

**Improvement of Selectivity  
of Trawl Codends Comparison  
of the Selectivity of Standard  
Diamond Mesh Codends in  
Three Different Mesh Sizes  
(100, 110 and 120mm)**

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**Seafish Report No.421**

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**May 1993**

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# **Sea Fish Industry Authority**

**Technology Division**



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**Seafish Report No. 421  
MAFF R&D Commission 1992/93  
Project Code MF0601**

**K. Arkley  
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#### **Summary**

This report describes trials by Seafish Technology into the selective characteristics of codends of three different mesh sizes; these were, nominally, 100, 110 and 120mm. The work was undertaken for MAFF's Chief Scientist's Group under their project reference MF0601.

The fishing trials were conducted on a chartered vessel *MFV Heather Sprig*, mainly in the Moray Firth, and targeting haddock, whiting and cod. The experiments used the covered codend technique and also measured essential gear performance parameters by use of a Scanmar package. Selection curves were calculated from the ratio of total fish caught against those only in the codend.

Problems were encountered in two respects. First the numbers of cod caught were very low and little significance can be attributed to that data set. Secondly, very large numbers of small haddock and whiting were encountered and there is a need for some caution in interpreting the data because of this.

The data have only been treated to a limited amount of analysis because the customer is expected to incorporate them into a general codend selectivity model.

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## 1. Introduction

The Sea Fish Industry Authority were commissioned by the Ministry of Agriculture Fisheries and Food to carry out research work under a project entitled "Improvement of Selectivity of Trawl Codends", Project Code MF0601.

Within this project one of the tasks was to obtain selectivity data on larger mesh sizes of diamond mesh codends namely 100mm, 110mm and 120mm. This data was required to update and extend the selectivity model of Armstrong et al (1989)<sup>†</sup>. The model has been used extensively to predict the effect on fish populations by changes to codend mesh sizes, numbers of meshes round the codend and extension lengths. Comprehensive data has been obtained previously by SOAFD Marine Laboratory for mesh sizes up to 90mm for the model. The general requirement now to increase mesh sizes beyond 90mm indicated a requirement to obtain actual data on codend selectivity for these larger mesh sizes. It was thought that simply extrapolating existing data on smaller mesh sizes was not sufficiently accurate.

Selectivity data were therefore gathered for codends of nominal mesh sizes of 100, 110 and 120mm fished in conjunction with a commercial design of fish trawl rigged with a supported codend cover arrangement.

## 2. Fishing Gear

The trawl net used to conduct the selectivity experiments was a rockhopper fish net with a 130ft headline supplied by Harvester Trawls, Peterhead, Scotland. The minimum legal mesh size employed in the construction of this gear is 100mm.

The parallel extension section of the net was constructed with 100mm mesh x 100 meshes giving a length of 10.7m.

All three experimental codends were constructed to be of the same overall length namely 6.1m and constructed in the same materials. Codend circumferences were 120 meshes in total giving 100 open meshes between selvages. Details of the codend specifications are shown in *Figure 1*.

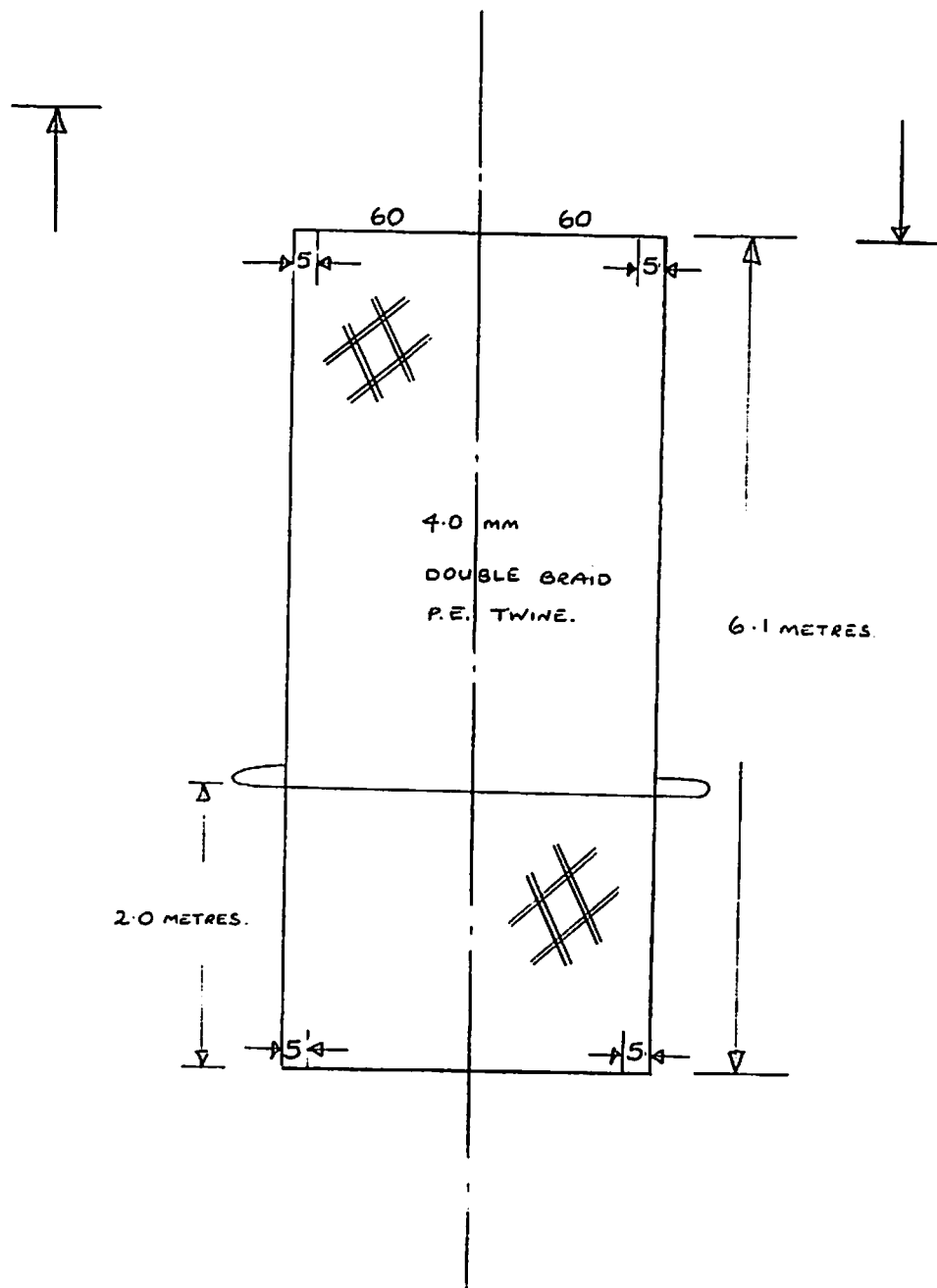
The cod end mesh sizes were measured both prior to fishing and on completion of the trials using an ICES mesh measuring gauge set at 4kg tension. The mesh measurements are shown in *Table 1*. The average of over 100 measured meshes for each size codends is given. The ICES gauge produces a lower value of mesh size measurement than the wedge gauge but is a more consistent and objective measurement. The materials were chosen, where possible, to give an ICES gauge measurement as close to the nominal measurement chosen. The mesh sizes referred to in this report are nominal as supplied by the net manufacturer.

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<sup>†</sup> Armstrong, D. W., R. J. Fryer, S. A. Reeves and K. A. Coull; 1989. Codend selectivity of cod, haddock and whiting by Scottish trawlers and seiners. ICES paper CM 1989/B:55.

It will be noticed that the codend supplied as 120mm nominal has an actual mesh size considerably greater than expected. This was due to the unavailability of more suitable netting material. Trawling operations were carried out using this net rigged with 30 fathom (54.9m) single sweeps and 20 fathom (36.6m) split bridles. The net was spread using 7ft (2.13m) Dangren 'V' doors.

All three experimental codends were constructed to the same specification apart from mesh sizes. Inside mesh measurements of 100, 110 and 120mm (nominal) were used.



**Codend Specifications**

**Fig. 1**

### **3. Codend Cover Arrangement**

In order to obtain selectivity data for the three mesh sizes of codend under consideration, the 'covered codend' method was employed.

This involves attaching a cover of small-mesh netting (35mm nominal) over the codend in such a way as to retain fish which escape from any areas of the codend itself. It is then possible to obtain length distributions of the fish retained within the codend and of those passing out into the cover. These can then be compared for each species and each mesh size.

For the covered codend method to give a representative measure of selectivity it is essential that the cover in no way affects the relative ability of fish of different sizes to pass out of the codend. In the past this method has frequently been criticized on the grounds that some fish which would normally escape from the codend if it were uncovered are prevented from doing so or are deterred by the presence of the cover. This effect has been referred to as 'masking'.

The 'masking' effect may be caused directly by the netting of the cover lying against the codend netting, or fish escape may be affected by their perception of the cover outside of the codend. Similarly the presence of fish between the codend and cover may influence the fish behaviour and escape attempts. The effect on the water flow through the codend, by the cover may also be another factor influencing the escape of fish and must therefore be considered.

In an attempt to reduce these problems and produce a more effective method for obtaining representative selectivity data using the covered codend technique, SOAFD's Marine Laboratory, Aberdeen produced a modified design of codend cover employing support hoops to reduce 'masking'.

It was this design of codend cover arrangement that was used to conduct this experiment.

The cover has a nominal mesh size of 35mm of twisted PE twine and was attached to the main codend by means of a short 'skirt' section of 50mm mesh of PA twisted twine. The overall cover length was 15.8m (52ft).

Support for the cover was provided by two detachable rings or hoops constructed from 50mm diameter alkathene pipe. These rings were attached to the net via large diameter 'codend' rings which were attached to the cover netting at intervals around its circumference (see photographs in Appendix III).

The cover netting was attached to the codend/extension at a point just above the codend extension 'joining round' so as to provide cover for the whole codend.

In order to provide adequate clearance between codend and cover, the rings were positioned, one at a point approximately 1 metre in from the end of the nylon 'skirt' section to support the forward end of the cover, and the other approximately half way between the positioning of the codend halving becket and the codline.

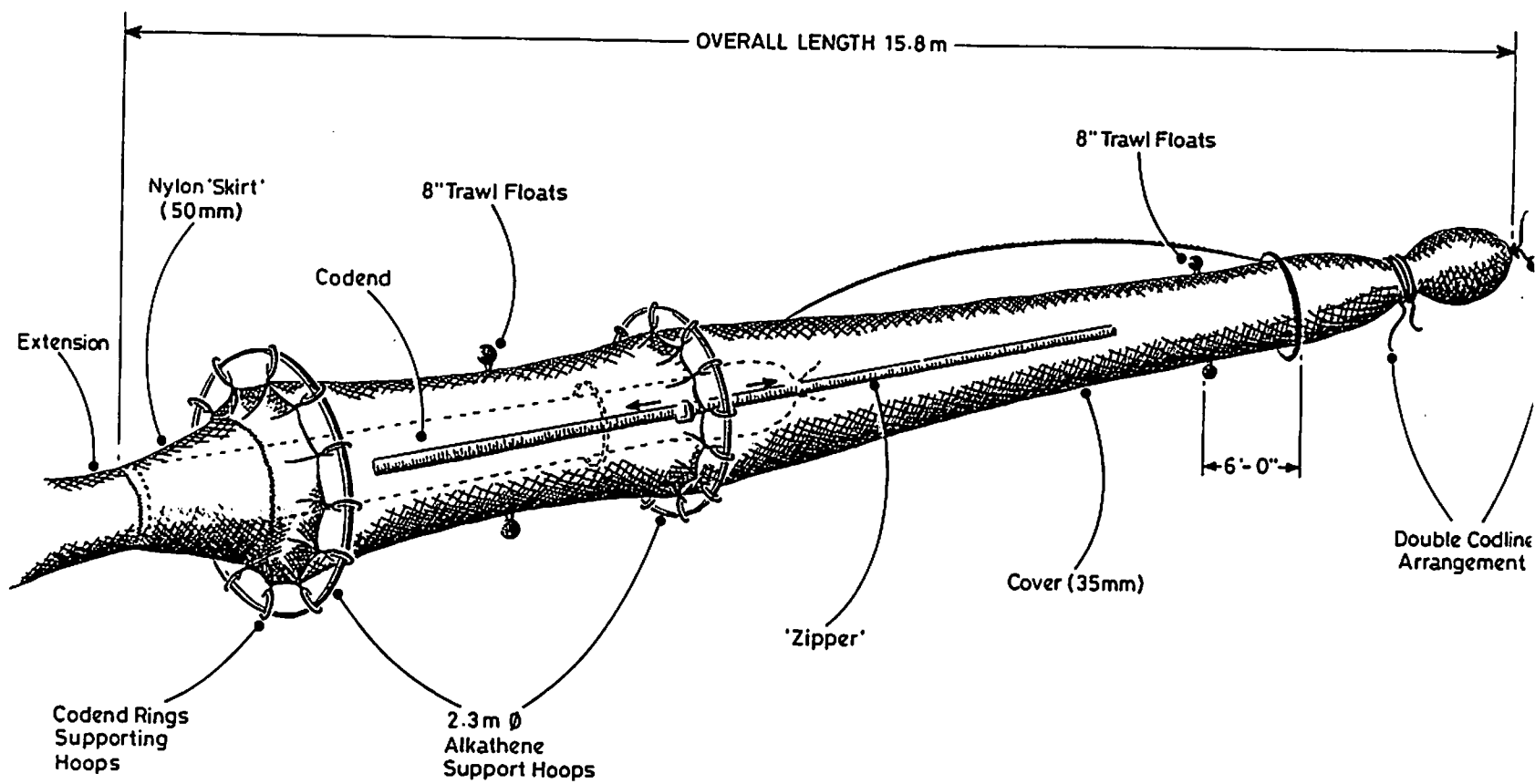
In this position the ring gave the best support at the point where the 'bulb' of the codend develops with the build-up of catch, thus reducing the clearance between codend and cover.

The codend cover arrangement is shown in *Figure 2* (perspective view).

To facilitate easy handling and operation of this arrangement, in particular emptying of codend and cover, two heavy duty nylon 'zippers' were incorporated within the top and lower sides of the cover. These two-way zippers extended from just below the first ring position to well below the end of the codend position.

During the hauling operation, as the catch is being lifted onboard, the zippers allow access inside the cover to remove the codend for emptying prior to emptying the cover. This separation of the two codends simplifies the handling operation considerably.





PERSPECTIVE VIEW OF CODEND COVER ARRANGEMENT

Fig.2

## **4. Fishing Operations and Experimental Procedure**

Prior to the experimental procedures commencing a 'shakedown' exercise was conducted to familiarize crew with the experimental fishing gear, namely the codend covers, and the associated handling arrangements. This familiarisation exercise proved very valuable in resolving potential problems prior to the start of the trials.

Scanmar net monitoring equipment was used to measure the gear geometry during the course of the exercise. This enabled a check to be made on the gear to ensure each tow was comparable. The gear parameters measured included -

- Headline height
- Wingend spread
- Door spread
- Warp tension
- Towing speed

Typical readings obtained from the exercise are shown in *Table 2*.

During the trials, towing times were set at approximately 2 hours. This enabled a total of six hauls for each of the three codend mesh sizes to be conducted during the time allowed.

It was aimed to conduct the fishing over similar periods of the day in order that the results would be more comparable. For this reason the first tow was started at first light and the final tow of each day completed just before darkness.

Any changes of fishing ground or gear modifications were carried out during the hours of darkness in order to maximise daylight fishing operations.

No handling problems were encountered with the small mesh cover or support hoops. The double 'zipper' arrangement made for a fairly simple method of handling the two codends separately.

The catches from the two codends (inside codend and cover) were kept separate by using a 'two-way' codend hatch and pounds.

The covered codend technique was used to gain selectivity data using the combined catches from the codend and the cover as a representative sample of the population of fish on the grounds at the time of the exercise. The ratio of the numbers of fish in the codend (inside) and those of the codend plus the cover at each fish length gives the proportion of fish retained by the codend under evaluation. These proportions can then be used to calculate the selectivity curve.

Fishing was conducted in the same general area for all three codend variants tested and each was tested over similar time periods, for similar durations, but it must be borne in mind that even small changes in fish populations resulting from time or ground changes may change the numbers of fish caught, the species mix, and the relative size ranges of fish captured.

This factor can be accounted for to some degree by increasing the number of hauls to try and even out this situation. However, due to time constraints only six hauls per variant were achieved.

Once the catches from the two codends were onboard the vessel and separated, they were examined to establish species and size mix.

Because of the differences in catch size between codend and cover the sampling procedure was slightly different.

With the relatively low numbers obtained in the codend the total catch was quantified and the species of interest sampled for length. The main species of interest were cod, haddock and whiting. The remaining components of the catch including the amounts of seabed debris were also recorded.

Where large quantities of fish were encountered in the cover, representative samples of each species were taken off and measured. By raising the sub-samples of each species to the totals of the whole catch in the cover, length/frequency distributions were then produced.

The catches from all hauls where no damage was sustained to the gear or when no problems were encountered were counted in the analysis.

## **5. Results and Analysis**

The general aim of this exercise was to gather selectivity data on three codend mesh sizes namely 100mm, 110mm and 120mm which could be used to update and extend the selectivity model of Armstrong et al (1989).

Considering that aim, the analysis of the results within this report have been limited to more general description with relevant comments and observations. It is envisaged that these results, if acceptable, will be incorporated into the Armstrong model by staff at SOAFD Marine Laboratory for a more detailed analysis at a later date.

Data for the three species of cod, whiting and haddock were collected from 6 hauls from each of the three mesh size variants, 100mm, 110mm and 120mm. However, data for cod were unreliable due to the very low numbers and the wide size ranges encountered. For this reason only the data for haddock and whiting are considered here. Haddock and/or whiting constituted the main part of the catch in almost all hauls.

The size of haddock ranged from 12-40cms with a bimodal distribution, that of whiting varied between 10 and 35cms with a less defined bimodal distribution.

It is important to note that the codend which was supplied by the manufacturer as a nominal 120mm codend (variant 3) actually gave mesh measurement readings with the ICES gauge more consistent with nominal 125mm mesh size. This problem arose due to material availability. Therefore, when considering these results the selectivity data for the largest mesh size should perhaps be taken as representative of 125mm rather than 120mm.

The results for this trial are presented in the form of length/frequency (L/F) distributions for each species and each codend mesh size.

*Figures 1-6* show the L/F distributions for haddock and whiting for each of the six hauls made for each mesh size under test. The data for codend and cover are shown separately. These data are then combined to show cumulative hauls for each codend mesh size and cover totals for each species and displayed in *Figures 7, 8 and 9* (haddock, whiting and cod respectively).

The figures for cod are shown to demonstrate the problems encountered in producing valid data with small numbers over wide size classes.

The L/F distributions for haddock and whiting (*Figures 1, 2, 3, 4, 5*) clearly show more than one year class present on the grounds, this is particularly marked for haddock.

The size distributions for haddock passing into the cover for all three mesh sizes are very similar. Similarly the retained portions of the catch are comparable for length class but the numbers encountered for the hauls with variant 3 (120mm) are markedly smaller.

These L/F distributions for both haddock and whiting indicate similar size populations were sampled with all three gear types. They also indicate that the fish encountered were predominantly below the minimum landing sizes (MLS) of 27cms and 30cms for whiting and haddock respectively.

The low numbers of larger size classes present in comparison to the smaller fish, meant that any selectivity data obtained for these groups could not be read with a high level of confidence.

Using the data collected selectivity curves were produced for each codend using the cumulative data from all valid hauls for haddock and whiting.

These selectivity curves are shown in *Figures 10 and 11* for haddock and whiting respectively. The selectivity parameters are compared in *Tables 3a and 3b*.

This information shows an increase in the 50% retention length (L50) for haddock as codend mesh size increases. However, the whiting data is not consistent in this respect. The L50 for the 100mm codend mesh size is slightly higher than that of the 110mm codend (36.6 as opposed to 36.3).

This factor is most likely attributable to the lack of reliable data for whiting for this mesh size. Considering the numbers of fish within the selection range (*see Figure 11*) the data are not significant.

The selection curves for the individual hauls (*Appendix 1, Figures 12 and 14*) for haddock, for the 110mm and 100mm mesh show very little haul by haul variation. The L50 ranges between 29.5 and 32.5 for the six hauls. The 100mm data shows a range of L50 from 25.0 to 30.2.

The haddock data for the 120mm mesh (*Figure 16*) shows a more varied haul by haul pattern with L50 varying between 34.3 and 53.8. Considering the haul by haul selection curves for whiting (*Figures 13, 15 and 17*) it is apparent that there is much greater variation for all three mesh sizes.

The data indicate that similar populations/size ranges of fish were sampled during the trials making the results for each codend mesh size comparable and relatively reliable in this respect. However, the quantities of fish encountered during testing of each codend varied more on a haul by haul basis.

A comparison of the catches of haddock and whiting (by numbers) in each codend and cover catch is shown in *Table 4*.

For haddock the percentage of the population sampled (codend and cover) that was retained in the codend varied between 1.1 and 8.5% between the three mesh sizes (100mm:8.5% retained, 110mm:5.3% retained and 120mm:1.1% retained), for whiting the variation between mesh sizes was only 0.4 of a percent (100mm:1.1%, 110mm:0.7% and 120mm:1.1%).

## **6. Discussion**

These results must be viewed with some caution and care must be exercised in their interpretation. The selectivity characteristics of the various codend mesh sizes can depend on the population fished and other factors. The fact that most of the fish sampled were of the smaller size ranges must be considered as must the possibility that high proportions of small fish will affect the selectivity characteristics of a codend as a result of differences in behavioural activity. In other words the selectivity of a codend may be influenced to a greater or lesser degree depending on fish density. This may also involve inter-species behaviour reactions within the fishing gear.

Another factor not to be dismissed is the effect of the codend cover on the selection of the codend. Despite the improved design of cover using supporting rings there is still the possibility that the cover is influencing escape by masking effects or alterations to the water flow or other conditions within the codend. In this exercise it was difficult to establish if any influences were attributable to the cover.

During the trials a limited amount of underwater observation was achieved by using an underwater video camera situated inside the codend cover. It was observed on some occasions that the small mesh cover was coming into contact with the inside codend in the region of the codend 'bulb'. The indications were that this situation could potentially cause 'masking' but during the limited observations made, no fish were seen passing out of the codend into the cover.

In this instance the influence of the cover on fish release is speculative but should still be borne in mind.

External conditions such as sea state and consequent vessel motion transmitted down to the gear may also affect the level of interference between codend and cover.

Although selectivity measurements were achieved for the three mesh sizes for haddock and whiting, a greater number of hauls sampling larger quantities of fish (particularly in the higher size groups) would be required to improve the likelihood of more significant results. More data are required for cod in order to establish selectivity parameters for these mesh sizes and this species.

## **7. Findings**

The selectivity characteristics for the three codends under test were found for haddock and whiting populations sampled during this exercise.

In this exercise very little difference was found between the percentage of the whiting catch retained by the three mesh sizes of codend.

The haddock catch showed some difference in the numbers retained between the three mesh sizes, ranging from 8.5% to 1.1% between the smallest and largest mesh respectively.

Differences in discard levels between the three mesh sizes were relatively small, probably as a consequence of the small size of fish encountered. A different result would be expected when fishing a different population. The proportion of whiting discards retained in the 120mm codend was high in comparison to the other two mesh sizes tested.

## **8. Acknowledgements**

Special thanks are extended to the skipper and crew of *MFV Heather Sprig* for their patience and hard work shown during the performance of these trials.

Seafish would also like to acknowledge SOAFD, Marine Laboratory, Aberdeen for the use of the codend cover and associated equipment. In particular, special thanks to Jack Robertson and Bob Kynock for their advice and guidance on the rigging and operation of the codend cover arrangement.

These trials were funded by the MAFF under the "Improvement of Selectivity of Trawl Gear" project 1992/93.

## **Tables and Figures**



**Table 1**

**Mesh Sizes Before and After Use**

|                   |  | 110mm Variant 1 |    |       |    | 100mm Variant 2 |    |       |    | 120mm Variant 3 |    |       |    |
|-------------------|--|-----------------|----|-------|----|-----------------|----|-------|----|-----------------|----|-------|----|
|                   |  | Before          |    | After |    | Before          |    | After |    | Before          |    | After |    |
|                   |  | mm              | n  | mm    | n  | mm              | n  | mm    | n  | mm              | n  | mm    | n  |
|                   |  | 108             | 6  | 107   | 2  |                 |    | 90    | 1  |                 |    | 118   | 1  |
|                   |  | 109             | 21 | 108   | 5  |                 |    | 91    |    |                 |    | 119   | 1  |
|                   |  | 110             | 15 | 109   | 20 |                 |    | 92    | 1  |                 |    | 120   | 3  |
|                   |  | 111             | 27 | 110   | 21 |                 |    | 93    |    | 121             | 1  | 121   | 6  |
|                   |  | 112             | 16 | 111   | 17 | 94              | 1  | 94    | 6  | 122             | 5  | 122   | 7  |
|                   |  | 113             | 11 | 112   | 23 | 95              | 1  | 95    | 4  | 123             | 3  | 123   | 4  |
|                   |  | 114             | 9  | 113   | 13 | 96              | 13 | 96    | 25 | 124             | 3  | 124   | 15 |
|                   |  |                 |    | 114   | 6  | 97              | 22 | 97    | 12 | 125             | 12 | 125   | 21 |
|                   |  |                 |    |       |    | 98              | 29 | 98    | 13 | 126             | 21 | 126   | 27 |
|                   |  |                 |    |       |    | 99              | 15 | 99    | 12 | 127             | 18 | 127   | 12 |
|                   |  |                 |    |       |    | 100             | 17 | 100   | 20 | 128             | 11 | 128   | 10 |
|                   |  |                 |    |       |    | 101             | 4  | 101   | 6  | 129             | 15 | 129   | 6  |
|                   |  |                 |    |       |    | 102             | 1  | 102   | 3  | 130             | 8  | 130   | 10 |
|                   |  |                 |    |       |    |                 |    | 103   | 2  | 131             | 4  | 131   |    |
|                   |  |                 |    |       |    |                 |    | 104   | 1  | 132             | 4  | 132   | 4  |
|                   |  |                 |    |       |    |                 |    | 105   |    |                 |    | 133   | 1  |
|                   |  |                 |    |       |    |                 |    | 106   |    |                 |    | 134   | 3  |
|                   |  |                 |    |       |    |                 |    | 107   |    |                 |    |       |    |
|                   |  |                 |    |       |    |                 |    | 108   | 1  |                 |    |       |    |
| Mean Mesh Size    |  | 111mm           |    | 111mm |    | 98mm            |    | 98mm  |    | 127mm           |    | 126mm |    |
| Nominal Mesh Size |  | 110mm           |    | 110mm |    | 100mm           |    | 100mm |    | 120mm           |    | 120mm |    |
| Number Measured   |  | 105             |    | 107   |    | 103             |    | 107   |    | 105             |    | 131   |    |

**Table 2**

**Fishing Gear Geometry - Results**

**Codend Cover Trials**

| VAR 1 110mm Codend |        |       |               | VAR 2 100mm Codend |        |       |               | VAR 3 120mm Codend |        |       |               |
|--------------------|--------|-------|---------------|--------------------|--------|-------|---------------|--------------------|--------|-------|---------------|
| H                  | W      | D     | Total Tension | H                  | W      | D     | Total Tension | H                  | W      | D     | Total Tension |
| (m)                | (m)    | (m)   | (tonnes)      | (m)                | (m)    | (m)   | tonnes        | (m)                | (m)    | (m)   | (tonnes)      |
| 4.5                | 16.4   | 55.0  | 2.57          | 4.2                | 16.2   | 55.0  | 2.40          | 4.2                | 16.2   | 55.0  | 2.50          |
| 4.3                | 16.3   | 57.6  | 2.33          | 4.17               | 16.1   | 55.6  | 2.86          | 4.15               | 16.1   | 55.5  | 2.55          |
| 4.4                | 16.4   | 56.6  | 2.39          | 4.2                | 16.2   | 56.0  | 2.79          | 4.2                | 16.2   | 55.0  | 2.55          |
| 4.4*               | 16.36* | 56.4* | 2.43*         | 4.19*              | 16.16* | 55.5* | 2.68          | 4.18*              | 16.16* | 55.2* | 2.53*         |

- \* Mean Values Over 3 Tows on Same Ground at 2.4 knts
- H - Headline Height
- W - Wingend Spread
- D - Otterboard Spread

**Instrumentation Trials**

| Tide    | 120mm Codend - Cover ON |      |       |               | 120mm Codend - Cover OFF |       |       |               |
|---------|-------------------------|------|-------|---------------|--------------------------|-------|-------|---------------|
|         | H                       | W    | D     | Total Tension | H                        | W     | D     | Total Tension |
| With    | 4.4                     | 16.6 | 56.0  | 2.7           | 4.7                      | 16.75 | 57.0  | 2.5           |
| Against | 3.4                     | 16.6 | 56.6  | 3.1           | 3.6                      | 17.6  | 57.5  | 2.9           |
| Mean    | 3.9                     | 16.6 | 56.25 | 2.9           | 4.15                     | 17.17 | 57.25 | 2.70          |

Table shows gear parameter measurements taken for net rigged with and without codend cover arrangement

**Table 3**

**Selectivity Characteristics for Three Codend Mesh Sizes  
For Haddock and Whiting**

|   | Mesh Size - Nominal (Measured) |               |               |
|---|--------------------------------|---------------|---------------|
|   | 100mm (98mm)                   | 110mm (111mm) | 120mm (126mm) |
| <b>3a Haddock</b><br>50% Retention Length (L50) | 28.4                           | 30.7          | 40.2          |
| Selection Range (cms)                           | 4.9                            | 5.5           | 8.9           |
| Selection Factor                                | 2.84 (2.9)                     | 2.79 (2.76)   | 3.35 (3.19)   |

|   | Mesh Size - Nominal (Measured) |               |               |
|---|--------------------------------|---------------|---------------|
|   | 100mm (98mm)                   | 110mm (111mm) | 120mm (126mm) |
| <b>3b Whiting</b><br>50% Retention Length (L50) | 36.6                           | 38.3          | 41.4          |
| Selection Range (cms)                           | 6.8                            | 6.4           | 9.6           |
| Selection Factor                                | 3.66 (3.73)                    | 3.3 (3.27)    | 3.45 (3.29)   |

**NOTE:** The 50% retention length of a codend is the fish length at which 50% of the species entering the codend is retained.

The selection range is the length difference between the 75% retention length and the 25% retention length.

The selection factor of a codend for a particular species is the ratio of the 50% retention length and the mean measured mesh size.

In Table 3 the selection factors have been given for both a nominal mesh size and an average measured mesh size to allow for the difference between the nominal and actual measurements of the largest mesh size used.

**Table 4**

**Comparison of Catches of Main Species (Numbers) In Each Codend and Cover Catch**

**4a Haddock**

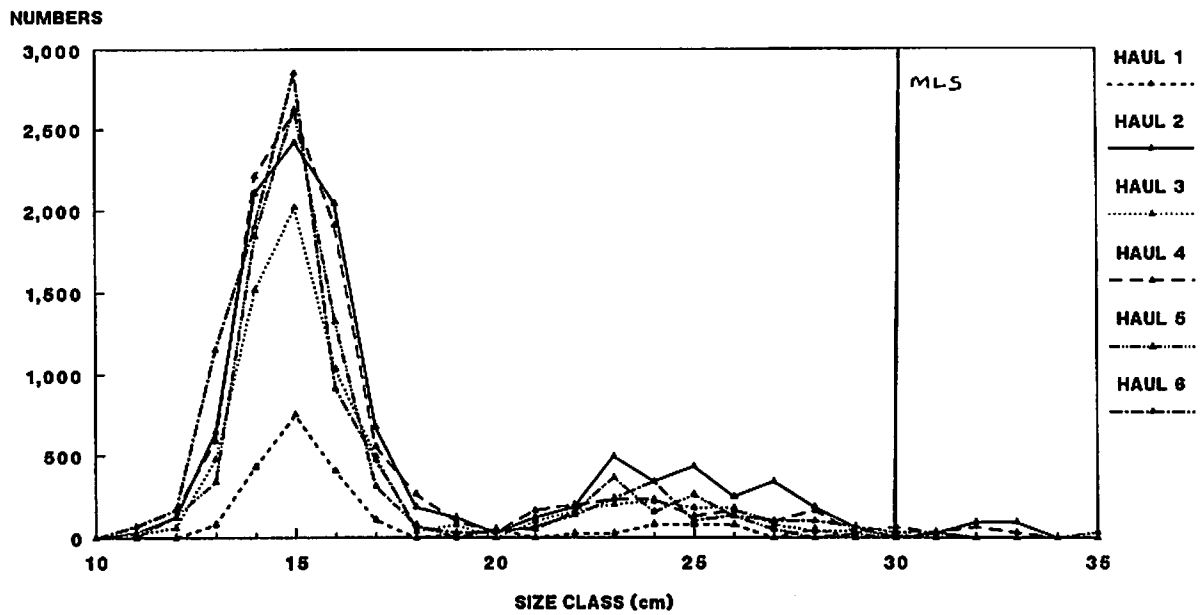
|   |                               | (MLS 30cms)<br>Codend Mesh Size (Nominal) |              |              |
|---|-------------------------------|---|--------------|--------------|
|   |                               | 100mm                                     | 110mm        | 120mm        |
| <b>Codend</b>                                     | <b>Totals</b>                 | <b>5231</b>                               | <b>2658</b>  | <b>471</b>   |
|   | <b>% Discards (below MLS)</b> | <b>57</b>                                 | <b>46</b>    | <b>53</b>    |
|   | <b>% Retained (above MLS)</b> | <b>43</b>                                 | <b>54</b>    | <b>47</b>    |
| <b>Cover</b>                                      | <b>Totals</b>                 | <b>58412</b>                              | <b>47389</b> | <b>41400</b> |
|   | <b>% Discards</b>             | <b>99</b>                                 | <b>99</b>    | <b>97</b>    |
|   | <b>% Retained</b>             | <b>1</b>                                  | <b>1</b>     | <b>3</b>     |
| <b>Total Numbers Sampled (Codend and Cover)</b>   |                               | <b>61643</b>                              | <b>50047</b> | <b>41871</b> |
| <b>% of Population Sampled Retained in Codend</b> |                               | <b>8.5</b>                                | <b>5.3</b>   | <b>1.1</b>   |

**4b Whiting**

|   |                               | (MLS 27cms)<br>Codend Mesh Size (Nominal) |              |              |
|---|-------------------------------|---|--------------|--------------|
|   |                               | 100mm                                     | 110mm        | 120mm        |
| <b>Codend</b>                                     | <b>Totals</b>                 | <b>420</b>                                | <b>201</b>   | <b>255</b>   |
|   | <b>% Discards (below MLS)</b> | <b>39</b>                                 | <b>32</b>    | <b>67</b>    |
|   | <b>% Retained (above MLS)</b> | <b>61</b>                                 | <b>68</b>    | <b>33</b>    |
| <b>Cover</b>                                      | <b>Totals</b>                 | <b>38572</b>                              | <b>28258</b> | <b>23738</b> |
|   | <b>% Discards</b>             | <b>96</b>                                 | <b>97</b>    | <b>94</b>    |
|   | <b>% Retained</b>             | <b>4</b>                                  | <b>3</b>     | <b>6</b>     |
| <b>Total Numbers Sampled (Codend and Cover)</b>   |                               | <b>38992</b>                              | <b>28459</b> | <b>23993</b> |
| <b>% of Population Sampled Retained in Codend</b> |                               | <b>1.1</b>                                | <b>0.7</b>   | <b>1.1</b>   |

**Cover Length-Numbers Plot**  
**HADDOCK**  
**Variant 1 (110 mm)**

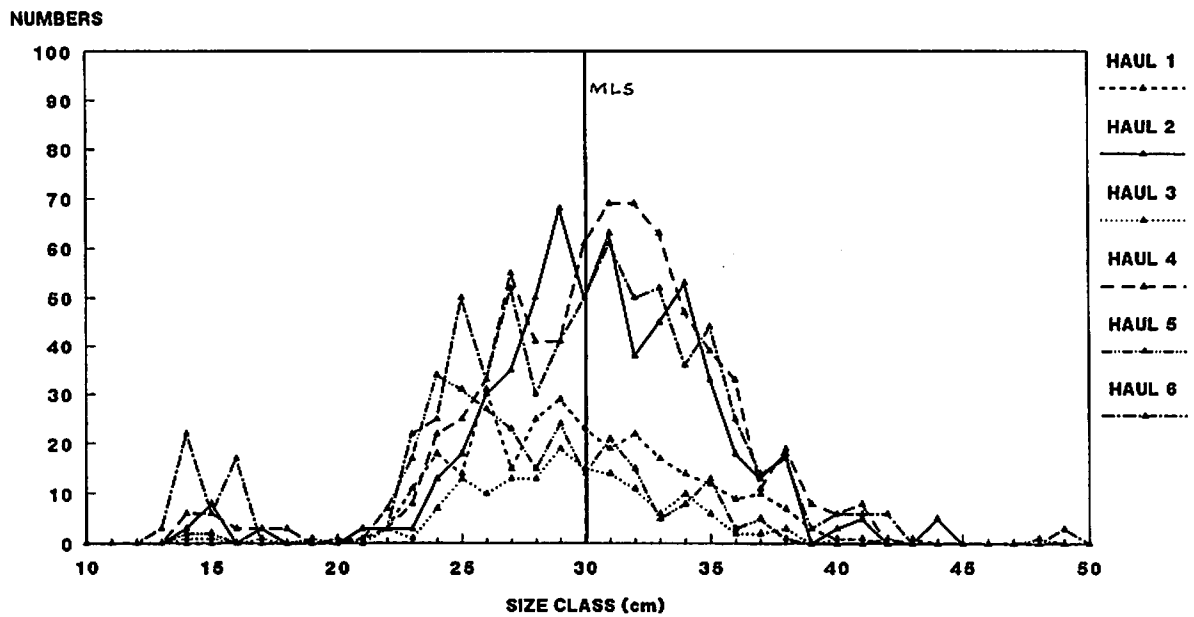
(a)



MFV Heather Sprig

**Codend Length-Numbers Plot**  
**HADDOCK**  
**Variant 1**

(b)



MFV Heather Sprig

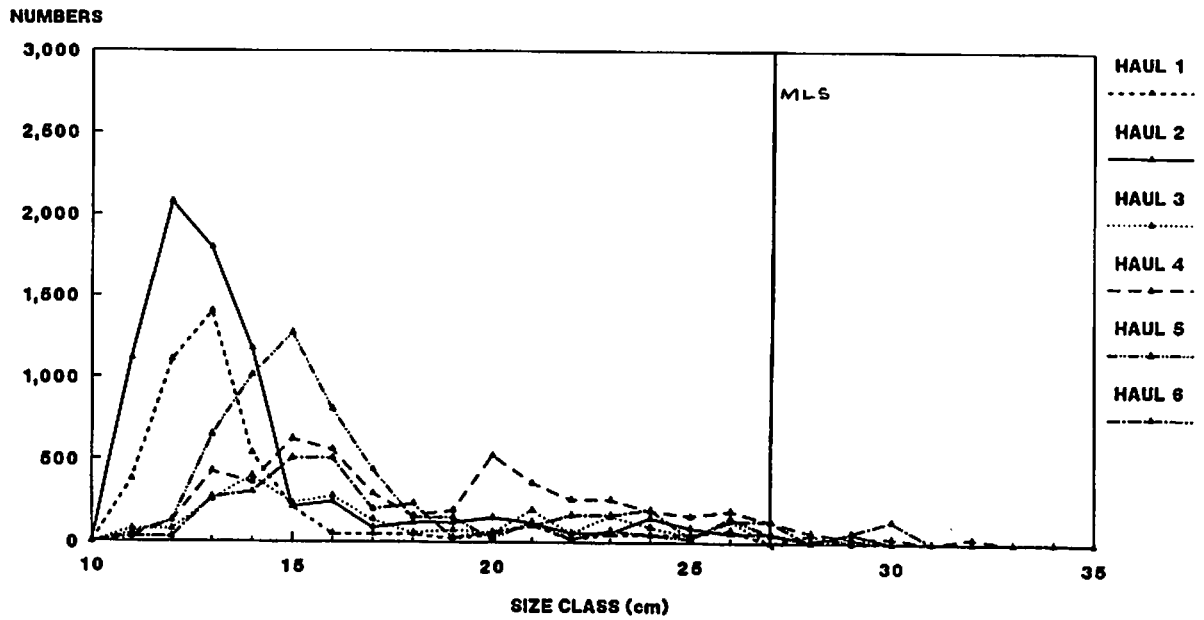
**Fig.1**

# Cover Length-Numbers Plot

WHITING

Variant 1 (110 MM)

(a)



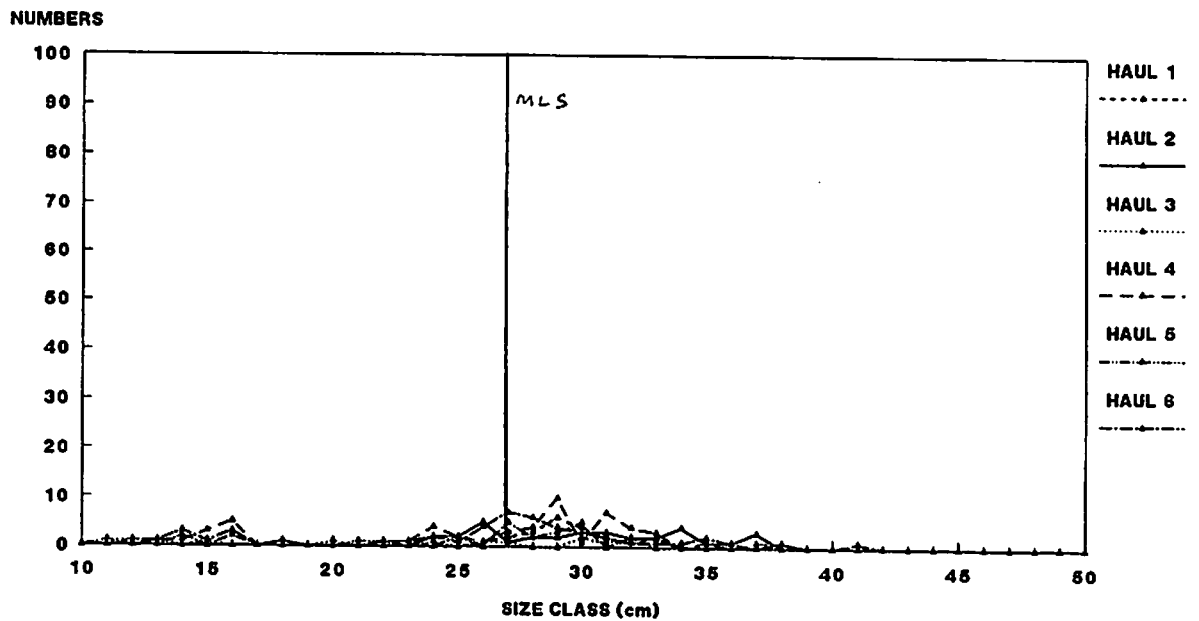
MFV Heather Sprig

# Codend Length-Numbers Plot

WHITING

Variant 1

(b)



MFV Heather Sprig

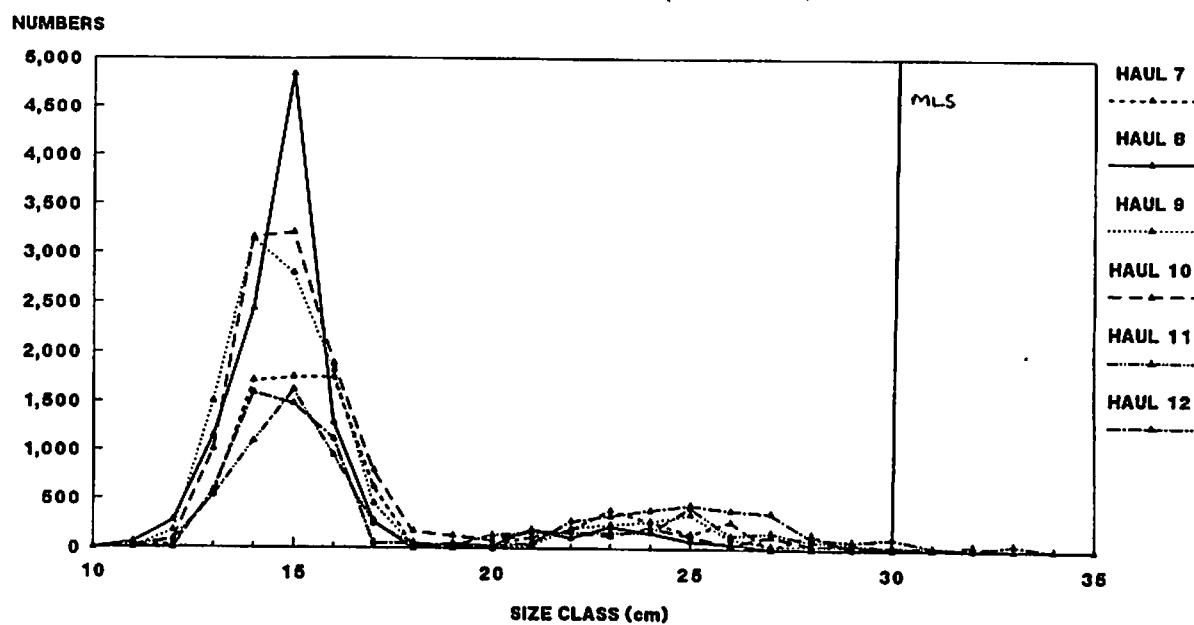
Fig.2

# Cover Length-Numbers Plot

HADDOCK

Variant 2 (100 MM)

(a)



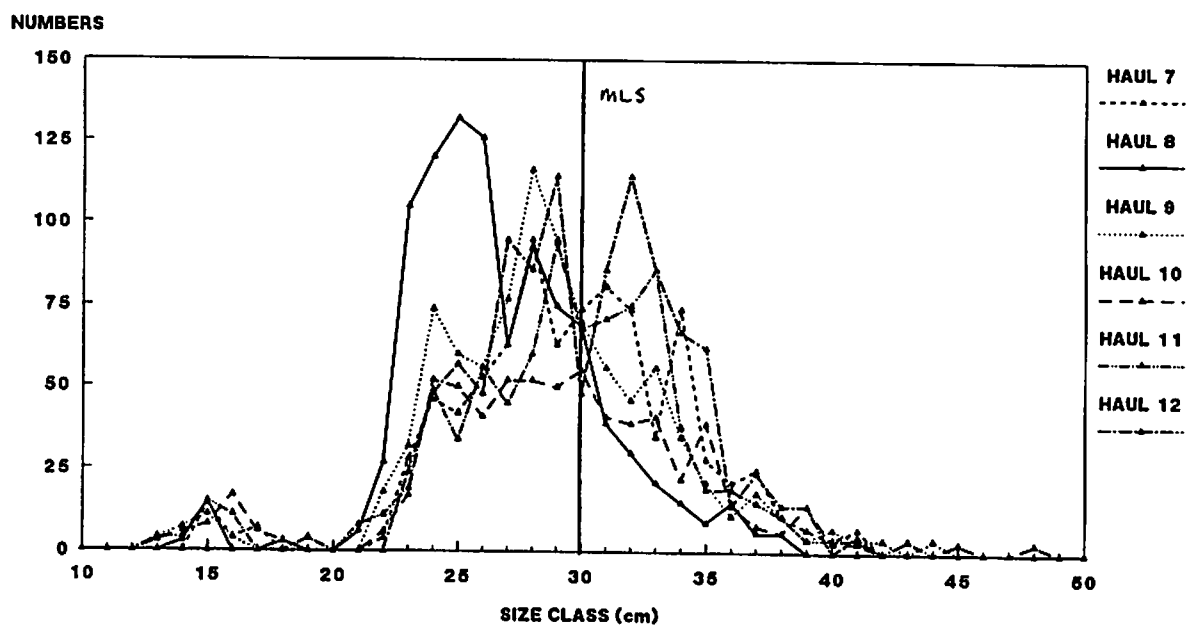
MFV Heather Sprig

# Codend Length-Numbers Plot

HADDOCK

Variant 2

(b)



MFV Heather Sprig

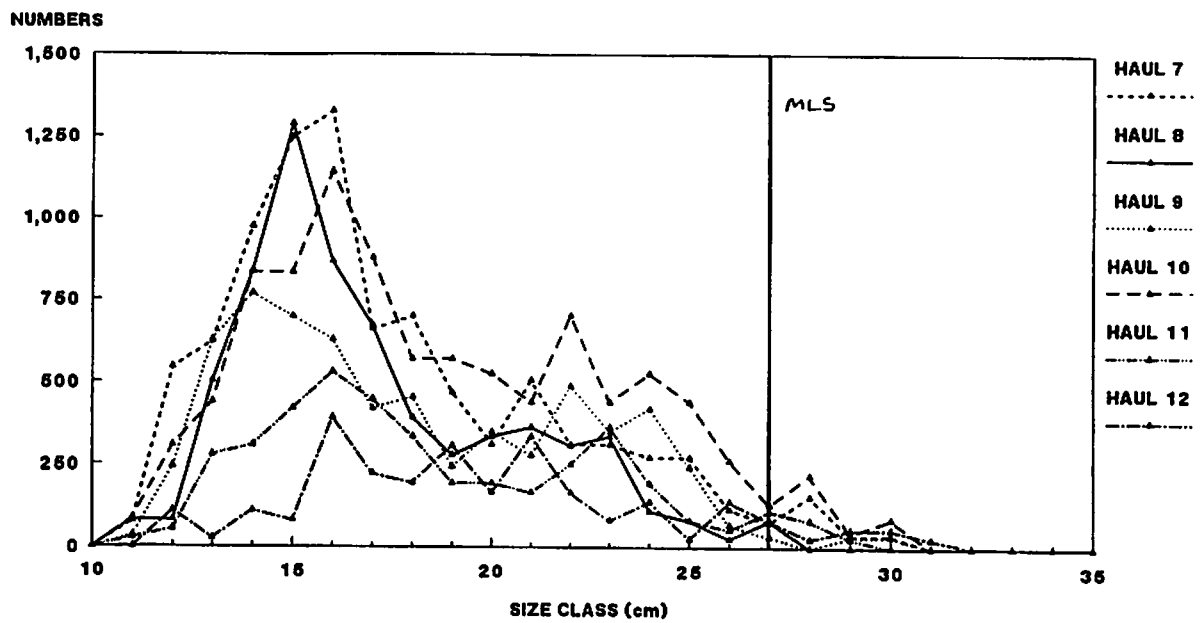
Fig.3

### Cover Length-Numbers Plot

WHITING

Variant 2 (100 mm)

(a)



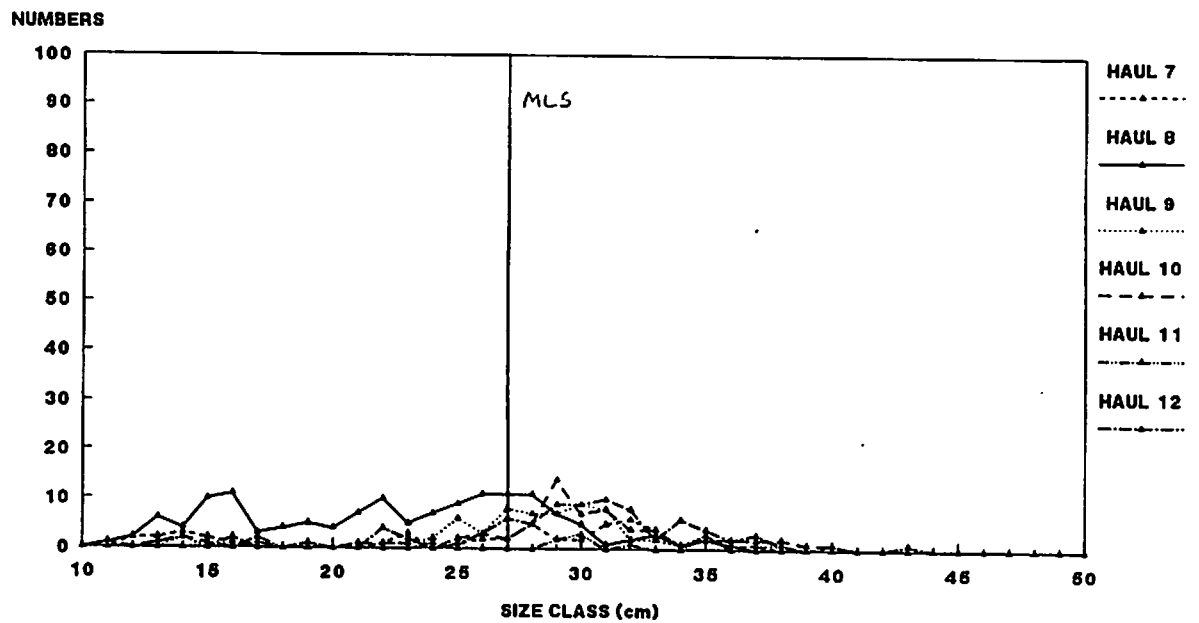
MFV Heather Sprig

### Codend Length-Numbers Plot

WHITING

Variant 2

(b)



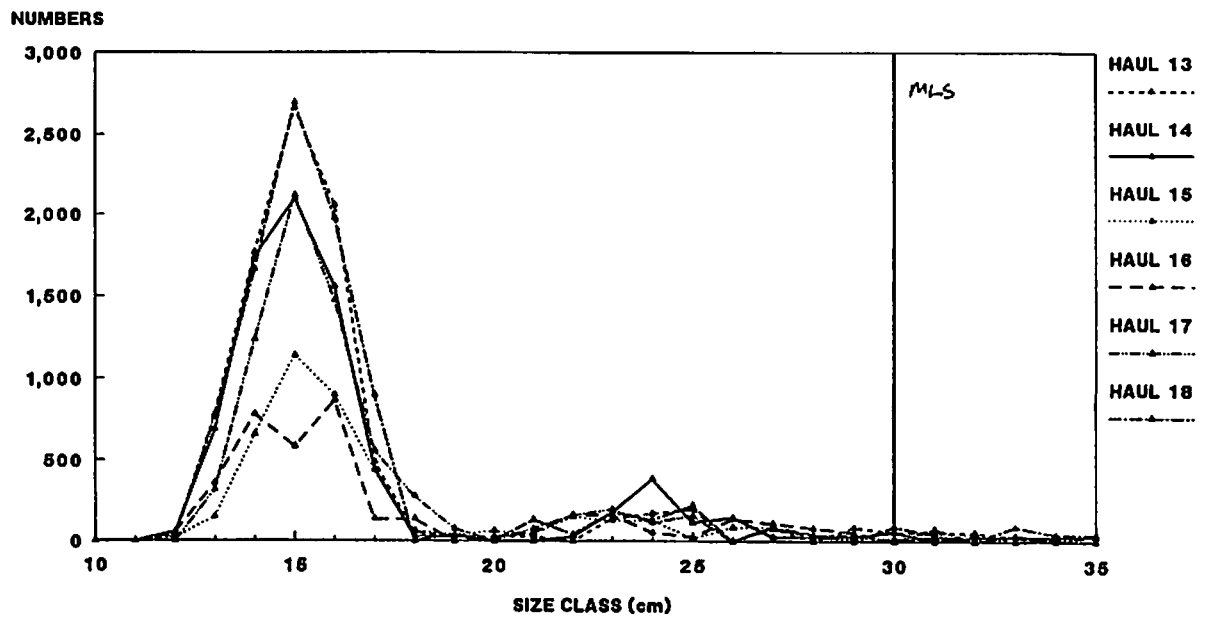
MFV Heather Sprig

Fig.4



**Cover Length-Numbers Plot**  
**HADDOCK**  
**Variant 3 (120 MM)**

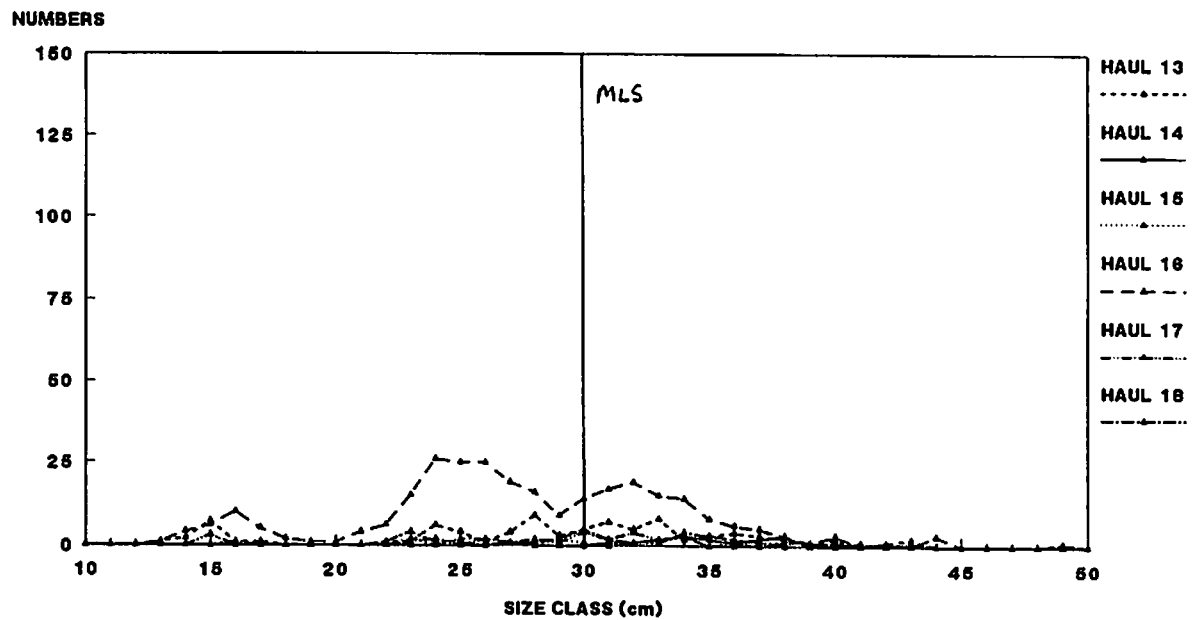
(a)



MFV Heather Sprig

**Codend Length-Numbers Plot**  
**HADDOCK**  
**Variant 3**

(b)



MFV Heather Sprig

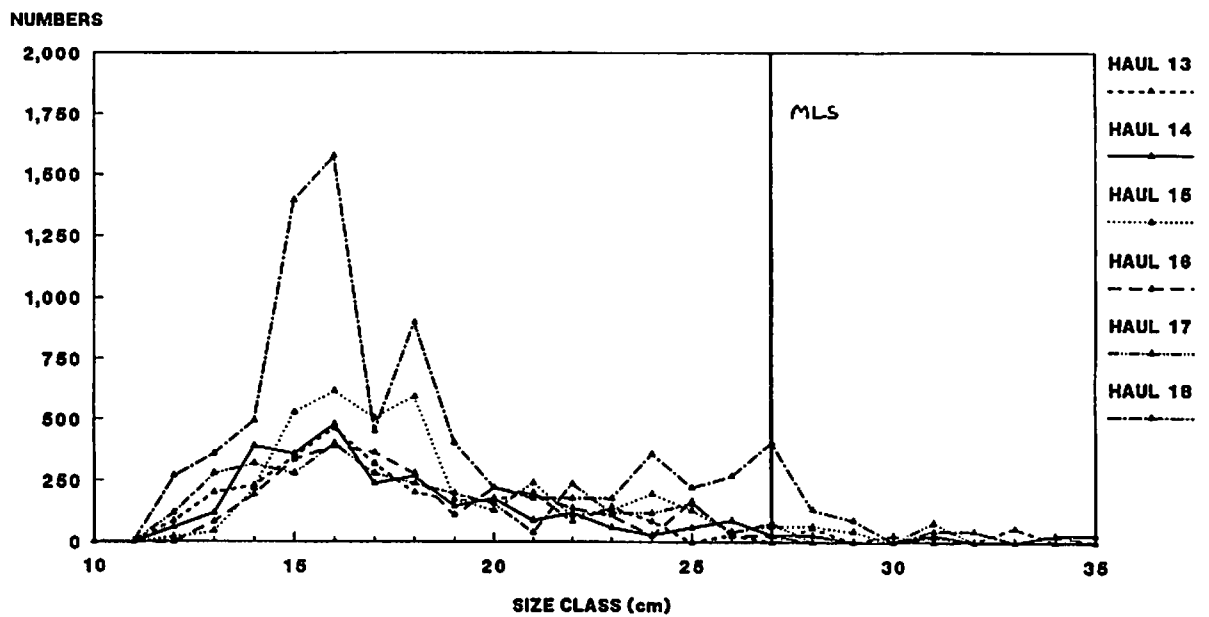
**Fig.5**

### Cover Length-Numbers Plot

(a)

WHITING

Variant 3 (120 MM)



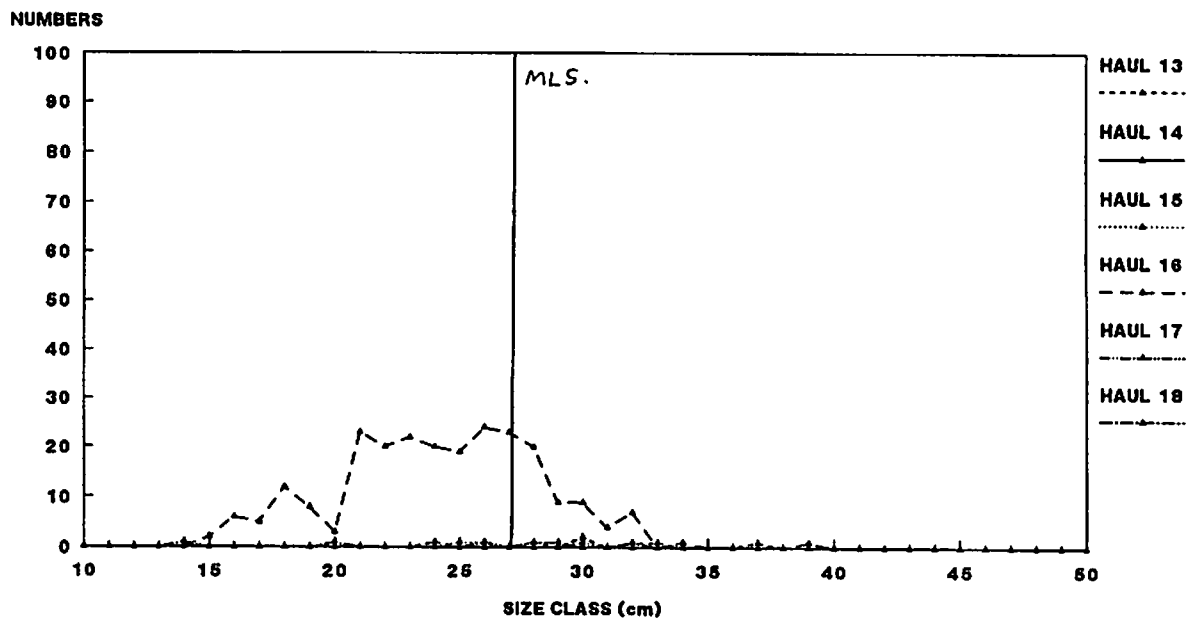
MFV Heather Sprig

### Codend Length-Numbers Plot

(b)

WHITING

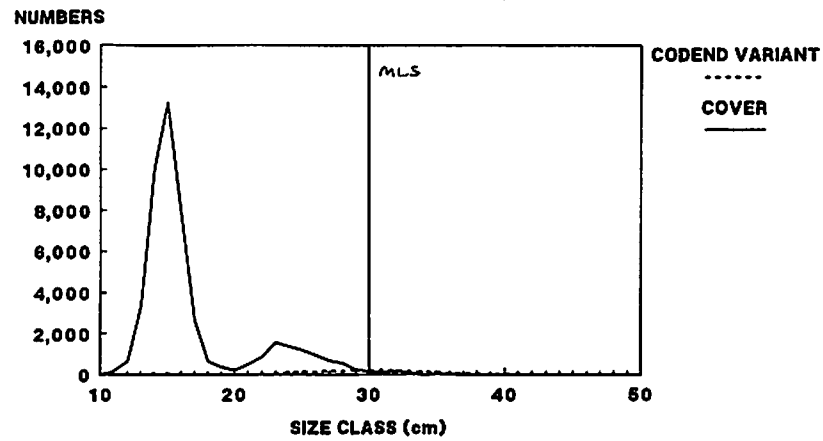
Variant 3



MFV Heather Sprig

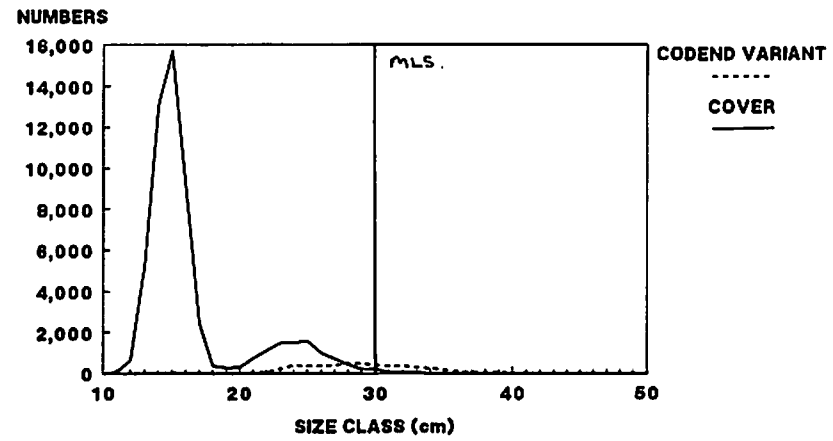
Fig.6

**Codend/cover Length-Numbers Plot**  
**HADDOCK**  
**Variant 1 (110 mm)**



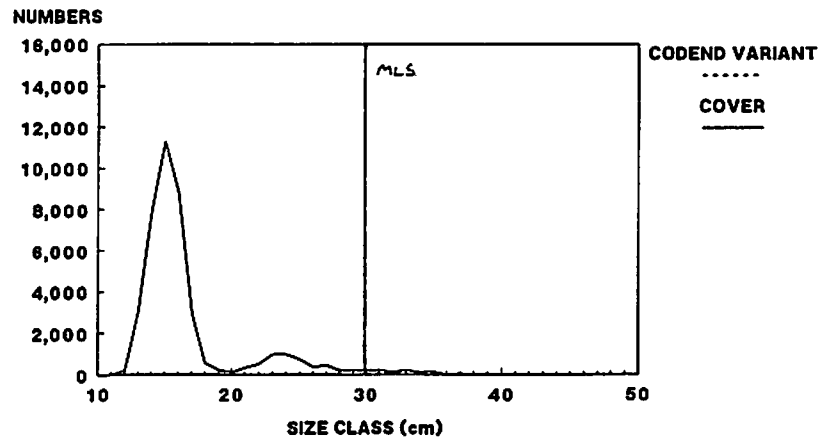
MFV Heather Sprig

**Codend/cover Length-Numbers Plot**  
**HADDOCK**  
**Variant 2 (100 mm)**



MFV Heather Sprig

**Codend/cover Length-Numbers Plot**  
**HADDOCK**  
**Variant 3 (120 mm)**



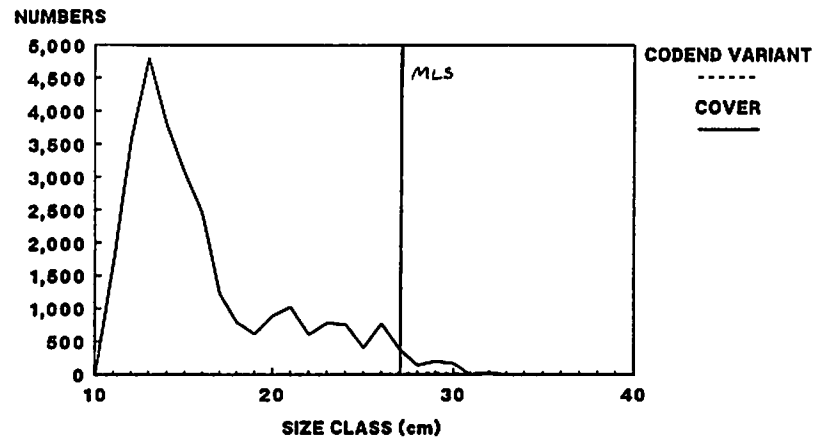
MFV Heather Sprig

**Fig.7**

### Codend/cover Length-Numbers Plot

Whiting

Variant 1 (110 mm)

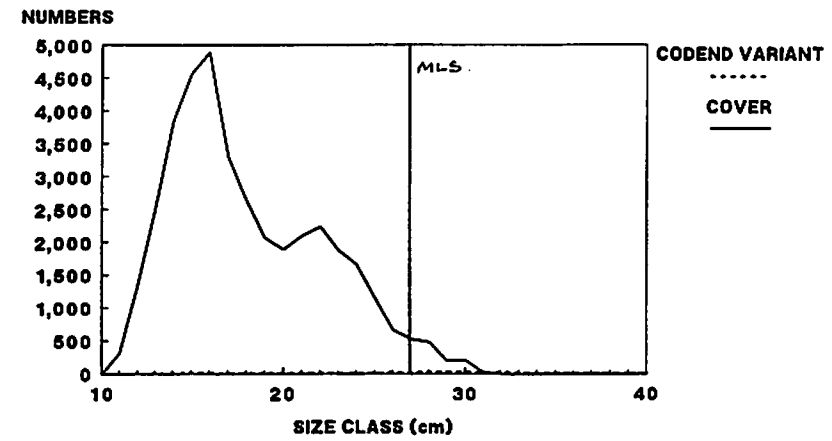


MFV Heather Sprig

### Codend/cover Length-Numbers Plot

Whiting

Variant 2 (100 mm)

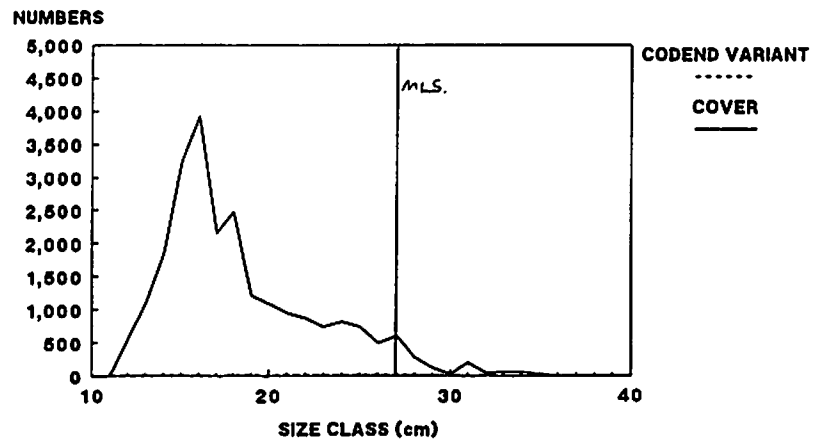


MFV Heather Sprig

### Codend/cover Length-Numbers Plot

Whiting

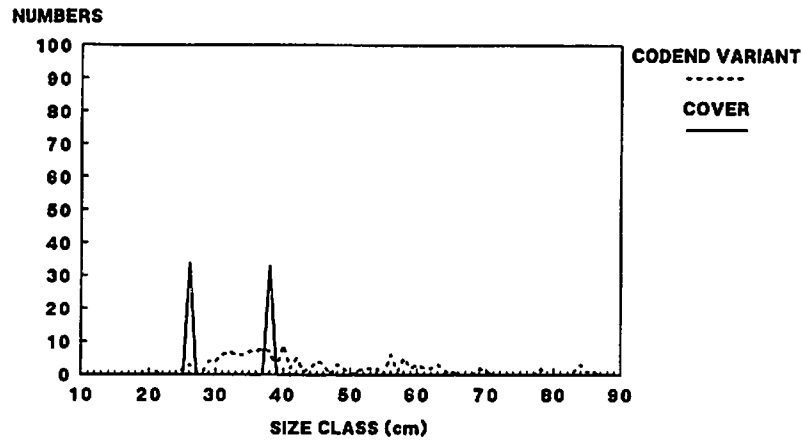
Variant 3 (120 mm)



MFV Heather Sprig

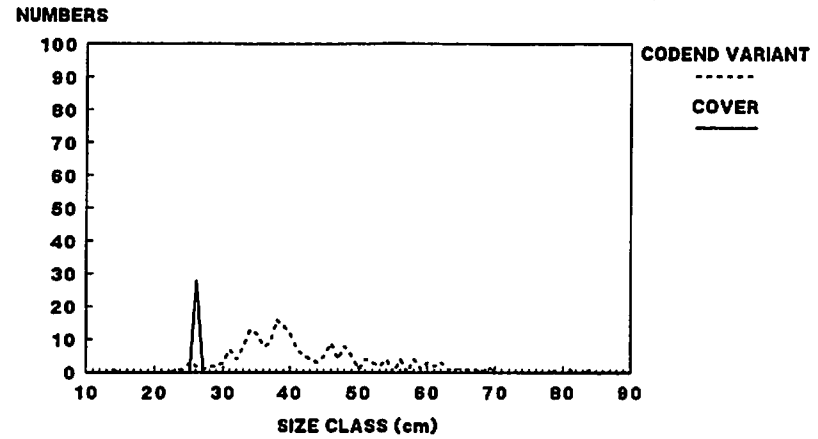
Fig.8

Codend/cover Length-Numbers Plot  
 COD  
 Variant 1 (110 mm)



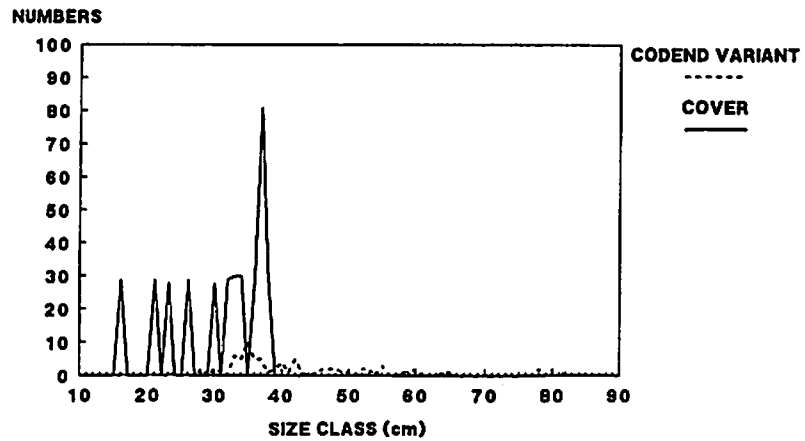
MFV Heather Sprig

Codend/cover Length-Numbers Plot  
 COD  
 Variant 2 (100 mm)



MFV Heather Sprig

Codend/cover Length-Numbers Plot  
 COD  
 Variant 3 (120 mm)

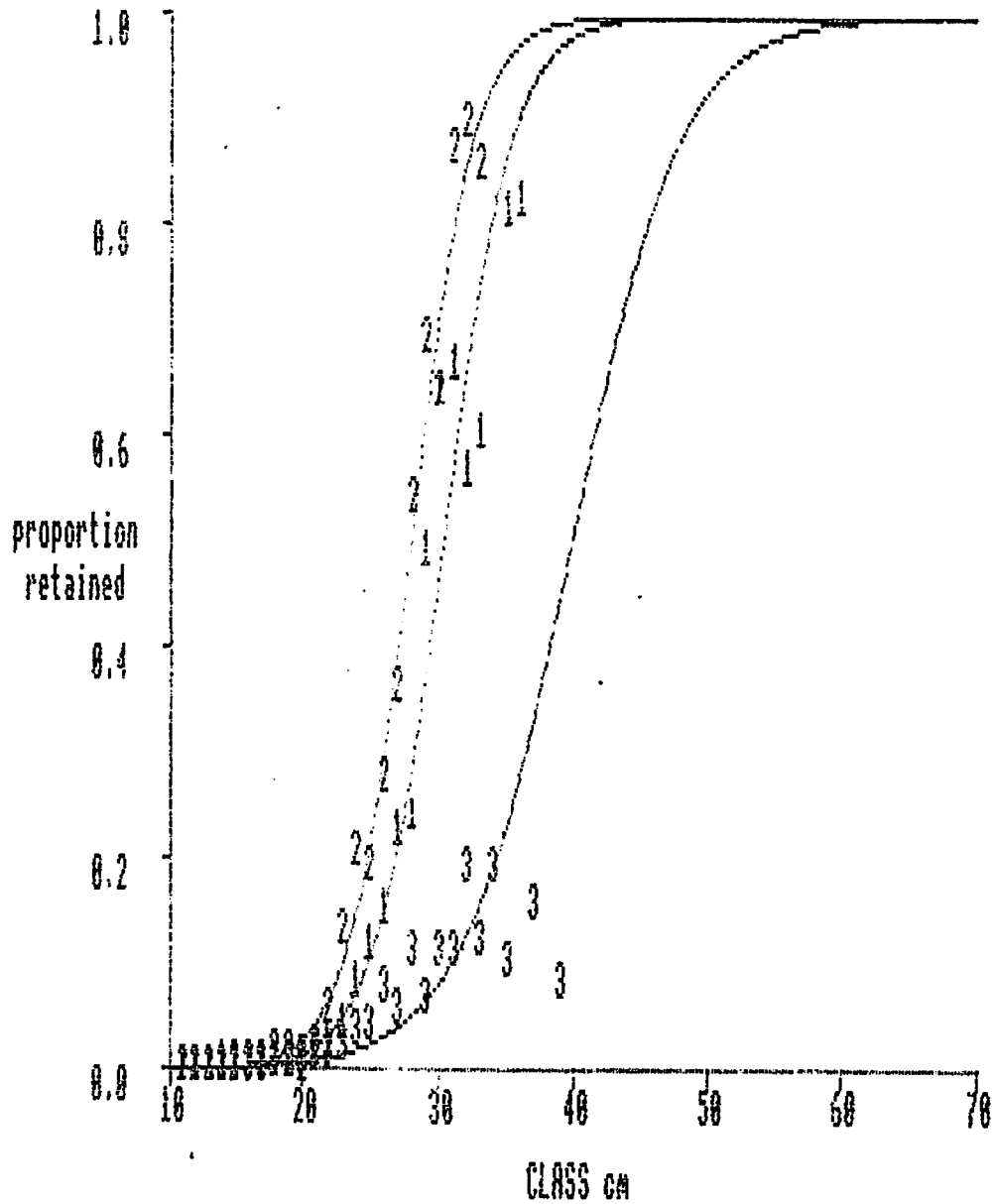


MFV Heather Sprig

# Selectivity Curves for Haddock

CUMULATIVE HADDOCK VARIANTS 1 2 3

1-----1 110 mm  
2-----2 100 mm  
3-----3 120 mm



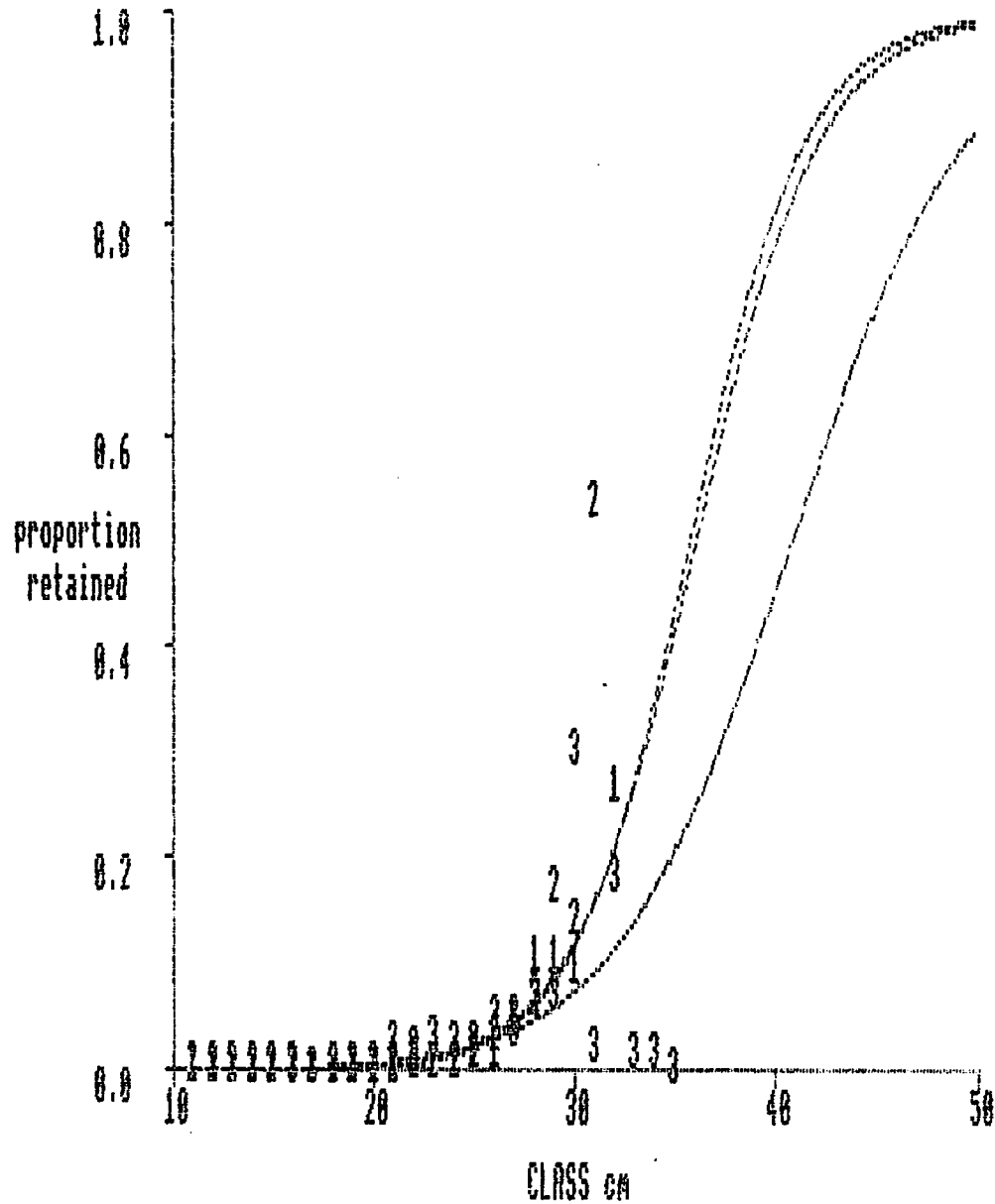
|   | mesh  | 50%  | 25%  | 75%  | selection |       | no. in S.R. |       |
|---|-------|------|------|------|-----------|-------|-------------|-------|
|   | size  | len  | len  | len  | factor    | range | codend      | cover |
| 1 | 110.0 | 30.7 | 28.0 | 33.5 | 2.79      | 5.5   | 1149        | 1515  |
| 2 | 100.0 | 28.4 | 25.9 | 30.8 | 2.84      | 4.9   | 2122        | 3389  |
| 3 | 120.0 | 40.2 | 35.8 | 44.7 | 3.35      | 8.9   | 64          | 212   |

Fig.10

# Selectivity Curves for Whiting

CUMULATIVE WHITING VARIANTS 1 2 3

1-----1 110 mm.  
2-----2 100 mm.  
3-----3 120 mm.



|   | mesh  | 50%  | 25%  | 75%  | selection |       | no. in | S.R.  |
|---|-------|------|------|------|-----------|-------|--------|-------|
|   | size  | len  | len  | len  | factor    | range | codend | cover |
| 1 | 110.0 | 36.3 | 33.1 | 39.5 | 3.30      | 6.4   | 33     | 12    |
| 2 | 100.0 | 36.6 | 33.2 | 40.0 | 3.66      | 6.8   | 66     | 0     |
| 3 | 120.0 | 41.4 | 36.6 | 46.2 | 3.45      | 9.6   | 2      | 0     |

Fig.11

## **Appendix I**

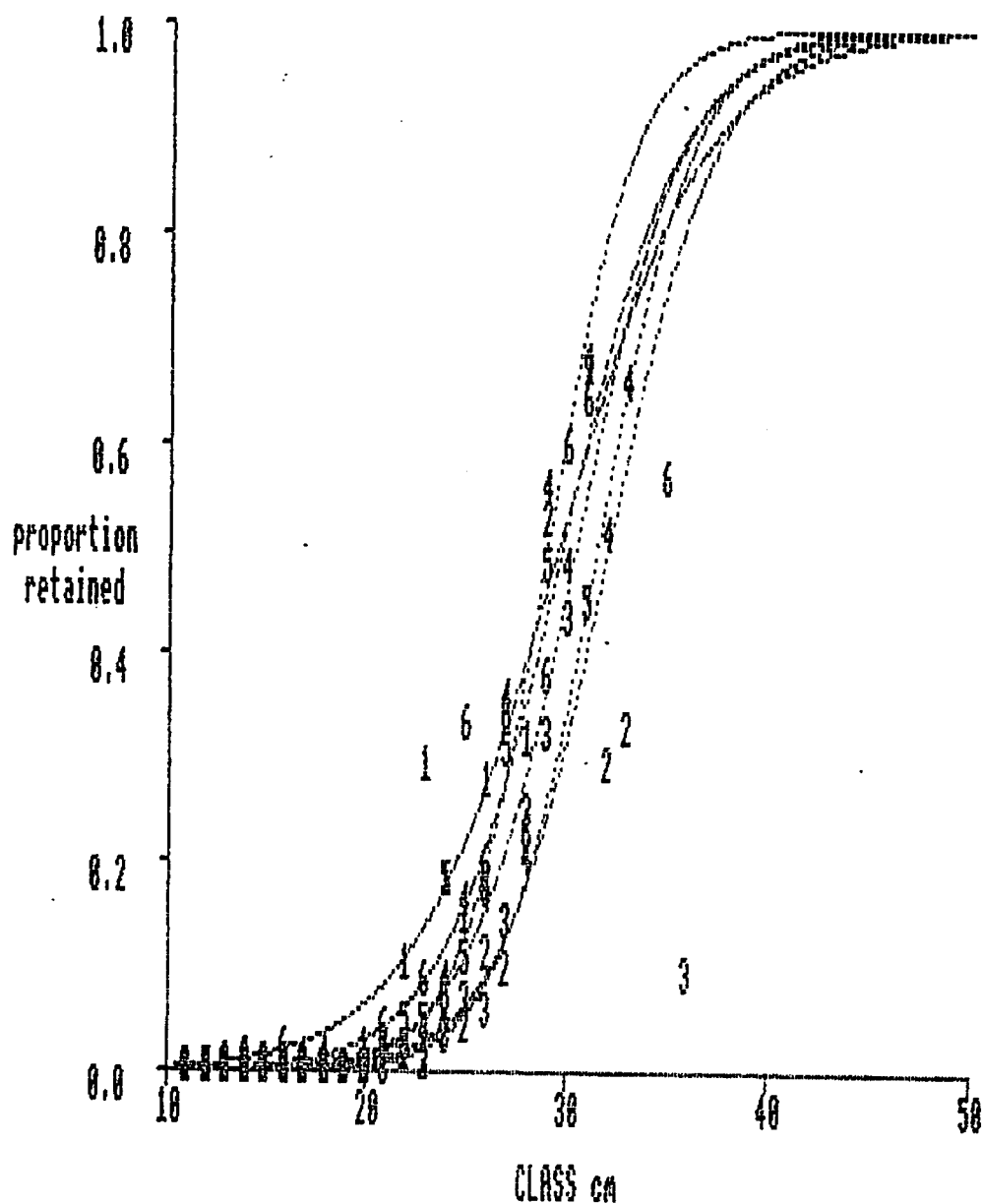
**Haul by Haul Selectivity Curves for Haddock and Whiting  
For Each of the Three Codend Mesh Sizes**



# HADDOCK VARIANT 1 110mm

## HAUL

- 1-----1
- 2-----2
- 3-----3
- 4-----4
- 5-----5
- 6-----6

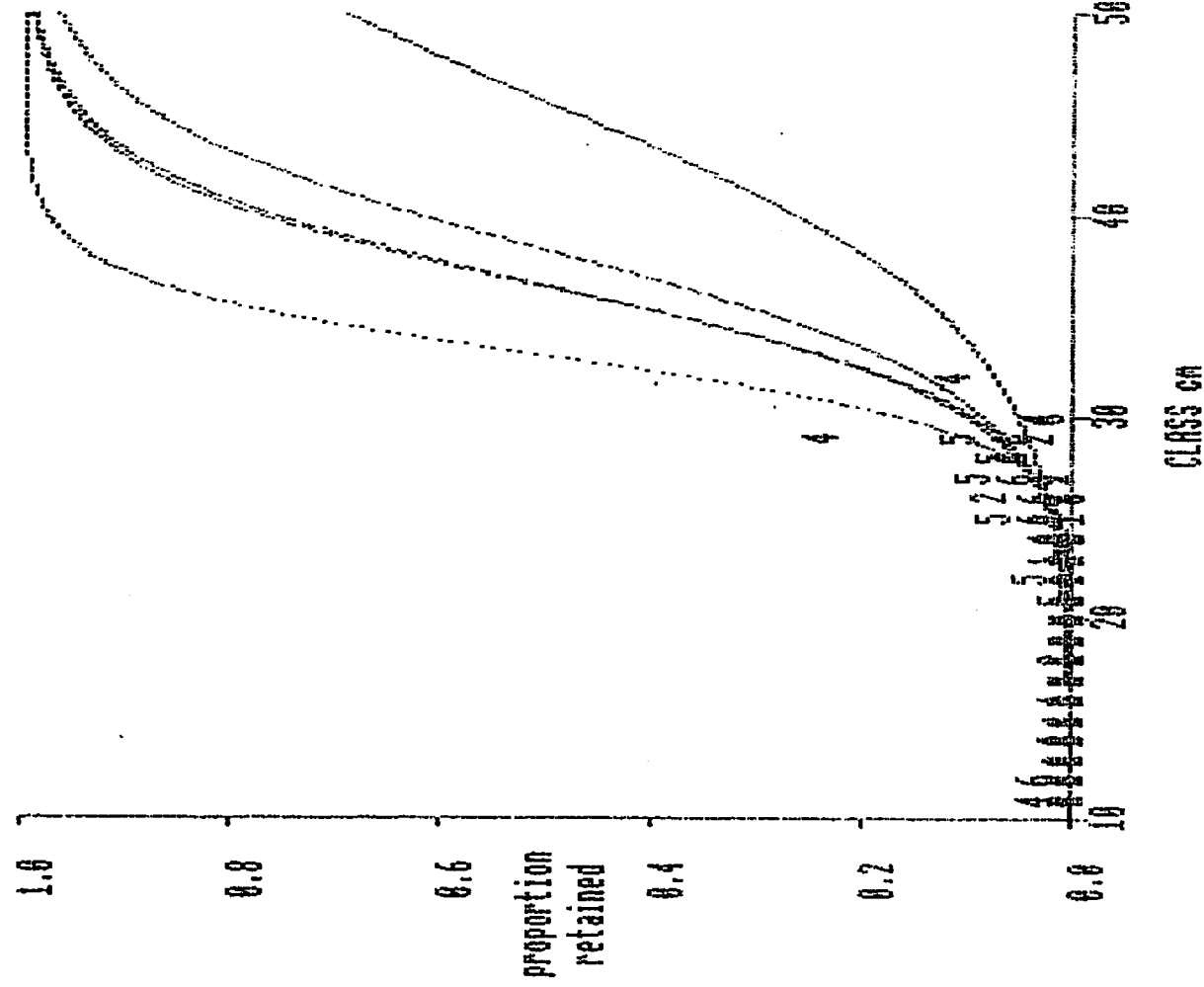


| Haul | mesh size | 50% len | 25% len | 75% len | selection factor range |     | no. in codend | S.R. cover |
|------|-----------|---------|---------|---------|------------------------|-----|---------------|------------|
| 1    | 110.0     | 30.0    | 26.0    | 33.9    | 2.73                   | 7.9 | 178           | 174        |
| 2    | 110.0     | 32.5    | 29.6    | 35.4    | 2.95                   | 5.8 | 303           | 272        |
| 3    | 110.0     | 31.9    | 29.4    | 34.5    | 2.90                   | 5.1 | 66            | 63         |
| 4    | 110.0     | 30.9    | 28.0    | 33.7    | 2.81                   | 5.7 | 322           | 418        |
| 5    | 110.0     | 29.5    | 27.1    | 31.8    | 2.68                   | 4.6 | 91            | 131        |
| 6    | 110.0     | 30.2    | 27.0    | 33.3    | 2.74                   | 6.3 | 291           | 405        |

Fig.12

# WHITING VARIANT I 110mm

HAUL  
 1-----1  
 2-----2  
 4-----4  
 5-----5  
 6-----6



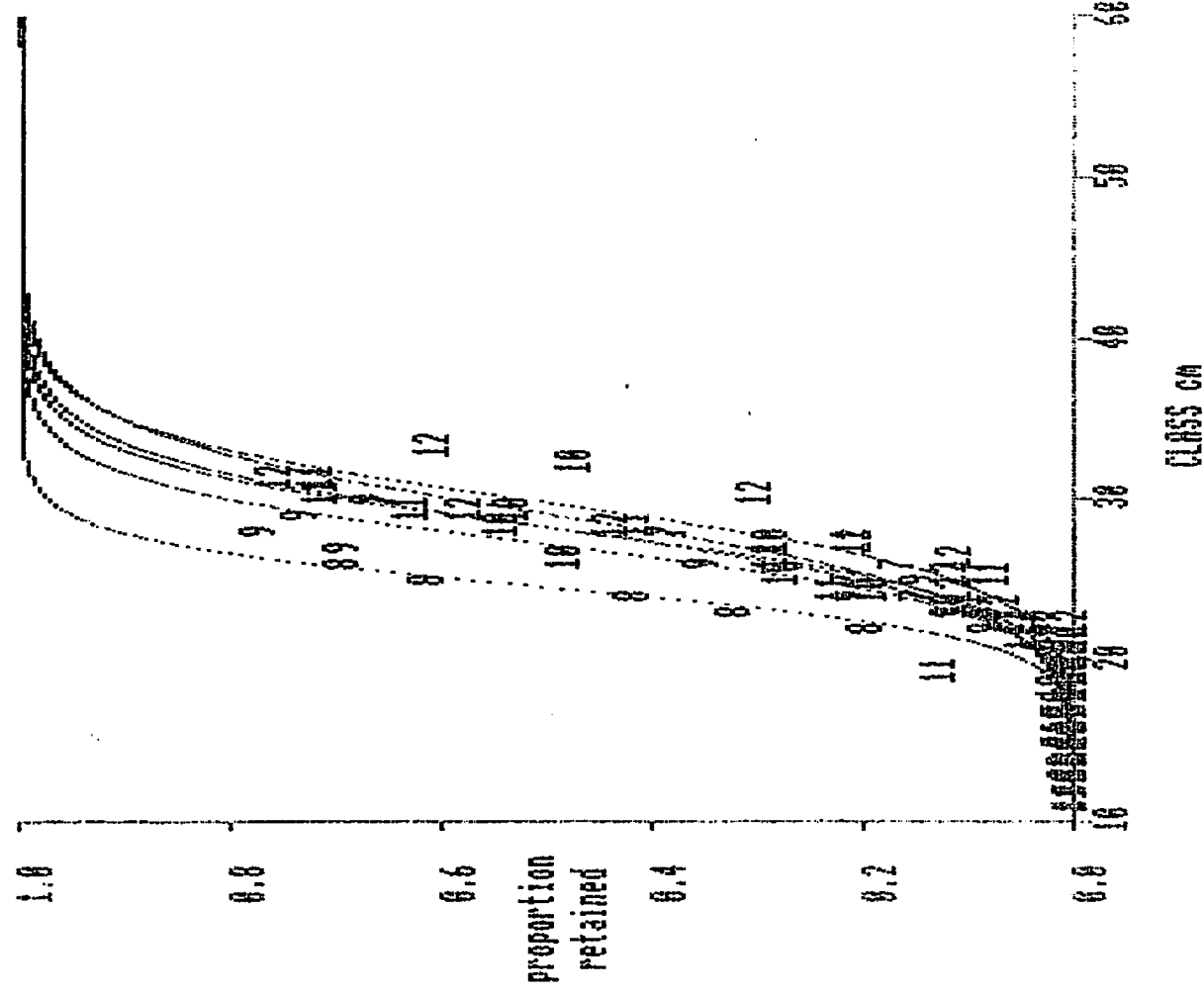
| Haul | mesh size | 50% len | 25% len | 75% len | selection factor | selection range | no. in codend | no. in S.R. cover |
|------|-----------|---------|---------|---------|------------------|-----------------|---------------|-------------------|
| 1    | 110.0     | 33.5    | 31.5    | 35.6    | 3.05             | 4.1             | 5             | 0                 |
| 2    | 110.0     | 37.0    | 33.8    | 40.1    | 3.36             | 6.3             | 10            | 0                 |
| 4    | 110.0     | 38.8    | 34.9    | 42.6    | 3.53             | 7.7             | 3             | 0                 |
| 5    | 110.0     | 37.0    | 33.7    | 40.3    | 3.37             | 6.6             | 2             | 0                 |
| 6    | 110.0     | 46.1    | 40.1    | 52.0    | 4.19             | 11.9            | 0             | 0                 |

Fig.13

# HADDOCK VARIANT 2 100mm

HAUL

7-----7  
8-----8  
9-----9  
10-----10  
11-----11  
12-----12



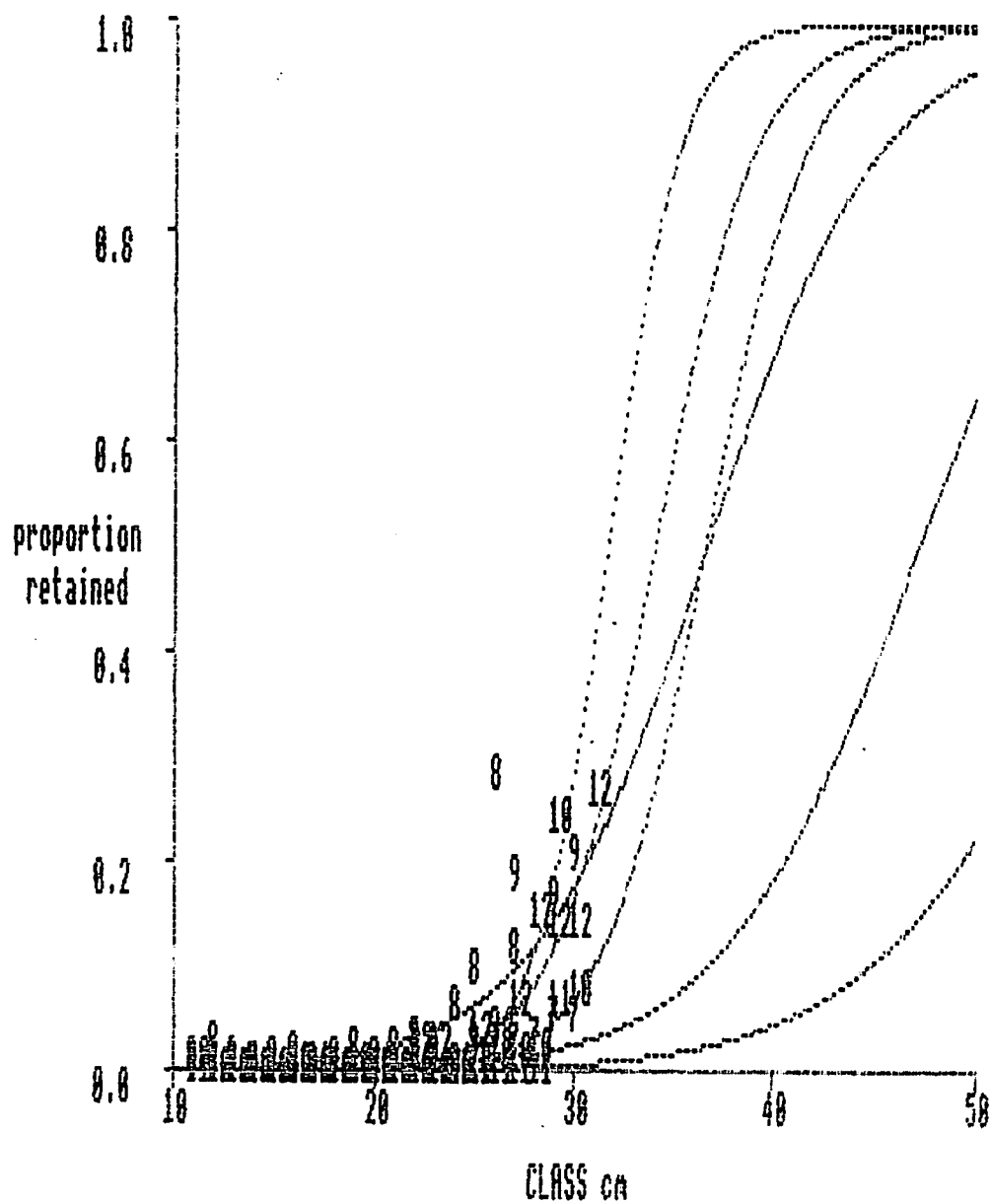
| Haul | mesh size | 50% len | 25% len | 75% len | selection factor | selection range | no. in codend | S.R. cover |
|------|-----------|---------|---------|---------|------------------|-----------------|---------------|------------|
| 7    | 100.0     | 28.7    | 26.3    | 31.1    | 2.87             | 4.8             | 325           | 486        |
| 8    | 100.0     | 25.0    | 23.3    | 26.6    | 2.50             | 3.3             | 379           | 506        |
| 9    | 100.0     | 27.6    | 25.4    | 29.8    | 2.76             | 4.4             | 348           | 562        |
| 10   | 100.0     | 28.7    | 26.1    | 31.3    | 2.87             | 5.2             | 261           | 323        |
| 11   | 100.0     | 29.5    | 26.6    | 32.4    | 2.95             | 5.8             | 384           | 491        |
| 12   | 100.0     | 30.2    | 27.6    | 32.8    | 3.02             | 5.2             | 454           | 661        |

Fig.14

# WHITING VARIANT 2 100mm

HAUL

7-----7  
8-----8  
9-----9  
10-----10  
11-----11  
12-----12



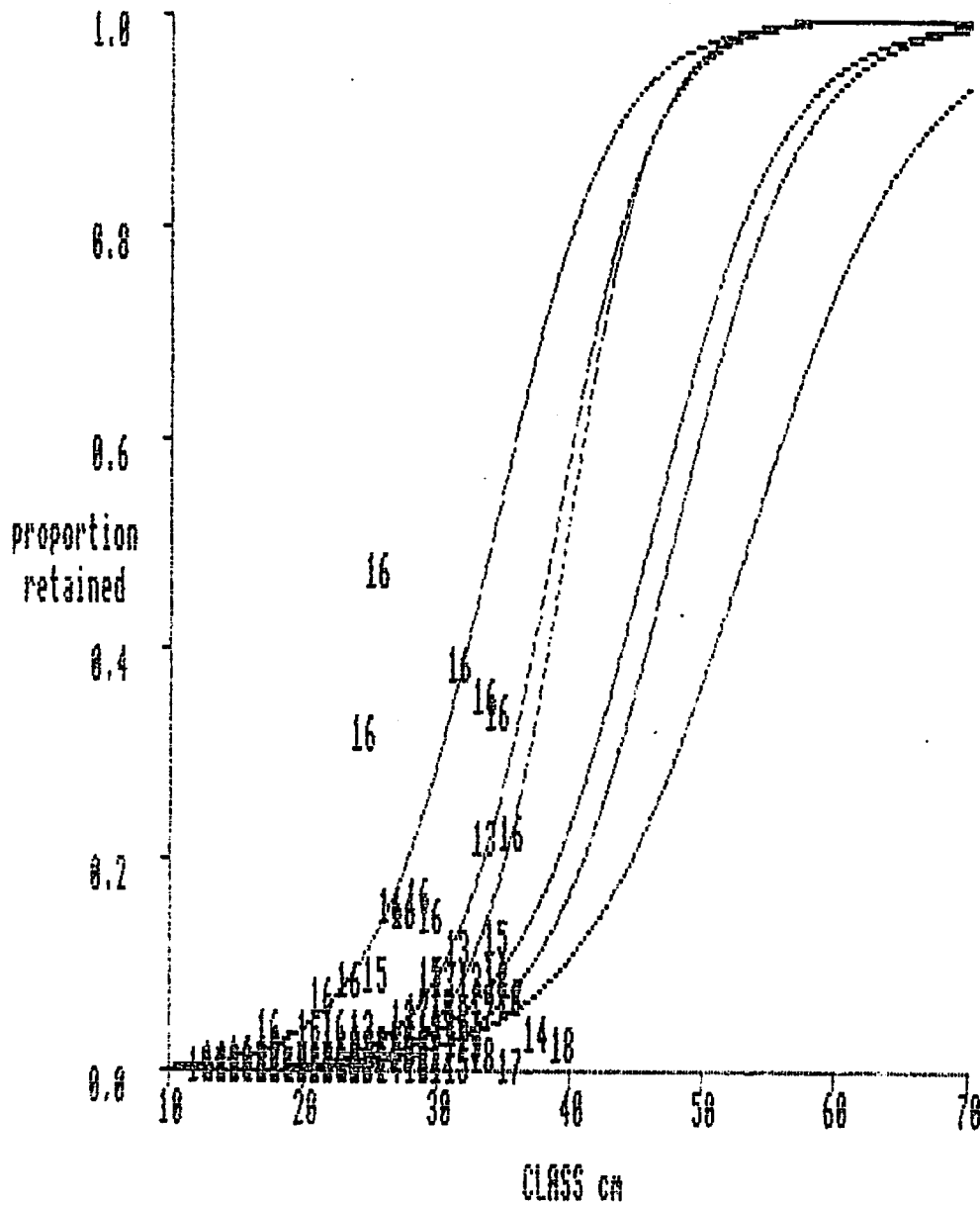
| Haul | mesh size | 50% len | 25% len | 75% len | selection factor | range | no. in codend | S.R. cover |
|------|-----------|---------|---------|---------|------------------|-------|---------------|------------|
| 7    | 100.0     | 47.7    | 42.4    | 53.0    | 4.77             | 10.6  | 0             | 0          |
| 8    | 100.0     | 37.1    | 32.3    | 42.0    | 3.71             | 9.6   | 9             | 0          |
| 9    | 100.0     | 32.2    | 30.2    | 34.1    | 3.22             | 4.0   | 22            | 46         |
| 10   | 100.0     | 37.1    | 34.3    | 39.9    | 3.71             | 5.6   | 10            | 0          |
| 11   | 100.0     | 57.5    | 51.3    | 63.6    | 5.75             | 12.3  | 0             | 0          |
| 12   | 100.0     | 34.5    | 31.7    | 37.3    | 3.45             | 5.6   | 29            | 21         |

Fig.15

# HADDOCK VARIANT 3 120mm

HAUL

13-----13  
14-----14  
15-----15  
16-----16  
17-----17  
18-----18



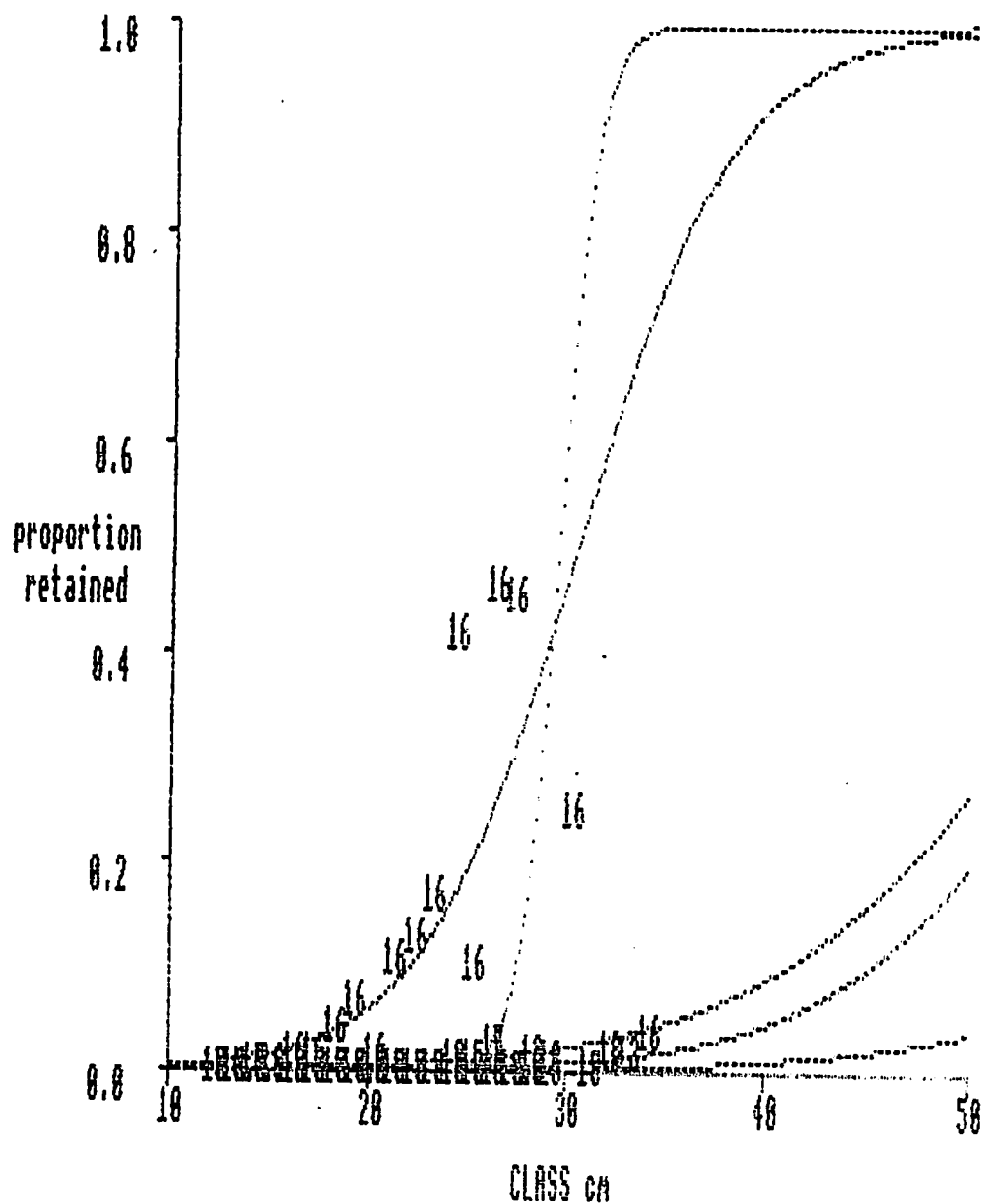
| Haul | mesh size | 50% len | 25% len | 75% len | selection factor | range | no. in codend | S.R. cover |
|------|-----------|---------|---------|---------|------------------|-------|---------------|------------|
| 13   | 120.0     | 39.0    | 34.9    | 43.0    | 3.25             | 8.1   | 16            | 0          |
| 14   | 120.0     | 53.8    | 46.8    | 60.7    | 4.48             | 13.9  | 0             | 0          |
| 15   | 120.0     | 46.3    | 40.8    | 51.7    | 3.86             | 10.9  | 0             | 0          |
| 16   | 120.0     | 34.3    | 29.4    | 39.2    | 2.86             | 9.7   | 110           | 173        |
| 17   | 120.0     | 39.9    | 36.4    | 43.5    | 3.33             | 7.1   | 4             | 5          |
| 18   | 120.0     | 48.1    | 42.8    | 53.4    | 4.01             | 10.6  | 1             | 0          |

Fig.16

# WHITING VARIANT 3 120mm

HAUL

13-----13  
15-----15  
16-----16  
17-----17  
18-----18



| Haul | mesh size | 50% len | 25% len | 75% len | selection factor | range | no. in codend | S.R. cover |
|------|-----------|---------|---------|---------|------------------|-------|---------------|------------|
| 13   | 120.0     | 58.2    | 49.8    | 66.7    | 4.85             | 16.9  | 0             | 0          |
| 15   | 120.0     | 29.9    | 28.9    | 30.9    | 2.50             | 2.0   | 0             | 80         |
| 16   | 120.0     | 30.9    | 26.6    | 35.1    | 2.57             | 8.5   | 93            | 97         |
| 17   | 120.0     | 77.1    | 67.8    | 86.4    | 6.42             | 18.6  | 0             | 0          |
| 18   | 120.0     | 59.2    | 52.3    | 66.1    | 4.94             | 13.8  | 0             | 0          |

Fig.17

## **Appendix II**

**Catch Data for Haddock and Whiting For the Three Codend Mesh Sizes Tested  
(Numbers at Each Length Class)**

MFV HEATHER SPRIG DCK 101  
COVERED CODEND TRIAL  
3 VARIANTS

110mm codend  
35mm cover

SPECIES: HADDOCK  
GEAR: VARIANT 1/COVER

| VARIANT 1     |      |  | COVER         |       |  |
|---------------|------|--|---------------|-------|--|
| SAMPLE TOTAL: | 1434 |  | SAMPLE TOTAL: | 1667  |  |
| RAISED TOTAL: | 2650 |  | RAISED TOTAL: | 47309 |  |
| MLS (cm)      | 30   |  | MLS (cm)      | 30    |  |
| % DISCARDS    | 46   |  | % DISCARDS    | 99    |  |
| % RETAINED    | 54   |  | % RETAINED    | 1     |  |

| CLASS | RAISED  | FREQ. | CLASS | RAISED  | FREQ. |
|-------|---------|-------|-------|---------|-------|
| cm    | NUMBERS | %     | cm    | NUMBERS | %     |
| 11    | 0       | 0     | 11    | 185     | 0.39  |
| 12    | 0       | 0     | 12    | 649     | 1.37  |
| 13    | 3       | 0.11  | 13    | 3300    | 6.964 |
| 14    | 34      | 1.20  | 14    | 10021   | 21.15 |
| 15    | 23      | 0.87  | 15    | 13203   | 28.03 |
| 16    | 20      | 0.75  | 16    | 7649    | 16.14 |
| 17    | 7       | 0.26  | 17    | 2639    | 5.569 |
| 18    | 3       | 0.11  | 18    | 636     | 1.342 |
| 19    | 1       | 0.04  | 19    | 364     | 0.768 |
| 20    | 2       | 0.00  | 20    | 204     | 0.43  |
| 21    | 11      | 0.41  | 21    | 509     | 1.074 |
| 22    | 22      | 0.83  | 22    | 863     | 1.821 |
| 23    | 62      | 2.33  | 23    | 1556    | 3.283 |
| 24    | 119     | 4.48  | 24    | 1369    | 2.889 |
| 25    | 151     | 5.68  | 25    | 1189    | 2.509 |
| 26    | 164     | 6.17  | 26    | 940     | 1.984 |
| 27    | 193     | 7.26  | 27    | 674     | 1.422 |
| 28    | 174     | 6.55  | 28    | 547     | 1.154 |
| 29    | 222     | 8.35  | 29    | 229     | 0.483 |
| 30    | 213     | 8.01  | 30    | 120     | 0.253 |
| 31    | 247     | 9.29  | 31    | 124     | 0.262 |
| 32    | 205     | 7.71  | 32    | 159     | 0.336 |
| 33    | 188     | 7.07  | 33    | 126     | 0.266 |
| 34    | 160     | 6.32  | 34    | 0       | 0     |
| 35    | 147     | 5.53  | 35    | 34      | 0.072 |
| 36    | 90      | 3.39  | 36    | 20      | 0.042 |
| 37    | 55      | 2.07  | 37    | 0       | 0     |
| 38    | 65      | 2.45  | 38    | 0       | 0     |
| 39    | 14      | 0.53  | 39    | 0       | 0     |
| 40    | 17      | 0.64  | 40    | 0       | 0     |
| 41    | 21      | 0.79  | 41    | 0       | 0     |
| 42    | 7       | 0.26  | 42    | 0       | 0     |
| 43    | 1       | 0.04  | 43    | 0       | 0     |
| 44    | 5       | 0.19  | 44    | 0       | 0     |
| 45    | 0       | 0     | 45    | 0       | 0     |
| 46    | 0       | 0     | 46    | 0       | 0     |
| 47    | 0       | 0     | 47    | 0       | 0     |
| 48    | 1       | 0.04  | 48    | 0       | 0     |
| 49    | 3       | 0.11  | 49    | 0       | 0     |
| 50    | 0       | 0     | 50    | 0       | 0     |



HFV HEATHER SPRIG DCK 101  
COVERED CODEND TRIAL  
3 VARIANTS

100mm codend  
35mm cover

SPECIES: HADDOCK  
GEAR: VARIANT 2/COVER

| VARIANT 2     |         |       | COVER         |         |       |
|---------------|---------|-------|---------------|---------|-------|
| SAMPLE TOTAL: | 1493    |       | SAMPLE TOTAL: | 1700    |       |
| RAISED TOTAL: | 5231    |       | RAISED TOTAL: | 56412   |       |
| MLS (cm)      | 30      |       | MLS (cm)      | 30      |       |
| % DISCARDS    | 57      |       | % DISCARDS    | 99      |       |
| % RETAINED    | 43      |       | % RETAINED    | 1       |       |
| CLASS         | RAISED  | FREQ. | CLASS         | RAISED  | FREQ. |
| cm            | NUMBERS | %     | cm            | NUMBERS | %     |
| 11            | 0       | 0     | 11            | 84      | 0.149 |
| 12            | 0       | 0     | 12            | 666     | 1.181 |
| 13            | 11      | 0.21  | 13            | 5331    | 9.45  |
| 14            | 20      | 0.38  | 14            | 13158   | 23.32 |
| 15            | 63      | 1.2   | 15            | 15719   | 27.06 |
| 16            | 36      | 0.69  | 16            | 8827    | 15.65 |
| 17            | 13      | 0.25  | 17            | 2459    | 4.359 |
| 18            | 6       | 0.11  | 18            | 362     | 0.642 |
| 19            | 4       | 0.08  | 19            | 279     | 0.495 |
| 20            | 0       | 0     | 20            | 323     | 0.573 |
| 21            | 14      | 0.27  | 21            | 748     | 1.326 |
| 22            | 66      | 1.26  | 22            | 1141    | 2.023 |
| 23            | 225     | 4.3   | 23            | 1495    | 2.65  |
| 24            | 389     | 7.44  | 24            | 1501    | 2.661 |
| 25            | 375     | 7.17  | 25            | 1590    | 2.819 |
| 26            | 380     | 7.26  | 26            | 1010    | 1.79  |
| 27            | 395     | 7.55  | 27            | 699     | 1.239 |
| 28            | 502     | 9.6   | 28            | 431     | 0.764 |
| 29            | 491     | 9.39  | 29            | 219     | 0.388 |
| 30            | 384     | 7.34  | 30            | 214     | 0.379 |
| 31            | 374     | 7.15  | 31            | 56      | 0.099 |
| 32            | 378     | 7.23  | 32            | 44      | 0.078 |
| 33            | 325     | 6.21  | 33            | 56      | 0.099 |
| 34            | 251     | 4.8   | 34            | 0       | 0     |
| 35            | 178     | 3.4   | 35            | 0       | 0     |
| 36            | 94      | 1.8   | 36            | 0       | 0     |
| 37            | 96      | 1.84  | 37            | 0       | 0     |
| 38            | 59      | 1.13  | 38            | 0       | 0     |
| 39            | 43      | 0.82  | 39            | 0       | 0     |
| 40            | 18      | 0.34  | 40            | 0       | 0     |
| 41            | 23      | 0.44  | 41            | 0       | 0     |
| 42            | 4       | 0.08  | 42            | 0       | 0     |
| 43            | 4       | 0.08  | 43            | 0       | 0     |
| 44            | 4       | 0.08  | 44            | 0       | 0     |
| 45            | 3       | 0.06  | 45            | 0       | 0     |
| 46            | 0       | 0     | 46            | 0       | 0     |
| 47            | 0       | 0     | 47            | 0       | 0     |
| 48            | 3       | 0.06  | 48            | 0       | 0     |
| 49            | 0       | 0     | 49            | 0       | 0     |
| 50            | 0       | 0     | 50            | 0       | 0     |

HPV HEATHEN SPRIG DCK 101  
COVERED CODEND TRIAL  
3 VARIANTS

120mm codend  
35mm cover

SPECIES: HADDOCK  
GEAR: VARIANT 3/COVER

| VARIANT 3     |                   |            | COVER         |                   |            |
|---------------|-------------------|------------|---------------|-------------------|------------|
| SAMPLE TOTAL: | 471               |            | SAMPLE TOTAL: | 1269              |            |
| RAISED TOTAL: | 471               |            | RAISED TOTAL: | 41400             |            |
| HLS (cm)      | 30                |            | HLS (cm)      | 30                |            |
| % DISCARDS    | 53                |            | % DISCARDS    | 97                |            |
| % RETAINED    | 47                |            | % RETAINED    | 3                 |            |
| CLASS<br>cm   | RAISED<br>NUMBERS | FREQ.<br>% | CLASS<br>cm   | RAISED<br>NUMBERS | FREQ.<br>% |
| 11            | 0                 | 0          | 11            | 0                 | 0          |
| 12            | 0                 | 0          | 12            | 212               | 0.512      |
| 13            | 2                 | 0.42       | 13            | 3076              | 7.43       |
| 14            | 6                 | 1.27       | 14            | 7050              | 18.98      |
| 15            | 16                | 3.4        | 15            | 11320             | 27.34      |
| 16            | 12                | 2.55       | 16            | 8049              | 21.37      |
| 17            | 6                 | 1.27       | 17            | 2903              | 7.205      |
| 18            | 2                 | 0.42       | 18            | 574               | 1.306      |
| 19            | 1                 | 0.21       | 19            | 228               | 0.551      |
| 20            | 1                 | 0.21       | 20            | 123               | 0.297      |
| 21            | 4                 | 0.85       | 21            | 344               | 0.831      |
| 22            | 8                 | 1.7        | 22            | 557               | 1.345      |
| 23            | 23                | 4.80       | 23            | 1005              | 2.428      |
| 24            | 35                | 7.43       | 24            | 1007              | 2.432      |
| 25            | 32                | 6.79       | 25            | 750               | 1.831      |
| 26            | 30                | 6.37       | 26            | 370               | 0.913      |
| 27            | 27                | 5.73       | 27            | 407               | 1.176      |
| 28            | 20                | 5.94       | 28            | 221               | 0.534      |
| 29            | 17                | 3.61       | 29            | 235               | 0.568      |
| 30            | 29                | 6.16       | 30            | 230               | 0.556      |
| 31            | 29                | 6.16       | 31            | 233               | 0.563      |
| 32            | 31                | 6.50       | 32            | 132               | 0.319      |
| 33            | 29                | 6.16       | 33            | 217               | 0.524      |
| 34            | 29                | 6.16       | 34            | 125               | 0.302      |
| 35            | 16                | 3.4        | 35            | 143               | 0.345      |
| 36            | 14                | 2.97       | 36            | 0                 | 0          |
| 37            | 11                | 2.34       | 37            | 60                | 0.145      |
| 38            | 10                | 2.12       | 38            | 0                 | 0          |
| 39            | 4                 | 0.85       | 39            | 45                | 0.109      |
| 40            | 7                 | 1.49       | 40            | 0                 | 0          |
| 41            | 1                 | 0.21       | 41            | 0                 | 0          |
| 42            | 2                 | 0.42       | 42            | 0                 | 0          |
| 43            | 3                 | 0.64       | 43            | 0                 | 0          |
| 44            | 3                 | 0.64       | 44            | 0                 | 0          |
| 45            | 0                 | 0          | 45            | 0                 | 0          |
| 46            | 0                 | 0          | 46            | 0                 | 0          |
| 47            | 0                 | 0          | 47            | 0                 | 0          |
| 48            | 0                 | 0          | 48            | 0                 | 0          |
| 49            | 2                 | 0.42       | 49            | 0                 | 0          |
| 50            | 0                 | 0          | 50            | 0                 | 0          |
| 51            | 0                 | 0          | 51            | 0                 | 0          |
| 52            | 0                 | 0          | 52            | 0                 | 0          |
| 53            | 0                 | 0          | 53            | 0                 | 0          |
| 54            | 0                 | 0          | 54            | 0                 | 0          |
| 55            | 0                 | 0          | 55            | 0                 | 0          |
| 56            | 0                 | 0          | 56            | 0                 | 0          |
| 57            | 0                 | 0          | 57            | 0                 | 0          |
| 58            | 0                 | 0          | 58            | 0                 | 0          |
| 59            | 0                 | 0          | 59            | 0                 | 0          |
| 60            | 0                 | 0          | 60            | 0                 | 0          |
| 61            | 1                 | 0.21       | 61            | 0                 | 0          |
| 62            | 0                 | 0          | 62            | 0                 | 0          |
| 63            | 0                 | 0          | 63            | 0                 | 0          |
| 64            | 0                 | 0          | 64            | 0                 | 0          |
| 65            | 0                 | 0          | 65            | 0                 | 0          |
| 66            | 0                 | 0          | 66            | 0                 | 0          |
| 67            | 0                 | 0          | 67            | 0                 | 0          |

MFV HEATHER SPRIG DCK 101  
COVERED CODEND TRIAL  
3 VARIANTS

110mm codend  
35mm cover

SPECIES: WHITING  
GEAR: VARIANT 1/COVER

| VARIANT 1     |                   |            | COVER         |                   |            |
|---------------|-------------------|------------|---------------|-------------------|------------|
| SAMPLE TOTAL: | 201               |            | SAMPLE TOTAL: | 900               |            |
| RAISED TOTAL: | 201               |            | RAISED TOTAL: | 20250             |            |
| MLS (cm)      | 27                |            | MLS (cm)      | 27                |            |
| % DISCARDS    | 32                |            | % DISCARDS    | 97                |            |
| % RETAINED    | 68                |            | % RETAINED    | 3                 |            |
| CLASS<br>cm   | RAISED<br>NUMBERS | FREQ.<br>% | CLASS<br>cm   | RAISED<br>NUMBERS | FREQ.<br>% |
| 11            | 2                 | 1          | 11            | 1693              | 5.991      |
| 12            | 2                 | 1          | 12            | 3560              | 12.6       |
| 13            | 3                 | 1.49       | 13            | 4813              | 17.03      |
| 14            | 6                 | 2.99       | 14            | 3001              | 13.45      |
| 15            | 5                 | 2.49       | 15            | 3084              | 10.91      |
| 16            | 10                | 4.98       | 16            | 2459              | 8.702      |
| 17            | 0                 | 0          | 17            | 1230              | 4.353      |
| 18            | 1                 | 0.5        | 18            | 797               | 2.02       |
| 19            | 0                 | 0          | 19            | 619               | 2.191      |
| 20            | 1                 | 0.5        | 20            | 891               | 3.153      |
| 21            | 1                 | 0.5        | 21            | 1027              | 3.634      |
| 22            | 3                 | 1.49       | 22            | 609               | 2.155      |
| 23            | 3                 | 1.49       | 23            | 788               | 2.789      |
| 24            | 9                 | 4.48       | 24            | 763               | 2.7        |
| 25            | 7                 | 3.48       | 25            | 412               | 1.458      |
| 26            | 12                | 5.97       | 26            | 773               | 2.736      |
| 27            | 19                | 9.45       | 27            | 382               | 1.352      |
| 28            | 17                | 8.46       | 28            | 146               | 0.517      |
| 29            | 25                | 12.4       | 29            | 209               | 0.74       |
| 30            | 18                | 8.96       | 30            | 169               | 0.598      |
| 31            | 15                | 7.46       | 31            | 0                 | 0          |
| 32            | 12                | 5.97       | 32            | 33                | 0.117      |
| 33            | 10                | 4.98       | 33            | 0                 | 0          |
| 34            | 5                 | 2.49       | 34            | 0                 | 0          |
| 35            | 4                 | 1.99       | 35            | 0                 | 0          |
| 36            | 2                 | 1          | 36            | 0                 | 0          |
| 37            | 4                 | 1.99       | 37            | 0                 | 0          |
| 38            | 4                 | 1.99       | 38            | 0                 | 0          |
| 39            | 0                 | 0          | 39            | 0                 | 0          |
| 40            | 0                 | 0          | 40            | 0                 | 0          |
| 41            | 1                 | 0.5        | 41            | 0                 | 0          |
| 42            | 0                 | 0          | 42            | 0                 | 0          |
| 43            | 0                 | 0          | 43            | 0                 | 0          |
| 44            | 0                 | 0          | 44            | 0                 | 0          |
| 45            | 0                 | 0          | 45            | 0                 | 0          |
| 46            | 0                 | 0          | 46            | 0                 | 0          |
| 47            | 0                 | 0          | 47            | 0                 | 0          |
| 48            | 0                 | 0          | 48            | 0                 | 0          |
| 49            | 0                 | 0          | 49            | 0                 | 0          |
| 50            | 0                 | 0          | 50            | 0                 | 0          |

MFV HEATHER SPRIG BCK 181  
COVERED CODEND TRIAL  
3 VARIANTS

100mm codend  
35mm cover

SPECIES: WHITING  
GEAR: VARIANT 2/COVER

| VARIANT 2     |     |  | COVER         |       |  |
|---------------|-----|--|---------------|-------|--|
| SAMPLE TOTAL: | 420 |  | SAMPLE TOTAL: | 1117  |  |
| RAISED TOTAL: | 420 |  | RAISED TOTAL: | 38572 |  |
| MLS (cm)      | 27  |  | MLS (cm)      | 27    |  |
| % DISCARDS    | 39  |  | % DISCARDS    | 96    |  |
| % RETAINED    | 61  |  | % RETAINED    | 4     |  |

| CLASS | RAISED  | FREQ. | CLASS | RAISED  | FREQ.  |
|-------|---------|-------|-------|---------|--------|
| cm    | NUMBERS | %     | cm    | NUMBERS | %      |
| 11    | 2       | 0.476 | 11    | 313     | 0.8115 |
| 12    | 4       | 0.952 | 12    | 1351    | 3.5025 |
| 13    | 9       | 2.143 | 13    | 2506    | 6.4969 |
| 14    | 11      | 2.619 | 14    | 3841    | 9.958  |
| 15    | 13      | 3.095 | 15    | 4576    | 11.864 |
| 16    | 15      | 3.571 | 16    | 4892    | 12.683 |
| 17    | 6       | 1.429 | 17    | 3307    | 8.5736 |
| 18    | 4       | 0.952 | 18    | 2653    | 6.878  |
| 19    | 7       | 1.667 | 19    | 2069    | 5.364  |
| 20    | 4       | 0.952 | 20    | 1890    | 4.8999 |
| 21    | 8       | 1.905 | 21    | 2095    | 5.4314 |
| 22    | 17      | 4.048 | 22    | 2234    | 5.7918 |
| 23    | 12      | 2.857 | 23    | 1886    | 4.8896 |
| 24    | 10      | 2.381 | 24    | 1669    | 4.327  |
| 25    | 19      | 4.524 | 25    | 1154    | 2.9918 |
| 26    | 22      | 5.238 | 26    | 675     | 1.75   |
| 27    | 29      | 6.905 | 27    | 525     | 1.3611 |
| 28    | 33      | 7.857 | 28    | 488     | 1.2652 |
| 29    | 41      | 9.762 | 29    | 202     | 0.5237 |
| 30    | 35      | 8.333 | 30    | 218     | 0.5652 |
| 31    | 32      | 7.619 | 31    | 28      | 0.0726 |
| 32    | 23      | 5.476 | 32    | 0       | 0      |
| 33    | 15      | 3.571 | 33    | 0       | 0      |
| 34    | 10      | 2.381 | 34    | 0       | 0      |
| 35    | 16      | 3.81  | 35    | 0       | 0      |
| 36    | 7       | 1.667 | 36    | 0       | 0      |
| 37    | 7       | 1.667 | 37    | 0       | 0      |
| 38    | 4       | 0.952 | 38    | 0       | 0      |
| 39    | 1       | 0.238 | 39    | 0       | 0      |
| 40    | 2       | 0.476 | 40    | 0       | 0      |
| 41    | 0       | 0     | 41    | 0       | 0      |
| 42    | 0       | 0     | 42    | 0       | 0      |
| 43    | 2       | 0.476 | 43    | 0       | 0      |
| 44    | 0       | 0     | 44    | 0       | 0      |
| 45    | 0       | 0     | 45    | 0       | 0      |
| 46    | 0       | 0     | 46    | 0       | 0      |
| 47    | 0       | 0     | 47    | 0       | 0      |
| 48    | 0       | 0     | 48    | 0       | 0      |
| 49    | 0       | 0     | 49    | 0       | 0      |
| 50    | 0       | 0     | 50    | 0       | 0      |

MFV HEATHER SPRIG DCK 101  
COVERED CODEND TRIAL  
3 VARIANTS

120mm codend  
35mm cover

SPECIES: WHITING  
GEAR: VARIANT 3/COVER

| VARIANT 3     |     |  | COVER         |       |  |
|---------------|-----|--|---------------|-------|--|
| SAMPLE TOTAL: | 255 |  | SAMPLE TOTAL: | 731   |  |
| RAISED TOTAL: | 255 |  | RAISED TOTAL: | 23738 |  |
| MLS (cm)      | 27  |  | MLS (cm)      | 27    |  |
| % DISCARDS    | 67  |  | % DISCARDS    | 94    |  |
| % RETAINED    | 33  |  | % RETAINED    | 6     |  |

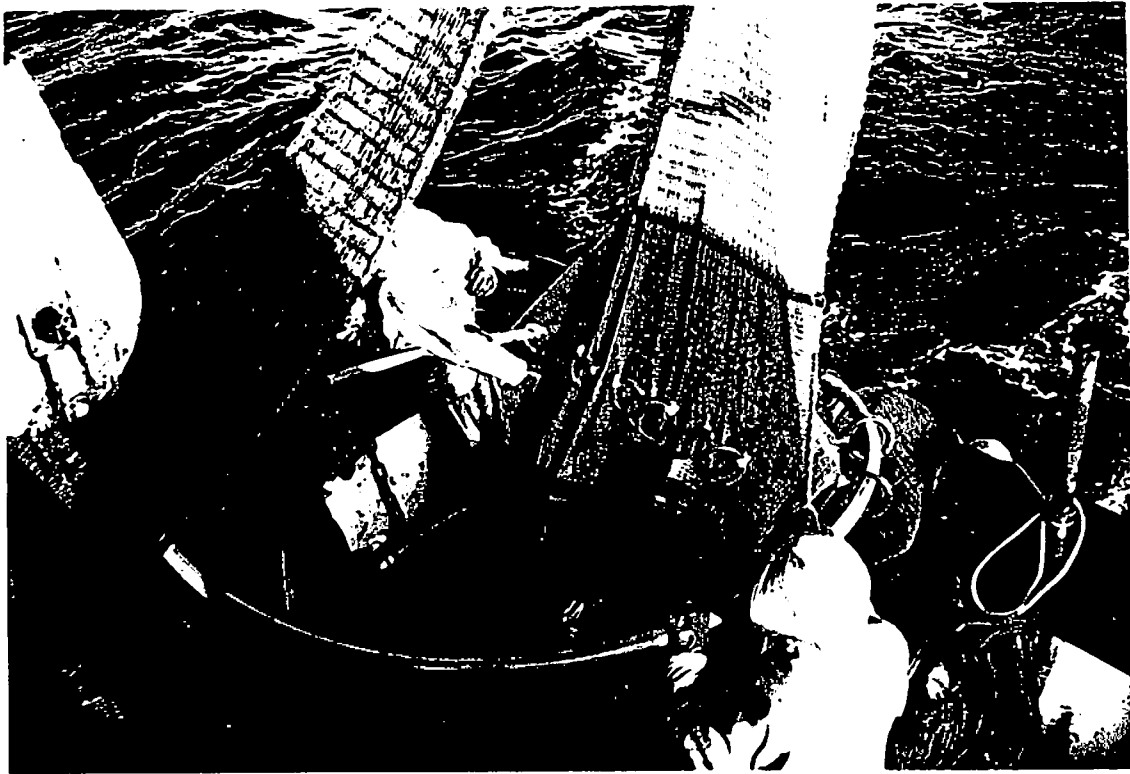
  

| CLASS | RAISED  | FREQ. | CLASS | RAISED  | FREQ. |
|-------|---------|-------|-------|---------|-------|
| cm    | NUMBERS | %     | cm    | NUMBERS | %     |
| 11    | 0       | 0     | 11    | 0       | 0     |
| 12    | 0       | 0     | 12    | 559     | 2.355 |
| 13    | 0       | 0     | 13    | 1091    | 4.596 |
| 14    | 1       | 0.39  | 14    | 1053    | 7.806 |
| 15    | 2       | 0.78  | 15    | 3247    | 13.68 |
| 16    | 6       | 2.35  | 16    | 3927    | 16.54 |
| 17    | 5       | 1.96  | 17    | 2159    | 9.095 |
| 18    | 12      | 4.71  | 18    | 2487    | 10.48 |
| 19    | 8       | 3.14  | 19    | 1217    | 5.127 |
| 20    | 4       | 1.57  | 20    | 1095    | 4.613 |
| 21    | 23      | 9.02  | 21    | 951     | 4.006 |
| 22    | 20      | 7.84  | 22    | 877     | 3.694 |
| 23    | 22      | 8.63  | 23    | 749     | 3.155 |
| 24    | 21      | 8.24  | 24    | 823     | 3.467 |
| 25    | 20      | 7.84  | 25    | 745     | 3.138 |
| 26    | 26      | 10.2  | 26    | 501     | 2.111 |
| 27    | 23      | 9.02  | 27    | 609     | 2.566 |
| 28    | 22      | 8.63  | 28    | 289     | 1.217 |
| 29    | 10      | 3.92  | 29    | 134     | 0.564 |
| 30    | 12      | 4.71  | 30    | 28      | 0.118 |
| 31    | 4       | 1.57  | 31    | 206     | 0.868 |
| 32    | 10      | 3.92  | 32    | 45      | 0.19  |
| 33    | 1       | 0.39  | 33    | 58      | 0.244 |
| 34    | 1       | 0.39  | 34    | 58      | 0.244 |
| 35    | 0       | 0     | 35    | 30      | 0.126 |
| 36    | 0       | 0     | 36    | 0       | 0     |
| 37    | 1       | 0.39  | 37    | 0       | 0     |
| 38    | 0       | 0     | 38    | 0       | 0     |
| 39    | 1       | 0.39  | 39    | 0       | 0     |
| 40    | 0       | 0     | 40    | 0       | 0     |
| 41    | 0       | 0     | 41    | 0       | 0     |
| 42    | 0       | 0     | 42    | 0       | 0     |
| 43    | 0       | 0     | 43    | 0       | 0     |
| 44    | 0       | 0     | 44    | 0       | 0     |
| 45    | 0       | 0     | 45    | 0       | 0     |
| 46    | 0       | 0     | 46    | 0       | 0     |
| 47    | 0       | 0     | 47    | 0       | 0     |
| 48    | 0       | 0     | 48    | 0       | 0     |
| 49    | 0       | 0     | 49    | 0       | 0     |
| 50    | 0       | 0     | 50    | 0       | 0     |

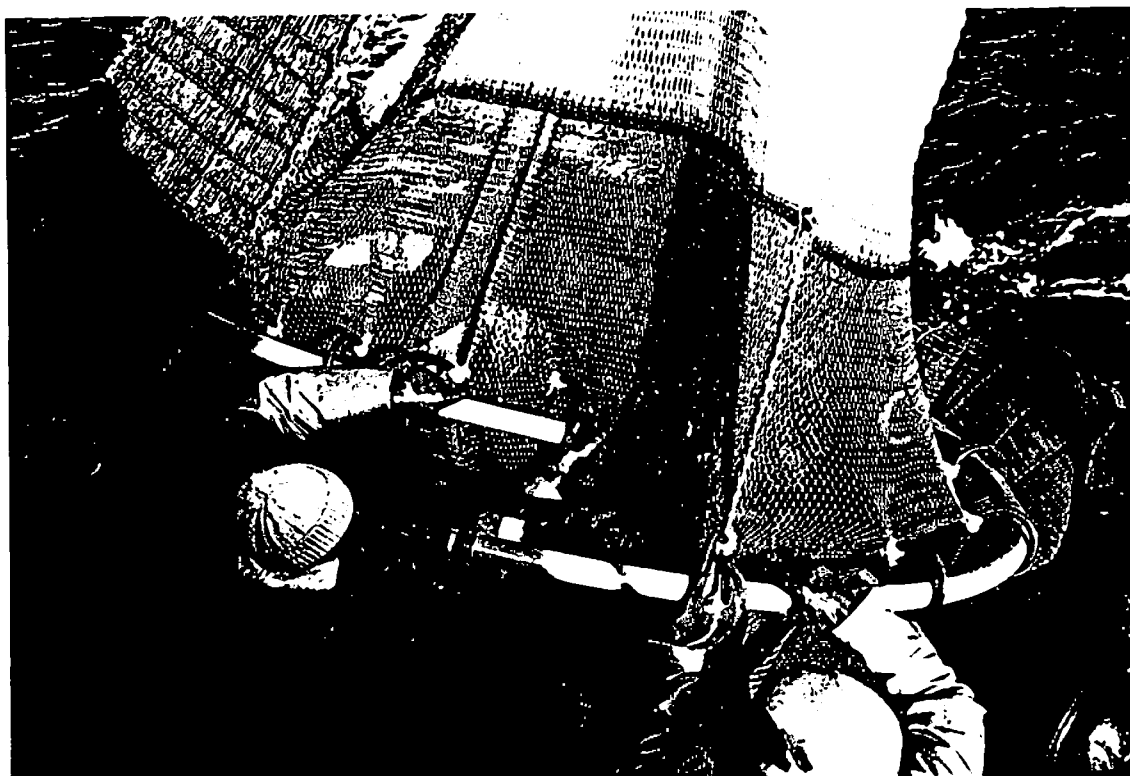
## **Appendix III**

### **Photographs Showing Codend Cover Arrangements Being Operated**

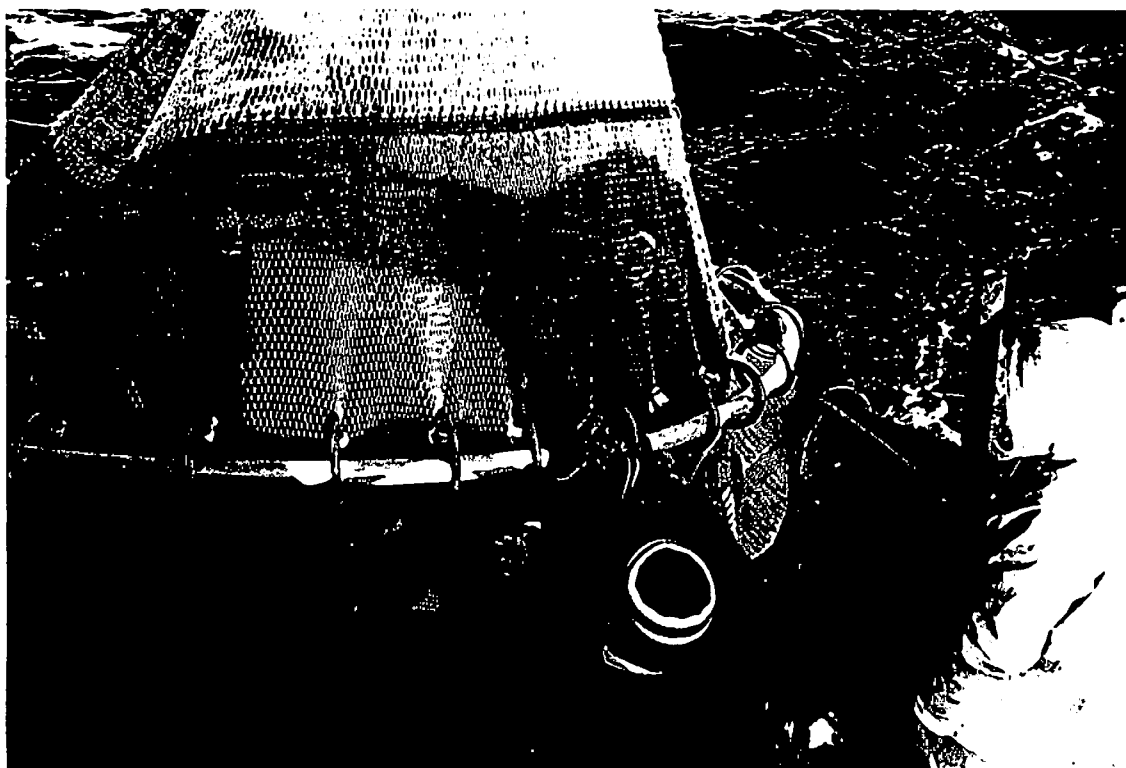
*Attaching support rings to codend cover*



*Attaching support hoops by way of 'codend' rings*

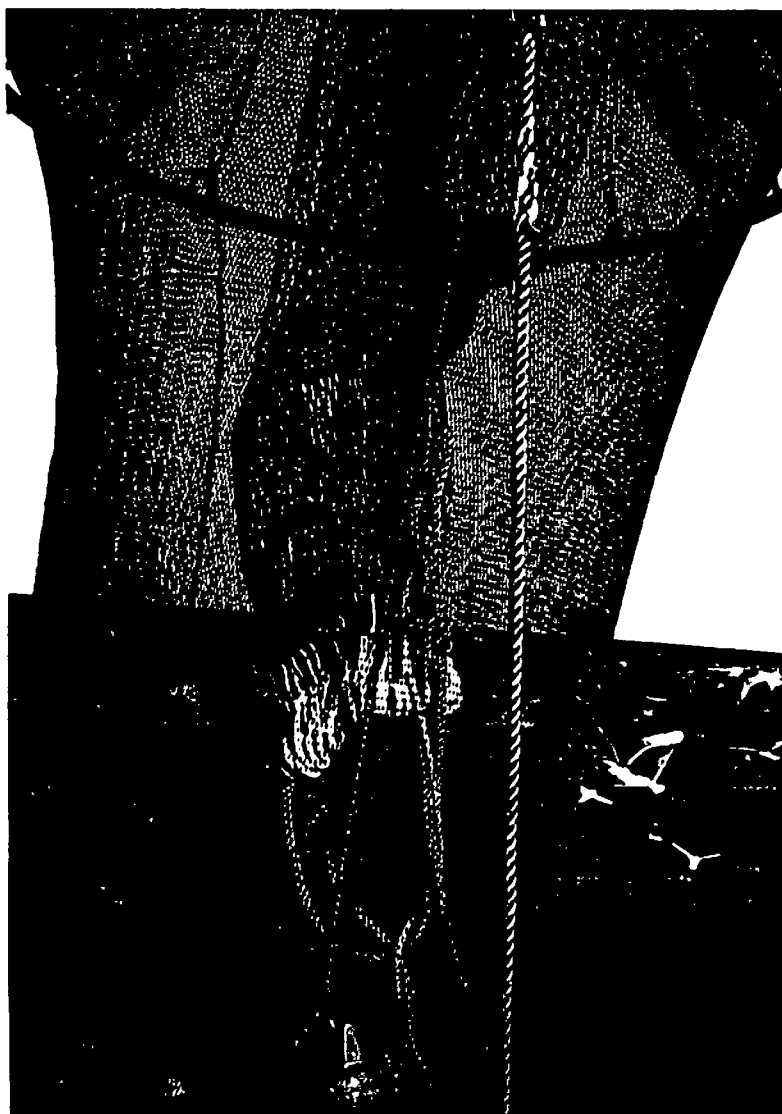
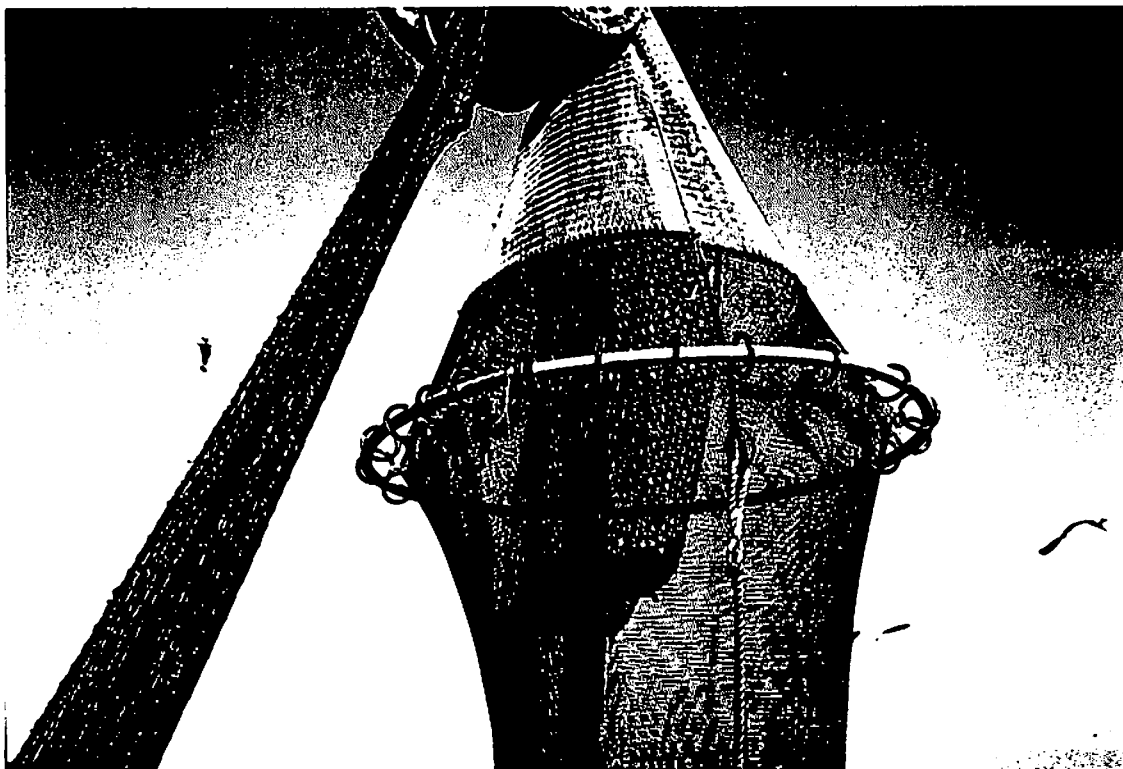


*Closing and securing support ring*

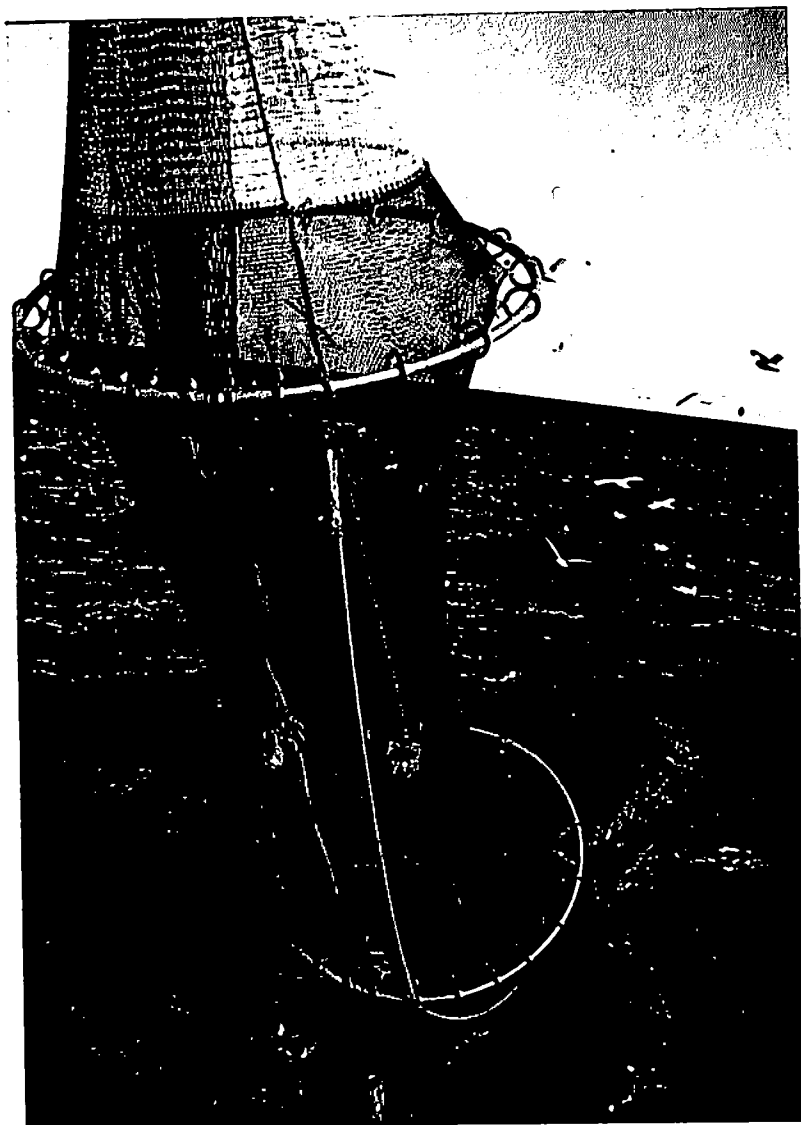




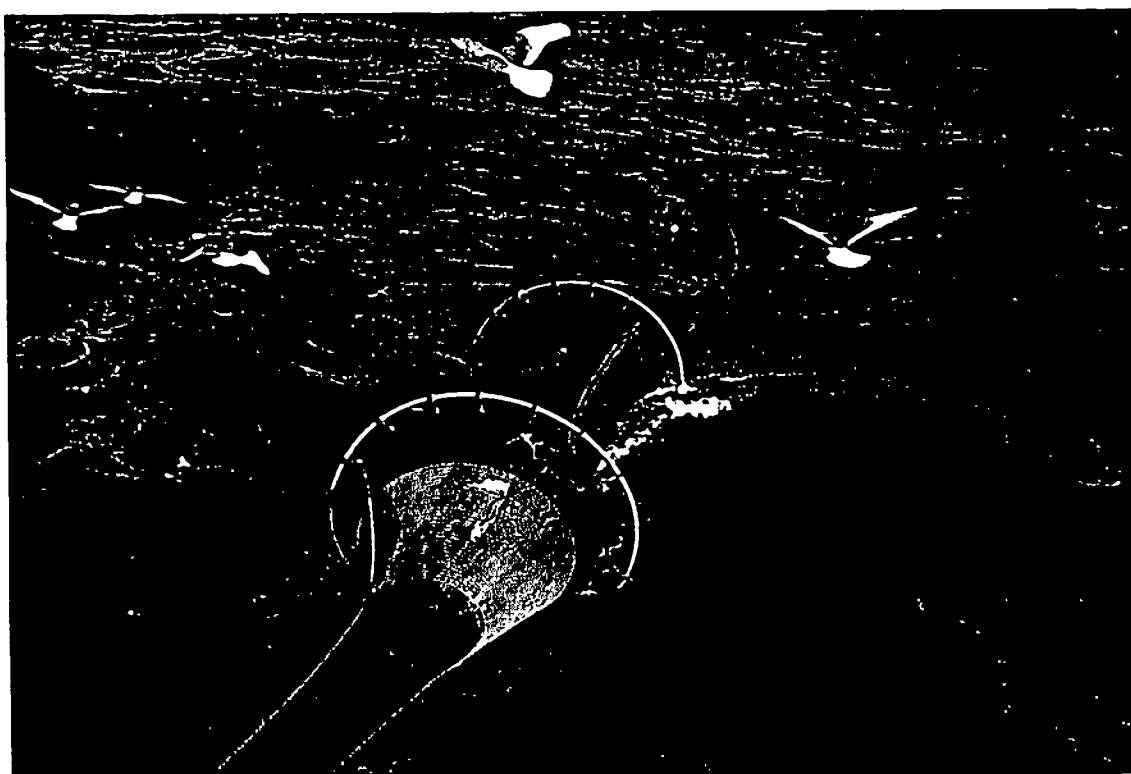
*First ring fitted and suspended from power block prior to fitting second ring*

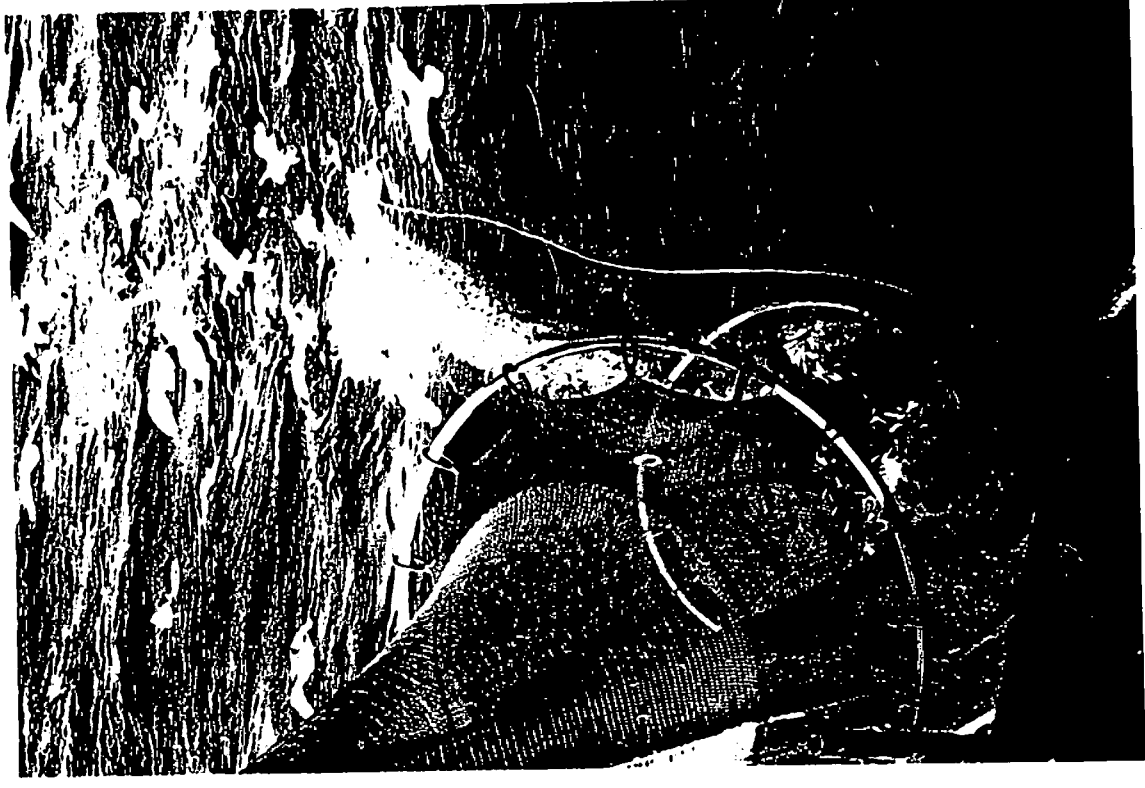


*Codend seen inside small mesh cover*

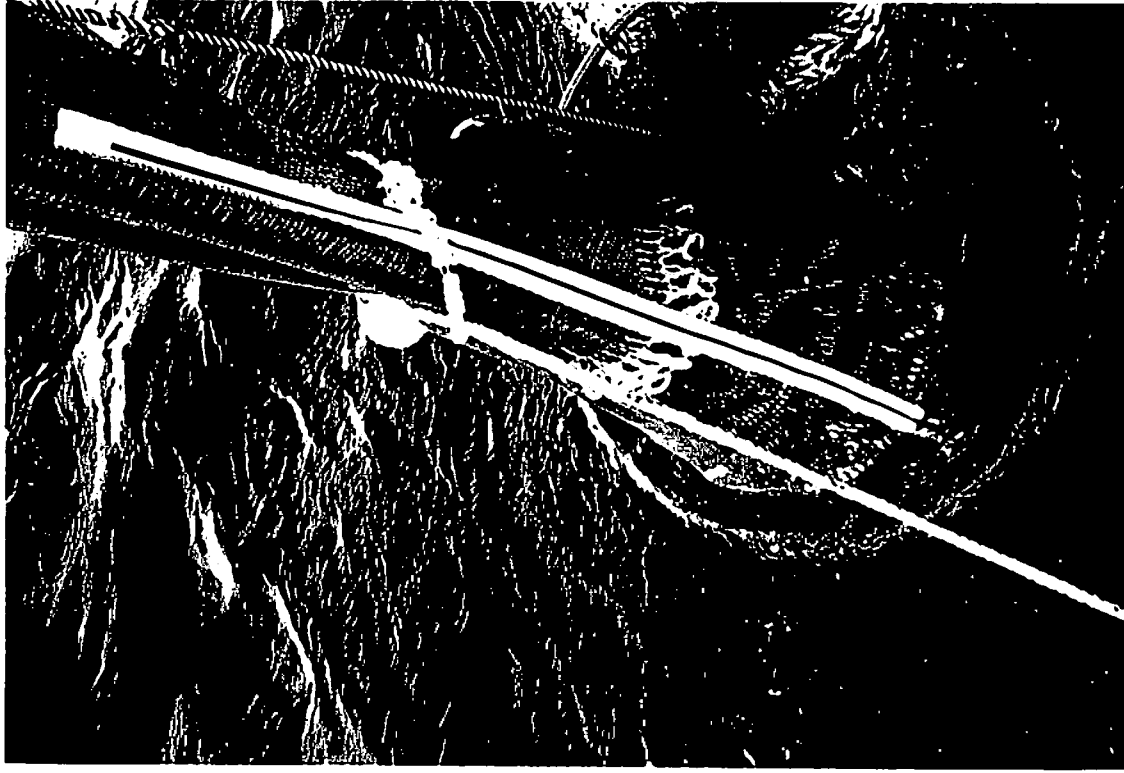


*Cover during shooting operation*





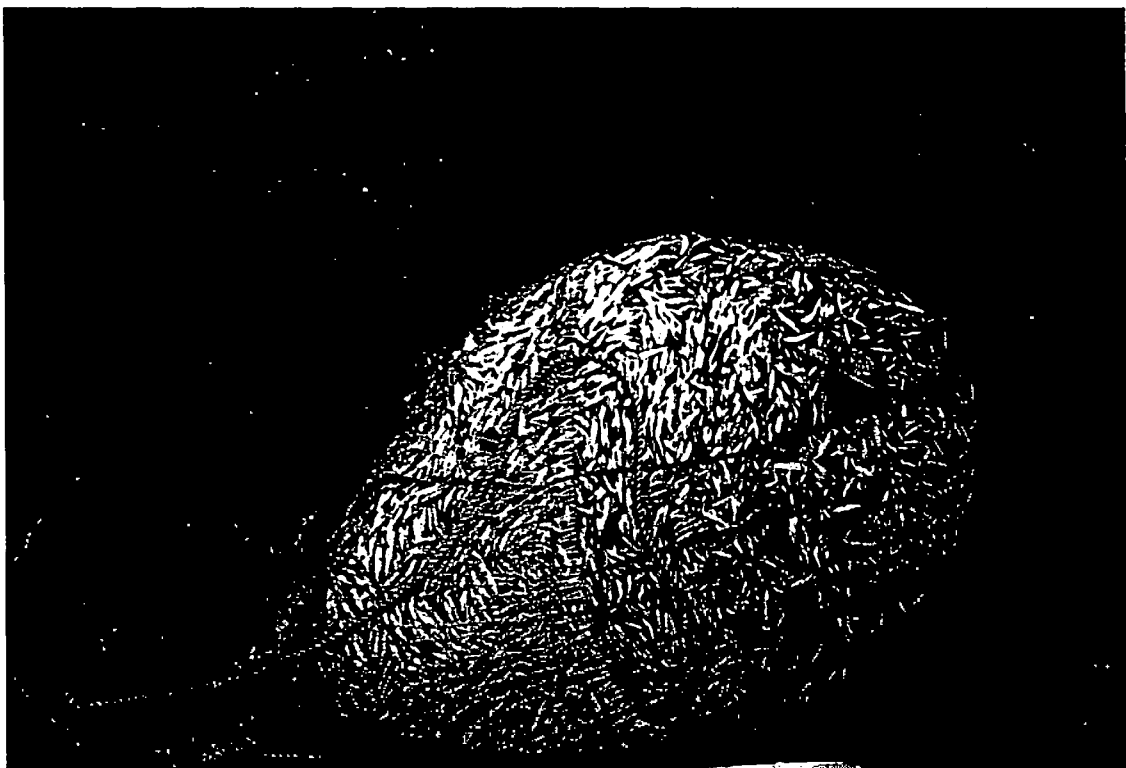
*Cover during hauling procedure*

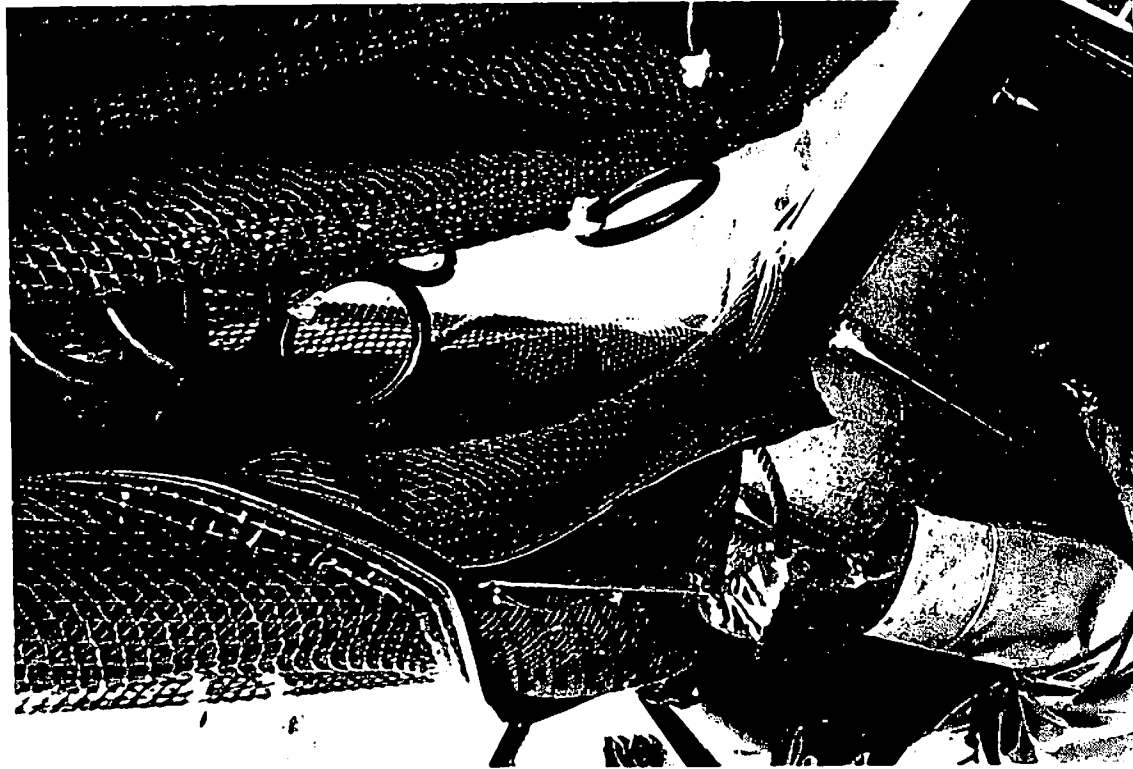


*Cover being hauled alongside. NOTE longitudinal zipper arrangement*

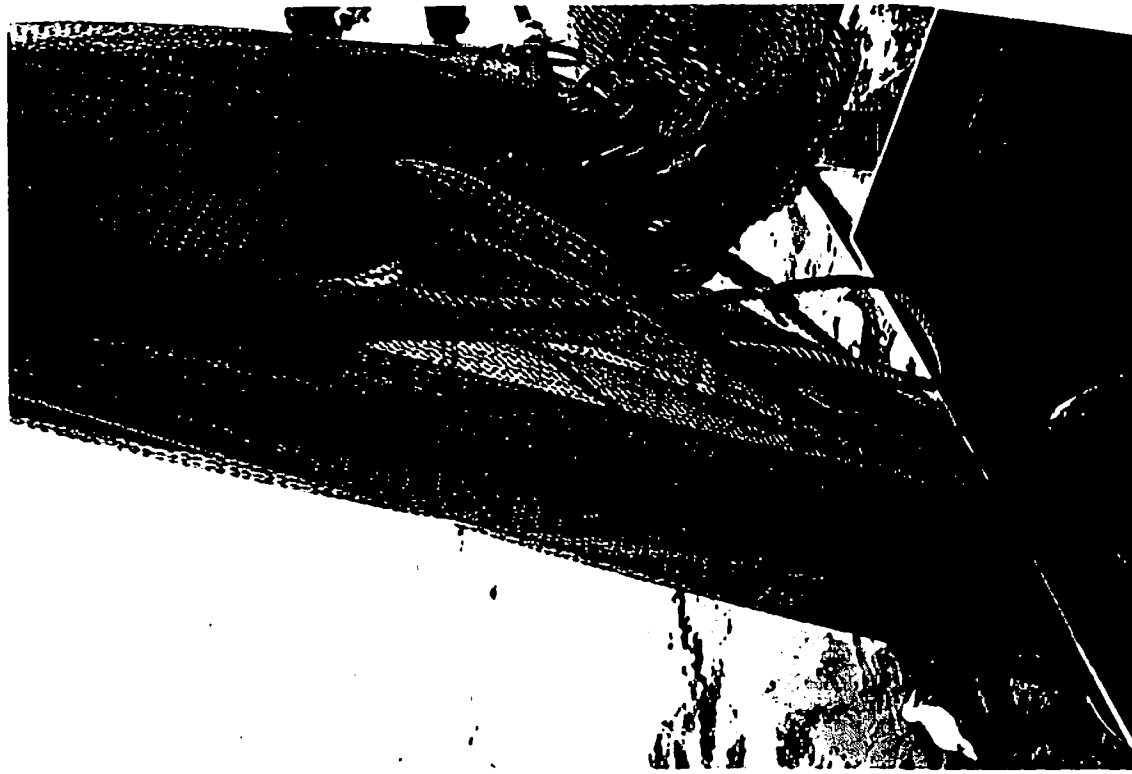


*Cover prior to hauling onboard*

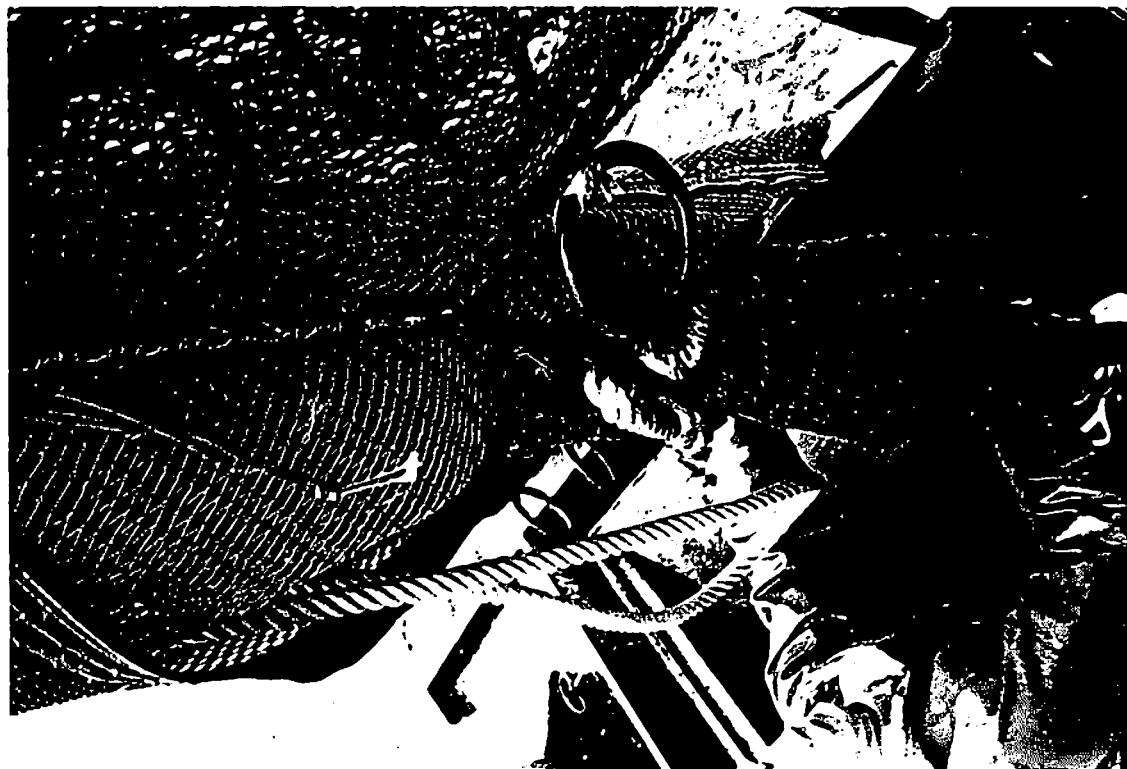




*Zipper being opened to release inside codend*



*Inside codend removed for emptying*



*Inside codend being replaced inside  
cover prior to emptying cover*



*Cover codend being emptied*

