FRESHWATER FISHERIES ADVISORY SERVICE

MARINE DEPARTMENT

INVESTIGATION REPORT

JOB NO. 28

ACCLIMATISATION SOCIETY DISTRICT: North Canterbury

TITLE OF JOB: Investigation of Lake Tennyson

OBJECTIVES: To determine the state of the trout population.

FINDINGS: This investigation was carried out during February 1960.

A. PHYSICAL FEATURES

Lake Tennyson is formed by the natural stoppage of the Clarence River in the headwaters, and is probably the result of glacial activity which caused a deep "pot-hole" to form in the bed of the Clarence. The lake is situated at about 3618 ft above sea level, and is approximately 27 miles north of Hanmer Springs. It is two miles long and just over one half a mile wide for most of its length.

The surrounding country is steep and tussock covered with many shingle and rock slides, but at the lower end the ground surrounding the outflow is marshy over some two or three hundred acres. At four points around the lake's margin there are small patches of beech bush varying from three to four acres to about 20 acres. This bush is completely clear of undergrowth.

Apart from the Clarence River, which both feeds and drains the lake, there are no tributaries of any size, though several small springs seep into the lake on the western shore.

B. BOTTOM FAUNA

Bottom fauna samples were taken with a square foot stream sampler around the lake edge, and with a Petersen Grab in the deeper water. Depth and vegetable growth were also noted at the same time, and the results are as follows.

(a) Square foot sampler

A total of fifty-two samples were taken at regular intervals around the lake edge, and the bottom varied very little in the entire circumference. The western shore was formed of large stones and gravel, while the remainder of the shore line was comprised of sharp angled gravel and coarse grit. In only two areas sampled weed was found to be growing within a few inches of the shore - in one case some very young plants of *Isoetes alpinus* were found, and in the other the weed was not identified.

The average number of animals per square foot was only 16.8 with the predominant species being one of the mayfly group - Deleatidium - which usually form an important part of a trout's diet. Other animals taken and their approximate density are shown in Table 1.

TABLE 1. Shore samples - animals found and their abundance.

Epeheroptera (Mayflies)	Trichoptera (caddis flies)	Plecoptera (Stoneflies)	Neuroptera (Dobson fly)	Diptera (True fly)	Mollusca (Shellfish)	Others
Deleatidium 31.5%	Hydropsyche 7.5%	Leptoperla 3.5%	Archichauliodes	Chironomid	Potamopyrgus 12.5%	Oligoch (worms) 12.5%
Atalophlebia	Hydroptilid	Stenoperla 4.5%		Culicidae	Isadora	Flatworms
Ameletus 1%	Olinga 6%				Corneocyclas	Coleoptera
	Pycnocentria 3.5%					(Parnid & Dytiscus beetles)

Total number of animals in 52 samples was 876.

(b) Petersen Grab

A total of thirty samples were taken with the grab, in seven series which extended to 3 or 6 chains from the shore, according to the depth of water at each site (see map). It will be noticed that no samples were taken along the major part of the eastern shore and this was because the bed of the lake shelved so steeply as to make it impossible to operate the grab, which tipped over when it reached the bottom.

Freshwater weeds were found in twenty of the samples, up to a depth of 45 ft but between 25 ft and 30 ft was the usual limit of plant growth. There were five species of weed found altogether with *Isoetes alpinus* being predominant.

The overall average number of animals per sample was 18.4, but the number varied considerably with the depth of water, and results can be seen in Table II. It will be observed that the greatest number of animals was found between 20 ft and 30 ft where larger numbers of the mollusc *Corneocyclas* were to be found than elsewhere.

Several features were most noticeable about the bottom fauna population of Lake Tennyson. Most important was the complete absence of members of the Odonata group which often form an important part of the diet of lake trout. Another absentee was the mollusc Diplodon, which could not inhabit so stoney a bottom as that at Tennyson, and this gravelly nature of the lake bed is probably also

responsible for the very low numbers of Chironomid larvae, particularly those of the black gnat or midge.

By far the greater proportion of the lake bed is at a greater depth than 30 ft and the sides slope down very rapidly to a depth of nearly 200 ft except at the lower end of the lake where there is a shelf of shallow water extending for about 200 yards. This great depth immediately limits the food producing abilities of the lake. The only fact on the credit side was the occurrence of quite large oligochaete worms which were found to a depth of 20 ft.

TABLE II. Petersen Grab Samples - animals found and their abundance at varying depths.

	9'-10'	11'-21'	21'-30'	31'-40'	41'-50'	51'-60'	61'-75'
Number of samples	7	9	3	2	3	3	3
Average number animals for all samples	26.6	14.7	49.7	11.5	11.0	5.7	4.3
Mollusca							
Potamopyrgus	38.6%	54.4%	22.8%	13.0%	24.2%	52.9%	32.6%
Corneocyclas	25.6%	8.3%	36.9%	4.3%	6.1%	5.9%	7.6%
Isadora	8.0%	17.3%	4.0%		3.0%		
Chironomid	12.8%	3.7%	29.5%	78.3%	12.1%		
Oligochaeta	8.4%	9.7%	4.7%	4.4%	54.6%	41.2%	7.6%
Trichoptera							
Hydroptilid	5.2%	6.0%					
Olinga	0.4%						
Others	1.0%		2.0%				53.8%

Total number animals found in 30 samples were 553.

C. NATIVE FISH

A fyke net was used to sample the native fish population of the lake. The net was set in each of two sites (see map) for four nights each, to give an indication of the native fish population and its composition.

Apart from eels, which were taken on four occasions, no native fish were recaptured. Further, extensive searching around the perimeter of the lake revealed a complete absence of bullies and galaxids, which are usually observable in clear water where they are present.

Galaxiids were observed in a tributary of the Clarence River some two or three miles above the lake, and in considerable numbers, but this was the only place where they were seen.

Of the five eels which were taken, two were opened up and their stomach contents examined. Results were:

(a) Several Isidora, 2 earthworms, 1 Potamopyrgus, 1 Corneocyclas, 1 Nematode and much unidentifiable matter.

(b) Several each of Isidora, Potamopyrgus and Oligochaeta.

D. TROUT STOCK

The trout stock was sampled by setting a gill net, which was formed of 2" netting for half its length and 3" for the other half, at various points around the lake. By this method 153 brown trout were caught and examined; they were weighed, measured and their condition factor worked out according to the Corbett scale.

The average condition factor of all fish caught in the netting programme was 37.9 which is poor, considering the time of the year, February, that the survey was carried out.

The fish below the catchable size (i.e. 12") had an average condition factor of 39.2 while those of catchable size averaged 36.5. The average condition of the smaller fish was somewhat higher than that of the takeable sized fish.

Figure I shows the size classes of the fish caught. Of the 153 trout weighed and measured 84 were below the legal size of 12". If the size limit were to be lowered to 10 inches then there would have been 33 more fish available to the angler, a total of 102 catchable fish instead of 69.

The majority of the netting was carried out over the shallow shelf at the bottom of the lake, as it was not possible or practicable to net in the exceedingly deep water predominating elsewhere. Round the sides of the lake, the shallow shelf is only a few feet wide, and is sometimes absent altogether. Observations in these areas showed that no trout rose in the centre of the lake, or very far out over the deep water. Numerous very small trout, from 3" to 8", were observed to feed in the extreme margin of the lake. These fish were usually in small shoals of up to six or eight fish.

The only really large fish seen were two of about 6 lbs to 7 lbs which were observed at the extreme upper end of the lake.

Thirtytwo trout were opened up and their stomach contents examined, the results being shown in Table III.

TABLE III. Contents of 32 stomachs - brown trout.

Animals found in stomachs	No. of stomachs in which each animal found	Animals found in stomachs	No. of stomachs in which each animal found
Potamopyrgus	24	Ladybird beetle	1
Corneocyclas	2	Adult flies	1
Olinga	6	Unidentified bug 1	1
Hydropsyche	1	Unidentified bug 2	1
Pycnocentria	1	Unidentified bug 3	3
Oligochaeta	1	Fish remains	2
Green or manuka beetle	9	Empty	2

E. SPAWNING FACILITIES

It would be possible, though unlikely, for brown trout to spawn in the gravel around the lake edge. The eastern shore in particular is composed of a very sharp gravel of a good spawning size. It is not smooth enough, or of a sufficient depth to make spawning there an attractive proposition for trout, hwoever. The Clarence River is a stable stream at that level, possessing a wide but very well consolidated flood bed. There is very little gravel in it, but any spawning carried on there would most likely be very successful.

The Clarence was examined for about three miles above its outlet into the lake, and these stable conditions prevailed throughout that distance. In addition there are several small tributaries which looked as though they would offer good gravel, though there was not sufficient time to examine these properly.

At the actual point where the Clarence leaves the lake, there is a small area of good gravel, and several small trout of about 2" to 2½" in length were noted there and in the reaches immediately below the lake.

F. DISCUSSION

The presence of the large fish presents certain problems in lakes of this nature. Where there is a large population of small trout there are often present many larger fish that feed on these small fish almost entirely. These "cannibalistic" trout will prevent the other trout present from reaching a size or condition desirable to the angler and at the same time are unavailable to the angler, under present regulations, because of their feeding habits.

The numbers of such trout present in Lake Tennyson is unknown due to the netting methods used, but are likely to be present in some numbers. It is desirable

to determine the population of cannibalistic trout present and to remove as many as possible. The latter can be done either by using angling methods that will take these fish or, more effectively, selective gill netting on a large scale.

Plankton sampling was not carried out but the production of plankton is usually low in lakes of this nature. This was borne out by the lack of native fish in any numbers that feed on plankton. Therefore, the introduction of a forage fish is unwise as food present is needed for trout.

Spawning conditions are adequate for the fish present and are not considered to be a limiting factor to trout production.

The lack of bottom fauna is of upmost importance and will limit the numbers of trout that Lake Tennyson can support but there is nothing that can be done to increase this supply of food. Even when present the bottom fauna was scanty and could not be expected to support a very high density of trout. At present the small fish present could utilize all the available food and only by reducing the number of these small fish could some be expected to reach the larger size or better condition desired by the angler. For this reason a much greater fishing pressure on smaller fish is needed to improve quality of fishing in this lake.

CONCLUSIONS AND RECOMMENDATIONS

1. Lake Tennyson is a deep lake with very little shallow water in which to support trout food.

2. Trout food, or bottom fauna, where present is of good quality for feeding purposes but in very low density.

3. There are large numbers of small, poorly conditioned brown trout inhabiting the shallow water at the lower end of the lake and the extreme margin and elsewhere.

4. Large fish are present, but in unknown numbers.

5. Spawning facilities appear adequate for the trout population present.

6. Consideration should be given to lowering the size limit, relaxing angling restrictions to enable anglers to catch more trout, particularly the larger trout.

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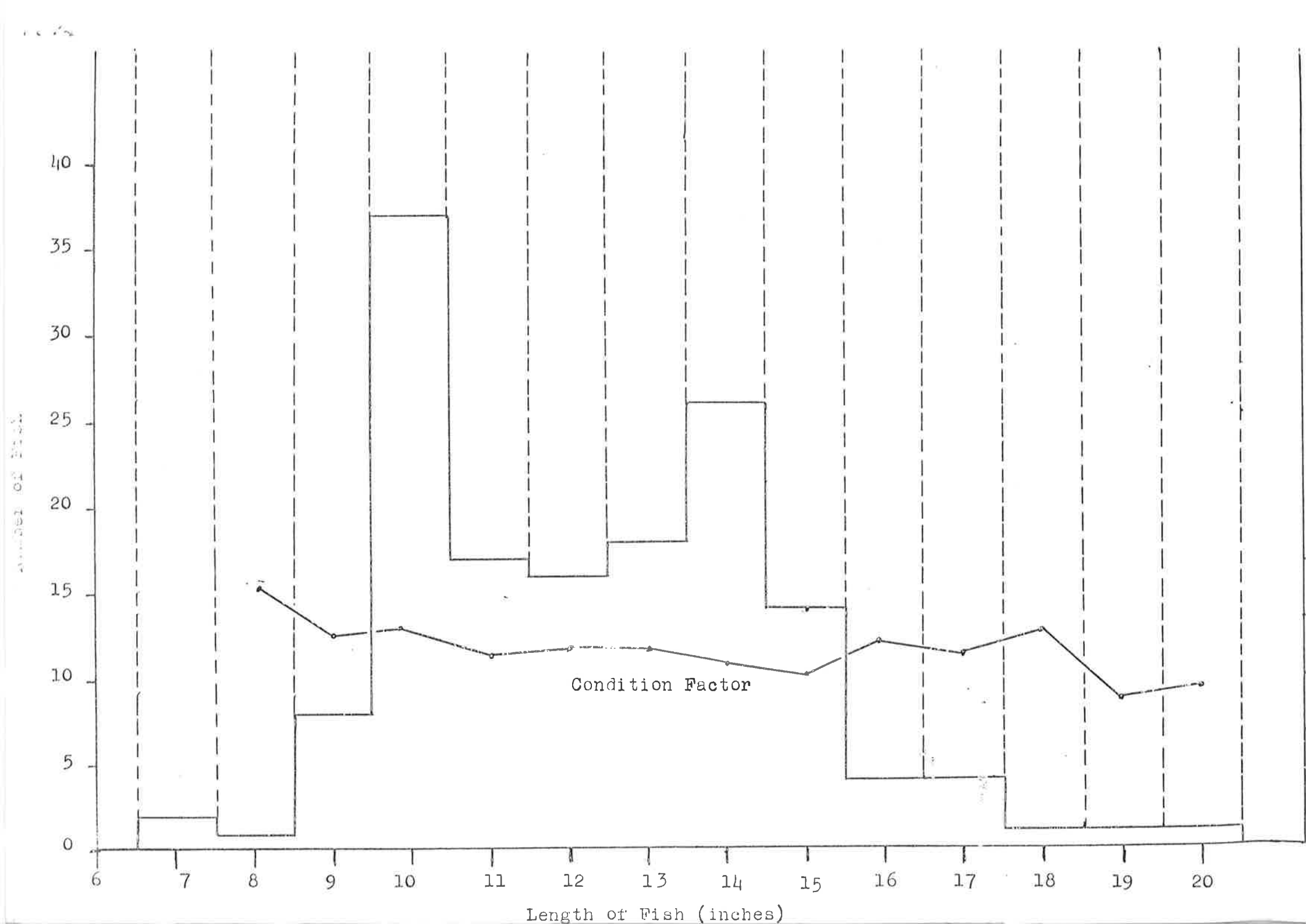
R.W. Little, Fisheries Officer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Condition Factor
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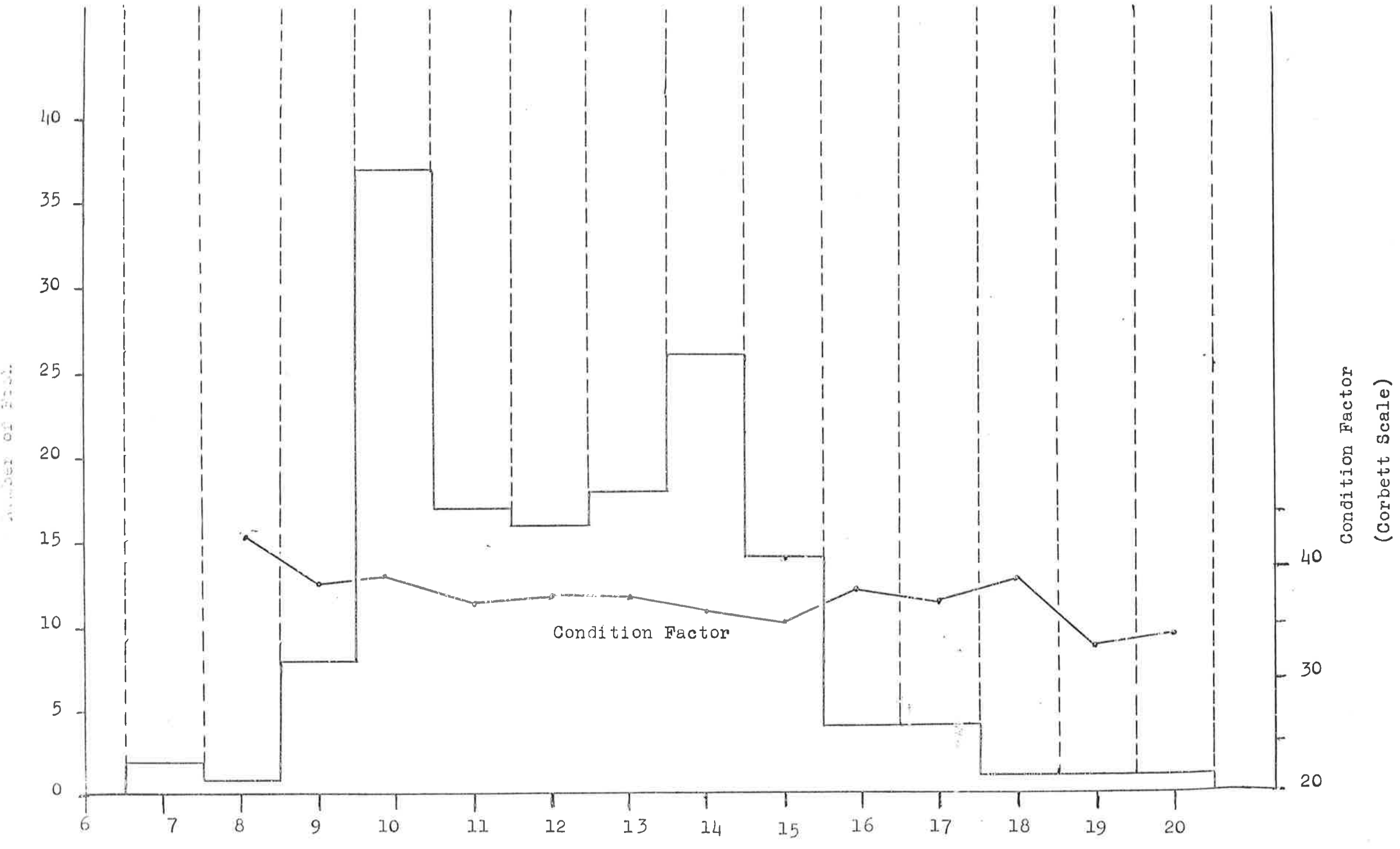
20
Length of Fish (inches)


Number of Fish
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35
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Condition Factor
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16
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18
19
20
Length of Fish (inches)
40
30
20
Condition Factor
(Corbett Scale)

LAKE TENNYSON

N

3619

FK 2

84'

4'
8'
25'
45'
60'
70'

7

13' 75'
47'

198'

B 33' 74'
56'

A 24' 60'
42'

198'

35'

4000

4500

5000

4000

35'

2

4

20' 23'
13' 16'
6' 8'

3

D

5 6

25' 33'
5'

E

FK 1

1

8 9

18' 12' 6'
15' 9'

F

3618

Scale = 3 inches To one half mile

0 1/2

18' 35'
20'
Figures represent Paterson Grab Samples depth at one chain intervals

FyKe Net

1 gill Net

35' - Depth

3146 - Altitude

— Bush

- Marsh