SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

TECHNICAL REPORT No. 203 MARCH, 1983

SET NET TRIALS ON MFV VICTORY OF HELFORD

June/July 1982

Author: P.H. MacMullen, F.D.O.

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SET NET TRIALS ON MFV VICTORY OF HELFORD, June/July, 1983

SUMMARY

This report describes trials which sought to relate various parameters to the size and species selectivity of static nets. It was also thought that there was a general need to describe some features of small boat gill netting to serve as an introduction to those who may not be well acquainted with this fishing method. To this end various aspects of this fishing are assessed and described in some detail as are some of the major items of equipment.

It is concluded that various factors can be identified as having a species or size related influence on the selective action of set nets. Of these, however, only the difference between monofilament and multimonofilament netting can be quantified on the basis of the trials results. Of the other factors, indications from these trials and other sources suggest that further investigations are warranted into different hanging rates and depths of netting. Further trials are now taking place to pursue these investigations.

P. MacMullen

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1. INTRODUCTION

These trials were part of the SFIA R&D programme commissioned by MAFF within the static fishing gear budget. It has involved investigations to relate various parameters to the size and species selectivity of static nets; it was also felt that there was a general need to describe some features of small boat gill netting to serve as an introduction to those who may not well be acquainted with this fishing method. To this end various aspects of this fishing method are assessed and described in some detail as are some of the major items of equipment.

It should also be noted that this is an interim report covering the first phase of the trials. Further work is planned for April/May 1983 to examine in more detail those parameters that seem to have some significance in respect of the selective action of set nets.

2. OBJECTIVES

(i) to identify and quantify those parameters influencing the size and species selectivity of the set nets used in the trials.

(ii) to describe various aspects of set-netting as a guide for those who may wish to become better informed about this fishing method.

3. BACKGROUND INFORMATION

3.1 Types of set nets

There are three main types of set net: gill nets, tangle nets and trammel nets. The main difference between the first two types is in the hanging ratio, i.e. the length of netting that is mounted onto a given length of rope. The term is explained in Appendix 2. Suffice it to say here that for gill nets the meshes are held open to the extent that fish tend to be caught around the gills; for tangle nets the meshes are open less and the tendency is for fish to become tangled by the mouth parts or some other appendage.

Trammel nets differ in that they are made up of three sheets of netting; an inner slack, small mesh sheet between two large mesh walls. Fish pass through one outer sheet and pull the slack, inner sheet out through the other wall forming a pocket. Trammels tend to be used mainly by very small inshore boats for flatfish. Their use is, however, widespread and may warrant investigation at some later stage.

3.2 Types of sheet netting used for set nets

The main requirement for most fisheries is low visibility netting and this is reflected in the preferences shown by fishermen as different materials have become available.

Most set nets are made of nylon (polyamide, abbreviated to PA) and this material is available as continuous filament, opaque silky strands; monofilament, cat gut; or multimonofilament which is a loosely twisted construction of fine monofilaments.

Continuous or multifilament tends to be used in low visibility water, turbid or deep; mono and multi monofilament are often used interchangeably although monofilament is marginally less visible and multi monofilament has the advantage of being softer and damaging fish less. Monofilament

netting also has the slight disadvantage that it tends to resist compaction, springing back after being pressed down. This property can make it difficult to stow on small boats where space is restricted.

In addition to nylon, continuous filament polypropylene is used for some applications. Polypropylene is buoyant and therefore can be used to advantage for wreck netting where it has less tendency to come fast than nylon.

3.3 Types of Fishing

Basically there are three methods of using set nets; on open ground, on features such as wrecks and, in shallower water, taking advantage of natural features to partly enclose areas.

On open ground, fleets of nets often totalling about 600 fathoms each are worked. This is often on rough ground which can only marginally be exploited by trawlers or seiners. The fleets of nets are normally set in line with the tide except during weak neaps when they may be set at some angle to the tide.

Wrecks, rocky outcrops or artificial reefs tend to aggregate fish. Short fleets are set over and around these features. This technique is well described in Field Report No. 821.

Also worth mentioning is the use of very large mesh tangling nets for ray, monkfish, turbot and other large fish. These nets are generally set in the same way as open ground set nets, on hard, rough areas.

3.4 Advantages of set netting

Any discussions of the advantages of set netting obviously involve comparisons; here, the assumed alternative is some type of active fishing method such as trawling or seining, rather than other passive methods such as lining or trapping.

This difference, of the fish finding the fishing gear rather than vice versa, is one of the principal advantages of static gear. Several studies undertaken, and listed in the bibliography, describe fuel consumption figures for gill netters as being anything from 10% to 50% less than that of demersal trawlers operating in a comparable mode.

Another feature of set nets is that, when gilling fish, they are very size selective. The size range selected is, of course, dependent upon both the mesh size and the girth of the various species of fish that encounter the net. The advantage of this being that virtually no undersized fish are landed, no sorting is necessary and the problems associated with the mortality of fish returned to the sea do not arise.

Also relevant is the suitability of these methods to a very wide range of vessels, from small dories to semi-automated vessels in the 30m plus size range, though larger vessels clearly require a fairly high density of fish to be competitive.

Also worth noting, and applicable to all static gear, is the quality of fish landed. Good sized fish are taken with none of the mechanical damage like bruising often associated with towed gear.

3.5 Disadvantages of Set-netting

There are a few major drawbacks to set netting but perhaps the most important is the restriction to working imposed by the tide. Small boats may be limited to working around 60% of the available time in some areas; this restriction being based on both the stability of the vessel and damage to netting when hauling in strong tides.

As with all static fishing methods as opposed to trawling or seining, it is probably true that catch rates are much more sensitive to fish behaviour dictated by biological factors.

Hard ground working and wreck netting can also cause substantial damage to gear. Perhaps 25% of sheet netting may have to be replaced per

month and this imposes the need for a substantial amount of time to be spent in overhauling gear. This may be achieved either during spring tide non fishing periods or by contract labour whilst another set of gear is in use.

Lost gear is detrimental in two ways; the straight financial loss and the phenomenon of 'ghost-fishing'. This latter effect has been studied in some detail and the reports are referred to in the bibliography. Loss of, or damage to, the catch may be significant in some areas at some times. This is generally as a result of infestation by amphipods (similar to woodlice) or crabs. There is currently some research being undertaken to reduce crab infestation but the problem of amphipods seems more intractable.

Also worth noting in this section is the time disadvantage that may be incurred during exploratory set-netting compared to, say, trawling. When trying new areas for their set-netting potential a minimum 24-36 hours is necessary in which to shoot and haul the gear; trawling or seining would require a test tow of perhaps only one hour to establish the presence of fish.

4. TRIALS VESSEL & GEAR

4.1 Vessel (See Figures 1 and 2)

Name:	VICTORY of Helford
L.b.p:	10.7m (35 ft)
Beam:	3.45m (11ft 4ins)
Draft:	1.1m (3ft 6ins)
Built:	G. Pearn - 1968
Engines:	1 x 108 h.p. Thorneycroft (main)
	1 x 30 h.p. Thorneycroft (auxiliary)
Layout:	Accommodation in forepeak Wheelhouse forward Engineroom amidships Fishroom aft

Deck Equipment:	Rapp Hydema KB 04 line/net hauler
Wheelhouse Equipment:	Decca Navigator Mk 21 Decca 48 mi. radar Kelvin Hughes MS44 Sounder Sailor Radiotelephones T121 & RT142

4.2 Crew and Trials Personnel

Skipper:	B. Kirby, The Kiln, Bishops Quay, Mawgan, Cornwall
Crew:	Two full time, one part time
SFIA:	P. MacMullen P. Neve

4.3 Standard Gear

The vessel normally works a variety of gill nets. At any one time the mesh sizes being used depend on the state of repair of the various nets and the availability of spare netting. During the trials periods covered by this report the gear comprised the following number of 50 fathom long nets in multi monofilament, (1.5 x 10).

3 x 4½ ins x 60 meshes deep
6 x 4¾ ins x 60 meshes deep
3 x 5 ins x 50 meshes deep
6 x 5¼ ins x 50 meshes deep
12 x 5¼ ins x 30 meshes deep

and in monofilament:

9 x 5 ins x 50 meshes deep

All these nets were hung at 50% (E = 0.5) and the rigging details are shown in Figure 3.

4.4 Modified Standard Gear

Three of the 5¼ ins mesh nets were re-rigged at a hanging rate E = 0.35; all other details of these nets were left unaltered. In addition a fleet of 12 x 50 fathom x 10½ ins mesh 'turbot' nets of 12 meshes deep was fished. The catches of those nets were monitored using differing amounts of flotation.

5. METHOD OF WORKING

The deck arrangement of VICTORY is shown in Figures 1, 2 and 4. Nets were stowed in large plastic bins - actually GPO letter-sorting bins. Each bin can hold about 300 fm of net. Each 'tier' of nets, comprising 9 or 12 x 50 fm nets therefore required two bins. Shooting, with the tide, was direct from the bins which were slid into position on the starboard side. The headline ran free while the footrope was thrown clear by one man.

To haul, the Skipper used the line-hauling sheave of the Rapp-Hydema hauler. The nets were laid loosely (flaked) onto the deck aft where one man cleared them. The remaining two men flaked the cleared nets into bins ready for shooting again.

During periods of heavy fishing all three crew would clear the nets. The fish was then thrown into a pound on the forward port side. When time permitted fish would be gutted before hauling the next fleet; otherwise gutting was carried out whilst steaming back at the end of the day. The fish was then washed, sorted and boxed ready for landing. It is worth noting that, on a number of these small boats, due to pressure of gear handling work, fish often lies ungutted for several hours and little protection is available against the drying effects of wind and sun.

6. TRIALS NARRATIVE

A total of 34 days of subsidised fishing was carried out between 9th June and 2nd August 1982. This covered four fishing periods of which the first day was spent shooting the gear. 30 x 24 hour periods of fishing were, therefore, carried out using an average of about 40 x 50 fm nets. The area covered is shown in Fig. 5. This is mostly hard and fairly rough ground which is worked by 10-12 local set-netters. These boats work, as described previously, for 7-10 day periods during the neap tides, weather permitting. Gill net soak time was generally about 24 hours; that for the tangle nets was 2-3 days. Within the trials period, data was collected regarding the following:-

mesh sizes of nets fished
rigging details
time fished
tide details
species and sizes of fish caught
method of capture
vertical disposition of fish within the nets

7. RESULTS & DISCUSSION

7.1 General

As this was the first exercise of this type carried out by the Authority in the UK, the discussion covers some practical aspects of the trials in addition to the more normal discussion of the characteristics of the trials data.

A selection of data is given in Appendix I. Because of the bulk of the data generated to date, and the need to be able to retrieve and correlate various parameters quickly, the data is now being stored on 'floppy' storage discs and a data management system has been devised.

7.2 Influence of Fishing Conditions

Weather conditions were good throughout the trials period, causing no time to be lost. Catch rates were, however, generally disappointing. It should be noted also that the Skipper chose to use a total of five different gill net mesh sizes as well as the tangle nets, although 30% of the gill nets used were, in fact, of 5¼ins mesh size. These variables, combined with the low catch rates, have resulted insome sample sizes being rather small at this point in the trials. Sample sizes are shown for some variables in Appendix I.

7.3 Catching mechanisms of various nets

Figure 6 shows the percentage of hake caught by different methods of attachment to the net. For the purposes of these trials gilled was taken to be meshing around, or very close to, the operculum; wedged was meshing past the operculum, usually near the point of maximum girth, and tangled meant no initial meshing, capture usually having resulted from the teeth, mouth parts, tail or other appendage catching in the netting.

As can be clearly seen from Figure 6, the predominant method of attachment for hake differs between monofilament and multimonofilament nets. The monofilament nets were mainly tangling hake, with virtually none being wedged or gilled; the multimonofilament nets wedged very few fish with most being gilled.

These characteristics do not, however, appear to affect the overall size selectivity of these nets for hake as can be seen from Figure 7. Saithe, on the other hand, were almost exclusively gilled by both types of netting. This resulted in the size selection range of each net being correspondingly smaller for saithe than for hake as shown in Figures 7 and 8.

7.4 Other Analyses

The influence of changed hanging rates cannot be assessed yet because of the small sample sizes obtained - see sections 7.2 and 7.5. The vertical disposition of fish in the nets is not yet available as it is dependent

on the computer analyses. This is because it is a fairly lengthy procedure requiring a calculation for each fish. Once available, these data will enable an assessment to be made of the effectiveness of increasing the depth of netting.

Early indications, though of little statistical significance, do not yet suggest any appreciable difference in catch rates between the nets of 0.5 and 0.35 hanging rates respectively although there is a possible increase in the amount of net damage and crab infestation with the 0.35 nets.

7.5 Trials Conditions

7.5.1 Size of Boat

Space was severely restricted on the trials vessel to the extent that it was not possible to carry two trials staff. This resulted in some difficulty when attempting not only to measure and record the length of each fish but also to relate this datum to the vertical disposition of that fish in the net. When clearing the nets was falling behind hauling, with a large amount of netting on deck, it could also be difficult to determine which section of the fleet a particular fish was being removed from. This could be significant where fleets were made up of a mixture of nets of different mesh sizes and also contained some sections of monofilament which had been 'shot in' when overhauling ashore.

7.5.2 Charter Conditions and Fishing Gear

The trials have, to some extent, highlighted the differences between a full charter and subsidised/supported fishing. In the former the most important decisions relating to the use of, and alterations to, the fishing gear are unequivocally the domain of the Authority's representative. In the latter, payment is effectively compensation for inconvenience and the potential loss of earnings that may result from

the use of experimental gear. In this case it should be emphasised that there was no lack of goodwill and cooperation but the skipper was the decision maker and his priority was to maintain his boat as a commercial fishing unit.

The non experimental gear had, therefore, to be overhauled and altered to the requirements of commercial expediency. This basic gear, however, was to supply 'control' data against which the experimental data would be assessed. As noted earlier, the combination of these and other circumstances caused new categories of data to arise and small sample sizes to result. This has had the overall effect of limiting the extent to which analysis can be undertaken at this point in the investigations.

The decision on what type of 'charter' to invoke is of course generally a compromise reached between the maximum desirable observation period and the available budget.

7.6 Assessment of Net Haulers

The hauler used on VICTORY for the trials comprises a rubber composite covered drum with an auxilliary line hauling sheave mounted to one side. The relatively small diameter of the drum however results in a rather low frictional force between its surface and the netting. Hauling with the drum, therefore, restricts working to shallow water. Using the line hauling sheave to grip the headline and footrope, however, enabled hauling to the limit of the hauler's torque. This reveals the general principle underlying hauler head design; maintaining sufficient friction to enable continuous hauling against widely varying resistance. This frictional force, however, has to be achieved in such a way that it does not result in damage to the fish or gear and, hopefully, without having to devote manpower exclusively to the hauler.

Apart from plain drums there are five methods of increasing effective hauling power:-

(i) Line hauling sheaves as above

(ii) Vee-rollers, where the gear is forced into the vee to achieve a greater contact area

(iii) Auxilliary drums. These exert a compressive force against the main drum. The auxilliaries may be passive, usually filled with water; actively forced against the main drum with a hydraulic ram; and may also be actively driven with either of these types. Additionally the main drum may be modified to take the form of a short, endless conveyor belt as shown in Figure 9.

(iv) Cam operated jaws rotating around a vertical axis. The Crossley hauler is a commercialised version of this method, shown in Figure 10.

(v) Interleaved bars welded onto a drum as shown in Figure 11. Home made versions of this type are quite popular in Cornwall. The gear is forced to snake between the bars with increasing resistance resulting in the gear being forced harder down towards the drum surface.

8. CONCLUSIONS

8.1 Trials Data

Various trends have been noted in the trials data but, of these, only those relating to the differences in selective action between monofilament and multimonofilament can yet be quantified. Analysis has shown a significant difference in the ways fish are caught by these two types of netting.

Of the other trends, indications from these trials and other sources suggest that further investigations are warranted into different hanging rates and depths of netting.

8.2 Trials Arrangement

The evidence presented suggests that, for the next phase of these trials, careful consideration needs to be given to the charter arrangements. Given that the next phase will involve the use of a slightly larger vessel, it may be found more cost-effective to invoke a full charter rather than a supported/subsidised fishing arrangement. Further, whichever trials arrangement is finally decided upon, it is considered essential that there should be two SFIA staff on this next phase of the trials.

P.H. MacMullen,
Fisheries Development
Officer

APPENDIX I

SAMPLE DATA-SHEET

SET NET TRIALS DATA SHEET

DATE 10/16	Fleet No. 2	Detail 3 x 4¾" + 3 x 4½"		
POSITION B16.85 I41.1 B16.85 I39.3	Depth(fm) 40	Ground	Wind SE3 Sea 2/3	Shot 0930 Haul 1000 (11/6)

SHOOT Easterly at Slack Water

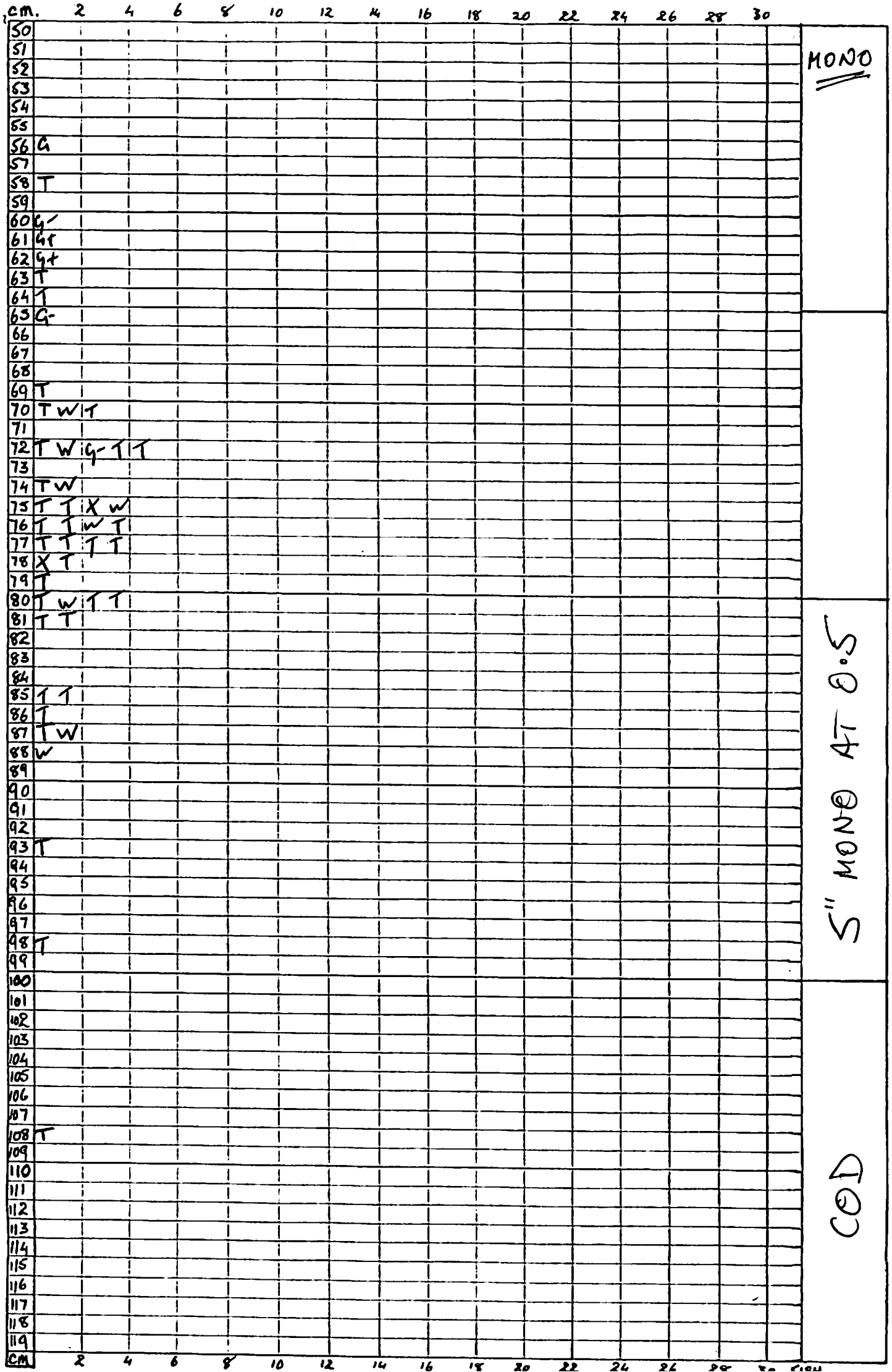
Net No.	Species	Position*	Type+	Length	Net No.	Species	Position*	Type+	Length
4¾"	Hake	2	T	89	4½"	Cod	1	T	88
	Saithe	2	G	61		Cod	1	T	104
	Saithe	2/3	G	61		Cod	2	T	90
	Saithe	2	G	62		Ling	1	G+	73
	Hake	3	W	92		Ling	2	G	81
	Pollack	2	W	73		Saithe	2	G	70
	Saithe	3	G	64		Ling	2	G	80
	Pollack	0	G-	79		Saithe	2/3	G	63
	Pollack	1	G	64		Hake	2/3	G-	84
	Hake	3	T	83		Saithe	2	G	64
	Pollack	2	W	85		Saithe	2	G	63
	Cod	1	T	102		Saithe	2	G	64
	Ling	1	G	94		Cod	1	T	92
	Saithe	2	G+	48		Monk		T	
	Saithe	2	G	62					
	Ling	1	G	97					
4½"	Hake	2/3	G-	89					
	Ling		G	99					

Gross Weights

Notes: 1 Lobster
20 Crabs

* Position: Footrope = 0; Bottom ¼ = 1; 2nd ¼ = 2; Top ½ = 3

\+ Type: Gilled = G; Wedged = W; Tangled = T; Other = X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MONO
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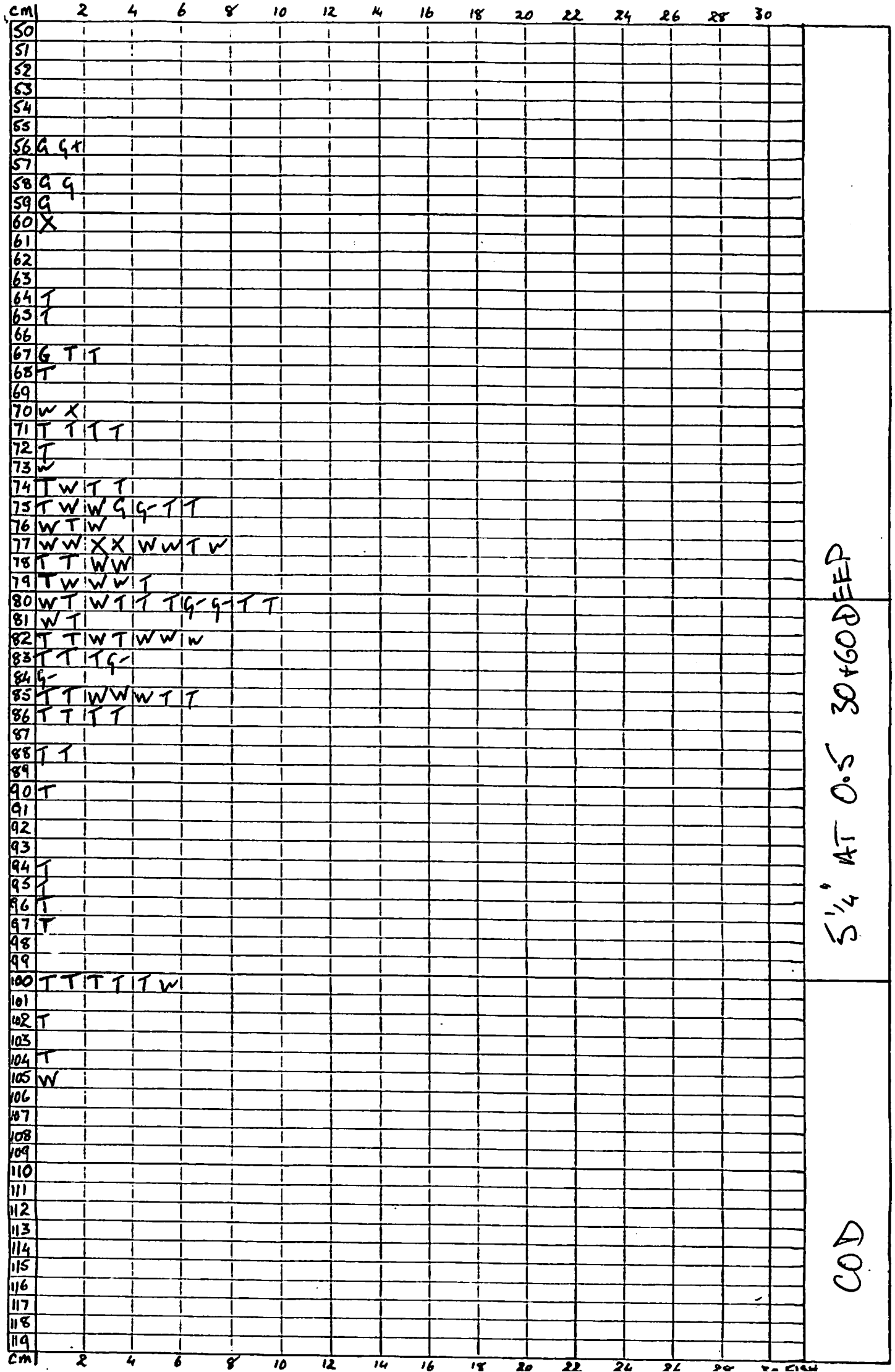
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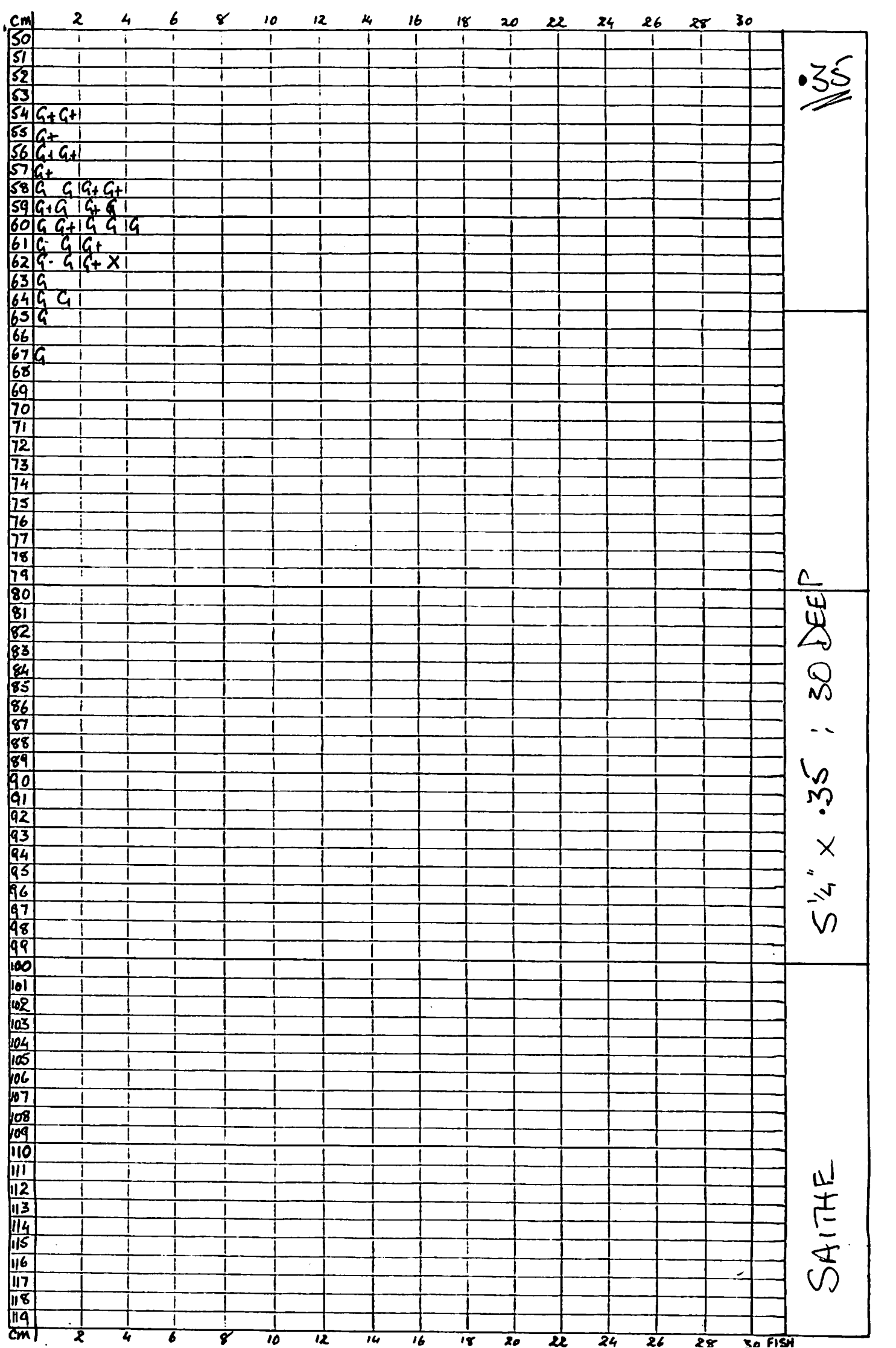
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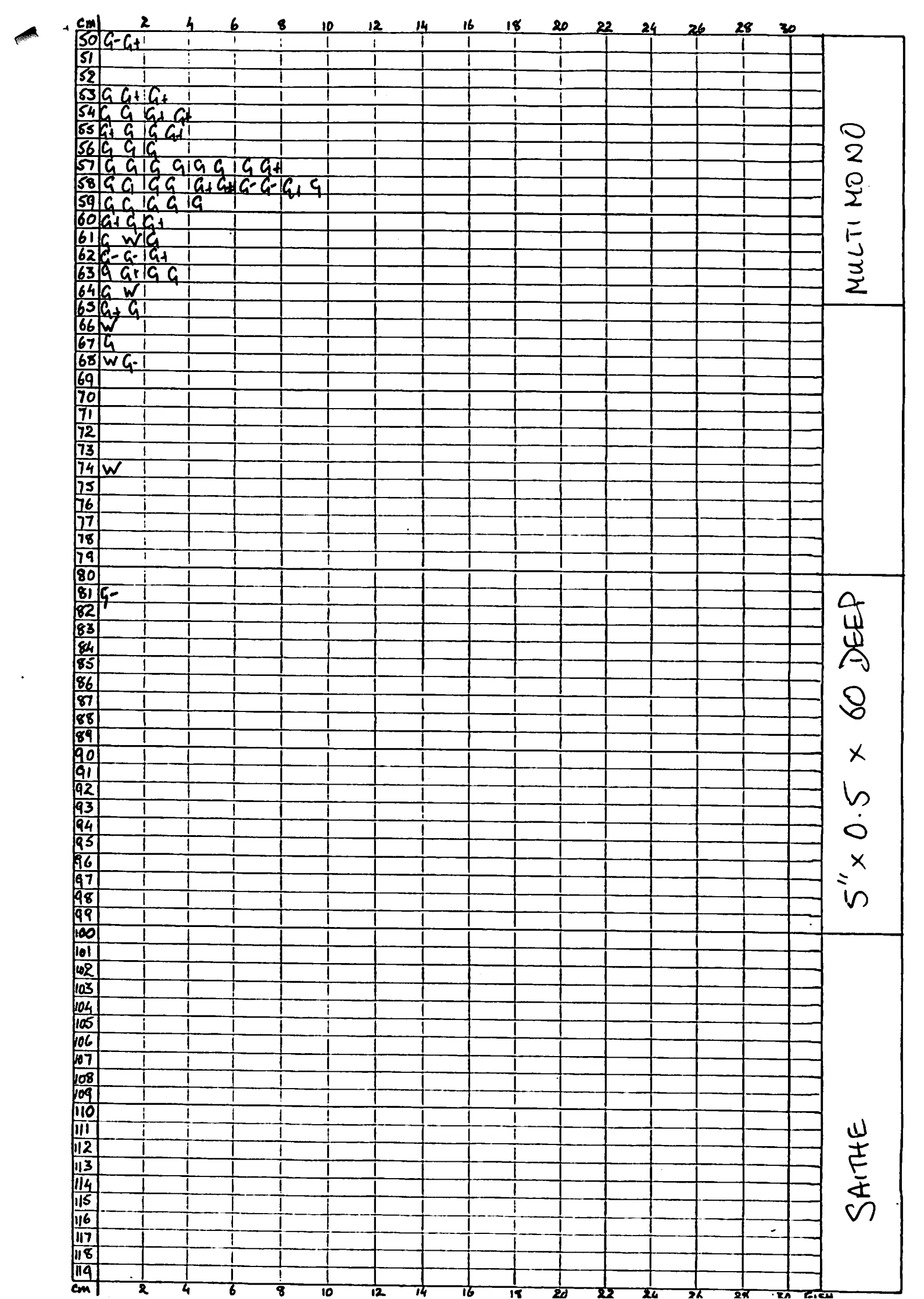
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65 G+ G
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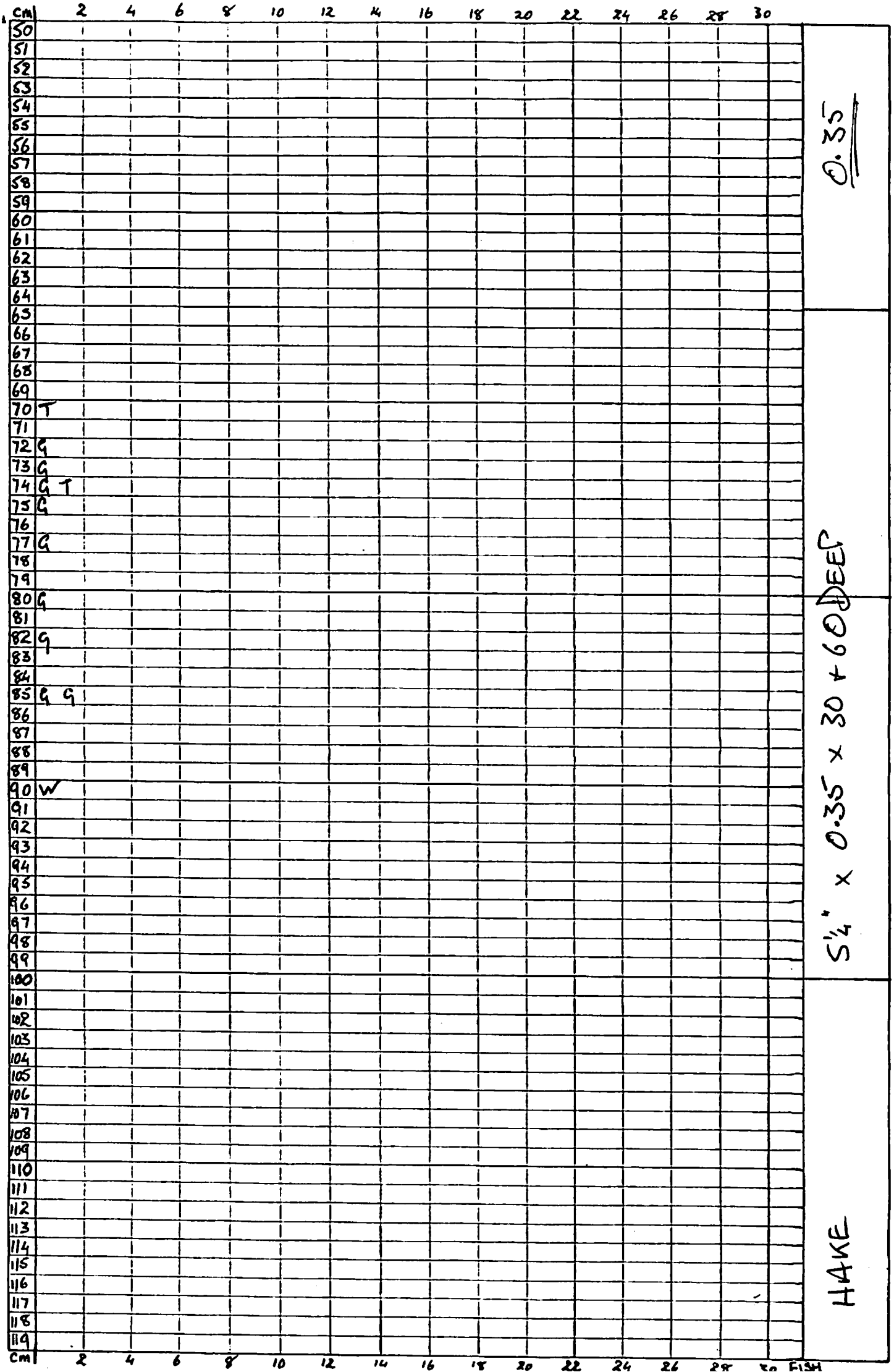
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T
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W
0.35
5¼" x 0.35 x 30 + 60 DEEP
HAKE
cm
2 4 6 8 10 12 14 16 18 20 22 24 26 28
TO FISH

BIBLIOGRAPHY

Remarkably little published information is available of the "set-netting-how to" category. There is a large number of published papers dealing fairly rigorously with the selective characteristics of set-nets in respect of different fish species. Few of these papers, however, are relevant to the contempory UK situation.

The best state-of-the-art paper is undoubtedly:

Hamley, J.M. 1975. Review of Gillnet Selectivity
J. Fish. Res. Board Can. 32: 1943-1969

This paper ". . . . . reviews studies on gillnet selectivity; the relevant characteristics of fish and nets, graphical and mathematical representation of selectivity curves, and methods of estimation". It also contains a very comprehensive bibliography.

The FAO catalogue of small scale fishing gear, published by Fishing News (Books) Ltd. contains a selection of typical set-net specifications. More up to date information is, however, available direct from the fishing press and gear manufacturers.

SFIA Field Report 803 describes a visit made to Denmark in 1979 to examine Danish net haulers.

Field Report 821 describes in good, practical detail, an observation trip aboard a Danish wreck and rough ground set-netter.

Field Report 870 describes fishing trials on an 80ft Scottish vessel converted to gill netting.

Scottish Fisheries working papers 7/82 and 12/82 (from DAFS Marine Laboratory, Aberdeen) report on Flume Tank measurements of various engineering performance parameters for gill nets.

Way, E.W. 1976 Lost gillnet retrieval experiments. Pub. Fisheries & Marine Service, Department of Environment, Canada

APPENDIX II

Explanation of Hanging Ratios

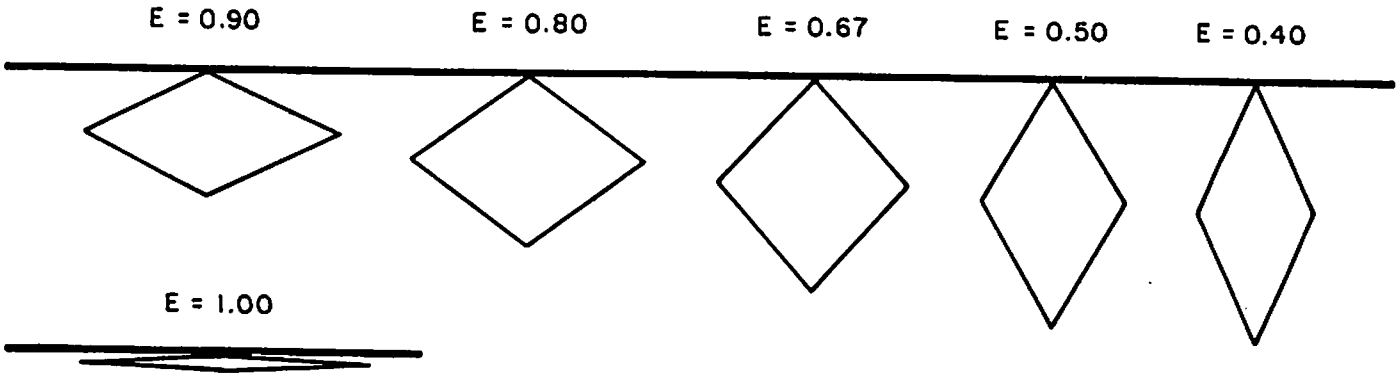


Figure . Usual hanging ratios (E).

The term hanging ratio (symbol E) designates the ratio between the length of a given portion of mounting rope and the length of the stretched netting hung on this portion of rope (figure).

The hanging ratio may be written as a decimal fraction, or as a vulgar fraction, or as a percentage, such as in the following example:

E=0.50 or E=1/2 or E=50%

In this . the decimal fraction has been specified only. It is, however, of interest to point out that the corresponding vulgar fraction can be used in common practice for net mounting. For instance, with E=0.50 or 1/2, we have two meshes mounted on the length of one stretched mesh. Also, following the same method, with E=0.80 or 4/5, we have five meshes mounted on the length of four stretched meshes. More generally speaking, when the hanging ratio can be expressed by a vulgar fraction, the denominator of this fraction represents the number of mounted meshes and the numerator the number of meshes, the stretched length of which corresponds to that of the rope.

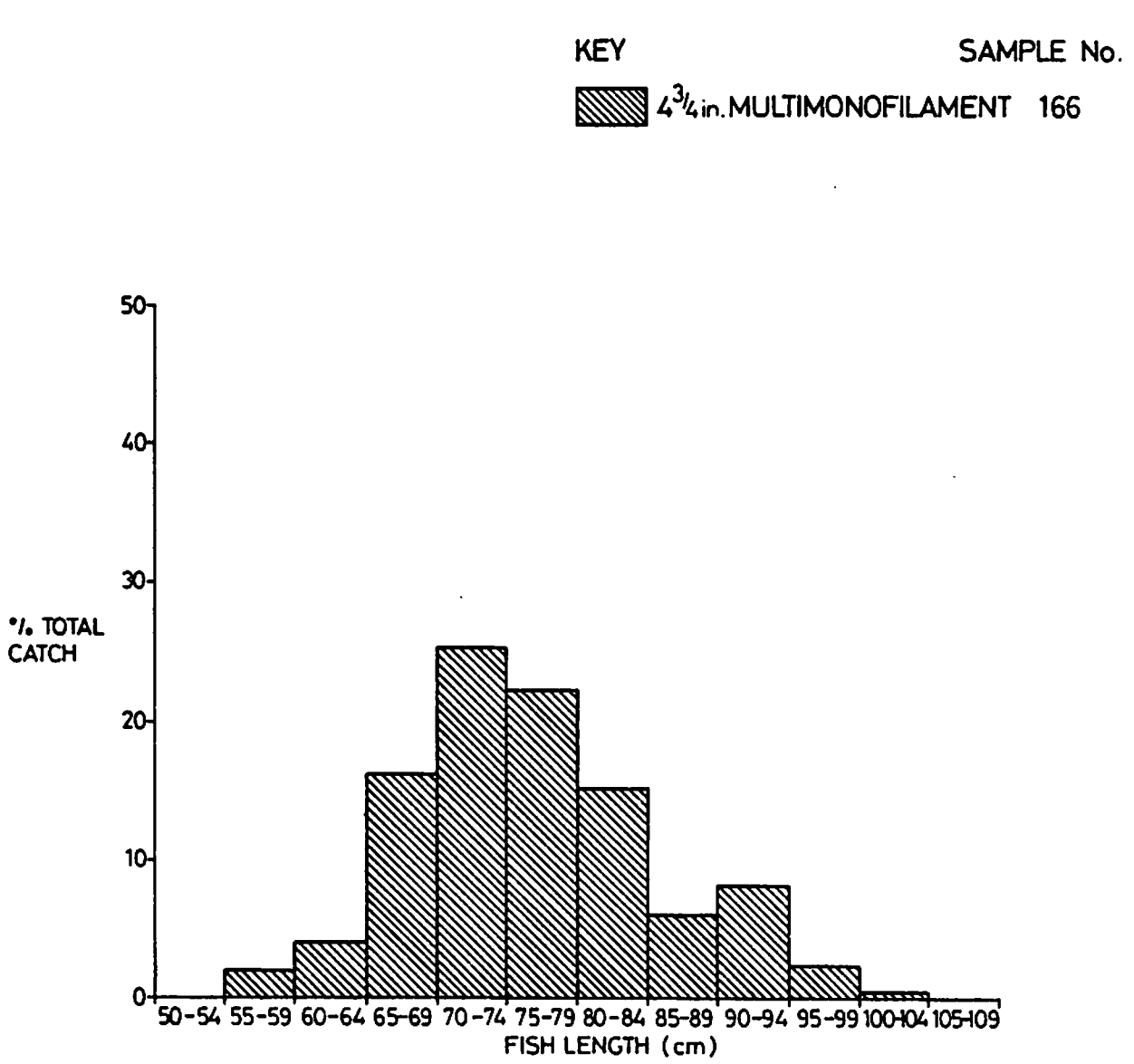


Fig. 7 LENGTH FREQUENCY BY MESH SIZE - HAKE

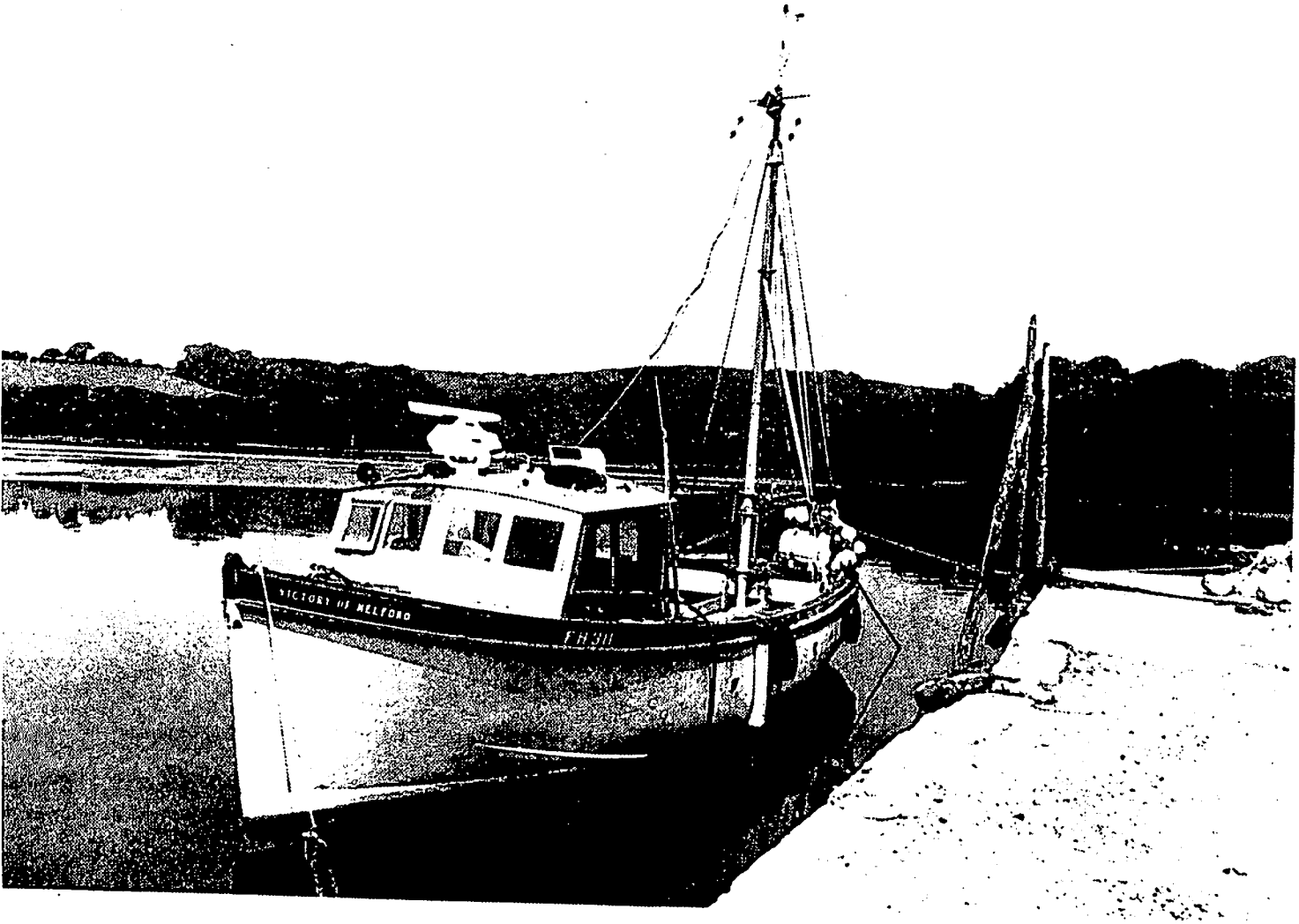


FIG 1 MFV VICTORY OF HELFORD

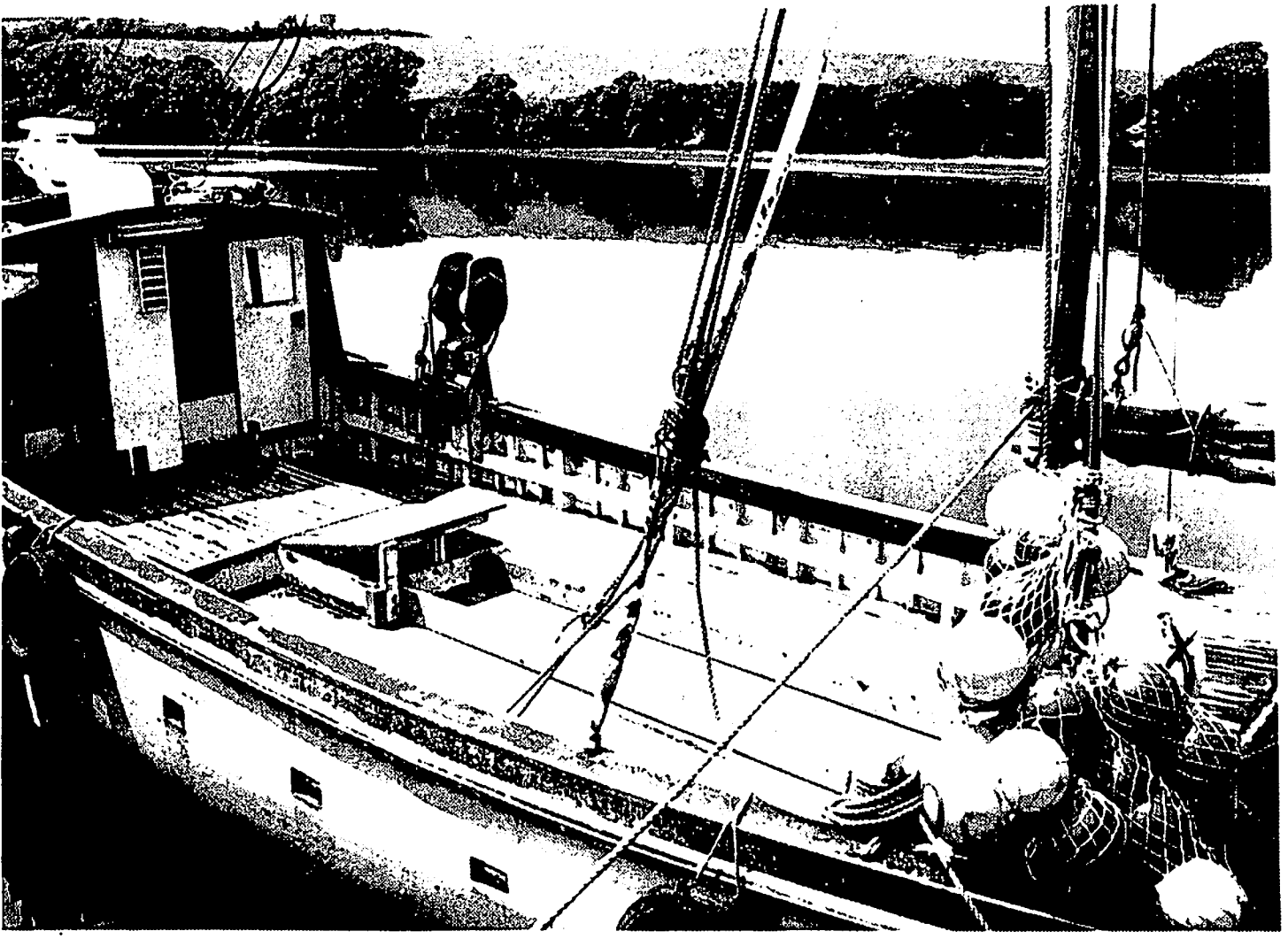


FIG 2 MFV VICTORY OF HELFORD

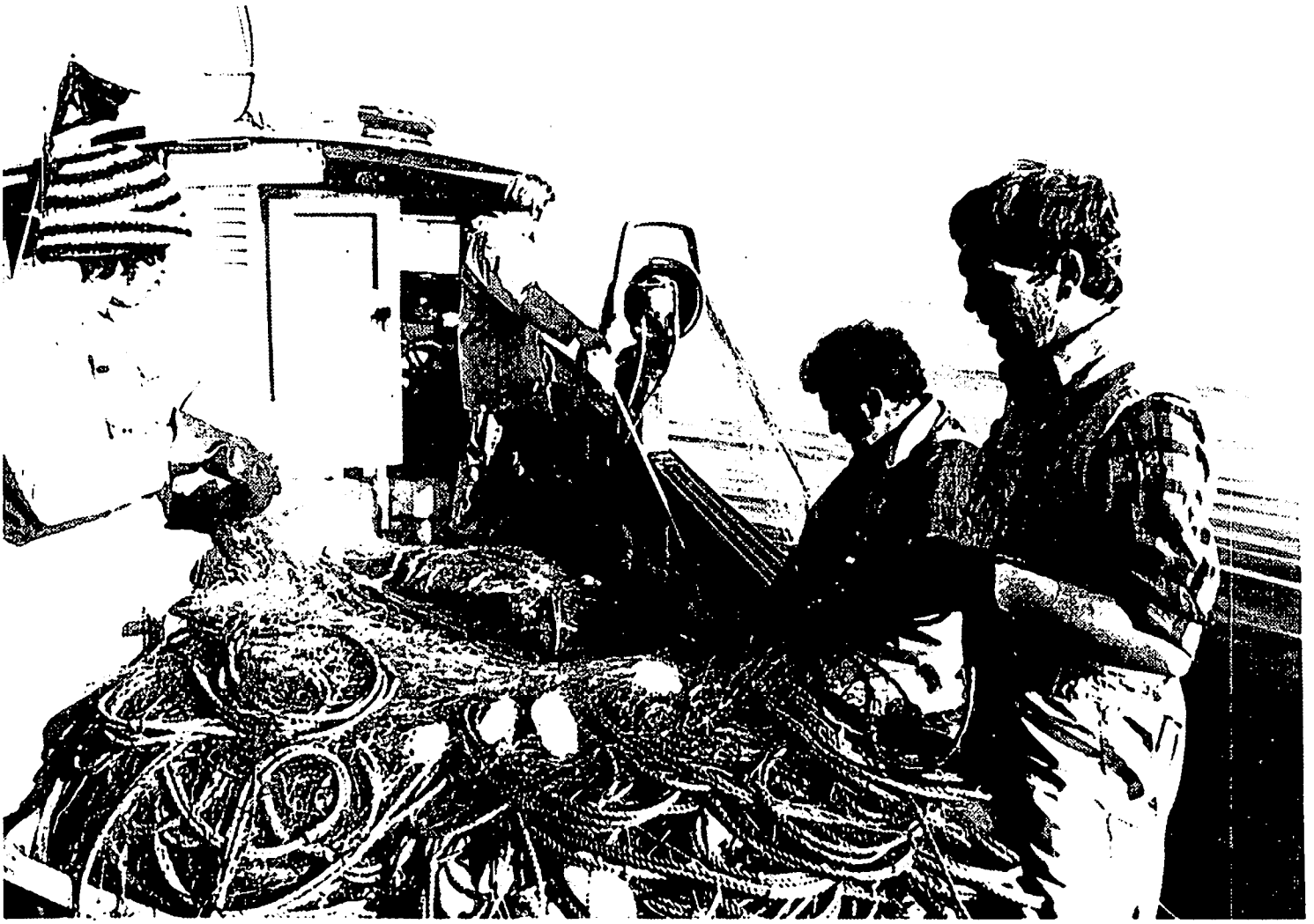


FIG 4 HAULING PROCEDURE

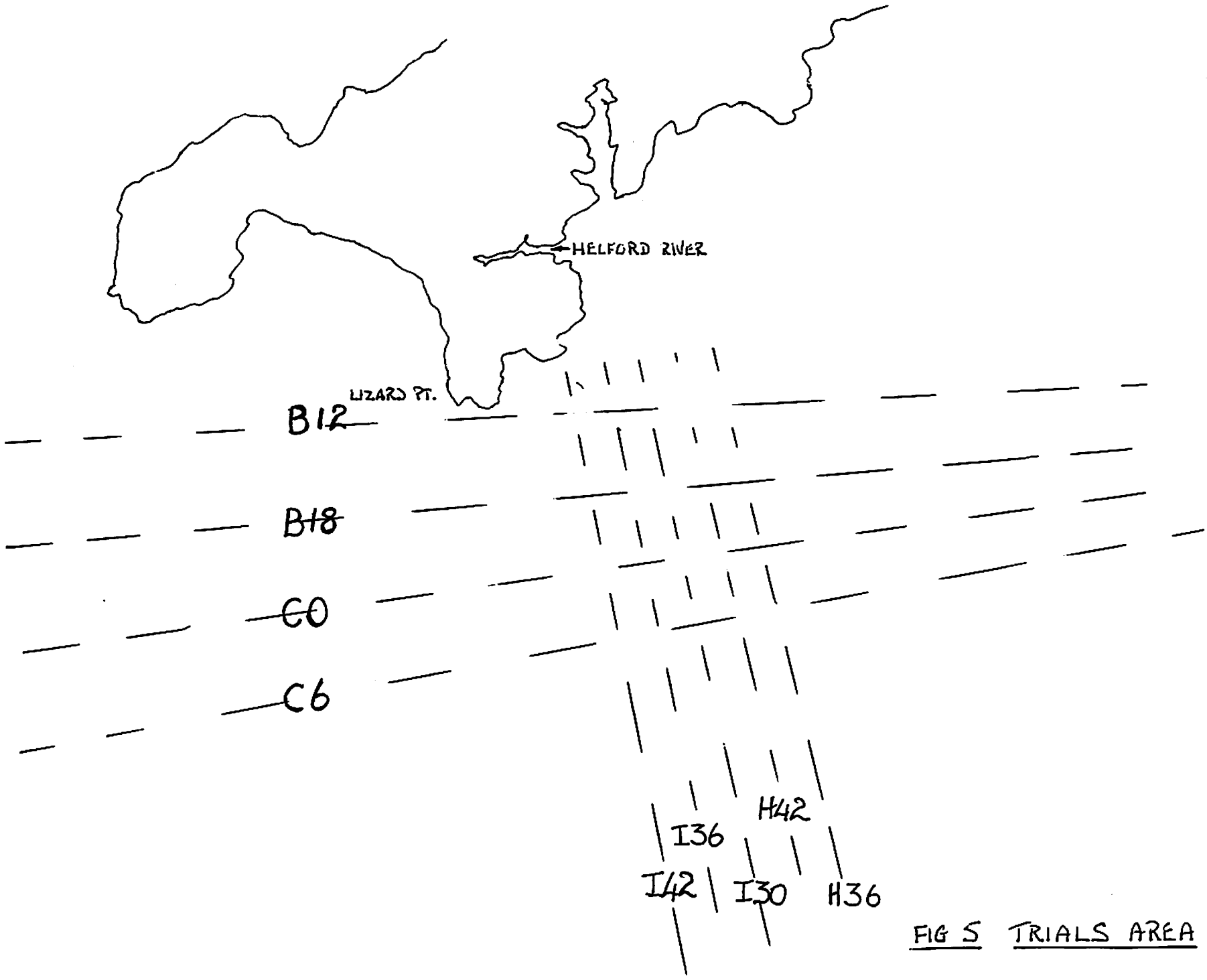
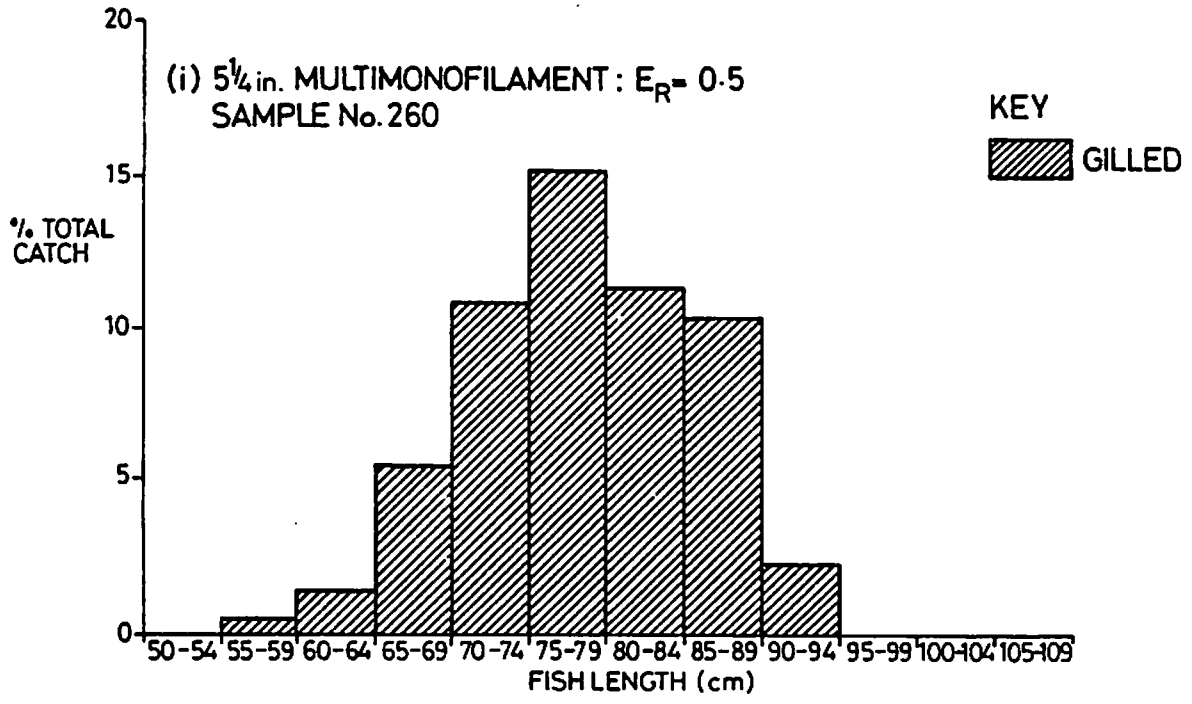
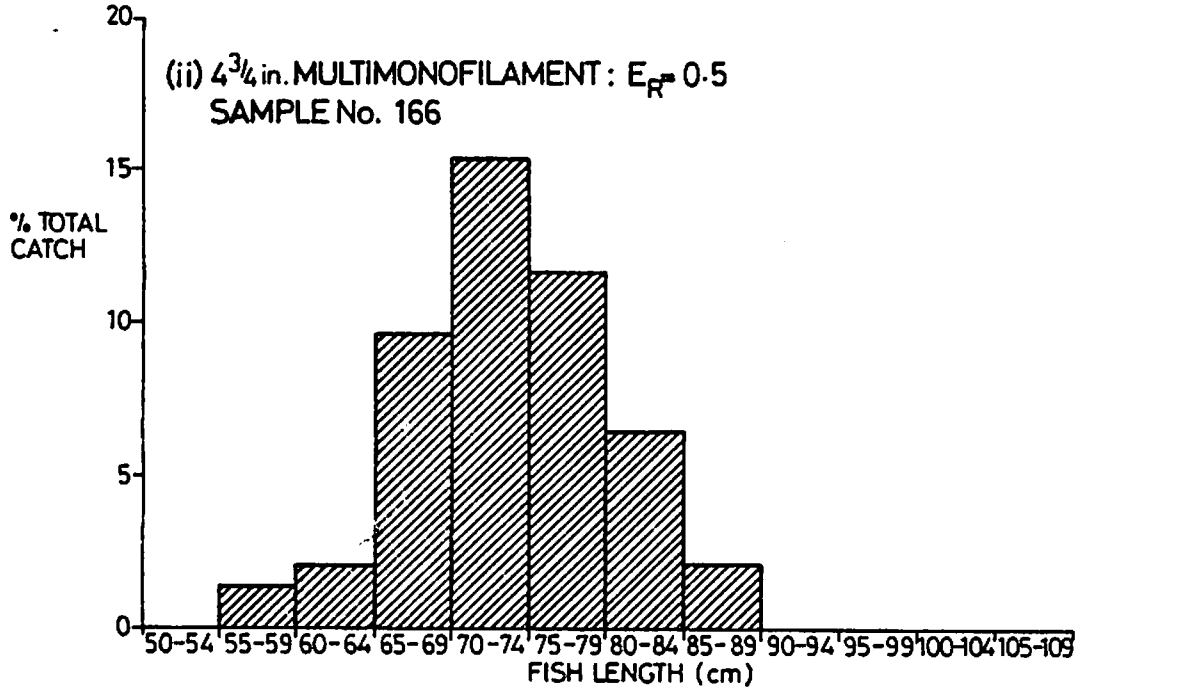


FIG 5 TRIALS AREA





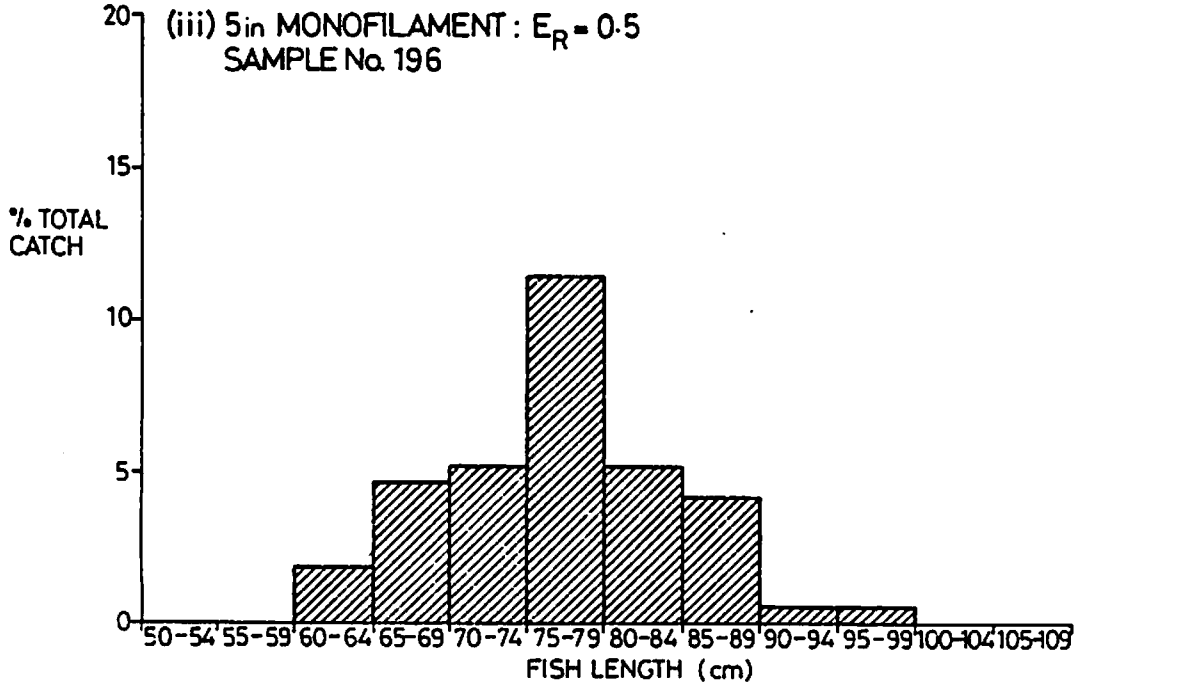
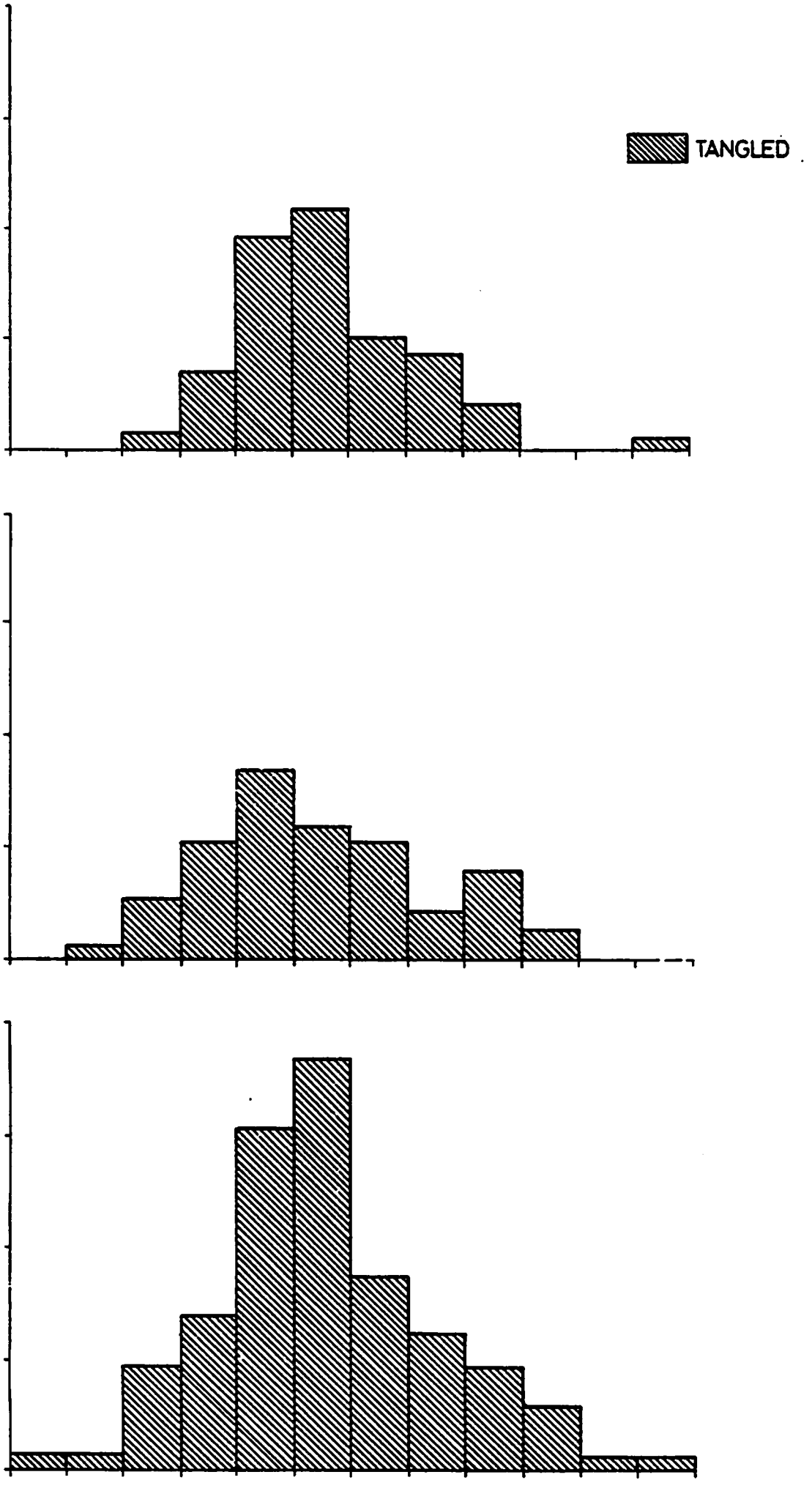


Fig. 6 LENGTH FREQUENCY BY METHOD OF ATTACHMENT - HAKE


TANGLED

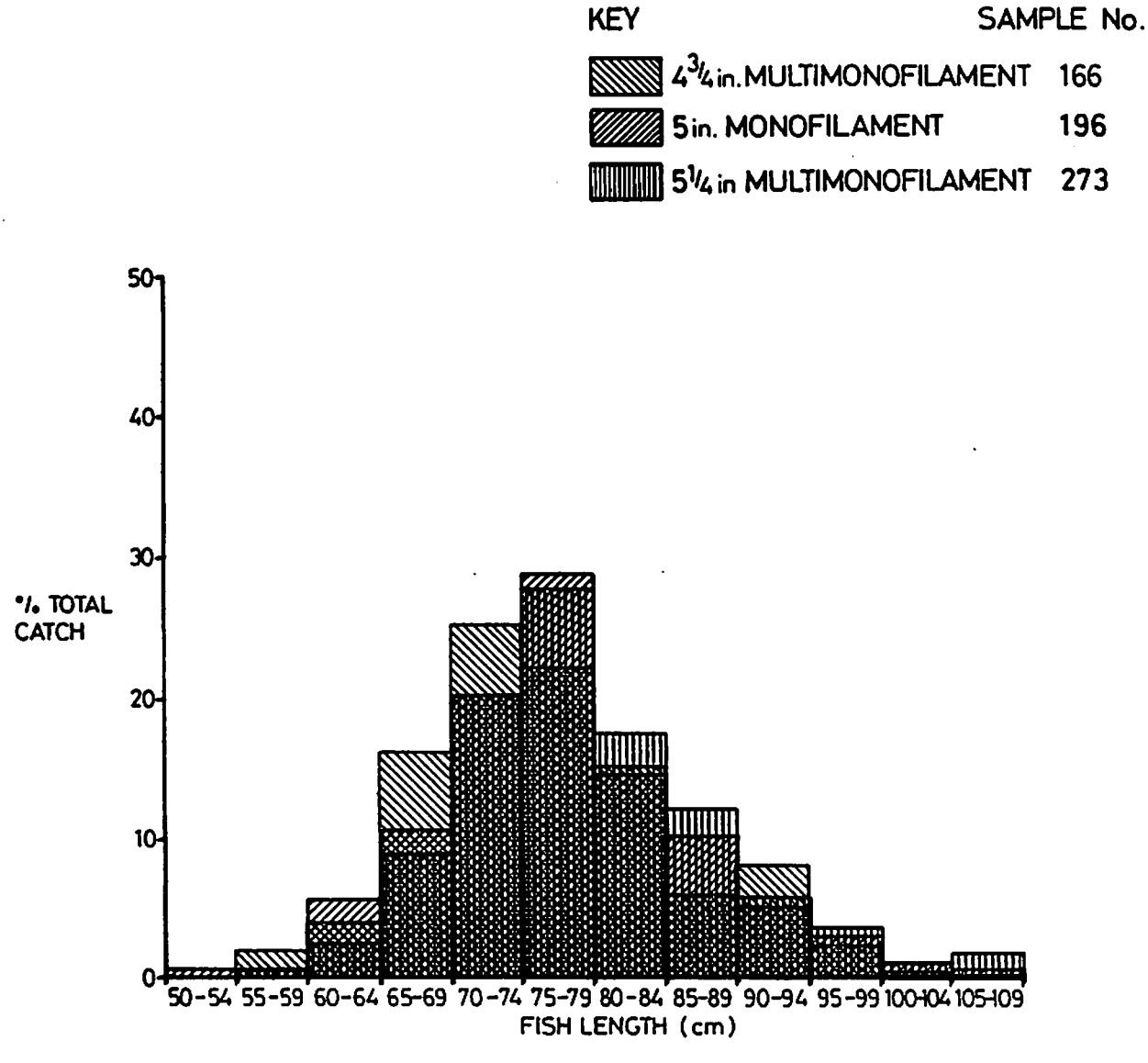


Fig. 7 LENGTH FREQUENCY BY MESH SIZE - HAKE

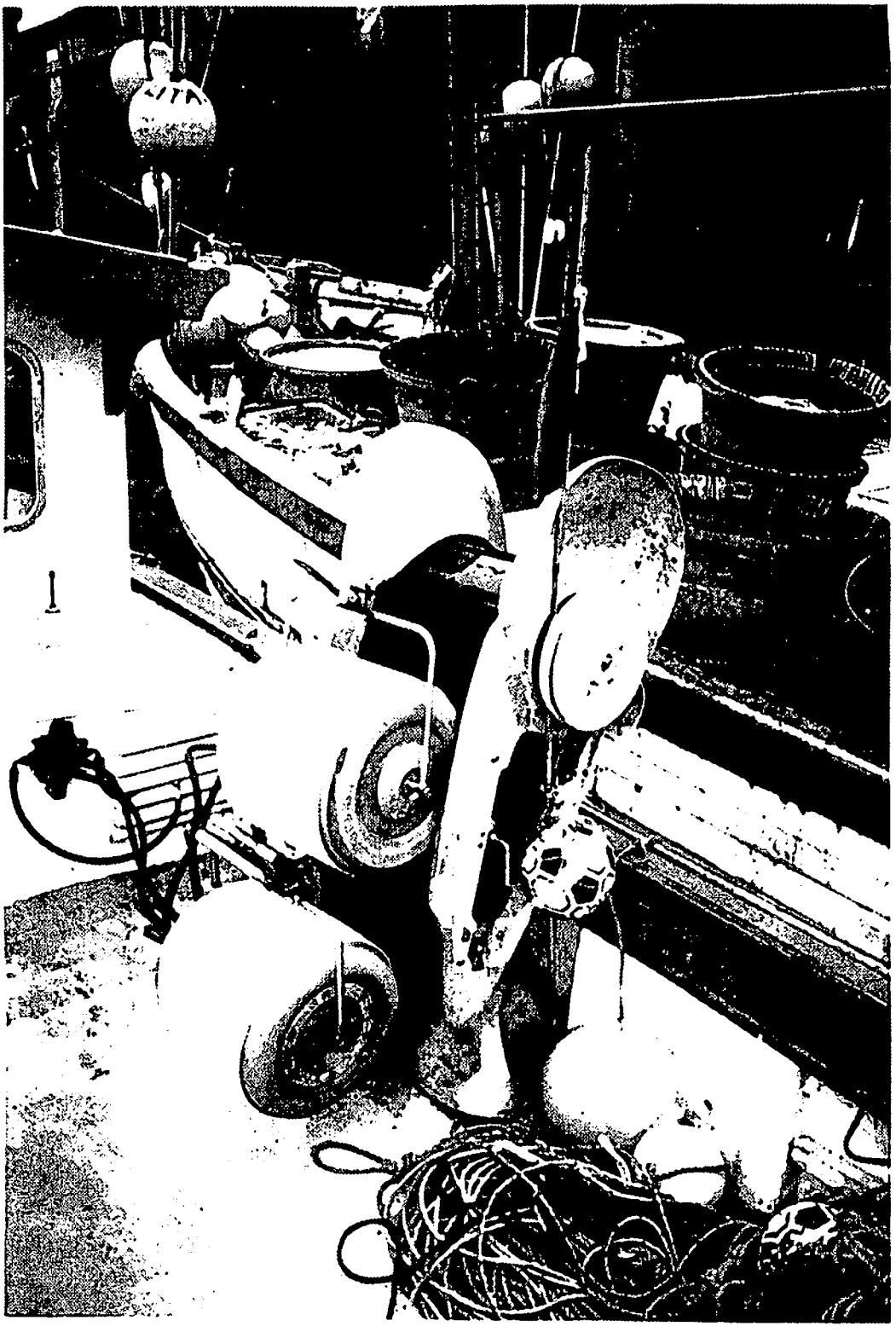
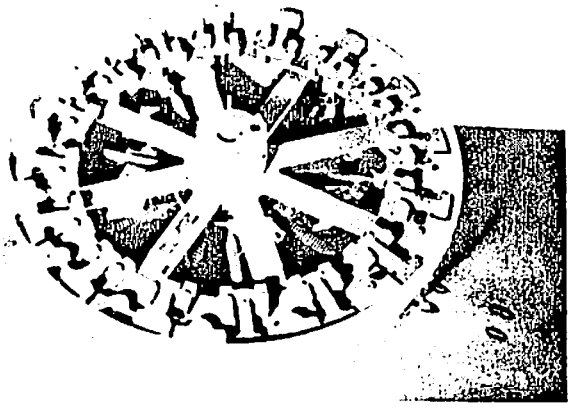
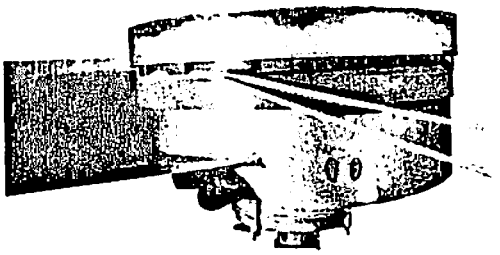


FIG 9. CONVEYOR-TYPE HAULER



TOP VIEW OF HEAD
Shows simple workings of
head mechanism.



SIDE VIEW OF NET LIFTER
Shows head and pan ready for
operation.

FIG 10. CROSSLEY HAULER

FIG 11. HOME-MADE HAULER — HELFORD