International Council for the Exploration of the Sea

ICES CM 1986/B:12
Fish Capture Committee
Ref: Shellfish Committee

Sess V: Gear Selectivity

SQUARE AND DIAMOND MESH TRAWL CODEND SELECTION TRIALS ON NEPHROPS NORVEGICUS (L)

by

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INTRODUCTION

The Marine Laboratory has been conducting selection experiments using square mesh in the codends of trawl nets. Square mesh can release more juvenile roundfish than traditional diamond mesh (Robertson, 1983; 1984; Robertson and Stewart, 1986). The effect of square mesh on other species including Nephrops norvegicus is being investigated. This report describes initial results on the selection characteristics of 65 mm diamond and 57 mm and 67.6 mm square mesh codends for Nephrops norvegicus. The covered codend technique was used.

MATERIALS AND METHODS

The research vessel "Aora" owned by Marine Biological Station, Millport, conducted nine tows during November 1984 and 14 tows in February 1985 in the Clyde, mainly to the north, west and south of the island of Cumbrae on commercial fishing grounds. The test codends were attached to a typical commercial dual purpose trawl of 25.8 m headline length with a upper wing mesh size of 120 mm, lower wing 60.7 mm, belly 61 mm and lower extension mesh size of 64 mm, as measured with an ICES gauge of 4 kg tension.

The trawl rig consisted of 1.8 m long vee otterboards with a single 3 m backstrop leading into double 36.6 m wire bridles. Rubber discs of 50 mm diameter were reeved hard packed onto the last 18.3 m of the lower bridles. In addition there was a 1.8 m chain extension between the lower bridle and wing end.

Comparisons were made between a 65 mm diamond and 67.5 mm square mesh codend during November and 65 mm diamond, 67.5 mm and 57 mm square mesh codends during February 1985. Codend length was 6.1 m with 120 meshes on the join round of the 65 mm diamond cases and 120 bars in the 67.6 mm and 57 mm square cases. Netting material was single twisted polyethylene of 400 m/kg runnage.

Nephrops population estimates were made using a small mesh codend cover (25.6 mm mesh twisted polyethylene twine 580 m/kg) over the codend to capture the escaping animals. The cover length was 9.2 m and the codend was hanging freely inside with no internal attachments to the cover. Both codend and cover were attached to the trawl at the same join round. The cover netting was approximately one and a half times the width of the test codend to minimise masking as recommended by Pope et al., (1975) and Stewart and Robertson (1985).

Regular mesh measurements were taken on each codend and the cover with an ICES gauge. Between 150 and 200 wet meshes were measured randomly along the codend in the top and lower panel immediately after a haul. All the codends were measured twice throughout the experiments. The average measurements thus derived are quoted in the report.

All of the Nephrops from the codend and cover were measured at the end of each haul and carapace length is recorded in the report.

Data Analysis Procedure

An appropriate method of analysis for data from codend mesh selection experiments is the fitting of a selection curve. The logistic curve is used in this analysis using the logit transformation on the proportions of fish retained at each length to fit a straight line by normal linear regression methods, and obtain estimates of the parameters of the curve. An iterative procedure using the expected logits, and suitable weights, gives corrections to these parameters, leading to maximum likelihood estimates of the parameters of the curve. When these parameters are established 50% points, selection ranges and selection factors can be calculated, which are then used as the basis for comparison of mesh selection.

Selection curves were drawn for each haul. Eight valid hauls were obtained in November and 13 in February. Two hauls (one from November and one from February) were not used in the analysis due to possible severe masking of the codend meshes by the cover and/or deficient numbers of animals, gear or codend cover damage.

RESULTS

The data collected during November and February have been presented in separate selection curves mainly because on all the November hauls large quantities of Laminaria weed were collected. Internal masking of the codend meshes by the weed may have occurred (see Discussion).

The selection curves for each codend are contained in Figures 1 and 2 for the November cruise and 3, 4 and 5 for the February cruises. Combined length/frequency distributions of animals retained by each codend for the November and February cruises may be found in Figures 6 and 7 respectively. The valid hauls for each codend were combined to give a single selection curve for each mesh size (Fig. 8 for November and Fig. 9 for February).

A summary of the selection features for each codend are as follows:

Mesh type	Mesh size (mm)	Month	No of combined hauls	50% length (mm)	Selection Factor	Selection Range (mm)	Percentage Nephrops retained in codend
Diamond	65	Nov	4	17.1	2.64	17.1	84
Square	67.6	Nov	4	39.3	5.82	19.0	40
Diamond	65	Feb	3	20.2	3.11	16.8	77
Square	67.6	Feb	4	26.3	3.88	50.6	54
Square	57	Feb	6	29.7	5.21	12.1	59

DISCUSSION

The Feburary 50% retention length of 20.2 mm for the 65 mm diamond mesh compares well with the figure of 21.1 mm for 65 mm mesh determined by Bennett (1984) and quoted in Briggs (1984). Hillis and Earley (1982) give a 50% figure of 22 mm for 70 mm mesh and again this falls reasonably close to the February data presented in this report.

If internal masking of the November codends did occur because of the catches of weed, then one would expect the 50% length for the November data to be lower than the February data which was weed free. This is indeed the case for the 65 mm diamond mesh but not for the 67.6 mm square mesh. This anomaly may be related to the fact that masking of the February 67.6 mm square mesh codend by the small mesh cover is thought to have occurred when quantities of shells were caught particularly in hauls 4, 5 and 6. The heavy codend may have sagged onto the small mesh cover, thus blocking the codend meshes for escape. It is therefore impossible to quantify the possible unpredictable effects that the catch of weed may have had on the November data.

It is felt that a truer measure of selection could be accomplished without covers by a direct alternate haul comparison of Nephrops catches from the codends or better still by comparing the two codends on a twin trawl.

Although a minimum number of hauls were achieved for all the codends it would seem that the 57 mm square mesh codend has better selection characteristics than the other diamond and square mesh codends used in this study. The selection ranges for the February 57 mm square and 65 mm diamond are 12.1 mm and 16.8 mm respectively. The 57 mm square mesh has a steeper selection curve giving sharper selection than both the 65 mm diamond and 67.6 mm square mesh. This is illustrated clearly in Figure 9. However, more data is required to verify this result.

Bennett (1985) has outlined the mangement problem in the Irish Sea Nephrops fishery where the permitted Nephrops mesh size is 10 to 15 mm less than that allowed for finfish. He reviewed recent work done by Main and Sangster (1982) on separator trawls which optimise Nephrops exploitation, while minimising finfish by-catches. Bennett postulates the possible use of separator trawls to solve some of the problems in the Irish Sea. Square mesh of 57 mm seems to have better selection characteristics than the present 70 mm diamond mesh on Nephrops. A separator trawl with square mesh in the lower codend to optimise retention of legal sizes of Nephrops whilst minimising discards and in the top codend a square or diamond mesh size that would retain a marketable fish by-catch, may give a better solution to the problem than by using diamond mesh codends with separator trawls.

Alternatively a horizontally divided square mesh codend could be used by itself. This would be less expensive to commercial fishermen than a full length separator panel that can require one third extra netting than the whole trawl. Such a codend could have square mesh in its lower part for Nephrops and a larger mesh size in the top part appropriate for the selection of marketable whiting and haddock. Various partly successful attempts to separate whiting and haddock from Nephrops in codends have been made, Symonds and Simpson (1971), Ferris (1970), Hillis (1983; 1984). The front aperture of square mesh codends can be designed to be bigger than diamond mesh codends, Robertson (1986). There could therefore be more room for separation which may improve the results obtained by these workers. However, cod is a particular problem where separation is less precise.

ACKNOWLEDGEMENTS

We thank Mick Parker and the crew of "Aora" for the excellent job they did in handling the gear and Jim Atkinson for organisational aid.

REFERENCES

Bennett, D.B. (1984). A review of Irish Sea Nephrops mesh selection. ICES CM 1984/K:5, Shellfish Committee.

Bennett, D.B. (1985). The problems of small mesh Nephrops trawls in the Irish Sea - are separator trawls the answer? ICES CM 1985/K:38, Shellfish Committee.

Briggs, R.P. (1984). A review of Nephrops mesh selection. ICES CM 1984/K:39, Shellfish Committee.

Ferris, G.D. (1970). Interim report on double storey codend Nephrops experiment. N Ireland, MS.

Hillis, J.P. and Early, J.J. (1982). Selectivity in the Nephrops trawl. ICES CM 1982/B:19, Fish Capture Committee.

Hillis, J.P. (1983). Experiments with a double codend Nephrops trawl. ICES CM 1983/B:29, Fish Capture Committee.

Hillis, J.P. (1984). Further experiments with a double codend Nephrops trawl. ICES CM 1984/K:36, Shellfish Committee.

Main, J. and Sangster, G.I. (1982). A study of separating fish from Nephrops norvegicus L. in a bottom trawl. Scottish Fisheries Research report number 24.

Pope, J.A., Margetts, A.R., Hamley, J.M. and Akyuz, E.F (1975). Manual of methods for fish stock assessment. Part III selectivity of fishing gear. FAO Fisheries Technical Paper, No. 41 Revision 1.

Robertson, J.H.B. (1983). Square mesh codend selectivity experiments on whiting (Merlangius merlangus (L) and haddock (Melanogrammus aeglefinus (L)). ICES CM 1983/B:25, Fish Capture Committee.

Robertson, J.H.B. (1984). Square mesh codend selectivity for haddock (Melanogrammus aeglefinus (L)) and whiting (Merlangius merlangus (L)) in a Scottish seine net. ICES CM 1984/B:30, Fish Capture Committee.

Robertson, J.H.B. (1986). The design and construction of square mesh codends. Scottish Fisheries Information Pamphlet, Number 12 (in press).

Robertson, J.H.B. and Stewart, P.A.M. (1986). An analysis of length selection data from comparative fishing experiments on haddock and whiting with square and diamond mesh codends. Scottish Fisheries Working Paper No 9, 1986.

Stewart, P.A.M. and Robertson, J.H.B. (1985). Small mesh codend covers. Scottish Fisheries Research Report Number 32.

Symonds, D.J. and Simpson, A.C. (1971). Preliminary report on a specially designed Nephrops trawl for releasing undersized roundfish. ICES CM 1971/B:6, Gear and Behaviour Committee.

NEPHROPS November 1984
Hauls 1,7,8,9
65mm diamond mesh

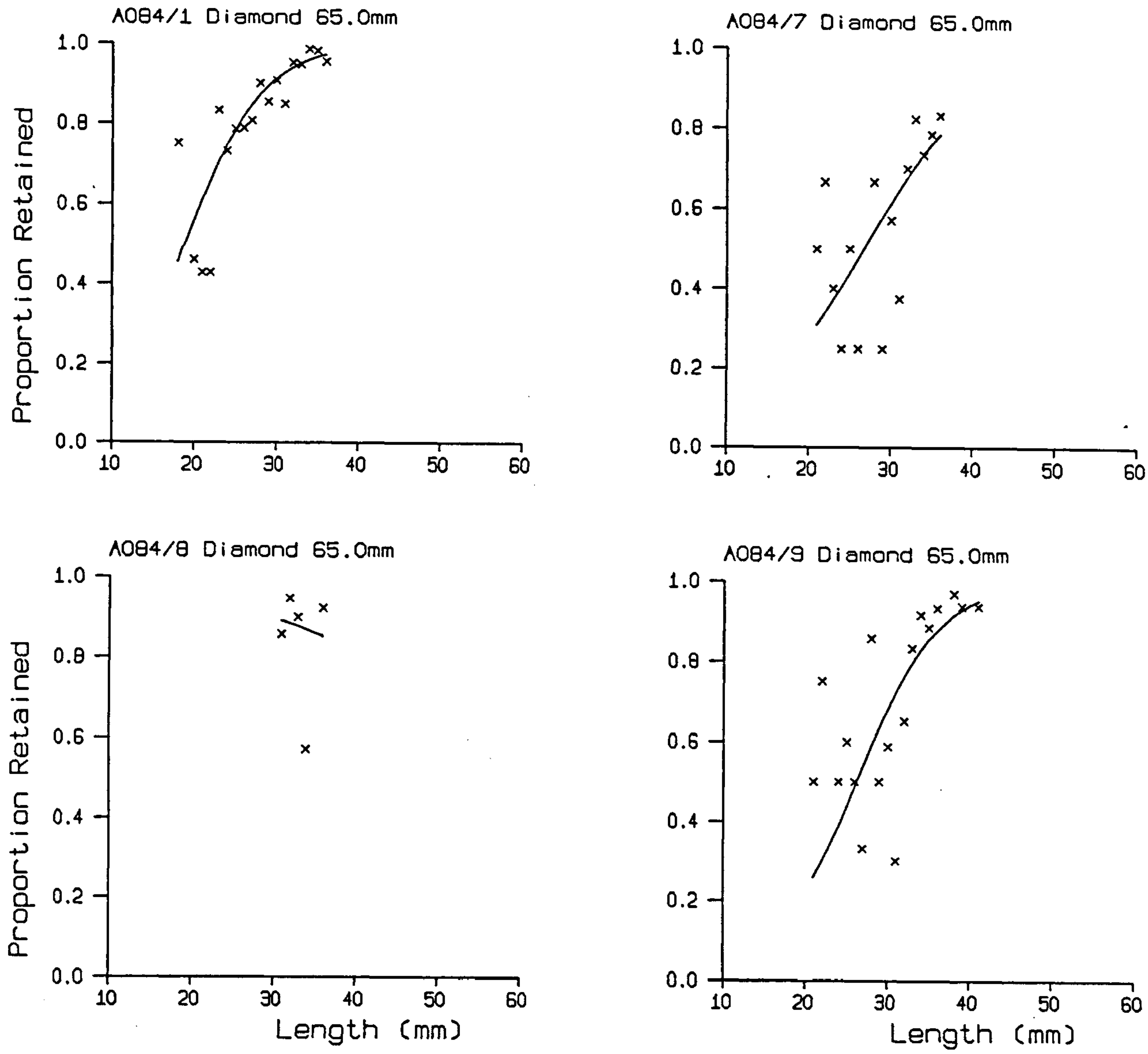


FIG 1

NEPHROPS November 1984
Hauls 2,4,5,6
67.6mm square mesh

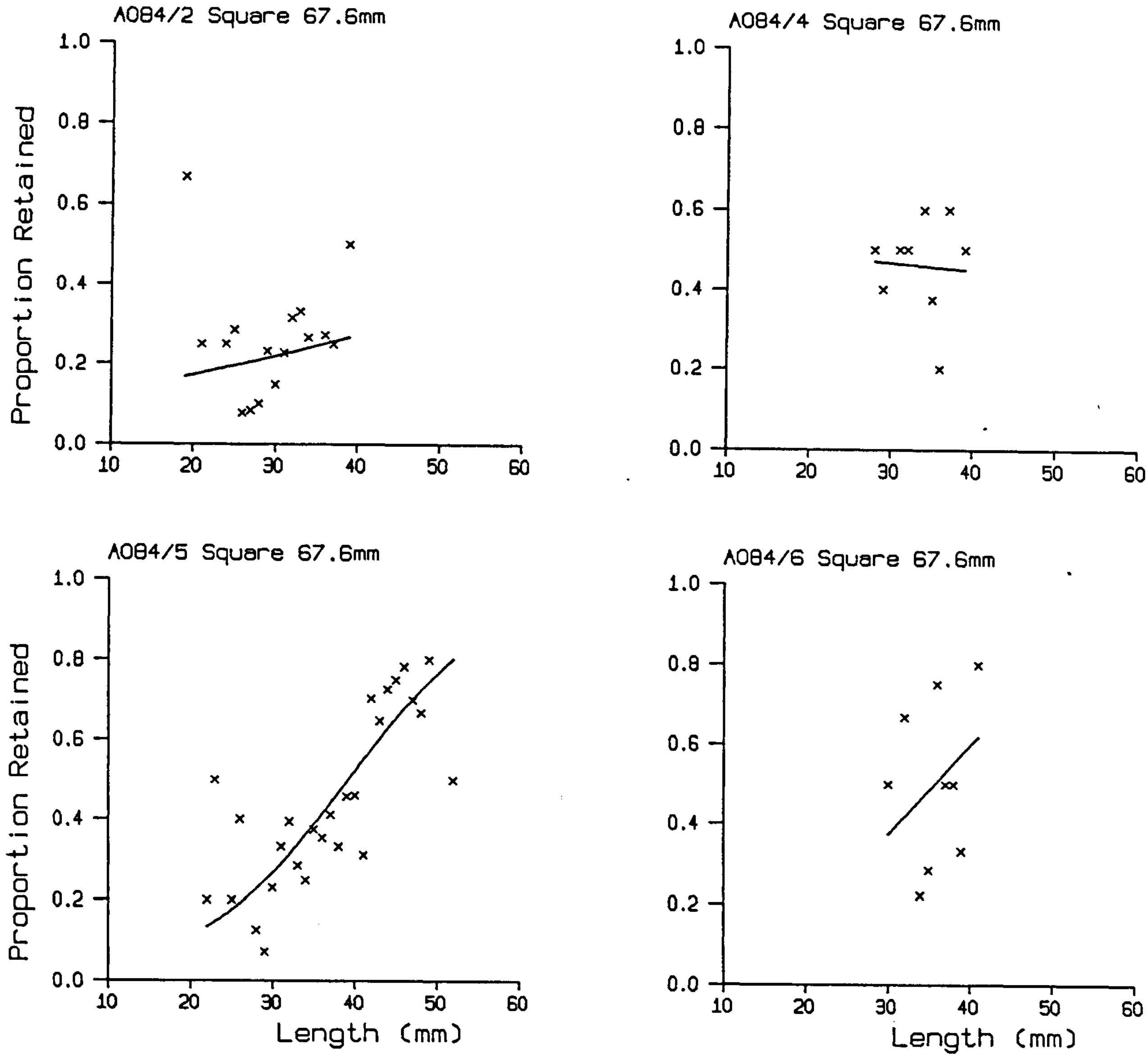


FIG 2

NEPHROPS February 1985
Hauls 1,2,14
65mm diamond mesh

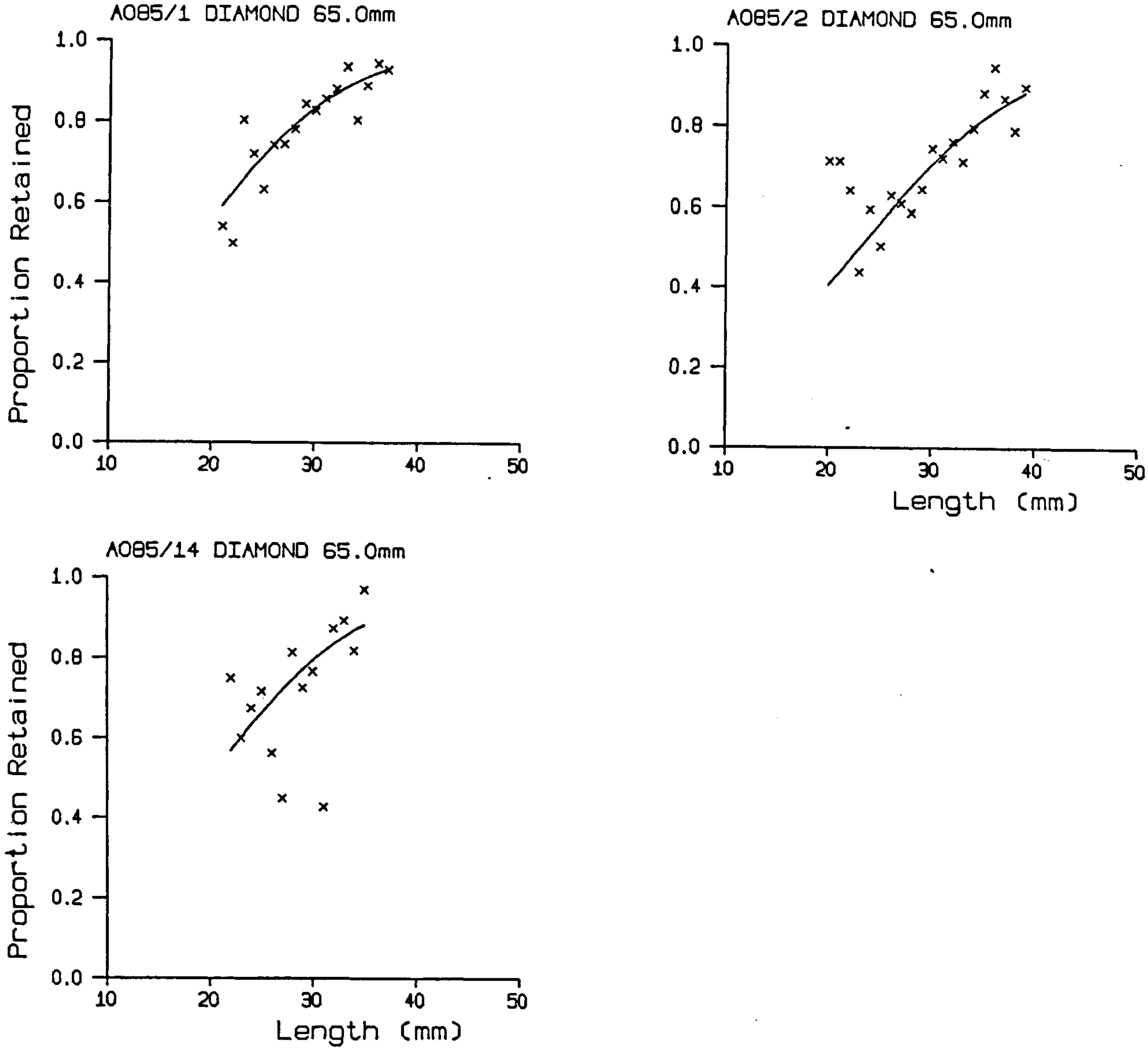


FIG 3

NEPHROPS February 1985
Hauls 3,4,5,6
67.6mm square mesh

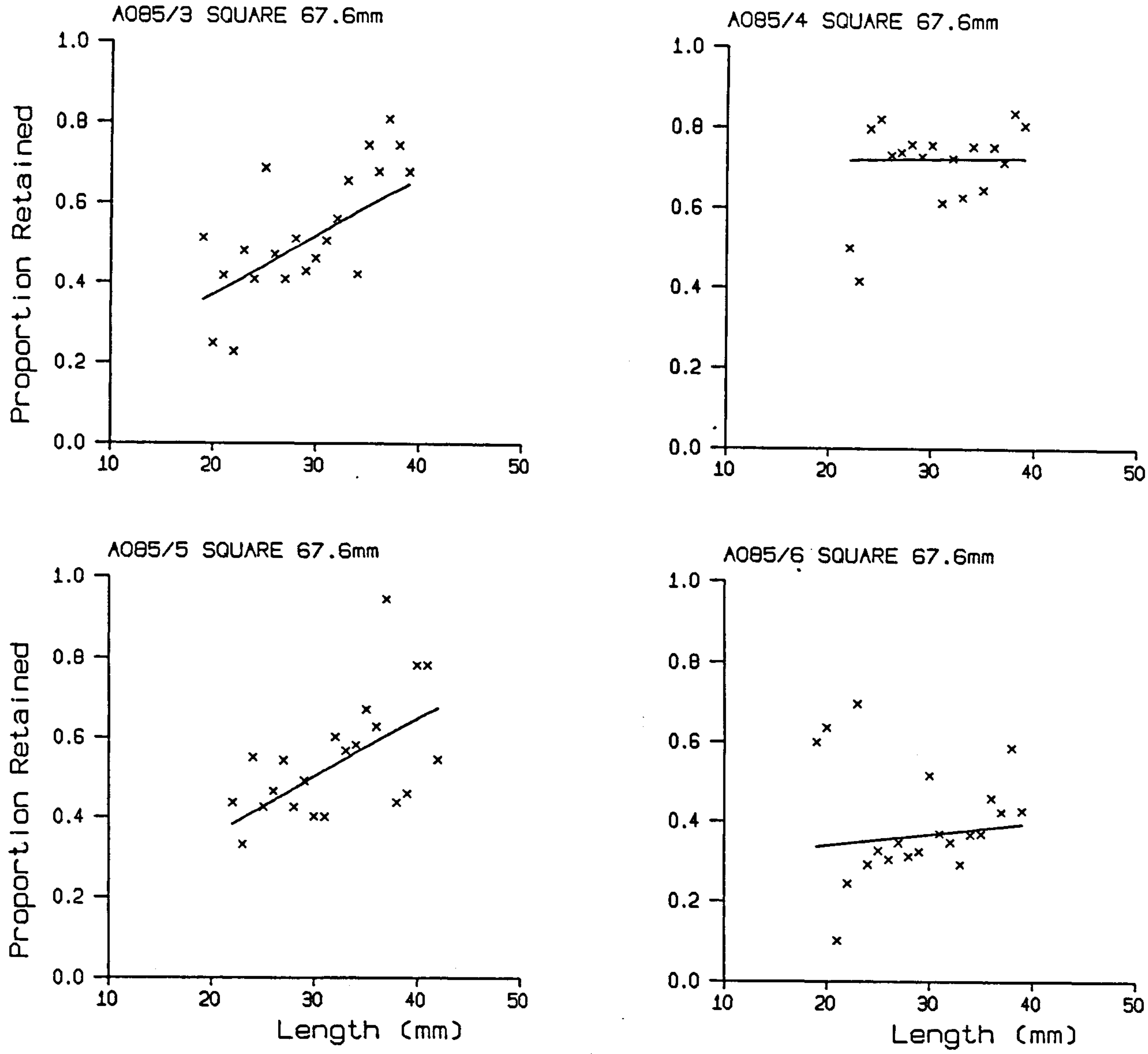


FIG 4

NEPHROPS February 1985
Hauls 7,8,9,10,11,12
57mm square mesh

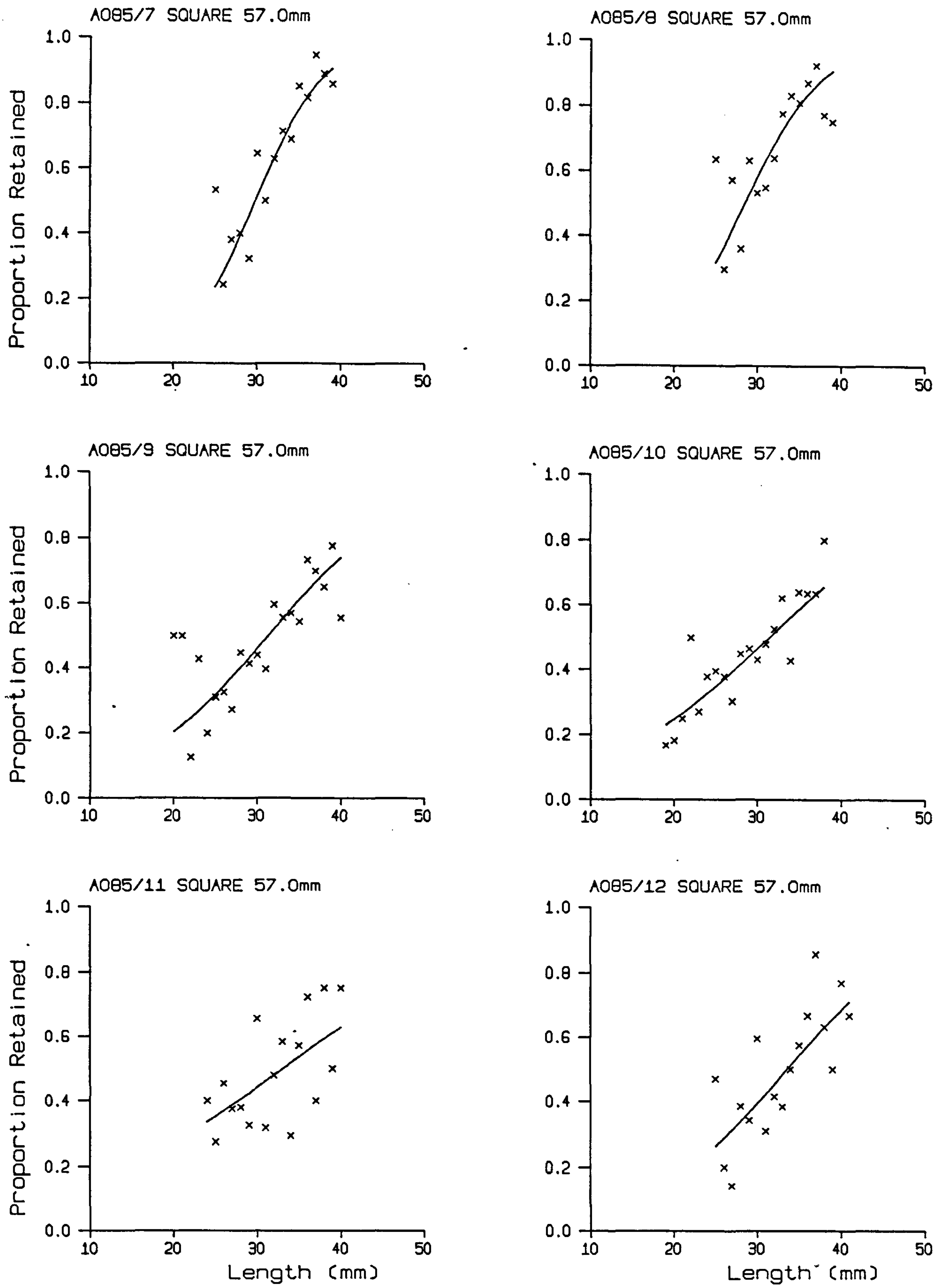
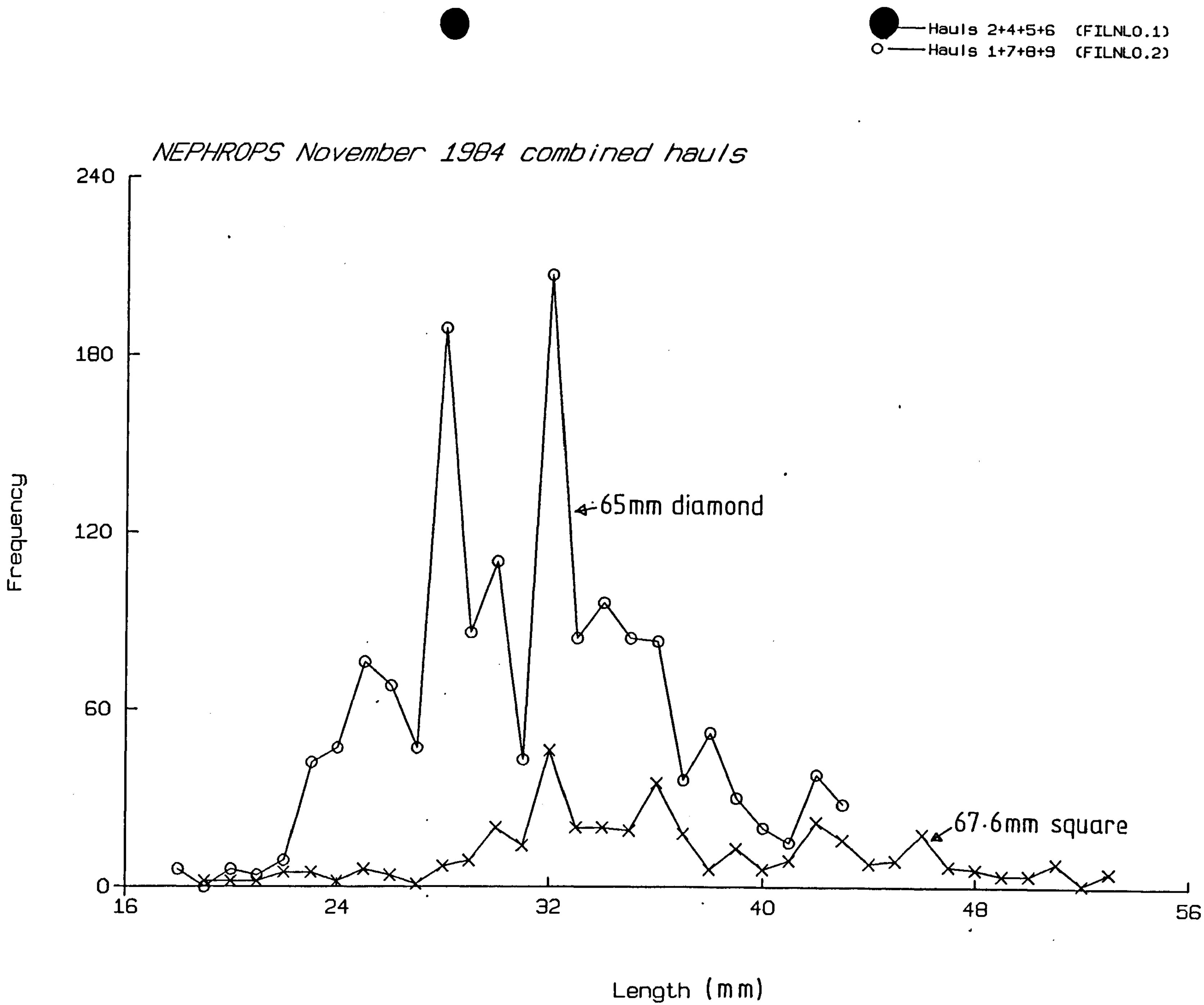


FIG 5



Hauls 2+4+5+6 (FILNLO.1)
Hauls 1+7+8+9 (FILNLO.2)
NEPHROPS November 1984 combined hauls
240
180
120
60
0
Frequency
65mm diamond
67.6mm square
16
24
32
40
48
56
Length (mm)

FIG 6

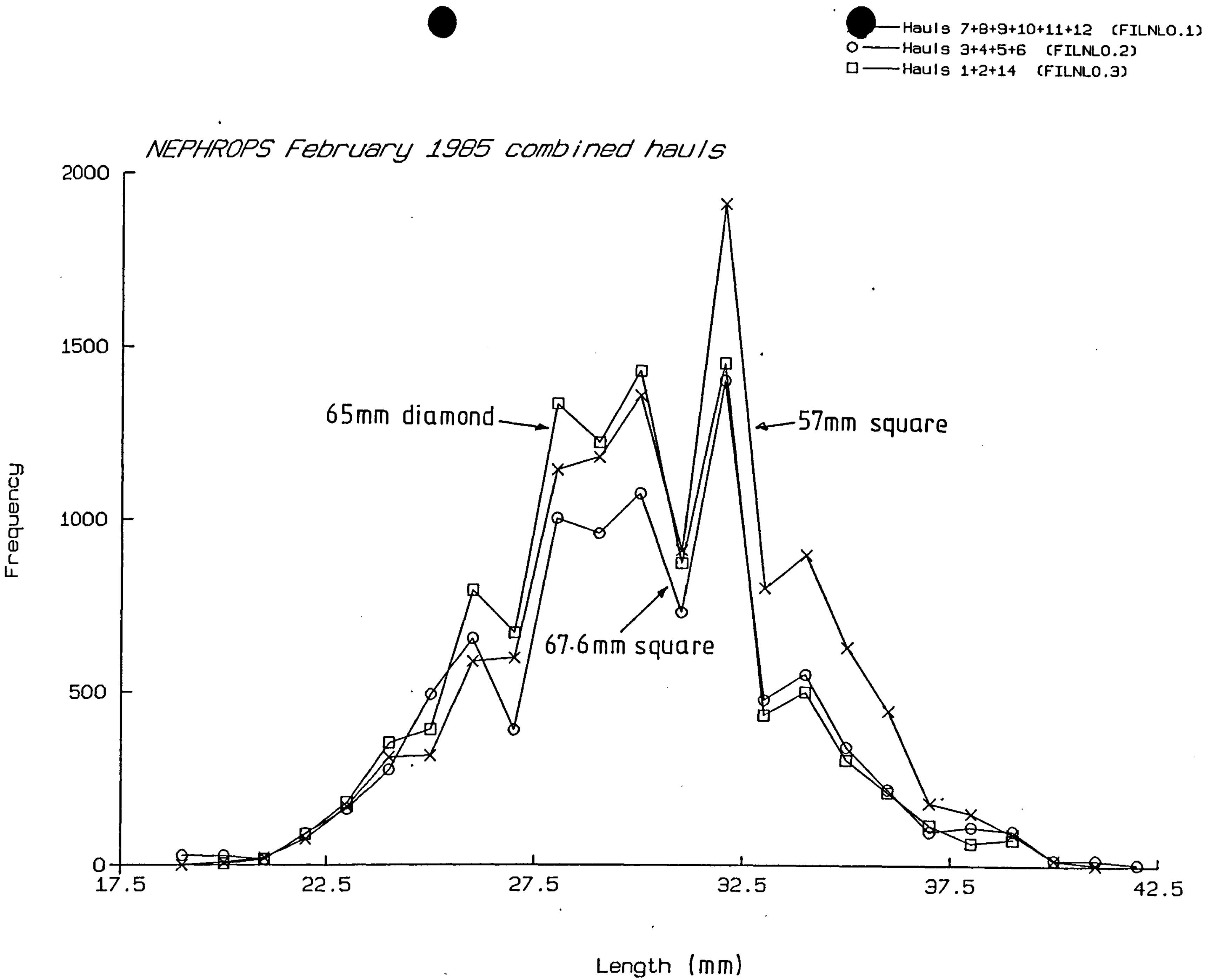
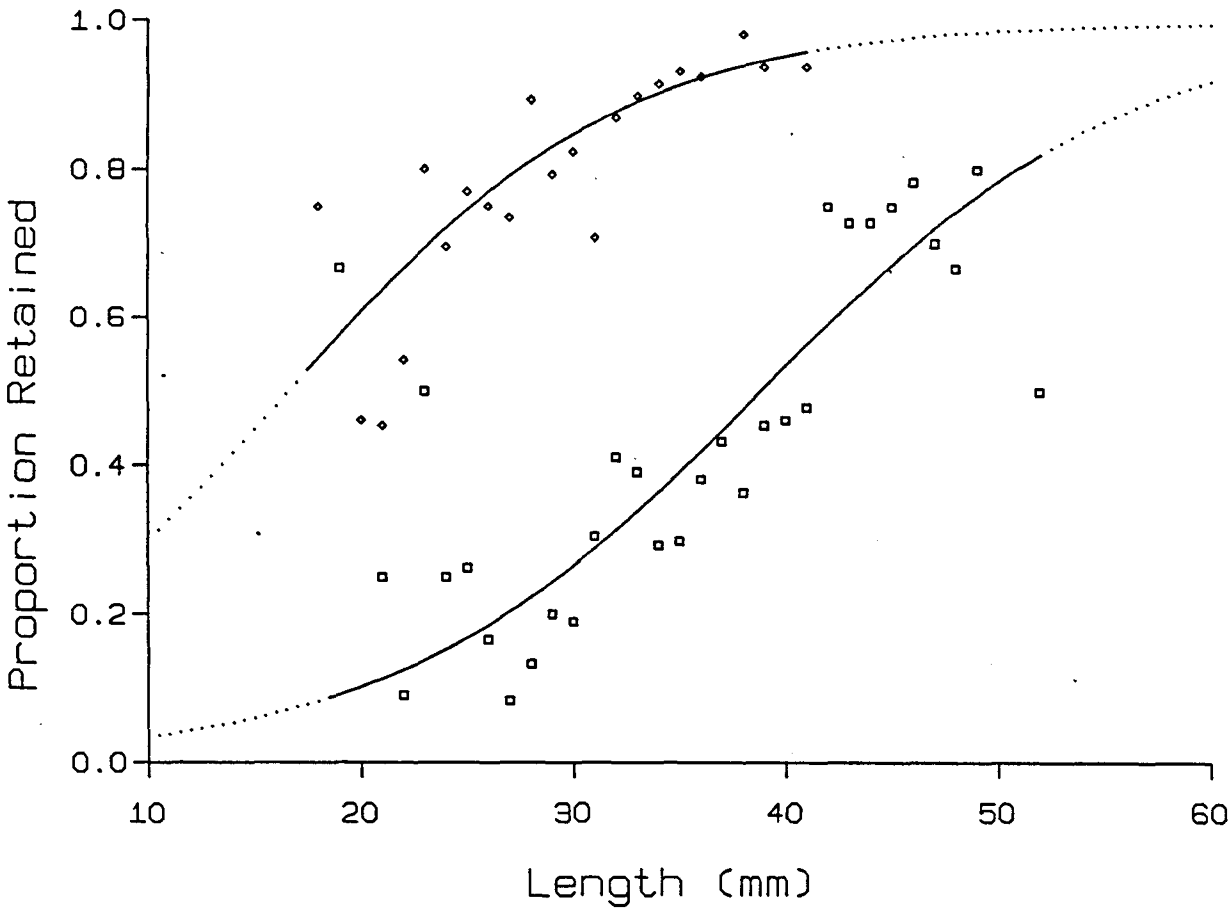

Hauls 7+8+9+10+11+12 (FILNLO.1)
Hauls 3+4+5+6 (FILNLO.2)
Hauls 1+2+14 (FILNLO.3)
NEPHROPS February 1985 combined hauls
65mm diamond
57mm square
67.6mm square
Frequency
Length (mm)
2000
1500
1000
500
0
17.5
22.5
27.5
32.5
37.5
42.5

FIG 7

NEPHROPS November 1984

Combined hauls

Square and diamond mesh



Haul	C.E.Mesh Size (mm)	50% Length (mm)	Selection Factor	Selection Range mm	Total No. Cod End	Total No. Cover	No. in S.R. Cod End	No. in S.R. Cover
□	67.60	39.3 ± 0.82	5.82	19.0	286	435	249	334
◇	65.00	17.1 ± 1.56	2.64	17.1	1553	286	138	65

□ Hauls 2+4+5+6 67.6mm square mesh

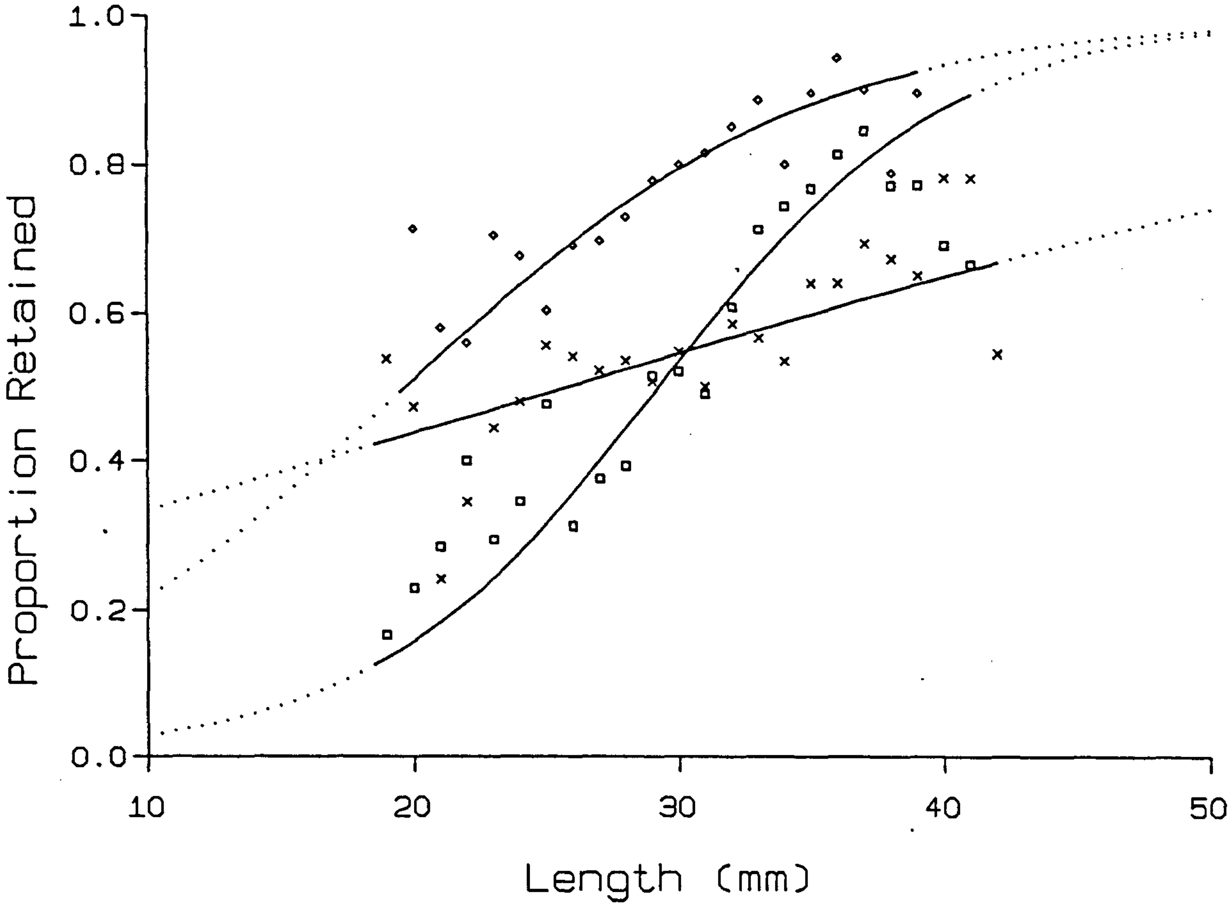
◇ Hauls 1+7+8+9 65mm diamond mesh

FIG 8

NEPHROPS February 1985

Combined hauls

Square and diamond mesh



Haul	C.E.Mesh Size (mm)	50% Length (mm)	Selection Factor	Selection Range mm	Total No. Cod End	Total No. Cover	No. in S.R. Cod End	No. in S.R. Cover
□	57.00	29.7 ± 0.15	5.21	12.1	4785	3296	3833	2999
×	67.60	26.3 ± 0.52	3.88	50.6	9250	7800	9244	7795
◇	65.00	20.2 ± 0.55	3.11	16.8	7448	2244	1936	944

□ Hauls 7+8+9+10+11+12 — 57mm square mesh

× Hauls 3+4+5+6 — 67.6mm square mesh

◇ Hauls 1+2+14 — 65mm diamond mesh

FIG 9