The origin of the kippering process is interesting, for these mullet are known throughout New Zealand as "herring", and are regarded by most as the true herring. Knowing that kippered herring were considered a delicacy in Europe, it was reasoned that the same state of affairs could exist here; hence the kippering process. The finished product is excellent in appearance and taste, and might be considered a delicacy in its own right.

FIG. 1 ANNUAL LANDINGS OF MULLET AND FLATFISH FOR LAKE ELLESMERE



At present mullet stocks in the harbours and estuaries of Canterbury are not exploited commercially, but they do provide recreational activity for amateur anglers.

The Fishery:

Since its inception the Lake Ellesmere fishery has been almost wholly dependent upon the flatfish population. This resource is liable to marked fluctuations from year to year (Fig. 1) which have imposed hardships on the fishermen. The utilisation of other species, as supplements or alternatives to the existing flatfish fishery, is therefore beneficial, as providing a more constant return to fishermen. Trout may not be taken commercially and the only other species besides mullet that occur in the lake in sufficient quantity to support a potential fishery are the long-finned and short-finned eels. The development of the mullet fishery should assist in producing a better balanced industry with fuller use being made of the known resources, as well as some measure of economic stability for the lake fishermen.

At the present time the recently expanded mullet fishery shows a marked seasonal character with a major peak in mid-winter and a lesser peak in summer. This is shown in Table 1.

Table 1: Weight of catch of yellow-eyed mullet in Lake Ellesmere for each month of 1961.

Month -											
Jan.	Feb.	Ma.	Ap.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4390	2092	969	-	1012	7010	19623	6381	33	108	1511	2068

(Wt. in lbs.)

The bulk of the catch for the main winter season was taken at Greenpark, and the success of this stage was due mainly to the good availability of the mullet and the fact that the eels were hibernating. The summer fishery was conducted mainly at Taumutu and its success was mainly due to the methods adopted to combat the eels. Instead of working over the nets once in 24 hours, the fishermen set them during the daylight hours only, often in the evening. The nets were closely attended and worked over constantly to keep the destruction of the catch by eels to a minimum. This practice also enabled any trout caught to be released quickly.

Investigation

In view of the above, it became desirable to investigate the effect of the present regulations controlling the type of nets which may be used to take yellow-eyed mullet in the lake. These regulations stipulate a maximum mesh size of 2¼", a minimum of 1¼", and, in addition, limit the mesh depth to 9. The maximum mesh size, and maximum depth restrictions were not imposed to conserve the mullet population but to protect trout stocks in the lake. However, it was suggested that, as the industry required a fish of not less than 28 to 29 cms, the present regulations were unsatisfactory, since they did not permit the taking of sufficiently large numbers of these bigger mullet. An increase of the maximum mesh size from 2¼" to 3¼", and the abolition of the mesh depth limit were therefore proposed. The essential point at issue was whether an increase in the mesh size over 2¼", and in the mesh depth over 9 meshes, would result in a significant increase in the number of trout caught in mullet nets.

At a very early stage in this investigation, it became clear that this question could be only answered in part since nets 9 meshes deep did not exist during the period of the investigation and it is extremely doubtful if they ever did. It is probable that mullet gill nets with a depth of only 9 meshes would be almost useless. In practise the fishermen use nets ranging in depth from 25 to 50 meshes depending largely on personal preference.

Method

Netting experiments were conducted in May, July, and October, 1961, making use of the rather restricted range of netting that was available. All mesh sizes were measured stretched between posts in accordance with regulations, using engineers vernier calipers. Since the nets varied in length and mesh depth, it was necessary to choose a convenient unit for comparative purposes. It is normal practice to calculate the theoretical area of the net and relate catches to unit area. In the present case some of the deeper nets had a number of meshes resting on the bottom where they were not in a position to fish. It was therefore decided to express catches in terms of lbs and numbers per 100 linear feet of net. For convenience the nets were joined together in a continuous fleet, and in each experiment the order of the nets in the fleet was kept constant. To avoid any possible bias due to position, the whole fleet was moved, nearly every day, to a different locality within the experimental area. After some preliminary trials, the nets were over-run early each morning, so that the period of fishing time was approximately 24 hours. The fishing time of the nets was therefore relatively constant.

Experimental Fishing

May:

Fishing was conducted originally in the vicinity of the Selwyn River mouth; mullet were scarce, while trout and eels were rather numerous. Eels caused considerable destruction to gilled mullet, during both day and night, but in contrast, trout were ignored. Mullet catches were very low during the day, but higher at night. The nets were then moved to the middle of the lake and finally to Taumutu, and the quantity of mullet increased sharply, becoming a commercial proposition. Simultaneously trout catches dropped to very low figures.

July:

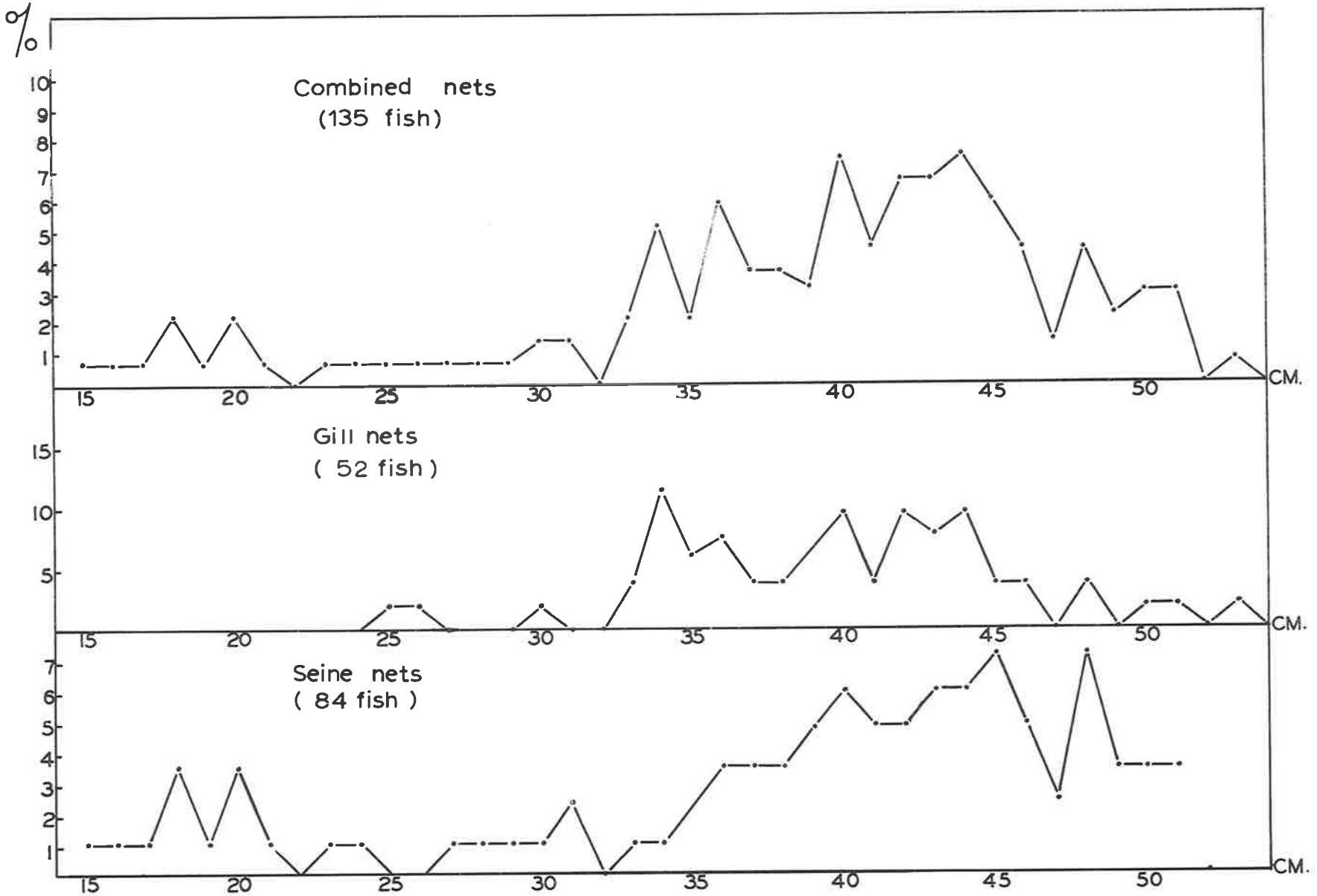
Fishing was conducted at Greenpark only, and large catches of mullet were obtained. No trout were caught until the heavy rainfall experienced during the latter half of the month caused a fresh in all rivers draining into the lake. Even after this, the total number of trout caught was small.

Eels were in hibernation during this period, and no losses were recorded from this cause; seagulls did a certain amount of damage to those fish caught in the upper meshes. Few fish were caught during the day, despite the high turbidity of the water. It is estimated that 95% of the commercial catch during this period was taken at night.

October:

Commercial fishing was suspended during the period due to the relative scarcity of mullet, and the renewed activities of eels. Experimental gill netting

FIG. 2 LENGTH FREQUENCY DISTRIBUTION OF TROUT TAKEN IN LAKE ELLESMERE JUNE — OCT. 1961



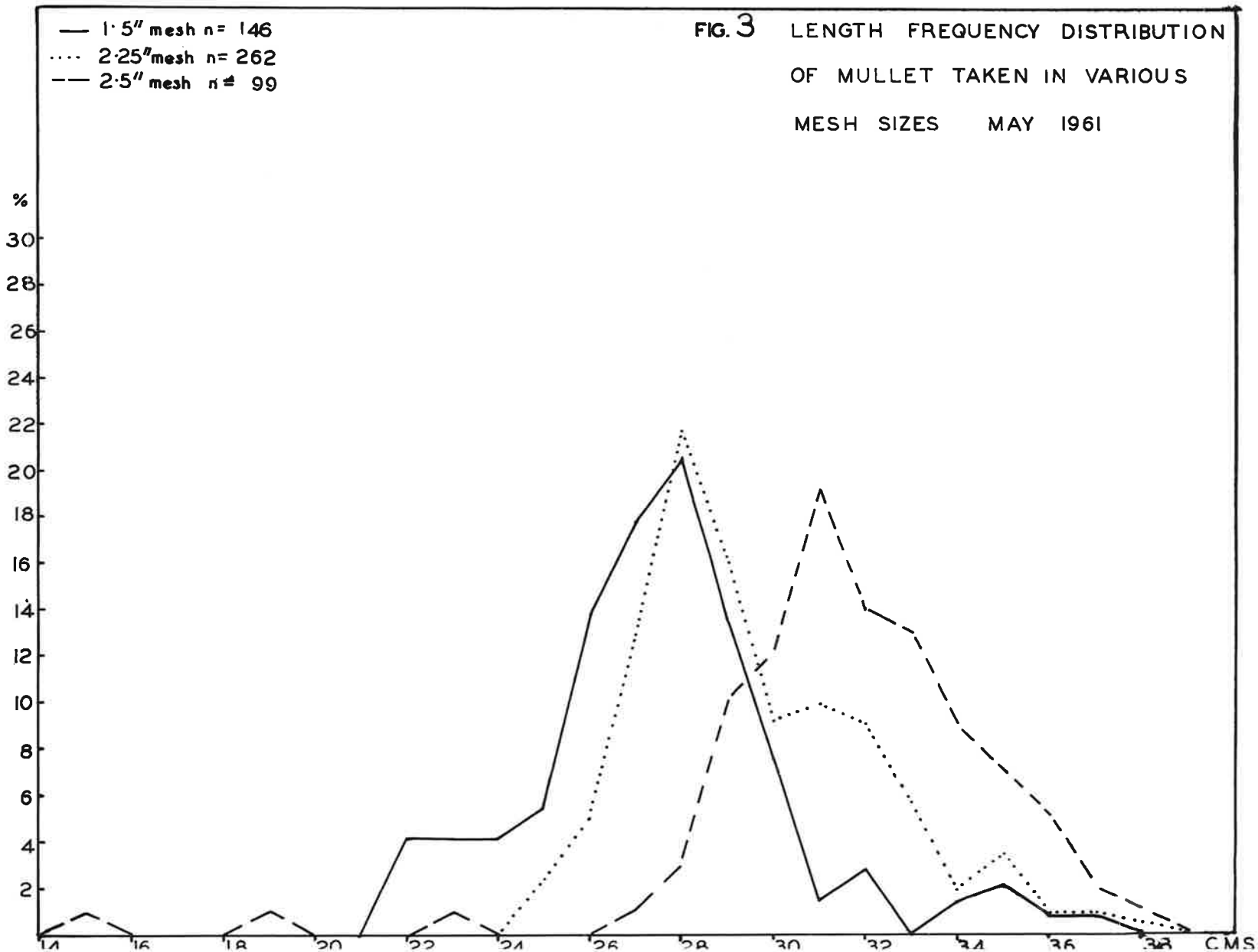


FIG. 3 LENGTH FREQUENCY DISTRIBUTION OF MULLET TAKEN IN VARIOUS MESH SIZES MAY 1961

was stopped after only two attempts, since eels did so much damage that only small pieces of vertebral column remained in nets which were themselves almost impossibly tangled. A large beach seine was then used to obtain more representative samples of both trout and mullet populations. In order to supplement these samples, a 2½" nylon gill net was set daily for short periods of about 2 hours.

Discussion

1. The data for gill netting experiments in May and July 1961 are summarised in tables 2 and 3. These show tendencies for the frequency of trout capture to increase with the size of the mesh, and for the nylon nets to be relatively more effective for trout. For example, the 3" mesh nylon took twice as many trout as the 2½" mesh nylon in terms of both numbers and weight. However, the data show that the rate of catch of a net varies greatly according to time and location, so that although the general tendencies are clear, the precise relations between the efficiencies of the various nets are still open to some doubt.

The size range of the trout population taken by mullet gill nets is shown in Figure 2. While it is evident that a fair size range of the population is effected, the majority are smaller than the mean size of the spawning run in the Selwyn (about 48 cm).

2. The length frequencies of mullet caught by nets of various mesh sizes are shown in Figures 3 and 4. If examined in conjunction with tables 2 and 3, there is some evidence that 3" mesh nets, while catching longer fish - model length 31 cms - apparently allow

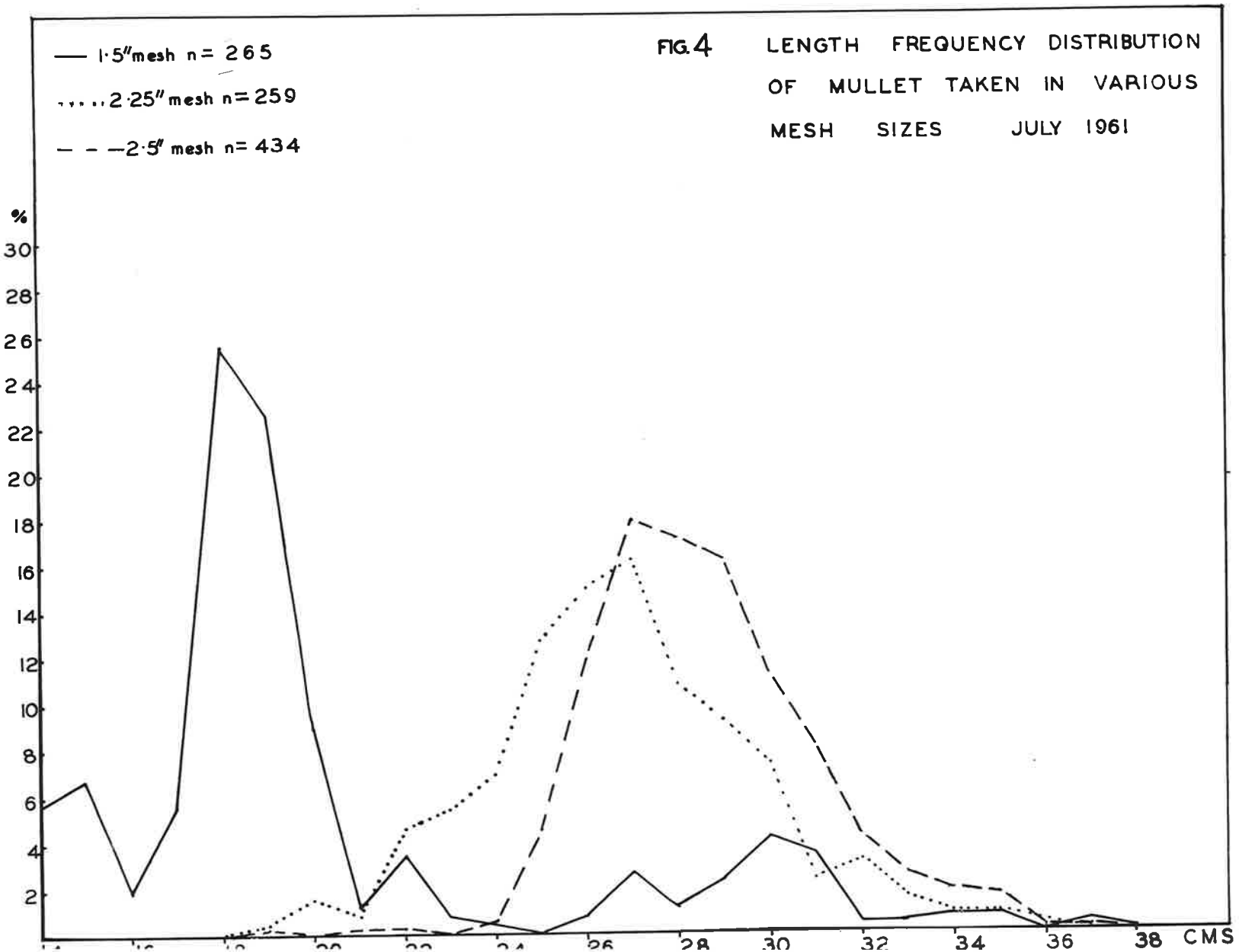


FIG. 4 LENGTH FREQUENCY DISTRIBUTION OF MULLET TAKEN IN VARIOUS MESH SIZES JULY 1961

a large proportion of the population to pass through the meshes. If intensity of fishing increases, it might be expected that the average age and size composition of the population would tend to decrease, so that nets of 3" mesh would give an even lower economic return than at present. In contrast the 1½" mesh, which is ¼" above the minimum legal size limit, is relatively efficient, but the bulk of the catch is commercially valueless because the fish are too small. The 2¼" and 2½" nets, on the other hand, appear to be more efficient from the commercial point of view in that they take a relatively large quantity of the more acceptable sizes. It is unfortunate that 2¾" nets were not available, as their performance might well have been similar to that of the 2½" net, while at the same time being less efficient than the 3" in taking trout.

Conclusion

1. Lake Ellesmere mullet nets are at present restricted by regulation to 9 meshes in depth. It has long been recognised by the fishermen that such nets are useless from the commercial point of view; and the regulation has been ignored.

It is therefore suggested that the regulation should be abolished.

2. Experimental netting indicates that better use could be made of the Lake Ellesmere mullet population if the minimum mesh size were raised to the present maximum of 2¼", and the maximum mesh size were raised to 2½" or possibly 2¾". The economic return from nets above this mesh size may be too low to justify expected increases in trout mortality.

TABLE 2: NUMBER OF FISH CAUGHT AND DAYS FISHED BY EACH NET IN EACH AREA

Nets			May						July									Mean catch per 100			
Mesh	Material	Length	Selwyn mouth			Centre & Taumutu			Series 1.			Series 2.			Total			Numbers		Wt. in lbs.	
			D	M	T	D	M	T	D	M	T	D	M	T	D	M	T	M	T	M	T
1½	Nylon	167'	-	-	-	-	-	-	2	265	0**	-	-	-	2	265	0	79.0	0	23.6**	0.0
2½	Nylon	165'	-	-	-	-	-	-	-	-	-	4	225	7	4	225	7	34.1	1.1	24.6	2.1
2¼	Nylon	79'	-	-	-	-	-	-	3	97	0	3	59	2	6	156	2	32.2	.4	18.4	0.6
2½	Cotton	148'	-	-	-	-	-	-	3	149	0	3	70	0	6	219	0	24.7	0	13.0	0.0
2¼	Cotton	156'	6	29	0	3	115	?	3	104	0	-	-	-	12	248	0+?	13.1	0	8.1	0.0+?
2½	Cotton	387'	6	101	3	3	344	?	-	-	-	-	-	-	9	445	3+?	12.7	.08	10.6	0.1+?
3	Nylon	179'	6	26	33	3	73	3+?	-	-	-	-	-	-	9	99	36+?	6.2	2.2	62	3.8?
TOTAL:				156	36		532	3*		615	0		354	9		1658	48*				

D = No. of days. M = Mullet. T = Trout.

* plus 3 trout. Net not reached. ** 3rd Test total numbers omitted by accident.

Total wt. includes 3 tests.

The nets in this table are arranged in the order of numerical rate of catch of mullet.

TABLE 3

Relative numbers and weights of mullet and trout caught by all nets in May and July.

DATE	TOTAL NUMBERS		RATIO
	Mullet	Trout	
MAY	688	42	16.4:1
JULY	970	9	188 :1
TOTAL:	1658	51	
	TOTAL WEIGHT lbs.		
MAY	552	64	8.6:1
JULY	575	16.6	34.7:1
TOTAL:	1127	80.6	

3. It would appear advisable to investigate the possibility of alternative fishing methods. Siebenaler, 1955, gives an account of various types of encircling nets used in Florida, and since these methods rely on capture over a short space of time, it is possible that if they were, trout taken incidentally could be released unharmed.

4. The extent to which trout are taken in the nets is affected by the mesh of the nets, the material of which they are made, the season, and the locality within the lake. In general the quantity of trout caught increases with the size of the mesh, and is possibly slightly higher for nylon than for cotton nets. While more work may be desirable on this aspect of the problem, it appears that damage to trout will be slight provided that the meshes used are not larger than $2\frac{3}{4}$", and that fishing is not conducted too close to the stream mouths. The continuous attention which is necessary in summer as a protection against eels provides an extra safeguard for the trout.

PART II.

OBSERVATIONS ON THE BIOLOGY OF THE YELLOW-EYED MULLET IN LAKE ELLESMERE.

Nomenclature

The yellow-eyed mullet has usually been assigned to the genus Agnostomus, but according to Thomson (1954), this is incorrect, for the latter is an American freshwater genus, and does not occur in New Zealand. In this report it is proposed to follow Thomson and use the name Aldrichetta forsteri (Cuvier and Valenciennes).

Length/Weight relationship

The length/weight relationship of mullet taken during experimental fishing in May and July 1961 is shown in Figure 5. The curve has been fitted by eye as a straight line to the data when plotted logarithmically.

The equation of this curve is:-

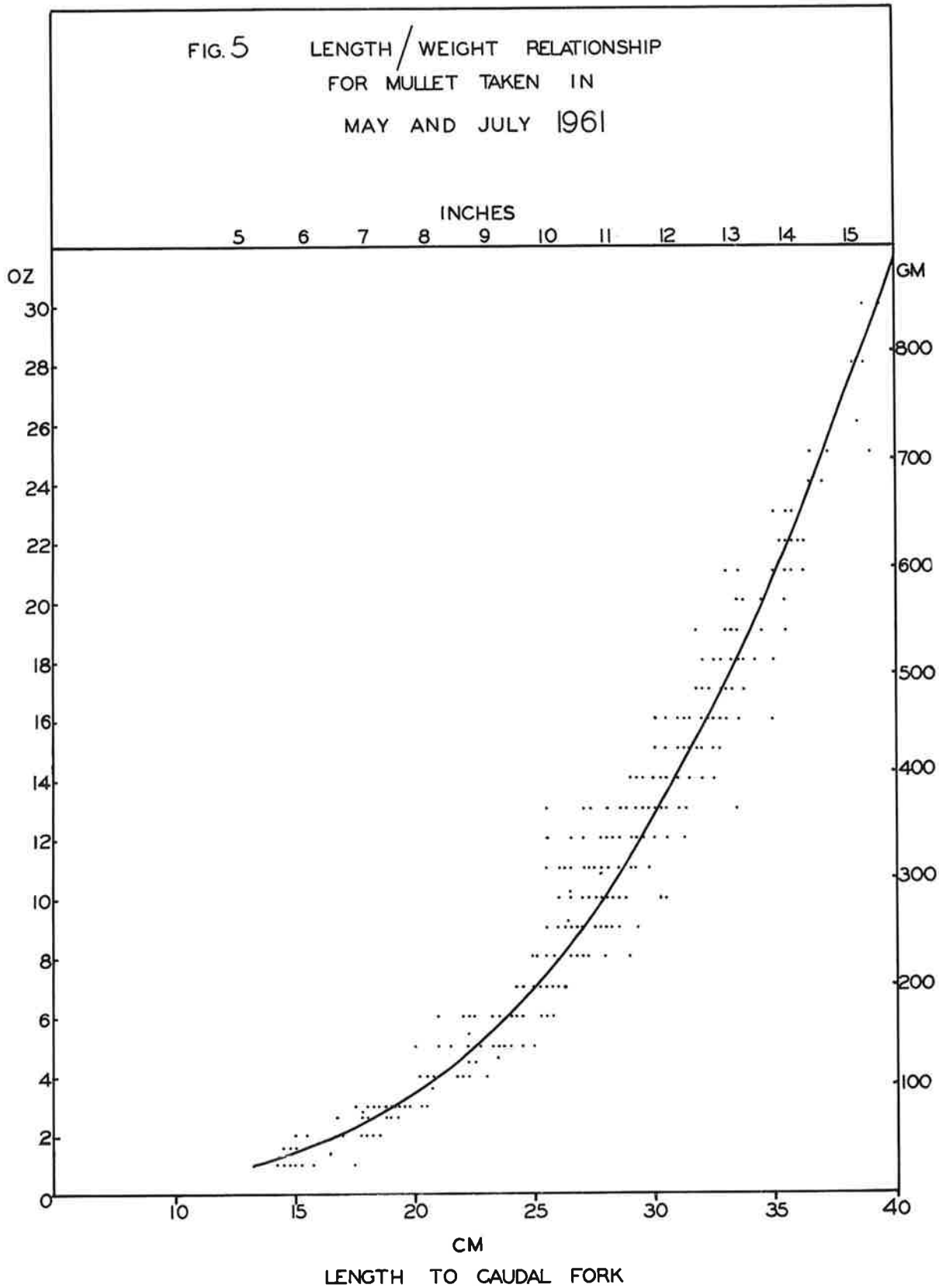
$$W = 10^{-4} \times 2.39 \times L^{3.2}$$

The largest fish taken during this investigation measured 39.5 cms (15.5") and weighed 850 gms (1 lb. 14 oz.)

Size distribution and population structure

Fig. 6A shows the composite length frequency curve for five nets ranging from 2½" to 3" in May 1961. It has a mode at 28 cms. Fig. 6B shows the composite length frequency curve for four nets ranging from 1½" to

FIG. 5 LENGTH / WEIGHT RELATIONSHIP FOR MULLET TAKEN IN MAY AND JULY 1961

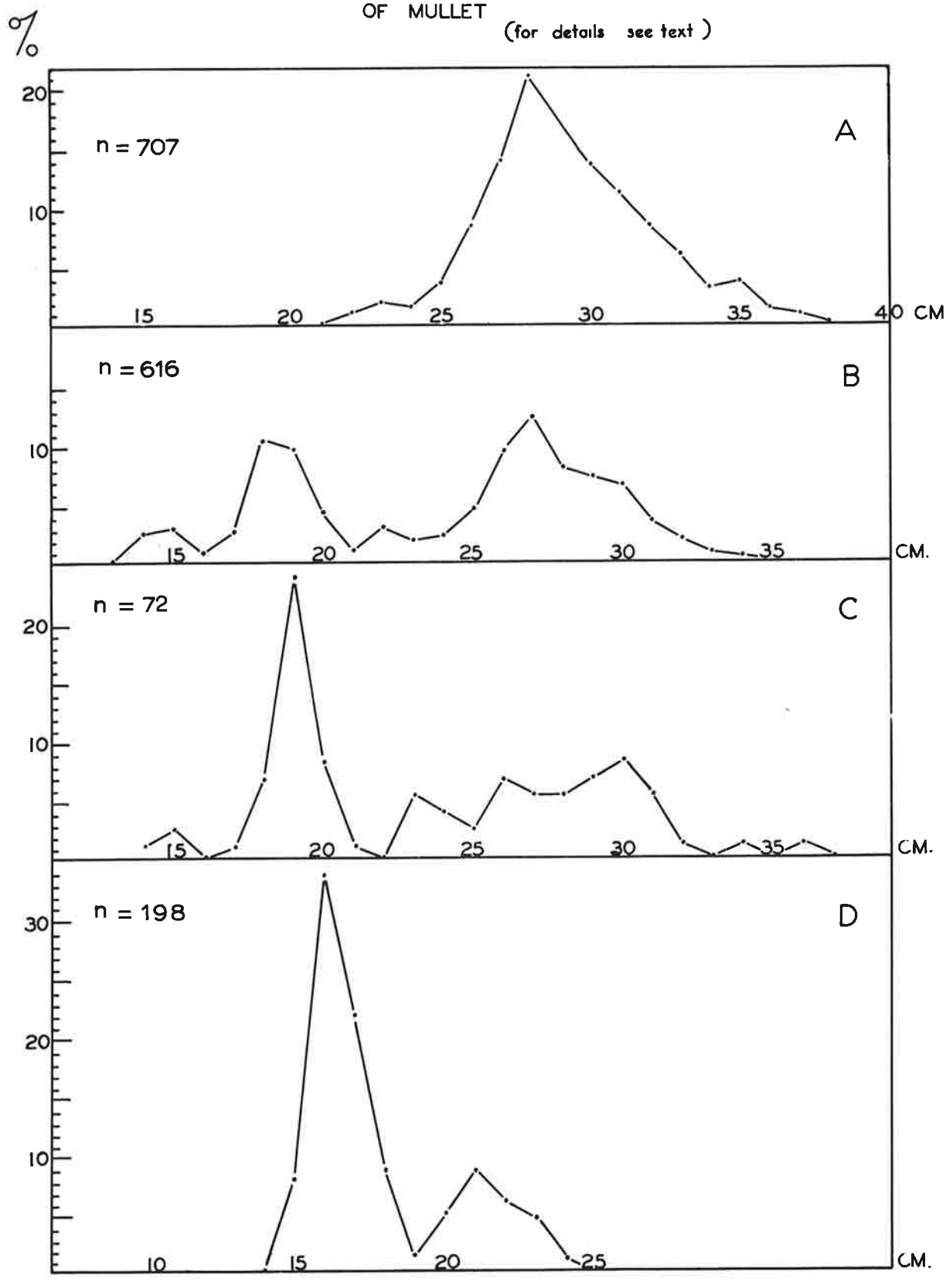


2½" taken in July. Younger age groups are now represented and the curve is strongly bimodal with 2 major modes at 18 and 27 cms. In October a large, small-mesh beach seine was used in conjunction with the gill nets to test whether the curves obtained by gill netting were, in fact, representative of the population structure rather than simply selection curves. The resulting curve (Fig. 6C) is essentially bimodal and on the whole is similar to the one obtained in July by gill netting, although there is a considerable difference in the proportions of the two main components of the population. These similarities indicate that the curves obtained by gill netting are reasonably representative of the population structure.

Lake Ellesmere fishermen have claimed that mullet in the lake grow to an unusually large size. In Australia Thomson (1954 and 1957) states that it attains at least 38 or 40 cms, but there, utilisation of this species is heavy and it is rarely seen above 32 cms. In New Zealand, Parrott (1957) records it as attaining 16" (40.6 cms) and averaging 9" (25.4 cms), while Graham (1956) records its maximum at 20" (50.8 cms) and averaging 11" (28 cms). However, the largest fish taken during the course of this investigation measured 39.5 cms. It does not appear, therefore, that the maximum size reached in Lake Ellesmere is exceptional.

There is, however, some evidence that mullet in the estuaries and harbours of Canterbury, are generally smaller than those found in Lake Ellesmere. Figure 6D shows the size distribution of a sample taken in Lyttelton harbour and comparison between this and 6C shows the difference between the Lake Ellesmere and Lyttelton harbour populations. Both these samples

FIG. 6 LENGTH DISTRIBUTION OF VARIOUS SAMPLES OF MULLET (for details see text)



were obtained in October 1961 using the same 1½" and 2½" nylon gill nets and beach seine, and the difference between them is marked. Both curves are bimodal, and they have the same general form, but the peaks occur at much smaller sizes in the Lyttelton harbour population. It is possible that the larger size of the Ellesmere fish is due to faster growth resulting from a lower level of interspecific competition in the lake.

Thomson (1957 a. and b.), in Western Australia, successfully used scale readings and the Petersen method for age determination. During this investigation scales were examined to see if this technique could be applied. Well defined summer and winter zones were present indicating that this method could be of great value, particularly if combined with the Petersen method.

Spawning Period

In Australia two races are recognised, and they are characterised by the time of the spawning season. There is a summer spawning group in Victoria and Tasmania, and a winter spawning group in Western Australia. Two years ago gravid females were recorded in Lake Ellesmere in February and March, indicating possibly that the spawning season in the lake occurs during the summer months.

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