Fisheries Science Partnership: 20010/11

Final Report

Thames Sole Selectivity

MFV “Harvester” (CK137) skippered by Clive Mills sailing from West Mersea

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Cefas

Executive Summary

This work was part of the UK's Fisheries Science Partnership (FSP). Trawlermen working in the Thames Estuary in the southern North Sea had suggested that square-mesh panels fitted to the underside of trawls used to catch Dover sole could reduce the catch and hence the discarding of unwanted benthos (e.g. urchins, crabs and starfish). A trawl was modified to incorporate a square-mesh section and was tested against a standard trawl on the MFV "Harvester".

In September 2010, 34 hauls were conducted and the catches were sampled by Cefas scientists. Two experiments were conducted with the square-mesh panel in two different positions.

A trawl fitted with a square-mesh panel near the footrope was the most successful design. It reduced the catch of unwanted benthos by 21% by volume, including 37% less volume of starfish, 27% less urchins and 23% less algae compared with a standard trawl. This design did not lose any marketable Dover sole, but caught significantly fewer Dover sole below the legal minimum landing size.

The skipper has now adopted this design and is currently using it during commercial fishing.

The Fisheries Science Partnership

The Fisheries Science Partnership (FSP) is a Defra-funded collaborative programme of scientific research between the UK fishing industry and scientists. Since it was established in 2003, the programme has undertaken more than 80 projects, including investigations into fishing gear selectivity, the examination of spatial patterns and catch compositions, and constructing time-series of relative abundance of commercial species. A full description of the development, aims and reports of the FSP programme can be found on the Cefas website (www.cefas.co.uk).

Figure 1 Dover Sole; (*Solea solea*); Cefas code SOL

Dover Sole

Dover Sole (Figure 1) are found all around the British Isles, mainly on sandy and muddy grounds from 10 to 100 m deep. Typically feeding on small crustaceans, worms and molluscs, they can grow up to 60 cm long and weigh 3 kg. Sole are caught mainly in trawls, but also in set nets. The EU adopted a management plan for flatfish in the North Sea in June 2007. This includes an annual 10% reduction of fishing mortality in relation to the fishing mortality estimated for the preceding year until a target level of fishing mortality is reached, with a maximum change in TAC of 15% per year (www.ices.dk/committe/acom/comwork/report/2010/2010/sol-nsea.pdf).

Introduction

Sole are caught with a variety of commercial gears in the North Sea. Otter trawlers working in the Thames Estuary, in the southern North Sea, use codends with a mesh size of 80 mm to target the species. However, when using meshes of this size, other unwanted species, notably starfish, urchins and crabs, can be caught and are discarded. The close contact of the trawl with the seabed required to catch sole means that occasional large quantities of unwanted organisms can be taken. In some fisheries, the use of trawls has been shown to reduce benthic production. Also, the capture of these unwanted species increases the sorting time on board and can affect the quality of the landed fish.

Figure 2 MFV “Harvester”, LOA 9.96 m, GT 16.08 t, main engine 112 kW

In recognition of these negative effects, local trawlermen suggested that square-mesh panels fitted to the underside of the net could reduce the capture of unwanted species while retaining marketable sole. The view was that this would improve sorting efficiency and catch quality, as well as having a positive environmental effect. MFV “Harvester” (Figure 2), a trawler engaged in this sole fishery, undertook trials to evaluate the selective properties of square-mesh panels for sole catches and discards of benthic species.

Methods

The gear

The fishing gear normally used by the “Harvester” in this fishery is a twin-rig trawl. In one of the two rigs the trawl was modified with the insertion of a square-mesh panel. The other rig remained as it would normally be used commercially, and the two trawls were fished simultaneously. The two rigs were otherwise the same (Appendix 2), including a double groundrope consisting of rubber discs linked by 20 cm of chain.

Two positions of square-mesh panel were tested. First, a square-mesh panel was positioned in front of the codend. The panel was 3 m long (Figures 3 and 4). For the second part of the trials, a square-mesh panel was positioned 0.5 m behind the footrope. That panel was 2.4 m wide and 2 m long (Figures 3 and 5). For both experimental panels, conventional 120 mm diamond-mesh PPE netting was used and turned to orientate the meshes into a square shape. The panels were fitted using a 2:1 ratio.

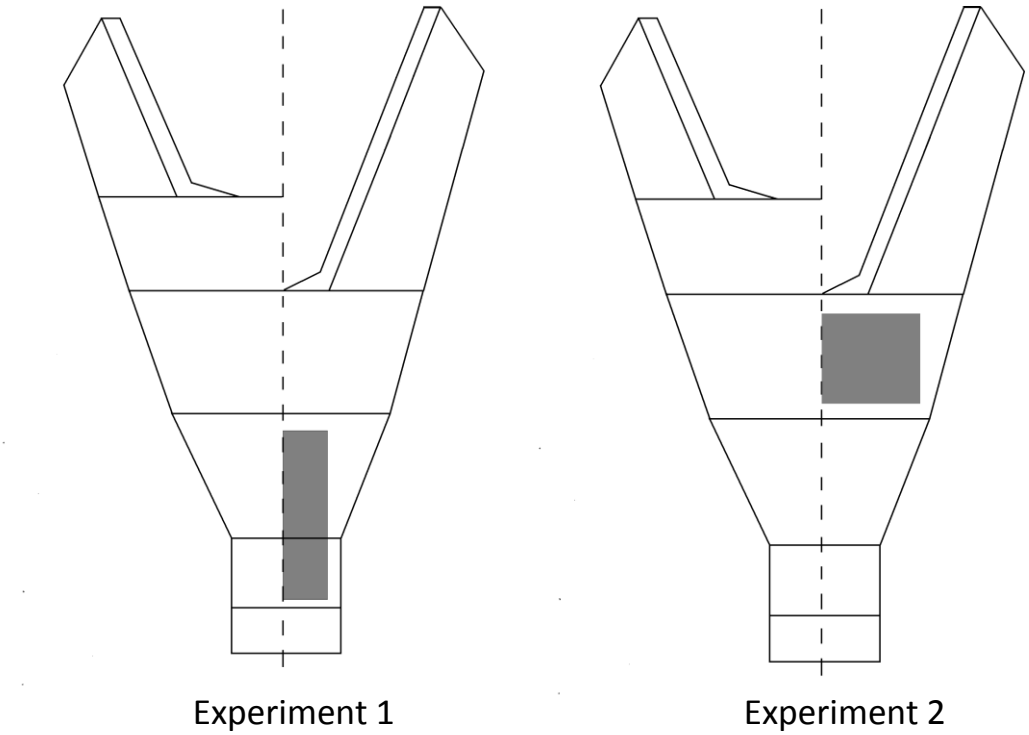


Figure 3 The two positions tested for the square-mesh panel on the underside of the trawl.

Figure 4 Position and fitting of the square-mesh panel for experiment 1, constructed of 120 mm diamond-mesh PPE

Figure 5 Position and fitting of the square-mesh panel for experiment 2, constructed of 120 mm diamond-mesh PPE

Sampling plan

The trials took place in September 2010, over 10 days. One of the two trawls in the twin-rig trawl had a square-mesh panel inserted. The experimental and standard rigs were swapped periodically from the port to the starboard side to ensure that there was no side bias. The hauls were conducted in areas normally fished by the vessel. All hauls took place during daylight, and were of normal commercial duration. For the first five days, the panel was in position near the codend (experiment 1; Figure 3).

A preliminary analysis of the data indicated that some of the unwanted organisms could have been escaping through the panel in this position, but so too were marketable sole. It was evident that the mesh size needed to be increased to allow more of the benthos to escape, but increasing the mesh size would mean a greater loss of marketable sole. It was agreed to change the position of the panel but to keep the mesh size of the panel at 120 mm. For the second five-day experiment, the panel was positioned near the footrope (experiment 2; Figure 3).

Information on the time, position and duration of hauls is given in Appendix 3. Cefas scientists measured the lengths of all fish species caught in each haul from each rig separately. The total volume and percentage composition (by volume) of the main components of the benthos was recorded.

Results

In all, 34 hauls were conducted between 20 September and 1 October (Appendix 2); 16 hauls with the square-mesh panel near the codend (experiment 1) and 18 hauls with the panel near the footrope (experiment 2). More details of the results are given in Appendices 4–8, but the main findings are summarised in the sections below.

Dover sole

Experiment 1

The standard trawl caught 540 sole compared with the 389 in the experimental trawl which had a square-mesh panel near the codend. There was therefore an average reduction of 20% in total numbers of sole caught per haul. On average, the experimental trawl caught 6% fewer sole above the minimum landing size (24 cm) per haul and significantly fewer fish <29 cm than the standard trawl.

Experiment 2

The standard trawl caught 484 sole compared with the 416 in the experimental trawl which had a square-mesh panel near the footrope. There was an average increase of 1% in total numbers of sole caught per haul. The experimental trawl caught 10% more marketable sole per haul and significantly fewer fish <24 cm.

Benthos

Experiment 1

The standard trawl caught on average 3.7 baskets of benthos each haul (~90 kg). There was therefore an average 13% reduction per haul in the volume of benthos caught with the square-mesh panel near the codend. The benthos was made up mainly of urchins, starfish, algae and dead oyster shells. Overall, the experimental trawl caught 28% less starfish and 47% less urchins.

Experiment 2

The standard trawl caught on average 4 baskets of benthos each haul (~100 kg). There was an average 21% reduction per haul in the volume of benthos caught with the square-mesh panel near the footrope. Overall, the experimental trawl caught 37% less starfish, 27% less urchins and 23% less algae.

Conclusions

- The standard trawl (one rig) caught on average 22 marketable Dover sole per haul and around 100 kg of benthos (mainly starfish, urchins, algae and shells).

- An experimental trawl fitted with a square-mesh panel near the codend reduced the catch of unwanted benthos by 13% overall by volume but also caught significantly fewer marketable sole <29 cm than the standard trawl.

- A second experimental trawl fitted with a square-mesh panel near the footrope reduced the catch of unwanted benthos by 21% overall by volume and did not lose any marketable Dover sole.

- The square-mesh panel fitted near the footrope significantly reduced discards by catching fewer Dover sole below the minimum landing size and also 37% less starfish, 27% less urchins and 23% less algae (by volume) than the standard trawl.

- The skipper has adopted the design of the square-mesh panel near the footrope and is currently using it during commercial fishing in both rigs.

Acknowledgements

The success of this work was due to the enthusiastic collaboration of a highly skilled team of people. We thank Clive Mills, the skipper and owner of the “Harvester”, and the crew, Nigel and Dean. Thanks are also due to Mike Montgomerie of Seafish and Nigel for their advice with the gear technology.

Industry feedback

Comments if warranted to be provided by Clive Mills

Appendix 1 Detailed operations plan

Thames Trawl Selectivity: September-November 2010

Detailed Operation Plan (02/08/2010)

VESSEL

Harvester

SKIPPER
Clive Mills

PROJECT MANAGER
Tom Catchpole

OBJECTIVES
The project will evaluate escape panels designed to reduce the capture of unwanted fish and benthos during normal commercial fishing practice in a trawl fishery in the Thames Estuary.

FISHING GEAR
The fishing gear used will be a twin-rigged otter trawl with an 80mm mesh codend. The two rigs will be identical as far as possible. An escape panel will be fitted to the belly of one of the rigs. The panel will be 120mm mesh size and will be orientated so the meshes adopt a square shape. The panel will be 2-3m in length and will be fitted 2-3m from the codend. Other panels of different mesh sizes (100/140mm) may be used during the trials depending on the initial results. The panels will be fitted by Clive Mills prior to the first day of the trials; Tom Catchpole will be in attendance. The rigs will be swapped over after every day of the trails. Trawl plans of the gear used will be submitted to Cefas.

AREA AND PERIOD OF OPERATION
The work will cover a total of 10 days during the period 15/09/10 to the 30/11/10. The first 5 days are scheduled for the 20-24/09/10 and the second from 27/09/10 to 01/10/10. The vessel will sail from West Mersea. The area of operation will be within ICES division IVc, the Thames Estuary, mainly in the waters of the Kent and Essex Sea Fisheries Committee. There are no pre-planned transects selected. The areas fished will be based on skipper's experience.

FISHING ACTIVITIES
The vessel will depart daily and complete 3-4 tows per day which should reflect normal fishing practice. After an initial evaluation of the escape panel underwater video footage of the panel will be shot. This will be dependent of whether a suitable location can be found to do the filming.

SORTING AND RECORDING THE CATCH
The crew will be required to assist in sorting the catch as required by the observer and preparing any fish for sale. Standard Cefas methods for sorting and measuring

commercial fish catches at sea will be carried out. The entire catch should be available to the observer for sampling, and none discarded without being recorded.

DATA TO BE RECORDED BY SKIPPER
The observer will provide recording sheets on which the skipper will record the following details for each tow:
Date
Tow number
Shooting and hauling times
Shooting and hauling positions (latitude and longitude)
Time and position at any significant change in tow direction
Other relevant information (e.g. tidal state, weather conditions)

The skipper should provide full details of the gear and rigging.

Under the dispensation requirements, the skipper should also keep log books in the usual way. All pages relating to the FSP trip should be annotated "Cefas FSP Thames Trawl Selectivity Survey". Copies of the logbook sheets and sales notes relating to the survey should be forwarded to Tom Catchpole as soon after the trip as possible.

DATA TO BE RECORDED BY SCIENTISTS
The observer must ensure that all catch composition, length frequencies and raising factors are fully and correctly entered on the recording sheets, and that all bridge log sheets are collated at the end of each sampling day. Any significant deviations from the survey plan should be reported to Tom Catchpole by the scientist.

Signed:

…….. (Skipper) …….(date)

……(CEFAS) …….(date)

Appendix 2 Specification of trawl used in the gear trials

Table 1 Specification of trawls

Trawl specification	
Fishing line length (each rig)	13m
Ground rope length (each rig)	11m
Rubber disc width	8cm
Net length	5.5m
Door spread (estimated)	17m
Wing-end spread (rigs combined)	14m

Appendix 3 The number duration and position of hauls

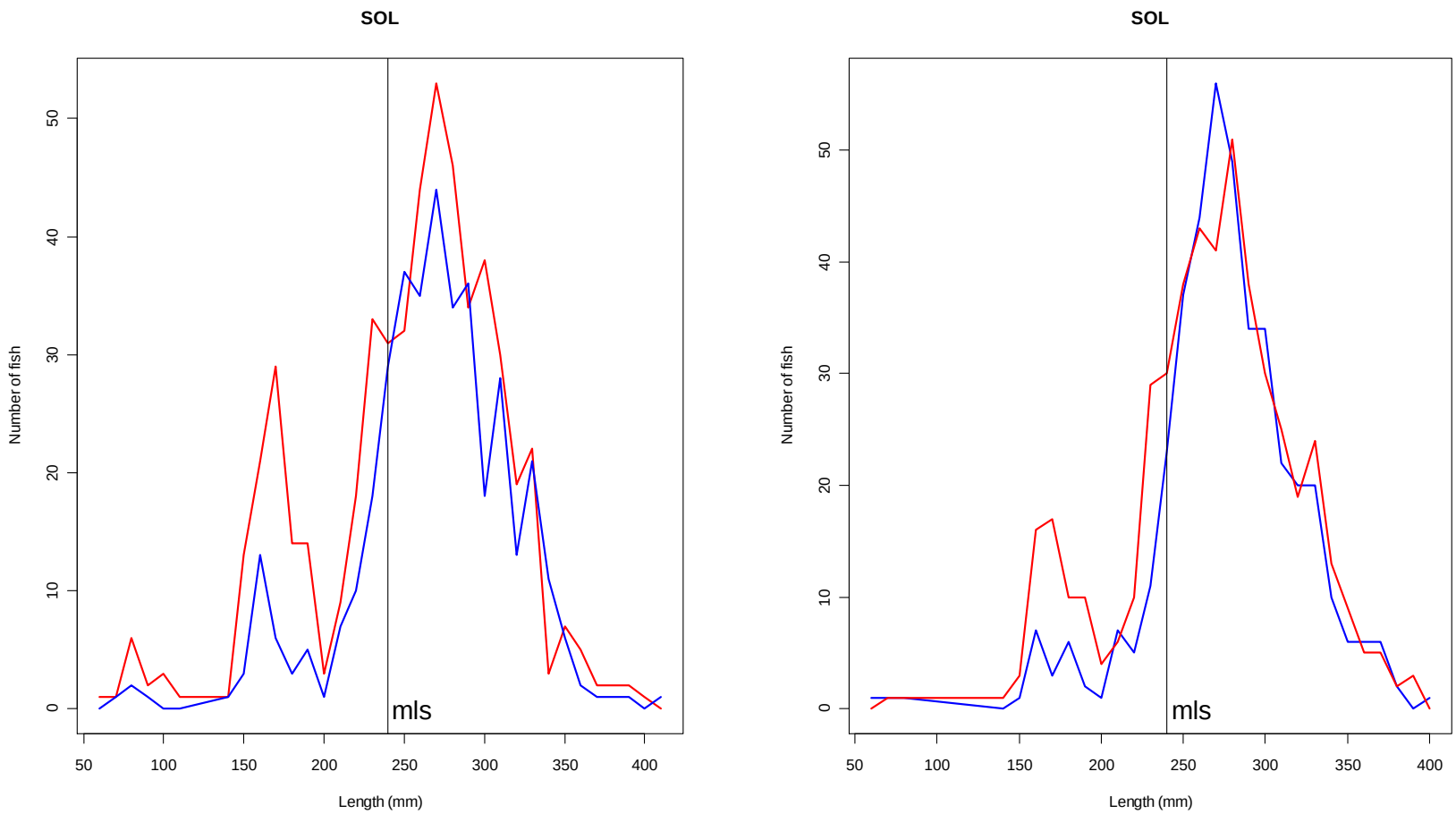
Haul number	Experiment	Shot date	Shot time	Depth	Latitude (N)	Longitude (E)	Tow duration
1	1	20-Sep-10	09:45	8	51 ' 44 "	1 ' 8 "	1.08
2	1	20-Sep-10	11:10	12	51 ' 44 "	1 ' 10 "	1.5
3	1	20-Sep-10	13:15	16	51 ' 44 "	1 ' 11 "	1.5
4	1	20-Sep-10	15:20	12	51 ' 44 "	1 ' 11 "	0.92
5	1	21-Sep-10	09:30	7	51 ' 43 "	1 ' 5 "	1.5
6	1	21-Sep-10	11:10	11	51 ' 44 "	1 ' 9 "	0.83
7	1	21-Sep-10	12:45	17	51 ' 43 "	1 ' 15 "	1.42
8	1	21-Sep-10	15:00	8	51 ' 43 "	1 ' 8 "	1
9	1	22-Sep-10	15:25	9	51 ' 45 "	1 ' 12 "	1.5
10	1	23-Sep-10	09:45	12	51 ' 43 "	1 ' 7 "	1.5
11	1	23-Sep-10	11:30	12	51 ' 44 "	1 ' 10 "	1.5
12	1	23-Sep-10	13:15	14	51 ' 45 "	1 ' 11 "	1.5
13	1	23-Sep-10	15:05	12	51 ' 44 "	1 ' 11 "	1.5
14	1	24-Sep-10	09:00	10	51 ' 44 "	1 ' 0 "	1.33
15	1	24-Sep-10	10:35	9	51 ' 44 "	1 ' 3 "	1
16	1	24-Sep-10	12:20	9	51 ' 44 "	1 ' 2 "	1.5
17	2	27-Sep-10	09:30	5	51 ' 43 "	1 ' 6 "	1.25
18	2	27-Sep-10	11:00	10	51 ' 44 "	1 ' 8 "	1.42
19	2	27-Sep-10	12:40	12	51 ' 45 "	1 ' 12 "	1.42
20	2	27-Sep-10	14:25	11	51 ' 47 "	1 ' 14 "	1.33
21	2	28-Sep-10	09:30	8	51 ' 44 "	1 ' 9 "	1.42
22	2	28-Sep-10	13:35	12	51 ' 43 "	1 ' 7 "	1.58
23	2	28-Sep-10	15:20	14	51 ' 45 "	1 ' 11 "	1.42
24	2	28-Sep-10	17:15	7	51 ' 44 "	1 ' 6 "	1.5
25	2	29-Sep-10	09:25	10	51 ' 44 "	1 ' 11 "	1.5
26	2	29-Sep-10	11:05	11	51 ' 43 "	1 ' 9 "	1.58
27	2	29-Sep-10	13:15	6	51 ' 43 "	1 ' 6 "	1.58
28	2	29-Sep-10	15:15	7	51 ' 44 "	1 ' 7 "	1
29	2	29-Sep-10	16:30	10	51 ' 43 "	1 ' 3 "	1.08
30	2	30-Sep-10	09:35	11	51 ' 44 "	1 ' 11 "	1.5
31	2	30-Sep-10	11:10	11	51 ' 44 "	1 ' 11 "	1.33
32	2	30-Sep-10	12:45	9	51 ' 45 "	1 ' 11 "	1.5
33	2	30-Sep-10	14:30	12	51 ' 46 "	1 ' 14 "	1.5
34	2	30-Sep-10	16:45	10	51 ' 44 "	1 ' 8 "	0.92

Appendix 4 The number of fish caught of each species in each rig for each experiment

Experiment	SPECIES	Experimental trawl	Standard trawl
1	WHITING-POUT (BIB)	75	34
	COD	10	11
	EDIBLE CRAB	5	9
	DAB	9	3
	EUROPEAN SEABASS	1	
	FLOUNDER (EUROPEAN)	155	191
	GOBY	1	1
	HORSE-MACKEREL (SCAD)	1	
	LOBSTER	1	3
	LESSER SPOTTED DOGFISH	12	7
	EUROPEAN PLAICE	8	10
	POGGE	3	2
	SOLE (DOVER SOLE)	389	540
	SEA SNAIL		1
	THORNBACK RAY (ROKER)	53	52
	TUB GURNARD	12	2
	WHITING	116	48
2	WHITING-POUT (BIB)	68	44
	COD	15	18
	EDIBLE CRAB	22	10
	DAB	10	6
	FLOUNDER (EUROPEAN)	210	246
	HORSE-MACKEREL (SCAD)	2	
	LOBSTER	4	4
	LEMON SOLE	1	3
	LESSER SPOTTED DOGFISH	10	13
	EUROPEAN PLAICE	5	7
	POGGE	4	
	SOLE (DOVER SOLE)	416	484
	SEA SNAIL		1
	THORNBACK RAY (ROKER)	161	123
	TUB GURNARD	14	11
	WHITING	117	65

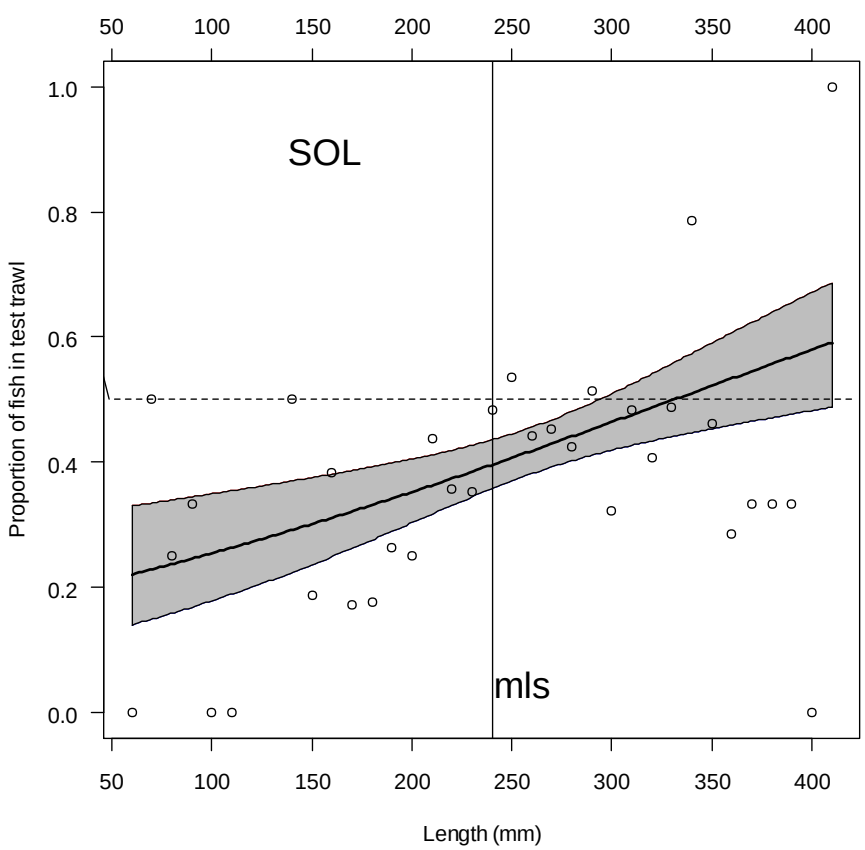
Appendix 5 List of non-fish species caught during gear trials

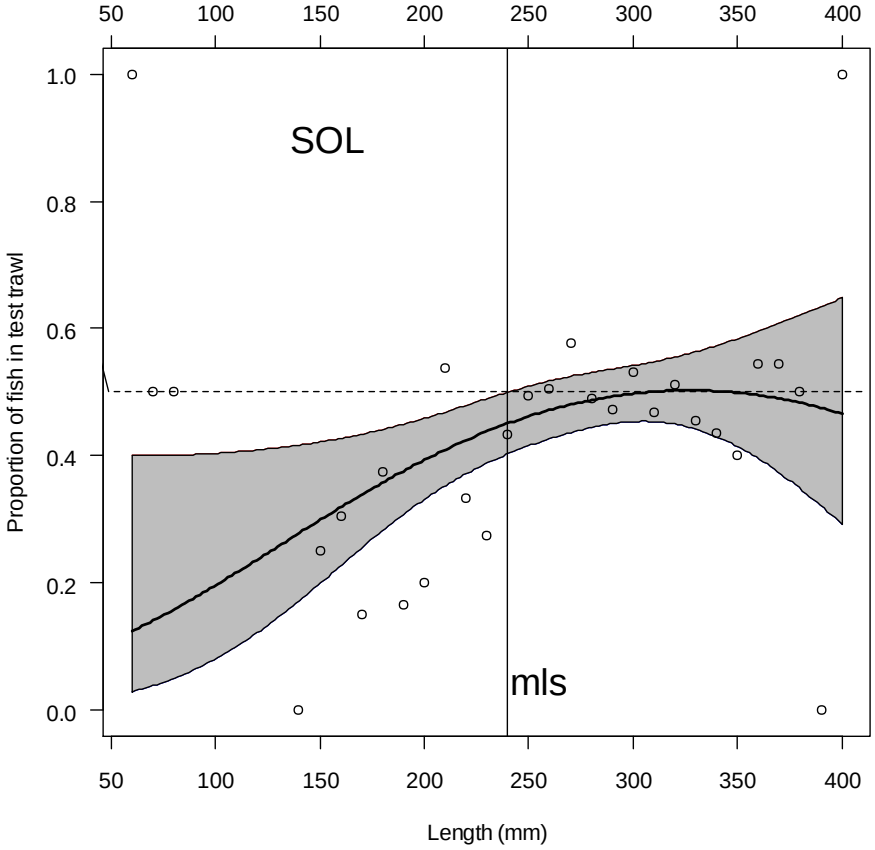
Species	Common name
Macropodia rostrata	Spider crab
Asterias rubens	Starfish
Carcinus maenas	Shore crab
Liocarcinus depurator	Swimming crab
Pagarus berhardus	Hermit crab
Buccinum undatum	Whelk
Psammechinus miliaris	Urchin
Echinocardium cordatum	Sea potato
Mytilus edulis	Mussel
Flustra foliacea	Hornwrack
Actinia fragacea	Strawberry anemone
Ophiuroids	Brittle stars
Crangon crangon	Brown shrimp
Slipper limpet	Crepidula fornicata
Polycheates	Bristleworms
Trivia monacha	European cowrie
Palaemon spp	Pink shrimp
Aurelia spp	Jellyfish
Aphrodite acculeata	Sea mouse
Algae	Seaweed various
Ostrea edulis shells	Oyster shells
Buccinum undatum eggs	Whelk eggs



Appendix 6 Numbers of Dover sole caught at length.

The standard rig (red) and experimental rig (blue) in experiment 1 (left) and experiment 2(right)





Appendix 7 Results from the catch comparison analysis for Dover sole.

Where the grey band drops below the horizontal dashed line (0.5) fewer fish are caught in the experimental trawl at those lengths (i.e. fewer sole were caught below 29cm in experiment 1 and below 24cm in experiment 2)

Appendix 8 Photos demonstrating benthos caught with standard trawl (left) against benthos caught with square-mesh panel near to footrope (right).