

Final Report

Bristol Channel Selectivity Trials

Prepared by

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The MFV “Our Josie Grace” skippered by Marcus White

Image courtesy Andrew Shaw

February 2011

Executive Summary

This work was carried out as part of the Fisheries Science Partnership (FSP), a Defra-funded collaborative programme of scientific research between the UK fishing industry and scientists.

Local trawlermen working in the Bristol Channel in a mixed demersal fishery wanted to know whether an increase in codend mesh size would be effective in reducing the levels of discards, and whether its use would result in the loss of marketable fish.

A 100 mm codend was fitted to one of a pair of twin-rigged otter trawls and was tested simultaneously against the 80-mm control codend on the other identical net on board the MFV “Our Josie Grace”. Between July and October 2010, 29 hauls were conducted. With the use of the larger mesh, discard rates dropped by 31% across all species, by up to 100% for some species. There was a 40% reduction in the retained part of the catch across all species, with reductions of up to 78% of some species.



Image 1. The catch from the control trawl.



Image 2. The catch from the test codend.

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The Fishery Science Partnership

The Fishery Science Partnership (FSP) is a Defra-funded programme of scientific research conducted in collaboration between the UK fishing industry and scientists.

Since it was established in 2003, the programme has undertaken numerous projects including fishing gear selectivity trials, examinations of spatial patterns and catch compositions, investigations into potential new fisheries and 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).

Introduction

The Bristol Channel demersal trawl fishery is categorised as a mixed fishery, with more than one species being targeted. The fishery mainly targets ray, but sole and bass are also targeted at certain times. At other times, a general mix of species, both flatfish and roundfish are targeted. According to local fishermen, the catch rates of these species can change considerably with area and time.



Image 3. A mixed haul of fish in the control codend.

Local trawlermen are keen to improve their environmental credentials, and were interested to know whether an increase in codend mesh size from the minimum 80 mm to 100 mm could reduce the levels of discarded fish and what the potential losses of marketable fish would be. The view of the local industry was that if smaller fish were able to escape from the trawl and hence not discarded, this would have a positive effect on local stocks. The concern from the industry, however, was that too many marketable fish would be lost, rendering their business non-viable. The twin rig trawler “Our Josie Grace” undertook trials to evaluate the selectivity of 100 mm codends relative to 80 mm codends for commercial and non commercial species in the Bristol Channel demersal trawl fishery.

Methods

The gear

The gear used for the trials was a pair of twin-rig box trawls with 18 m footropes, rigged on 10 and 12 inch rockhoppers. The trawls were coupled to 15 fathom split bridles which in turn were attached to a short length of sweep (~5 fathoms). A set of A1, 6 foot otterboards were used to spread the trawls.

New codends were used in the trial for both the 80 mm control codends and the 100 mm test codends. Both the test and control codends were constructed of 4 mm diameter polyethylene twine and were of a standard length of 100 meshes. To keep the cut-offs at the same length, the cut-off rope was placed 30 meshes from the last round on the test codend and 36 meshes from the last round on the control codend. The mesh sizes of the codends were checked with the Omega net-measuring gauge.

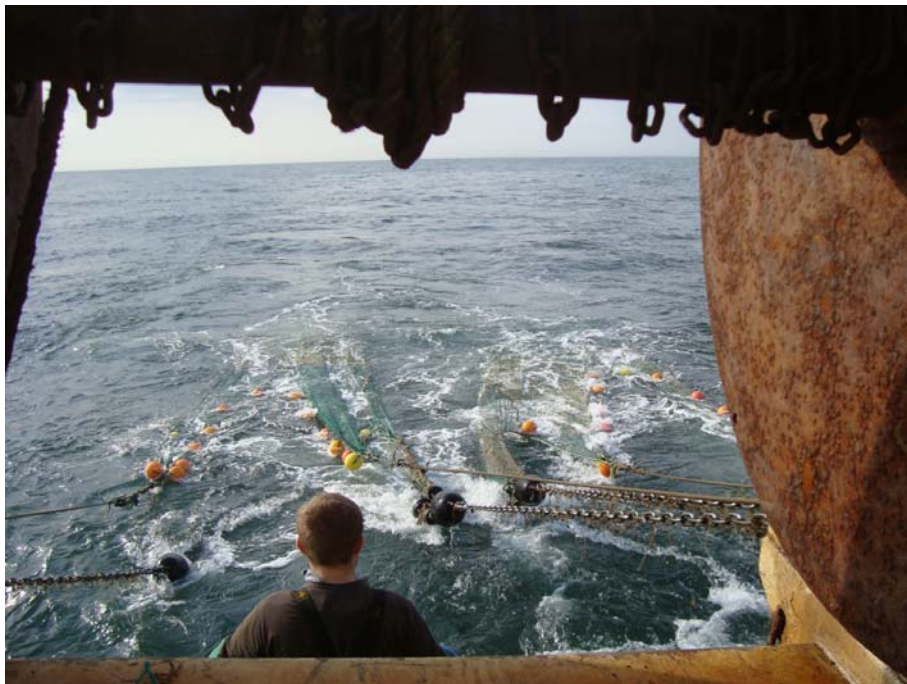


Image 4. The test and control nets being deployed.

Sampling plan

To account for seasonal variability in the catch, the fishing trials took place over a period of four months, between July and October 2010. Four trips of 1.5–3 days each were conducted.

The trials followed the vessel's normal fishing pattern and were carried out in both daylight and darkness. Haul duration was kept at 4 h where possible, to simulate normal fishing patterns.

Hauls were conducted off the North Devon coast, including Bideford Bay, West of Lundy, and in the North and South Bristol Channel.

The 80 mm and 100 mm codends were fished simultaneously side-by-side on the twin-rig trawls. Cefas scientific staff measured the lengths of all the fish caught in each haul, with the catch from each codend measured separately. The crew sorted the catch as they would normally do, and the retained fraction and discard fraction were sampled separately. When catch volumes were high, a known fraction was measured (i.e. the catch was sub sampled) and raised to provide an estimate for the haul.

Statistical analysis

Total numbers and weights discarded and retained for each species were compared between the 80 mm and 100 mm codends. The total numbers caught at each length for each species were compared between the 80 mm and 100 mm codends.

The R programming environment was used to perform a catch comparison analysis, using the method of Holst and Revill (2009).

Results

For the 29 hauls conducted between July and October, a total of 51 species were caught. A full species list along with Cefas three-letter codes can be found in Appendix 1. Of these, 14 species had little or no commercial value. Further, small grades of plaice, dab, whiting, and lemon sole were not retained because the processor was not able to accept them. The species that made up the greatest numbers of the landed component were lesser spotted dogfish. This was followed by the ray species, blonde, thornback and painted (small-eyed), starry smooth hound, gurnards, sole and plaice. The discarded component consisted mainly of dab, bib, whiting, lemon sole and ray (also see Appendix 2).

Discards

Discards dropped by 31% by number when using the 100 mm codend compared with the 80 mm codend. In the test trawl, they reduced by between 6% and 100%, with 100% changes in sole, lesser spotted dogfish, squid, starry smooth hounds, bass and gurnards. The species making up most of the discards by number were dab, plaice, lemon sole and rays (Table 1).

Species	CONTROL		TEST		% change	% change
	Discarded	Retained	Discard	Retained	Discards	Retained
SOLE	4	496	0	107	-100.0	78.4
LESSER SPOTTED DOGFISH	34	7495	0	1720	-100.0	-77.0
GREY GURNARD	75	326	1	161	-98.7	-50.6
BASS	2	112	0	54	-100.0	-51.8
SQUID	0	218	0	117	0.0	-46.3
STARRY SMOOTH HOUND	28	565	0	352	-100.0	-37.7
TUB GURNARD	26	198	1	134	-96.1	-32.3
PLAICE	336	225	221	297	-34.1	32.0
RED GURNARD	3	259	0	221	-100.0	-14.7
BLOND RAY	438	372	319	329	-27.2	-11.4
THORNBACK RAY	579	359	493	332	-14.9	-7.5
SPOTTED RAY	87	93	93	88	6.5	-5.4
SMALL EYED RAY	110	288	104	292	-5.5	1.5
DAB	4604	0	794	0	-82.8	0
LEMON SOLE	279	73	45	113	-83.9	54.8

Table 1. Top 15 species sampled ranked by percentage change.

The lack of market opportunities meant that all dab and bib were discarded. Most lesser spotted dogfish were retained when they were >47 cm. Sole discards were reduced to zero with the larger mesh, as were bass and red gurnard. Lemon sole discards were reduced in number by 84%, dab by 83%, plaice by 34%, and tub gurnard by 96%.

Retained

There was an overall 40% reduction in the retained part of the catch. For example, the largest reduction in the number of retained fish in the test codend was for sole (78% reduction), followed by lesser spotted dogfish at 77%, which although in most UK waters has little value, the local vessels land as pot-bait. There was a 46% reduction of retained squid in the test codend. Plaice and lemon sole were the only two species that saw significant rises in retention rates, lemon sole by 54% and plaice by 32%.

The graphics below show the total numbers caught at each length in the 80 mm and 100 mm codends. Ray species showed similar catch numbers at length between the two codends, i.e. smaller rays were not able to escape from the 100 mm codend. In contrast, the 100 mm codends caught fewer small sole and lemon sole and gurnard. Length frequency plots for the most abundant species are provided in Appendix 3.

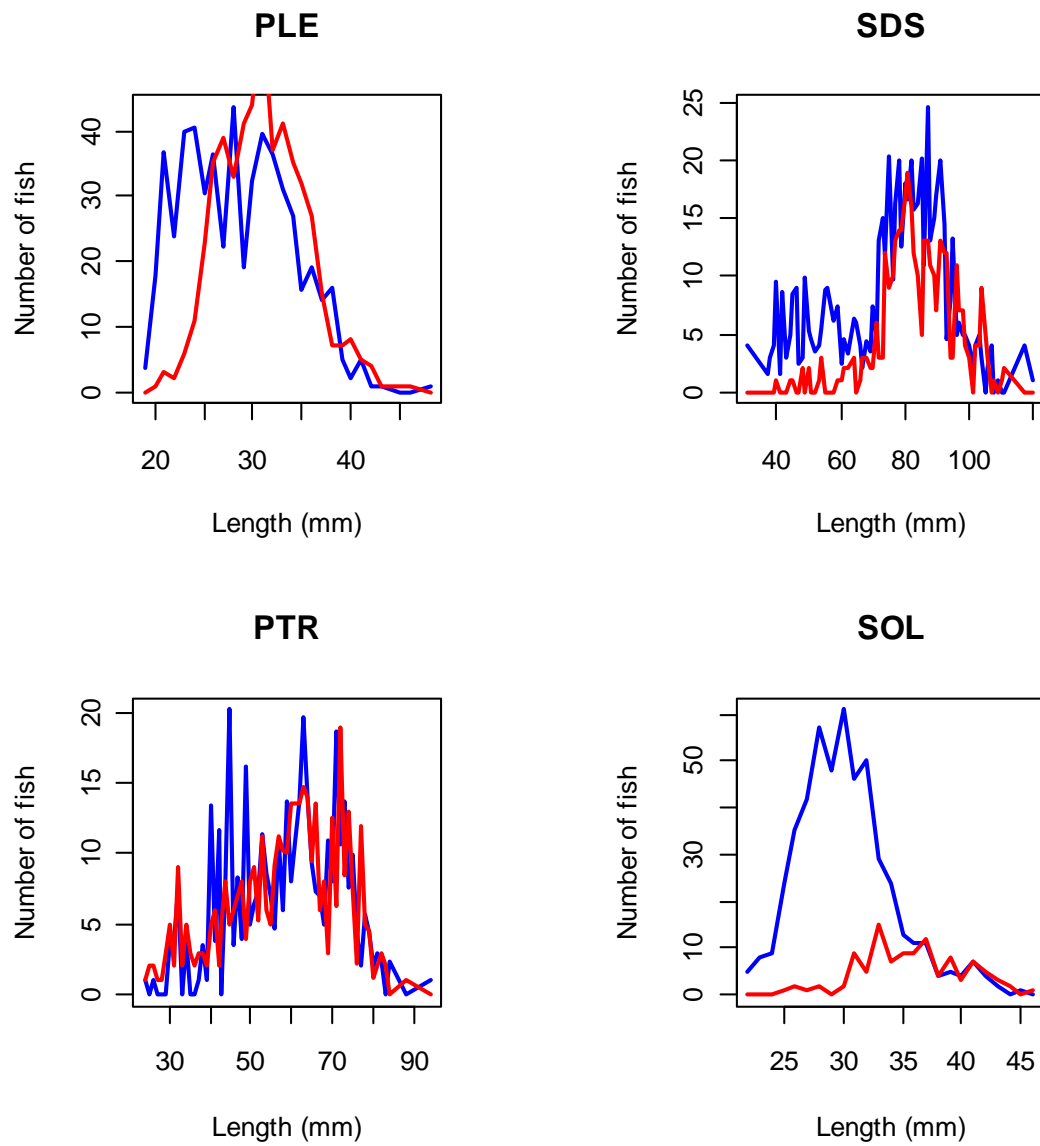


Figure 1. Numbers at length from the control codend (blue) and the test codend (red) for plaice PLE, starry smooth hound SDS, painted ray PTR and sole SOL.

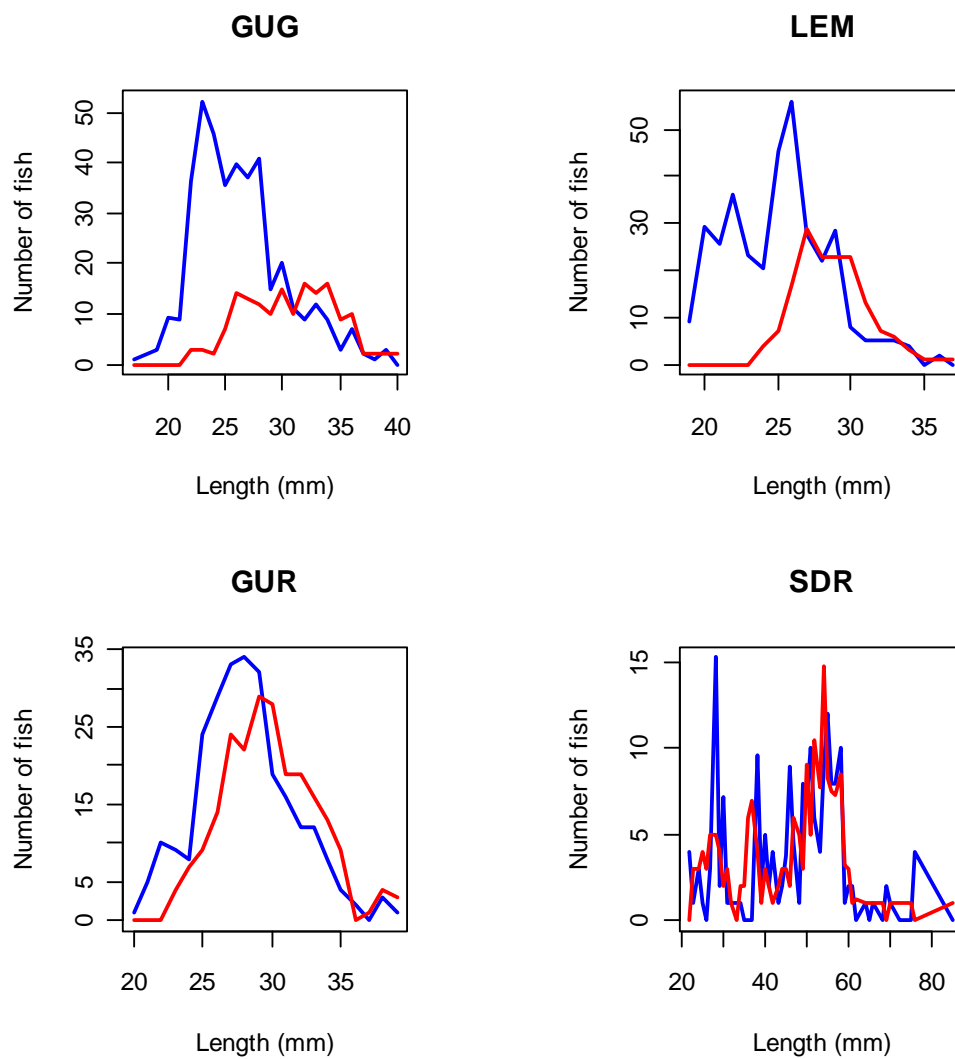


Figure 2. Numbers at length from the control codend (blue) and the test codend (red) for grey gurnard GUG, lemon sole LEM, red gurnard GUR and spotted ray SDR

Catch comparison

Figure 3 below is a graphic representation of a General Linear Mixed model as used in catch comparison trials in the North Sea, and shows the proportions caught in the test codend, for lesser spotted dogfish, dab, blonde ray and thornback ray. The horizontal line bisecting 0.5 shows the length at which the fish make up 50% of the catch (in both codends), indicating that at that length the codends would be catching the same. Below the line, the test codend catches less, and above the line, more. The grey shading is the 95% confidence limit. Therefore, for lesser spotted dogfish for example, the test codend catches less fish at length than the control below 58 cm. For dab, the test codend retains less fish <27 cm than the control. For blond and thornback rays, fish across a wide length range are retained by both the test and control nets. Graphs for the main species caught are provided in Appendix 4. Overall the analysis demonstrates that the reduction in capture of smaller fish in the 100 mm test codend meant that fewer fish were discarded.

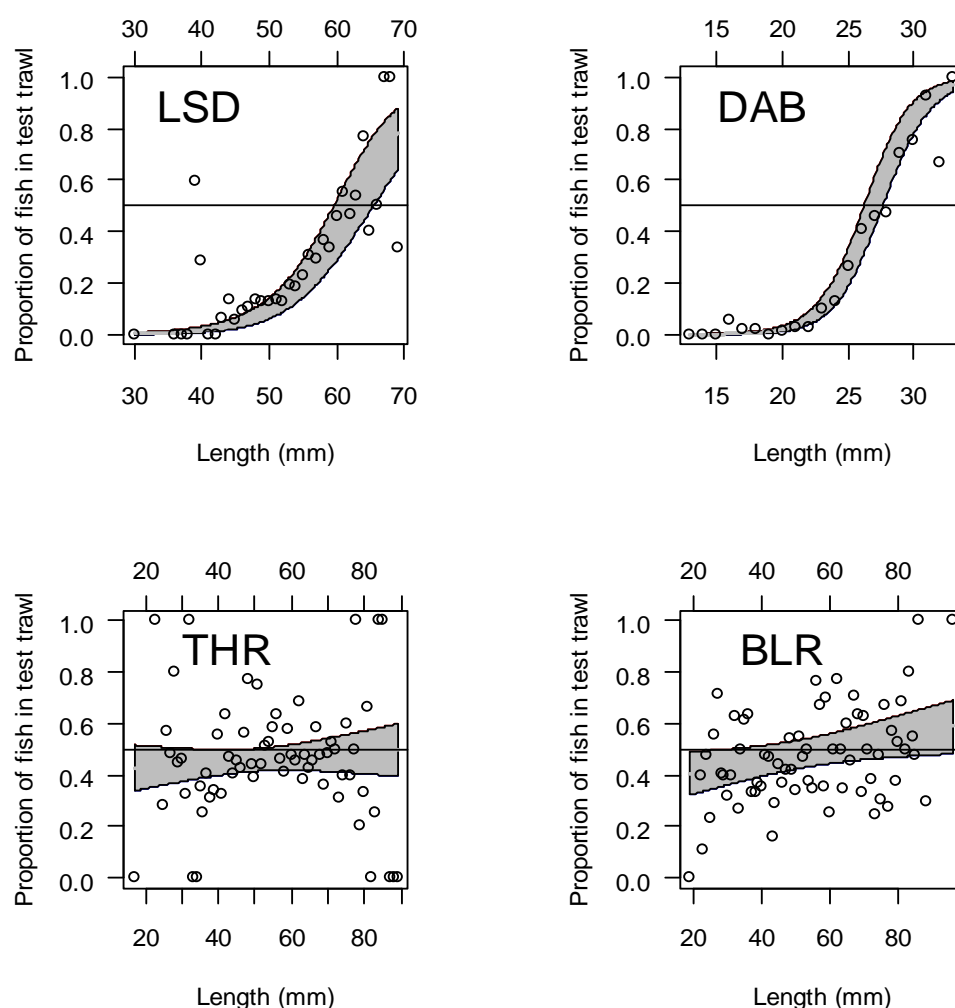


Figure 3. GLMM for the proportion of fish caught in the test codend for lesser spotted dogfish LSD, dab, thornback ray THR and blonde ray BLR.

Conclusions

- The species that were retained included lesser spotted dogfish, rays, gurnard, sole and plaice
- The species most discarded by number were dab, plaice, lemon sole and ray.
- Overall, there was a 31% reduction in discarded catches by number when using the larger mesh.
- Overall, there was a 40% reduction by number in retained catches when using the larger mesh.
- Species demonstrating the most notable change in discards by number were sole, lesser spotted dogfish, bass, squid, starry smooth hound, and gurnard.
- Species demonstrating the most notable change in retention by number were sole, lesser spotted dogfish, bass, squid and grey gurnard.
- If ray species make up most of the retained component, this study would indicate that a move to 100mm mesh size would have little effect on the numbers of fish retained or discarded.
- The move to 100mm mesh would result in significant losses of marketable size sole (78%), squid (46%), and lesser spotted dogfish (77%).

Reference

Holst, R., and Revill, A. 2009. A simple statistical model for catch comparison studies. *Fisheries Research*, 95: 254–259.

Acknowledgements

The success of this work was made possible by the enthusiastic collaboration of all those involved. We thank Marcus White, skipper of “Our Josie Grace”, crewmen Gavin and Andy, and Scott Wharton, the owner. Thanks are also due to Sam Smith and Simon Armstrong, the Cefas scientific observers, and Clive Palfrey of the Net Loft.

Appendix 1

Species caught during the trials.

CODE	SPECIES	Common name
ATS	<i>Alloteuthis subulata</i>	SQUID (<i>Alloteuthis</i> spp)
BIB	<i>Trisopterus luscus</i>	BIB/POUT
BLL	<i>Scophthalmus rhombus</i>	BRILL
BKS	<i>Spondyllosoma cantharus</i>	BLACK SEA BREAM
CDT	<i>Callionymus lyra</i>	COMMON DRAGONET
COD	<i>Gadus morhua</i>	COD
COE	<i>Conger conger</i>	CONGER EEL
CRE	<i>Cancer pagurus</i>	EDIBLE CRAB
CTC	<i>Sepia officinalis</i>	CUTTLEFISH
CUR	<i>Raja naevus</i>	CUCKOO RAY
DAB	<i>Limanda limanda</i>	DAB
DGN	<i>Scyliorhinus stellaris</i>	GREATER SPOTTED DOGFISH
ESB	<i>Dicentrarchus labrax</i>	BASS
GAG	<i>Galeorhinus galeus</i>	TOPE
GUG	<i>Eutrigla gurnardus</i>	GREY GURNARD
GUR	<i>Aspitrigla cuculus</i>	RED GURNARD
HAD	<i>Melanogrammus aeglefinus</i>	HADDOCK
HKE	<i>Merluccius merluccius</i>	HAKE
HOM	<i>Trachurus trachurus</i>	HORSE MACKEREL
JOD	<i>Zeus faber</i>	JOHN DORY
LBE	<i>Homarus gammarus</i>	LOBSTER
LEM	<i>Microcostmus kitt</i>	LEMON SOLE
LIN	<i>Molva molva</i>	LING
LSD	<i>Scyliorhinus canicula</i>	LESSER SPOTTED DOGFISH
MEG	<i>Lepidorhombus whiffiagonis</i>	MEGRIM
MON	<i>Lophius piscatorius</i>	MONKFISH (ANGLERFISH)
MUR	<i>Mullus barbatus</i>	RED MULLET
PLE	<i>Pleuroneectes platessa</i>	PLAICE
POD	<i>Trisopterus minutus</i>	POOR COD
POG	<i>Agonus cataphractus</i>	POGGE
PTR	<i>Raja microocellata</i>	PAINTED/SMALLEYED RAY
SCE	<i>Pecten maximus</i>	SCALLOP
SCR	<i>Maja squinado</i>	SPIDER CRAB
SDR	<i>Raja montagui</i>	SPOTTED RAY
SDS	<i>Mustellus asterias</i>	STARRY SMOOTHHOUND
SMH	<i>Mustellus mustellus</i>	SMOOTHHOUND
SBR	<i>Pagellus bogaraveo</i>	RED SEA BREAM
SOL	<i>Solea solea</i>	DOVER SOLE
SOS	<i>Pegusa lascaris</i>	SAND SOLE
SOT	<i>Buglossidium luteum</i>	SOLENETTE
SQC	<i>Loligo</i> spp	SQUID

TBR	<i>Gaidropsarus vulgaris</i>	THREE BEARDED ROCKLING
THR	<i>Raja clavata</i>	THORNBACK RAY
TKT	<i>Zeugopterus punctatus</i>	TOPKNOT
TUB	<i>Trigla lucerna</i>	TUB GURNARD
TUR	<i>Scophthalmus maximus</i>	TURBOT
WHG	<i>Merlangius merlangus</i>	WHITING
ECR	<i>Torpedo nobiliana</i>	COMMON ELECTRIC RAY
FLE	<i>Pleuroneectes flesus</i>	FLOUNDER
MAC	<i>Scomber scombrus</i>	MACKEREL
HER	<i>Clupea harengus</i>	HERRING

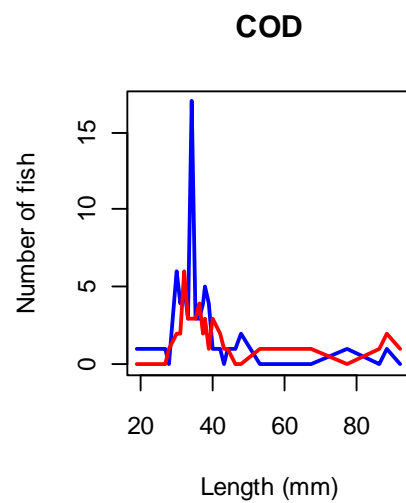
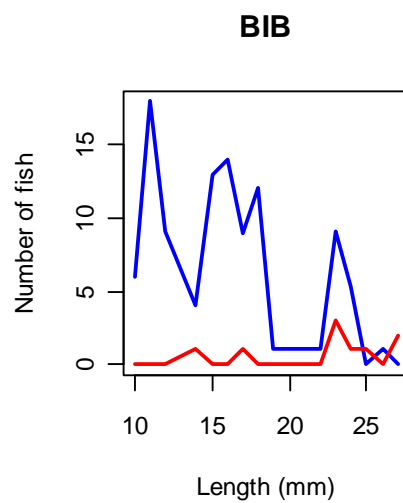
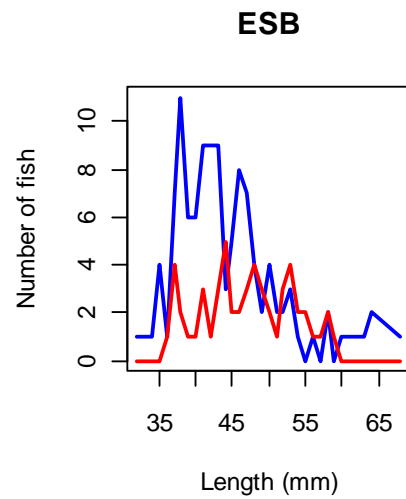
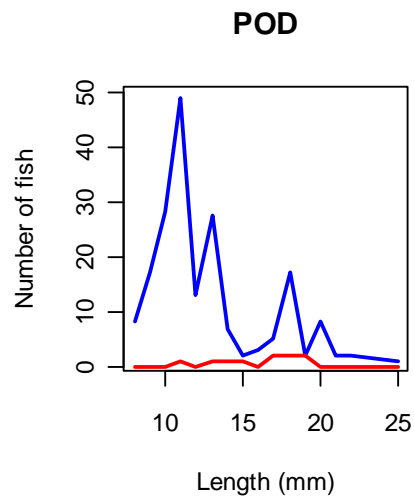
Appendix 2

The 25 most abundant species encountered during the trials by number.

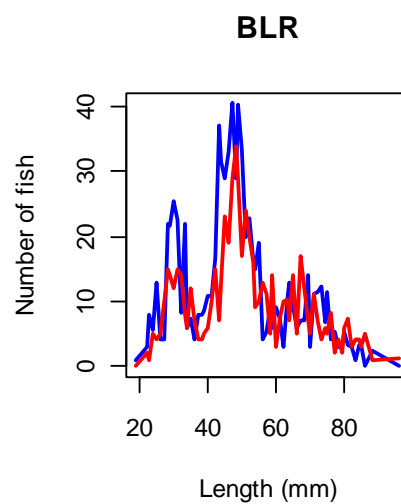
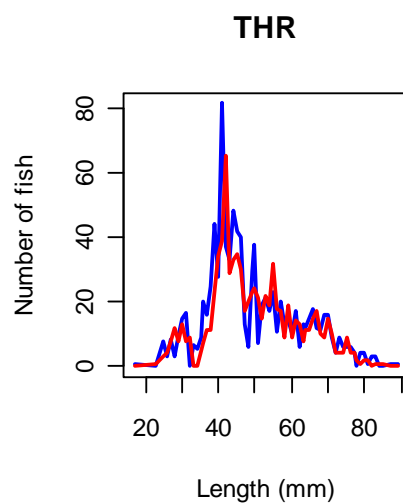
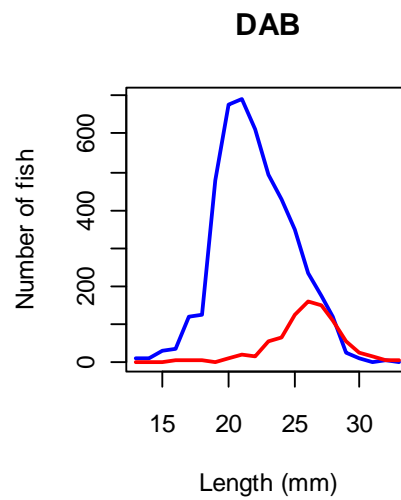
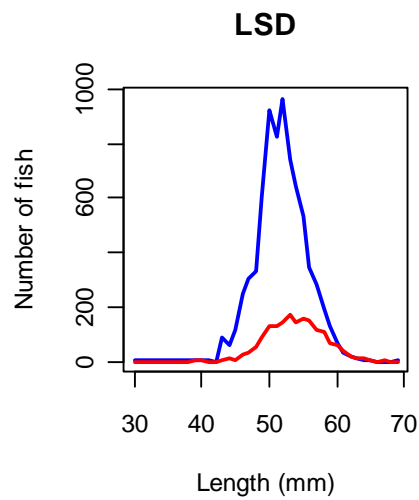
Species	CONTROL		CONTROL	TEST		TEST	Grand Total
	Discards	Retained	TOTAL	Discards	Retained	TOTAL	
BIB	102		102	9		9	111
BLR	438	372	810	319	329	648	1458
COD	51	14	65	25	19	44	109
DAB	4604		4604	794		794	5398
DGN		24	24		29	29	53
ESB	2	112	114		54	54	168
GUG	75	326	401	1	161	162	563
GUR	3	259	262		221	221	483
HAD	38		38	3		3	41
JOD	25	95	120	2	107	109	229
LBE	31	5	36	37	15	52	88
LEM	279	73	352	45	113	158	510
LSD	34	7495	7528		1720	1720	9249
PLE	336	225	561	221	297	518	1079
POD	191		191	10		10	201
PTR	110	288	398	104	292	396	794
SDR	87	93	180	93	88	181	361
SDS	28	565	593		352	352	945
SOL	4	496	500		107	107	607
SOS		46	46		3	3	49
SQC		218	218		117	117	335
THR	579	359	938	493	332	825	1763
TUB	26	198	224	1	134	135	359
TUR	45	13	58	28	14	42	100
WHG	195	5	200	15		15	215
Grand total	7366	11320	18686	2262	4557	6819	25505

Appendix 3

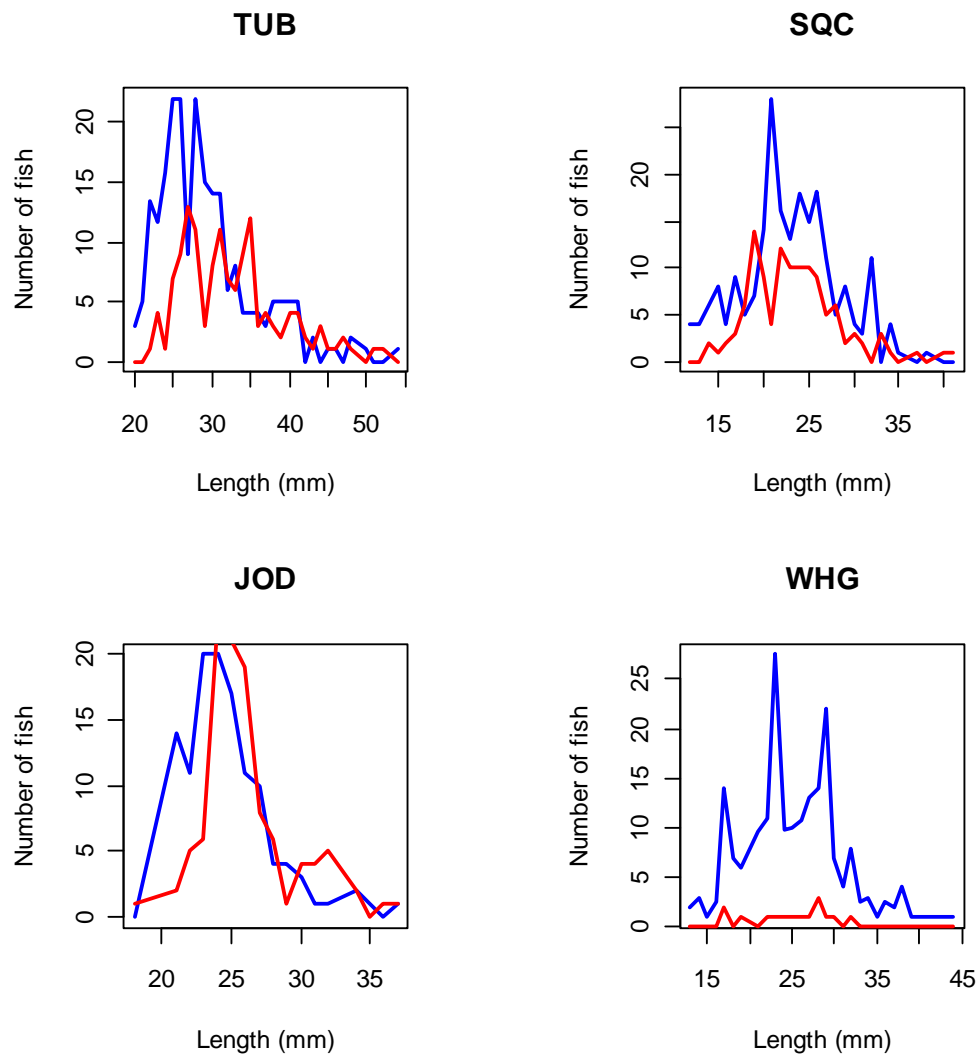
Numbers at length from the control codend (blue) and the test codend (red) for poor cod (POD), bass (ESB), bib and cod.



Numbers at length from the control codend (blue) and the test codend (red) for lesser spotted dogfish (LSD), dab, thornback ray (THR) and blonde ray (BLR).



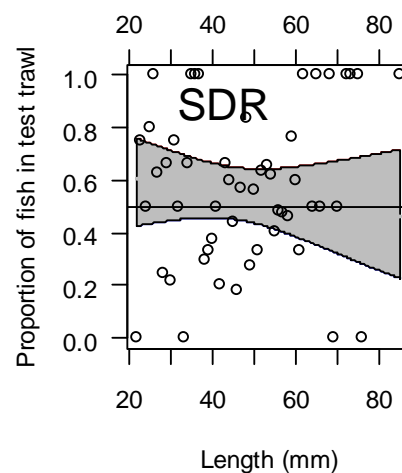
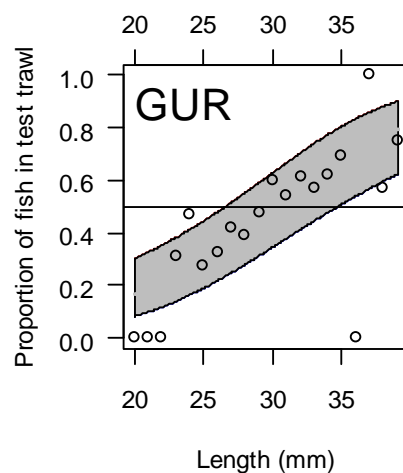
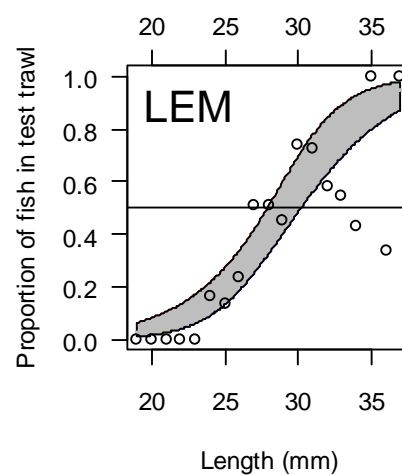
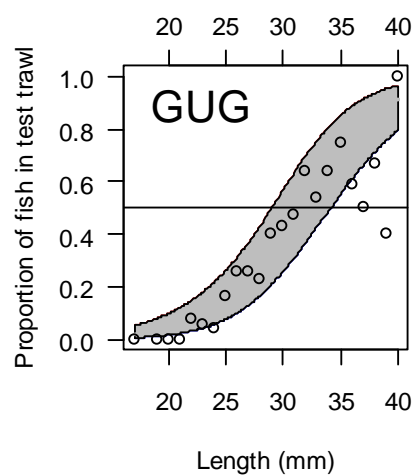
Numbers at length from the control codend (blue) and the test codend (red) for tub gurnard (TUB), squid (SQC), John Dory (JOD) and whiting (WHG).



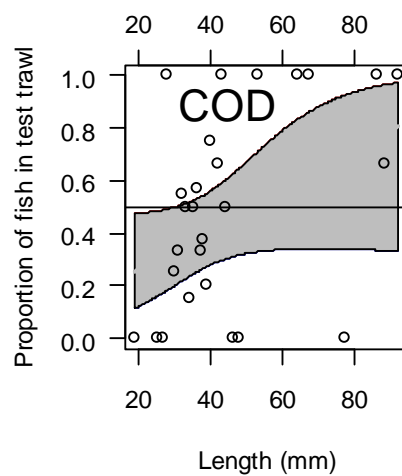
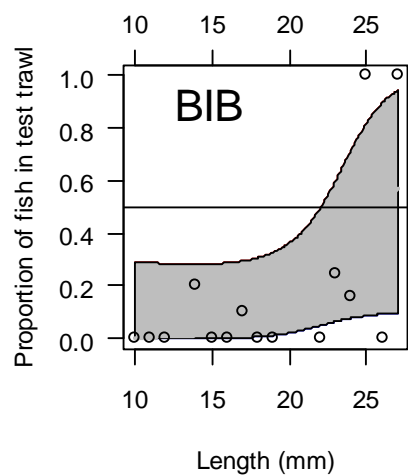
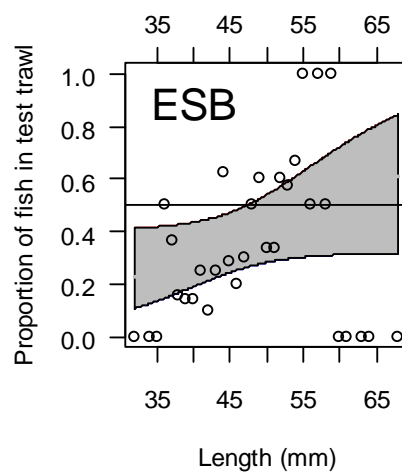
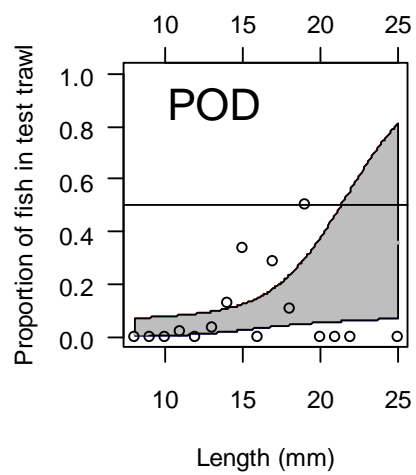
Appendix 4

Catch composition graphs showing the proportion of fish caught in the test codend for grey gurnard (GUG), lemon sole (LEM), red gurnard (GUR) and spotted ray (SDR).

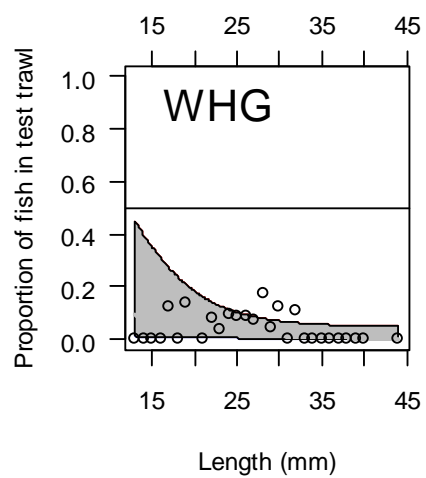
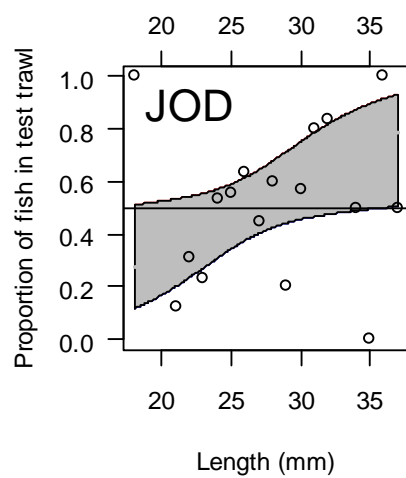
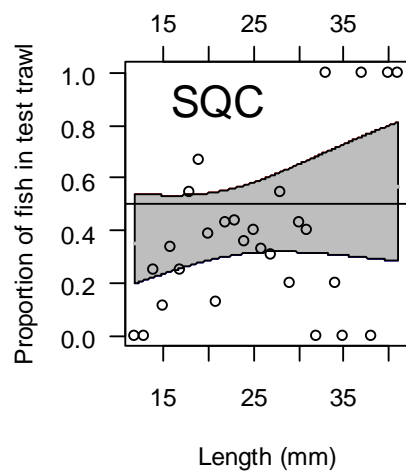
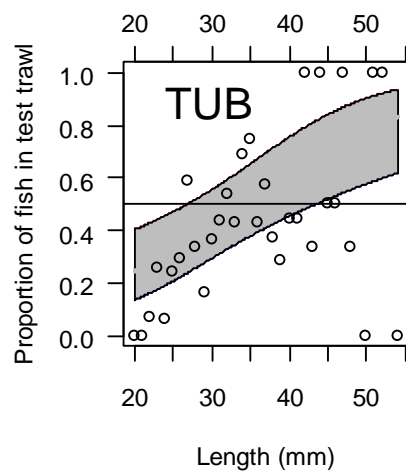
The horizontal line at 0.5 is the point at which the two codends catch the same. Below the line, the test codend catches less at length, and above the line, it catches more. The grey shading denotes the 95% confidence limits.



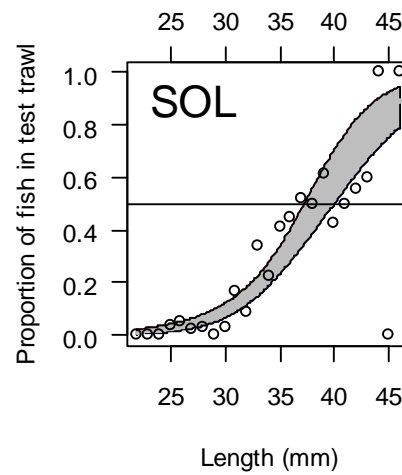
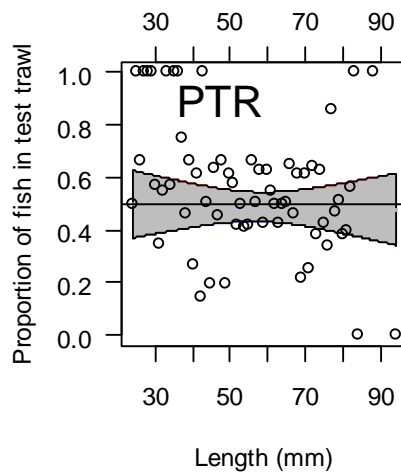
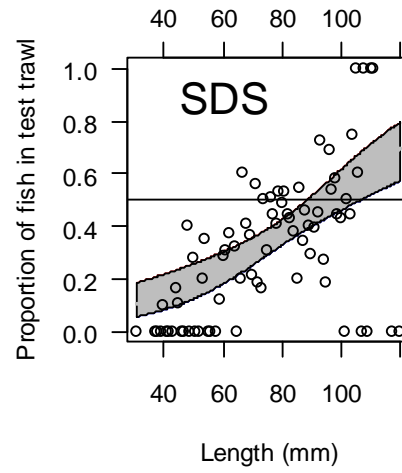
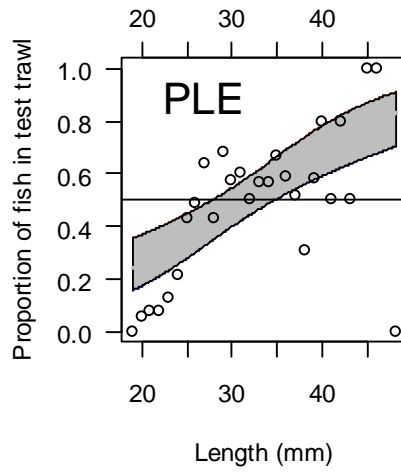
Catch composition graphs for poor cod (POD), bass (ESB), bib and cod.



Catch composition graphs for tub gurnard (TUB), squid (SQC), John Dory (JOD) and whiting (WHG).



Catch composition graphs for plaice (PLE), starry smooth hound (SDS), painted ray (PTR) and sole (SOL).



Detailed Operation Plan for MF041 FSP

THE CENTRE FOR ENVIRONMENT, FISHERIES AND AQUACULTURE SCIENCE

LOWESTOFT LABORATORY, SUFFOLK, NR33 0HT, ENGLAND

Bristol Channel 100mm vs 80mm cod-end selectivity trials.

Vessel: ***Our Josie Grace BD277***

Duration: 10 days fishing, split into three trips

Dates:

It is proposed the survey be carried out over a three-month period to achieve best coverage and to take into account seasonality of the fishery. The 1st survey is to be conducted on or around the 19th July. The second trip will take place on or around the 6th September. The final trip will take place on or around the 25th October.

All dates area weather dependant.

Area: Trials will take place in the Bristol Channel (ICES area VII_f, statistical rectangles, 30E5, 30E4, 30E3, 31E6, 31E5, 31E4, 31E3.).

All fishing is to take place in English waters.

Gear: The vessel will use two identical 10 fathom “Box” trawls rigged on 12 & 14” rock- hopper footropes. One net to be fitted with an 80mm Single braided cod-end, & the 2nd net to be fitted with a 100mm cod –end. Both cod-ends shall be supplied by CEFAS and be constructed of the same diameter twine.

Staff: David Peach & _____ (CEFAS) trip1.

David Peach & Grant Course (CEFAS) trip 2.

David Peach & _____ (CEFAS) trip 3.

Aims:

To compare the differences in selectivity of the standard 80mm cod-ends compared to the larger 100mm cod-ends, of both the retained & discarded catch in a mixed demersal fishery.

This will be achieved by:

Deploying, simultaneously, two nets, one with a 80mm cod-end & the other with a 100mm cod-end.

Tow durations will be the same as commercial operations to replicate other known selectivity parameters, i.e. cod-end fill etc.

Fishing activity:

Fishing will take place throughout the twenty-four hour period to cover environmental factors known to have a significant effect on catch & discard composition. i.e. day, twilight, & night hauls.

If the vessel encounters large catches, the hauls must be kept separate, possibly requiring the vessel to halt fishing, until the previous haul is processed.

Rest Periods:

The Scientists must have a sufficient period of sleep (minimum 7 hours per 24-hour period).

Crew requirements:

The crew will be required to assist in sorting the retained & discarded components of the catch as required by the CEFAS scientists aboard the vessel.

If a day or days at sea is lost due to adverse weather conditions &/or mechanical failure then the day should be rescheduled for later in the same month at the earliest possible convenience.

Skipper's requirements:

The skipper will record;

- Shoot & haul position (Lat & Lon) to the nearest minute.
- Tow duration
- Depth
- Course changes of more than 90°
- Estimated door spread
- Wind force & direction
- Average speed over ground (SOG)
- Sea conditions

Data collection:

CEFAS scientists will collect numbers at length data from both the retained & discard component, of both the 80mm & 100mm cod-end. Raising factors where possible should be 1. Where not achievable, lowest raising factors possible to be used.

All hauls fished to be sampled

The observers will maintain a diary of activities, and a draft cruise report in standard CEFAS format will be prepared for submission to CEFAS immediately after the cruise. The cruise narrative should be written at sea and read and agreed by the skipper (report will bear the sentence “seen in draft by skipper”).

Signed.....(Cefas).....(Date)

Signed.....(owner).....(Date)

Industry comment

Comments by Marcus White (Skipper):

As far as the contract went with the 80mm and 100mm cod ends, I was very pleased with the information which was collected. I was very surprised at the amount of difference of discards and retained fish of the two cod ends, my concerns were that there is not a great deal of white fish in the Bristol Channel which is where the 100mm cod end would be better. Also Dogfish were able to get out of 100mm cod end which I feel that they would overtake the fishing ground which could eat all food that other fish feed on and may make other species move off the normal fishing ground where the dogfish are less found.

I would like to thank all that took part in this contract for their help.

Comments by S Wharton(owner):- First of all I would like to thank CEFAS for allowing the 'Our Josie Grace' to carry out the selectivity trials. As owner of the vessel any reduction in potential earnings creates a problem as from a financial point of view we run on very tight margins and any reduction in earnings can potentially create a big problem but I do recognise we must all make the effort in reducing discards. Potentially a 78% reduction in Sole, a 40% reduction in Squid also reduction in Bass and a 77% reduction in Spotted Dogfish and many other species, could put us out of business so I feel a move to a larger mesh size would have to be done over a period of time of possibly up to 5 years, that would allow the vessel time to adapt to the changes (to achieve anything it would have to be done at a European level. We already have the 100mm ruling in when targeting white fish, I believe this to be very affective and I am fully supportive of using 100mm mesh sizes when targeting such species, Haddock, Cod and Whiting. As Marcus has pointed out there is also big reductions in catches of lesser Spotted Dogfish when using 100mm Cod Ends and I believe it is very important that such species are taken off the ground to allow other species to feed and breed. There are examples all over the world where fishery management has allowed these situations of the more dominant fish to overtake the seabed this must not be allowed to happen. Also this would lead to big problems for the Whelk fishery as they rely on the lesser Spotted Dogfish to bait there pots with. I feel a move to 100mm when targeting Bass would be very beneficial to the Bass fishery and would support such a move. On the whole after reading the survey (as I was not a part of it) it sounds like it went very well for both skipper and crew and the scientists aboard the vessel, it has given us many questions to consider and in buying large it looks like it has also given us many answers to the questions we were seeking.