Discard and Effort Survey: Channel ICES Areas VIId and e 1995

Consultancy Report No. CR110

September 1996

MAFF R&D Commission 1994/96
Project Code MF0127

Sea Fish Industry Authority

Technology Division

Discard and Effort Survey: Channel ICES Areas VIId and e 1995

Consultancy Report No. 110
MAFF R&D Commission 1994/96
Project Code MF0127

Authors: G. Course, M. Emberton, W. J. Lart.
Date: 12 September 1996

Acknowledgements

This project could not have been successfully carried out without the willing support of the skippers and crews who took us to sea and allowed us to sample on their vessels and who answered the effort questionnaire. In particular we would like to thank Mr David Pessel and Mr David Scott of NFFO and Mr Malcolm Cooke of the South Western Fish Producers' Organisation who provided valuable contacts and made efforts to find us vessels for sampling. We would also like to thank those in the Sussex, Devon and Cornwall Sea Fisheries Committees and in MAFF at Brixham, Plymouth and Looe who answered our questionnaires.

We would also like to thank Dr Mike Pawson at MAFF DFR who initiated this work and provided us with help at all stages including the drafting of section 5.4. Nick Holmes and Gary Howlett organised the reading of the otoliths.

Finally we would like to thank the Channel Fisheries Study Group who provided the conceptual framework for the study.

Table of Contents

continued.../

Appendices:

continued.../

Figures:

continued..../

continued..../

Tables:

Sea Fish Industry Authority

Technology Division

Discard and Effort Survey: Channel ICES Areas VIId and e 1995

Consultancy Report No. 110
MAFF R&D Commission 1994/96
Project Code MF0127

Authors: G. Course, M. Emberton, W. Lart.
Date: 12 September 1996

Executive Summary

Introduction

Fishery resources in the English Channel are subject to a high level of exploitation by an increasingly mobile and flexible fishing fleet. Resource availability has become dependent upon recruitment variability. Effort is directed onto both quota and non quota species according to availability of resources and quota under the EC Common Fisheries Policy (CFP). Fishery resources are targeted by a variety of métiers[1] and landed to ports in a number of nations. Management regimes and market conditions may vary nationally, regionally and seasonally.

An important component of fisheries assessment is obtaining estimates of the level of total catch and discard rate of a given resource or component of that resource (length group or year class). This improves estimates of fishing mortality and when units of fishing effort pursuing different métiers compete for common resources, observations of total catch across the whole length range are required in order to assess the level of interaction between métiers. This is particularly important in multi-species fisheries such as in those in the English Channel because fish discarded in one fishery may be landed in another. Observations of total catch also enable the investigation of means for reducing discarding through technical conservation measures or encouraging a market for otherwise discarded fish.

Observations of landed catch at markets do not enable a full description of the total catch because a component of that catch is discarded. The criteria used by the fishermen for deciding whether to retain or discard certain species or size group of a species may vary as a consequence of the commercial and management regime under which the fishery is operating.

[1] A métier is defined as a fishing activity which is characterised by one catching gear and a group of target species, operating in a given area during a given season, within which the catches taken by any unit of fishing effort account for the same pattern of exploitation by species and size group.

Outline

This project aimed to examine the feasibility of studying discarding practices in the UK towed gear fisheries pursued in ICES Areas VIId and e of the eastern and western English Channel and to survey the levels and targeting of fishing effort.

The results of the survey are analysed in order to describe the discarding practices and relate these to biological, commercial, gear selectivity and other factors affecting the fisheries. These analyses enable the description of total catch and discarding practices and illustrate the relevance of these data in fishery assessments and in the discussion of the means for reducing discards. They also enable an insight into the motivating factors associated with the fishermen's pursuit or discarding of commercial species.

The report:

- Describes the onboard sampling technique and the measures taken to verify the performance of the technique.

- Describes the strategy adopted for weighting the available sampling effort between métiers and compares the outturn of the survey in terms of the original design.

- Records the results of the effort survey of the fishermen and fisheries organisations, carried out by questionnaire, which describes fishing effort qualitatively in terms of seasonal use of gear types and target species and estimates the seasonal effort in hours fished per quarter in the various métiers sampled.

- Compares the total catch composition (% by number of each species) of the sampled trips by cluster analysis and compares these results with gear type, mesh size, season and main target species.

- Describes the variations in the catch composition and discarding practices between selected codend mesh sizes and ports within the métiers sampled.

- Describes the quarterly variations in catch composition and discarding practices in relation to the relative economic value of the species captured and the named target species as described in the effort survey.

- Estimates by métier, using raising factors derived from the effort survey, the quantity by weight of the major landed and discarded species. These results are presented in the form of métier interaction tables.

- Describes, by métier, the estimated raised length-frequency distributions of the two species, plaice and sole, for which stock assessment is currently carried out.

- Discusses the use of discard data in fishery assessments.

- Discusses observed features of the catch composition of lemon sole, whiting and cuttlefish in relation to features of these species' life cycles.

- Discusses possible means for reducing discarding in lemon sole, plaice and cuttlefish fisheries.

Sampling strategy

The sampling strategy adopted used the métiers defined by the Channel Fisheries Study Group as sampling units. The following towed gear métiers were selected:

Code	Name	Description
U1.1	UK TR WEST	UK otter trawl, western Channel
U1.2	UK TR EAST	UK otter trawl, eastern Channel
U1.3[2]	UK PAIR TR WEST	UK pair trawl, western Channel
U2.1	UK BEAM OFF EAST	UK beam trawl, offshore, eastern Channel
U2.2	UK BEAM OFF WEST	UK beam trawl, offshore, western Channel
U2.3	UK BEAM IN WEST	UK beam trawl, inshore, western Channel
U4.1	UK DREDGE WEST (Scallop)	UK scallop dredge, western Channel
U4.5	UK TR WEST (Queen)	UK queen scallop trawl, western Channel

The sampling strategy weighted the planned sampling effort, in man weeks, on the basis of the proportionate share (by weight) of landings taken from previous landings data (mean 1989-90) of each of the métiers. Of the above métiers only U1.1, U1.2, U1.3 and U2.2 were sampled at levels approaching the original planned level. This was due in part to reluctance by the fishermen from Newlyn and Rye to accept discard officers on vessels pursuing the beam trawling métiers U2.3 and U2.1. Some sampling was achieved in the scallop dredge métier U4.1 but only on vessels using spring loaded gear; access to vessels using French type dredges was denied. No evidence of queen scallop trawling was found during the year of sampling.

The outturn of the sampling effort was compared with a revised plan based on the reported landings for 1995. The method was found to weight sampling effort successfully in the métiers in which landings had not changed substantially during the period between the date of the landing statistics and the year sampled. However landings of the scallop dredge métier increased relative to the other métiers during this period and consequently insufficient sampling effort was undertaken in this métier. Future studies should use more up-to-date landing statistics to weight sampling effort.

Variation in catch composition

The cluster analysis grouped the total catch composition of the trips into groups which broadly correspond to seasonal target species as perceived in the effort survey. Variations in total catch composition were also observed in fisheries using small meshed codends to catch squid; no large catches of other resource species were observed. These observations can be considered manifestations of the fishermen's ability to target fishing on desired resource species and the seasonal variation of the resource species.

For two species, lemon sole and cuttlefish there were adequate data to investigate features of these species' biology which would not be available from market samples. These are discussed in relation to published descriptions of their life cycle as described in Pawson (1995).

---

[2] UK PAIR TR WEST was defined by this study as a subdivision of UK TRAWL WEST. It was not described by the Channel Fisheries Study Group as a separate métier.

Lemon soles were targeted in the western otter trawl métier (U1.1) during the spring and early summer. In this fishery the proportion of small fish was low and discarding occurred at or just larger than the minimum landing size (MLS). This suggests good separation between adults and juveniles in the west. In contrast, the catches of lemon sole in the eastern otter trawl métier (U1.2) during the spring and summer consisted mostly of small fish which resulted in a high discard rate.

Cuttlefish catches consisted of two distinct size groups - adults and juveniles - which were caught in various locations in the Channel in different seasons. Both size distributions were captured on their overwintering grounds in the beam offshore west métier (U2.2) during the spring but the juveniles were discarded. By late spring the adults were targeted in the eastern Channel by the otter trawl east métier (U1.2) where they are considered to spawn, having migrated from their overwintering areas. The modal size of cuttlefish in catches decreased in this métier during the summer suggesting an influx of juveniles; all of these catches were landed. In the autumn both the western trawl métiers targeted adult cuttlefish on their overwintering grounds; juveniles were not present in the catches at this time of year.

Variations in discarding practices

The biological, economic, legal and human influences on discarding practices are discussed.

It was found that the discarding practices were closely related to economic value; species which formed a high proportion of the landed catch or had a high unit value exhibited lower discard rates provided they were large enough to be legally landed or marketed.

The size composition of the high value species in the catches; sole, turbot, brill and bass meant that discarding was rarely required. For minor species; gurnard and pout whiting, the presence of markets for bait in certain ports was found to be an important influence on discarding practice.

There was some evidence that both lemon sole and plaice were retained at a slightly larger size than the MLS when larger fish predominated in the catches. Discarding of whiting appeared to be related to the catch composition; when captured with other more valuable species discarding of the species larger than the MLS increased.

The predominant legal influence on discarding practices was the MLS. No evidence of discarding of over-quota fish was observed.

Fishery assessments

The uses of discard data in fisheries assessments are discussed in terms of:

- Assessments of stocks carried out by ICES working groups.
- The modelling of technical interactions between métiers and the assessment of the effect of conservation measures.
- The assessment of the ecological effects of fishing.

The raised length-frequency data for plaice showed that discarding patterns for the species were variable between métiers. It was found that the proportion of discarded plaice in the otter trawl east (U1.2) métier constituted a significant proportion of the total catch whilst it was much lower in the other métiers. Thus assessment of the plaice stock which normally is based only on biological data from landings from one or more fleets, would be significantly enhanced by the knowledge of discarded numbers at age by métier.

Discard data provide information on the total catch and hence allow the evaluation of fishing mortality across the whole length range of all exploited species. Taking into account the exploitation patterns (selectivity) and levels of effort of the various gears could enable modelling of the technical interactions between métiers and assessment of the effect of conservation measures, such as mesh size increases and closed areas, taken to reduce fishing mortality. The métier interaction tables presented in this study would provide a useful guide for all interacting métiers if discard and effort information were available.

Information on discarded weight and number of commercial and non commercial species can be used to assess the ecological effects of fishing in terms of the mortality of young fish and benthic invertebrates and the provision of a food supply for scavenging species. However it must be recognised that organisms retained in the net are not the only ones to suffer mortality due to fishing, since a proportion of those encountering the gear are killed or damaged *in situ* on the seabed.

Means for reducing discarding

Discard survey data can reveal opportunities for reducing discard levels either by technical conservation measures or by stimulating a market for otherwise discarded fish.

In this study the possibility of reducing discards of lemon sole and plaice in the eastern otter trawl métier (U1.2) and cuttlefish in the beam trawl west métier (U2.2) are discussed. It is emphasised that there was a need for economic, biological and stock assessment parameters to be considered when deciding on suitable courses of action.

Conclusions and further work

The conclusions of the study are that:

- Most discarding of main resource species occurred due to fish being below the MLS or below marketable size in the absence of an MLS. In most cases the size composition of the catches resulted in low discard rates when compared with other Seafish discard studies.

- Further work on studying discarding practices in the English Channel is necessary to adequately describe discarding patterns in métiers which were not adequately sampled.

- There is a requirement for routine monitoring of discards in the Channel fisheries through a sampling scheme stratified by métier. It was identified that the accuracy of assessments of plaice fisheries would be improved by data from such monitoring because of the variation between métiers and the high discard rates of this species in the eastern otter trawl métier.

- The study revealed possible opportunities for further study to reduce discarding by technical measures in cuttlefish, lemon sole and plaice fisheries.

1. Introduction

1.1 English Channel Fisheries

The fisheries in the English Channel are characterised by effort being targeted on many different resource species by a variety of boats on a seasonal basis. Almost all the resources are currently subject to a high level of exploitation with their availability being heavily dependent upon recruitment variability. Increasing mobility of vessels and restrictions on landings of species managed under quota allocations as part of the EC Common Fisheries Policy, has lead to increasing flexibility of effort. Effort is directed onto both quota and non-quota species opportunistically according to availability of resources and quota (Tétard, Boon *et al.*, 1995).

1.2 Purpose of Discard and Effort Studies

In a common resource fishery exploiting a variety of species, units (boats) compete for marketable fish under commercial and management regimes which may vary nationally, regionally and seasonally. The mix of species that are captured is dependent upon;

- the availability of each species due to biological and environmental factors, i.e. recruitment, growth and survival;
- selectivity of the gear;
- the fishermen's knowledge of the spatial and temporal distribution of the stocks which are being sought.

The catch is sorted by the fishermen into fish which are considered as being marketable and the remainder, which are discarded. The perception of marketability may vary as a consequence of changes in the commercial and management regimes. Common resources which are landed in one fishery may be discarded in another fishery with which it interacts.

Studies of the total catch (landings + discards) are intended to increase the accuracy of assessment of individual stocks because discard mortality is then properly accounted for. There is also a requirement to manage fisheries on the basis of all exploited species. In a multi-species fishery in which effort is directed from one resource to another according to resource availability, market forces and management regimes, interactions between fisheries can only be fully described if total catch and discard data are available. Complete assessment of the multi-species fisheries of the English Channel therefore requires discard data.

There is also a requirement to adequately describe fishing effort and the motivating factors which encourage fishermen to pursue or discard particular species. Information on the length-frequency distributions and quantity by weight of discarded species may highlight means by which discarding may be reduced. This could be accomplished either through management measures designed to protect certain size ranges of particular species or by stimulating demand for otherwise discarded species. Observations of total catch could also enable some aspects of the life cycle of exploited species to be more fully described.

Thus discard and effort studies must be considered an important part of fisheries assessment since they enable scientists to gain data on the total catch and discard rates of all species available to fishermen during their normal working conditions. They also provide an opportunity to obtain independent estimates of effort and to gain an insight into the motivating factors which influence targeting and discarding of exploited species.

Data on discards are particularly important in making future predictions of the potential effect of management controls and market changes because the additional information on discarded fish improves the quality of data entered into fisheries models.

2. Aims and Objectives

The requirement for this project was identified by MAFF DFR Lowestoft as a part of the need for discard and effort information for use by the Channel Fisheries Study Group. In particular the Channel Fisheries Study Group's description of the towed gear métiers for the UK currently rely on reported landings and effort data and require estimates of discards in order to more fully describe the impact and interactions of those fisheries.

This project aimed to examine the feasibility of studying discarding practices in the UK towed gear fisheries prosecuted in ICES areas VIId and e; the eastern and western English Channel respectively. The results are analysed with a view to guiding further work and describing the relative contribution of biological, management, gear selectivity, commercial and other factors affecting discarding practices in these fisheries.

The objectives were as follows:

1. To verify certain onboard sampling methods.

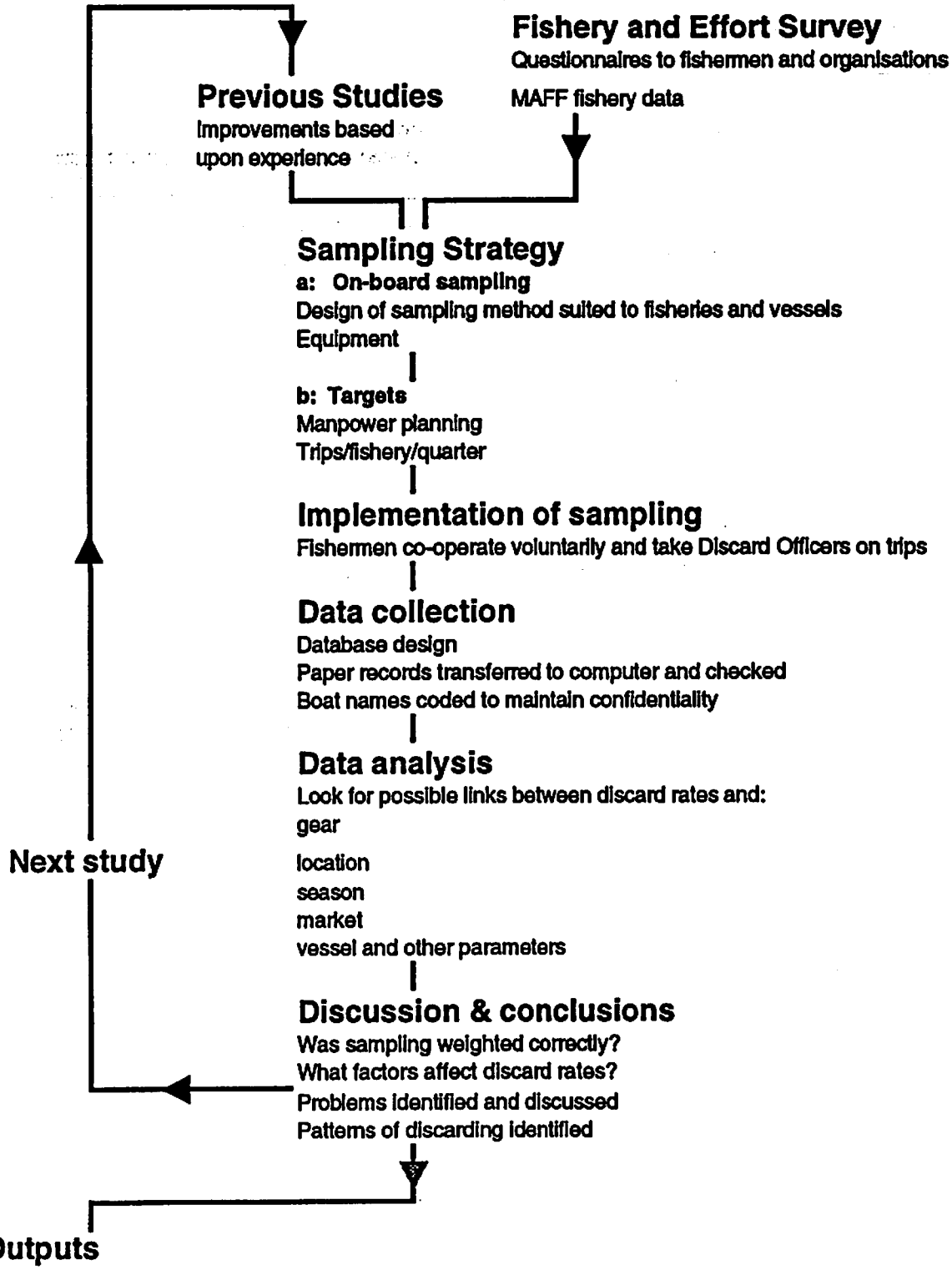
2. To investigate the means by which sampling of effort and catch could be most effectively targeted.

3. To describe the fisheries in terms of seasonal effort and catch and assess the validity of the sampling scheme in terms of total catch composition.

4. To describe and discuss the relative contributions of commercial, management, gear selectivity and biological factors affecting catch composition and discarding practices.

5. To provide estimates of effort, landed and discarded catch by the towed gear métiers for stock assessment purposes.

6. To discuss the means by which discarding could be reduced thereby avoiding wastage of resources.



1 Feasibility studies for MAFF discard monitoring schemes
2 Appropriate sampling methods.
3 Estimates of discard rates of assessed species; potentially used for Fish Stock Assessment
4 Regional descriptions of possible factors affecting Catch composition and Discarding Practices
5 Input in support of selectivity research
6 Identification and quantification of under-utilised resources
7 Descriptions of Fishing Effort

Figure 1. Outline of Seafish Discard Studies Project Plans

3. Methods

3.1 Project Design

Seafish had undertaken a number of studies of discarding practices in towed gear fisheries prior to the commencement of this study (Dunlin and Hepples 1991; Dunlin 1993; Hepples 1993; Emberton, Course and Lart, 1995) and a study of catch composition and effort levels in static gear fisheries (Smith, Lart and Swarbrick 1995).

Arising out of these surveys a system for planning and management of these projects has evolved; this is outlined in Figure 1. Whilst the overall design of these surveys was similar the detailed methods for project planning, onboard sampling methods and analysis of the results has differed according to the particular aims of the project, conditions prevailing in the fisheries and prior knowledge of the fisheries to be studied.

In this survey initial planning was carried out by Seafish in consultation with the Channel Fisheries Study Group during the period October-December 1994. Fishermen's organisations, Producer Organisations and major fishing concerns were approached for their support which was, in the main, granted.

Sampling was initiated during January-February 1995 and the onboard methodology investigated and refined during this period. Thereafter sampling trips were implemented weighted on a quarterly basis as described below (in Section 3.2). Within the overall framework field staff decided where and which vessels to sample during each quarter. Consent to sail on particular vessels was obtained by field staff by approaching the Skipper of the vessel; normally the name and sailing date would be reported to Seafish at Hull for safety purposes. The effort survey was continued throughout this period of the study.

Data were entered and checked on database files throughout this period with extractions carried out at intervals to monitor progress. The final extractions, data processing and writing up were undertaken during January-April 1996.

Outputs take the form of this report and databases on catch and effort are available on discs.

3.2 Sampling Strategy

3.2.1 Métier definition

In order to provide a structured approach to the description of fishing effort, Tétard, Boon *et al.*, (1995) adopted the 'métier' system for describing fishing activity:

> *"A métier is defined as a fishing activity which is characterised by one catching gear and a group of target species, operating in a given area during a given season, within which the catches taken by any unit of fishing effort account for the same pattern of exploitation by species and size group".*

This concept was adopted in order to overcome difficulties with normal assessment data in circumstances where vessels have the freedom to switch between catching gears and

resource species. Because it describes a fishing activity rather than landings or effort on particular stocks, interacting activities can be more fully described in terms of their species composition and the consequences of changes in operating conditions.

The métier system of classification of fisheries requires discard data because it describes differences in 'catch' between fisheries and therefore should include discards as well as landings. Métiers exploiting common resources but landing to different markets may display different discarding characteristics. Therefore effort and landings data alone would not reveal the full extent of interactions.

3.2.2 Weighting sampling effort

Tétard, Boon *et al.*, (1995) was used as the main source of information on towed gear métiers in the Channel and their relative importance. From this a sampling strategy which weighted sampling by métiers and port areas was devised.

The towed gear métiers were selected for sampling are described in Table 1.

The percentage landings in tonnes by métier (from the mean 1989-90 landings data described in Tétard, Boon *et al.*, 1995) were used to apportion the levels of sampling effort in man weeks by métier for the year.

Although the métiers are not defined by port, there is a requirement to coordinate man power allocation throughout the Channel and study period. The main ports associated with the métiers are shown in Table 2. Accordingly the Channel was divided into three port areas Area 1; Southwest Area 2; South centre Area 3; Southeast (Table 7). Tétard, Boon *et al.*, (1995) was used to select the main target ports based on the total landings to that port by a particular métier. The targets also had to take into account seasonal fluctuations in fishing activity.

The planned sampling strategy is shown in Table 3 which indicates which gear type and port should be targeted and how often for each quarter. For manpower planning purposes one Trip = 1 man week of sampling. For otter trawling trips this would consist of 2-4 successive one day trips during one week. Beam trawling trips were longer and could be 5-7 successive days continually at sea.

This sampling scheme was not intended to provide absolute targets to be met every quarter. It was intended to keep the sampling balanced and proportional to the relative level of landings by weight in each métier.

Table 1
Métiers selected for sampling during this study

Code	Name	Activity as described in this report
U1.1	UK TR WEST	Otter trawl west
U1.2	UK TR EAST	Otter trawl east
U1.3*	UK PAIR TR WEST	Pair trawl west
U2.1	UK BEAM OFF EAST	Beam east
U2.3	UK BEAM IN WEST	Beam inshore west
U2.2	UK BEAM OFF WEST	Beam offshore west
U4.1	UK DREDGE WEST (SCALLOP)	Scallop dredge west
U4.5	UK TR WEST (QUEEN)	Queen trawl west

*N.B. PAIR TRAWL WEST was defined in this study as a sub-division of OTTER TRAWL WEST; it does not appear in Tétard, Boon *et al.*, (1995).

Table 2
The main ports associated with the different métiers in the English Channel (derived from Tétard, Boon *et al.*, 1995)

PORT	OTTER W.	OTTER E.	BEAM OFF W.	BEAM OFF E.	BEAM IN W.	SCAL DRED W.	SCAL DRED E.	QUEEN TR. WEST
Brixham	•		•		•	•		
Looe	•					•		•
Newhaven		•					•	
Newlyn	•		•		•	•		
Plymouth	•		•		•	•		•
Poole		•						
Portsmouth				•		•	•	
Rye		•					•	
Shoreham				•				
Weymouth						•		

Table 3
The target ports and man week allocations for the English Channel

QUARTER 1

PORT	OTTER	BEAM OFF	BEAM IN	SCAL DRED	QUEEN TRAWL
Newlyn	1	1	1		
Looe					
Plymouth	1			1	
Brixham	1		1		
Weymouth					
Poole	1				
Portsmouth		1			
Shoreham					
Newhaven	1				
Rye	1		1	1	

QUARTER 2

PORT	OTTER	BEAM OFF	BEAM IN	SCAL DRED	QUEEN TRAWL
Newlyn	1		2		
Looe	1				
Plymouth	1			1	
Brixham	1	1	1	1	
Weymouth					
Poole	1				
Portsmouth					
Shoreham					
Newhaven	1		1		
Rye	1			1	

QUARTER 3

PORT	OTTER	BEAM OFF	BEAM IN	SCAL DRED	QUEEN TRAWL
Newlyn	1		1	1	
Looe	1				
Plymouth	1			1	1
Brixham	1	1	1	1	
Weymouth					
Poole	1				
Portsmouth					
Shoreham					
Newhaven	1				
Rye	1		1		

QUARTER 4

PORT	OTTER	BEAM OFF	BEAM IN	SCAL DRED	QUEEN TRAWL
Newlyn	1	1	1	1	
Looe	1				
Plymouth	1		1		1
Brixham	1		1		
Weymouth					
Poole	1				
Portsmouth					
Shoreham					
Newhaven	1				
Rye	1		1	1	

3.3 Effort Survey

This was carried out by questionnaire designed so that information from both fishermen (skippers) and fisheries related organisations (Sea Fisheries Committees, MAFF offices, Producer Organisations) could be obtained. Unfilled examples of these are shown in Figures 2 and 3 respectively.

The organisations' questionnaires were sent out prior to the commencement of sampling so that the completed forms could be used to aid in the distribution of sampling effort and manpower. These requested information on fishing effort from the important ports in that area, so that the number of boats operating in a particular métier could be identified. However, due to lack of response from the first circulation of these questionnaires, the questionnaires were reissued to fisheries organisations when sampling was completed.

The fishermen's questionnaires were designed to provide information on the boats' specifications, which species were targeted and in which months this occurred. Fishing effort levels in terms of hours fished per day and days fished per month for each boat were requested, as was the fishermen's own estimates of total effort in terms of numbers of boats pursuing the same activity from the port where they were interviewed.

The fishermen's own perceptions of the target species fished each month and the gear types used to target each species were noted. Where possible information was also obtained on the reasons for changing to different gear types.

The questionnaires for fisherman were expected to be retrieved by one of three routes:

- Questionnaires were distributed, during reconnaissance tours of the ports with completed forms to be gathered in again on the next visit to that area.
- To be completed during personal interviews with fishermen in port.
- To be completed during personal interviews with fishermen whilst the discard officer was on board carrying out a sample trip.

CHANNEL DISCARD QUESTIONNAIRE FOR FISHERMEN

DATE:		SHEET NO:	

Boat Code No:	
Registered (Y/N):	
Home Port:	
Power (HP):	
LOA:	
Gear Type:	

Target Species:	

Seasons Fished by Month for the Main Target Species:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Main Fishing Grounds:	

Typical Seabed Type:	
Distance to Grounds:	
No. of Hauls/Day:	
Average Tow Time:	
Number of Days Fished/Month:	
General Towing Speed:	

Any gear changeover in year (Y/N): If Yes, when and why:

How many boats do you think are involved in this activity with this gear from this port:	
Does this change throughout the year. If Yes, why?	

Additional comments:

All information will be treated in the strictest confidence. No individual vessel or gear will be identified in any material published as a result of this survey. Your assistance is greatly appreciated.

Signed Research Officer .....

Figure 2. Channel Effort Questionnaire for Fishermen

Date		Sheet No.

Name of Organisation:
Please give a brief explanation of your role in fisheries:
What area of coast and 3 main ports are you associated with? Area:
Main Ports: 1) 2) 3)

Please fill in the following tables with approximate number of boats, main target species and ground usually fished:

Port 1	Number	Target Species	Ground
Otter Inshore			
Otter Offshore			
Beam Inshore			
Beam Offshore			
Scallop Dredge Inshore			
Scallop Dredge Offshore			
Important Others			

Port 2	Number	Target Species	Ground
Otter Inshore			
Otter Offshore			
Beam Inshore			
Beam Offshore			
Scallop Dredge Inshore			
Scallop Dredge Offshore			
Important Others			

Port 3	Number	Target Species	Ground
Otter Inshore			
Otter Offshore			
Beam Inshore			
Beam Offshore			
Scallop Dredge Inshore			
Scallop Dredge Offshore			
Important Others			

How many days a month does your average vessel spend at sea?

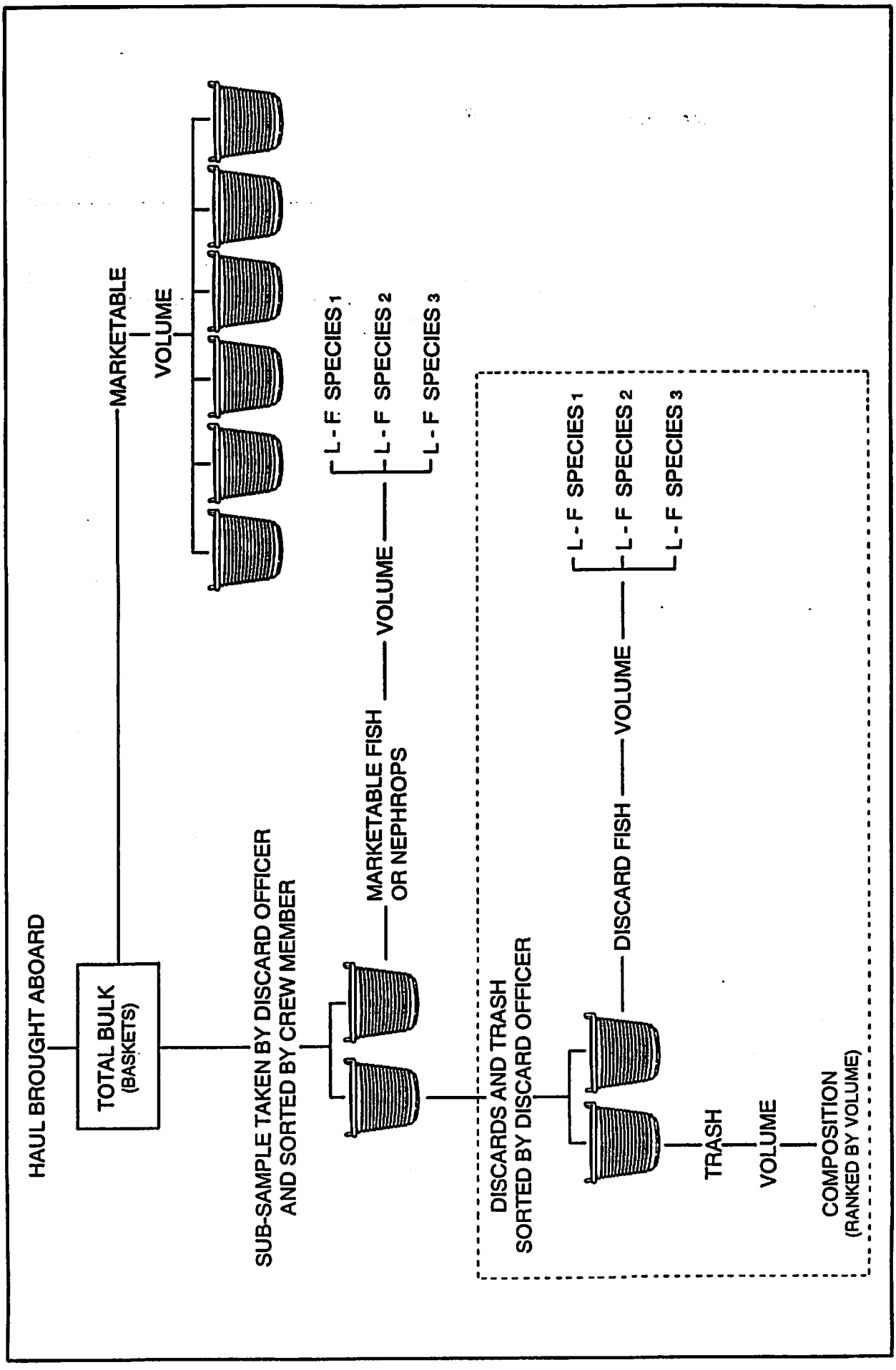
Are there any regular seasonal variations that occur in your area?

Additional comments:

All information will be treated in the strictest confidence and no individual vesel or gear will be identified.

Signed Research Officer.....

Figure 3. Channel Fisheries Effort Questionnaire for Fisheries Organisations



Sampling Method: Otter and Beam Trawlers Fig.4

3.4 Onboard Catch Sampling

A sampling trip was defined as a either a series of day trips (usually 2 or 3 days) on board the same vessel or a continuous trip lasting up to 7 nights. If the gear type was changed during this time this was defined as another trip.

Sampling was carried out on as many hauls as practicable during each trip. On long trips attempts were made to avoid any diurnal variation by sampling equal numbers of day and night hauls. Data collected for each trip are shown in Table 4 and for each haul in Table 5. Equipment used is listed in Table 6.

3.4.1 Sampling technique - otter and beam trawlers

In previous studies (Emberton *et al.*, 1995) a sampling method was developed for use on otter and beam trawlers. This was adopted as described below.

Catch processing

On all of the vessels studied, the basic procedure for catch processing was found to be similar:

A: catch emptied from codend(s) onto deck or into pounds.
B: gear checked and shot away again.
C: entire catch sorted prior to gutting; discards were dumped and the retained catch was sorted into baskets.
D: catch then gutted, washed and stowed as appropriate.

Catch sampling

The sampling method was designed to fit into this procedure with the minimum of disruption to normal routines and is described pictorially in Figure 4.

1 (during B above):
Prior to any sorting by the crew, a sub-sample was taken from the whole, and as yet untouched catch. This was done using a shovel, by vertically sampling each horizontal quarter of the catch until the required sample size was obtained (usually 1 or 2 baskets). These baskets were then set aside.

2 (after C but prior to D above):
The volume (in baskets) of all fish retained by the crew was recorded.

3 (after C but prior to D above):
The sample was then sorted by the crew into landings and discards/trash.

The volumes of the retained and discarded fish and other components described as trash (see below) from the sub-sample was estimated using the calibrated baskets. Length-frequency distributions of the retained and discarded fish by species were obtained for the fish in the sub-sample. Where the volume of discarded fish was too high to be processed in a reasonable time (approximately half a 37kg basket per haul was the normal quantity) the amount of discards was reduced by Dutch shuffle and an additional raising factor obtained for these discards. The discards were then analysed in the same way. Otoliths were removed as required:

Lemon sole: 5 otoliths per trip from every 2cm length group starting at 15cm.
Plaice: 5 otoliths per trip from every 5cm length group starting at 15cm.
Whiting: 5 otoliths per trip from every 5cm length group starting at 15cm.

The trash (sorted from sub-sample) was ranked by volume and the components of the trash were coded for database entry and are listed below to help with future use of the archive data:

No trash present	N
Mud	MUD
Coal	COA
Sand	SAN
Crab	CRB
Shells (dead)	SHE
Whelk egg cases	EGG
Starfish	STA
Jellyfish	JEL
Hydroids and algae	WEE
Stones	STO
Sea urchins	URC

Catch raising factors
The raising factor to haul level for total catch both landings and discards was calculated as follows:

$$\textit{Raising Factor to Haul (RFH)} = \frac{\textit{Total volume of fish retained from haul}}{\textit{Total volume of retained fish in sample}}$$

3.4.2 Sampling technique - scallop dredges

When emptied onto the deck of a vessel, scallop dredge catches were invariably found to be composed mainly of rocks. These catches are difficult to sample by shovel in the normal way. Consequently, a suitable method was developed.

Catch processing

The catch processing routine aboard dredgers was found to be generally as follows:

A: dredges emptied down each side of deck.
B: gear checked and shot away again.
C: scallops and fish selected from catch, and discards and trash are dumped.
D: scallops measured against a gauge. Undersized animals are dumped. The retained scallops are counted and bagged. Retained fish are gutted, washed and stowed.

Catch sampling

1 (during B, above):
A section of the deck was chosen each haul and from this all of the catch excluding stones was collected until a basket was filled. Care was taken to ensure that all sections of the deck were adequately sampled over the course of the trip; usually this involved taking samples from alternate sides of the vessel.

2 (during C, above):
A crew member selected all of the marketable fish and scallops from the sample. These were then analysed by species and length-frequency distributions obtained by the discard officer. The observations were recorded and this retained portion of the catch was then returned to the crew for normal processing.

3: The discarded fish and scallops were also analysed as above and were then dumped.

4 (after D, above):
The crew were asked for the total number of scallops retained for that haul.

Haul raising factors

Raising factor: scallops (also used for fish captured in scallop dredges).

$$\textit{Raising Factor to Haul (RFH[Sc])} = \frac{\textit{Total number of scallops landed from haul}}{\textit{Number of scallops landed from sample}}$$

A refinement of this technique which was possible on small vessels in good weather was to measure all the fish (both marketable and discarded) from each haul. Thus these fish would be allocated a raising factor of 1.0.

Tables 4, 5 and 6
Data collected by trip and haul and equipment used for discard sampling

Table 4 Data Collected for Each Trip

Sailing and Landing Details
Date of sailing and landing
Port of landing
Landing tally by species (boxes or stones)
Boat Details
Port of sailing
Number of crew available to process catch
Gear type (beam trawl, otter trawl, scallop dredge)
Beam/fishing line length (metre) - not measured but informed by skipper
Codend mesh size (mm) - as above

Table 5 Data Collected for Each Haul

Date
Shoot time
Shoot position
Shoot depth (fathoms)
Haul time
Haul depth (fathoms)

Table 6 Equipment Used for Discard Studies

Measuring board
Data recording forms
Pencil
Otolith knife
Otolith storage board
Calibrated fish baskets - nominally 6 stone (37kg) but actual capacity dependent upon species marked in tenths
Shovel

3.4.3 Species codes and size measurements

A complete list of species and their coding in this report is shown in Table 58, Appendix 1. Size measurements to the nearest centimetre below were made as follows:

Fish excluding rays
Total length from snout to longest tail finray.

Rays
Total width (wingspan).

Cephalopods
Dorsal length of the mantle from funnel to anterior end.

Scallops
Shell length parallel with hinge.

3.4.4 Between sample variation

In order to examine between-sample variation, each sample of every haul was analysed on a three-day otter trawl trip (métier = U1.1 Otter Trawl West) undertaken during the first quarter of the study.

The whole bulk of the catch of each haul was sampled in the normal way using a shovel and placed in baskets. The samples were then sorted into landings and discards by the fishermen. The sorted landings and discards were kept separate for each sample and the order in which the samples were taken was noted. The volumes of landings and discards and trash were noted and length-frequency distributions of all species were obtained in the normal way.

3.4.5 Data processing

The raw data were stored on Borland Paradox™ datafiles and processed using Microsoft Excel™ and NAG™ GENSTAT©.

Discards and landings by number and weight of all species (see Appendix 1 for species codes) were raised to haul level (using RFH and RFH[Sc] as appropriate) and then aggregated to the factor being investigated. The results were not raised by effort at this stage; they only represent the results from the trips actually observed.

Weights (kg) were calculated using the appropriate length-weight relationships (Bedford *et al.*,, 1986; Harley pers comm, 1996).

The percentage discard rate and percentage of discards above the Minimum Landing Size (MLS) by number were also calculated (where appropriate):

$$\% \ Discard = \left(\frac{No.\ Discarded}{Total\ Catch} \right) * 100\%$$

$$\% \ Discard > MLS = \left(\frac{No.\ Discarded > MLS}{Total\ Catch} \right) * 100\%$$

Where Total Catch = No. Discarded + No. Landed

Unit values (£/kg) of the species were only obtainable (from MAFF and Seafish databases) as mean values by port for the period January-November 1995. These were calculated as mean values by métier where appropriate.

The estimated values of the landed catch were obtained from the unit values of each species multiplied by their estimated weight. From these results the proportional value of each species the values of the total landings was calculated by port or métier and quarter as appropriate. These are only considered to provide a guide to the relative values of the species in the landed catch; supply and demand would be expected to also have an influence and the size/grade of the fish was not taken into account.

Table 7
Targets and Achievements by Quarter

First Quarter(Jan-Mar inclusive)	Manweeks							
	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1;South West (Newl, Looe, Plym, Brix).	3	1	3	4	1	0	0	0
Area2;South Centre (Weym, Poole, Portsm).	1	0	1	0	0	0	0	0
Area3;South East (Shoreham, Newh, Rye).	1	1	2	2	1	0	0	0
TOTALS	5	2	6	6	2	0	0	0
TOTAL TRIPS	13	8						

Second Quarter(Apr-Jun inclusive)	Manweeks							
	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1;South West (Newl, Looe, Plym, Brix).	4	3	4	5	2	2	0	0
Area2;South Centre (Weym, Poole, Portsm).	0	0	1	0	0	0	0	0
Area3;South East (Shoreham, Newh, Rye).	1	0	2	2	1	0	0	0
TOTALS	5	3	7	7	3	2	0	0
TOTAL TRIPS	15	12						

Third Quarter(Jul-Sept inclusive)	Manweeks							
	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1;South West (Newl, Looe, Plym, Brix).	3	1	4	6	3	1	1	0
Area2;South Centre (Weym, Poole, Portsm).	0	0	1	0	0	0	0	0
Area3;South East (Shoreham, Newh, Rye).	1	0	2	2	0	0	0	0
TOTALS	4	1	7	8	3	1	1	0
TOTAL TRIPS	15	10						

Fourth Quarter(Oct-Dec inclusive)	Manweeks							
UPDATE 24/10/95	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1;South West (Newl, Looe, Plym, Brix).	4	2	4	5	1	0	1	0
Area2;South Centre (Weym, Poole, Portsm).	0	0	1	0	0	0	0	0
Area3;South East (Shoreham, Newh, Rye).	1	0	2	1	1	0	0	0
TOTALS	5	2	7	6	2	0	1	0
TOTAL TRIPS	15	8						

ANNUAL NUMBER OF TRIPS	58	38

4. Results

4.1 Sampling Strategy

4.1.1 Targets and achievements by port and gear

The information concerning the number of targeted trips, with one man week being taken as one sea trip and the actual sampling trips achieved for each of the four quarters are shown in Table 7.

Quarter 1

There were 13 targeted man weeks of sampling the 1st quarter. From Table 7 it can be seen that only 8 sea trips were achieved. This was mainly due to the constraints of poor winter weather leading to cancelled trips and through the requirement to establish contacts with compliant skippers. Since the lowest weight was attached to Area 2 it was not sampled at all. The length of the beam trawler trips in Area 1 (up to 7 nights) also reduced the manpower available for other métiers. The discard officers were unable to find any vessels scallop dredging from the ports surveyed this quarter in Area 3.

Quarter 2

A total of 13 trips was achieved out of a total target of 15. These trips are well distributed amongst the areas and ports; the only serious deficit was beam trawling from the southeast group of ports. All of the scallop dredging trips were on vessels using spring-loaded Newhaven dredges; no boats using French dredges were sampled.

Quarter 3

A total of 15 trips were planned for this quarter and 10 of these trips were achieved. As in other quarters, no trips were achieved in Area 2 (central). Only one western beam trawl trip out of the targeted 3 was achieved and no beam trawlers were sampled in the east (target = 1 trip). The otter trawl west métier was over sampled by two trips and the eastern otter trawl target was successfully fulfilled. Of the 3 targeted scallop trips in the west only 1 was achieved and although queen trawling was targeted in the west no evidence of this activity occurring could be found.

Quarter 4

Only 8 trips out of a target of 15 were achieved for the fourth quarter. In December several planned trips were cancelled by the skippers due to poor weather conditions, resulting in no sampling trips being carried out in this month. Of the three sample areas only the southwest (Area 1) was well sampled and the number of planned otter trawl west trips was exceeded. However there was an overall shortfall in the other métiers. Of the four planned trips from the southeast (Area 3), only one otter trawl trip was achieved and this trip consisted of only one haul the trip being abandoned due to worsening weather conditions. Two scallop trips in the west were planned for this quarter but very little of this activity was occurring and access to vessels that were using French dredges was denied. A queen scallop trawl trip was also targeted for this quarter, but no evidence of this métier was found.

Tables 8 and 9
Targets and achievements for all quarters in the English Channel Discard Study
Comparison between original sampling allocation based on previous landings and outturn for 1995

Table 8: Targets based on the landing statistics from Telard, Boon et al 1995 prior to sampling

All Quarters (Jan-Dec inclusive)	Manweeks							
UPDATE 13/02/96	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1: South West (Newl, Looe, Plym, Brix)	14	7	15	20	7	3	2	0
Area2: South Centre (Weym, Poole, Portsm	1	0	4	0	0	0	0	0
Area3: South East (Shoreham, Newh, Rye)	4	1	8	7	3	0	0	0
TOTALS	19	8	27	27	10	3	2	0
	Target	Achieved	Diff.					
TOTAL TRIPS	58	38	20					

Table 9: Targets based on the 1995 (January-November) MAFF landing statistics

All Quarters (Jan-Dec inclusive)	Manweeks							
UPDATE 13/02/96	Beam		Otter		Scallop		Queenie	
	Target	Achieved	Target	Achieved	Target	Achieved	Target	Achieved
Area1: South West (Newl, Looe, Plym, Brix)	10	7	20	20	20	3	0	0
Area2: South Centre (Weym, Poole, Portsm	0	0	0	0	0	0	0	0
Area3: South East (Shoreham, Newh, Rye)	5	1	6	7	0	0	0	0
TOTALS	15	8	26	27	20	3	0	0
	Target	Achieved	Diff.					
TOTAL TRIPS	61	38	23					

No targets were set for Area 2 as landings only specify area caught, i.e. areas VIIe & VIId.

4.1.2 Comparison with 1995 landings data

The sampling trip allocations were revised at the end of the study using the landings statistics from vessels fishing in VIId and VIIe (supplied by MAFF) for January-November 1995 inclusive. These were allocated using the same procedure above based on percentage of landings by weight in each métier. The man week allocation based on this landings data is compared with the original sampling strategy and outturn in Tables 8 and 9.

From Table 8 it can be seen that of the total 58 planned sample trips, 38 were achieved. Otter trawling métiers were completely sampled; beam trawling métiers were under-sampled by 11 trips; scallop dredging was under-sampled by 8 trips and of the 2 planned queenie trawl trips none were achieved there being no evidence of effort in this métier during this year. No trips were sampled from the central Channel (Area 2), although 5 trips were planned.

In Table 9 the targets have been adjusted using the landings data for January-November 1995. This allows a comparison between what was targeted, what would have have been targeted using the same weighting scheme applied to current landings data, and what was actually achieved. No targets are given for the central region because this table is based on landings data divided into the eastern and western Channel ICES areas (VIId & e), rather than by port.

The most important difference between the two targets tables is the growth in the importance of scallop dredging; there is also a reduction in the requirement for beam trawling sampling. These differences reflect changes in the landed weight per annum from these gear types.

As far as achievements are concerned the outturn of numbers of trips in the western channel beam and west and eastern otter trawling gears were in line with the revised targets. The deficiency in scallop dredging is due partly to the low target set making it less of a priority and the lack of access to boats using French dredges. However with hindsight the scallop dredge métier should have been given more weight at the expense of the trawling métiers since the intention was to weight the trips according to the landings.

(Note: because the MAFF statistics upon which these results are based only cover the period January-November 1995 there may be some distortion in these figures in favour of scallop dredging because scallop dredging effort is a summer activity [section 4.3.2]).

4.1.3 Sampling achievements by métier

Table 10 summarises the total number of trips and the total duration of hauls in the métiers actually sampled. Of the 7 métiers listed above (section 3.2.2) four were successfully sampled with a fifth (U2.1 Beam East) having been sampled on only one trip. There was not much activity in the beam inshore west métier at the ports sampled and no queenie trawling was observed.

The total number of beam trawling trips was less than otter trawling trips. However the increased length of these trips and the fact that most of the otter trawling trips were day boats which did not fish all night, meant that the actual number of hours sampled in beam trawl west exceeded those for otter trawl west.

Table 10
Number of trips and total duration of trawling sampled by métier

MÉTIER CODE	ACTIVITY	TOTAL TRIPS	TOTAL DURATION (HRS)
U1.1	Otter trawl west	18	255
U1.2	Otter trawl east	7	102
U1.3	Pair trawl west	2	20
U2.1	Beam east	1	20
U2.2	Beam offshore west	7	283
U4.1	Scallop dredge west	3	49

4.2 Between Sample Variation

The results of the between-replicate variation study are shown in Table 11. Because the minimum number of replicates (=baskets) in a haul was 5 and in some hauls the last replicate was a part basket, only the variation of total numbers in the first 4 replicates could be investigated. The mean numbers of individuals of each species in these four replicates was investigated by analysis of variance (ANOVA). For the species shown in Table 11 there was no significant difference between the replicates for this parameter. Analysis by Tamsett in Cotter *et al.*, (1995) on this data set showed no significant difference in the discard rate of lemon sole (the most numerous species) between the replicates.

Therefore no bias was expected from taking only the first replicate as would be normal sampling practice.

Table 11
Variation between first four replicates (baskets) for the species shown

SPECIES	REPLICATE	HAULS OBSERVED	MEAN	95% CONF LIMIT
DAB	1	9	20.8	9.1
	2	9	17.1	9.2
	3	9	16.0	7.8
	4	9	20.1	10.6
GUX	1	9	16.1	9.7
	2	9	17.9	8.4
	3	9	17.2	8.2
	4	9	18.4	10.3
HOM	1	8	3.4	5.2
	2	8	2.4	3.7
	3	8	2.6	2.0
	4	8	8.2	10.1
LEM	1	8	36.6	13.0
	2	8	39.2	12.5
	3	8	40.9	14.5
	4	8	28.5	10.3
MUR	1	5	2.3	2.9
	2	5	3.1	2.7
	3	5	2.4	1.7
	4	5	1.1	1.6
PLE	1	9	12.8	6.4
	2	9	13.1	7.4
	3	9	13.6	6.2
	4	9	13.5	5.3
WHG	1	9	3.5	2.4
	2	9	2.7	1.9
	3	9	2.3	1.6
	4	9	3.4	1.7

4.3 Métier Description

4.3.1 Effort survey - data collection

Initially only 2 questionnaires were returned from the fisheries related organisations. Therefore it was decided to recirculate the these questionnaires at the conclusion of the sampling programme. This resulted in a total of 7 completed forms.

Thirty four questionnaires designed for the fishermen were filled in, but successful completion was found to depend upon the method of distribution. It was found that the best method of obtaining good quality information was to interview skippers whilst in port or on sampling trips. No questionnaires were returned when distributed *en mass* to the fishermen.

4.3.2 Effort survey - effort by métier

Métiers are defined by activity and not by port. However all the activity observed in catch survey was associated with the eastern and western ends of the Channel onboard vessels working out of ports in these areas. Thus the questionnaire data were grouped by port within areas:

Eastern Ports: Newhaven, Rye, Portsmouth, Shoreham.
Western Ports: Brixham Plymouth, Looe.

Table 12 gives an overall description of the boats questioned by their main gear type. However not all the vessels used this gear type all of the time. Tables 13 and 21 shows the extent to which boat used multiple gears and Figure 5 shows gear usage on a seasonal basis.

Table 12
Summary of boat LOA and power by main gear type (from effort survey)

PORTS			BOAT TYPE				
			BEAM	MULTI*	OTTER	PAIR	SCALLOP
EASTERN	Number of Boats		5	3	3	0	0
	LOA(m)	Max	26	12	13	0	0
		Mean	22	11	11		
		Min	14	10	10	0	0
	POWER(HP)	Mean	310	268	208		
WESTERN	Number of Boats		5	4	10	3	1
	LOA(m)	Max	30	15	17	12	26
		Mean	24	13	13	12	26
		Min	21	12	10	11	26
	POWER(HP)	Mean	438	228	229	194	796

* Indicates boat using multiple gear types

From the completed questionnaires it was possible to obtain data on the number of boats in the port, days spent at sea/month and hours/day fished. It was intended that this information would give an estimate of effort/quarter in hours fished in each métier. However it was difficult to judge just how many boats were pursuing each métier during each quarter because of the degree of switching between métiers which occurred.

Therefore it was decided to treat the 34 fishermen's questionnaires (one questionnaire=one boat) data as a representative sample of the towed gear fleet. In order to estimate total effort in each métier for each quarter, the number of boat months reported in the fishermen's questionnaire in each gear type in each quarter was calculated (from Figure 5) for the western and eastern ends of the Channel (Tables 14 & 22).

The proportion of the total effort represented by the respondents was calculated and was then applied to the total number of boats reported by the fisheries organisations to be operating in the areas (153 boats in the west and 60 boats in the east) and the result expressed in boat months (Tables 15 & 23).

Both the questionnaires gave consistent estimates on the mean number of days fished per boat per month; at 18.5 days per month. This was combined with questionnaire and observational data on the number of hours fished per day (Table 16 & 24).

The hours of trawling actually sampled in each métier were then totalled by quarter and divided into the estimated total fished (Tables 18,19 and 25, 26) resulting in a Raising Factor by Effort (RFE) in each métier for each quarter (Tables 20 and 27).

$$RFE = \frac{Total\ estimated\ hours\ fishing\ per\ quarter}{Total\ hours\ sampled\ per\ quarter}$$

The results shown in Tables 18 and 25 are estimates of potential effort per quarter; no allowance is made for bad weather or other sources of loss of effort. They only pertain to ports for which total numbers of vessels were estimated; boats may move in and out of the study area and to different ends of the Channel depending on which species they are targeting.

In the data obtained from MAFF landings of fish were reported as far away as Hartlepool as being captured in ICES areas VIId & VIIe during 1995; for a complete description of effort more data are required.

4.3.3 Effort survey - target species by season

Respondents were asked to name the main target species by month. No limit was set as to how many target species could be named and fishermen used their own criteria for assessing what constituted a 'target species'. The total number of respondents who reported targeting each species by gear type and month was calculated (Tables 28 and 29). These results show clear seasonal trends in named target species. These are described more fully in relation to the catches observed in section 4.4.3.

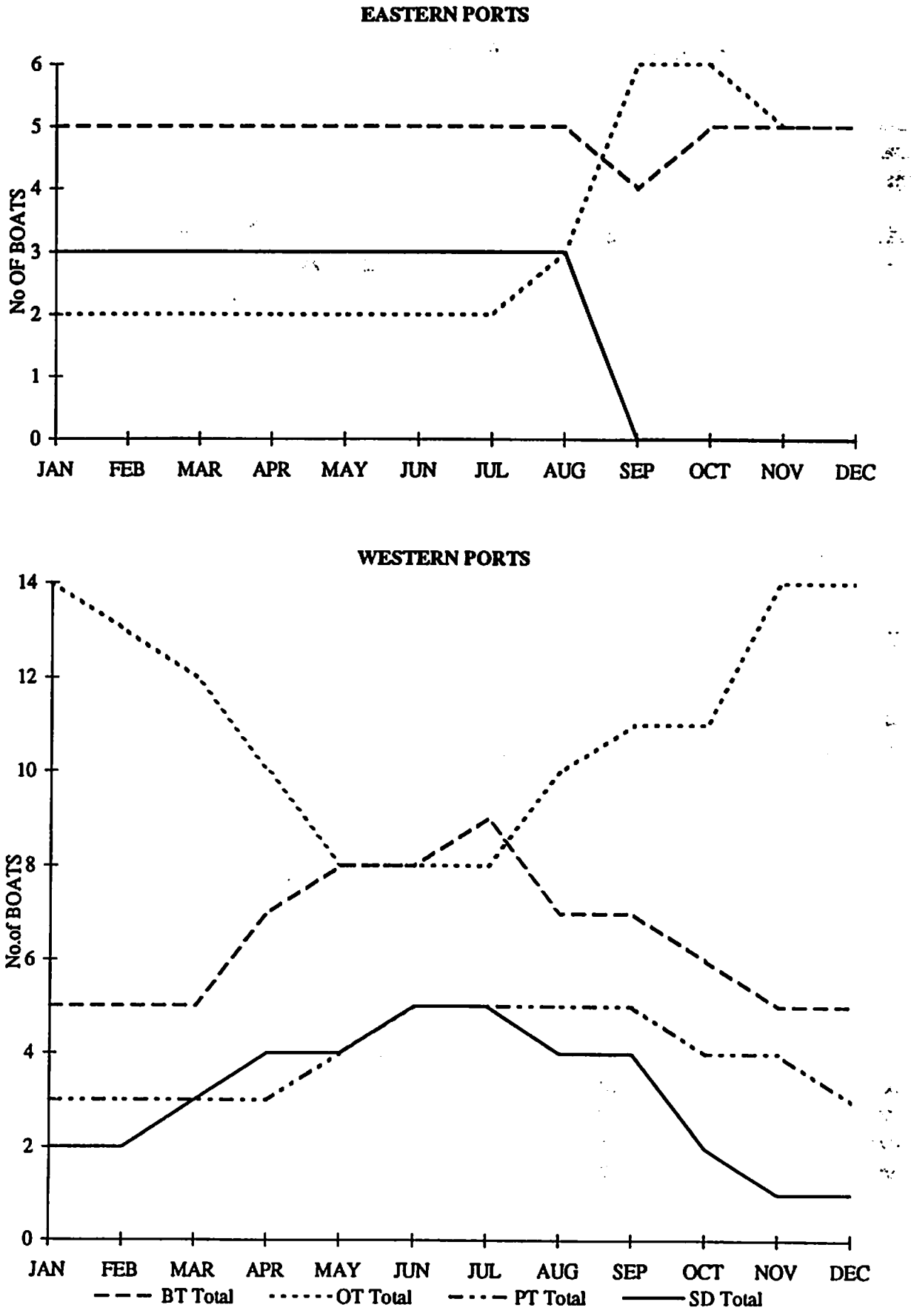


Figure 5. Effort Survey: Numbers of vessels reporting effort in the different gear types by month

Tables 13-20
Activities of boats and estimated effort raising factors for western ports

Table 13: Effort Survey - complimentary or substituted gear types of boats sampled in the questionnaires

	Number of boats using 1 or more towed gears in sample			
BT	3			
OT	4	6		
SD	4	3	1	
PT	0	2	0	2
	BT	OT	SD	PT

Table 14: Effort Survey - sample boat months by gear type per quarter as estimated from Figure 5

Total = 296 boat months per annum

QUARTER	BT	OT	SD	PT
1	15	39	7	9
2	28	26	13	12
3	23	29	13	12
4	16	39	4	11

Table 15: Effort Survey - estimated total boat months by gear type per quarter obtained by apportioning the results in Table 14 to the potential total number of boat months in the area (153x12=1836)

QUARTER	BT	OT	SD	PT
1	93	242	43	56
2	174	161	81	74
3	143	180	81	74
4	99	242	25	68

Table 16: Effort Survey - estimated number of days/month and hours/day fished by gear type

	BT	OT	SD	PT
Days/month	18.5	18.5	18.5	18.5
Hours/day	19	12	13	8

Table 18: Estimated total hours fished/quarter by gear type from Tables 15 & 16

QUARTER	BT	OT	SD	PT
1	33402	53703	10455	8117
2	62351	35802	19417	10823
3	51217	39933	19417	10823
4	35629	53703	5974	9921

Table 19: Catch Survey - total hours sampled/quarter and gear type

QUARTER	BT	OT	SD	PT
1	30	65	0	0
2	139	63	41	17
3	21	67	8	3
4	72	62	0	0

Table 20: Raising factor by quarter and gear type

QUARTER	BT	OT	SD	PT
1	1113	826	n/a	n/a
2	449	568	474	637
3	2439	596	2427	3608
4	495	866	n/a	n/a

Tables 21-27
Activities of boats and estimated effort raising factors for western ports

Table 21: Effort Survey - complimentary or substituted gear types of boats sampled in the questionnaires

	Number of boats using 1 or more towed gears in sample		
BT	2		
OT	1	4	
SD	3	0	0
OTHER		1	
	BT	OT	SD

Table 22: Effort Survey - sample boat months by gear type per quarter as estimated from Figure 5

Total = 122 boat months per annum

QUARTER	BT	OT	SD	PT
1	6	15	9	0
2	6	15	9	0
3	11	14	6	0
4	16	15	0	0

Table 23: Effort Survey - estimated total boat months by gear type per quarter obtained by apportioning the results in Table 14 to the potential total number of boat months in that area (60x12=720)

QUARTER	BT	OT	SD	PT
1	35	89	53	0
2	35	89	53	0
3	65	83	35	0
4	94	89	0	0

Table 24: Effort Survey - estimated number of days/month and hours/day fished by gear type

	BT	OT	SD	PT
Days/month	18.5	18.5	18.5	18.5
Hours/day	23	12	13	0

Table 25: Estimated total hours fished/quarter by gear type from Tables 23 and 24

QUARTER	BT	OT	SD	PT
1	14903	19833	12790	0
2	14903	19833	12790	0
3	27322	18510	8527	0
4	39742	19833	0	0

Table 26: Catch Survey - total hours sampled/quarter and gear type

QUARTER	BT	OT	SD	PT
1	20	33	0	0
2	0	31	0	0
3	0	35	0	0
4	0	4	0	0

Table 27: Raising factor by quarter and gear type

QUARTER	BT	OT	SD	PT
1	745	601	n/a	n/a
2	n/a	640	n/a	n/a
3	n/a	529	n/a	n/a
4	n/a	4958	n/a	n/a

Table 28

Effort survey western ports - number of boats listing each target species by gear type and month

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
BT	ANY	1	1	1	1	2	2	2	2	2	1	1	1
	BLL	1	1	1	1	1	1	1	1	1	1	1	1
	CTL	3	2	0	0	0	0	0	0	0	1	3	3
	MON	1	1	1	1	1	1	1	1	1	1	1	1
	PLE	1	2	2	3	3	3	3	2	2	2	2	2
	SOL	1	2	2	3	4	4	5	4	4	3	1	1
	TUR	1	2	2	2	2	2	2	2	2	2	1	1

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
OT	ANY	1	0	0	2	2	2	2	0	1	1	1	1
	BSE	0	0	0	0	0	0	0	0	0	0	1	1
	CTL	2	2	2	2	2	0	1	2	3	3	4	5
	LEM	10	11	10	6	2	1	1	1	1	1	4	6
	MUR	0	0	0	0	0	0	1	1	1	1	0	0
	PLE	1	1	1	1	1	2	1	1	1	1	1	1
	SKA	0	0	0	0	0	1	1	1	0	0	0	0
	SOL	1	1	0	0	0	2	2	2	1	1	1	1
	SQC	2	2	1	1	1	1	4	7	6	6	6	5
	WHG	0	0	1	1	1	2	2	2	2	2	2	1

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PT	ANY	1	1	1	1	1	1	1	1	0	1	1	1
	CTL	1	0	0	0	0	0	0	0	0	0	1	1
	LEM	1	2	2	2	1	1	0	0	0	0	0	0
	SQC	0	0	0	0	0	1	4	5	4	3	3	3
	WHG	0	0	0	0	2	2	2	2	4	3	3	2

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SD	SCX	2	2	3	4	5	5	5	4	4	2	1	1

Effort data obtained from 24 fishermen's questionnaires

Table 29

Effort survey eastern ports - number of boats listing each target species by gear type and month

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
BT	BLL	1	1	1	1	1	1	1	1	1	1	1	1
	CTL	1	1	1	1	1	1	1	1	2	2	2	2
	LEM	1	1	1	1	1	1	2	2	1	1	1	1
	PLE	1	1	1	1	1	1	1	1	1	1	1	1
	SOL	1	1	1	1	1	1	1	2	3	3	3	3
	TUR	1	1	1	1	1	1	1	1	1	1	1	1

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
OT	BSE	0	0	0	1	1	1	1	1	0	0	1	1
	COD	4	4	2	2	1	1	1	1	2	4	4	4
	CTL	0	0	1	2	4	4	2	2	2	1	0	0
	LEM	0	0	0	0	0	0	0	0	1	1	2	2
	MUR	0	0	0	0	0	0	0	0	1	1	1	1
	PLE	1	2	4	4	4	2	3	3	3	1	1	1
	POL	1	0	0	0	0	0	0	0	0	1	1	1
	SBZ	0	0	0	1	1	1	0	0	0	0	0	0
	SCX	1	2	2	1	0	0	0	0	0	0	0	0
	SOL	2	2	2	1	2	5	4	4	4	4	4	3
	SQC	0	0	0	0	0	0	0	0	1	1	1	1
	WHG	3	2	0	0	0	0	0	0	1	3	3	3

		QUARTER 1			QUARTER 2			QUARTER 3			QUARTER 4		
GEAR TYPE	SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SD	SCX	3	3	3	3	3	3	3	3	0	0	0	0

Effort data obtained from 10 fishermen's questionnaires

4.3.4 Catch survey - distribution of effort - haul positions

The geographical extent of the métiers sampled as described in Tétard, Boon *et al.*, (1995) are shown in Figures 6a to 10a. For each of the métiers in the positions of the sampled hauls are shown by quarter:

Figures 6b-e: Otter trawl west
Figure 7b-e: Beam trawl offshore west
Figure 8b-c: Scallop dredge west
Figures 9b-d: Otter trawl east
Figure 10b: Beam trawl east

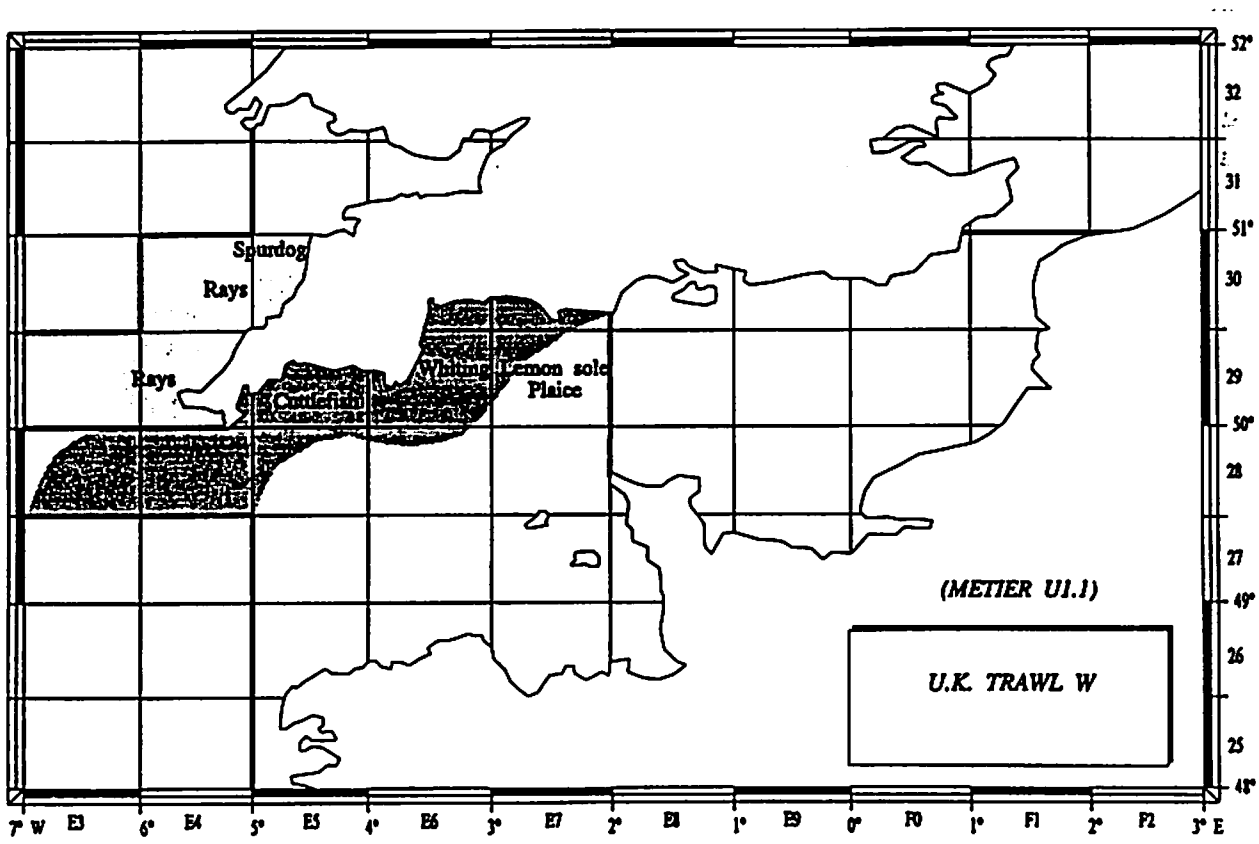


Figure 6a. Geographical extent of otter trawl west as described in Tétard, Boon *et al.*, (1995)

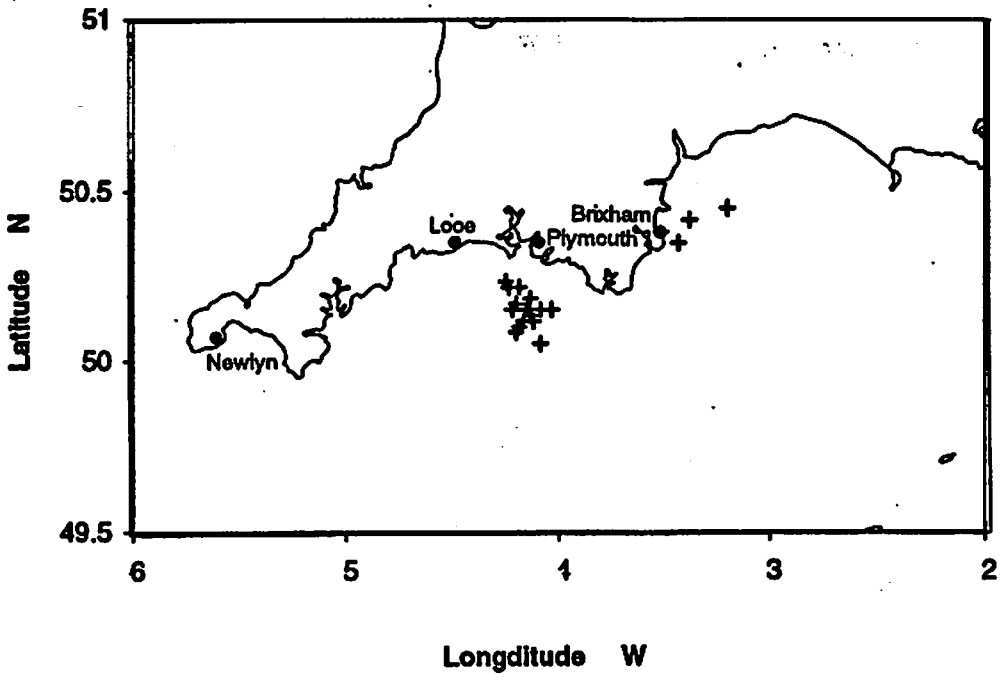


Figure 6b. Haul positions otter trawl west : Quarter 1

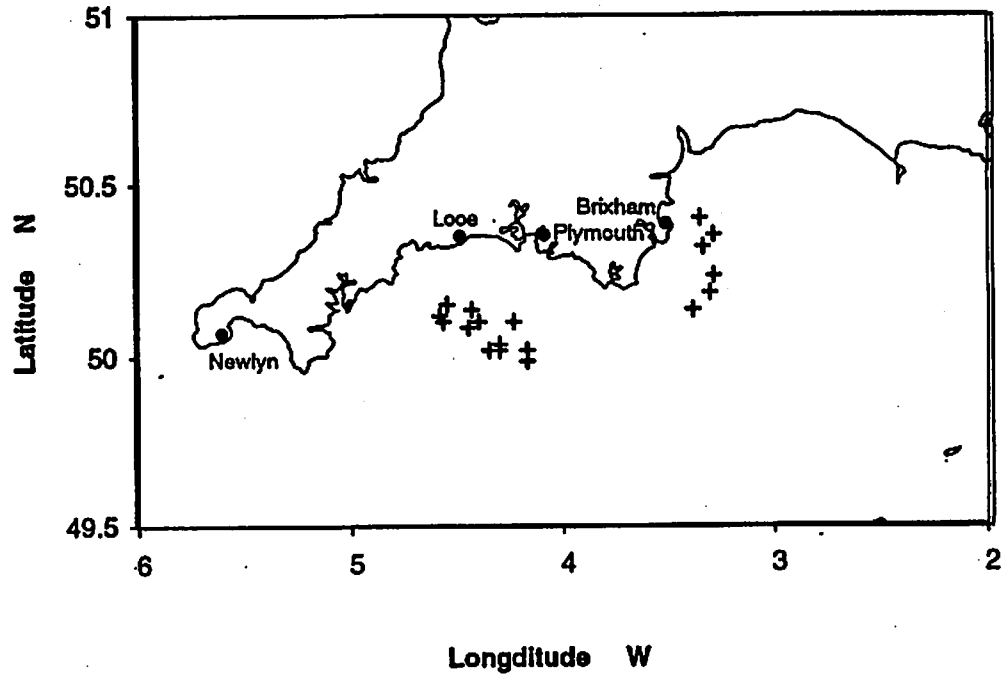


Figure 6c. Haul positions otter trawl west : Quarter 2

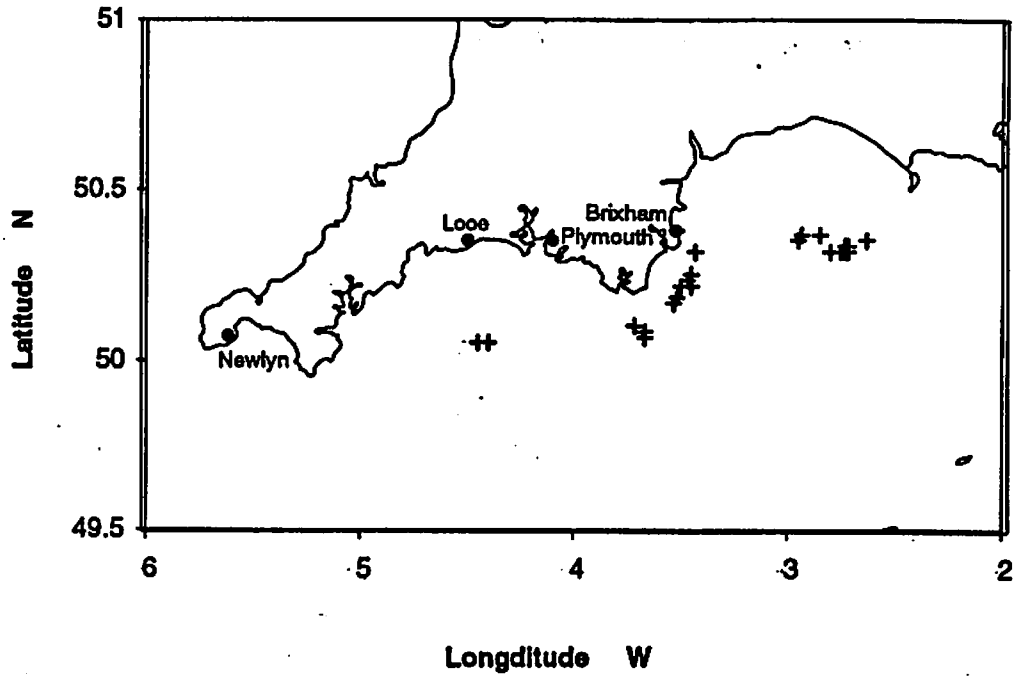


Figure 6d. Haul positions otter trawl west : Quarter 3

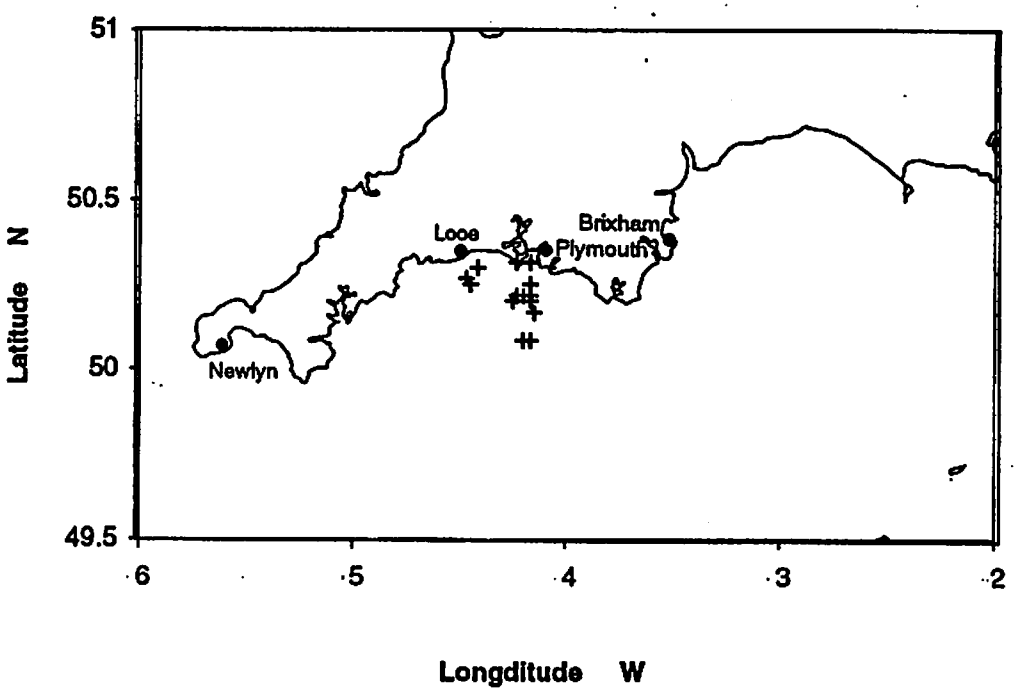


Figure 6e. Haul positions otter trawl west : Quarter 4

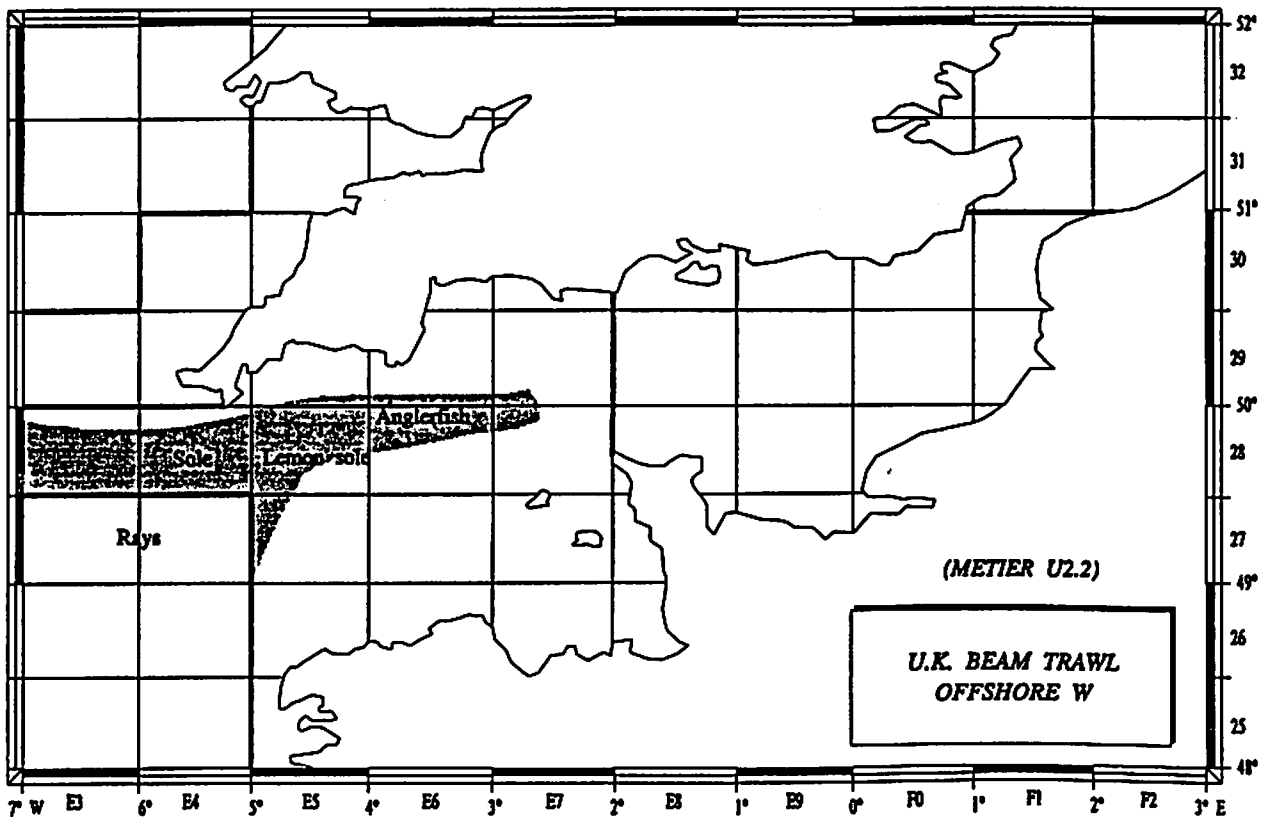


Figure 7a. Geographical extent of beam trawl offshore west as described in Tétard, Boon *et al.*, (1995)

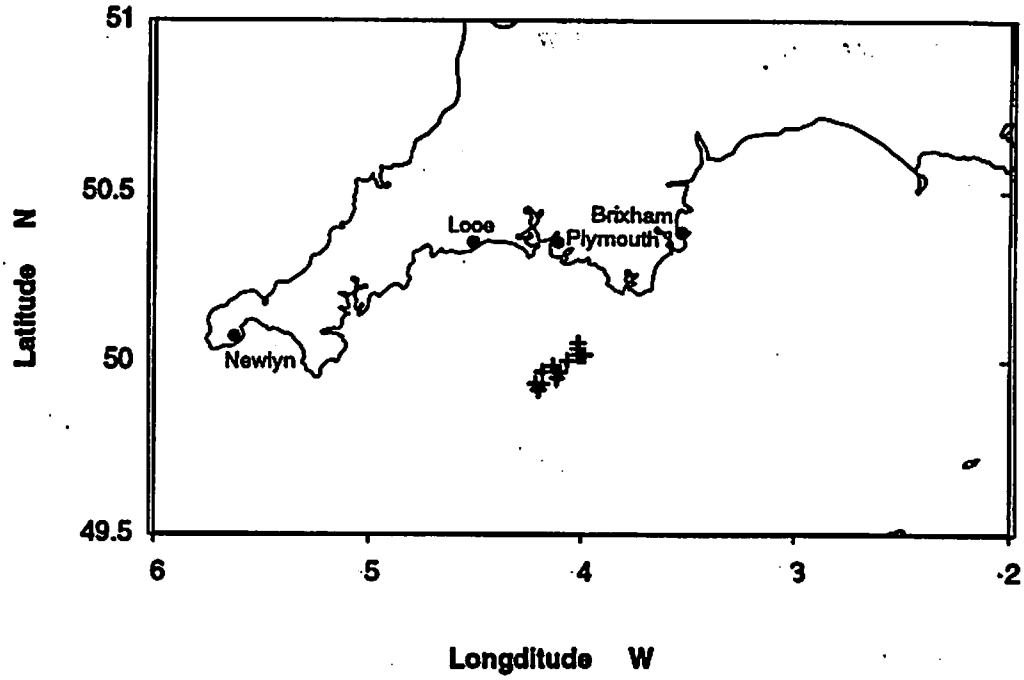


Figure 7b. Haul positions beam trawl offshore west : Quarter 1

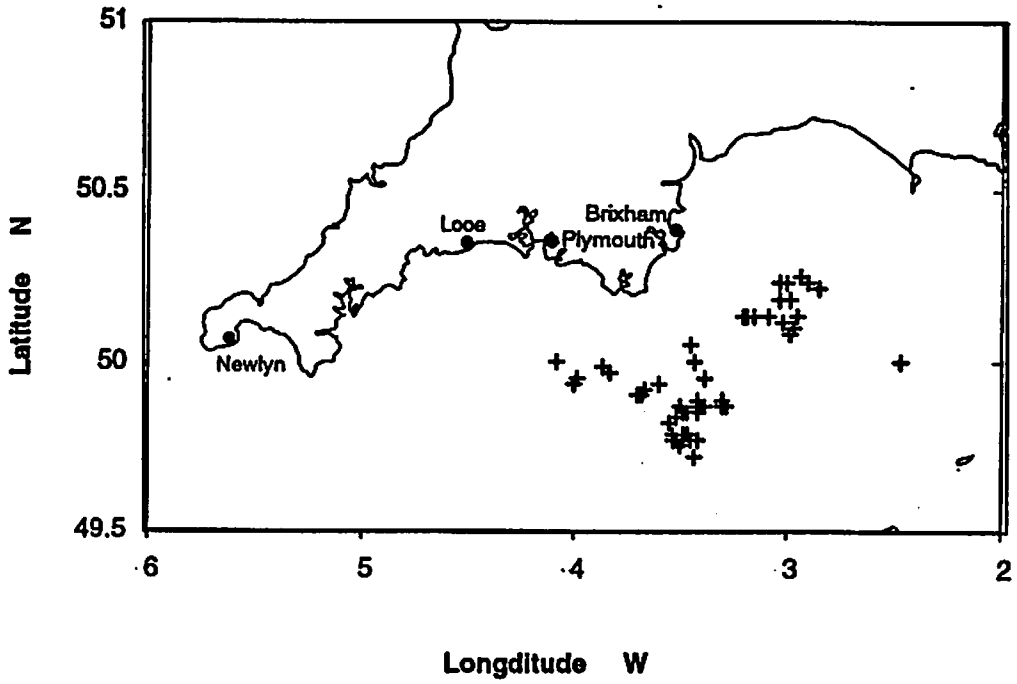


Figure 7c. Haul positions beam trawl offshore west : Quarter 2

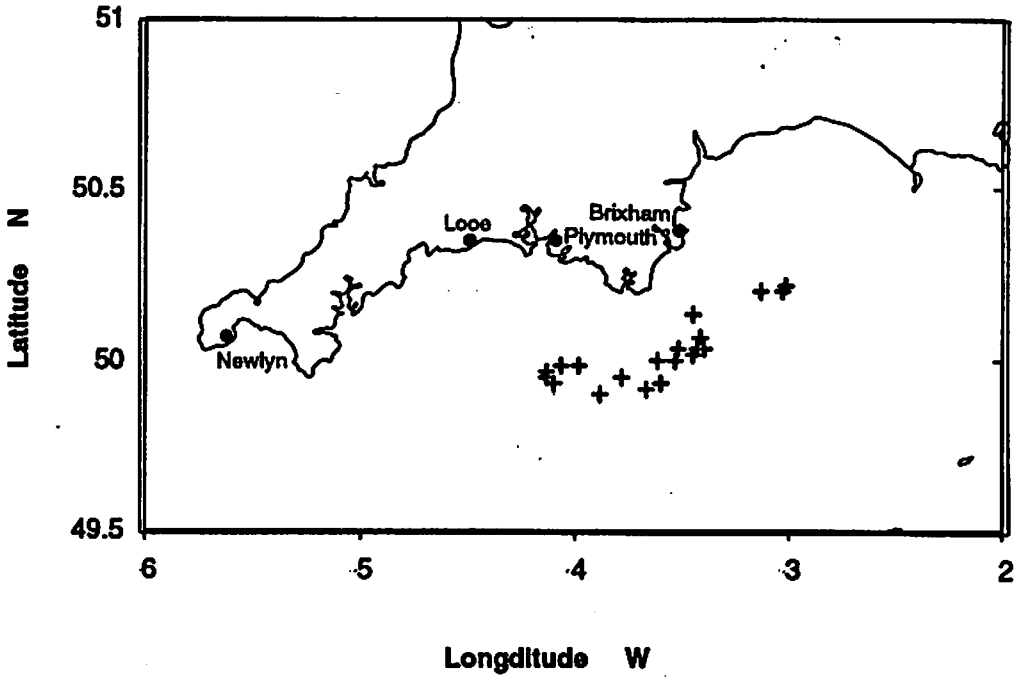


Figure 7d. Haul positions beam trawl offshore west : Quarter 3

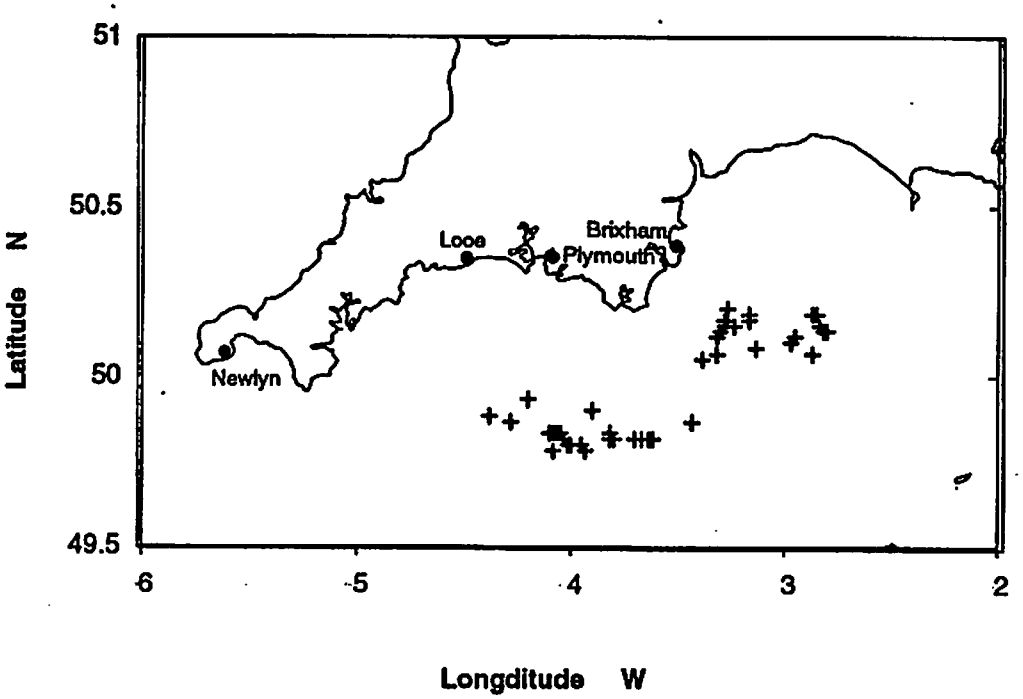


Figure 7e. Haul positions beam trawl offshore west : Quarter 4

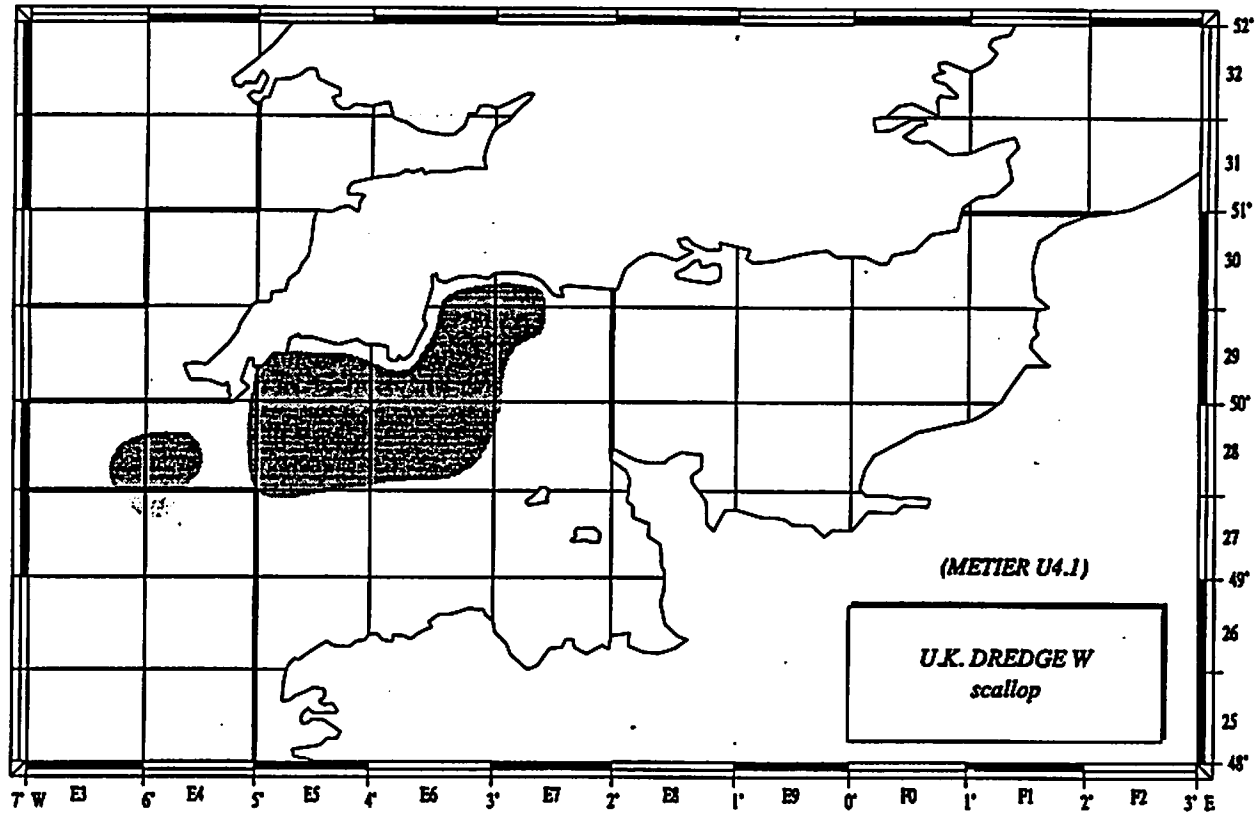


Figure 8a. Geographical extent of scallop dredge west as described in Tétard, Boon *et al.*, (1995)

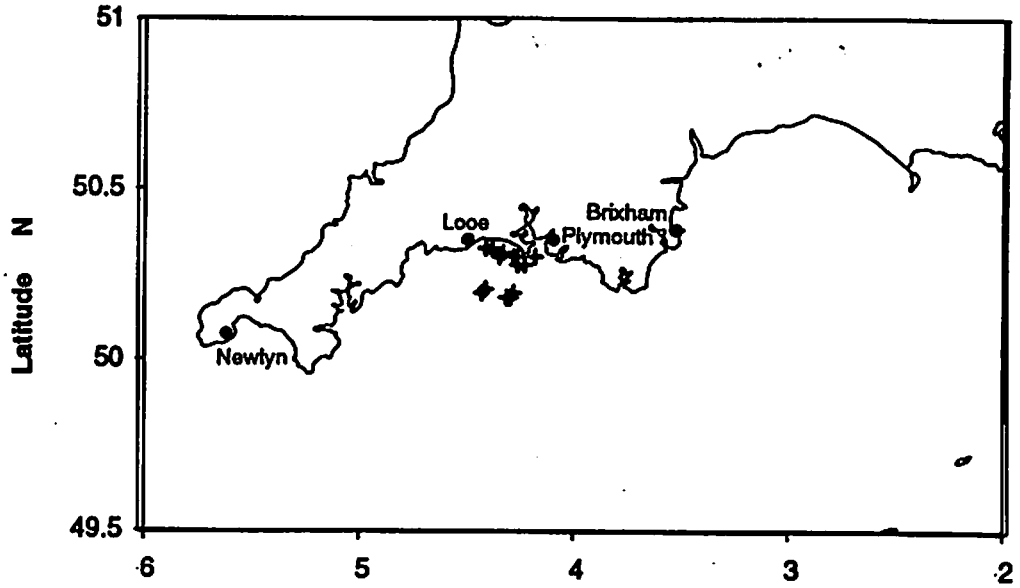


Figure 8b. Haul positions scallop dredge west : Quarter 2

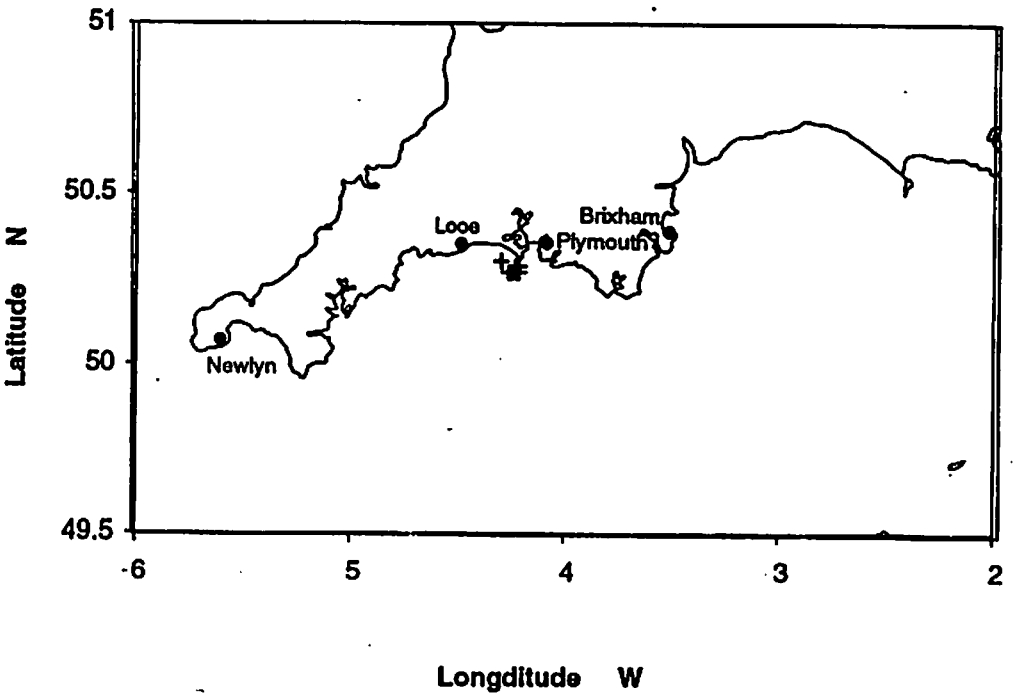


Figure 8c. Haul positions scallop dredge west : Quarter 3

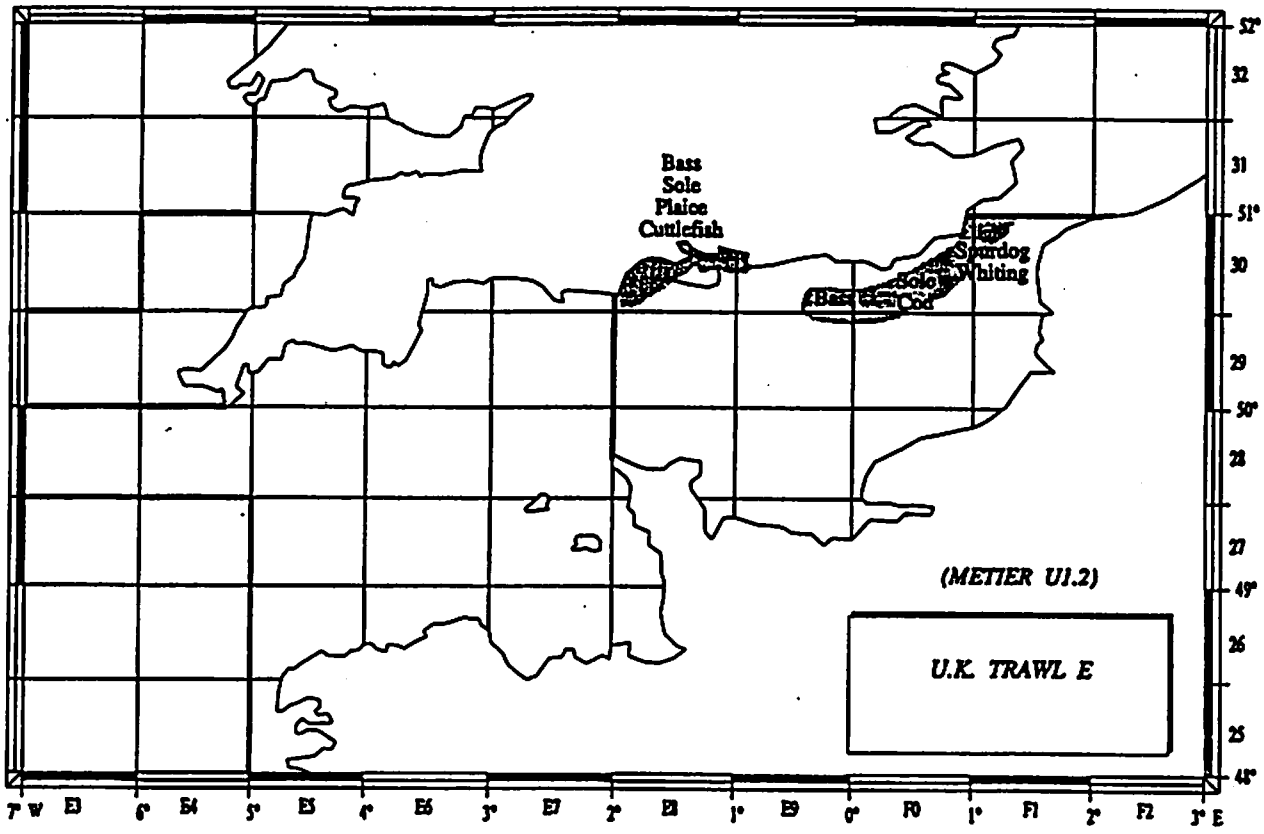


Figure 9a. Geographical extent of otter trawl east as described in Tétard, Boon *et al.*, (1995)

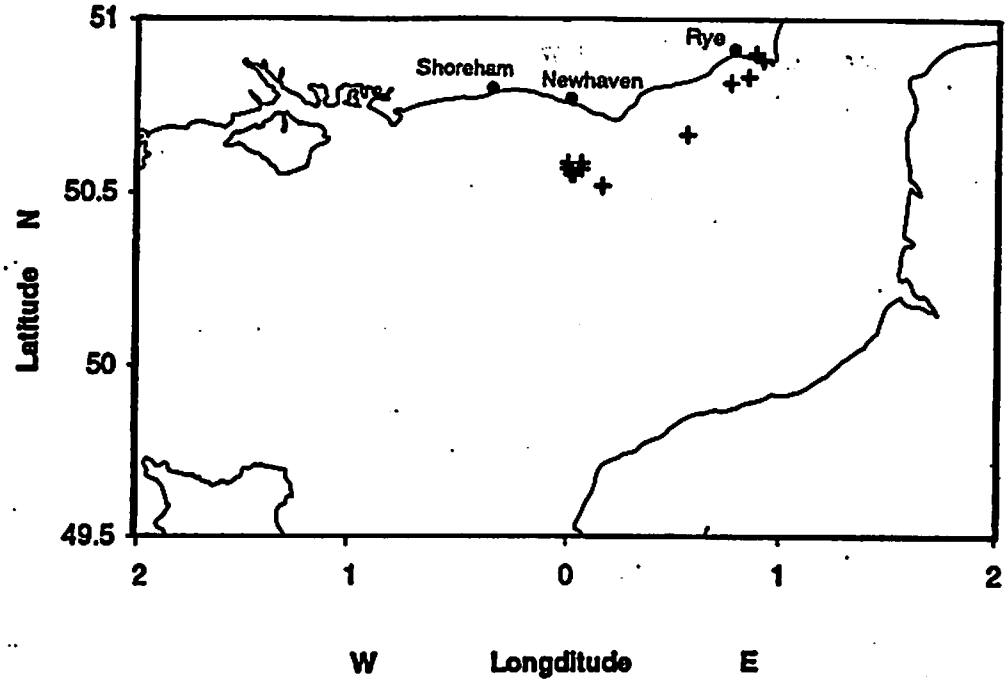


Figure 9b. Haul positions otter trawl east : Quarter 1

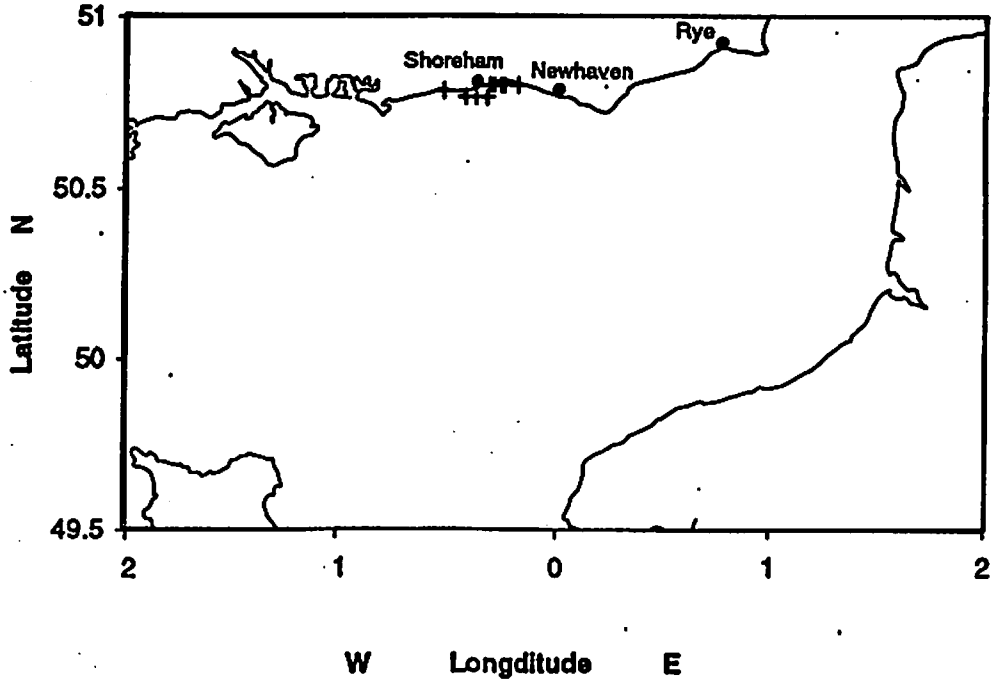


Figure 9c. Haul positions otter trawl east : Quarter 2

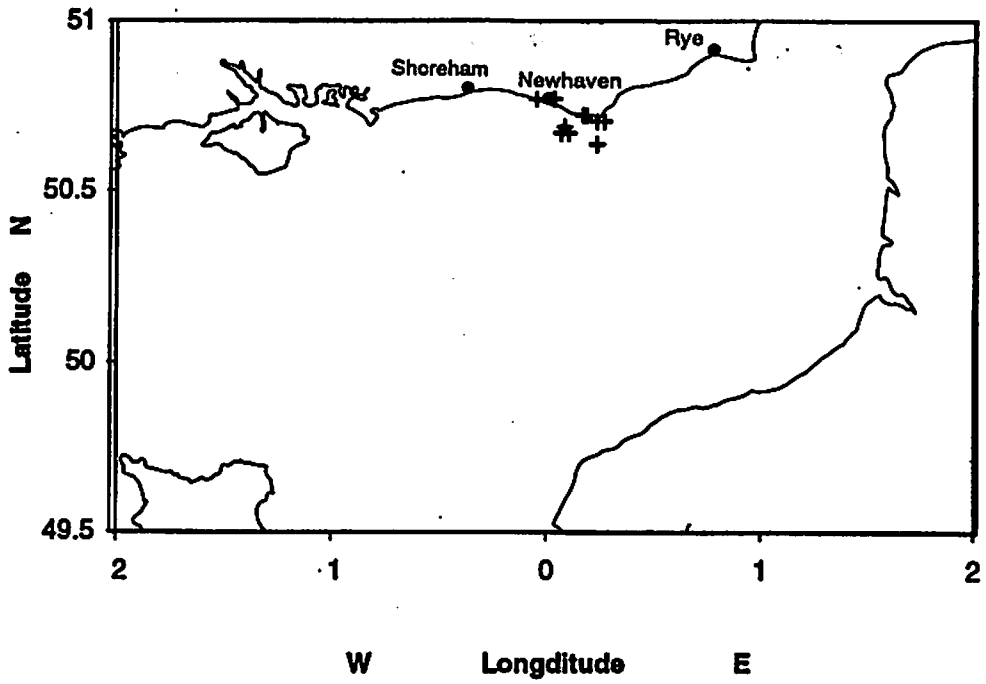


Figure 9d. Haul positions otter trawl east : Quarter 3

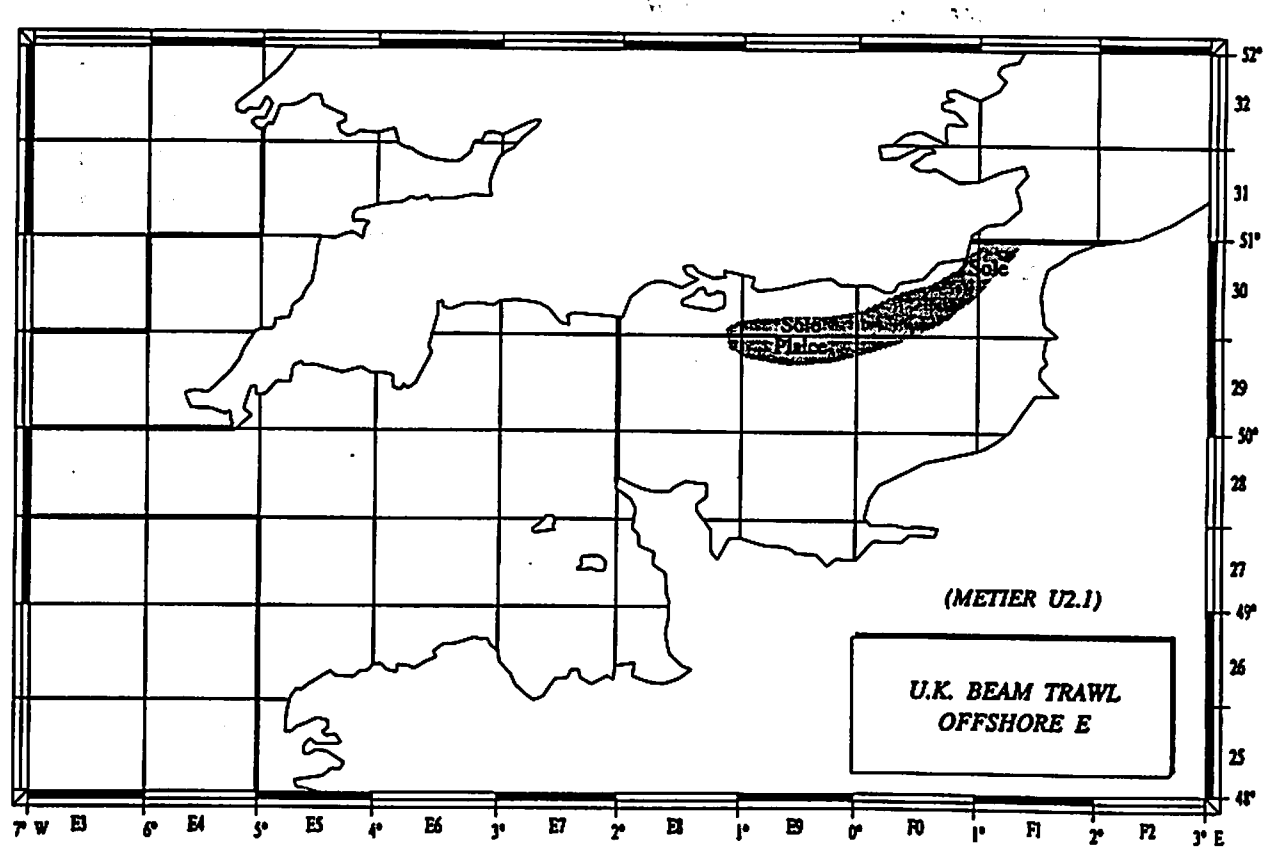


Figure 10a. Geographical extent of beam trawl east as described in Tétard, Boon *et al.*, (1995)

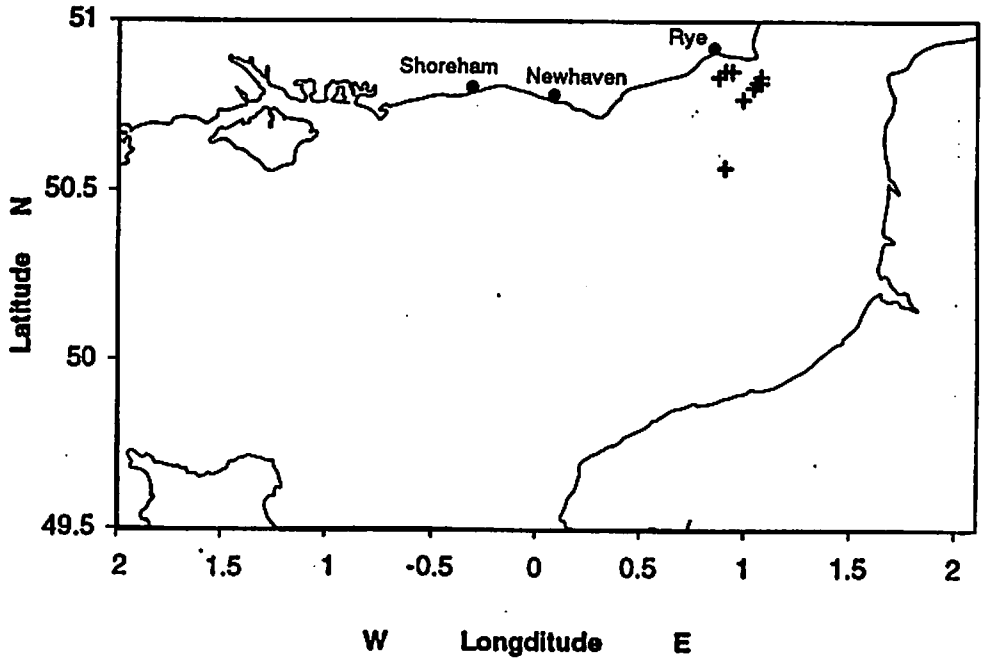


Figure 10b. Haul positions beam trawl east : Quarter 1

4.3.5 Catch survey - between trip variation - cluster analysis

The métier classification scheme uses gear and catch parameters to describe fishing effort and all units operating in each métier are considered to exert the same exploitation pattern on all species captured. The métiers used to stratify sampling effort in this study were based upon gear parameters, effort and landings data. There is a requirement to assess whether the stratification designed around effort and landings data is suitable for sampling the total catch (landings + discards).

In order to compare the level of similarity between trips the percentage of the total catch by numbers *(%Px)* of all species in Table 56 (Appendix 1) with the exception of the non resource species (sand soles and dragonets) was calculated for each trip:

$$\%Px = (Nx/TN) * 100$$

Where: Nx = Estimated numbers of individuals of that species x in the catch
TN = Total number of individuals of all species in the catch

With the large numbers of species and trips it was necessary to analyse the data by cluster analysis. This was carried out by generating similarity indices between the trips from the percentage of the total catch *(%Px)* for each species. The similarity index chosen was the 'Ecological' type on GENSTAT©. The contribution of each of the *%Px* takes the form:

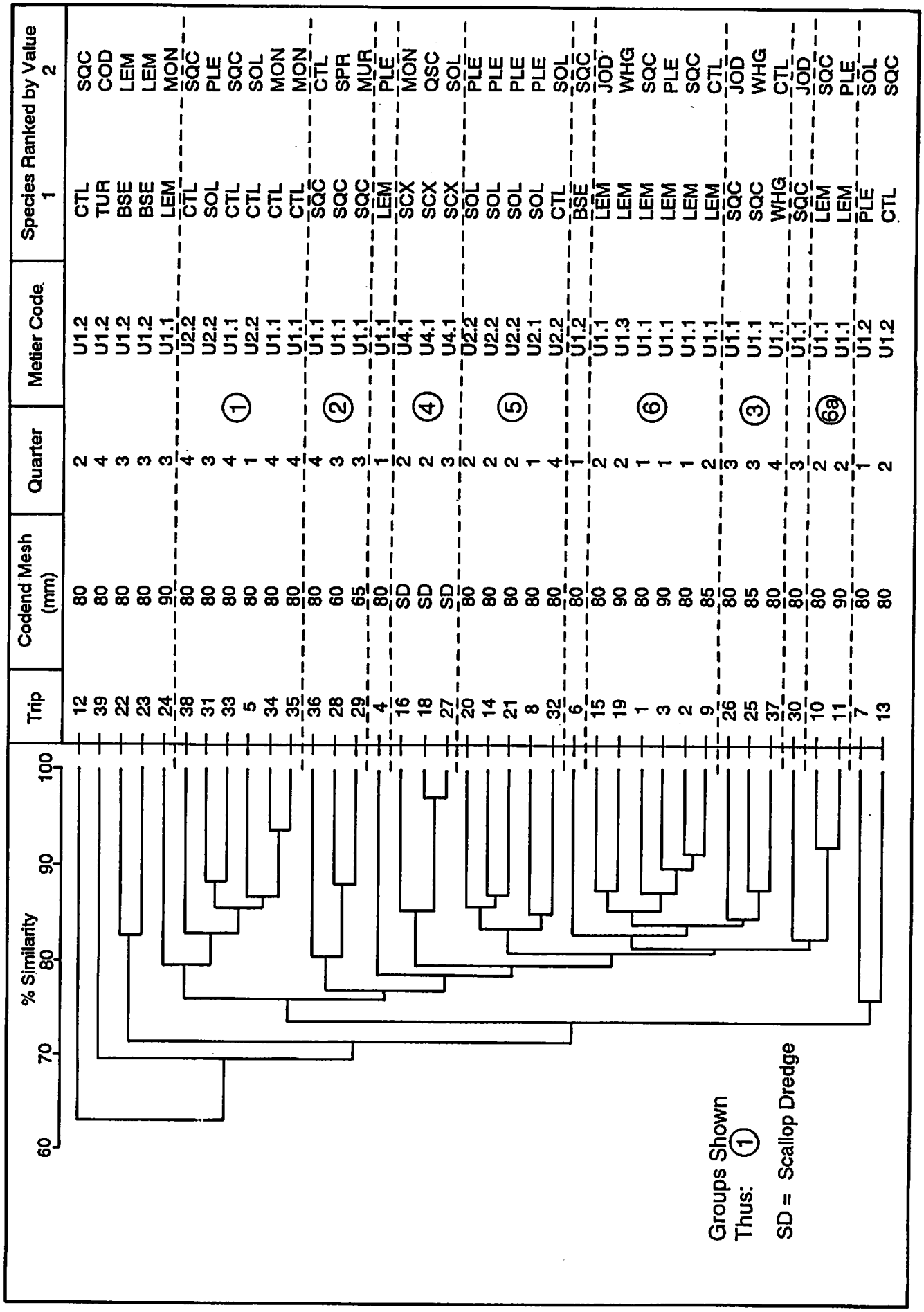
$$1 - \left(\frac{\%Px_i - \%Px_j}{Range} \right) \qquad Weight = 1$$

$$unless\ Px_i = Px_j = 0 \qquad Weight = 0$$

Where $\%Px_i$ and $\%Px_j$ are the percentage by number of the species in trips i and j and the range is the observed range of *%Px* over all the trips. The index is formed by multiplying each contribution by the corresponding weight, summing all these values and then dividing by the sum of the weights.

The index is designed so that trips with identical proportions of each species would result in a value of 100% and differing proportions would result in decreasing similarity indices. The exception to this is when both the proportions are equal to zero; this avoids the absence of species in both trips contributing to similarity.

The results of the analysis are obtained as a matrix (see Appendix 2, Table 59) showing the % similarity of each of the combinations of trips. In order to arrange the trips into more or less homogeneous groups cluster analysis was carried out on this matrix. This process takes the form of grouping all the most similar trips together and displaying them in the form of a dendrogram (Figure 11). Each of the groups of branches on the dendrogram represents a more or less similar group. The groups were merged, which defines the point at which the branches of the dendrogram are brought together using the



Dendrogram derived from similarity indices based upon the percentage total catch composition by number of each species of each trip. Also shown are the trip code, the codend mesh size, the quarter, the allocated metier code based upon gear type and location and the two highest value species as a proportion of the landed catch.

Fig.11

'average linking' method. This merges the groups at the point of average similarity between the two adjoining groups. The effect of this method is to show how the trips fall into similar groups and how these groups compare with one another in terms of similarity.

Also shown are the quarter, métier code, cod end mesh size and the two species with the highest share of landed values from that trip ranked in order of value. This gives a guide to the gear used and the most valuable target species for each trip.

There are 6 main clusters on the dendrogam. They are as follows:

1) Comprises mostly of trips landing cuttlefish using otter and beam trawling gear in the western channel during the 1st and 4th quarters of the year. The only exception to this is trip 31 for which sole and plaice were the two species with the highest share of landed values.

2) This group contains only trips which had squid as the highest share of landed values using otter trawls in the western Channel in the 3rd and 4th quarters. The two most similar trips used 60 or 65mm meshed codends.

3) Trip landings in this group had squid or whiting ranked first or second in terms of share of value from western pair or otter trawls. The majority of these trips used larger mesh than group 2.

4) The only constituents of this distinct group were the three scallop dredging trips.

5) All of this group were beam trawling trips landing sole as a major species with most of the trips occurring in quarter 2. The majority were western Channel trips; the single eastern Channel beam trawling trip also occurred in this group.

6&6a) These groups contain the majority of the trips landing lemon sole using otter and pair trawls during quarters 1 and 2.

The remaining trips all fall outside the above groups and include mostly otter trawling trips landing a variety of species fishing in the eastern Channel. There were not as many sampling trips in this métier as in the western métiers and the poor grouping may reflect this as well a more diverse catch composition.

These results show that although the cluster analysis based on total catch does not always group the trips in exactly the métiers and seasonally most valuable target species, the majority of trips belong to groups which bear some relationship to these parameters.

4.3.6 Catch survey - variation between codend mesh sizes

The codend mesh size data were obtained by discussion with the skipper of the vessel and not measured directly. There was some variation within métiers according to the species targeted in particular seasons (Table 30).

The normal minimum codend mesh size of 80mm was invariably used in the beam trawling métiers. Codend mesh sizes of 80 and 90mm were used to target lemon sole in the otter and pair trawl métiers. The use of 85mm mesh was generally considered a precautionary measure against manufacturing faults resulting in mesh sizes below the minimum of 80mm.

For targeting mackerel, horse mackerel, herring, pelagic cephalopods (in these observations squid), pilchards or blue whiting it is permitted (under EC council regulations 3094/86) to use codend mesh sizes as small as 32mm provided that:

- at least 50% of the retained catch from any one haul consisted of species from the above list,
- the cumulative retained catch for the trip is composed of not less than 80% of the above species, and
- not more than 10% of protected species; these are all species with an MLS plus monkfish, ling, eels and cuttlefish.

Strictly, each of these codend mesh sizes should be considered a separate métier. However other gear parameters were not normally changed and these variations are considered a normal part of the seasonal activity of the vessels sampled.

Otter trawl west contained the largest variety of mesh sizes.

In the first quarter two trips were made on successive days targeting lemon sole using 80 and 90mm mesh codends. Although this was an experiment carried out with the consent of the fishermen to examine the effect of different codend mesh, the use of 90mm codend mesh to target lemon sole was not atypical. These results provide the best comparison so they are presented here. Figure 12 shows that the larger mesh size caught a smaller proportion of fish of below the MLS of 25 cm. The percentage discards is lower in the 90mm mesh size; the vessel sampled appears to have operated a policy of landing fish at a minimum of circa 27cm length.

In the third quarter three trips were made on vessels targeting squid using a variety of mesh sizes between 60 and 80 mm.

Tables 31-33 shows the catch composition by number for all three mesh sizes. These results show that in the trips sampled the small mesh sizes when used to target squid did not result in mortality of undersized resource species; catches of lemon sole, whiting and plaice were very low by number with low or zero discard rates. The length-frequency distributions for squid (Figure 13) show zero or very low discard rates with proportionately more smaller squid in the smaller mesh sizes.

Table 30

Number of hauls and total hours towing by quarter, métier and codend mesh size

Quarter	Metier Code	Activity	Codend Mesh size (mm)	Data	Total	Comments
1	U1.1	UK OTTER TRAWL WEST	80	No. of Hauls	12	Normal min
				Total Hours Trawled	45	codend mesh
			90	No. of Hauls	6	Used for lemon
				Total Hours Trawled	19	soles (experiment)
	U1.2	UK OTTER TRAWL EAST	80	No. of Hauls	12	Normal min
				Total Hours Trawled	33	codend mesh
	U2.0	UK BEAM INSHORE EAST	80	No. of Hauls	8	Normal min
				Total Hours Trawled	20	codend mesh
	U2.2	UK BEAM OFFSHORE WEST	80	No. of Hauls	16	Normal min
				Total Hours Trawled	30	codend mesh
2	U1.1	UK OTTER TRAWL WEST	80	No. of Hauls	8	Normal min
				Total Hours Trawled	33	codend mesh
			85	No. of Hauls	4	
				Total Hours Trawled	19	
			90	No. of Hauls	2	Used for lemon
				Total Hours Trawled	11	soles
	U1.2	UK OTTER TRAWL EAST	80	No. of Hauls	11	Normal min
				Total Hours Trawled	31	codend mesh
	U1.3	UK PAIR TRAWL WEST	90	No. of Hauls	4	
				Total Hours Trawled	17	
	U2.2	UK BEAM OFFSHORE WEST	80	No. of Hauls	75	Normal min
				Total Hours Trawled	139	codend mesh
	U4.1	UK DREDGE WEST	Scallop Dredge	No. of Hauls	23	
				Total Hours Trawled	41	
3	U1.1	UK OTTER TRAWL WEST	60	No. of Hauls	3	Used for Squid
				Total Hours Trawled	8	
			65	No. of Hauls	8	Used for Squid
				Total Hours Trawled	25	
			80	No. of Hauls	10	Normal min
				Total Hours Trawled	29	codend mesh
			90	No. of Hauls	1	Lemon sole &
				Total Hours Trawled	5	Monk
	U1.2	UK OTTER TRAWL EAST	80	No. of Hauls	11	Normal min
				Total Hours Trawled	35	codend mesh
	U1.3	UK PAIR TRAWL WEST	85	No. of Hauls	1	
				Total Hours Trawled	3	
	U2.2	UK BEAM OFFSHORE WEST	80	No. of Hauls	21	Normal min
				Total Hours Trawled	42	codend mesh
	U4.1	UK DREDGE WEST	Scallop Dredge	No. of Hauls	10	
				Total Hours Trawled	8	
4	U1.1	UK OTTER TRAWL WEST	80	No. of Hauls	15	Normal min
				Total Hours Trawled	62	codend mesh
	U1.2	UK OTTER TRAWL EAST	80	No. of Hauls	1	Normal min
				Total Hours Trawled	4	codend mesh
	U2.2	UK BEAM OFFSHORE WEST	80	No. of Hauls	41	Normal min
				Total Hours Trawled	72	codend mesh

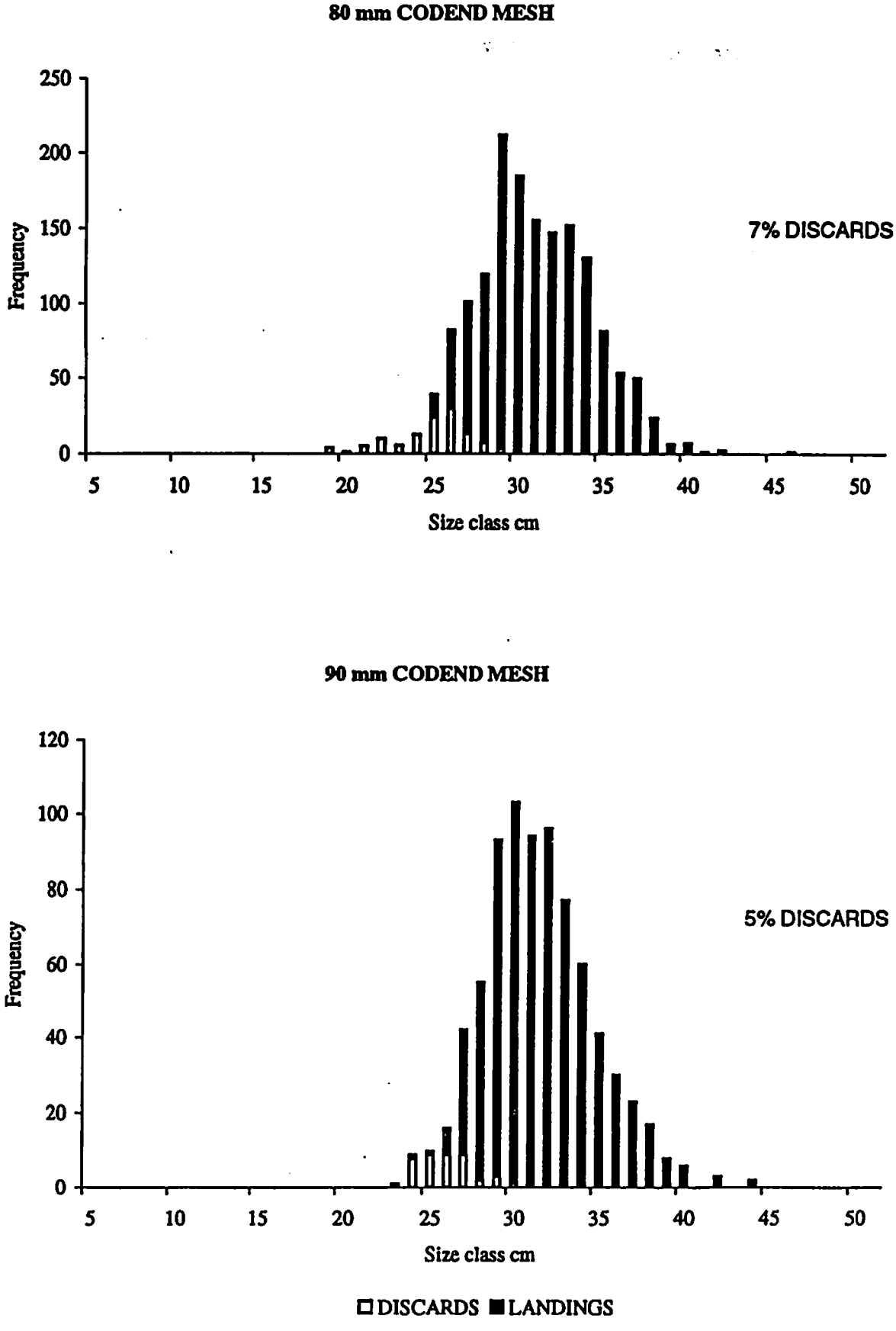


Figure 12. Catch Survey Otter Trawl West Quarter 1:
Length-frequency distributions for Lemon sole in two different codend mesh sizes

Tables 31-33: Catch survey - Otter Trawl West Quarter 3
Catch composition by numbers of all species for three mesh sizes used in Quarter 3

Table 31

MESH	SPECIES	DISCARDS	MARKETABLE	TOTAL CATCH	%DR	%DR>MLS
60	DET	1023	0	1023	100	0
	HOM	721	248	969	74	63
	QSC	858	0	858	100	0
	SQC	28	652	680	4	0
	GUX	171	312	482	35	0
	BIB	91	23	114	80	0
	LSD	65	0	65	100	0
	SPR	0	44	44	0	0
	DAB	0	27	27	0	0
	LEM	0	26	26	0	0
	WHG	0	16	16	0	0
	JOD	0	14	14	0	0
	MUR	0	12	12	0	0
	UNR	0	5	5	0	0
	MAC	0	3	3	0	0

Table 32

MESH	SPECIES	DISCARDS	MARKETABLE	TOTAL CATCH	%DR	%DR>MLS
65	DET	8607	0	8607	100	0
	HOM	2752	1757	4510	61	55
	GUX	0	3720	3720	0	0
	SQC	0	3078	3078	0	0
	BIB	1124	65	1189	95	0
	QSC	429	0	429	100	0
	MUR	0	387	387	0	0
	LEM	0	208	208	0	0
	WHG	12	91	103	12	0
	CRE	44	0	44	100	0
	COD	0	26	26	0	0
	LSD	23	0	23	100	0
	SPR	0	23	23	0	0
	JOD	0	17	17	0	0
	DAB	14	0	14	100	100
	SCX	14	0	14	100	0
	PLE	0	13	13	0	0
	THR	0	13	13	0	0
	UNR	0	11	11	0	0

Table 33

MESH	SPECIES	DISCARDS	MARKETABLE	TOTAL CATCH	%DR	%DR>MLS
80	SQC	0	1235	1235	0	0
	WHG	14	694	708	2	1
	GUX	269	430	699	38	0
	HOM	73	229	302	24	23
	DAB	177	48	225	79	76
	LEM	14	172	186	8	0
	DET	160	0	160	100	0
	JOD	16	132	148	11	0
	LSD	110	0	110	100	0
	SPR	0	48	48	0	0
	MLP	35	0	35	100	0
	PLE	0	24	24	0	0
	MAC	0	20	20	0	0
	MUR	0	12	12	0	0
	BLR	0	6	6	0	0
	COD	0	5	5	0	0
	SCX	0	5	5	0	0
	CRE	4	0	4	100	0
	LIN	0	4	4	0	0

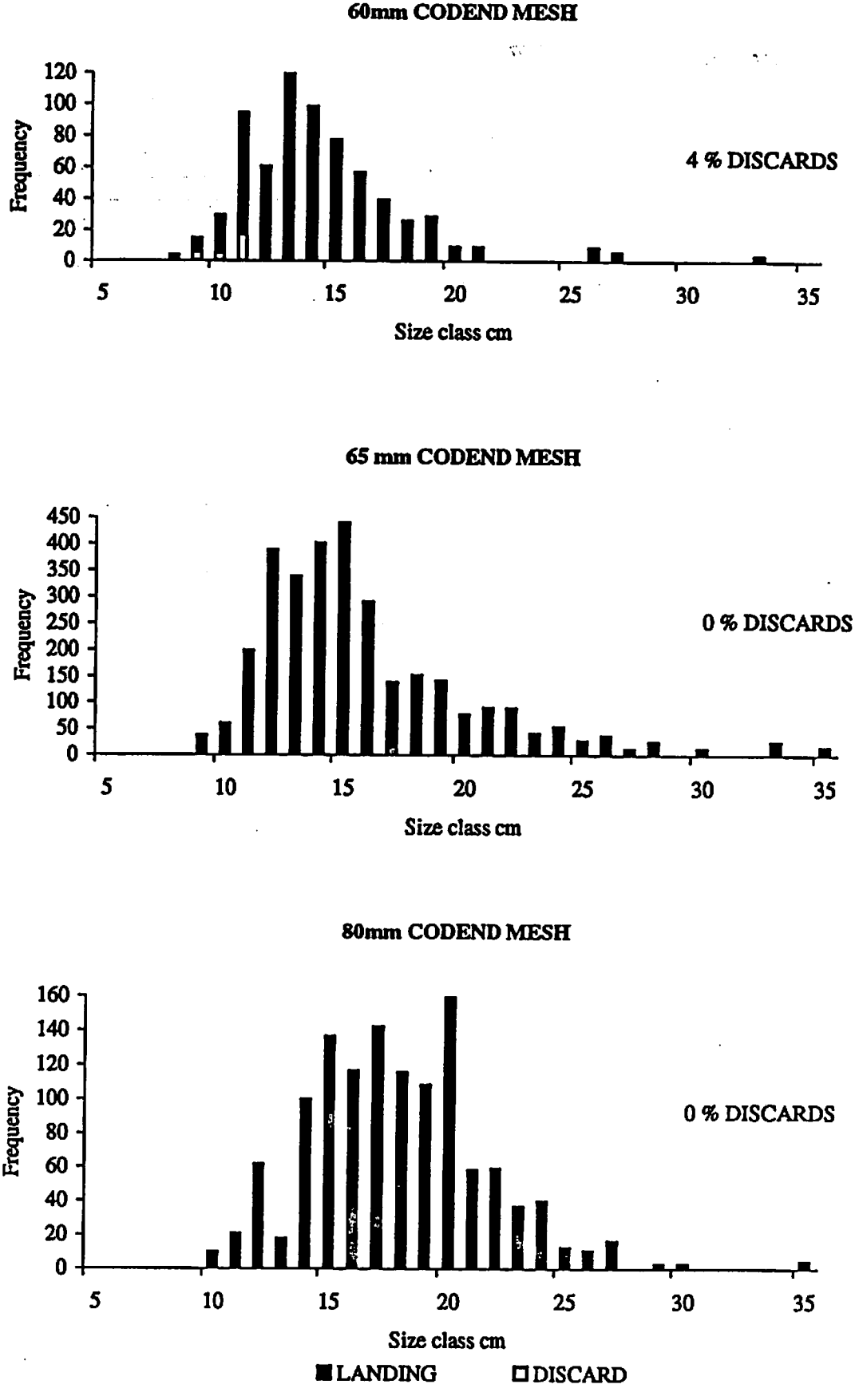


Figure 13. Catch Survey Otter Trawl West Quarter 3:
Length-frequency distributions for Squid in three different codend mesh sizes

4.4 Factors Affecting Discarding Practices

4.4.1 Catch survey - variation between ports

Variation in the market conditions between the different ports may affect discarding practice. For species with an MLS, only those fish above MLS are marketable since fishermen are compelled to discard fish below MLS (very small quantities of fish below MLS were landed). Other species may be landed at a size determined by market forces.

Tables 34 and 35 show some discard rates of a selection of species landed to the three ports involved in the otter trawl west métier. The contribution which each of these species made to the landed catch for each port is also shown.

For species with an MLS (Table 34), there were no substantial differences between ports with the exception of whiting. For whiting the discard rate above the MLS at Plymouth is much higher than the other two ports. However the retained quantity and value of whiting was a very low percentage of the overall landed catch at this port.

The situation was more variable for species without an MLS (Table 35). Of particular interest are gurnards (GUX) and pout whiting (BIB) for which length-frequency distributions are shown in Figures 14 and 15. For both species prices were highest and discard rates were lowest in Brixham.

The length-frequency distribution suggest that the size distribution of gurnards captured from vessels landing to all three ports were similar; however discard rates were highly variable between ports being 9,75 and 94% for Brixham, Looe and Plymouth respectively. Brixham vessels appear to have access to populations of larger pout whiting of which they retained a higher proportion and landed to a higher price than the other two ports.

Table 34: Catch Survey - Otter Trawl West MLS Species Landed in 3 Ports
Total numbers above MLS, total catch, %DR>MLS and % value of total landed catch

		NUMBERS			VALUE	
PORT	SPECIES	DISCARDS ABOVE MLS	TOTAL CATCH	%DIS>MLS	£/kg	%TOTAL LANDINGS
BRIXHAM	LEM	0	308	0	2.85	49
No of Hauls=30	PLE	14	81	18	1.01	2
Hours Trawled=103	SOL	0	2	0	5.52	1
	WHG	4	265	2	0.42	5
LOOE	LEM	7	322	2	2.55	38
No of Hauls=14	PLE	6	53	11	1.02	3
Hours Trawled=61	SOL	0	2	0	4.83	0
	WHG	5	190	3	0.46	5
PLYMOUTH	LEM	77	1469	5	3.06	27
No of Hauls=25	PLE	80	700	11	1.35	9
Hours Trawled=91	SOL	0	7	0	5.94	0
	WHG	109	227	48	0.56	1

Table 35: Catch Survey - Otter Trawl West Non MLS Species Landed in 3 Ports
Total numbers and discard rates and % value of total landed catch

		NUMBERS				VALUE	
PORT	SPECIES	DISCARDS	MARKETABLE	TOTAL CATCH	% DR	£/kg	%TOTAL LANDINGS
BRIXHAM	BIB	2218	1204	3422	65	0.38	6
No of Hauls=30	CTL	0	82	82	0	1.50	1
Hours Trawled=103	DAB	2230	442	2672	83	0.69	6
	GUX	453	4739	5192	9	0.50	8
	HOM	3550	2399	5949	60	0.25	3
LOOE	BIB	744	12	756	98	0.20	0
No of Hauls=14	CTL	41	690	731	6	0.84	14
Hours Trawled=61	DAB	641	86	727	88	0.28	1
	GUX	841	283	1124	75	0.20	1
	HOM	342	0	342	100	0.27	0
	MON	6	18	24	26	1.85	2
PLYMOUTH	BIB	220	35	255	86	0.32	0
No of Hauls=25	CTL	71	1485	1556	5	1.50	38
Hours Trawled=91	DAB	5850	320	6170	95	0.50	6
	GUX	5936	398	6334	94	0.49	4
	HOM	253	0	253	100	0.14	0
	MON	49	123	172	29	1.93	8

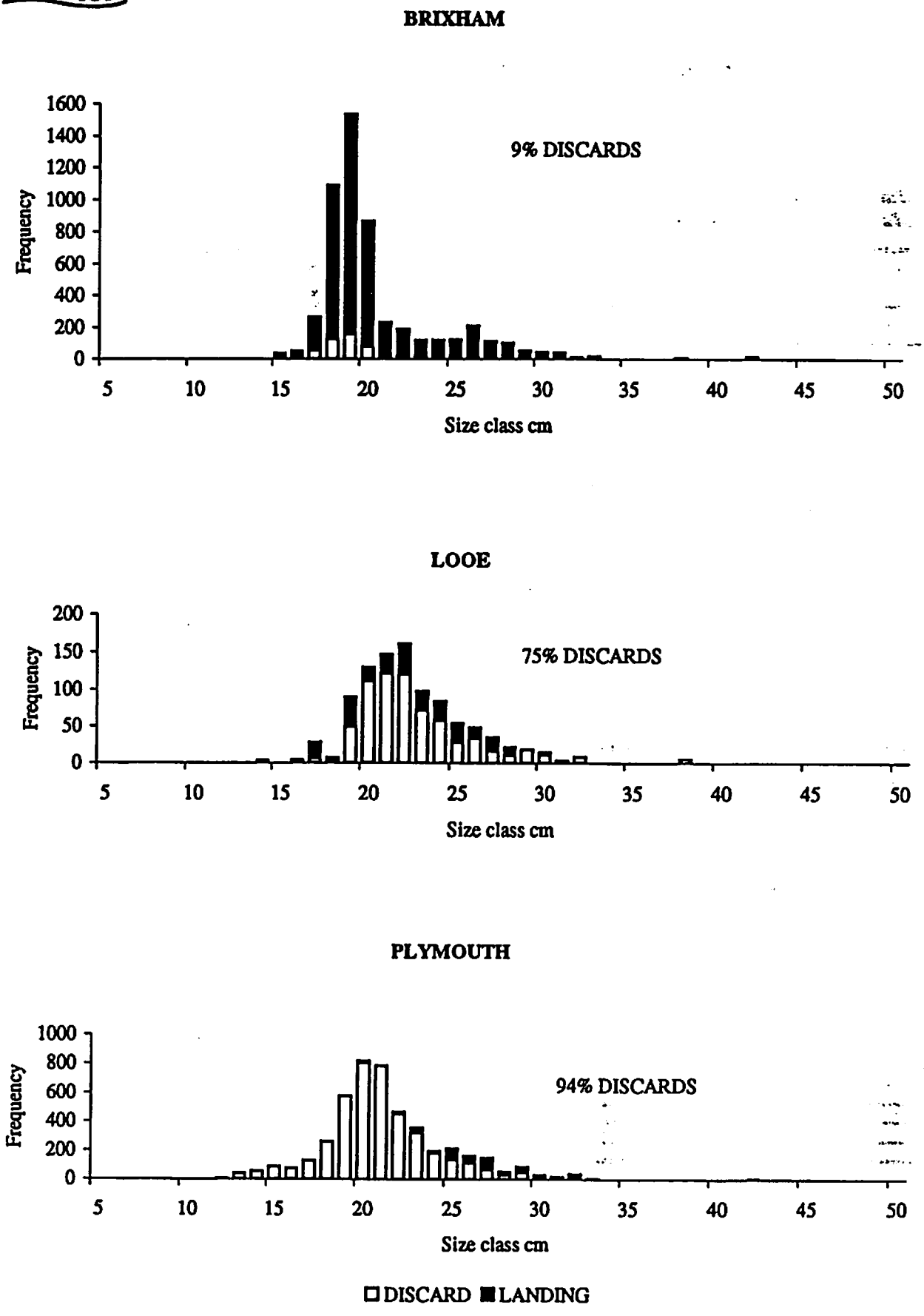


Figure 14. Catch Survey Otter Trawl West:
Length-frequency distributions for Gurnards captured by vessels landing to three different ports

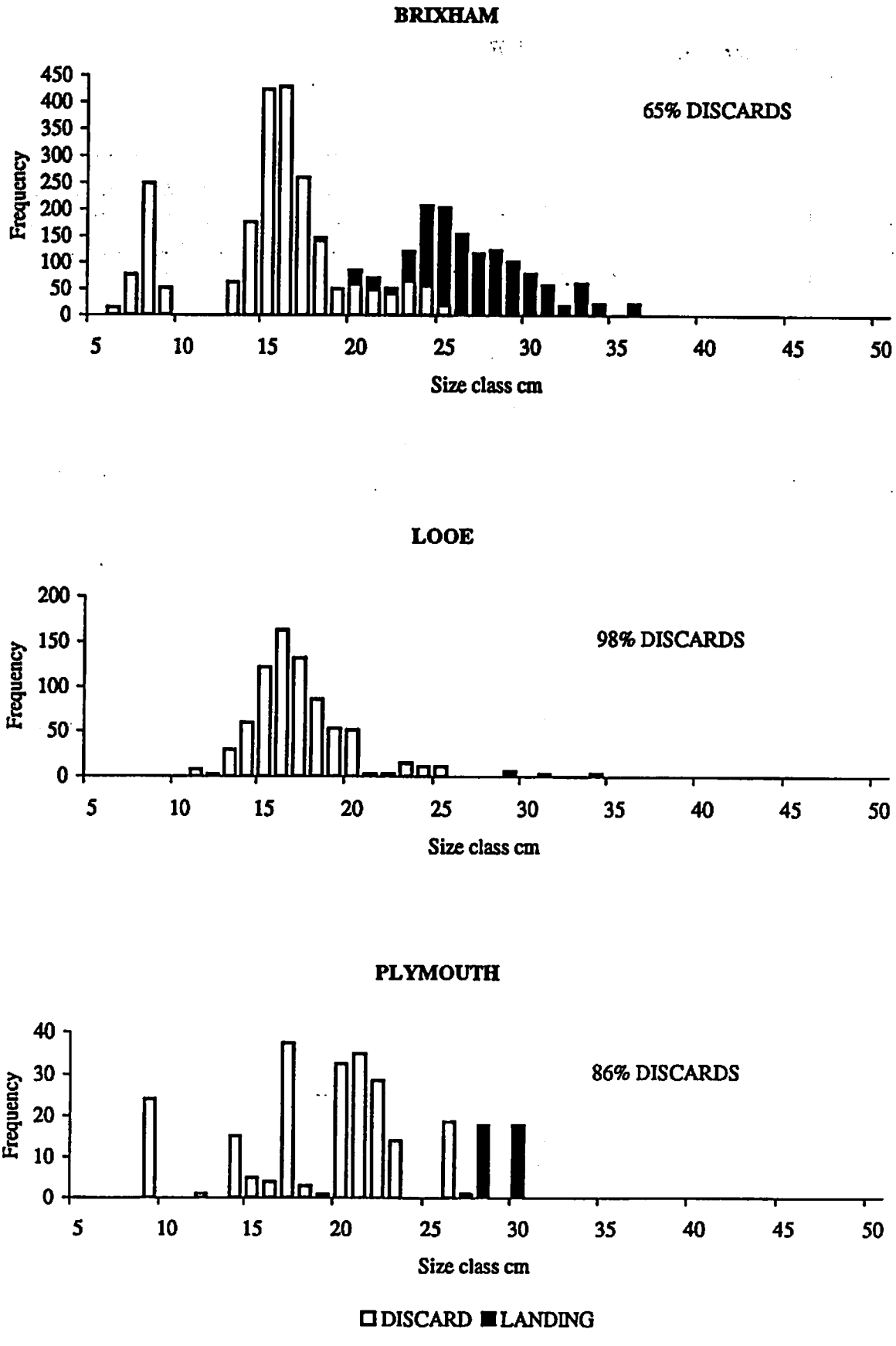


Figure 15. Catch Survey Otter Trawl West:
Length-frequency distributions for Pout Whiting captured by vessels landing to three different ports

4.4.2 Effort and catch surveys - discarding practices by season and métier

Seasonally targeted species
Data on percentage discard rates by number (overall and >MLS), unit price and percentage value of the landed catch are tabulated by quarter, métier and species in Tables 36-52. Each table is sorted by species in descending order of percentage value of the total landings during that quarter. Also shown are numbers and weights of discarded and landed catch. From these tables, the main species were selected to illustrate discarding practices with length and by métier and the way in which relative values and seasonal variations can influence discarding rates. These are shown in Figures 16-42. These results are described in relation to the data on the numbers of respondents naming each species as target species, shown in Tables 28 and 29.

Quarter 1 (Tables 36-39)
Métiers sampled - otter trawl west, beam offshore west, otter trawl east, beam inshore east.

Lemon sole (Figure 16)
The only fishery in which there were substantial numbers of lemon sole captured was the otter trawl west métier. Here the species constituted 62% of the value of the landings and it was the most frequently named target species during this time of year (Table 28).

Discard rates were low at 7% and were concentrated around and just above the MLS of 25cm; half of these discards by number were fish of lengths above the MLS. Two different mesh sizes were used in this métier during this quarter and different discard rates were found for these mesh sizes (section 4.3.6).

In the other three métiers very few fish were sampled but the trend appears to be toward higher discard rates in the eastern métiers (43% for beam east and 51% for otter trawl east). The catch was composed of smaller fish in the eastern métiers and discarded fish were predominantly below the MLS. A small amount of undersized landings occurred in the beam offshore west métier species but the species had a low discard rate (5%) in this métier.

Plaice (Figure 17)
Plaice were named a target species by all of the métiers sampled in this quarter. This species also contributed to the total landed values and was a main contributor by weight in all the catches. Plaice had relatively low unit values of £1.29/kg in the east and £1.13/kg in the west which reduced plaice's share of the total landed values, even though they are one of the main contributors by weight.

In the otter trawl west métier, discarding occurred at lengths above the MLS of 25cm. In the otter trawl east métier there was a sharp differentiation between discards and landings at the MLS. This difference in discarding practice may be due part due to the different size distribution of plaice captured; in the otter trawl west there was a preponderance of large plaice in the catches. This may have resulted in relatively less interest the small plaice with lengths just above MLS.

No undersized plaice were caught in the beam offshore west métier and no discarding occurred. This contrasts with the beam east where there was an 18% discard rate for plaice; the majority of these were smaller than the MLS.

Sole (Figure 18)
Sole were only caught in the two beam trawl métiers and what little discarding occurred above the MLS of 24cm but this was probably due to poor fish quality. No undersized fish were landed.

Whiting (Figure 19)
Whiting were only named as a main target species in the otter trawl east métier for which they contributed 6% of the total landed catch value in this métier. In terms of weight the species makes a substantial contribution being similar to pout whiting and flounders in both catches and landings. However the species' share of the landed value was ranked fifth after bass, squid, plaice and lemon sole and the discard rate above MLS was 25%; the fishermen only retained the larger fish.

In the other métiers, whiting were not named as target species and did not significantly contribute to the landed catch values. The discard rate for whiting varied between 5% and 82%. The length distributions were similar in both otter trawling métiers with discarding at lengths above and below the MLS. Very few whiting below the MLS were captured with the exception of the beam east métier. Only a small proportion of the small quantity of legally sized whiting caught were landed from this métier. In contrast the beam offshore west landed all whiting larger than the MLS with few undersized fish captured.

Cuttlefish (Figure 20)
Both western métiers consider cuttlefish as target species with a higher proportion in beam offshore west compared with otter trawl west. There is no MLS for cuttlefish, so discarding practices are dictated by market forces; a minimum retention size of around 15cm was observed for cuttlefish during this quarter.

The only métier that caught large numbers of cuttlefish was beam offshore west in which the species was ranked first in terms of landed value.

Contrasting length distributions of cuttlefish were observed in the catches of the two western métiers were; a larger proportion of small cuttlefish were captured in the beam offshore west giving a discard rate of 79%, whereas otter trawl west's discard rate was lower at 62%. However only small numbers of cuttlefish were captured in otter trawl west.

Squid (Figure 21)
Squid was reported as a target species for this quarter only in the otter trawl west métier. They were caught in the two otter trawl métiers in both cases being in the highest ranking three species in terms of share of the landed value (15% and 17% in the east and west respectively). Discard rates were similar in both east and west at 8% and 11% respectively; discarding appears not to be related to size in the west. Perhaps quality considerations influenced discarding during this quarter.

Table 36: Catch Survey Quarter 1
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.1		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDED CATCH	%TOTAL LANDINGS
No OF HAULS= 18	LEM	156	2211	2367	7	3	28.7	721.2	2.82	2035	62
TOTAL HOURS	SQC	20	224	245	8	0	7.5	127.6	3.89	496	15
TRAWLED= 65	PLE	110	733	843	13	9	19.2	316	1.13	356	11
	JOD	35	58	93	38	0	7.2	26.6	3.58	95	3
	TUR	0	7	7	0	0	0	9.5	6.55	62	2
	CTL	71	43	114	62	0	20.7	42.1	1.28	54	2
	WHG	115	387	502	23	22	22	98.4	0.48	47	1
	DAB	2846	249	3096	92	91	271.8	61.2	0.49	30	1
	MON	17	10	27	63	0	3.2	16.2	1.78	29	1
	BSE	0	6	6	0	0	0	3.1	5.88	18	1
	SPR	1	8	9	12	0	0.5	13.9	1.01	14	0
	SOL	0	6	6	0	0	0	2.5	5.43	14	0
	MUR	126	4	130	97	39	4.4	2.1	5.29	11	0
	COD	0	9	9	0	0	0	9.4	1.13	11	0
	HAD	0	5	5	0	0	0	3.6	0.92	3	0
	BLR	0	1	1	0	0	0	2.5	1.02	3	0
	MAC	57	15	72	79	30	12.6	5.6	0.36	2	0
	CUR	1	1	2	50	0	0.5	2.1	0.92	2	0
	THR	0	2	2	0	0	0	1.9	1.02	2	0
	FLE	0	32	32	1	0	0	12.5	0.12	1	0
	BIB	73	10	83	88	0	3.8	2.9	0.30	1	0
	GUX	2675	2	2677	100	0	263.9	1.6	0.40	1	0
	HER	10	4	13	72	72	1	0.6	0.36	0	0
	WIT	1	1	2	50	50	0.1	0.2	0.38	0	0
	BLL	1	0	1	100	100	0.5	0	4.21	0	0
	CRE	4	0	4	100	0	0	0	1.27	0	0
	HKE	10	0	10	100	0	0.7	0	1.72	0	0
	HOM	253	0	253	100	100	40.4	0	0.22	0	0
	LSD	427	0	427	100	0	125.2	0	0.30	0	0
	MEG	3	0	3	100	33	0.2	0	1.22	0	0
	PIL	30	0	30	100	0	0	0	0.13	0	0
	SCR	4	0	4	100	0	2.4	0	0.60	0	0

Results are totalled by quarter for trips sampled

Table 37: Catch Survey Quarter 1
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 2.2		NUMBERS					WEIGHT		VALUE		
BEAM OFFSHORE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=16	CTL	1508	412	1920	79	0	190.9	472.4	1.28	605	37
TOTAL HOURS	SOL	8	171	178	4	0	0.3	69.1	5.43	375	23
TRAWLED=30	LEM	13	231	245	5	0	1.7	63.7	2.82	180	11
	SCX	0	428	428	0	0	0	129.1	1.35	174	11
	PLE	0	333	333	0	0	0	119.5	1.13	135	8
	MON	39	33	72	54	0	4	29.8	1.78	53	3
	DAB	1888	233	2121	89	89	161.1	55.9	0.49	27	2
	SQC	0	14	14	0	0	0	5	3.89	19	1
	WHG	7	124	131	5	0	0.9	32.2	0.48	15	1
	JOD	0	9	9	0	0	0	3.4	3.58	12	1
	HKE	0	9	9	0	0	0	4.6	1.72	8	0
	GUX	756	47	803	94	0	67.1	14.1	0.40	6	0
	BIB	574	26	599	96	0	104.4	10.3	0.30	3	0
	WIT	7	9	16	43	0	0.4	2.7	0.38	1	0
	CRE	3	0	3	100	0	0	0	1.27	0	0
	HER	46	0	46	100	100	4.7	0	0.36	0	0
	HOM	21	0	21	100	100	1.4	0	0.22	0	0
	LSD	37	0	37	100	0	5.5	0	0.30	0	0
	MAC	113	0	113	100	11	19.4	0	0.36	0	0
	QSC	1027	0	1027	100	0	0	0	0.20	0	0
	SCR	29	0	29	100	0	17.5	0	0.60	0	0

Results are totalled by quarter for trips sampled

Table 38: Catch Survey Quarter 1
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

U.K. 1.2		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL EAST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	%DR	%DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=12	BSE	0	108	108	0	0	0	65	5.60	364	27
TOTAL HOURS	SQC	20	158	178	11	0	2.8	91.3	2.55	233	17
TRAWLED=33	LEM	179	170	349	51	8	29.7	43.6	3.22	140	10
	PLE	182	357	539	34	0	22	107.4	1.29	139	10
	WHG	309	577	886	35	25	53.9	168.7	0.53	89	6
	SOL	0	44	44	0	0	0	13.2	4.61	61	4
	FLE	705	569	1274	55	33	147.4	215.3	0.23	49	4
	DAB	3139	449	3588	87	87	311	117.2	0.41	48	3
	SPR	10	10	20	50	0	0	26.7	1.45	39	3
	COD	14	18	33	44	0	4.3	25.1	1.43	36	3
	BIB	1122	413	1535	73	0	181.9	167.9	0.21	35	3
	THR	19	10	29	66	0	19.7	21.9	1.45	32	2
	HOM	35	340	375	9	9	5.5	94.6	0.33	31	2
	MUR	10	10	20	50	0	0.3	3.1	7.90	24	2
	LSD	10	117	127	8	0	0	74.9	0.22	16	1
	JOD	0	10	10	0	0	0	4.3	3.44	15	1
	CTL	0	10	10	0	0	0	12.4	1.07	13	1
	BLR	3	6	9	33	0	0.2	5	1.28	6	0
	GUX	451	30	481	94	0	62.8	5.1	0.31	2	0
	HER	0	3	3	0	0	0	0.5	0.41	0	0
	BLL	3	0	3	100	0	0.2	0	3.56	0	0
	CUR	10	0	10	100	0	9.8	0	1.45	0	0
	DET	33	0	33	100	0	0	0	0.00	0	0
	DGH	38	0	38	100	0	11.2	0	0.23	0	0
	SCR	30	0	30	100	0	22.6	0	4.53	0	0
	SCR	30	0	30	100	0	22.6	0	0.68	0	0

Results are totalled by quarter for trips sampled

Table 39: Catch Survey Quarter 1
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

U.K. 2.1
BEAM EAST
No OF HAULS=10
TOTAL HOURS TRAWLED=20

	NUMBERS					WEIGHT		VALUE		
SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	%DR	%DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
SOL	50	896	946	5	1	5.8	227.1	4.61	1047	59
PLE	195	918	1114	18	2	24.9	252.3	1.29	326	18
LEM	148	198	346	43	6	20.4	49.7	3.22	160	9
BLL	0	31	31	0	0	0	24.2	3.56	86	5
TUR	0	6	6	0	0	0	8.6	5.19	45	3
SCX	0	23	23	0	0	0	14.9	1.25	19	1
SPR	65	16	81	80	0	17.8	10	1.45	15	1
COD	0	9	9	0	0	0	9.7	1.43	14	1
BIB	940	162	1103	85	0	139.5	58.1	0.21	12	1
THR	0	6	6	0	0	0	6.1	1.45	9	1
SQC	0	8	8	0	0	0	3.4	2.55	9	0
GUX	145	78	223	65	0	13.2	19	0.31	6	0
CUR	15	7	22	68	0	4.7	3.7	1.45	5	0
DAB	848	37	885	96	94	73.1	8.5	0.41	3	0
BLR	0	4	4	0	0	0	2.6	1.28	3	0
WHG	111	24	136	82	23	15.6	6.1	0.53	3	0
FLE	35	42	76	45	0	4.4	12.7	0.23	3	0
LSD	10	10	20	50	0	1.8	4.6	0.22	1	0
CRE	10	18	28	35	0	0	0	1.01	0	0
DET	92	0	92	100	0	0	0	0.00	0	0
DGH	12	0	12	100	0	3.5	0	0.23	0	0
MON	6	0	6	100	100	0.6	0	6.46	0	0
SCR	51	0	51	100	0	36.8	0	0.68	0	0

Results are totalled by quarter for trips sampled

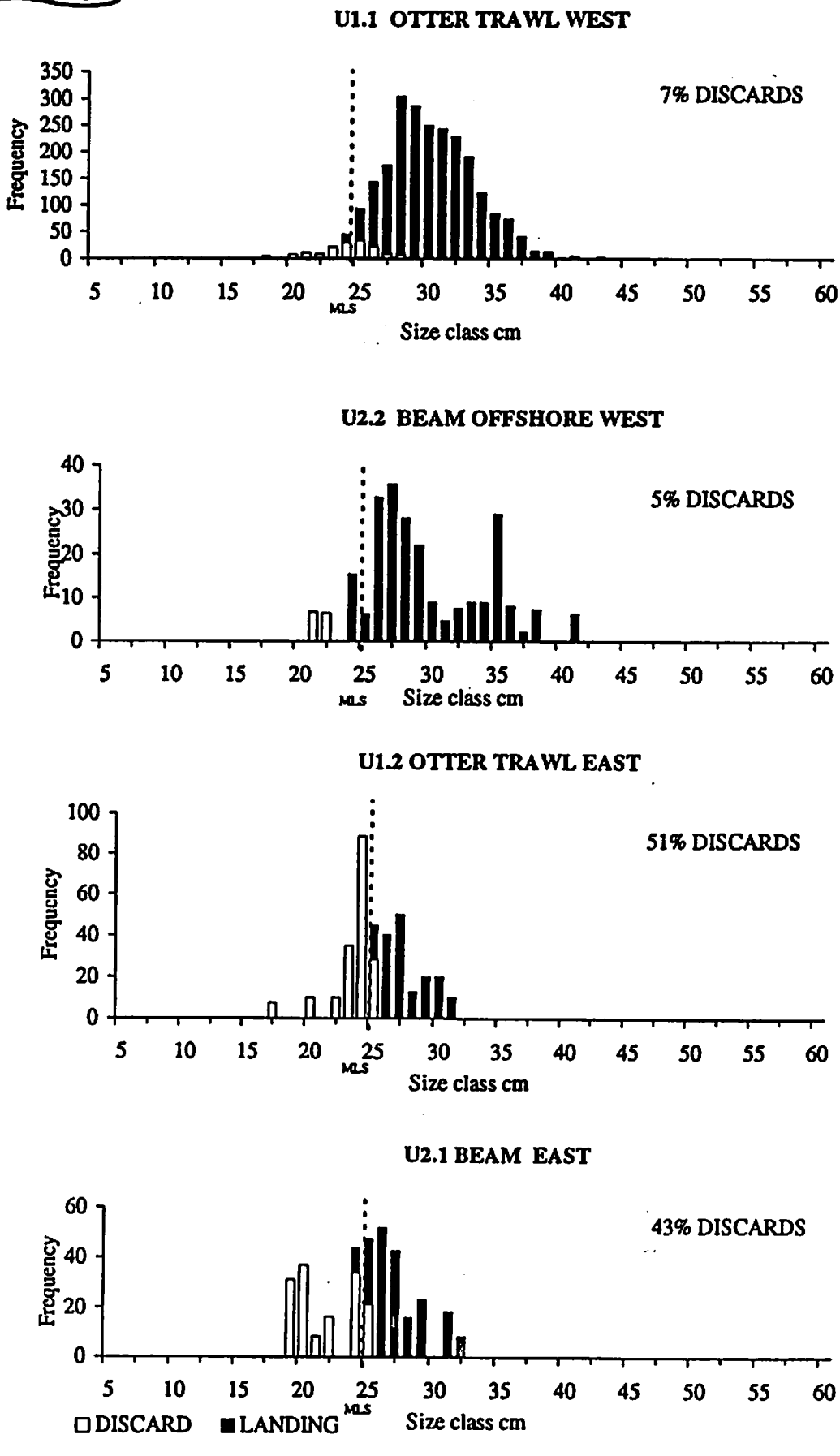


Figure 16. Catch Survey Quarter 1:
Length-frequency distributions for Lemon sole landings and discards

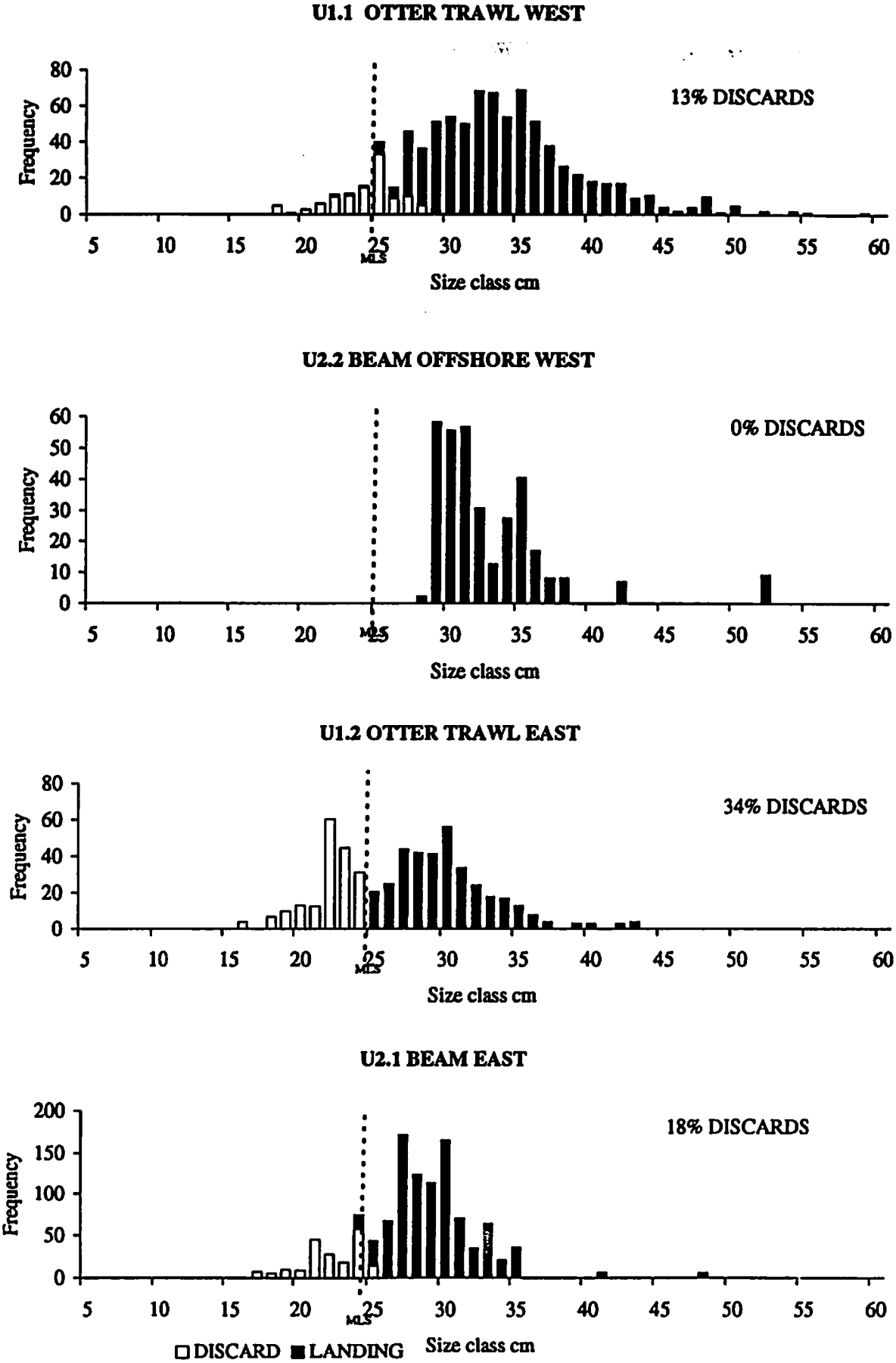


Figure 17. Catch Survey Quarter 1:
Length-frequency distributions for Plaice landings and discards

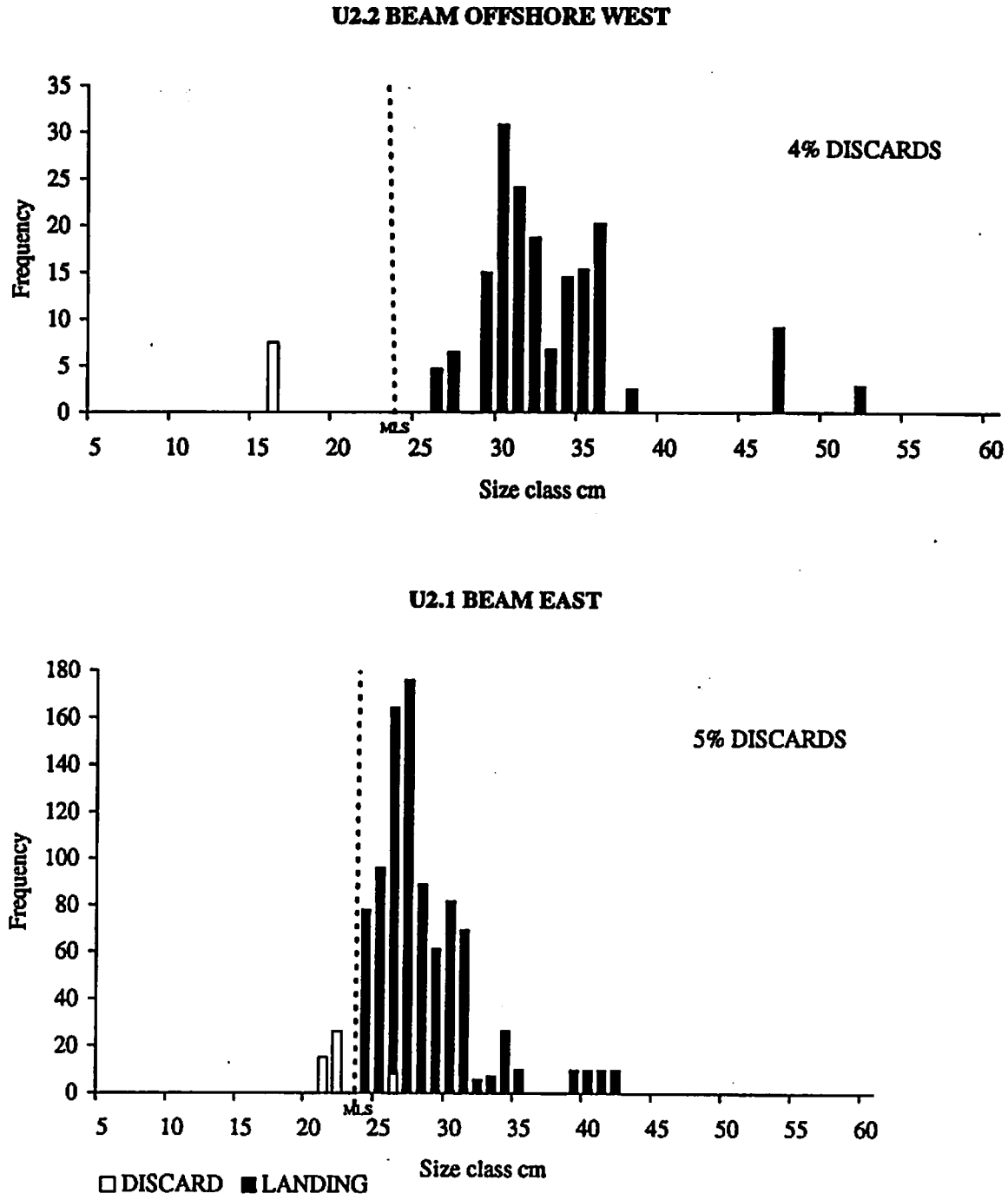


Figure 18. Catch Survey Quarter 1:
Length-frequency distributions for Sole landings and discards

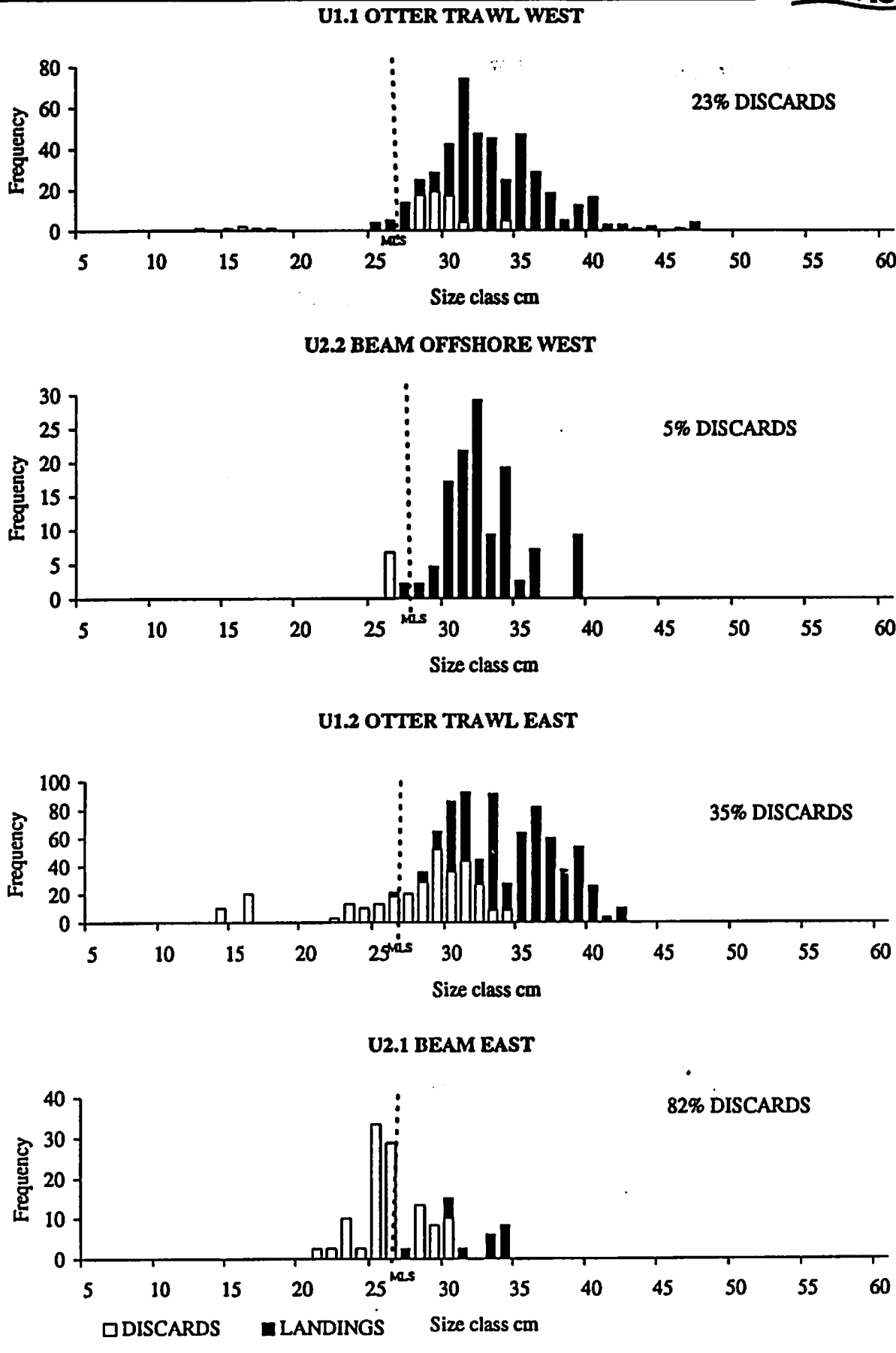
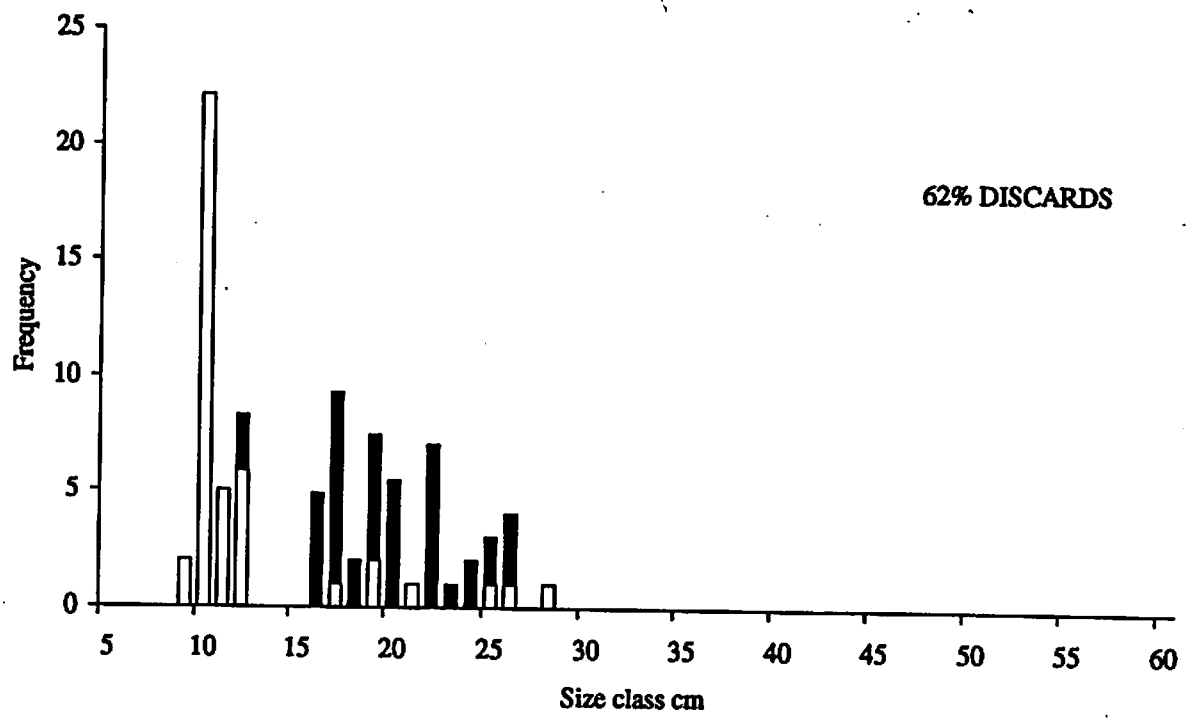


Figure 19. Catch Survey Quarter 1:
Length-frequency distributions for Whiting landings and discards

U1.1 OTTER TRAWL WEST



U2.2 BEAM OFFSHORE WEST

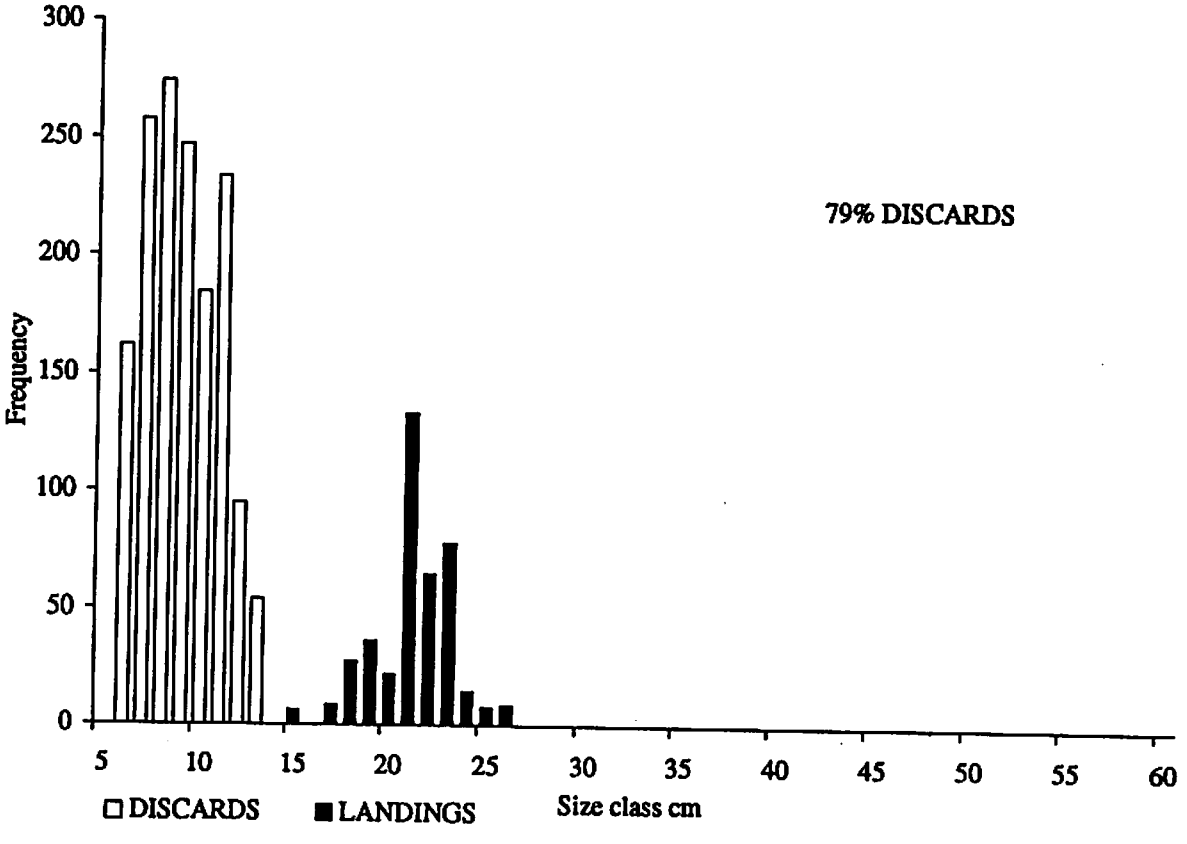


Figure 20. Catch Survey Quarter 1:
Length-frequency distributions for **Cuttlefish** landings and discards

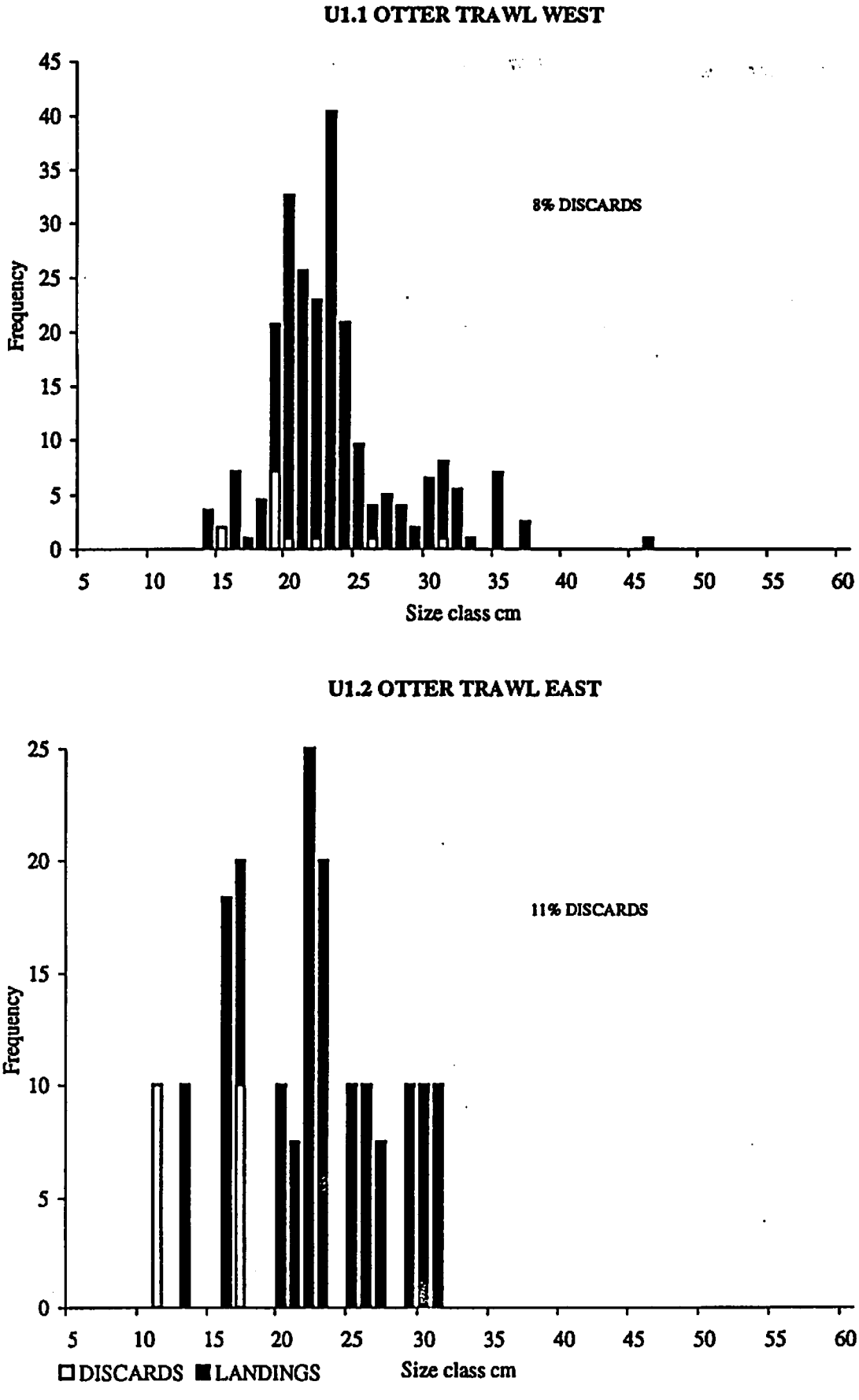


Figure 21. Catch Survey Quarter 1:
Length-frequency distributions for Squid landings and discards

Quarter 2 (Tables 40-44)
Métiers sampled: otter trawl west, beam offshore west, otter trawl east, pair trawl west, scallop dredge west.

Lemon sole (Figure 22)
In otter trawl west, lemon sole contributed 63% of the total landed value but is listed as a target by a decreasing proportion of respondents. There is a similar pattern in the pair trawl west métier. Beam east named lemon sole as a main target species at this time, but no data is available on catch as no sampling took place.

The discard rates in the western métiers were slightly higher than in the first quarter. Virtually no discarding of fish larger than the MLS occurred; this contrasts with the first quarter when larger fish (>30cm length) were present as slightly a higher proportion of the catch and some discarding of fish larger than the MLS occurred.

Plaice (Figure 23)
Plaice was named as a target species by an increased proportion of respondents in the otter trawl east and beam trawl west métiers and ranked second in terms of value in the latter métier during this quarter. It was ranked third in terms of weight and value below cuttlefish and squid in the otter trawl east métier.

Discard rates in the otter trawl métiers for plaice were high at 39% in the west and 75% in the east and the beam offshore west had a discard rate of 17% for plaice. This was substantially higher than in the first quarter and was mostly accounted for by fish smaller than the MLS.

The proportion of larger fish in the catches was higher in the three western métiers (particularly in the beam offshore west métier) than in the east. As observed in the first quarter discarding at lengths above the MLS was slightly more prevalent when larger fish were present in the catches.

Sole (Figure 24)
Sole were predominant in the catches in the beam offshore west métier in this quarter. The species was named as a main target species by an increasing proportion of respondents partaking in this métier during this quarter and it contributed 55% of the total catch value. This contrasts with the previous quarter when it only accounted for 23% of the landed value ranked second below cuttlefish at 37%.

The discard rate in this métier was very low during this quarter at 7% and few undersize fish were caught. This was a very similar discarding pattern to the first quarter's results.

Whiting (Figure 25)
Respondents partaking in the pair trawl west and otter trawl west métiers considered whiting a target species during this quarter.

The percentage of the landed value of the catch was low for this species in all except the pair trawl métier. Here 8% of the landed catch value was whiting and was ranked second by value behind lemon sole and equal with plaice. The weight of whiting in the catch in this métier was similar to that of lemon sole but the landed value was approximately one eighth of this species. Considerable discarding of whiting larger than the MLS occurred. Even if all of the whiting discarded had been landed it would have contributed less than 3% to landed catch values.

In contrast this species was caught in relatively smaller quantities by weight in otter trawl west and is ranked fifth by value of landed catch in this métier but a very low discard rate above the MLS was observed.

In the other two métiers the species was not named as a target species and relatively small quantities were caught; considerable discarding occurred above the MLS of 27cm.

Cuttlefish (Figure 26)
Cuttlefish was only considered as a major target species in the otter trawl east at this time of year; however most métiers caught cuttlefish.

In otter trawl east they contributed 68% of the total landed value ranking first in terms of value and in otter trawl west, 14% being proportionally the second most valuable species after lemon sole. In these two métiers the discard rates for cuttlefish were very low (0% and 7%, respectively).

The catches in the otter east trawl métier consisted of only large cuttlefish of >15cm with no discards. In contrast the otter trawl west catches contained a variety of sizes up to 25cm but the majority were between 7 and 15cm; although some of the smaller animals were discarded the fishermen did not appear to be operating a consistent retention size.

However in the beam offshore west métier all the animals were small; the majority below 15cm and the discard rate was 100%.

Scallops (Figure 27)
Scallops were caught in two métiers; scallop dredge west and beam offshore west. In the scallop dredge west métier the discard rate 49% and the MLS of 10cm was strictly observed.

In beam offshore west very few scallops were captured with most of these being above the MLS of 10cm. This MLS was adhered to in this métier resulting in a low discard rate of 9% due to the high proportion of of large, legally sized scallops being captured. Even though only a few were caught, they are still retained because scallops have quite a high unit value of £1.35/kg.

Table 40: Catch Survey Quarter 2
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.1		NUMBERS					WEIGHTS		VALUES		
OTTER TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDED CATCH	%TOTAL LANDINGS
No OF HAULS=14	LEM	211	1474	1685	13	0	29.4	470	2.82	1326	63
TOTAL HOURS	CTL	41	542	583	7	0	4.4	221.2	1.28	283	14
TRAWLED= 63	JOD	3	62	65	5	0	0.3	34	3.58	122	6
	PLE	127	198	325	39	6	15	70.9	1.13	80	4
	WHG	65	602	667	10	1	9.5	136.5	0.48	65	3
	BIB	994	452	1446	69	0	81.2	146	0.30	44	2
	DAB	2511	444	2955	85	84	202.4	75.9	0.49	37	2
	SQC	0	34	34	0	0	0	9.4	3.89	37	2
	LSD	5	137	143	4	0	1	83.4	0.30	25	1
	MON	6	14	21	30	0	1.2	13.2	1.78	23	1
	SOL	0	8	8	0	0	0	2.8	5.43	15	1
	GUX	565	278	843	67	0	71.8	37.6	0.40	15	1
	HOM	313	164	477	66	62	21.9	26.4	0.22	6	0
	MAC	0	40	40	0	0	0	9.8	0.36	4	0
	DGS	0	11	11	0	0	0	7.1	0.38	3	0
	COD	5	6	11	48	0	1.3	2.3	1.13	3	0
	MUR	0	3	3	0	0	0	0.2	5.29	1	0
	WIT	20	3	23	87	9	1.3	0.7	0.38	0	0
	CRE	8	0	8	100	0	0	0	1.27	0	0
	CUR	1	0	1	100	0	0.1	0	0.92	0	0
	SCR	4	0	4	100	0	1.9	0	0.60	0	0

Results are totalled by quarter for trips sampled

Table 41: Catch Survey Quarter 2
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.3		NUMBERS					WEIGHT		VALUE		
PAIR TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=18	LEM	141	719	861	16	2	19.9	253.3	2.82	715	67
TOTAL HOURS	WHG	391	814	1205	32	25	65.3	187.3	0.48	90	8
TRAWLED=17	PLE	27	245	273	10	0	3.3	77.8	1.13	88	8
	GUX	693	1214	1908	36	0	44.5	184.2	0.40	73	7
	SQC	19	29	48	39	0	2.9	7.8	3.89	30	3
	HKE	36	54	90	40	0	4	16.8	1.72	29	3
	MEG	0	23	23	0	0	0	12.3	1.22	15	1
	JOD	47	9	56	84	0	2.4	1.9	3.58	7	1
	HOM	739	269	1008	73	72	44.9	26.8	0.22	6	1
	CTL	9	14	23	40	0	1.4	3.4	1.28	4	0
	DAB	852	9	861	99	99	70.8	2.8	0.49	1	0
	WIT	0	9	9	0	0	0	1.8	0.38	1	0
	MAC	0	9	9	0	0	0	0.6	0.36	0	0
	BIB	667	0	667	100	0	33	0	0.30	0	0
	COD	42	0	42	100	21	10.7	0	1.13	0	0
	DGS	9	0	9	100	0	6.9	0	0.38	0	0
	LSD	100	0	100	100	0	75.8	0	0.30	0	0
	MUR	14	0	14	100	100	0.6	0	5.29	0	0

Results are totalled by quarter for trips sampled

Table 42: Catch Survey Quarter 2
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 2.2		NUMBERS					WEIGHT		VALUE		
BEAM OFFSHORE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=75	SOL	164	2293	2458	7	3	17.5	823.5	5.43	4472	55
TOTAL HOURS	PLE	512	2445	2957	17	3	62.2	980.2	1.13	1105	14
TRAWLED=139	TUR	0	25	25	0	0	0	63.6	6.55	417	5
	LEM	42	384	427	10	0	5.9	127.8	2.82	361	4
	JOD	30	103	133	22	0	1.1	64.1	3.58	230	3
	BIB	3723	2144	5867	63	0	656.9	743.7	0.30	224	3
	MON	28	174	202	14	0	3.8	123.7	1.78	220	3
	BLL	0	46	46	0	0	0	51.8	4.21	218	3
	LSD	1360	1298	2658	51	0	397.2	613.3	0.30	184	2
	GUX	2688	3477	6165	44	0	260	459.5	0.40	183	2
	MUR	15	61	76	20	20	0.8	27.9	5.29	148	2
	SQC	0	116	116	0	0	0	27.5	3.89	107	1
	SCX	14	137	151	9	0	2	53.6	1.35	72	1
	SCR	351	121	472	74	0	243.9	116	0.60	70	1
	WHG	202	403	605	33	26	37.3	130.5	0.48	63	1
	BLR	49	28	78	63	0	8	29.7	1.02	30	0
	DAB	4284	240	4523	95	94	452.6	61.1	0.49	30	0
	COD	5	18	23	22	22	2.7	18.5	1.13	21	0
	SPR	58	21	79	73	0	5.9	16.4	1.01	17	0
	HKE	0	8	8	0	0	0	2.2	1.72	4	0
	MEG	219	11	230	95	0	8.4	2.1	1.22	3	0
	POL	0	4	4	0	0	0	2.6	0.71	2	0
	CRE	280	178	458	61	0	0.1	0.1	1.27	0	0
	CTL	493	0	493	100	0	68.1	0	1.28	0	0
	HAD	9	0	9	100	63	2	0	0.92	0	0
	HOM	51	0	51	100	61	2.5	0	0.22	0	0
	QSC	451	0	451	100	0	0	0	0.20	0	0
	SPT	6	0	6	100	0	0.1	0	0.37	0	0
	THR	23	0	23	100	0	1.4	0	1.02	0	0
	UNR	6	0	6	100	0	2.2	0	1.00	0	0
	WIT	11	0	11	100	0	0.6	0	0.38	0	0

Results are totalled by quarter for trips sampled

Table 43: Catch Survey Quarter 2
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 4.1		NUMBERS					WEIGHT		VALUE		
SCALLOP DREDGE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=23	SCX	5369	5669	11037	49	3	780.7	1207.2	1.35	1626	93
TOTAL HOURS	MON	0	9	9	0	0	0	40.7	1.78	72	4
DREDGED=41	BLL	0	7	7	0	0	0	10.9	4.21	46	3
	CRE	158	0	158	100	0	0.1	0	1.27	0	0
	CTL	19	0	19	100	0	4.4	0	1.28	0	0
	QSC	156	0	156	100	0	0	0	0.20	0	0
	SCR	16	0	16	100	0	22.7	0	0.60	0	0

Results are totalled by quarter for trips sampled

Table 44: Catch Survey Quarter 2
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

U.K. 1.2		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL EAST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	%DR	%DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=11	CTL	0	343	343	0	0	0	504.2	1.07	541	68
TOTAL HOURS	SQC	0	73	73	0	0	0	67.4	2.55	172	22
TRAWLED=31	PLE	377	123	500	75	20	44.7	36.5	1.29	47	6
	UNR	0	2	2	0	0	0	6.6	1.62	11	1
	GUX	19	73	92	21	0	1.2	14	0.31	4	1
	SBZ	8	13	21	38	5	0.9	5.7	0.69	4	0
	BSE	0	1	1	0	0	0	0.7	5.60	4	0
	DAB	467	43	510	92	92	40.4	7.2	0.41	3	0
	GAR	0	24	24	0	0	0	5.7	0.44	3	0
	FLE	115	18	133	86	14	14.2	7	0.23	2	0
	THR	0	1	1	0	0	0	0.9	1.45	1	0
	LSD	0	9	9	0	0	0	5.5	0.22	1	0
	POL	0	2	2	0	0	0	1.5	0.79	1	0
	COD	2	1	3	67	0	0.6	0.5	1.43	1	0
	MAC	0	28	28	0	0	0	7.6	0.03	0	0
	HOM	0	1	1	0	0	0	0.3	0.33	0	0
	BIB	592	0	592	100	0	47.9	0	0.21	0	0
	BLL	11	0	11	100	0	1.1	0	3.56	0	0
	CUR	32	0	32	100	0	5.2	0	1.45	0	0
	DET	3	0	3	100	0	0	0	0.00	0	0
	LUM	35	0	35	100	0	42	0	0.11	0	0
	SPR	80	0	80	100	0	12.8	0	1.45	0	0
	WRA	11	0	11	100	0	0.8	0	0.00	0	0

Results are totalled by quarter for trips sampled

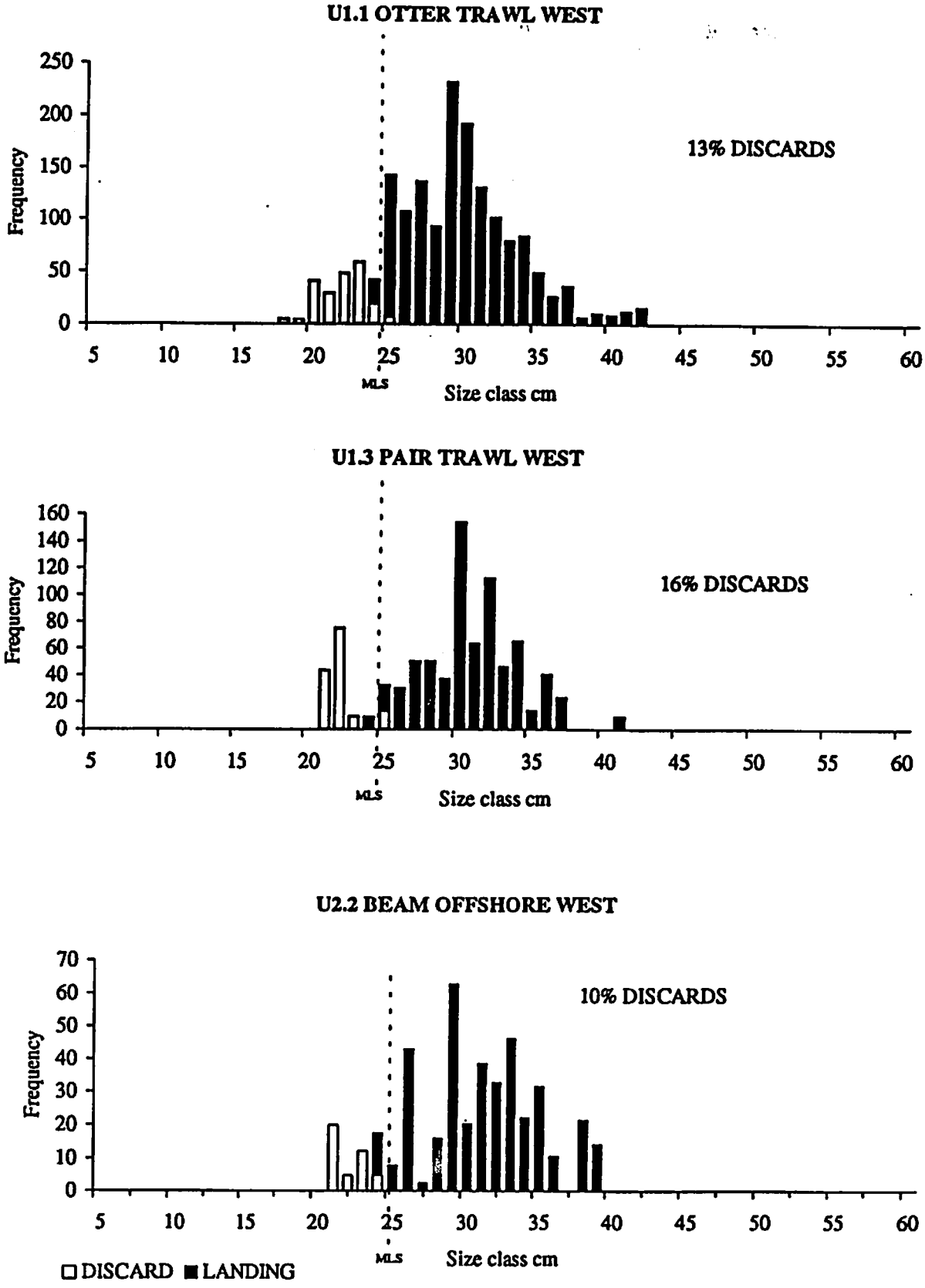


Figure 22. Catch Survey Quarter 2:
Length-frequency distributions for Lemon sole landings and discards

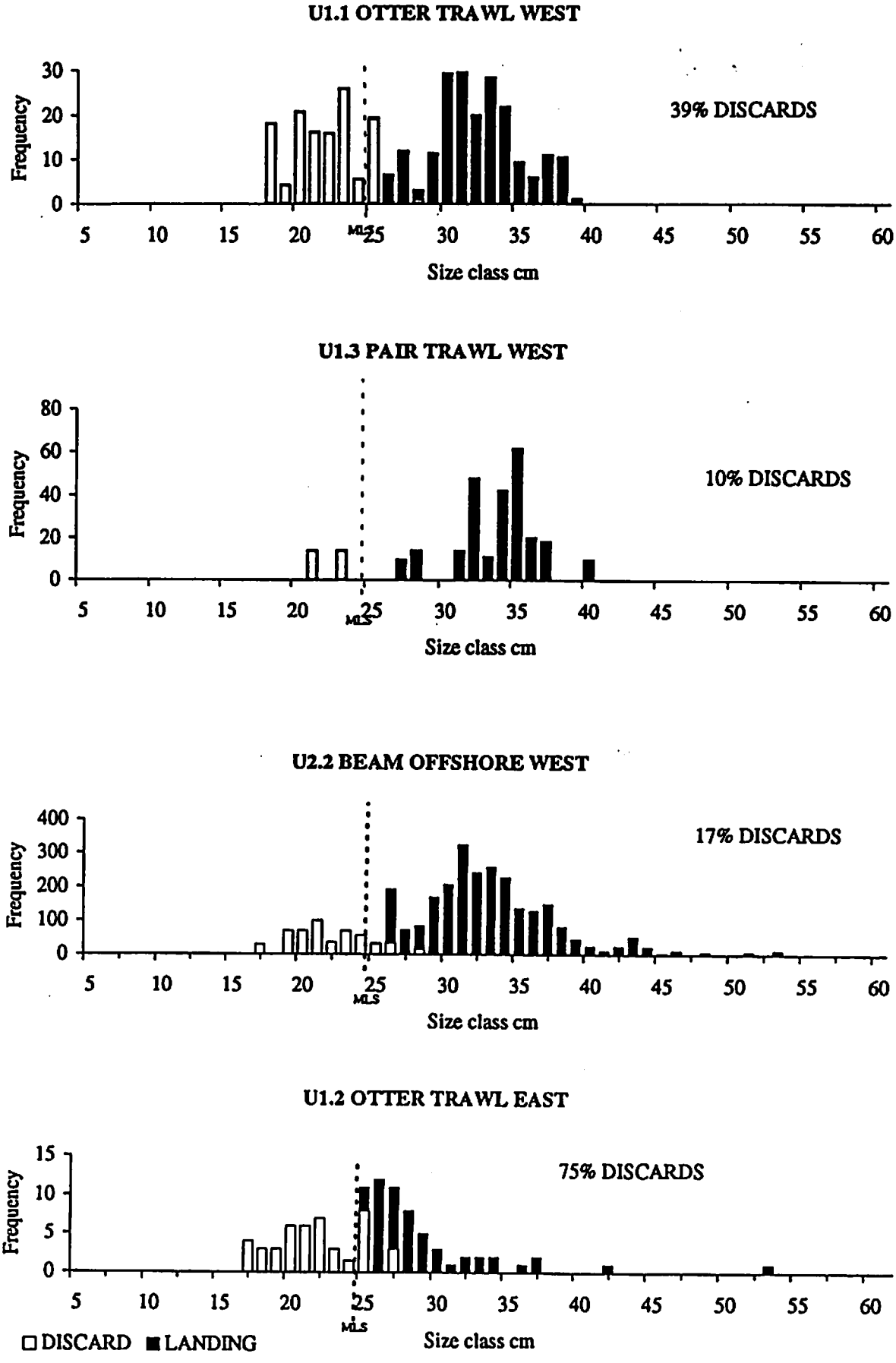


Figure 23. Catch Survey Quarter 2:
Length-frequency distributions for Plaice landings and discards

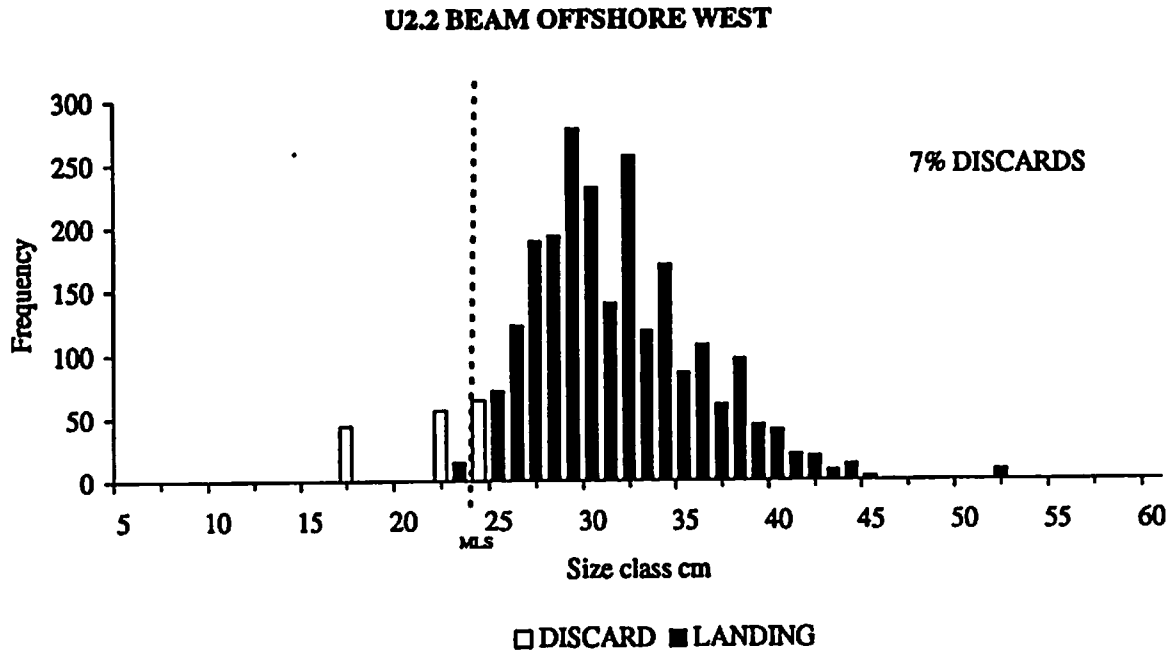


Figure 24. Catch Survey Quarter 2:
Length-frequency distributions for Sole landings and discards

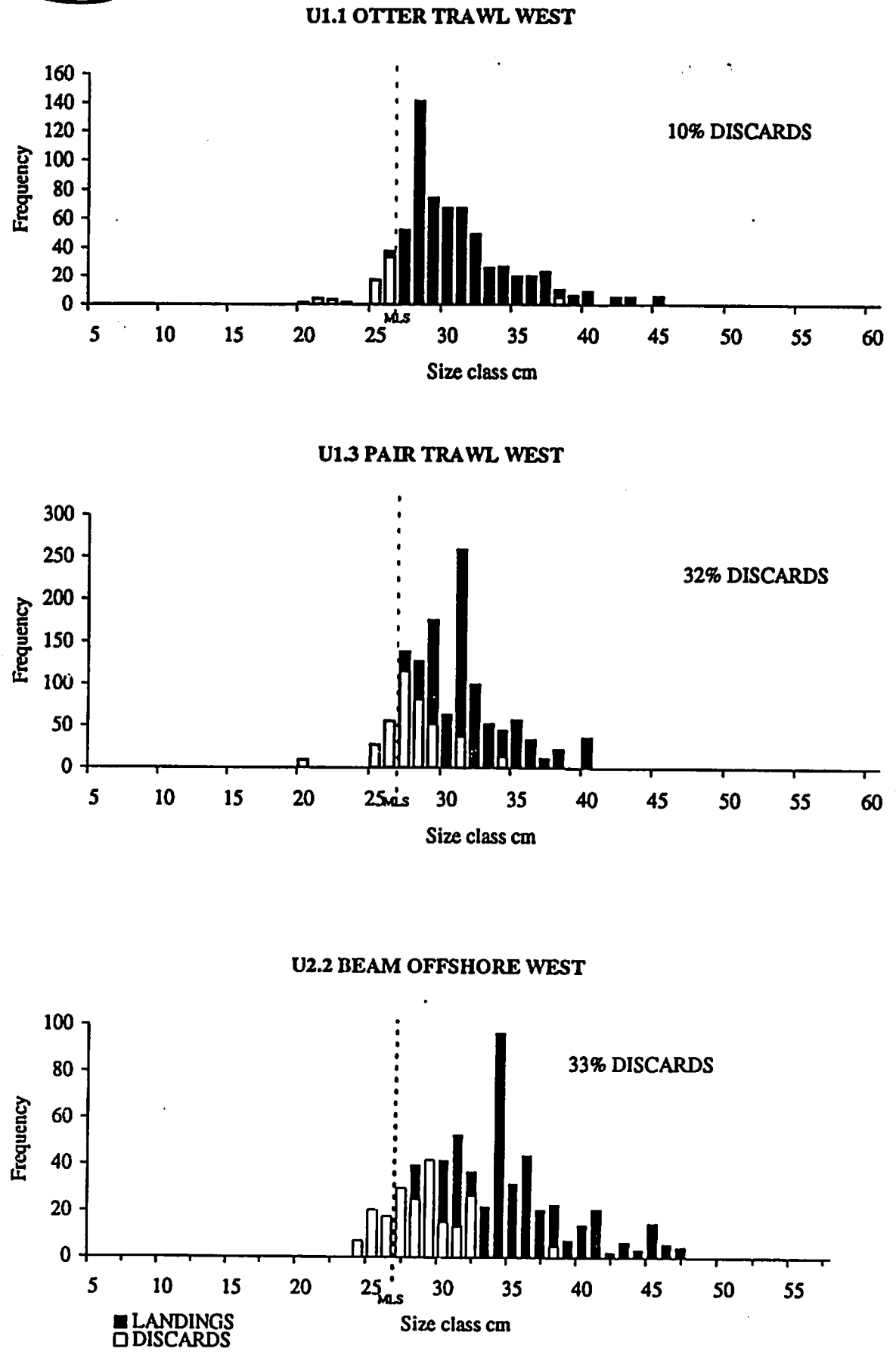
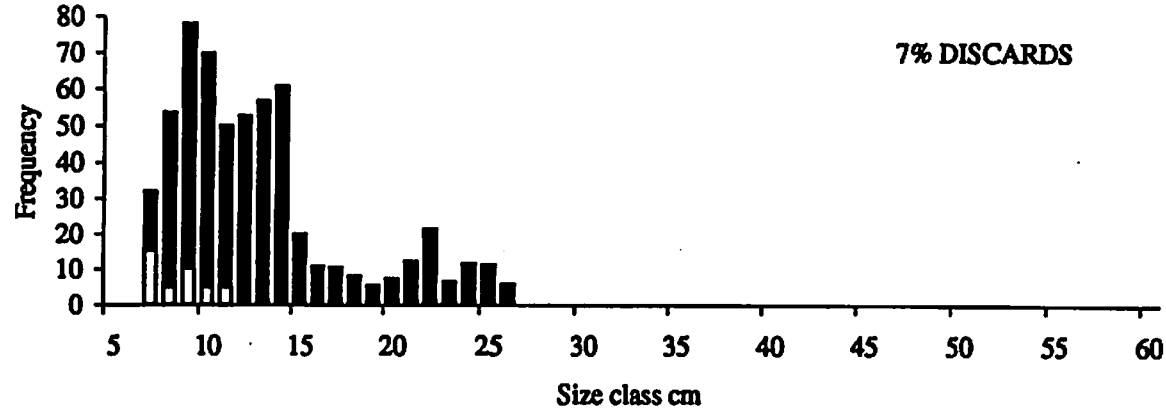
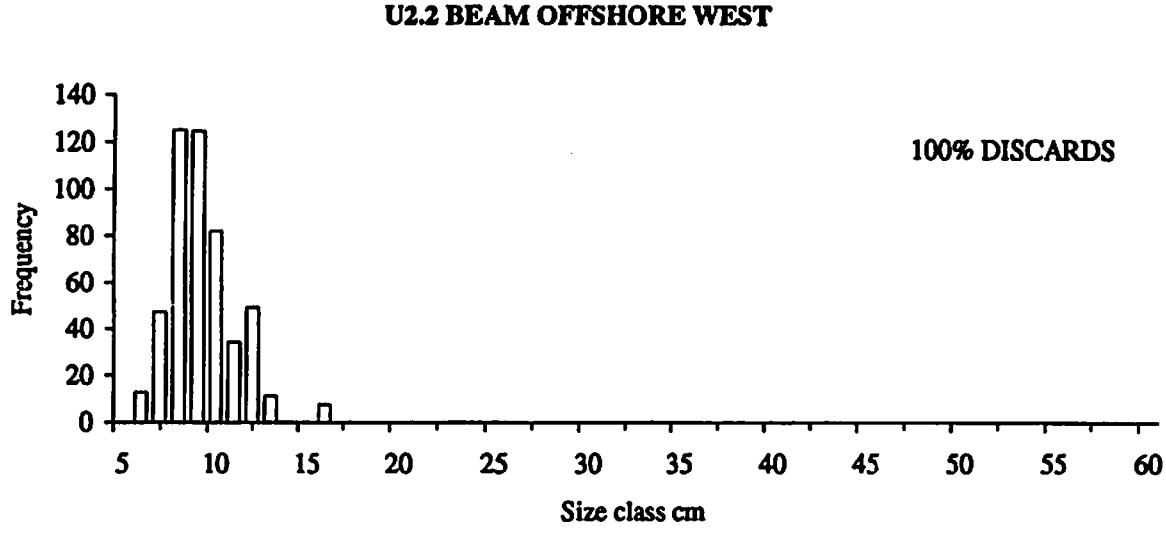


Figure 25. Catch Survey Quarter 2:
Length-frequency distributions for Whiting landings and discards





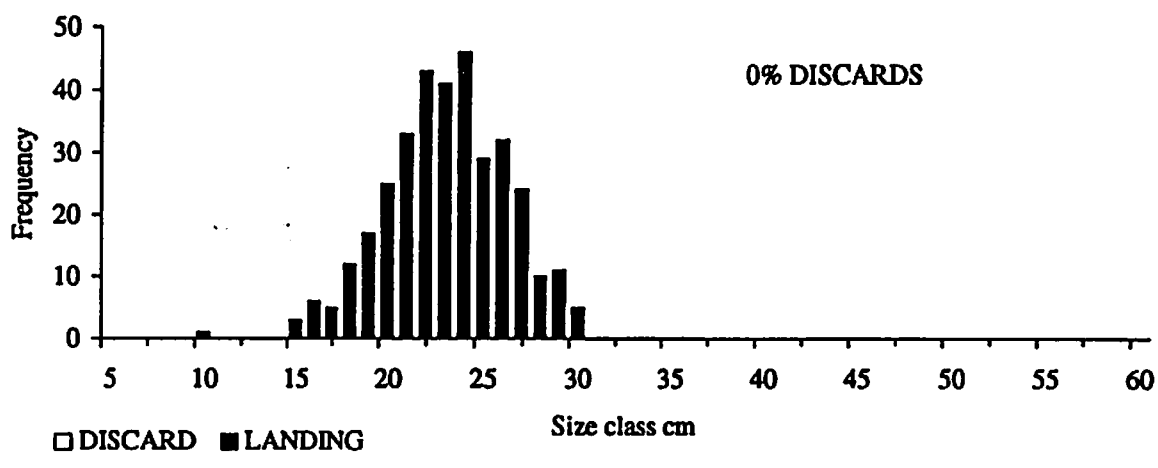


Figure 26. Catch Survey Quarter 2:
Length-frequency distributions for **Cuttlefish** landings and discards

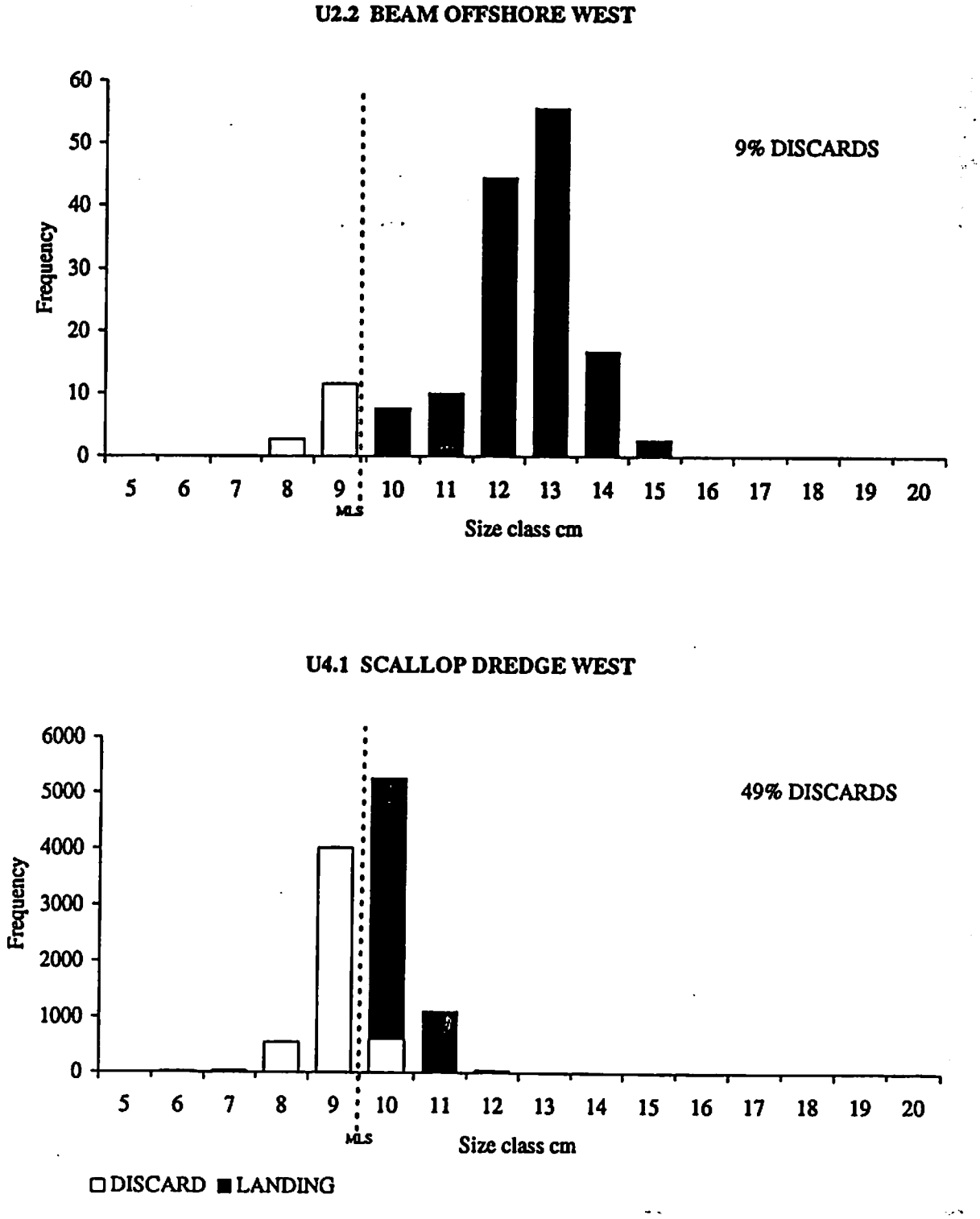


Figure 27. Catch Survey Quarter 2:
Length-frequency distributions for Scallops landings and discards

Quarter 3 (Tables 45-49)
Métiers sampled: otter trawl west, beam offshore west, otter trawl east, pair trawl west, scallop dredge west.

Lemon sole (Figure 28)
In the third quarter, fishermen pursuing the eastern beam trawl métier considered lemon sole as a target species, but no catch information was available from this métier.

The otter trawl east métier had the highest discard rate for lemon sole at 79%, all of which were below the MLS of 25cm. The overall length-frequency distribution indicates a catch composed mostly of small fish.

In all the western trawl métiers a higher proportion of larger fish were caught in comparison with the east with very few fish occurring below the MLS. There was no discarding of fish larger than the MLS.

Plaice (Figure 29)
Plaice were considered as a target species in the beam inshore east, beam offshore west, and the otter trawl east métiers.

However only the beam offshore west caught plaice in any quantity in terms of proportionate weight or value making up 21% of the landed catch by value and ranking second behind sole. The length-frequency distribution indicates that these were mostly large fish of greater than 28cm length, only 2% of which were discarded. All those that were discarded were between 28cm and 30cm in length. Otter trawl west caught and landed very few plaice during this quarter.

Although it was considered a target species of the otter trawl east métier during this quarter in the contribution to the landed catch values was very low (1%) and the discard rate was high at 82% mostly due to the presence of large numbers of small individuals in the catches.

Sole (Figure 30)
Beam offshore west considered sole as a target species during this quarter. The 24% share of the total landed value in this métier was substantially lower than the previous quarter, plaice, lemon sole, squid and monk having become relatively more important.

Overall, no sole under the MLS were caught and no sole were discarded at any size. Sole also contributed 5% of scallop dredge west's estimated landed catch value.

Bass (Figure 31)
Bass was not considered as a target species by many of the respondents interviewed. However the otter trawl east métier during this quarter, it was the main contributor to the total catch value (42% share) which corresponds with it being named as a target species during this quarter. Bass has a tendency to shoal. This can lead a high variation between hauls thus this relatively small sample may not be representative.

The discard rate was estimated at 7% and there was no discarding of fish larger than the MLS as would be expected for a species with a high unit value.

Whiting (Figure 32)
In the third quarter, whiting were named as a major target species in pair trawl west. In this métier it was the largest contributor by weight to the landed catch and at 37% of the landed value it contributes at a similar level landed value as squid at 39%. The discard rate was 10% the majority of which were just larger than the MLS. (It should be noted that these results were obtained from only one haul).

Whiting was not a major value contributor in any of the other métiers. Discard rates were low at 3% and 17% for otter trawl west and east respectively and most of the discarding was of fish sized at or just above the MLS.

In contrast beam offshore west had a high discard rate of 74% for a similar length range of fish but the quantity caught by weight and value is relatively very much lower.

Horse mackerel (Figure 33)
This species has been included because large quantities were caught in the otter trawl west métier during this quarter of which, 62% were discards. The majority were caught and landed by a vessel targeting squid. They were retained to aid in meeting the legal requirements of catch composition described in section 4.3.6. Horse mackerel are also landed for bait purposes. Otter trawl east and beam offshore west also caught horse mackerel, but not in sufficient numbers to obtain any useful information. Horse mackerel were not considered as target species and did not significantly contribute to the total catch values.

Cuttlefish (Figure 34)
Cuttlefish were named as a target species by participants in both the otter trawl métiers in this quarter. However, only in otter trawl east and beam offshore west was this species sampled at this time of year. The species contributed to catches substantially by weight in otter trawl east but was of minor importance in beam offshore west.

The catches in otter trawl east métier consisted mainly of smaller cuttlefish (7-15cm), whereas in beam offshore west the cuttlefish were larger with none smaller than 17cm captured.

No MLS exists for cuttlefish and no discarding occurred in either métier.

Squid (Figure 35)
During this quarter, otter and pair trawlers in the west considered squid as target species and this corresponds to their ranking in terms of weight and/or value in the catches.

There was some variation in codend mesh size and some western otter trawlers used 60 or 65mm codends because they were targeting squid (see section 4.3.6).

Virtually no discarding of squid occurred throughout the métiers.

Scallops (Figure 36)

The scallop dredge west métier caught large numbers of scallops, as would be expected, but as in quarter 2 some were also captured in the beam offshore west métier.

In the scallop dredge west métier, scallops ranging from 6-12cm were captured and there was a discard rate of 34%. No scallops above the MLS of 10cm were discarded and some landings were measured as being below the MLS.

Scallops were assessed visually for size by comparison with a gauge and measured by visual comparison with a measuring board. This visual assessment may have led to some inaccuracy in determining the exact size of marginal scallops; also sometimes shells become chipped during handling. No undersize scallops were caught in the beam offshore west métier and no discarding occurred.

Table 45: Catch Survey Quarter 3
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.1		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=22	SQC	28	4972	5000	1	0	1.5	1117.4	3.89	4345	70
TOTAL HOURS	LEM	14	486	500	3	0	2.4	164.1	2.82	463	7
TRAWLED=67	JOD	16	163	179	9	0	3	120.1	3.58	430	7
	MUR	0	411	411	0	0	0	61.9	5.29	328	5
	GUX	440	4745	5185	8	0	27.6	441.7	0.40	175	3
	SPR	0	115	115	0	0	0	114.1	1.01	116	2
	WHG	26	823	849	3	0	3.6	198.6	0.48	95	2
	BIB	1960	755	2715	72	0	79.6	195	0.30	59	1
	HOM	3580	2235	5814	62	55	132.7	152.6	0.22	34	1
	COD	0	35	35	0	0	0	25.4	1.13	29	0
	THR	0	13	13	0	0	0	24	1.02	24	0
	MON	0	4	4	0	0	0	12.4	1.78	22	0
	PLE	0	45	45	0	0	0	18.3	1.13	21	0
	UNR	0	17	17	0	0	0	11.8	1.00	12	0
	BLR	0	6	6	0	0	0	9.3	1.02	9	0
	DAB	210	83	292	72	70	18.6	15.7	0.49	8	0
	MEG	0	4	4	0	0	0	5	1.22	6	0
	SCX	14	5	20	73	0	1.5	3.5	1.35	5	0
	MAC	0	23	23	0	0	0	10.2	0.36	4	0
	LIN	0	8	8	0	0	0	6.6	0.47	3	0
	CRE	49	0	49	100	0	0	0	1.27	0	0
	LSD	198	0	198	100	0	117.8	0	0.30	0	0
	QSC	1287	0	1287	100	0	0	0	0.20	0	0

Results are totalled by quarter for trips sampled

Table 46: Catch Survey Quarter 3
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.3		NUMBERS					WEIGHT		VALUE		
PAIR TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=1	SQC	0	132	132	0	0	0	26.4	3.89	103	39
TOTAL HOURS	WHG	96	912	1008	10	8	15.7	206.3	0.48	99	37
TRAWLED=3	LEM	0	24	24	0	0	0	8.5	2.82	24	9
	MON	0	12	12	0	0	0	7.5	1.78	13	5
	SPR	0	12	12	0	0	0	10.1	1.01	10	4
	PLE	0	24	24	0	0	0	8.4	1.13	9	4
	GUX	492	144	636	77	0	30.8	20.1	0.40	8	3
	BIB	144	0	144	100	0	5.5	0	0.30	0	0
	DAB	36	0	36	100	100	3.1	0	0.49	0	0
	HOM	72	0	72	100	100	3.5	0	0.22	0	0
	LSD	24	0	24	100	0	21.5	0	0.30	0	0

Results are totalled by quarter for trips sampled

Table 47: Catch Survey Quarter 3
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 2.2		NUMBERS					WEIGHT		VALUE		
BEAM OFFSHORE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=21	SOL	0	332	332	0	0	0	144.4	5.43	784	24
TOTAL HOURS	PLE	40	1597	1637	2	2	10.3	603.5	1.13	680	21
TRAWLED=42	SQC	0	164	164	0	0	0	136.5	3.89	531	16
	LEM	50	404	454	11	0	8.2	137.8	2.82	389	12
	MON	15	216	231	6	0	2.3	200	1.78	356	11
	BLL	0	17	17	0	0	0	32.2	4.21	136	4
	SCX	0	200	200	0	0	0	84.1	1.35	113	3
	CTL	0	109	109	0	0	0	81.8	1.28	105	3
	GUX	3614	716	4330	83	0	7.2	142.1	0.40	56	2
	MUR	0	51	51	0	0	0	8.4	5.29	44	1
	JOD	0	13	13	0	0	0	11	3.58	39	1
	BIB	1747	260	2007	87	0	496.5	107.5	0.30	32	1
	DAB	1394	109	1503	93	93	180.9	29.4	0.49	14	0
	WHG	151	53	204	74	64	39.5	18.9	0.48	9	0
	CRE	142	203	345	41	0	0.1	0.2	1.27	0	0
	CUR	0	30	30	0	0	0	0.1	0.92	0	0
	HOM	21	0	21	100	100	3.6	0	0.22	0	0
	LSD	157	0	157	100	0	70.2	0	0.30	0	0
	SCR	21	0	21	100	0	22.5	0	0.60	0	0
	SPR	17	0	17	100	0	3.1	0	1.01	0	0
	WIT	15	0	15	100	0	0.8	0	0.38	0	0

Results are totalled by quarter for trips sampled

Table 48: Catch Survey Quarter 3
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 4.1		NUMBERS					WEIGHT		VALUE		
SCALLOP DREDGE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=10	SCX	1582	3075	4657	34	1	224.8	629.7	1.35	848	94
TOTAL HOURS	SOL	0	12	12	0	0	0	8.4	5.43	46	5
DREDGED=8	THR	0	1	1	0	0	0	2.7	1.02	3	0
	PLE	0	1	1	0	0	0	1	1.13	1	0
	CUR	0	1	1	0	0	0	1.1	0.92	1	0
	WIT	0	1	1	0	0	0	0.6	0.38	0	0
	CRE	20	1	21	95	0	0	0	1.27	0	0
	SCR	1	0	1	100	0	0	0	0.60	0	0

Results are totalled by quarter for trips sampled

Table 49: Catch Survey Quarter 3
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

U.K. 1.2		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL EAST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	%DR	%DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=11	BSE	16	210	226	7	0	6.2	146.8	5.60	822	42
TOTAL HOURS	LEM	2172	577	2749	79	0	305.6	135.9	3.22	437	22
TRAWLED=35	CTL	0	463	463	0	0	0	148.3	1.07	159	8
	COD	9	114	123	7	0	3.2	76.6	1.43	109	6
	SQC	0	122	122	0	0	0	41.5	2.55	106	5
	MUR	0	187	187	0	0	0	13.2	4.53	60	3
	DGH	0	125	125	0	0	0	161.8	0.23	38	2
	BIB	2398	414	2812	85	0	303.9	138.1	0.21	29	1
	WHG	40	199	239	17	17	6.1	53	0.53	28	1
	SOL	0	24	24	0	0	0	5.3	4.61	24	1
	BLL	0	6	6	0	0	0	6.6	3.56	23	1
	PLE	256	56	312	82	14	33.9	17.6	1.29	23	1
	POL	161	51	213	76	62	44.6	25.3	0.79	20	1
	LSD	0	128	128	0	0	0	75.8	0.22	16	1
	GUX	84	231	316	27	0	9.6	51.6	0.31	16	1
	HOM	6	164	169	3	3	0.3	31.9	0.33	11	1
	SBZ	304	49	353	86	0	20.3	14.8	0.69	10	1
	FLE	53	57	110	48	3	7.8	32.8	0.23	7	0
	JOD	0	4	4	0	0	0	2	3.44	7	0
	SPR	15	4	19	78	0	1	4.6	1.45	7	0
	DAB	636	43	679	94	91	62.3	10.4	0.41	4	0
	CUR	0	4	4	0	0	0	2.7	1.45	4	0
	CRE	26	0	26	100	0	0	0	1.01	0	0
	DET	80	0	80	100	0	0	0	0.00	0	0
	GAG	0	73	73	0	0	0	0	0.20	0	0
	MLP	654	0	654	100	0	0	0	0.00	0	0
	QSC	132	0	132	100	0	0	0	0.00	0	0
	SCR	218	0	218	100	0	153.4	0	0.68	0	0
	SHD	40	0	40	100	0	0	0	0.00	0	0

Results are totalled by quarter for trips sampled

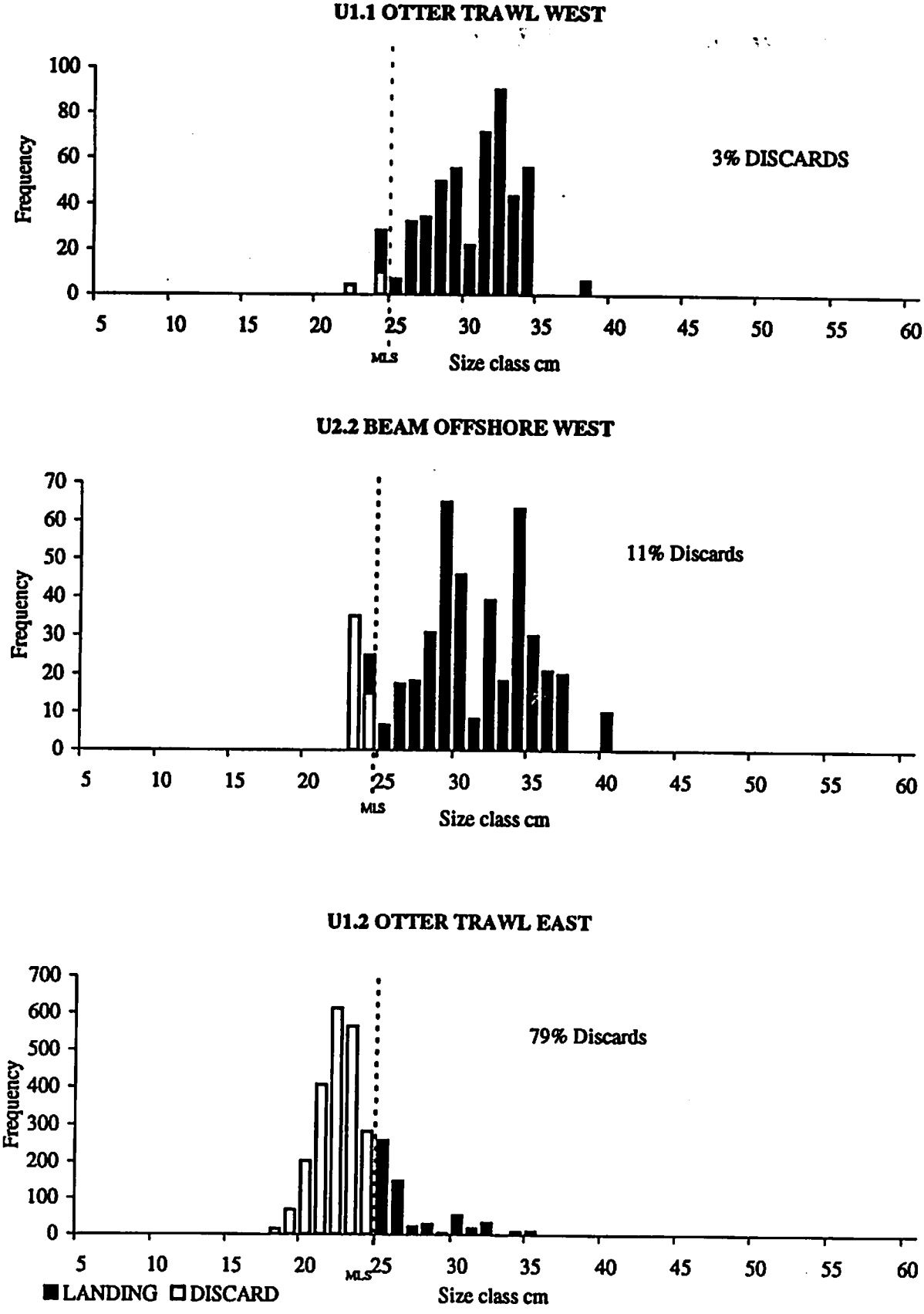


Figure 28. Catch Survey Quarter 3:
Length-frequency distributions for **Lemon sole** landings and discards

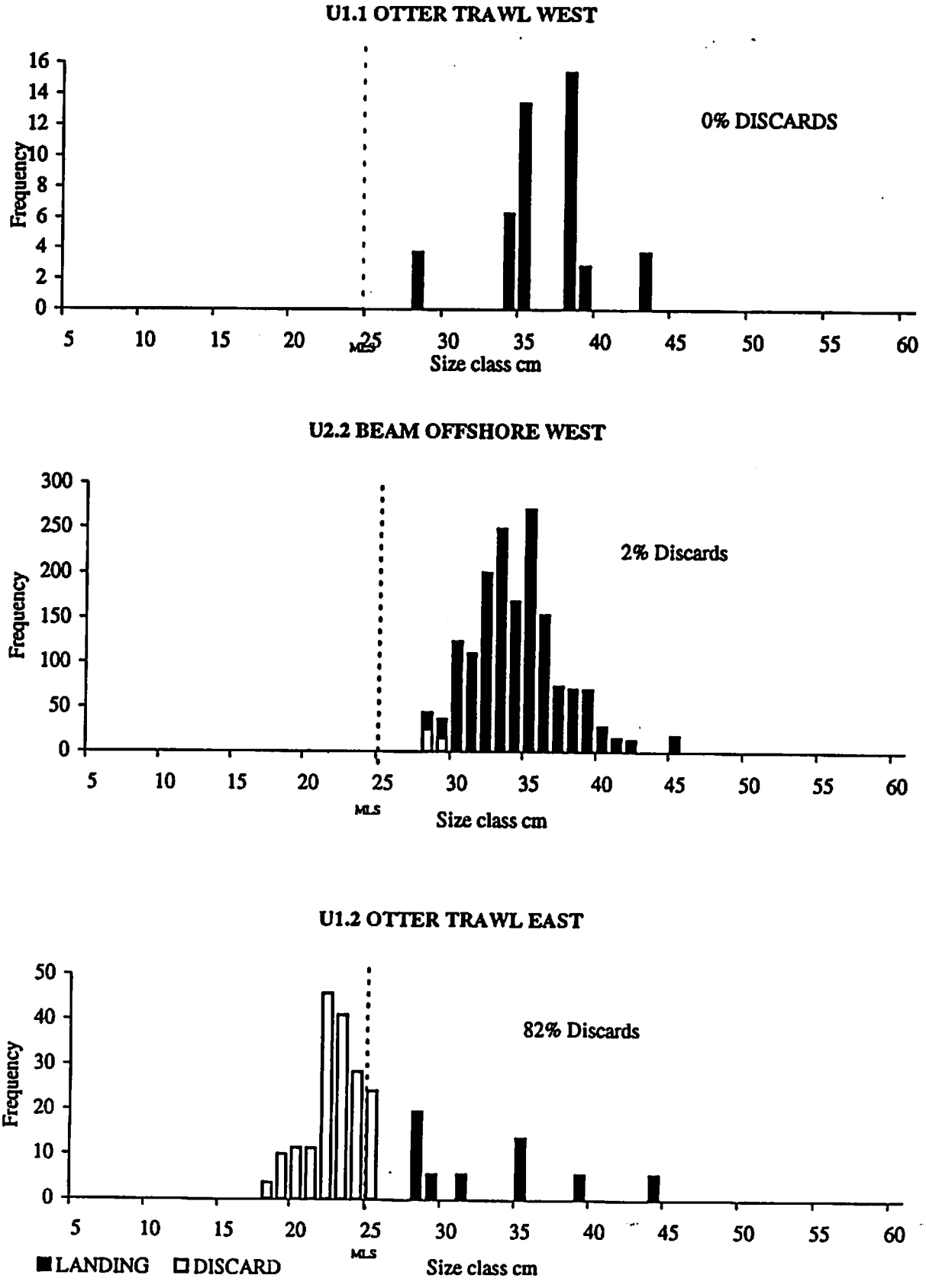


Figure 29. Catch Survey Quarter 3:
Length-frequency distributions for Plaice landings and discards

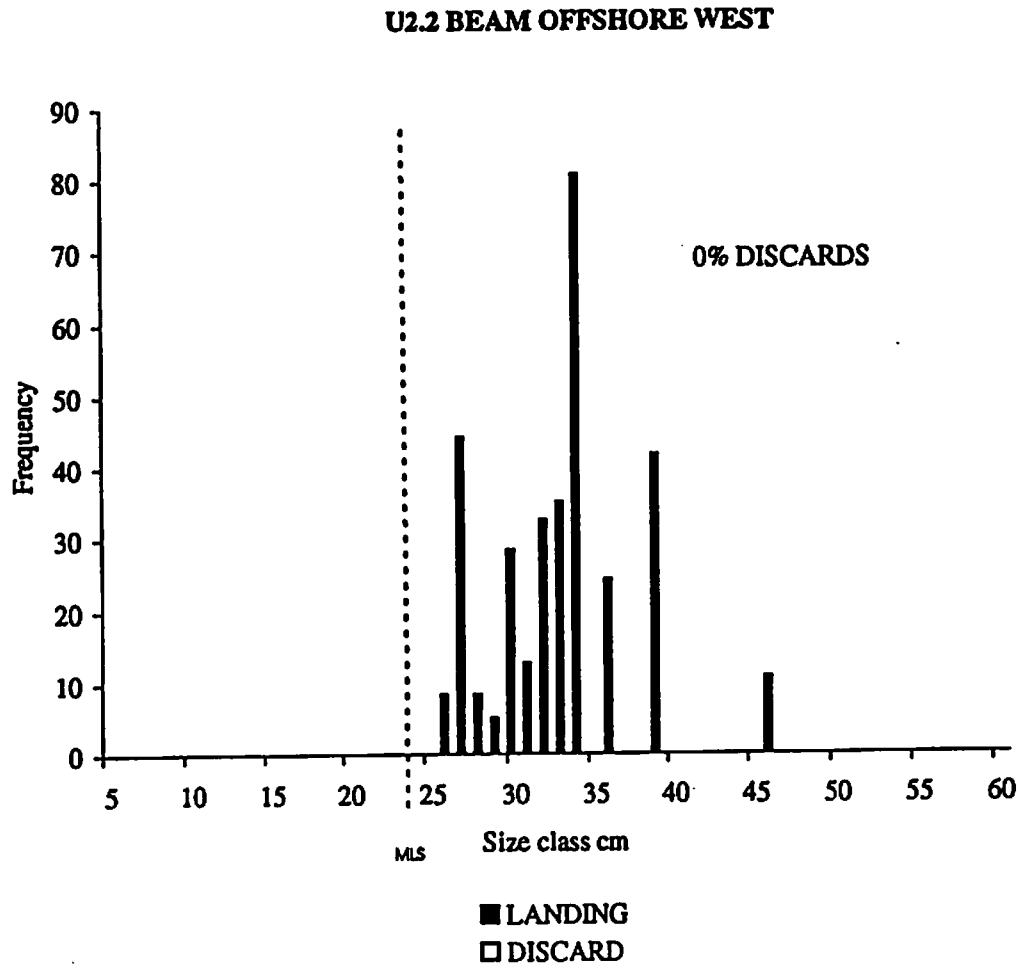


Figure 30. Catch Survey Quarter 3:
Length-frequency distributions for Sole landings and discards

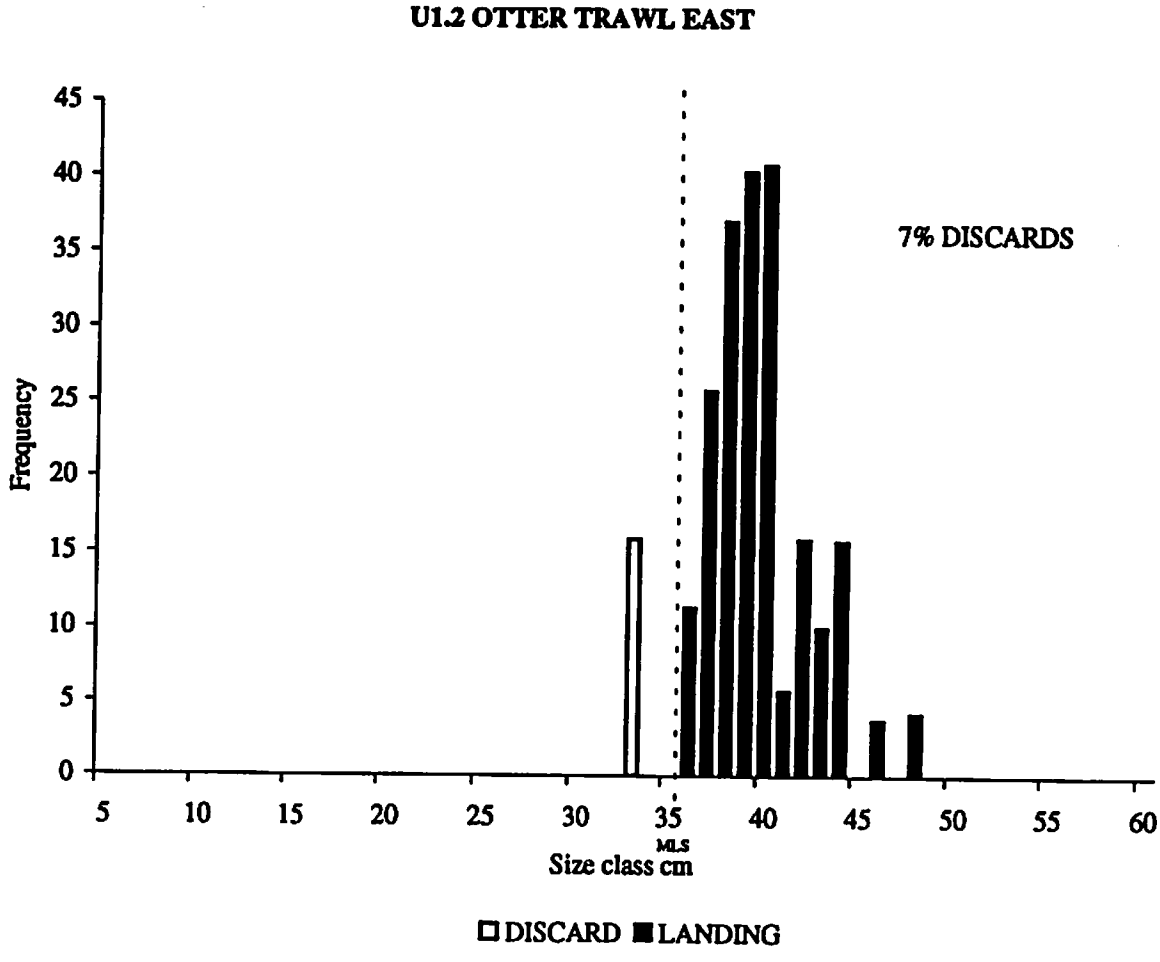


Figure 31. Catch Survey Quarter 3:
Length-frequency distributions for Bass landings and discards

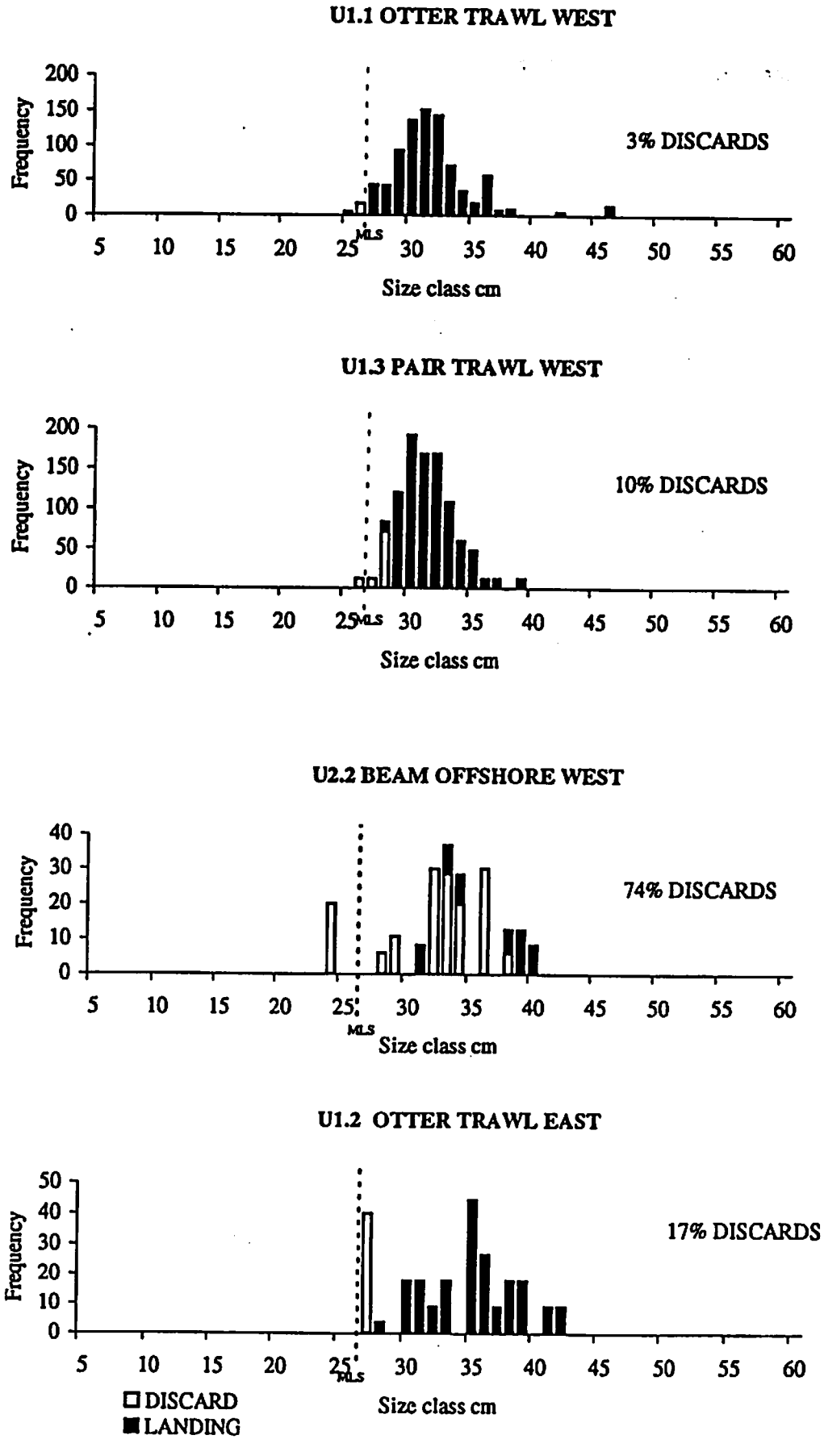
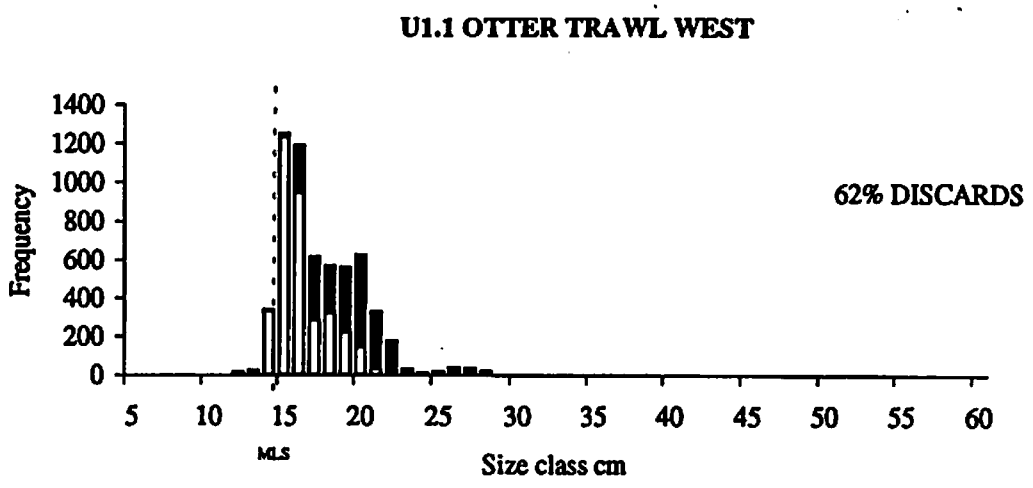
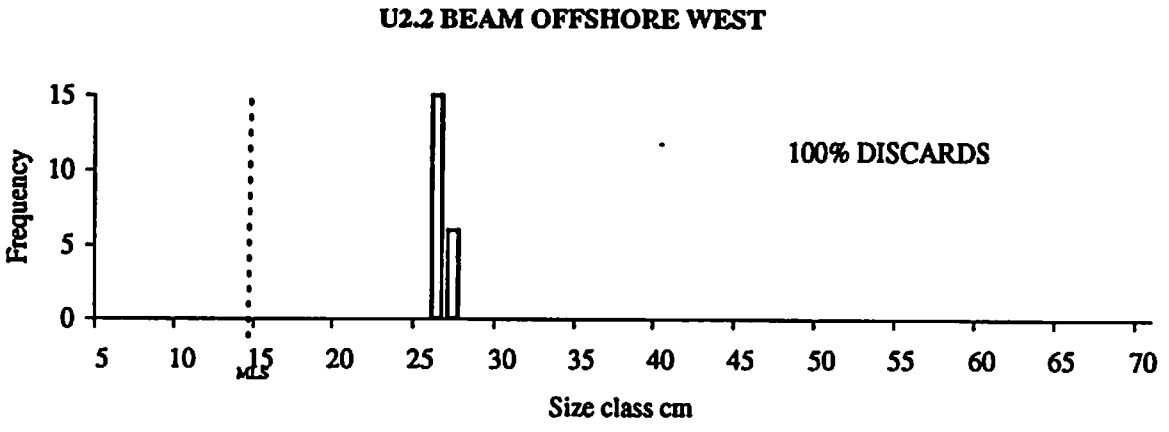


Figure 32. Catch Survey Quarter 3:
Length-frequency distributions for Whiting landings and discards





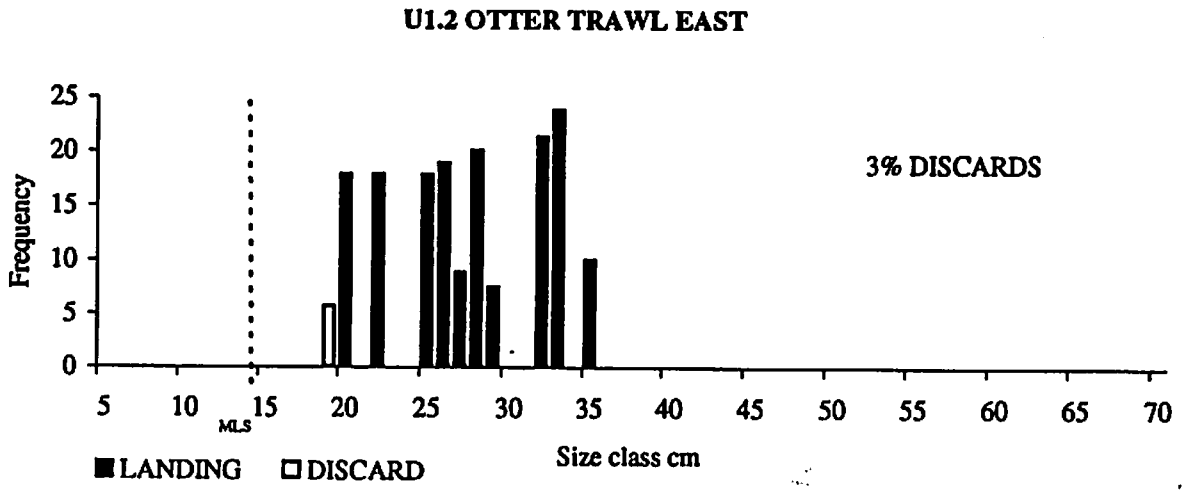
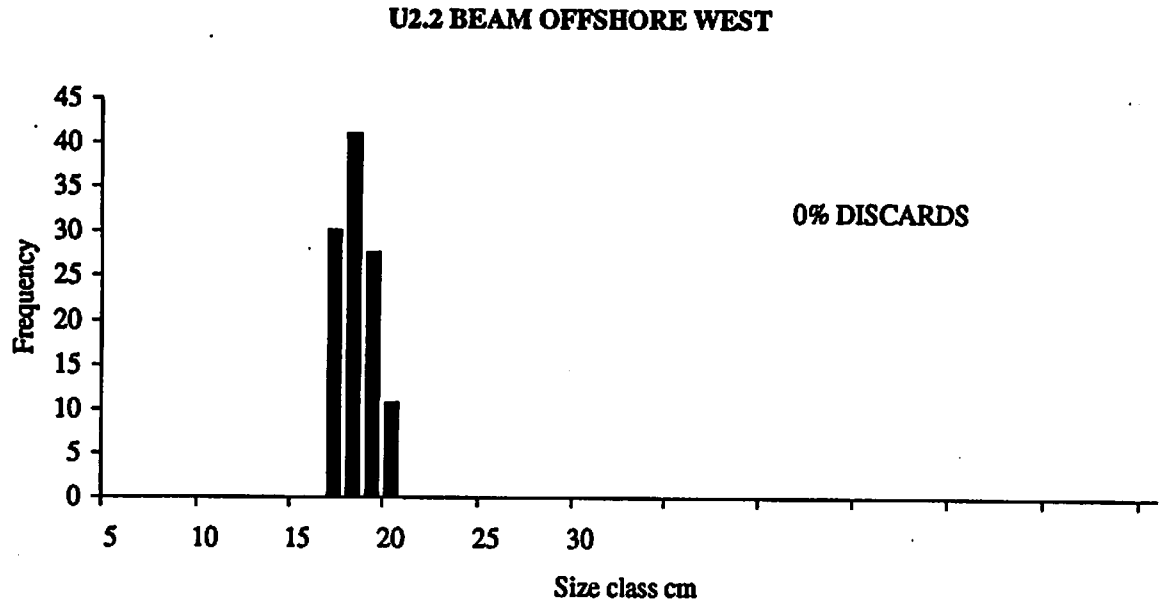


Figure 33. Catch Survey Quarter 3:
Length-frequency distributions for **Horse mackerel** landings and discards



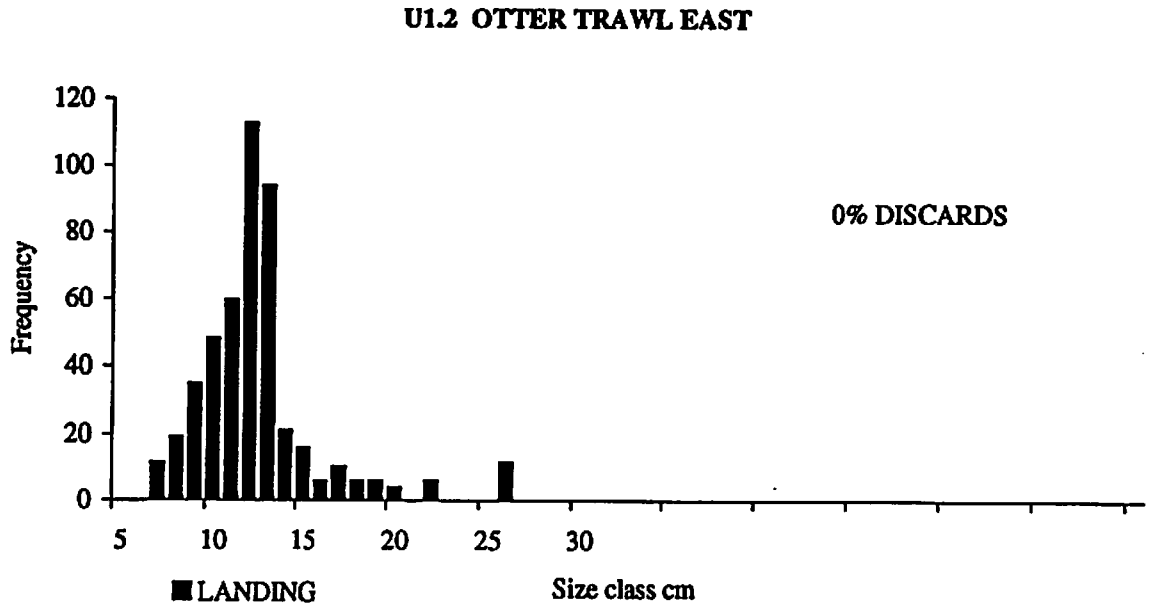
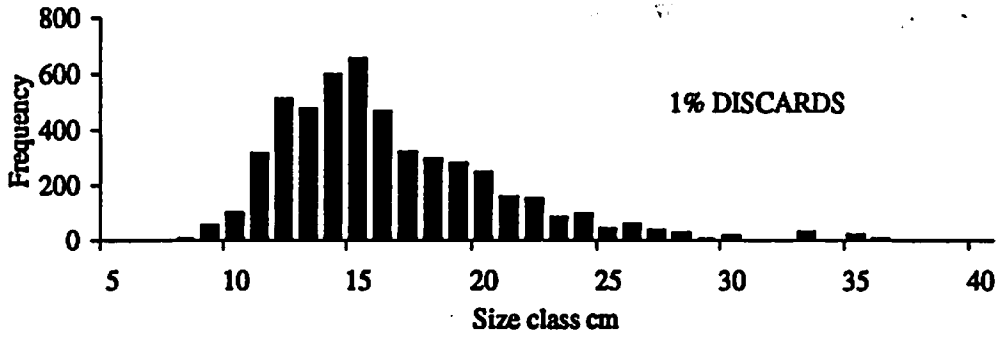
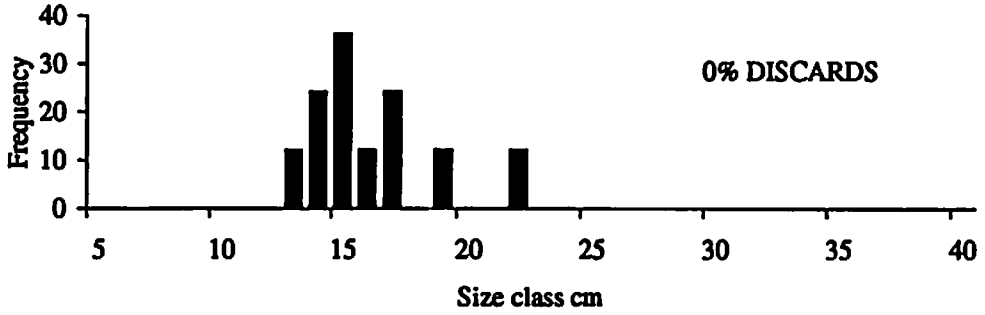


Figure 34. Catch Survey Quarter 3:
Length-frequency distributions for **Cuttlefish** landings and discards

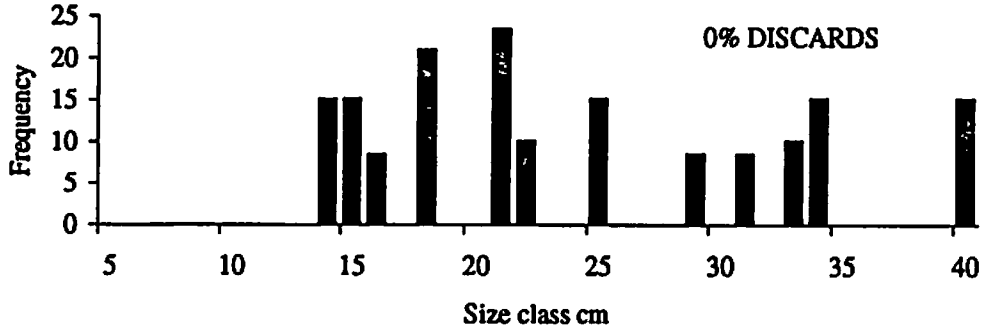
U1.1 OTTER TRAWL WEST



U1.3 PAIR TRAWL WEST



U2.2 BEAM OFFSHORE WEST



U1.2 OTTER TRAWL EAST

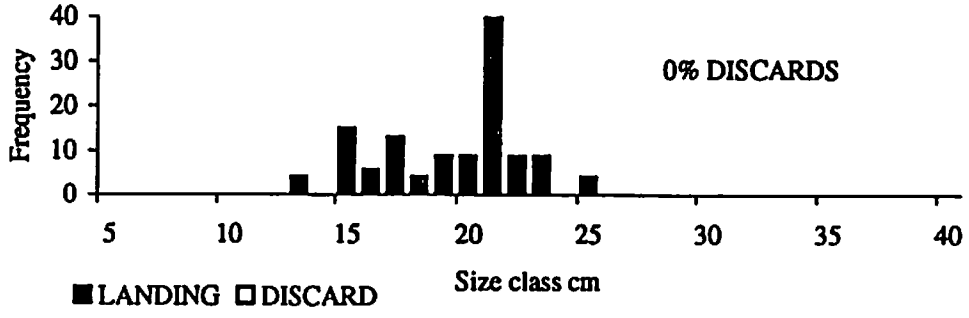


Figure 35. Catch Survey Quarter 3:
Length-frequency distributions for Squid landings and discards

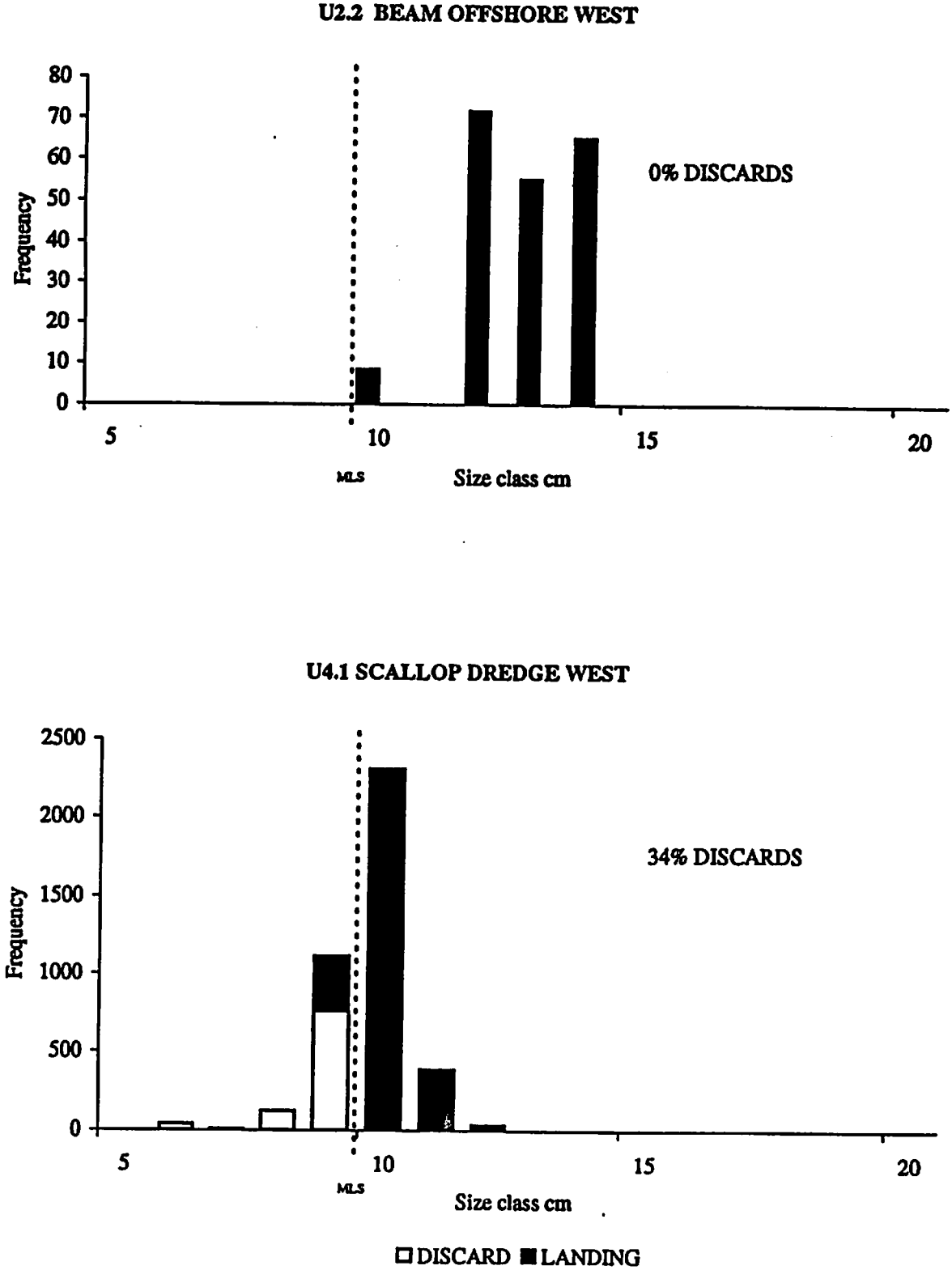


Figure 36. Catch Survey Quarter 3:
Length-frequency distributions for Scallops landings and discards

Quarter 4 (Tables 50-52)
Métiers sampled: otter trawl west, beam offshore west, otter trawl east (1 haul only).

Lemon sole (Figure 37)
Respondents partaking in the otter trawl west, beam inshore east and otter trawl east, all considered lemon sole as a target species, yet this species was caught in very small quantities and did not significantly contribute to catch values or weights during this quarter. However most of the sampling took place in the early part of the quarter due to limiting weather conditions; lemon sole are considered a target species towards the end of this period.

Only beam offshore west caught sufficient numbers to obtain a length-frequency distribution. No fish above 35cm were caught in this métier and only a small proportion of undersized fish (MLS=25cm) were captured. These were also landed resulting in a discard rate of 0%. No undersize fish were caught in the two otter trawl métiers and no fish were discarded.

Plaice (Figure 38)
In all métiers during this quarter the lowest proportion of respondents named plaice as a target species and it did not contribute greatly to the total catch values(<5%) in any of the métiers. The majority of the fish that were captured in the west were relatively large and this lead to a low discard rates in both otter and beam trawl west.

Sole (Figure 39)
Sole were only caught in two métiers, beam offshore and otter trawl west. The species contributed 15% of the total landed value in beam offshore west and were ranked second to cuttlefish. This correlates with the decreasing proportion of respondents naming sole together with an increased proportion naming cuttlefish as target species during this quarter.

In both métiers, no undersized fish were caught and the discard rates were 0%. Only beam offshore west captured sufficient numbers of sole to give an adequate length-frequency histogram.

Whiting (Figure 40)
Whiting were captured in all three trawl métiers with the otter trawl métiers catching the highest proportion by weight. No discarding occurred in any of the métiers and no fish below the MLS of 27cm were sampled.

Cuttlefish (Figure 41)
This species ranked highest in terms of weight and value in the catches of the two western trawl métiers during this quarter. Both these métiers considered cuttlefish as a major target species at this time of year as did the unsampled beam trawl east métier. No cuttlefish were sampled in the otter trawl east métier and it was not named as a target species at this time of year.

No cuttlefish below 11cm in length were sampled and the catches consisted of large individuals with similar length-frequency distributions in both métiers. No discarding occurred; this contrasts with results obtained in quarters 1 and 2 in these métiers where large numbers of small cuttlefish were caught and discarded particularly in beam offshore west.

Squid (Figure 42)

Squid were named as a main target species in otter trawl west. The species was ranked second in terms of the share of landed catch value after cuttlefish in this métier. Participants in pair trawl west also name it as a target species in this quarter but pair trawlers were not sampled so no catch information is available.

The length-frequency distributions of squid in both western métiers are similar and very few squid were discarded. Discards in beam offshore west (5%) consisted of several small squid of 12cm length. Squid of this length were landed in otter trawl west.

Table 50: Catch Survey Quarter 4
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 1.1		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=15	CTL	0	1672	1672	0	0	0	1617.8	1.28	2072	54
TOTAL HOURS	SQC	0	362	362	0	0	0	186.2	3.89	724	19
TRAWLED=62	MON	32	113	144	22	0	5.8	215.2	1.78	383	10
	BLL	0	34	34	0	0	0	35.3	4.21	149	4
	WHG	0	1153	1153	0	0	0	298.5	0.48	143	4
	PLE	24	344	368	7	0	2.8	117.1	1.13	132	3
	BSE	0	9	9	0	0	0	11.8	5.88	69	2
	GUX	3550	396	3946	90	0	142.1	77	0.40	31	1
	JOD	0	15	15	0	0	0	5.7	3.58	20	1
	COD	0	16	16	0	0	0	15.6	1.13	18	0
	HKE	0	24	24	0	0	0	9.3	1.72	16	0
	SCX	0	37	37	0	0	0	9.7	1.35	13	0
	LEM	0	6	6	0	0	0	3.1	2.82	9	0
	DAB	3154	72	3226	98	97	325.1	15.2	0.49	7	0
	MAC	1	48	49	2	0	0.2	14	0.36	5	0
	SOL	0	15	15	0	0	0	0.7	5.43	4	0
	BIB	155	35	190	81	0	18.1	12	0.30	4	0
	HER	0	37	37	0	0	0	8.5	0.36	3	0
	MUR	0	6	6	0	0	0	0.4	5.29	2	0
	CRE	0	14	14	0	0	0	0	1.27	0	0
	CUR	1	0	1	100	0	0.4	0	0.92	0	0
	LSD	267	0	267	100	0	193	0	0.30	0	0
	QSC	90	0	90	100	0	0	0	0.20	0	0
	SCR	22	0	22	100	0	22.6	0	0.60	0	0
	SPR	1	0	1	100	0	0.4	0	1.01	0	0

Results are totalled by quarter for trips sampled

Table 51: Catch Survey Quarter 4
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

UK 2.2		NUMBERS					WEIGHT		VALUE		
BEAM OFFSHORE WEST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	% DR	% DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=41	CTL	0	4029	4029	0	0	0	3896.3	1.28	4989	49
TOTAL HOURS	SOL	0	641	641	0	0	0	279.3	5.43	1517	15
TRAWLED=72	SQC	25	525	550	5	0	2	312.4	3.89	1215	12
	MON	0	263	263	0	0	0	415.6	1.78	739	7
	PLE	7	727	734	1	0	0.6	442.5	1.13	499	5
	MUR	0	258	258	0	0	0	45.3	5.29	240	2
	LEM	0	243	243	0	0	0	80	2.82	226	2
	TUR	0	11	11	0	0	0	23.9	6.55	157	2
	SCX	0	280	280	0	0	0	98.3	1.35	132	1
	BLL	0	38	38	0	0	0	30	4.21	126	1
	BIB	1547	754	2300	67	0	213.1	280.6	0.30	85	1
	JOD	0	19	19	0	0	0	17.5	3.58	63	1
	SCR	16	72	88	18	0	28.9	100.3	0.60	60	1
	GUX	5175	585	5760	90	0	9.7	131.1	0.40	52	1
	LSD	1159	181	1340	86	0	268.7	107.6	0.30	32	0
	WHG	0	106	106	0	0	0	37.1	0.48	18	0
	DAB	490	144	634	77	77	39.5	29.6	0.49	14	0
	BLR	15	5	20	75	0	4.2	4.9	1.02	5	0
	CRE	31	188	219	14	0	0	0.1	1.27	0	0
	HOM	40	0	40	100	100	4.9	0	0.22	0	0
	QSC	1096	0	1096	100	0	0	0	0.20	0	0
	SPR	125	0	125	100	0	29.9	0	1.01	0	0

Results are totalled by quarter for trips sampled

Table 52: Catch Survey Quarter 4
Estimated total numbers and weights (kg) of catch and values (£) of landed catch by species

U.K. 1.2		NUMBERS					WEIGHT		VALUE		
OTTER TRAWL EAST	SPECIES	DISCARDS	LANDINGS	TOTAL CATCH	%DR	%DIS>MLS	DISCARDS	LANDINGS	£/kg	LANDINGS	%TOTAL LANDINGS
No OF HAULS=1	TUR	0	6	6	0	0	0	10.3	5.19	53	35
TOTAL HOURS	COD	0	24	24	0	0	0	32.2	1.43	46	31
TRAWLED=4	WHG	0	165	165	0	0	0	34	0.53	18	12
	LEM	0	12	12	0	0	0	3.5	3.22	11	7
	GUX	6	73	79	8	0	0.4	25.5	0.31	8	5
	BIB	6	98	104	6	0	0.3	25.7	0.21	5	4
	LSD	0	37	37	0	0	0	23.6	0.22	5	3
	SQC	0	6	6	0	0	0	0.8	2.55	2	1
	PLE	0	6	6	0	0	0	1.1	1.29	1	1
	DAB	0	6	6	0	0	0	1	0.41	0	0
	DET	6	0	6	100	0	0	0	0.00	0	0
	MLP	6	0	6	100	0	0	0	0.00	0	0
	THR	43	0	43	100	0	7.6	0	1.45	0	0

Results are totalled by quarter for trips sampled

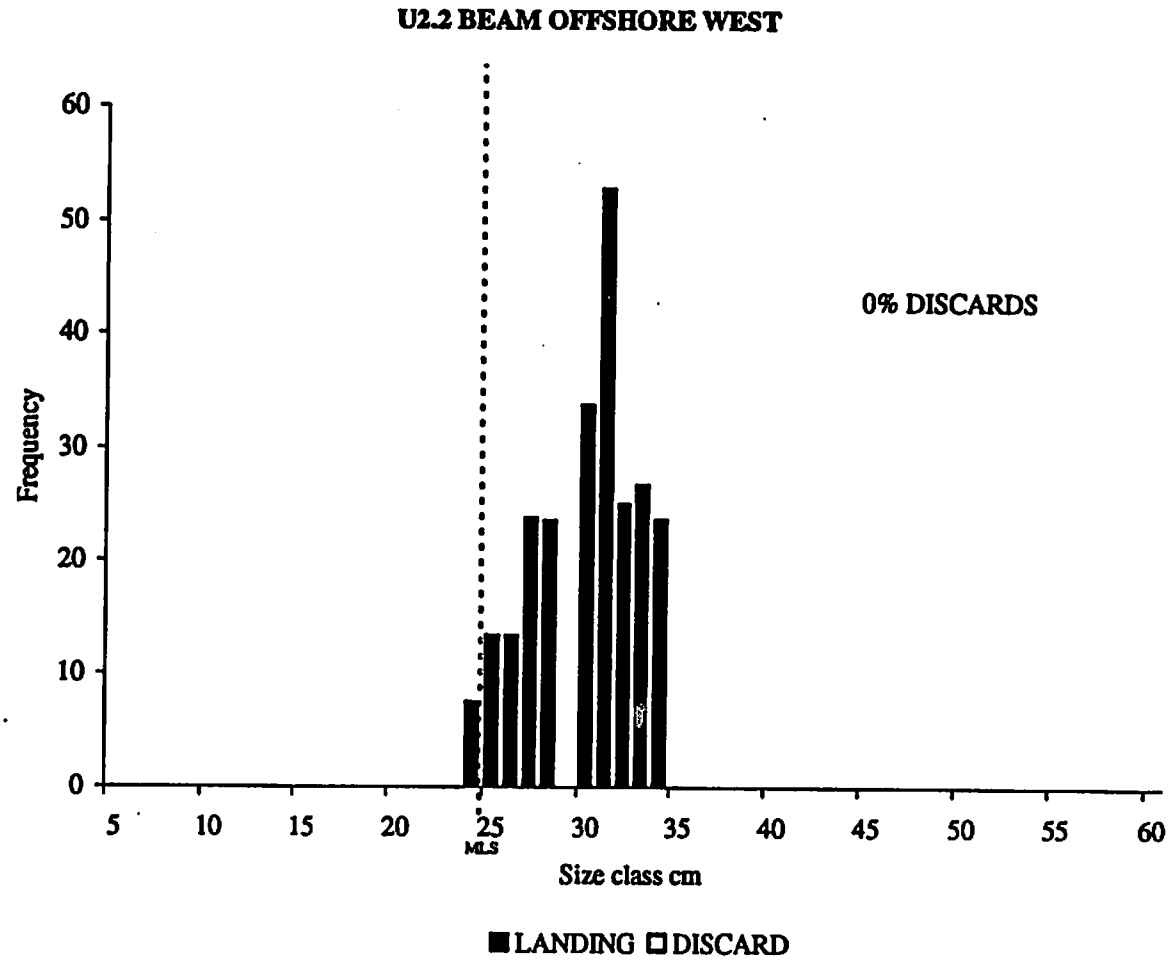


Figure 37. Catch Survey Quarter 4:
Length-frequency distributions for Lemon sole landings and discards

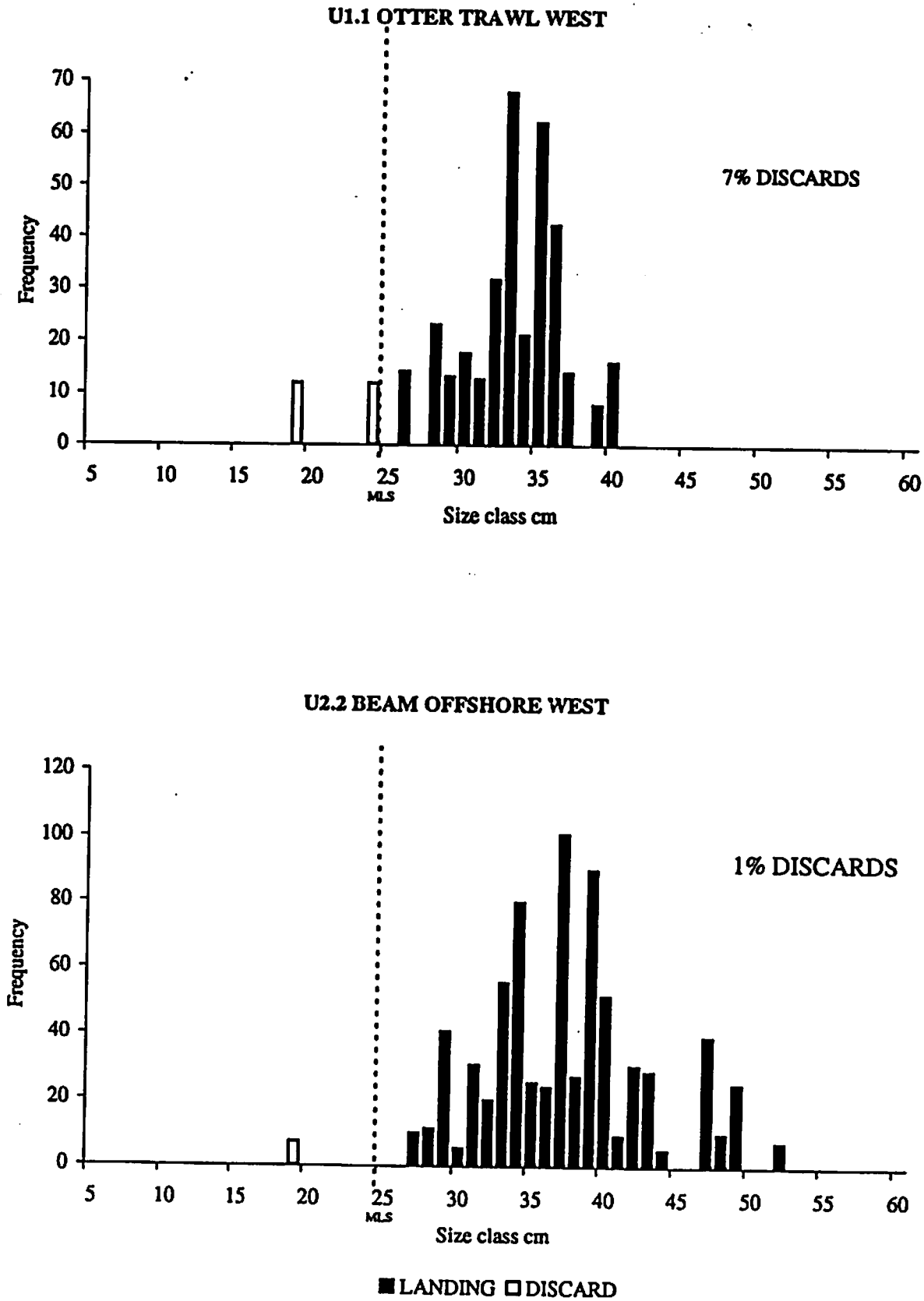


Figure 38. Catch Survey Quarter 4:
Length-frequency distributions for Plaice landings and discards

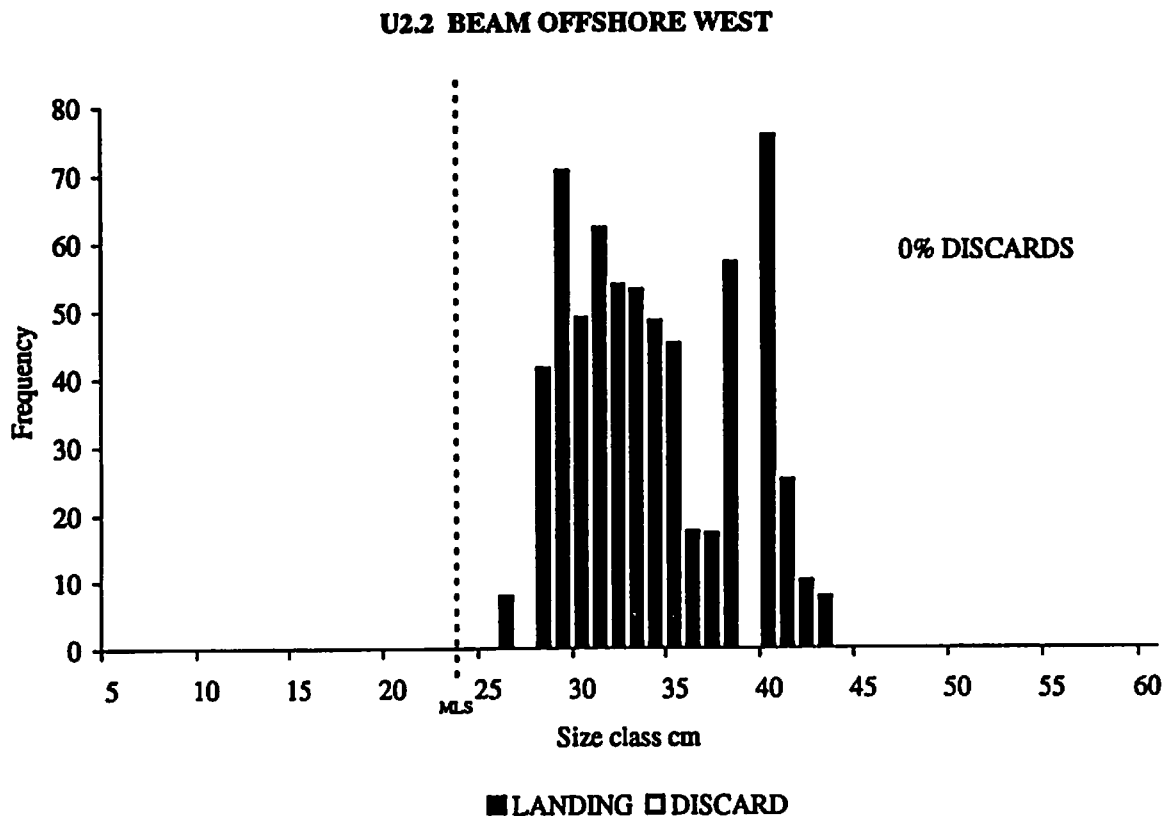


Figure 39. Catch Survey Quarter 4:
Length-frequency distributions for Sole landings and discards

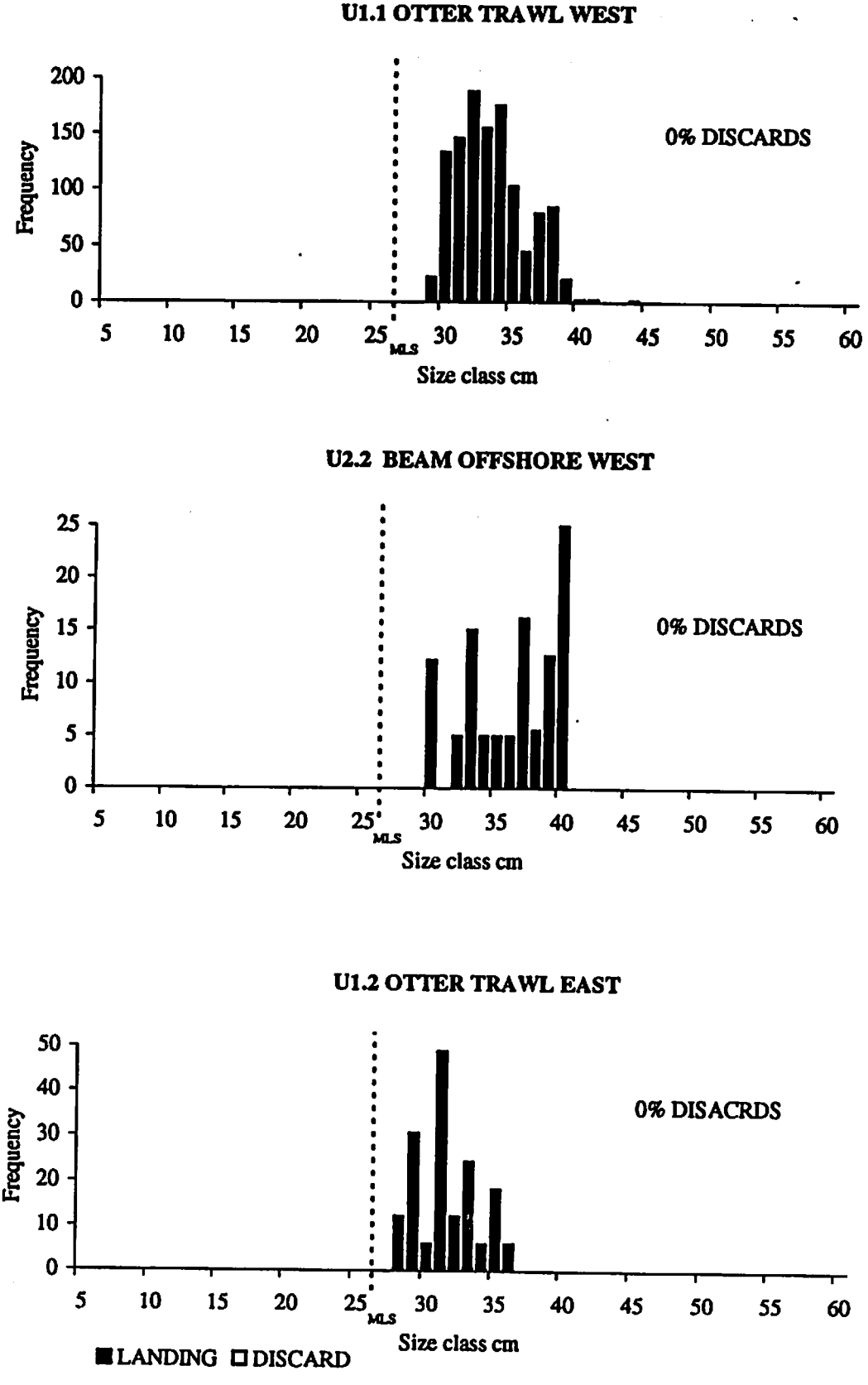


Figure 40. Catch Survey Quarter 4:
Length-frequency distributions for **Whiting** landings and discards

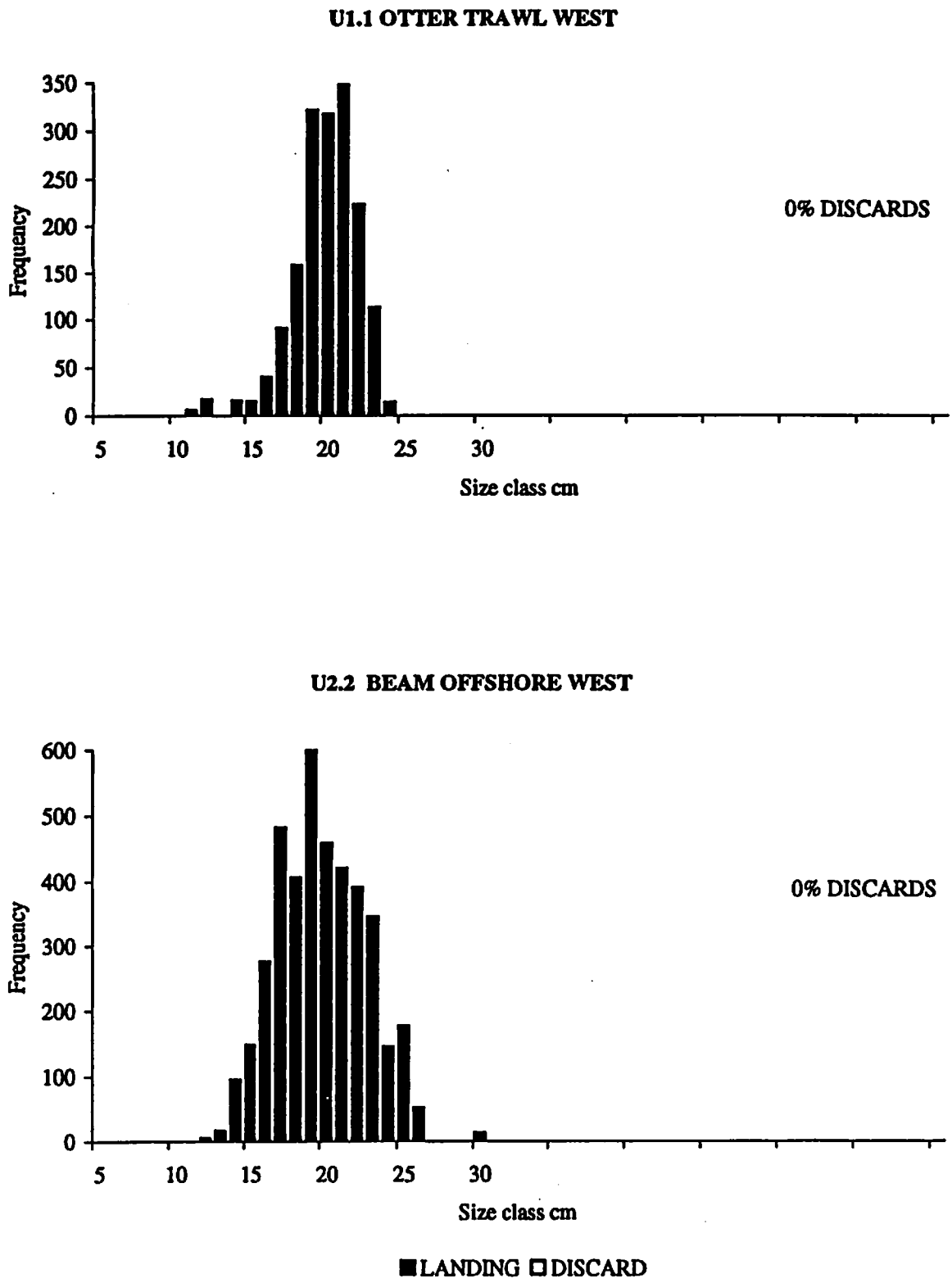
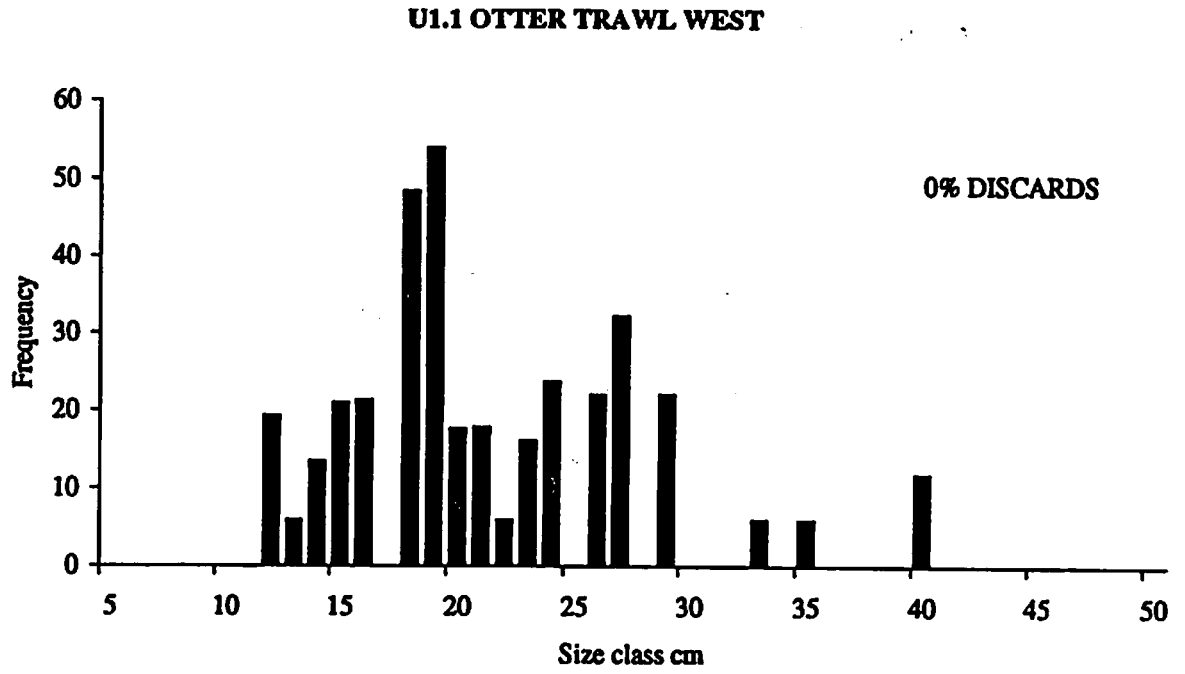


Figure 41. Catch Survey Quarter 4:
Length-frequency distributions for Cuttlefish landings and discards



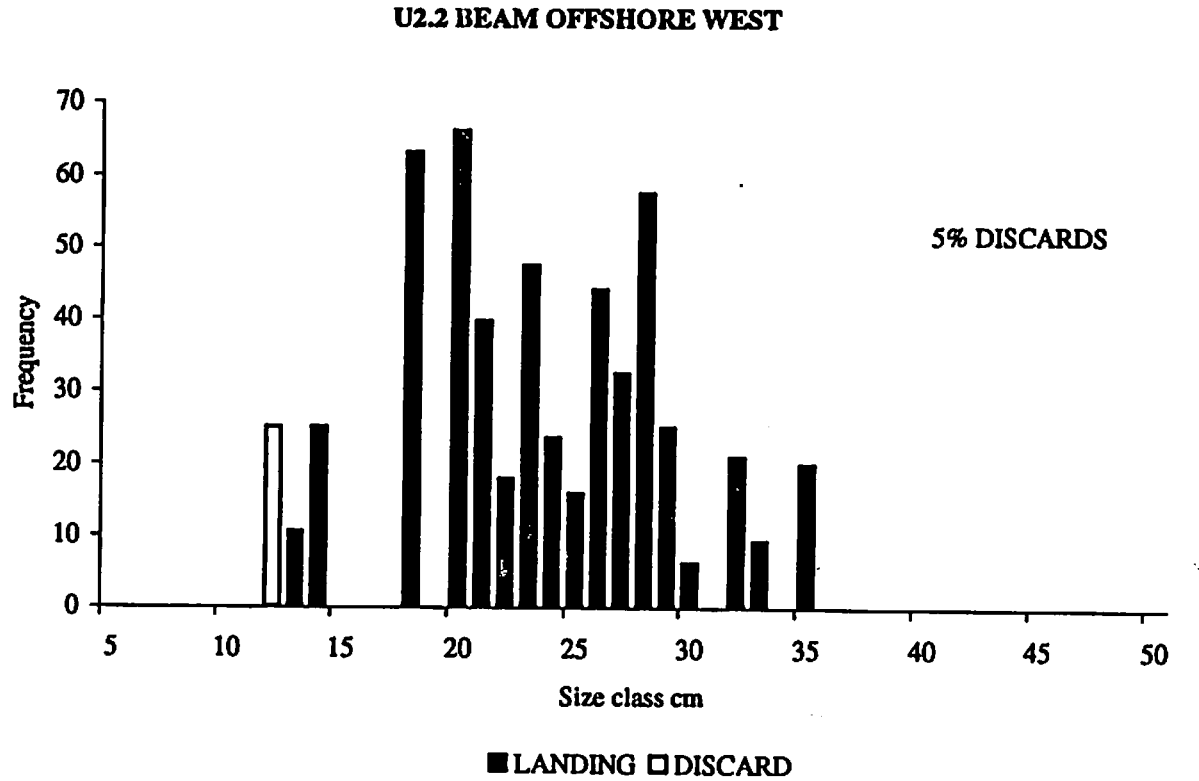


Figure 42. Catch Survey Quarter 4:
Length-frequency distributions for Squid landings and discards

4.4.3 Non seasonally targeted species

These include monkfish, pout whiting (BIB) and dab.

Monkfish (Figure 43)

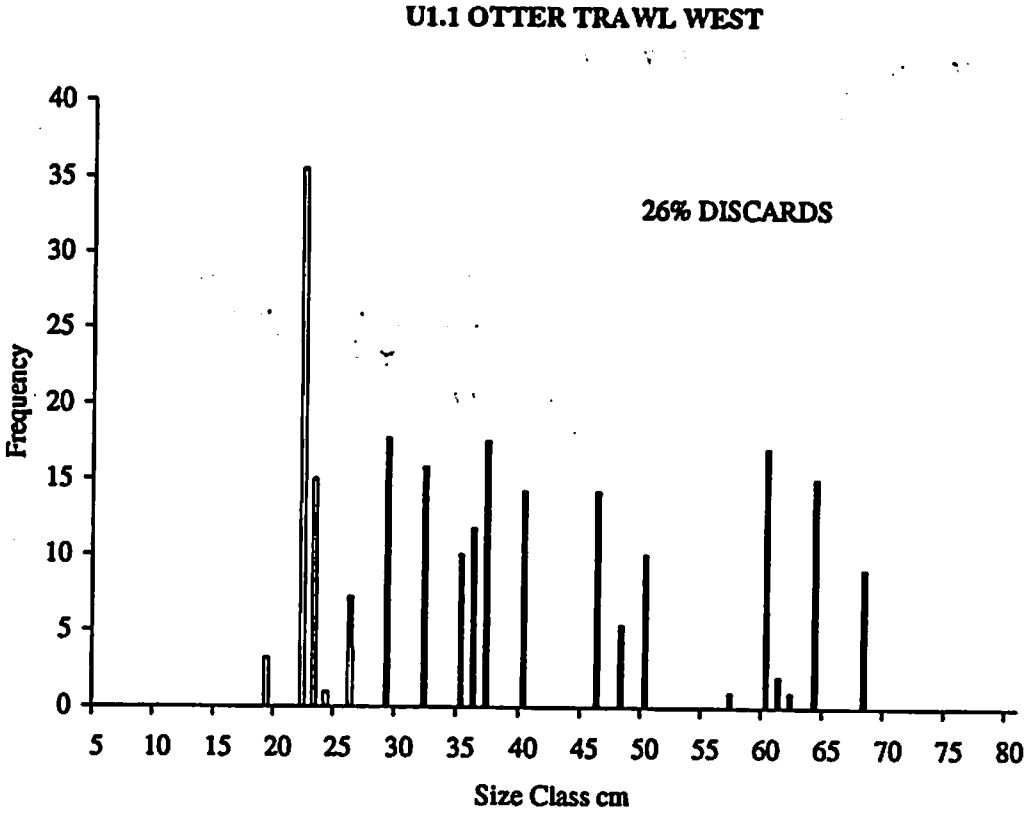
Of the non seasonally targeted species monkfish had the highest unit value at £1.78/kg. Monkfish are considered a year round target species by a minority of respondents in the beam offshore west métier. However they featured most highly in the samples in quarters 3 & 4 both by weight and share of landed value. There is no MLS and discarding was related to size in both western trawl métiers sampled; no monkfish over 27cm were discarded but some were landed below that length.

Pout whiting (Figure 44)

Pout whiting had a low unit value at £0.30/kg in the west and £0.21/kg in the east. The species occurred in the samples from all métiers but did not exceed 4% by value of the total landed catch on a quarterly basis. Overall discard rates were high in all métiers and only larger fish were landed (see section 4.4.1 for a comparison between ports).

Dabs (Figure 45)

Although the unit value of dabs is similar to whiting at £0.49/kg in the west and £0.41/kg in the east this species had a high discard rate in all métiers. In most métiers the fishermen retained the majority of fish above 26cm and the high discard rates occurred because of the large numbers of small dab captured which were not considered marketable. Dabs did not contribute more than 1% of the value of the landed catch in any of the métiers on a quarterly basis.



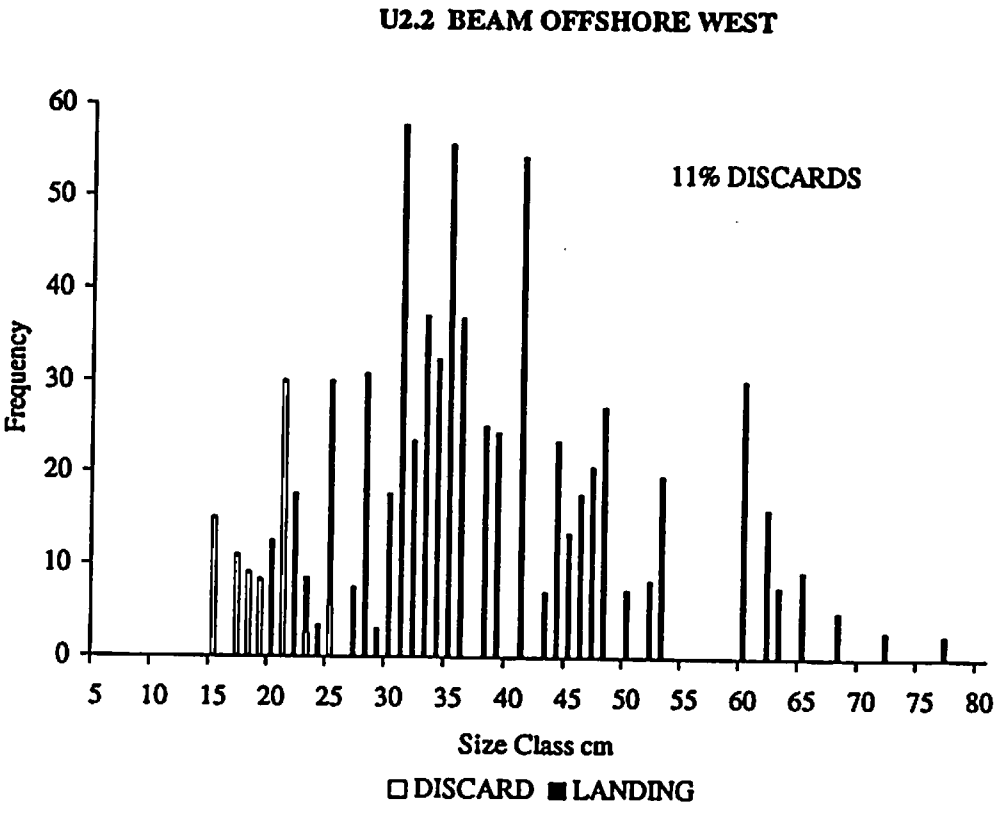
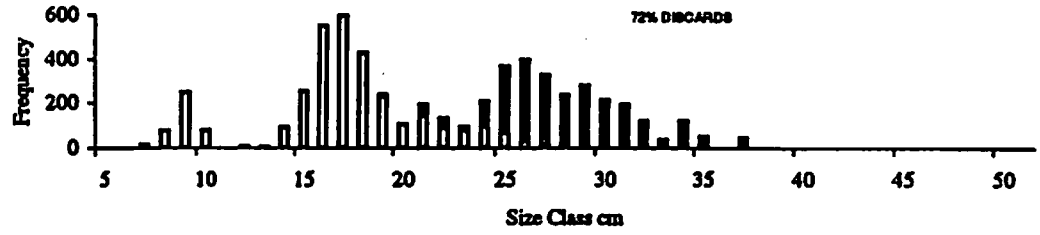
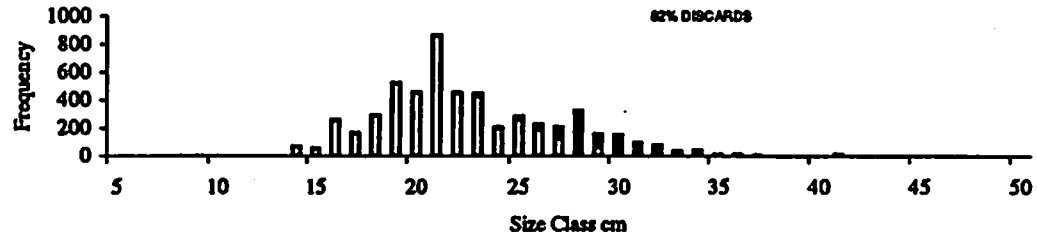


Figure 43. Catch Survey All Quarters:
Length-frequency distributions for Monkfish landings and discards

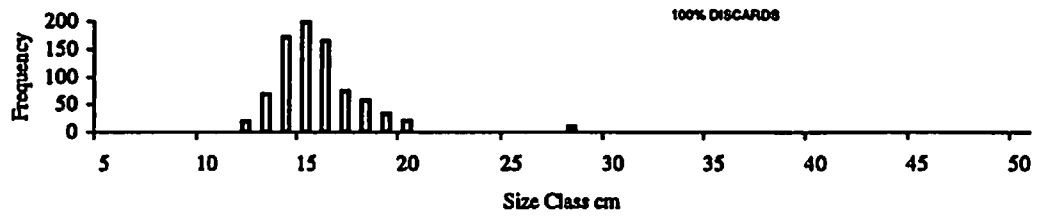
U1.1 OTTER TRAWL WEST



U1.2 OTTER TRAWL EAST



U1.3 PAIR TRAWL WEST



U2.2 BEAM OFFSHORE WEST

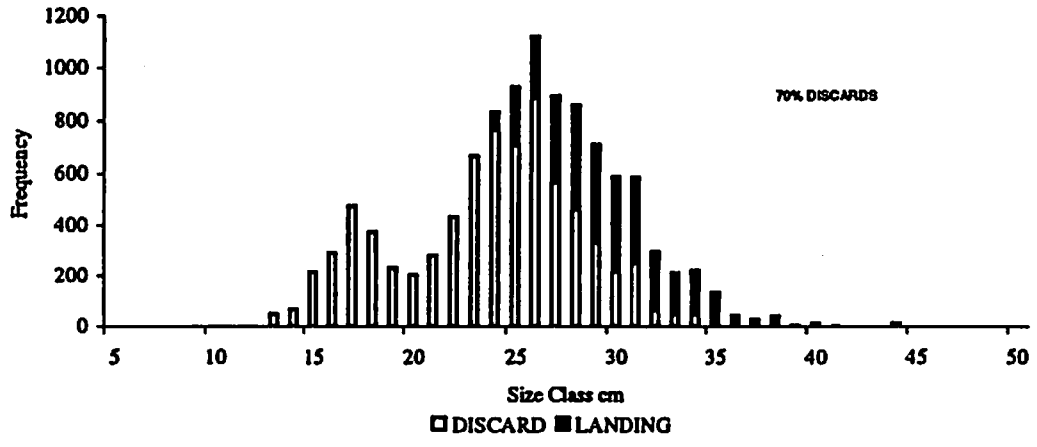


Figure 44. Catch Survey All Quarters:
Length-frequency distributions for **Pout Whiting** landings and discards

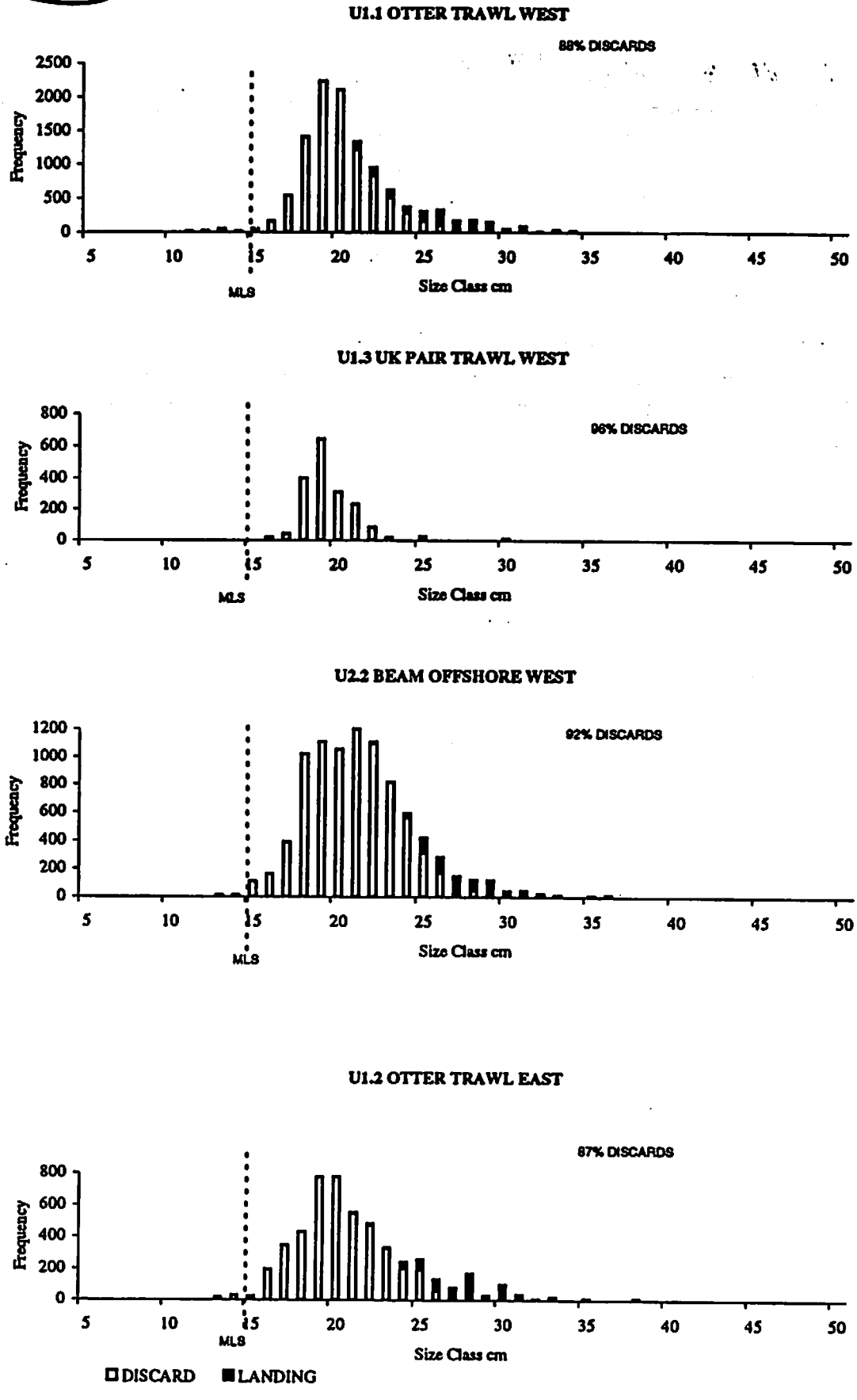


Figure 45. Catch Survey All Quarters:
Length-frequency distributions for Dab landings and discards

4.5 Effort and Catch Surveys - Raised Estimates of Catch and Métier Interactions

The estimates of discards and landings by métier and quarter were raised using the effort raising factor (RFE) derived from the effort survey (section 4.3.2). These results were then used to provide data for the Métier Interaction Tables and raised length-frequency tables. Since they are raised from both catch and effort data the result will contain the biases inherent in both these data sets. In particular only the ports of Brixham, Looe and Plymouth were sampled in the west and Newhaven and Shoreham in the east; landings undoubtably occur outside this area.

4.5.1 Raised numbers in catch at length by métier

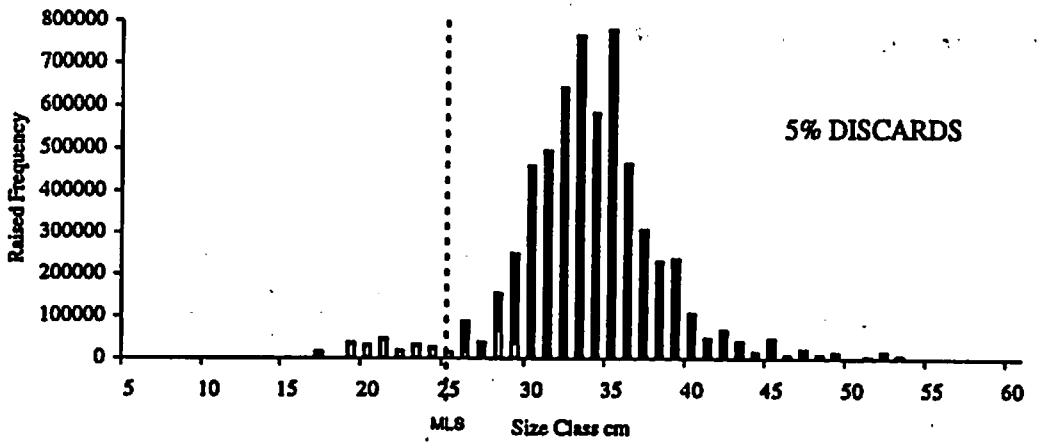
The raised numbers at length for plaice and sole in each métier are shown in Figures 46-47. These two species were chosen as the species for which stock assessments are carried out in the eastern and western English Channel. Also shown is the discard rate in percentage by numbers terms.

4.5.2 Métier interaction tables

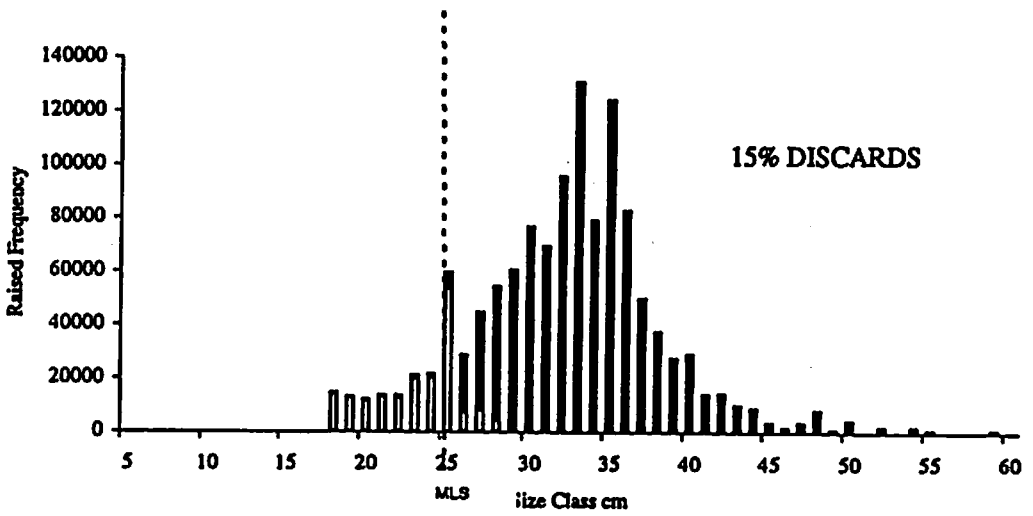
The raised discards and landings data for the métiers for which there was adequate data are presented in the same format as the data in Tétard, Boon *et al.*, (1995), Tables 53-56. Complimentation or substitution was assessed from the results of the effort survey. Only those métiers in this study are presented as interacting métiers; other métiers outside the study may interact with these métiers. Species were chosen on the basis of the first 10 ranked by weight in the total catch.

The landings reported to MAFF for the year 1995 are also shown; these are lower for most species but of a similar order of magnitude when compared with the landings estimated by this study.

U2.2 BEAM OFFSHORE WEST



U1.1 OTTER TRAWL WEST



U1.2 OTTER TRAWL EAST

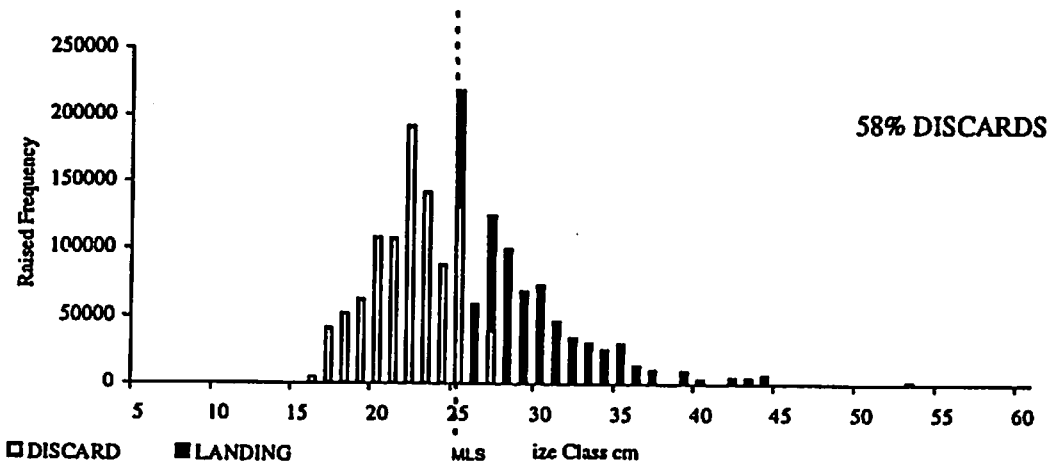


Figure 46. Catch and Effort Surveys All Quarters:
Raised length-frequency distribution for Plaice

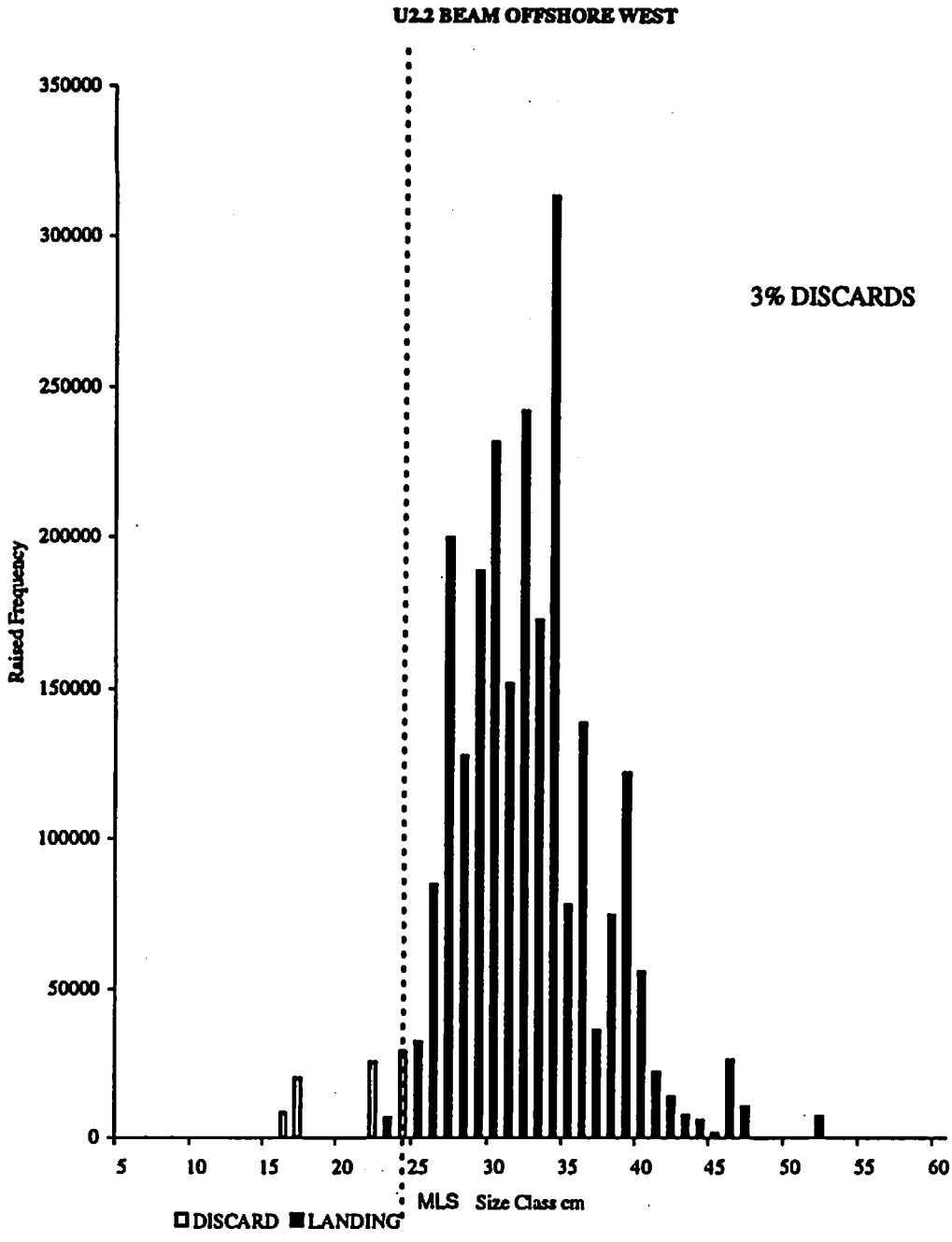


Figure 47. Catch and Effort Surveys All Quarters:
Raised length-frequency distribution for Sole

Table 53

TABLE OF METIER INTERACTIONS

Seafish Channel Discard Study

METIER NAME	CODE
UK TR W	U1.1

ESTIMATED LANDINGS AND DISCARDS (TONNES) OF MAIN SPECIES BY THIS METIER (YEAR 1995)

	Boats	Months	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	TOTAL D	TOTAL L
			Cuttle		L Sole		Squid		Whiting		Plaice		Gurnard		Pout		Monk		J Dory		Dab		(all species)	
Metier in VIIe	81	425	20	1562	42	963	7	938	26	536	27	414	396	353	112	212	8	215	8	118	632	116	1280	5425
MAFF Landings				793		850		498		926		226		144		136				110		571		5408

ESTIMATED ANNUAL LANDINGS AND DISCARDS (TONNES)

CODE	INTERACTIVE METIER	Boats	Months																				COMPLEMENTERY OR/AND SUBSTITUTION Boats	Months	C	S
U2.2	UK BEAM OFF W	58	509	243	2654	42	963	1	505	114	159	53	2264	214	634	1728	746	12	782	1	68	843	176			*?	*?
U4.1	UK DR W scallop	27	230									0	2					0	19							*?	*?

COMMENTS: UK DR W scallop results from Quarters 2 & 3 and a limited number of inshore boats only

LEVEL OF COMPETITION		
D	L	G
		**
		**

L = LANDINGS
D = DISCARDS
G = GROUND

Table 54

TABLE OF METIER INTERACTIONS

Seafish Channel Discard Study

METIER NAME	CODE
UK BEAM OFF W	U2.2

ESTIMATED LANDINGS AND DISCARDS (TONNES) OF MAIN SPECIES BY THIS METIER (YEAR 1995)

	Boats	Months	D Cuttle	L Cuttle	D Plaice	L Plaice	D Sole	L Sole	D Monk	L Monk	D Pout	L Pout	D Gurnard	L Gurnard	D Squid	L Squid	D L Sole	L L Sole	D Scallop	L Scallop	D Dab	L Dab	TOTAL LANDINGS D (all species)	TOTAL LANDINGS L (all species)
Metier in Vile	58	508	243	2654	53.2	2264	8.15	937	11.7	782	1728	746	214	634	0.99	505	24.4	504	0.9	421	843	176	2283.7	9447.6
MAFF Landings				686		302		245				139		51		37		133		54				2364

ESTIMATED ANNUAL LANDINGS AND DISCARDS (TONNES)

CODE	INTERACTIVE METIER	Boats	Months																				COMPLEMENTERY OR/AND SUBSTITUTION Boats	Months	C	S
U1.1	UK TR W	81	825	19.6	1562	26.7	414	0	4.29	8.35	215	112	212	398	353	7.11	938	41.8	963			632	116			*?	*?
U4.1	UK DR W scallop	27	230			0	2.4	0	20.4	46	0									916	2101					*?	*?

COMMENTS: UK DR W scallop results from Quarters 2 & 3 and a limited number of inshore boats only

LEVEL OF COMPETITION		
D	L	G
		•
		•

L = LANDINGS
D = DISCARDS
G = GROUND

Table 55

TABLE OF METIER INTERACTIONS

Seafish Channel Discard Study

METIER NAME	CODE
UK DR W scallop	U4.1

ESTIMATED LANDINGS AND DISCARDS (TONNES) OF MAIN SPECIES BY THIS METIER (YEAR 1995)

	Boats	Months	D Scallop	L Scallop	D Sole	L Sole	D Monk	L Monk	D Rays	L Rays	D Brill	L Brill	D Plaice	L Plaice	D	L	D	L	D	L	D	L	TOTAL LANDINGS D	TOTAL LANDINGS L
Metier in VIIe	27	230	916	2101	0	20.4	0	19.3	0	15.8	0	5.16	0	2.4									915.67	2163.7
MAFF Landings				7570		154		n/a		19				53										9566

ESTIMATED ANNUAL LANDINGS AND DISCARDS (TONNES)

CODE	INTERACTIVE METIER	Boats	Months																					
U2.2	UK BEAM OFF W	58	508	0.9	421	8.15	937	11.7	782					53.2	2264									
U1.1	UK TR W	81	825											26.7	414									

COMPLEMENTERY OR/AND SUBSTITUTION

Boats	Months	C	S
		*?	*?
		*?	*?

LEVEL OF COMPETITION

D	L	G

COMMENTS: UK DR W scallop results from Quarters 2 & 3 and a limited number of inshore boats only

L = LANDINGS
D = DISCARDS
G = GROUND

Table 56

TABLE OF METIER INTERACTIONS

Scatish Channel Discard Study

METIER NAME	CODE
UK TR E	U1.2

ESTIMATED ANNUAL LANDINGS AND DISCARDS (TONNES) OF MAIN SPECIES BY THIS METIER (YEAR 1995)

	Boats	Months	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	TOTAL LANDINGS D	TOTAL LANDINGS L
			Cuttle		Pout		Whiting		Cod		LS Dogs		Gurnard		Flounder		Squid		Bass		L Sole			
Metier In	22	348	25.2	2007	144	272	33	688	4.66	216	0.01	205	45.6	168	102	151	1.69	124	3.27	117	180	115	539.11	4081.4
Total Internat. landings from																								
Total Internat. landings from the Channel																								

ESTIMATED ANNUAL LANDINGS AND DISCARDS (TONNES)

CODE	INTERACTIVE METIER	Boats	Months																					

COMPLEMENTERY OR/AND SUBSTITUTION

Boats	Months	C	S

LEVEL OF COMPETITION

D	L	G

COMMENTS:

L = LANDINGS
D = DISCARDS
G = GROUND

5. Discussion

This project aimed to assess the feasibility of measuring discarding levels in the UK towed gear métiers operating in the English Channel and to describe and discuss the factors affecting discard rates of species captured in these fisheries.

An assessment of the success any study requires discussion of the sampling techniques and strategy. A discussion of the factors affecting discard rates requires analysis of the catch composition and the factors affecting the fishermen's discarding practices. There is also a requirement for consideration of the use of these results for stock assessment purposes. The analysis may yield possible means by which discarding may be reduced.

5.1 Sampling Techniques and Strategies

5.1.1 Sampling techniques

Discard sampling techniques are discussed in detail in Emberton *et al.*, (1995) and Cotter *et al.*, (1995). The technique used for this study was considered suitable because it enabled sampling of all species in the catch and could be carried out in the same way in all métiers sampled (with some modifications for scallop dredging).

5.1.2 Sampling strategies

The statistical aspects of discard sampling in terms of the design of surveys and the number of samples required in relation to the variation found at each level are fully discussed in Cotter *et al.*, (1995). This section will not consider these aspects of discard surveys but will discuss the extent to which the original sampling plan was fulfilled and possible means for improving the design of future surveys.

The use of past landings data to weight future discard surveys assumes only gradual changes in the proportions of landings from each métier from year to year. In this survey this was not always the case; increased landings from scallop dredging resulted in a shortfall in the targeted sampling of this activity.

The method produced well balanced sampling for the other métiers. The majority of the quarterly effort raising factors (RFE) were between 500-1500 (total range 449-4958) suggesting reasonably consistent weighting by quarter; however these results only apply to those vessels sampled in the effort survey.

Other schemes could have been used to target sampling effort. Simply visiting the ports on a rota basis during each quarter and sampling a representative selection of the effort from each port and gear type was adopted by earlier studies (Dunlin *pers.com.*). However when sampling in a new area, especially one as geographically extensive as the English Channel, it is useful for field staff to have some guide to the relative numbers of trips required in each category. In future the use of more recent landings and effort data may enable sampling plans to be updated more regularly.

Randomisation of the sampling between vessels, as would be expected for routine monitoring, might prove difficult to operate if the strata within which this was carried out were geographically dispersed. On some occasions trips on particular vessels were not possible due to engine failure or other reasons but staff were able to arrange trips on other vessels within the same port and gear stratum. If a randomised strategy had required the officer to travel to another port then time would have been lost.

The fishermen in the different ports varied in their level of cooperation with the study. Access was not a problem for the trawling gears in Plymouth, Looe, Brixham, Shoreham and Newhaven and very few trips were refused. For scallop dredging there were no problems obtaining access to boats using spring loaded or Newhaven dredges but access to vessels using French dredges was denied. The only port where access was completely denied was Newlyn in Cornwall. After initial cooperation, fishermen from Rye in Sussex, were also unwilling to take discard officers although further discussion could probably have yielded more trips from this port.

The lack of access to vessels from the ports of Newlyn and Rye has resulted in a deficit in the sampling of the beam inshore west (U2.3) and beam east (U2.1) métiers. In those métiers sampled most of the hauls observed were situated within the expected areas, but in general they are concentrated nearer to the ports where sampling was permitted and the full anticipated ranges of the métiers were not sampled.

This could be due to the information on the geographical ranges of the métiers being incorrect. Cephalopod species have become a more valuable component compared with the more traditional species such as plaice. This may have altered the geographical pattern of fishing from previous years as fishermen found these resources in new locations. However it seems most likely that the lack of sampling from Newlyn and Rye did have an effect on the spatial distribution of sampling effort in the west and east respectively.

The effort survey results reveal the extent to which vessels switch between gear types and named target species on a seasonal basis. The cluster analysis of the total catch data indicate that allocation of trips to métiers using gear type and seasonal target species results in groupings which are, in the main, also reflected in the total catch composition. This suggests that the métiers divided seasonally into quarters are valid strata for the study of the total catch composition. This emphasises the need for designing the sampling strategy and analysing the results by métier rather than vessel type or port.

5.2 Factors Influencing Catch Composition

The composition of the catch available to the fishermen has an important influence on the discard rates of the captured species. Large numbers of small individuals below the MLS will result in a high discard rate for that species. Seasonal changes in catch composition could be due to:

- Seasonal variations in the availability of species due to migrations or behavioural changes.
- Seasonal variations in the spatial distribution of hauls.
- Variations in the selectivity of the gear on a seasonal basis.

It is not the intention to carry out a detailed analysis of all of these factors. Discard studies reveal total catch rather than landed catch as would be available from market surveys. Thus more information is available on the composition of the catches and the comparative impact of fishing on the fish populations.

The results of the cluster analysis suggest that trips can be sensibly grouped on a seasonal and métier basis in terms of overall similarities in total catch composition. When grouped on a quarterly basis the catch composition of the trips varied in a manner which was congruent with the fishermen's perceptions of the target species. The locations of the fishing varied between métiers and seasons. Fishermen using particular codend mesh sizes captured particular target species. The overall catch composition also varied with codend mesh size; small mesh sizes used for fishing for squid did not result in large catches of small fish of other resource species.

These observations can be considered manifestations of the fishermen's ability to 'target' fishing on desired resource species and the variation in the seasonal availability of those species.

Seasonal variations in total catch composition of a selection of species are discussed below in relation to literature on their biological features. These species were chosen because the results of the survey produced information which was relevant to studies of their biology and which would not have been available from market samples.

Lemon sole

Lemon sole are abundant in the extreme west of the English Channel off Newlyn, all year round. Between April and June the sexually mature fish move into most inshore western Channel waters to spawn. Juveniles less than approximately 18cm in length are considered to prefer rocky, boulder-strewn areas, which are geographically close to the sand-flats preferred by the adults. Tagging studies suggest that the distance covered by lemon sole in the western Channel during their migration is not great which leads to the belief that the western lemon sole form one discreet stock (Pawson, 1995).

Effort is targeted towards the lemon sole in the western Channel in the first and second quarters, resulting in high proportions of this species in the catches by weight and value. The low discard rate throughout the year in the western métiers suggests good separation between the adults and juveniles.

This contrasts with the situation in the east. Here the species are described as target species in the quarters 3 and 4 although not with the same intensity as in the west in the spring. Catch observations for quarters 2 and 3 in the eastern otter trawl métier show a very high discard rate with the catch being composed mostly of smaller fish. This suggests that juvenile fish are more available to the fishery in the east. The eastern métiers were poorly sampled during quarter 4 so no further information is available.

Whiting

Whiting are considered to move from the central North Sea into the eastern Channel and southern North Sea in winter and the spawning occurs between February and May (Pawson,

1995). In the eastern otter trawl métier whiting are considered target species in the first and fourth quarters and are main contributors to the total catch by weight at this time.

Unfortunately no information is available for the western channel because all recaptured fish during the MAFF tagging experiments were recaptured within 3 months of being tagged (Pawson, 1995). However, the fishermen's effort and catch information would suggest an increased availability of whiting possibly due to an influx of fish in the western channel during the second and third quarters.

The length-frequency distributions are similar in all the métiers during each quarter with a trend towards larger fish in the catches in quarter 4. There is no evidence in these results for any of the métiers catching substantial quantities of small whiting.

Cuttlefish
Pawson (1995) summarises current knowledge of the migrations cuttlefish in the English Channel:

> *"During the winter, cuttlefish congregate in the Hurd Deep situated in the central western channel, where the water depth is greater than 70m. In the spring they migrate inshore and eastward, so that they can spawn in the shallower waters. During this migration period the cuttlefish are considered to swim high up in the water column, thus avoiding the bottom towed fishing gear. After breeding in April and May most cuttlefish die. From July to September the juveniles hatch and inhabit the inshore waters. In October as the inshore waters start to cool, they migrate back to the offshore waters of Hurd Deep where they over-winter. The following spring the cycle repeats itself as the cuttlefish move back inshore to breed."*

The results obtained in this study are consistent with these observations. In quarter 1 the beam offshore west métier catches consisted of two size groups; a numerous small size group of juveniles and a group of adults; the juvenile cuttlefish were all discarded. Cuttlefish were not considered a target species or captured in significant quantities in the east during this quarter.

By the second quarter the larger cuttlefish have disappeared from the western beam trawling catches but the juveniles remain vulnerable to the gear. The eastern otter trawl catches are dominated by adult cuttlefish in this quarter and they are considered a main target species.

In the third quarter the modal size of the cuttlefish in the east is very much smaller suggesting that this could be an influx of juveniles; these could be representatives of the same group which were discarded by the beam trawlers in the west during the previous quarter.

In the fourth quarter both the western otter and beam trawl catches are dominated by large cuttlefish. These could be the group observed in inshore waters in quarter 3 having migrated offshore for the winter. There are no juveniles in the western trawl catches at this time of year suggesting that they are either not present in this area or they are not vulnerable to the trawl at this time of year.

5.3 Factors Affecting Discarding Practices

The factors affecting discarding practices aboard a vessel may be grouped into natural, technological, human, economic and legal influences, as depicted in Table 57. These factors may interact in complex ways to affect selection and discarding of the catch.

Table 57
Possible factors affecting discarding practices aboard a vessel

	ENVIRONMENTS				
	NATURAL	TECHNOLOGICAL	HUMAN	ECONOMIC	LEGAL
FACTORS	WEATHER (WORKING CONDITIONS ON DECK) UNSORTED CATCH SIZE, COMPOSITION AND QUALITY STORAGE LIFE OF SPECIES CONDITION OF SPECIES	EQUIPMENT (DECK AND FISHROOM) CAPACITY	MANPOWER ORGANISATION AND EFFICIENCY DURATION OF TRIP COMFORT / FATIGUE MORALE INFLUENCE OF SKIPPER AND / OR MATE CREW CHANGES BETWEEN HAULS AND / OR TRIPS	DEMAND PRICES RELATIVE VALUE OF SPECIES WITHIN CATCH	MLS QUOTAS AND OTHER RESTRICTIONS POTENTIAL FOR PROSECUTION AND PENALTIES

Factors which could affect the catch composition are described in Emberton *et al.*, 1995

Catch composition and economic value

Discarding practices appeared closely related to economic value. Tables 36-52 show clearly that more valuable species in terms of unit value and in terms of overall contribution to the landed catch value exhibit lower discard rates, provided that they were large enough to be marketed or legally landed.

High unit value species such as sole, turbot, brill and bass were very rarely discarded, provided that they were larger than the MLS, and the size composition of the catches was such that very little discarding of undersized fish of these species was necessary.

Discarding practices for whiting, which has a relatively low unit value but can be caught in considerable bulk, appear to be influenced most by the overall catch composition. When large proportions by weight of whiting, along with other more valuable species were caught by pair trawlers in quarter 2, discarding above the MLS tended to be high. By the following quarter (quarter 3) whiting had become more important economically to this métier and discarding above the MLS was observed to decrease.

It seems likely that heavy landings of a species depress price levels and that this may affect discarding practice; discarding of whiting may be particularly affected by this factor. The use of annual price data precludes a full seasonal evaluation of this effect in this study. However it may contribute to the contrast between the discarding practice observed for whiting in the pair and otter trawling métiers in quarter 2. In pair trawlers a higher proportion the large catches of whiting above the MLS were discarded as described above. In contrast discards above the MLS were low in the otter trawling métier and whiting made up a very much lower proportion of the catches by weight and value.

The beam trawling métiers land high unit value species such as sole, turbot and monkfish and discarding of whiting of lengths above the MLS was more prevalent.

For species with high unit values such as squid, cuttlefish and monkfish but no MLS, market forces appear to be the most important determiner of discarding practices. For squid, discarding was for the most part negligible down to the very smallest size captured (8cm). The retention size for cuttlefish was variable between métiers with the otter trawlers landing smaller individuals than the beam trawlers. Beam trawlers in the western channel discarded all cuttlefish of less than 15cm whilst otter trawlers in both east and west landed cuttlefish as small as 7cm.

The retention size for monkfish is less easily determined; the largest monkfish discarded was 27cm but some were retained below that size. Fish as large as 77cm were captured and the majority of monkfish landed were between 30 and 50cm so a 27cm monkfish is a relatively small fish.

Minor species in value terms including pout whiting, gurnards and horse mackerel are landed according to market conditions in the port to which the vessel is landing. Brixham appears to be of importance for the marketing of these species. The presence of vessels pursuing potting métiers increases demand for bait which these species can be used for. One Brixham vessel went as far as buying pout whiting and sometimes dabs from other vessels and steaming all the way to France in order to land these species. The economic importance of these minor species to the fishermen that land them should not be underestimated. When profit margins are squeezed, small marginal increases in overall landings can be of significance and discarding practices influenced accordingly.

Legislative

The main resource species regulated by MLS; lemon sole, plaice, whiting and scallops were targeted in seasonal fisheries. In most cases the MLS has the largest influence on discarding practices. The overall length-frequency distribution of the catch appeared to have some influence on the discarding pattern of lemon sole and plaice; when there was a high proportion of larger fish in the catch the fishermen start to retain fish at a slightly larger size (lemon sole and plaice quarters 1 and 2).

The study did not knowingly witness any discarding of fish due to quota being unavailable on the trips undertaken in this study. Quota restrictions did not appear to have an important influence on the size at which fish were discarded. It is possible that fishermen may have made efforts to fulfill their quota allocation by selecting larger fish and this could be manifested in the discarding of plaice above the MLS when there was a preponderance of larger fish in the catches. However a similar effect was noted for lemon sole which were not regulated by quota.

It is possible that access was denied to vessels which were likely to be discarding over-quota fish. Access was denied on a gear type or port basis. If over-quota discarding was more prevalent on boats fishing from Newlyn, Rye or using French dredges then it would have been missed. There were no apparent changes in the pattern of consent in the boats actually

sampled which might indicate that the skipper expected to be discarding over-quota fish and would rather not have the fact witnessed.

It is important to understand that this survey relates to fish designated as marketable or not at the point at which they were sorted on deck (no disposal of fish once the catch had been sorted and placed below was observed). The survey did not seek to establish the fate or mode of recording of the fish once it had been sorted and the quota status of the boats were never discussed. Thus no comment can be made as to what alternative arrangements might have been made for over-quota fish.

There have been some well publicised efforts to raise the issue of discarding of over-quota monkfish (Baldry 1995). This survey did not reveal any discarding over-quota fish of this species. However it forms a relatively small proportion of the catches on a quarterly basis; the highest being 11% by value in quarter 3 or third in terms of ranked share of the landed catch. Monkfish were rarely mentioned as targeted species by the fishermen in the effort survey. It appears that the fishermen do not specifically target this species and therefore the option of changing location or gear type if quotas for the species are being exceeded whilst in pursuit of other species may not be available.

Human factors
The effect of variation in the human element between different vessels should also be considered. Different skippers and mates may have different policies on discarding fish and the morale, comfort and level of supervision of the crew may have an influence. However these factors are very difficult to separate from the other factors affecting discarding practices.

5.4 Fishery Assessments

5.4.1 Stock assessment

Data from discard surveys are used to support annual assessments of the stocks of cod, whiting and haddock in the North Sea, Irish Sea and west of Scotland, which are carried out by the North Sea and Northern Shelf Demersal Working Groups of the International Council for the Exploration of the Sea (ICES). However, these data provide only partial coverage of the fishing fleets and fish stocks of interest to the UK industry, and this study complements that in the Irish Sea (Emberton *et al.*, 1995) in providing an insight to the level and pattern of discarding of assessed and non-quota species in the UK trawl métiers in the English Channel

Biological samples of catches landed by all trawl métiers covered by this study are used in the assessments of sole and plaice stock in the east and west English Channel. These catch-at-age data do not include discards, which this study has shown to constitute a significant proportion of the catches of plaice in the eastern otter trawl métier in particular. The data presented here imply that discarding occurs at different rates within the various métiers, and therefore that stock assessments based only on data from biological samples of the landings of one or two 'fleets' - as is often the case - would be significantly improved by knowledge of discarded numbers-at-age.

Monitoring, rather than a single survey of discarding, is necessary because of the many variable factors affecting discarding. Reporting frequency should be at least annual so that discards can be updated on the same time scale as landings. A higher frequency would permit better analysis of factors affecting discarding, but is only necessary for stock assessments if they are carried out using, for example, quarterly catch-at-age data.

ICES stock assessments make use of updated series of numbers-at-age landed to estimate fishing mortality, *F*, and numbers-at-age in the stock. Where discarding rates are fairly constant, the absence of discard data is not important for short-term catch forecasts, but they become more valuable when discarding is variable, or when long term forecasts are attempted.

One way to incorporate discards into a stock assessment is to use an estimated average rate of discarding, e.g. DR = D/C, where D is the numbers discarded and C is the numbers caught (at age) on a sample of fishing trips, as given in Figures 46-47. Conversion of length-frequency distributions to age structures would be carried out by the use of an age-length key. The age-length key for the discards and retained fish would be constructed using the otoliths collected on discard trips and from market samples respectively (see Appendix 3). An estimate of the total caught by the métier (C_1) can then be obtained from the total numbers landed (at age), *L*:

$$C_1 = \frac{L}{1 - DR}$$

This permits official data on landings to be adjusted if necessary to allow for missing or untrustworthy values, before applying the discard correction.

5.4.2 Technical interactions

Discard data can also be applied to modelling the technical interactions between métiers, and for assessing the effect of conservation measures for reducing fishing mortality, such as mesh size increases and closed areas. Métier interaction tables such as those shown in Tables 53-56, provided that they include landings, discard and effort data on all interacting métiers, can form a useful starting point when studying these interactions. In these cases it is important to be able to evaluate the mortality generated across the whole size range of a particular species caught by different gears, taking into account their exploitation pattern (selectivity) and level of effort. Since reporting of discard estimates is required at least annually for stock assessment purposes, assessment of technical conservation measures need not create additional demands for discard data unless seasonal or local improved accuracy is essential, for example, with respect to a seasonally closed area. Comparisons from year to year which form part of these assessments should allow for the major influences of varying year-class strengths on discarding, amongst other factors.

Discard data are also useful for assessing the ecological effects of fishing, both in generating additional mortality of young and non-target fish and invertebrates, and because discards provide a large, dependable food supply to many scavenging species. For these studies, monitoring should aim to provide information on biomass as well as numbers of fish discarded, and should encompass both commercial and non-commercial species. Data for environmental purposes can usually be collected easily during a discard survey, although it must be recognised that organisms brought up in the net are not the only ones to suffer the effects of fishing; beam trawls and other heavy gear, for example, will leave many animals crushed on the sea bed.

5.5 Means for Reducing Discarding

There is scope for using discard survey data as a basis for investigating the means by which discards may be reduced. Analysis of discard data can outline where and when discarding may be most prevalent and, in conjunction with stock assessment parameters, indicate where systematic studies of technical measures may prove appropriate. There is also the possibility of using overall estimates of discards by weight and grade to assess the viability of developing markets for the discarded fish.

For lemon sole and plaice the prevalence of small individuals in the east results in higher discard rates in the eastern métiers. Plaice was named as a target species in the east during the quarters sampled and the combined contribution by value of both these species to the landed catch was not negligible. Discussion of appropriate technical or management measures such as changes in mesh sizes or closed areas would have to take into account the economic importance and management requirements of other species. Discard survey data enables a more complete analysis of the consequences of the possible options than would landings data alone.

The use of codend mesh sizes larger than the legal minimum is indicative of a desire to retain only larger fish; larger than minimum codend mesh sizes were used in some métiers. However it is also used as a means for reducing the amount of trash caught in the gear. The discard rate of lemon sole in the otter trawl west métier in the first quarter was reduced by the use of a 90mm codend. This was partly because the fishermen were discarding fish longer than the MLS; the presence of large fish in the catches appeared to encourage the fishermen to increase the retention size. However in the following quarter all lemon sole larger than the MLS were being retained and the length-frequency distribution indicates that the catch was composed of smaller fish. This suggests that the 90mm codend mesh size would not be considered suitable by all the fishermen in this fishery throughout the year. Data on selectivity, stock assessment parameters and more information on the criteria used to select the fish is required for a full description of the acceptability of 90mm codend mesh.

Small cuttlefish (<15cm) suffer a high discard rate in the western offshore beam trawl fishery during the first quarter. Since there is no MLS and the otter trawl métiers land cuttlefish smaller than 15cm during some seasons there is the possibility of finding a market for these cuttlefish. However Arkley *et al.*, (1996) found that one of the attractive features of the beamer landings of cuttlefish as far as marketing was concerned was the uniform large size of the individuals; this encouraged a premium price when compared with the unsorted landings from inshore vessels. Therefore marketing the catch of small individuals may be

difficult. Technical measures in terms of mesh size or other gear parameters could be considered. However the requirements of the other species in the catch would have to be taken into account; the discard rates for other species in this métier are low during this quarter.

6. Conclusions

1. For the species examined there is no evidence of any bias in mean total numbers per sample between the first and subsequent samples from one haul. Thus for the purpose of this survey the sampling technique used was considered valid.

2. In making initial plans for surveys, past landings data are a viable data source for weighting sampling effort, provided that catch and effort in the fisheries have not changed substantially. The method could be improved by obtaining more current catch and effort data.

3. Fishermen's descriptions of effort and observations of total catch were consistent with the métiers as described in Tétard, Boon *et al.*, (1995); it was found that there were variations in total catch composition on a quarterly basis which could be related to seasonal migrations of the resource species.

4. Most discarding of resource species occurred due to fish being below the MLS or below marketable size in the absence of an MLS. In most cases the size composition of the catches resulted in comparatively low discard rates when compared with other Seafish discard studies. For the minor species variations in discarding practices were closely related to economic value and differences were observed between ports for the same species. No discarding of fish due to quota limitations was observed.

5. Though the catch at length data for the trawl métiers used in the assessments of sole and plaice stock in the east and west English Channel do not include discards, these have been shown to constitute a significant proportion only for plaice in the eastern otter trawl métier.

6. The study revealed possible opportunities for reduction of discarding. However it also emphasized the need for economic, biological, technological and stock assessment parameters to be considered when deciding suitable courses of action.

7. Further Work

7.1 Discard Studies

There is a requirement to study discarding practices in the métiers for which access was difficult:

- Scallop dredging both east and west and including French dredging
- Beam trawl east and beam trawl inshore west

There is also a requirement to continue to study discarding practices in the métiers sampled in this study in order to take account of annual variations. The effort survey could be enhanced by obtaining more information on the motivating factors which encourage fishermen to switch effort between métiers.

7.2 Technical and Biological Studies

The study of technical means for the reduction of discards of cuttlefish in beam trawling through better selectivity and for the reduction of discards in the lemon sole and plaice otter trawl fisheries in the eastern channel.

Investigations of the biological features of the lemon sole and plaice populations in the eastern Channel in order to estimate the importance of the high discard rates of this species in this area.

8. References

Arkley, K., M.S. Jacklin, M. Boulter, J. Tower 1996
The Cuttlefish (*Sepia officinalis*): A guide to its exploitation in UK waters.
Seafish Report No. SR467

Baldry, T., 1995
Fighting on the same side.
Western Morning News, 28th December 1995, page 6

Bedford, B.C., Woolner and B.W. Jones, 1986
Length-weight relationships for commercial fish species and conversion factors for various presentations.

Cotter, J., *et al.*, 1995
Assessment of Discarding Rates for Commercial Species.
Final Report to the Commission of the European Communities
Contract Ref; BIOECO/93/003

Dunlin, G.N. and S.G. Hepples, 1991
MAFF Funded Discard Study English NE Coast 1990-1991.
Seafish Report No. 395

Dunlin, G.N., 1993
MAFF Funded North East Coast Discard Study English Final Report 1992.
Seafish Report No. 416

Emberton, M., G.P. Course and W. Lart, 1995
Irish Sea Finfish and Nephrops Discard Study 1993/94.
Seafish Consultancy Report No. 99

Pawson, M.G., 1995
Biogeographical identification of English Channel Fish and Shellfish Stocks.
MAFF Fisheries Research Technical Report No. 99

Smith, M., W. Lart and J. Swarbrick, 1995
A Study of the Catch Composition, Effort Levels and Discard Rates in the English Set Net Fisheries during 1992/93.
Seafish Report No. 431

Tétard, A., M. Boon *et al.*, 1995
Catalogue International des Activites des Flottilles de la Manch Approch des Interactions Techniques. Brest IFREMER, 337 pp.

Interim Reports

Four Quarterly interim report were produced during this study. They are:

Course, G.P., M. Emberton and W. Lart 1995
MAFF Funded Channel Discard Study Interim Report 1st Quarter January-March 1995

Course, G.P., M. Emberton 1995
MAFF Funded Channel Discard Study Interim Report 2nd Quarter April-June 1995

Course, G.P., M. Emberton 1995
MAFF Funded Channel Discard Study Interim Report 3rd Quarter July-September 1995

Course, G.P., M. Emberton 1995
MAFF Funded Channel Discard Study Interim Report 4th Quarter October-December 1995

APPENDICES

Appendix I - Species Names and Codes

Table 58: Species codes used in tables

MAFF code	Common name(s)	Genus and species
BIB	Pout whiting (pouting)	*Gadus luscus*
BLL	Brill	*Scophthalmus rhombus*
BLR*	Blond ray	*Raja brachyura*
BSE	Bass	*Dicentrachus labrax*
COD	Cod	*Gadus morhua*
CRE	Crab - brown; mixed sexes	*Cancer pagurus*
CTL	Cuttlefish	*Sepia officinalis*
CUR*	Cuckoo ray	*Raja naevus*
DAB	Dab	*Limanda limanda*
DET*	Dragonet	*Callionymus spp*
DGH	Dogfish (Unidentified)	*Unspecified*
DGS	Spurdog	*Squalus acanthias*
FLE	Flounder (fluke)	*Platichthys flesus*
GAG	Tope	*Galeorhinus galeus*
GAR	Garfish	*Belone belone*
GUX	Gurnard & latchet	*Triglidae spp.*
HAD	Haddock	*Melanogrammus aeglefinus*
HER	Atlantic herring	*Clupea harengus*
HKE	Hake	*Merluccius merluccius*
HOM	Scad, horse mackerel	*Trachurus trachurus*
JOD	John dory	*Zeus faber*
LBD	Lobsters	*Homarus gammarus*
LEM	Lemon sole	*Microstomus kitt*
LIN	Ling	*Molva molva*
LSD	Lesser spotted dogfish	*Scyliorhinus canicula*
LUM	Lumpsucker	*Cyclopterus lumpus*
MAC	Atlantic mackerel	*Scomber scombrus*
MEG	Megrim	*Lepidorhombus whiffiagonis*
MON	Monkfish, Anglerfish	*Lophius piscatorius*
MUR	Red mullet	*Mullus surmuletus*
OCT	Octopus	*Unspecified*
PIL	Pilchards	*Sardina pilchardus*
PLE	Plaice	*Pleuronectes platessa*
POK	Saithe, coley, blackjack	*Pollachius virens*
POL	Pollack	*Pollachius pollachius*
QSC	Queen scallops	*Aquipecten opercularis*
RIB	Ribbon Fish	*Unspecified*
SBZ	Sea bream	*Pagellus spp.*
SCR	Spider crabs	*Maia squinado*
SCX	Scallops	*Pecten maximus*
SHD	Shads (Twaite & Allis)	*Alosa spp.*
SOL	Sole (Dover)	*Solea solea*
SOS	Sand sole	*Pegusa lascaris*
SPR*	Spotted ray	*Raja montagui*
SPT*	Sprats	*Sprattus sprattus*
SQC	Squid	*Loligo spp.*
STR*	Sting Ray	*Dasyatis pastinaca*
THR*	Thornback ray	*Raja clavata*
TUR	Turbot	*Scophthalmus maximus*
UNR	Undulate ray	*Raja undulata*
WHE	Whelks	*Buccinium undatum*
WHG	Whiting	*Merlangius merlangus*
WIT	Witch	*Glyptocephalus cygnoglossus*
WRA	Wrasses	*Unspecified*

* Denotes non MAFF codes

Appendix II - Between Trip Similarity

Table 59: Shows the between trip similarity matrix used in the cluster analysis

Trip No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
1	---																																					
2	85	---																																				
3	82	88	---																																			
4	74	81	80	---																																		
5	79	80	78	74	---																																	
6	75	82	76	74	76	---																																
7	70	76	77	66	73	76	---																															
8	74	79	80	73	75	77	73	---																														
9	78	88	85	76	79	75	66	76	---																													
10	76	82	80	70	73	75	66	77	76	---																												
11	72	84	81	70	74	75	62	78	74	90	---																											
12	63	66	69	56	66	61	53	64	60	56	50	---																										
13	68	73	74	66	73	70	67	78	67	67	66	51	---																									
14	75	77	78	71	77	74	70	80	77	76	77	64	71	---																								
15	81	85	80	73	75	80	72	77	76	76	76	59	72	73	---																							
16	72	78	78	68	69	73	63	72	69	66	62	52	60	72	70	---																						
18	75	82	81	70	73	76	63	74	73	69	63	51	60	74	75	75	---																					
19	77	85	82	74	74	77	72	78	80	79	79	62	69	76	83	73	76	---																				
20	72	71	72	67	71	70	67	75	71	71	70	58	67	80	68	68	68	71	---																			
21	74	74	76	67	73	71	70	77	70	68	69	59	66	82	71	69	68	74	79	---																		
22	66	71	72	61	64	67	60	69	64	67	66	49	62	70	63	60	62	66	67	64	---																	
23	64	67	69	63	63	64	57	68	64	63	64	50	60	67	62	61	64	65	64	62	76	---																
24	73	77	78	64	71	72	59	71	73	69	66	50	61	77	70	64	64	78	68	69	61	61	---															
25	77	82	82	67	75	76	65	74	77	71	69	56	64	77	75	71	74	81	71	69	62	61	74	---														
26	76	81	79	71	74	77	66	76	75	73	72	60	67	76	79	70	70	78	70	67	64	62	68	80	---													
27	78	84	82	75	75	76	68	75	80	73	72	61	64	76	77	85	97	79	72	70	66	65	73	80	78	---												
28	69	77	76	62	71	70	62	72	68	69	68	59	63	72	68	67	67	73	66	63	58	58	64	72	71	76	---											
29	74	81	83	68	71	72	65	71	73	75	73	61	65	74	72	71	73	79	67	67	67	63	72	78	79	78	83	---										
30	74	77	76	66	69	73	66	75	72	76	76	59	70	76	73	69	70	76	71	68	63	61	70	75	77	75	75	73	---									
31	78	78	81	72	77	75	72	79	77	75	75	63	72	82	74	75	74	78	76	78	65	62	77	78	75	75	69	74	72	---								
32	75	77	79	71	79	74	72	79	75	73	75	66	72	80	73	71	72	74	76	75	71	67	70	73	74	76	73	77	73	78	---							
33	82	84	81	67	81	77	68	73	80	70	69	58	66	78	78	62	68	76	70	72	60	59	71	76	73	74	67	73	70	83	73	---						
34	76	81	79	65	80	73	65	70	77	67	64	51	60	74	72	61	62	74	67	70	58	57	70	72	68	72	64	70	66	78	71	81	---					
35	81	85	82	69	81	76	67	72	82	70	69	56	63	76	76	61	63	78	69	72	60	60	73	78	71	72	68	73	69	79	72	86	92	---				
36	75	78	77	65	75	71	61	73	73	65	64	65	62	73	70	63	67	71	69	67	60	60	63	72	78	74	71	74	71	70	76	70	66	69	---			
37	76	81	79	71	72	72	66	72	78	73	70	57	62	73	73	71	74	82	69	70	62	60	70	83	78	78	70	73	74	73	72	71	66	71	73	---		
38	72	72	75	63	76	68	62	69	72	65	66	59	64	78	66	65	67	71	69	66	59	58	71	74	68	71	66	70	67	78	70	78	73	74	70	68	---	
39	66	70	72	55	66	67	55	65	61	63	59	45	56	70	65	60	57	69	66	61	58	57	56	67	66	66	58	62	65	69	68	58	53	58	60	66	63	---
Trip No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39

Note: Trip 17 was invalid so these data were not used

Appendix III - Age Length Keys For Discards

Table 60: Shows the age:length key for discarded whiting combined first three quarters of 1995

	AGE			
	1	2	3	4
LENGTH (cm)				
20-24	3	1	0	0
25-29	2	25	2	0
30-34	0	0	0	1

Table 61: Shows the age:length key for discarded plaice - combined first three quarters of 1995

	AGE		
	1	2	3
LENGTH (cm)			
15-19	2	12	3
20-24	6	16	7
25-29	0	2	0
25-30	0	0	1