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COMMERCIAL SMALL CRAFT PAIR TRAWLING TRIALS LAKE CHILWA, MALAWI 1971

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ABSTRACT

The results are reported of commercial small craft pair trawling trials conducted on Lake Chilwa from May to August 1971.

Type of vessels and equipment used and the fishing method and operation employed are described and design data given for the different trawls used.

The effects on catching efficiency of varying amounts of small mesh netting trawls are dealt with and recommendations made for trawls design modifications.

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INTRODUCTION

Lake Chilwa, position 35° 45′ E and 150° 15′ S (Fig. 1) is the twelfth largest natural lake in Africa. Approximately 1000 km² in area the lake measures 40km by 27km. Of the total area roughly 67km² is open water, the remainder being made up of a surrounding reed belt (widest in the north and north-east sides) and a seasonal flooded plain.

Lake Chilwa, though of considerable size, is very shallow. At the end of the rains in May 1971 when the commercial pair trawling trials began, the average depth of the lake was approximately 2.25 metres. By mid-August, at the end of the trials, the water level had dropped by approximately ½ metre. There is no outlet from the lake and the drop in level (approx. 0.75 to 1.00 metre per annum) is caused by evaporation. The water is saline and very turbid.

Periodically the lake dries; KALK (1970) has described this phenomenum. This has occurred three times within living memory, the most recent occurrence being in 1968 when the lake was completely dry for a short period. The lake refilled during the heavy rains of 1968/69 and at the time of writing the average depth is approximately 1.75 metres.

Very little is known about the overall fish stock density or distribution. The three species which make up the annual production (Table 1)—*Barbus paludinosus* Peters, *Clarias mossambicus* Peters and *Tilapia shirana*

chilwae Trewavas are caught in the outer reed areas and in an approximate 1½–3km wide strip along the edge of the open water area.

Exploratory small craft pair trawling carried out by the Fisheries Department (RATCLIFFE 1971) and by members of the University of Malawi Lake Chilwa Research Project during 1970–72 has shown that the open water area supports stocks of all three species, the most dominant in the trawl net catches being the *Barbus*. This species is at present caught only by seine nets operated from six fishing beaches along the southern and eastern shores of the lake, in fish traps set in the reed areas and by scoop nets fished in the close proximity of fishing villages along the shore.

Of the three species caught, dried *Barbus* generally commands the highest retail price of the processed fish found in the local markets. It is also very much in demand for export to Rhodesia and Zambia to the extent that buyers are paying K12.00 (2 Kwacha = £1 Sterling) per 27 kilogram bag of dried *Barbus* at the beaches, i.e. 40–44 Tambala per kilogram (100 Tambala = 1 Kwacha) which is a much higher price than normal for beach purchases of processed fish throughout the country.

In view of the demand and high market value of the dried *Barbus* and because this species is being heavily exploited in only a few suitable sites around the lake, the trawling experiments have been directed towards the catching of *this* fish at an economical commercial level rather than *all* the three main species.

The commercial trawling trials were started in May 1971, after catches from the monthly exploratory trawling being carried out in several selected sites (Fig. 1) had reached the considered economic commercial level of 23 kg per hour (RATCLIFFE 1971).

The main aims of the trials were to explore the possibility of achieving an economic hourly catch rate over long periods in the same area of the lake and to evaluate the effect of trawl design alterations on catching efficiency.

EQUIPMENT

The vessels used were 17ft dories built by local boat builders (under Departmental supervision) at a cost of K180.00 each. They were built as general purpose fishing boats and can be used individually for gill netting, long lining and scoop netting. The power units were 4–5 H.P. British Seagull

Table 1. Estimated fish landings from Lake Chilwa and National Production in short tons 1963–71

Year	*Tilapia*	*Barbus*	*Clarias*	Total Lake Chilwa	Total Malawi
1963	1,012	212	2,376	3,600	15,100
1964	3,351	206	2,243	5,800	14,500
1965	4,720	2,562	2,518	9,800	20,800
1966	1,540	3,115	3,345	8,000	19,300
1967	250	210	3,140	3,600	15,800
1968	4	8	88	100	19,800
1969	5	40	3,159	3,200	26,000
1970	371	1,615	2,643	4,600	37,000
1971	983	1,334	1,683	5,000	43,100

N.B. Annual grand totals 1969–71 rounded to nearest hundrend short tons.

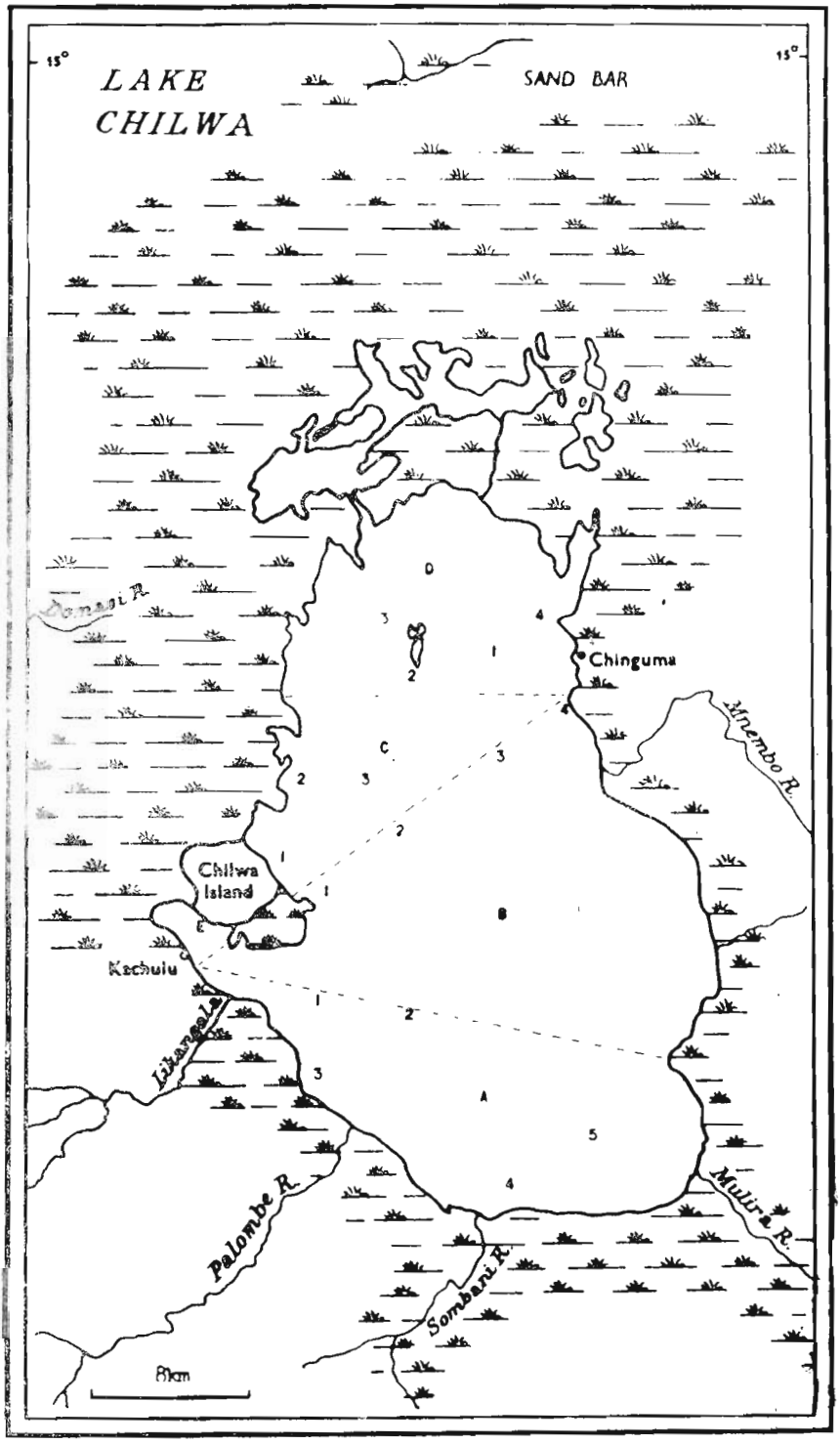


Figure 1. Map of Lake Chilwa showing exploratory trawling sites.

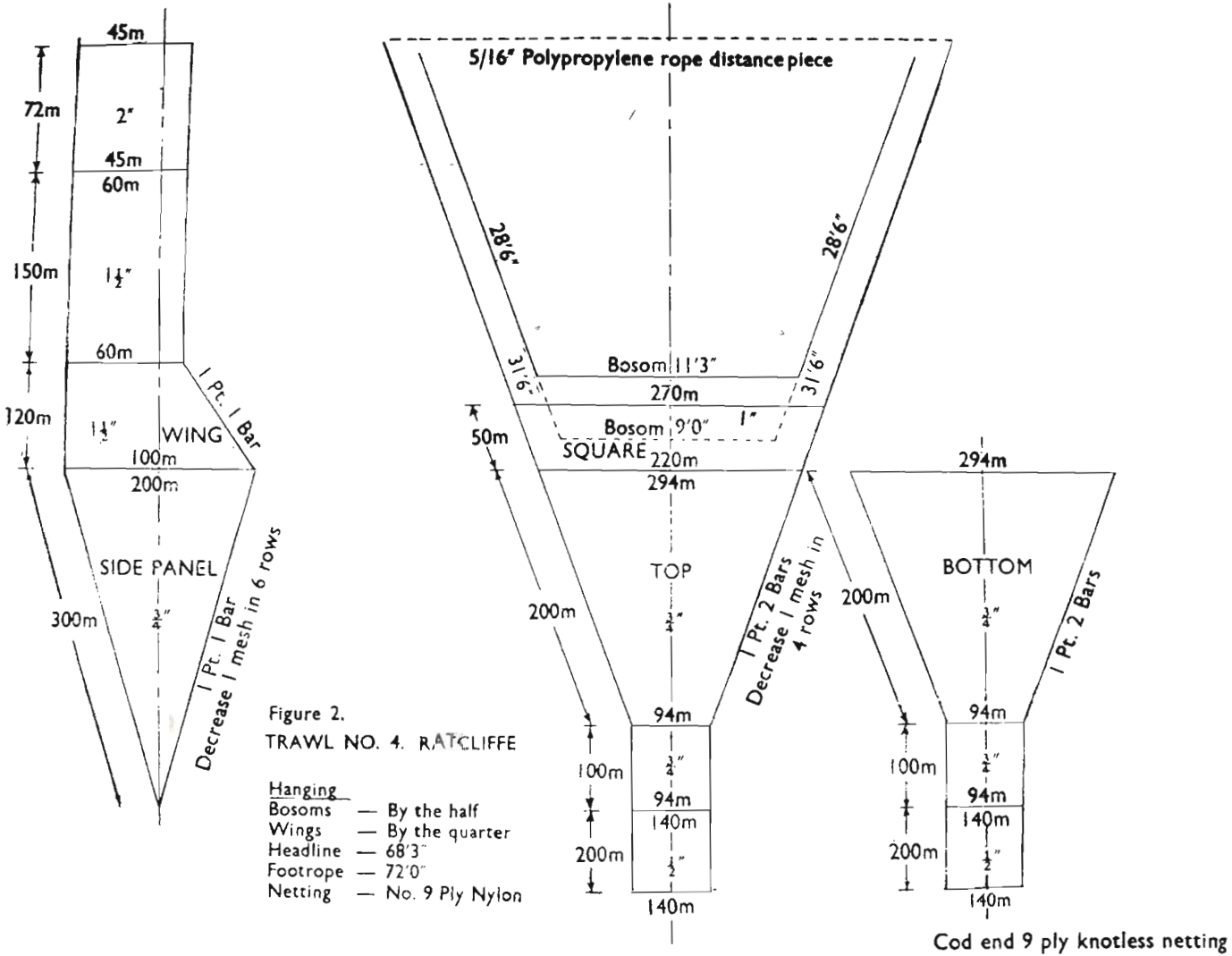


Figure 2.
TRAWL NO. 4. RATCLIFFE

Hanging	
Bosoms	— By the half
Wings	— By the quarter
Headline	— 68'3"
Footrope	— 72'0"
Netting	— No. 9 Ply Nylon

Cod end 9 ply knotless netting

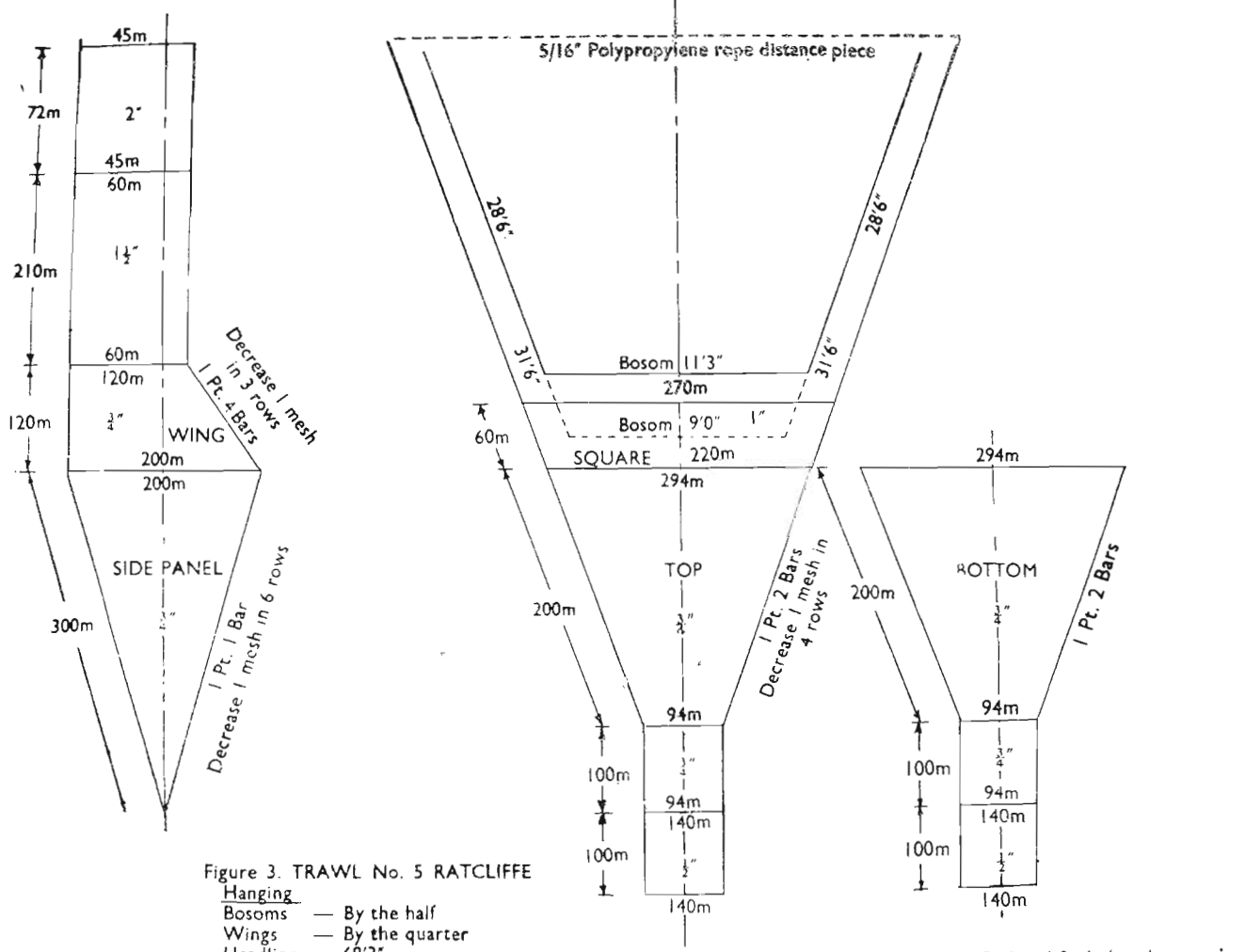


Figure 3. TRAWL No. 5 RATCLIFFE

Hanging

Bosoms — By the half
Wings — By the quarter
Headline — 68'3"
Footrope — 72'0"
Netting — No. 9 Ply Nylon

Cod end 9 ply knotless netting

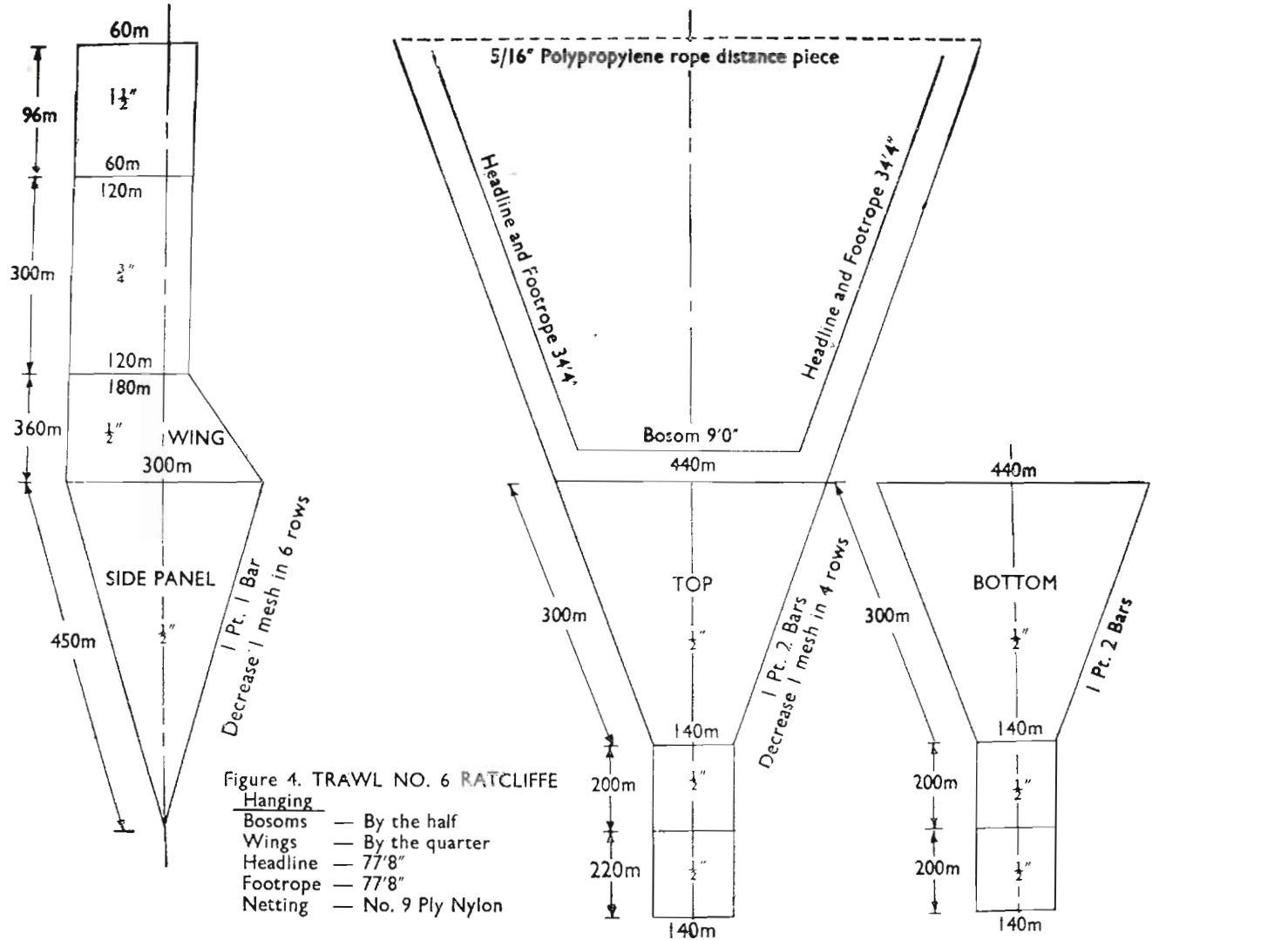


Figure 4. TRAWL NO. 6 RATCLIFFE

Hanging

Bosoms	— By the half
Wings	— By the quarter
Headline	— 77'8"
Footrope	— 77'8"
Netting	— No. 9 Ply Nylon

Cod end 9 ply knotless netting

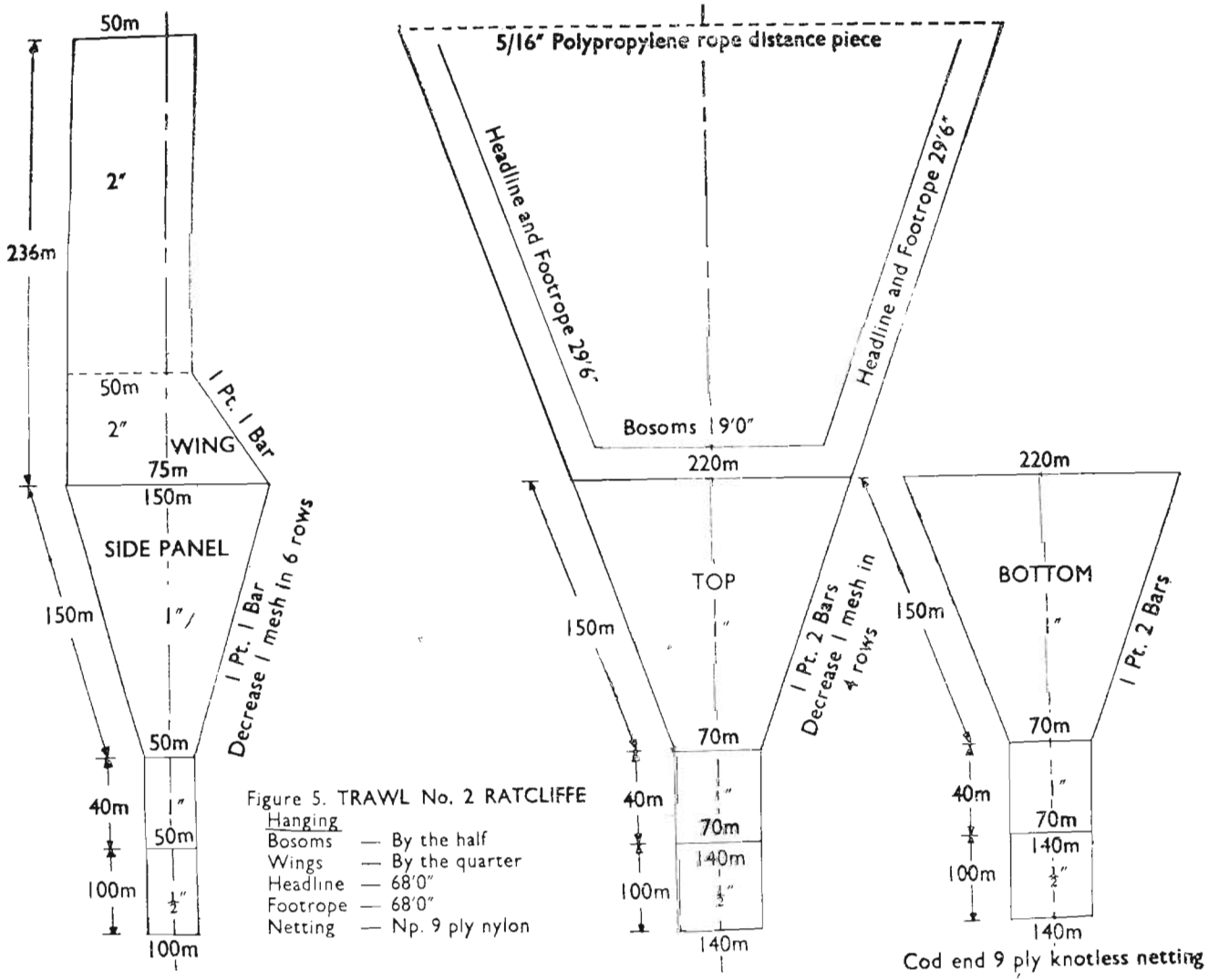
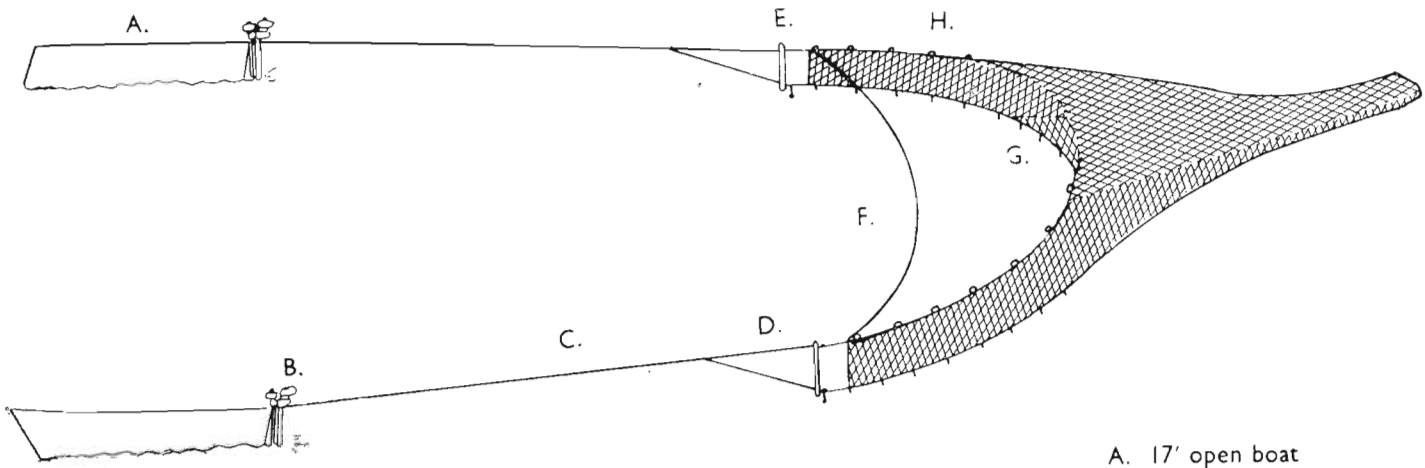


Figure 5. TRAWL No. 2 RATCLIFFE

Hanging

Bosoms	— By the half
Wings	— By the quarter
Headline	— 68'0"
Footrope	— 68'0"
Netting	— Np. 9 ply nylon

Figure 6



A. 17′ open boat
B. British Seagull outboard motor
C. Towing ropes
D. Bridles
E. 5′ danleno sticks
F. Spread distance rope
G. Old pieces chain
H. 3″ diam. plastic gill-net floats

Outboard motors costing K180.00 per motor. All trawl nets (Figs. 2, 3 4—designed by RATCLIFFE) were constructed by the technical staff of the Lake Chilwa Fisheries Station from various mesh size 9 ply sheet netting manufactured by the local net factory and normally used in seine net construction. Towing ropes, bridles, headlines and footropes were made from 5/16″ polypropylene rope also available locally. All the materials used are either produced in Malawi or imported items normally available in Malawi.

The trawl nets used were modelled on the design of No. 2 net (Fig. 5) RATCLIFFE (1971) which was the first net to make catches of over 50kg per hour (July 1970). All the trawls were designed to fish from surface to bottom in up to depths of 3 metres. It is probable that their efficiency is greatly impaired by drag caused by excessive slack netting when used in depths less than 1½ metres. However, the highest catch rate of 90kg per hour was made by trawl No. 2 during September 1970 in 1.25 metres of water. The various trawl net section sizes were virtually the same but several permutations of different mesh sizes were used. The cost of the trawling unit, i.e. two boats equipped with two complete trawls and tow ropes, was approximately K900.00.

METHOD

Two trawls are used, one in each boat. When only one trawl was used considerable time was wasted removing the large numbers of *Barbus* which hang by their serrated hard dorsal spine in the netting (dipping the trawls in 2–1 mixture of bitumastic and white spirit lessens tangling to a certain extent).

When shooting the trawl the two boats come together. The appropriate trawl wing is passed over to the boat whose net is not being shot and attached to the danleno stick already in that boat. The stick is then lowered into the water until it is clear of the stern and the bridles are made fast to a cleat near the stern. The engine is then started, the boat moves away and the trawl is dragged out of the other boat, care being taken to avoid tangling. When the trawl is in the water the bridles of the second boat are made fast, after which the engine on this boat is also started. The trawl is then towed for two or three minutes to ensure that it has opened correctly and then the towing ropes are gradually run out (Fig. 6).

When hauling, the two boats come together and continue towing until the trawl closes. Both engines are then stopped and the trawl is hauled into the boat from which it was originally shot. It is quickly detached from the danleno sticks and the second trawl, already prepared for shooting, is attached.

OPERATION

The trials were conducted along commercial lines to the extent that all the fish was sold to local buyers or the general public. The *Barbus*, which was sun dried and lightly smoked, was sold at a price varying from K9.00 to K12.00 per 27kg bag. The *Tilapia* and *Clarias* were sold either fresh for 8–10 Tambala per kilogram or smoked for 50 Tambala per kilogram.

During May fishing was only carried out during daylight hours. From June to the end of the trials in August the unit was operated by two five-man crews (a crew comprised 1 fisheries Technical Assistant, 1 Departmental Fisherman and 3 Labourers) on a day and night shift basis. During the day shift the morning catch was collected from the trawling boats and brought ashore by a small 15ft carrier boat. This was found necessary as fish kept aboard longer than

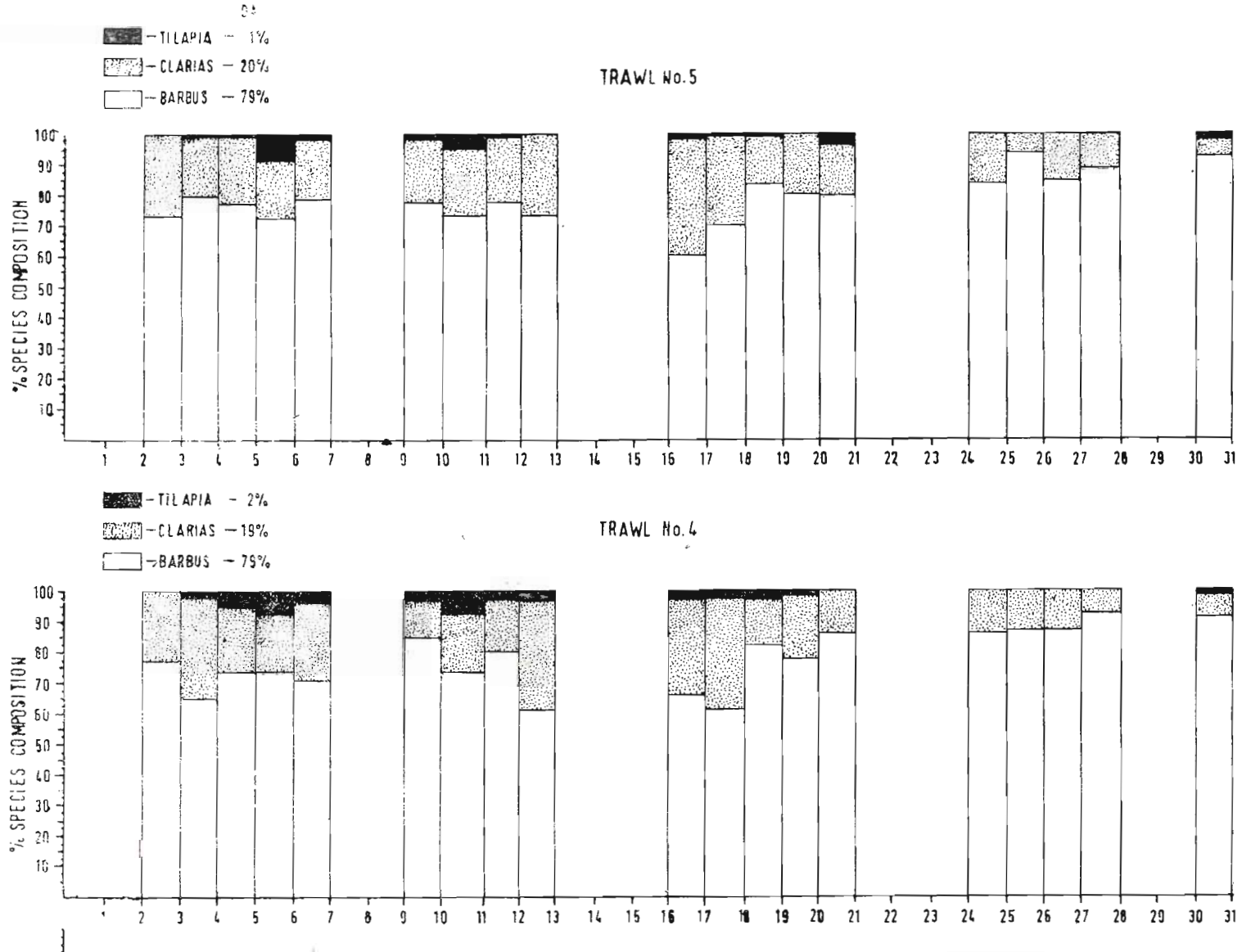
three or four hours was in a very poor condition. Since it was cooler at night, night catches were not landed until 6.00 a.m. the following morning when the boats returned to the beach to change crews. All the fishing was carried out in the north-east corner of Area E (Fig. 1) and as information on sustainable commercial yield was being sought no attempt was made to move to other areas on the several occasions when the catch rate fell below the economic level of 23kg per hour.

In the course of the trials three trawls were used No. 4, No. 5 and No. 6. During May and for 6 days in June trawls No. 4 and No. 5 were fished. Trawl No. 6 was constructed in June after an examination of the May catch figures showed that the average hourly catch rate of trawl No. 5 for that month was 7 kgs per hour higher than the 28 kgs per hour returned by trawl No. 4 (Fig. 7). For the remainder of the trials the fishing was carried out with trawls No. 5 and No. 6. As previously stated, the size of the three trawls was virtually the same, the main difference in design being confined to the inclusion of more small mesh netting in the body and wings of trawls No. 5 and No. 6.

Table 2. Other exploratory fishing results from trawls Nos. 4,5 and 6 at various stations during 1971/72

Date 1971	Area	No. Tows	Total Towing Time Hrs	Weight of Different Species in Kilograms			Total Catch Kgs	Kgs of Fish/Hrs	Trawl No.
				Barbus	*Clarias*	*Tilapia*			
7 June	C1	1	0.75	20.4	0.9	0.9	22.2	27.8	5
7 June	D1–2	3	2.25	46.7	11.3	0.9	58.9	26.2	4 & 5
8 June	D1	6	4.50	112.5	15.4	4.0	131.9	29.3	4 & 5
9 June	D2	4	3.00	99.7	8.6	0.5	108.8	36.3	4 & 5
31 Aug	C1	1	0.50	1.8	0.9	0.5	3.2	6.4	5
31 Aug	B3	1	0.50	9.1	1.4	0.5	11.0	22.0	6
31 Aug	D2	1	1.00	29.0	3.6	1.8	34.4	34.4	6
1 Sept	D1	3	2.25	39.5	3.2	0.5	43.2	19.2	5
1 Sept	D2	1	1.00	22.0	2.7	0.5	25.2	25.2	6
15 Sept	A4	1	0.5	9.5	1.8	0.5	11.8	23.6	5
15 Sept	A4	1	0.5	5.4	0.9	0.5	6.8	13.6	6
16 Sept	A5	1	1.0	8.6	2.3	0.9	11.8	11.8	6
16 Sept	A5	2	1.0	15.8	4.5	0.9	21.2	21.2	5
1972									
3 Jan	B2	2	1.50	8.2	0.9	2.3	11.4	7.6	5 & 6
24 Jan	B2	2	1.0	(Til. Fry—90.00)		16.8	106.8	106.8	6
26 Jan	D1–2	6	4.50	62.6	1.4	20.1	84.1	18.7	5
27 Jan	D4	4	3.00	17.2	0.9	7.3	25.4	8.5	5
28 Jan	E	2	1.50	13.2	1.4	2.3	16.9	11.3	5
28 Mar	E	1	0.5	19.5	3.6	2.7	25.8	51.6	5
28 Mar	C1	1	0.5	19.5	2.7	0.9	23.1	46.2	5
28 Mar	B2	1	0.5	24.5	—	0.5	25.0	50.0	5
29 Mar	D4	1	0.5	31.7	0.5	0.5	32.7	65.4	5
29 Mar	D1	1	0.5	2 × 27 Kg *Tilapia* Fry			54.0	108.0	5

Fig. 7 TOTAL CATCHES-CHATCH RATES-SPECIES COMPOSITION-MAY 1971



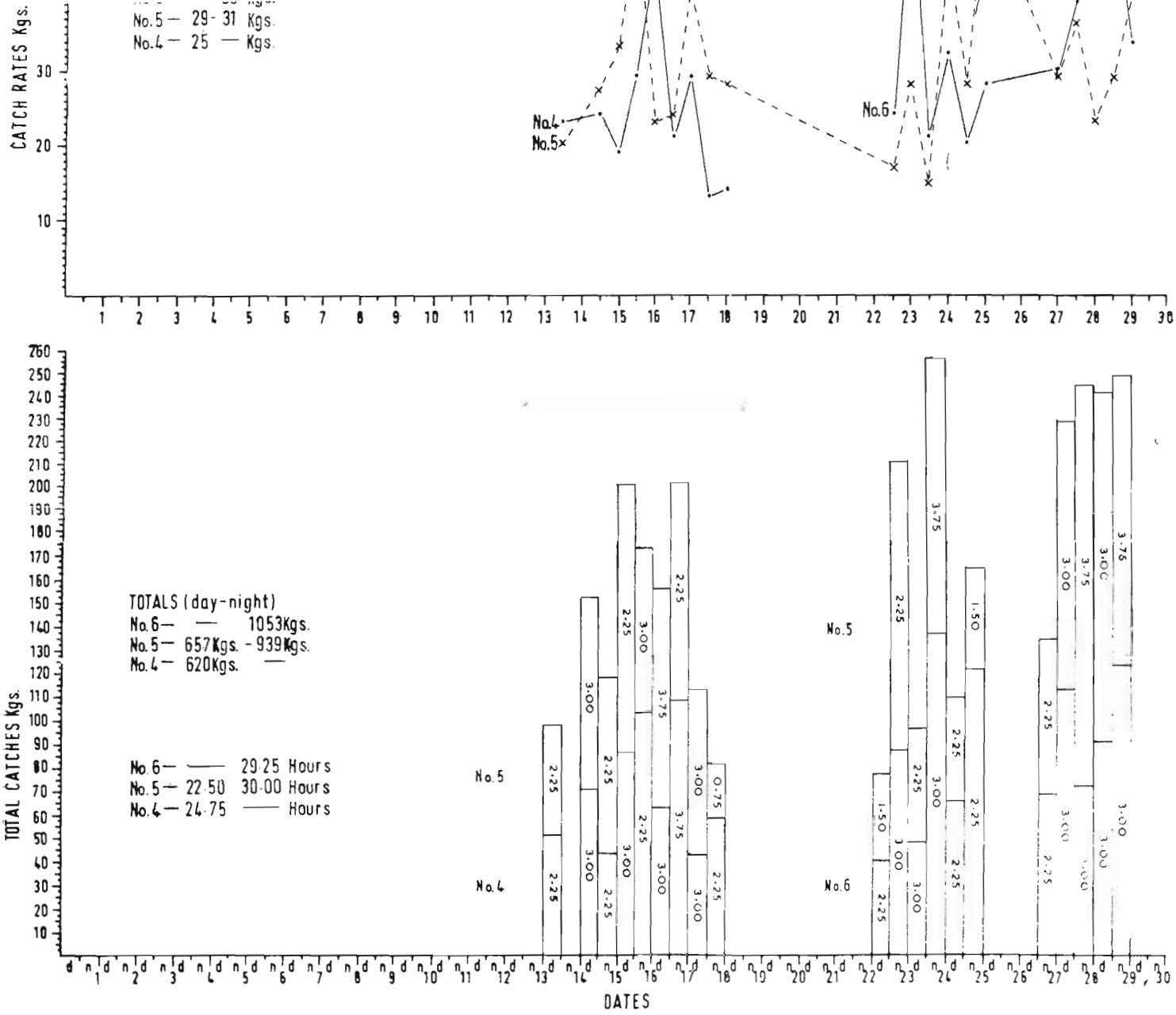

CATCH RATES Kgs.
No.5 — 29-31 Kgs.
No.4 — 25 — Kgs.
No.4
No.5
No.6
TOTAL CATCHES Kgs.
TOTALS (day-night)
No.6 — — 1053Kgs.
No.5 — 657Kgs. - 939Kgs.
No.4 — 620Kgs. —
No.6 — —— 29.25 Hours
No.5 — 22.50 30.00 Hours
No.4 — 24.75 —— Hours
No.5
No.4
No.6
DATES

Fig. 8 TOTAL CATCHES-CATCH RATES-SPECIES COMPOSITION-JUNE 1971

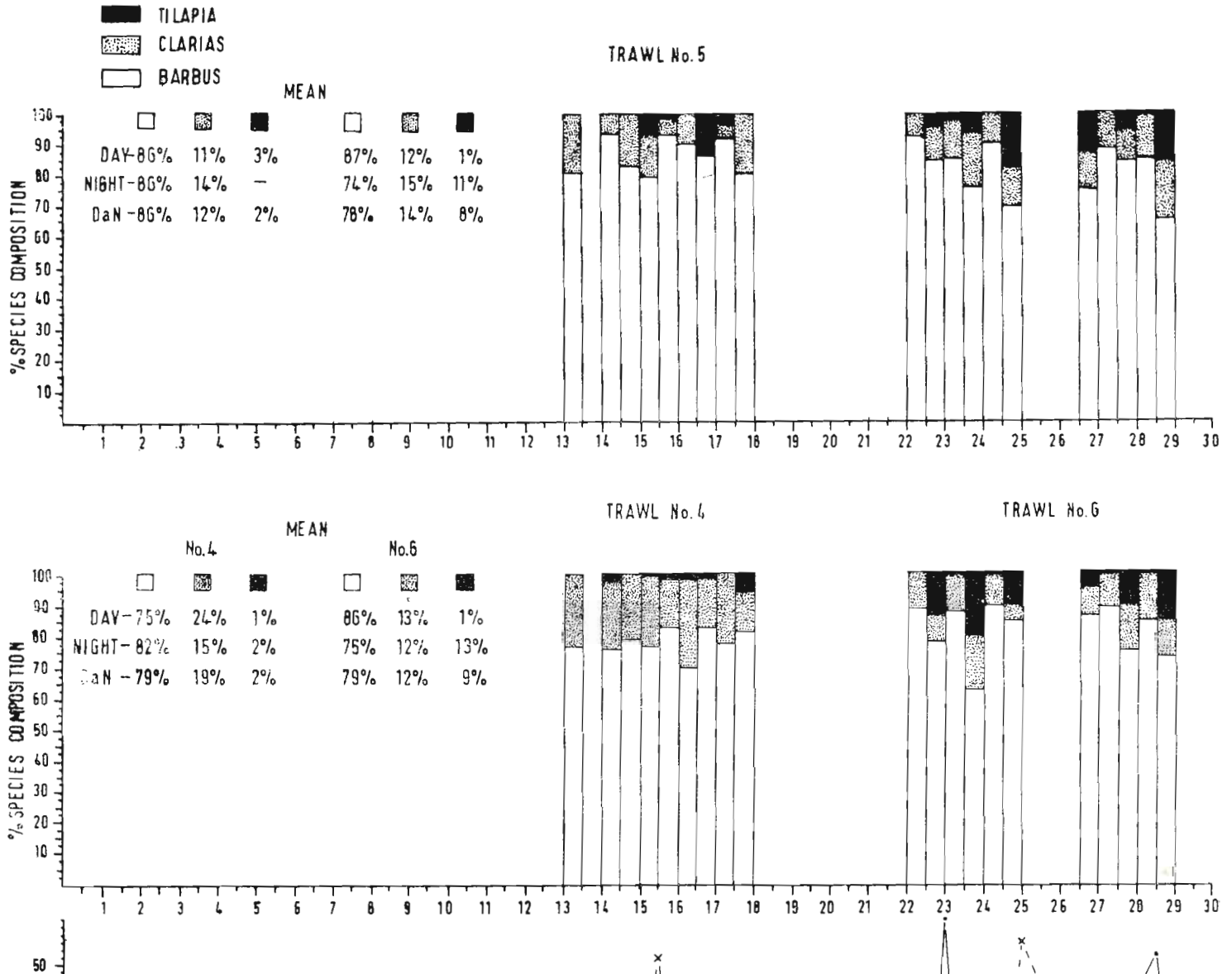


Table 3. Summary of Monthly Catches

Month	Trawl No.	Weight Kgs			Total Weight	Towing Time Hrs.	Kgs/Hr	No. of *Tilapia* Fry	Petrol Litres	Oil Litres
		Barbus	*Clarias*	*Tilapia*						
May	4	605.8	151.3	15.3	772.3	27.50	28	Not Record-ed	270	27
	5	686.3	174.3	14.3	874.9	25.00	35			
June	4	488.1	120.2	11.9	620.2	24.75	25	5,135		
	5	567.9	78.3	10.5	656.7	22.50	29	6,461		
	5	738.9	127.6	72.6	939.1	30.00	31	6,938	540	54
	6	831.9	131.7	89.9	1,053.5	29.25	36	5,201		
July	5	1,801.8	219.0	158.7	2,179.5	93.00	23	13,861	945	94.5
	6	2,423.1	442.2	328.0	3,193.3	109.50	29	22,588		
August	5	616.9	98.5	63.6	779.0	39.00	20	6,010	405	40.5
	6	742.5	153.0	149.9	1,045.4	41.25	25	4,589		
Totals		9,503.2	1,696.1	914.7	12,114.0	441.75	27	70,783	2,160	216

The trials were terminated in the middle of August when the combined catch rates of trawls No. 5 and No. 6 were frequently below the economic level. Exploratory trawling carried out in area D (where the depth of water was approximately 1.75 metres) during late August and early September (Table 2) produced catch rates of over 25 kg per hour. But apart from the occasional large catch of *Tilapia* fry no prolonged period when economic catches were made was recorded for the remainder of 1971.

RESULTS

The combined catches of the trawls used during the trials amounted to 12,114 kg and the total number of towing hours was 441.75 (Table 3). The average hourly catch rate of 27 kg achieved for the trial period was 4 kg higher than the considered economic catch rate for this method of fishing. A total of 2160 litres of petrol and 216 litres of two-stroke oil was used. The estimated retail cost of this fuel based on a petrol and oil mixture price of 70 Tambala per 4 litres, was K416.00. The amount realised from the sale of the catch was approximately K900.00, but a far more realistic price would have been K1,100.00. The low sale price of K9.00 per bag was due in part to the failure of a local buyer to purchase the bags of dried/smoked *Barbus* that had been reserved for him for shipment to Zambia. This coincided with a glut of fish on the local markets during August. Another factor was the local fish buyers' assumption that fish caught and sold by a Government body should be sold at less than the normal price of K11.00 per bag.

During the trials the outboard motors were operational for approximately 500 running hours. After examination it was found that the only parts that needed replacing were the propellor shaft bushes, gearbox thrust washers and the external brass thrust pads, all of which had been worn by the extra thrust required for trawling.

Figures 7 to 10 give a graphic summary of the total monthly catches, the average hourly catch rates and the species composition for the three trawls used.

During May the unit fished solely during the daytime with trawls Nos. 4 and 5 (Fig. 7). In only four days out of a total of 19 did No. 4 returned a greater average daily hourly catch rate than No. 5. Both trawls produced monthly averages of over 23 kg per hour—No. 4 28 kg per hour, No. 5 35 kg per hour. The species composition of the total catch by each trawl was virtually identical, with *Barbus* being the most predominant species followed by *Clarias* and *Tilapia* respectively.

In June Nos. 4 and 5 were used both day and night for a short period. No. 5 returned an average catch rate of 29 kgs per hour and No. 4 25 kgs per hour (Fig. 8).

For the May and June period that the No. 4 and No. 5 combination was used No. 4 had a total catch of 1,392.6 kgs *Barbus* 1,093.9 kgs, *Clarias* 271.5 kgs, *Tilapia* 27.2 kgs) for 52.25 towing hours. The total catch for No. 5 for 4.75 hours less towing was 1,531.6 kgs (*Barbus* 1,254.2 kgs, *Clarias* 252.6 kgs, *Tilapia* 24.8 kgs). The additional *Barbus* caught by No. 5 can be directly attributed to the greater amount of small mesh netting in this trawl design.

From June 23rd to the end of the trials on August 18th the No. 5 and No. 6 combination was used. During this period No. 5 returned a total catch of 3,897.6 kgs (*Barbus* 3,157.6 kgs, *Clarias* 445.1 kgs, *Tilapia* 294.9 kgs) for *162* towing hours. No. 6 which was operational for *180* hours had a total catch of 5,292.2 kgs (*Barbus* 3,997.5 kgs, *Clarias* 726.9 kgs, *Tilapia* 567.8 kgs). The average hourly catch rate for No. 6 was 29 kgs per hour, which was 5 kgs per hour more than the 24 kgs per hour returned by No. 5.

The increased efficiency of No. 5 compared with that of No. 4 was due to more *Barbus* being caught. In the case of No. 5 and No. 6 the latter caught more of all three species. The larger number of *Barbus* caught by No. 6 can again be attributed to the greater amount of small mesh netting in this trawl design. Generally the *Barbus* caught by No. 6 contained a higher percentage of small fish than the *Barbus* from No. 5. The addition of more small mesh netting in the various trawl designs resulted in a reduction of towing speed. Consequently No. 6, which had the most small mesh in its design, had the lowest towing speed and the ability of this trawl to catch more of the larger species could be attributed to its having a seine-like herding action rather than a trawl chasing action. Considering the large amount of small mesh the former action would be less inclined to produce pressures in the trawl entrance, which could have the effect of scaring away the *Tilapia*.

The majority of the *Tilapia* were caught, by all trawls, during night time. The amounts returned by No. 6 in July and August represented 18% and 25% of the nightly catches respectively (Figs. 9 & 10). The *Tilapia* were of a size normally associated with catches from 51 mm (2″) and 64 mm (2½″) and gill nets.

The number of *Tilapia* fry (70,783) recorded (Table 3) during the trials was not large considering the amount of fishing effort (all fry was returned live to the water). However, in early 1972 instances of 45 to 50 kgs per half hour tow were recorded in other areas of the lake (Table 2).

Apart from the August average hourly catch rate in respect of No. 5, all the trawls used returned monthly hourly catch rates of 25 kgs or over and occasionally had daily or nightly hourly rates of double this amount. No. 6 proved to be the most productive net but the *Barbus* caught were

Fig. 9 TOTAL CATCHES-CATCH RATES-SPECIES COMPOSITION-JULY 1971

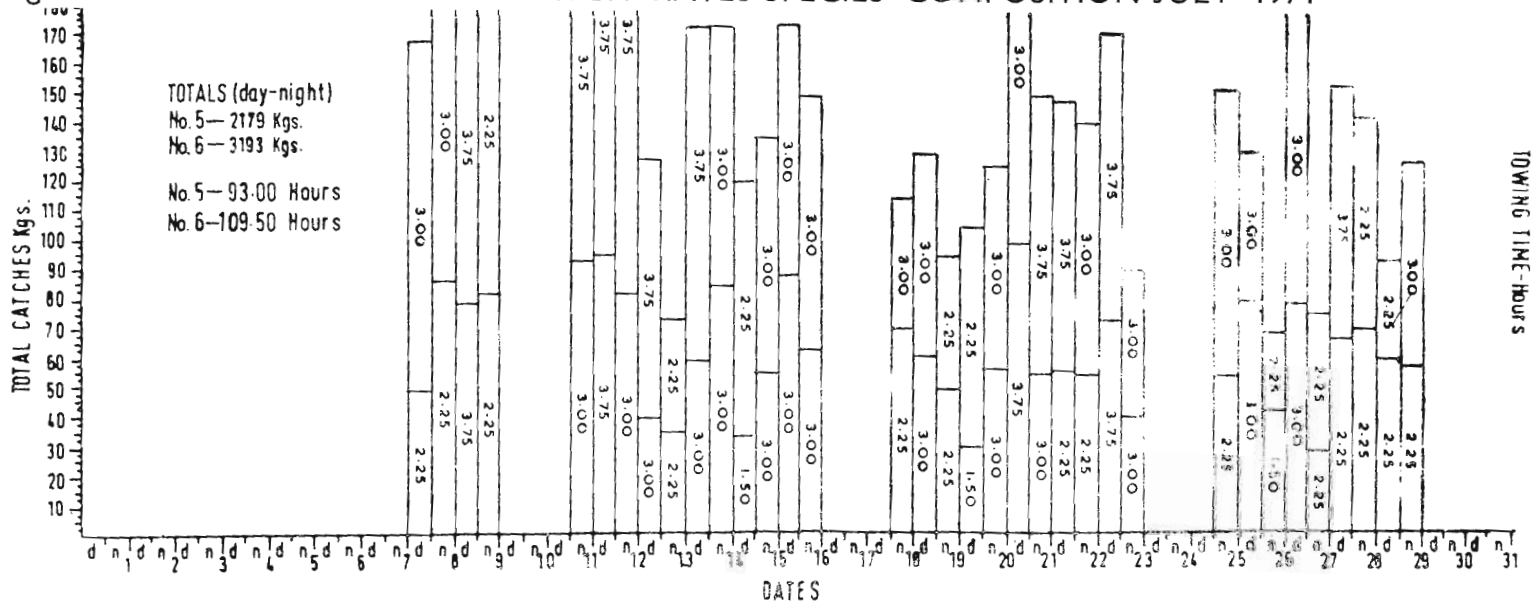
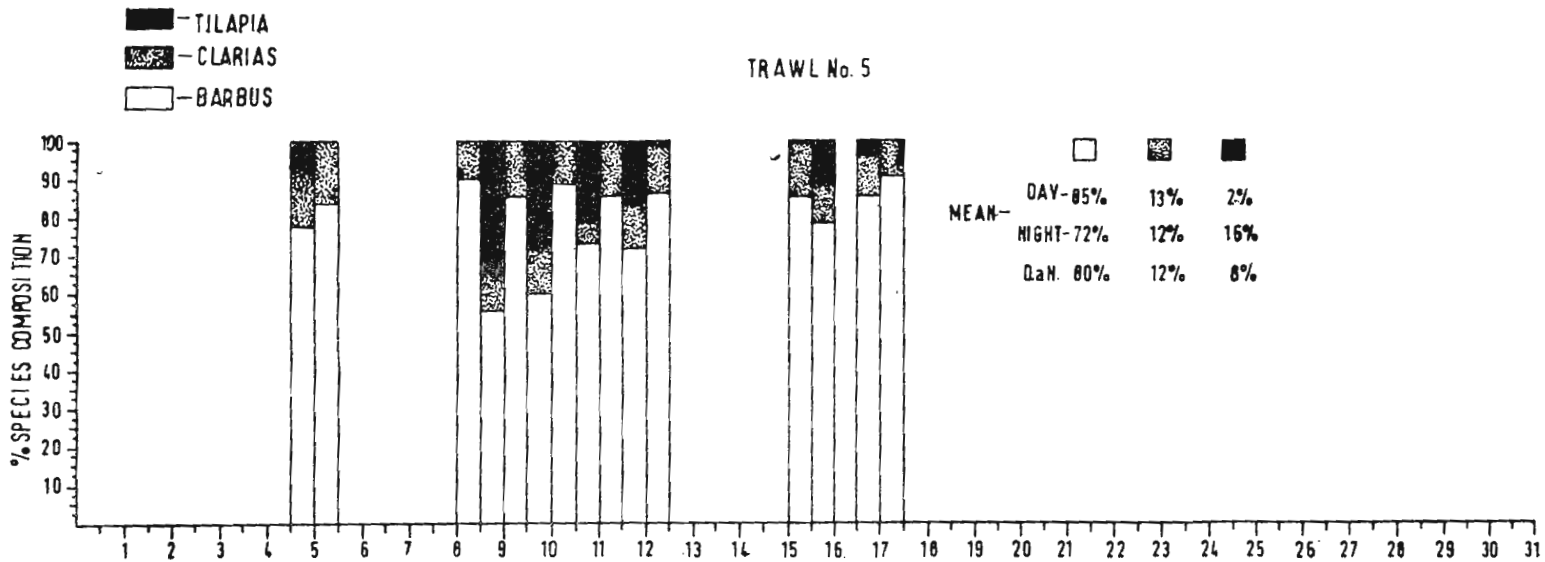


Fig. 10 TOTAL CATCHES-CHATCH RATES-SPECIES COMPOSITION-AUGUST 1971



generally smaller than those caught by No. 4 and No. 5. In June, July, and August the average hourly catch rate for No. 6, which was fished for a total of 61 daily or nightly periods, was appreciably below the considered economic fishing level on 11 occasions and 5 of these were in August when the hourly catch rates were generally lower than those of previous months. No. 5, which was fished alternately with No. 6, had 12 daily or nightly periods when the average hourly catch rate was below the considered economic level, but the hourly average was regularly less than that of No. 6. No. 4 was the least efficient trawl, but on only 7 of the 28 daily or nightly periods when it was used was the average hourly catch rate below the considered economic level.

SUMMARY

The commercial trawling trials which started early in May 1971 and finished mid-August 1971 were confined to the north-east corner of Area E. As information on sustainable commercial yield was being sought no effort was made to move to other areas when occasionally the catch rate fell below the considered economic level of 23 kgs per hour.

The boats used, which were locally constructed, were powered by 4.5 H.P. British Seagull Outboard motors. The three trawls were virtually the same size but several permutations of different mesh sizes were used. Total cost of a trawling unit which comprised two boats, two outboard motors and two trawls complete with towing gear, was approximately K900.00.

During May fishing was done only during daylight hours but fishing was conducted both day and night for the remainder of the trials. On several occasions average daily or nightly hourly catch rates for the different trawls were below the economic level of 23 kgs hour. But only once (August, Trawl No. 5 20 kgs per hour) was the average monthly catch rate for a particular trawl below the economic rate.

The total amount of fish caught by the unit during the trials was 12,114 kgs. This had an estimated market value of K1100.00 but because of marketing difficulties it only realised some K900.00.

The total number of towing hours was 441.75 and the average hourly catch rate for the trials was 27 kgs per hour. Some 2,376 litres of petrol and oil mixture were used (estimated retail cost K416).

Trawl No. 6 was the most productive net but the other trawls were regularly returning hourly catch rates in excess of 23 kgs per hour.

CONCLUSIONS AND RECOMMENDATIONS

The main aims of the trials were to explore the possibility of achieving an economic hourly catch rate over long periods in the same area of the lake and also to evaluate

[1]Catches of two trawling units Malawi Young Pioneer Fisheries Pilot Scheme Trawls No. 5 Design—Area E—August* 1972

Unit No.	Weight Kgs. *Barbus*	*Clarias*	*Tilapia*	Total Weight	Towing Time Hrs.	Kgs/Hr.
1	2809	341	82	3232	40	81
2	2905	367	79	3351	39	86

*Note the very high hourly catch rates.

Fig. 10 TOTAL CATCHES-CHATCH RATES-SPECIES COMPOSITION-AUGUST 1971

■ – TILAPIA
▒ – CLARIAS

TRAWL No. 5

the effect of trawl design alterations on catching efficiency. The results obtained have shown that it is possible during certain months of the year to trawl at a commercial level for prolonged periods in the same area, Work by FURSE (1972) has produced evidence of commercial viability in other areas during the same months. The addition of more small mesh net in the same basic trawl size increased the catching efficiency. It is certain from the results obtained that had the trials been carried out with a unit equipped with two trawls of No. 6. design that the total catch would have been much greater.

At various times during the trials there were periods when both trawls in the combination being used were fishing well above the considered economic level and others when they were both below it. The results of exploratory trawling carried out by the Fisheries Department and the University of Malawi (FURSE 1972) show that the best fishing months are from April to August. In August, trawl No. 5 on 10 occasions out of a total of 15 returned daily or nighlty average hourly catch rates less than 23 kgs per hour. During May, only 1 out of 19 daily average hourly catch rates for this trawl was below the considered economic level.

There appears therefore to be a definite trawling season and within that season certain biological conditions exist, yet to be determined, that cause fluctuations in catch rates.

All the trawls on several occasions returned daily or nightly hourly averages of more than double the economic level. (In late April 1972 a unit fishing in area B4 with trawl No. 5 caught 81 kgs of *Barbus* from a 30 minute tow.) There is therefore no reason to radically alter the basic trawl size or design.[1] However, it is recommended that catching efficiency comparison trials should be conducted with a trawl similar in size to No. 6 but having lighter six ply $\frac{1}{2}''$ mesh netting instead of nine ply $\frac{1}{2}''$ mesh netting. It is further recommended that a set of trawls with shallower side panels be constructed for use during the annual low water level periods.

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