

Final Report

*Programme 11: A simple trawl
modification designed to reduce cod
catches*

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Locker, Frank Armstrong, Arnold Locker and Andrew Allard



The MFV's Jubilee Quest and Our Lass II engaged in paired gear trials to evaluate a trawl modification aimed at reducing cod catches (July 2009)

September 2009

INTRODUCTION

An executive summary of this work

The simple trawl modification described in this work, has been demonstrated to reduce the catches of cod by over 55% in a mixed North Sea demersal whitefish fishery.

Background to the work

In order to catch fewer cod and thereby service conservation objectives in the North Sea, Grimsby skipper 'Graham Hall' (MFV Jubilee Quest GY900) designed a demersal trawl modification to facilitate cod escapement.

This trawl modification consists of an escape panel (mesh size 300 mm) which can be fitted to the belly of standard designs of demersal whitefish trawl which are used by the fishing industry.

To evaluate the efficacy of this trawl modification, Cefas scientists and fishing industry members collaborated in this FSP project to compare the catches from the modified trawl (fitted with a belly escape panel) to those from an unmodified trawl of the same design.

In this work both trawls were repeatedly towed alongside each other along parallel tracks on commercial fishing grounds in the North Sea. In total, 26 sets of paired-haul catch data were obtained for subsequent analysis.

The work was undertaken in July 2009, during two weeks of sea trials in the North Sea aboard two English registered trawlers.

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 numerous projects, such as investigations into fishing gear selectivity, the examination of spatial patterns and catch compositions, 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 at the Cefas website (www.cefas.co.uk)

INTRODUCTION

Introduction: Why this work was undertaken

North Sea cod is currently subject to stringent long-term conservation objectives, whereas other fish stocks are believed to be in a more robust state. There is a need to investigate techniques, which can reduce cod catches in the North Sea while allowing the fishing industry to continue to harvest other demersal fish species. It is believed modifying the trawls currently used by the fishing industry may have some potential in reducing the quantities of cod caught and is therefore an area worthy of further investigation.

The work detailed in this report describes scientific trials to evaluate the efficacy of a trawl modification suggested by a Grimsby skipper ‘Graham Hall’ and which is designed to reduce cod catches in a North Sea whitefish demersal fishery.¹

Introduction: The aim of this work

The aim of this work was to evaluate the effect of a simple trawl modification (belly escape panel) upon the catches of demersal fish species, with a particular interest in cod.

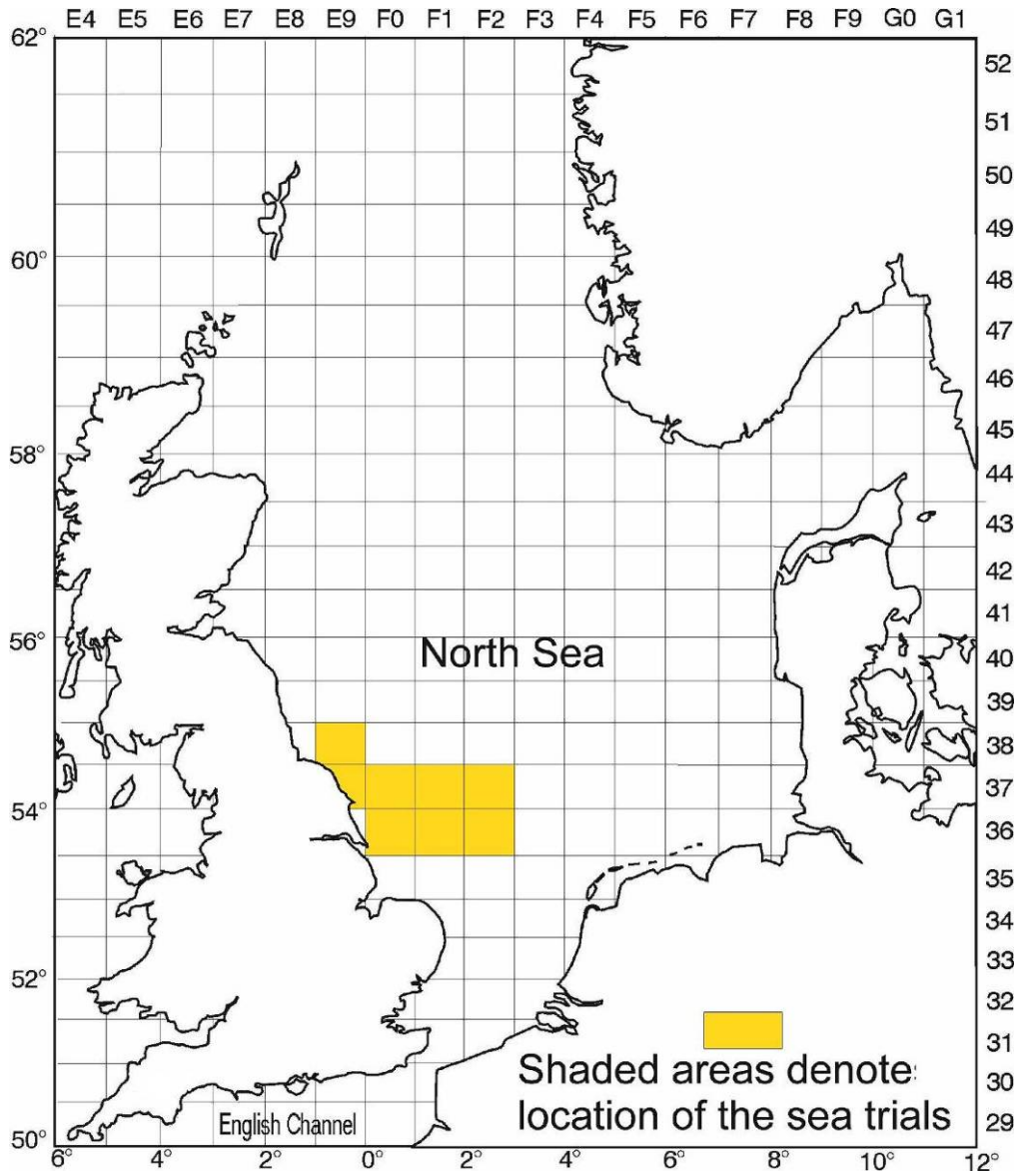
Introduction: Table of contents

An executive summary of this work	2
<i>The Fisheries Science Partnership</i>	2
Introduction: Why this work was undertaken	3
Introduction: The aim of this work	3
Introduction: Table of contents	3
Method: Where and when the paired gear trials took place.....	4
Method: The two trawlers engaged in the paired gear trials.....	5
Method: How the industry trawl was modified to reduce cod catches	6
Method: Technical details on trawls	6
Method: How the standard and modified trawls were towed along parallel courses beside each other, so that the catches could be legitimately compared	7
Method: What information was recorded	8
Results: Cod - How cod catches were affected by the trawl modification	9
Results: Cod catches - points of note	10
Results: Haddock - How haddock catches were affected by the trawl modification...	11
Results: Haddock catches - points of note	12
Results: Whiting - How whiting catches were affected by the trawl modification	13
Results: Whiting catches - points of note	14
Results: Plaice - How plaice catches were affected by the trawl modification	15
Results: Plaice catches - points of note	16
Results: Lemon sole - How lemon sole catches were affected by the trawl modification	17
Results: Lemon sole catches - points of note.....	18
Conclusions: Main findings from this study	19
Appendix: Personnel engaged in the study	20
Appendix: The operational plan agreed before the paired gear sea trials began	21

¹ Additional comparative sea trials were also planned which involved the ‘Eliminator’ trawl, however this aspect of the work was dropped as the ‘Eliminator’ trawl was badly damaged on the sea bed early in the sea trials

METHOD

Method: Where and when the paired gear trials took place



- ❖ Average recorded depth of water was 60 m (Range from 36-91m)
- ❖ Paired gear trials took place between 20th July - 1st August 2009

METHOD

Method: The two trawlers engaged in the paired gear trials



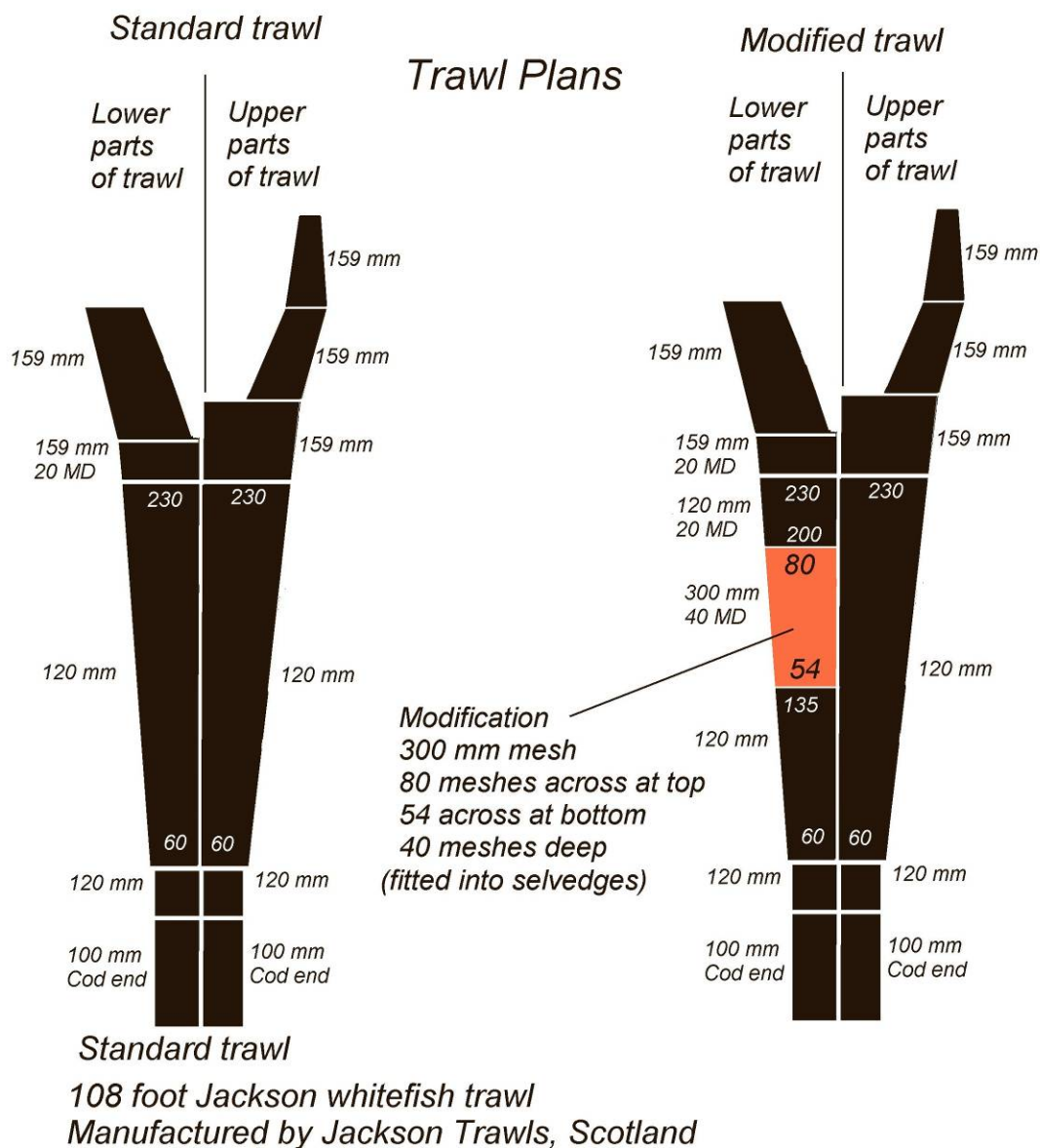
MFV *Our Lass II* (WY 261) skippered by James Locker
Main engine power 480 kW, vessel length 21.5m, home port Whitby



MFV *Jubilee Quest* (GY 900) skippered by Graham Hall
Main engine power 347 kW, vessel length 21.1m, home port Grimsby

METHOD

Method: How the industry trawl was modified to reduce cod catches



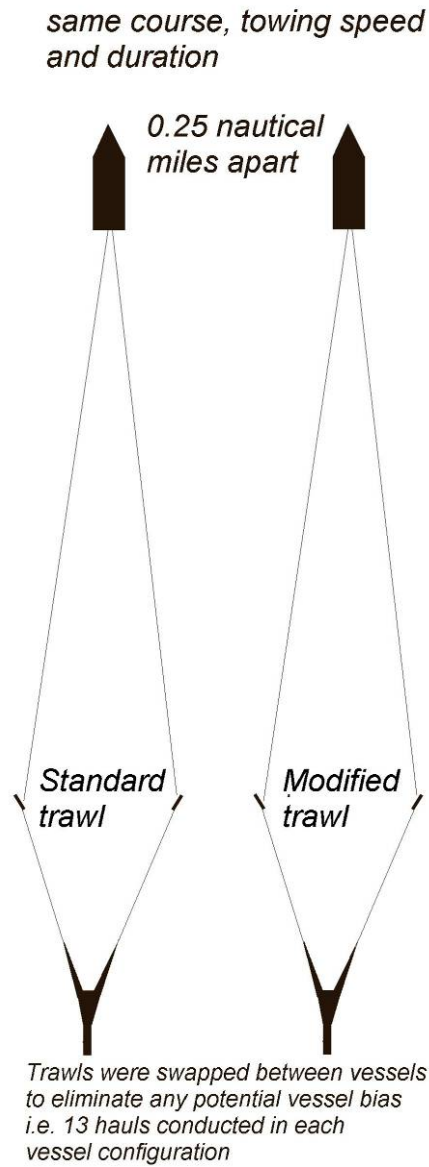
Method: Technical details on trawls

The trawls in this work are a commonly used commercial design of demersal fish trawl manufactured by Jackson Trawls in Scotland. Both trawls were of the same design, except that one (the modified trawl) was fitted with a modified belly panel for the purpose of this study.

The aim of this modification was to facilitate the release of cod. Both trawls were rigged with comparable rock-hopper ground gears. New and identical cod ends, constructed from 5mm diameter double twine, with a mesh size of 100 mm were fitted to both trawls.

METHOD

Method: How the standard and modified trawls were towed along parallel courses beside each other, so that the catches could be legitimately compared



- ❖ 26 hauls successfully completed in total
- ❖ Average haul duration was 4.3 hours (Range 2.7 – 5.7 hours)
- ❖ Hauls conducted throughout day and night (i.e. 24 hours)

METHOD

Method: What information was recorded



An example catch obtained during the trials

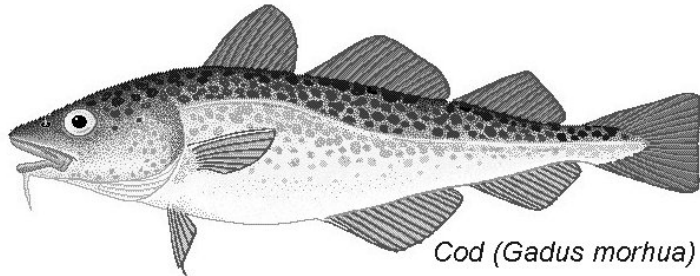


Cefas scientist measuring and recording fish in the catch

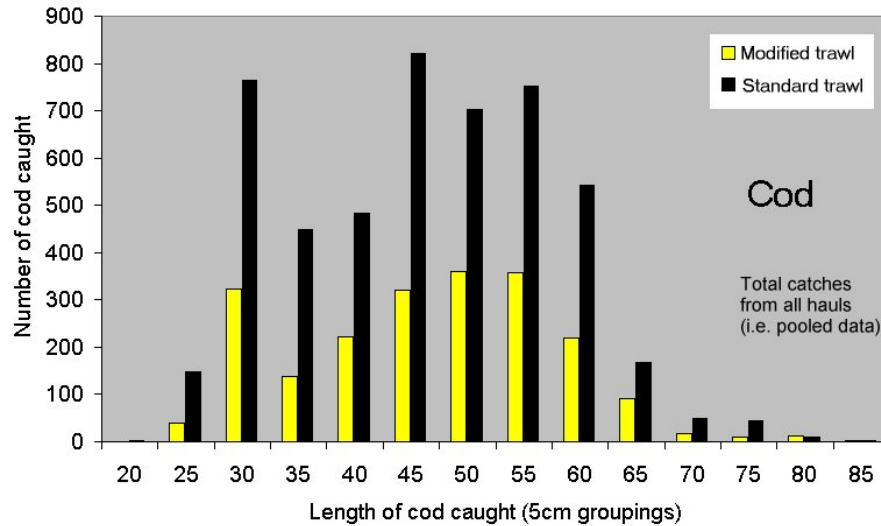
- ❖ Cefas scientists were onboard both vessels throughout the trials
- ❖ For each haul, details such as towing positions, depth, speed etc were recorded
- ❖ For each haul, the scientists measured all of the fish (to 1 cm below) from the catches
- ❖ Fish were identified to species level
- ❖ Sub-sampling techniques were used when catch levels were high

RESULTS

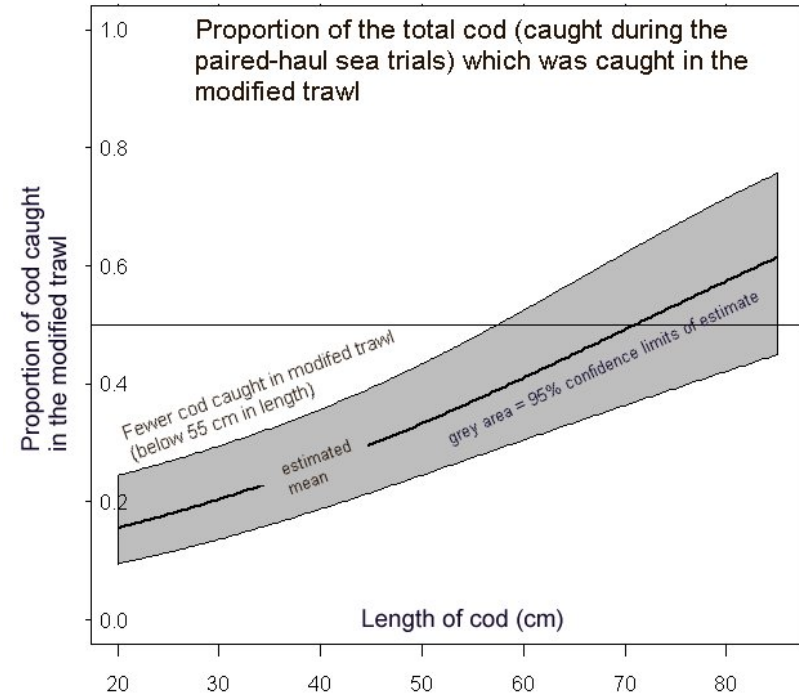
Results: Cod - How cod catches were affected by the trawl modification



Basic catch data for cod (pooled data)



Statistical analysis of the cod data (GLMM analysis)*



*Generalised linear mixed model

See Holst R., Revill A.

A simple statistical method for catch comparison studies. Fisheries Research 95 (2009) 254-259

RESULTS

Cod catches during the sea trials

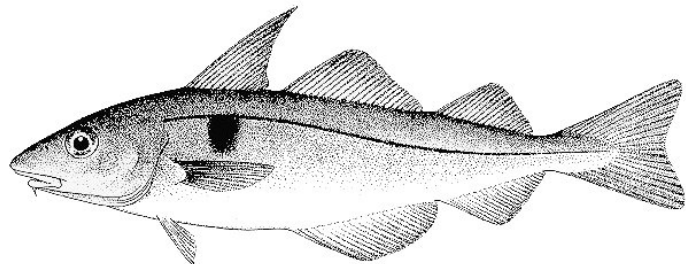
Species: COD		
Number of fish caught		
Haul code	Modified trawl	Standard trawl
1	16	22
2	7	2
3	16	639
4	11	101
6	189	204
7	152	456
8	10	82
9	297	254
10	103	194
15	24	91
16	142	172
17	20	82
18	6	35
51	14	16
52	19	24
53	8	0
54	312	154
55	131	950
56	193	674
57	77	78
58	50	114
59	128	223
65	17	58
66	72	130
67	85	162
68	17	27
Total	2,116	4,943
<i>p-value (by Wilcoxon rank test) = 0.00</i>		

Results: Cod catches - points of note

- (a) During the sea trials, cod was caught in 26 paired hauls
- (b) The modified trawl caught fewer cod (in total) than the standard trawl in 22 of the 26 paired hauls (i.e. 85 % of cases)
- (c) The Wilcoxon analysis indicated a high statistical probability ($p=0.00$) that the difference in cod catches *was not* due to chance alone
- (d) The standard trawl caught 4,943 cod in total during the trials, while the modified trawl caught significantly fewer individuals (2,116) (43 % by comparison)
- (e) The GLMM analysis of the cod catches also indicated that the modified trawl caught fewer cod, particularly below 55 cm in length

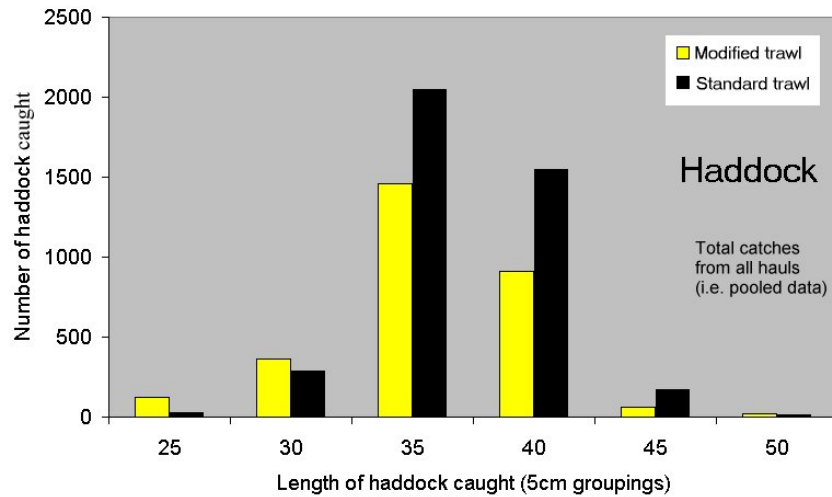
RESULTS

Results: Haddock - How haddock catches were affected by the trawl modification

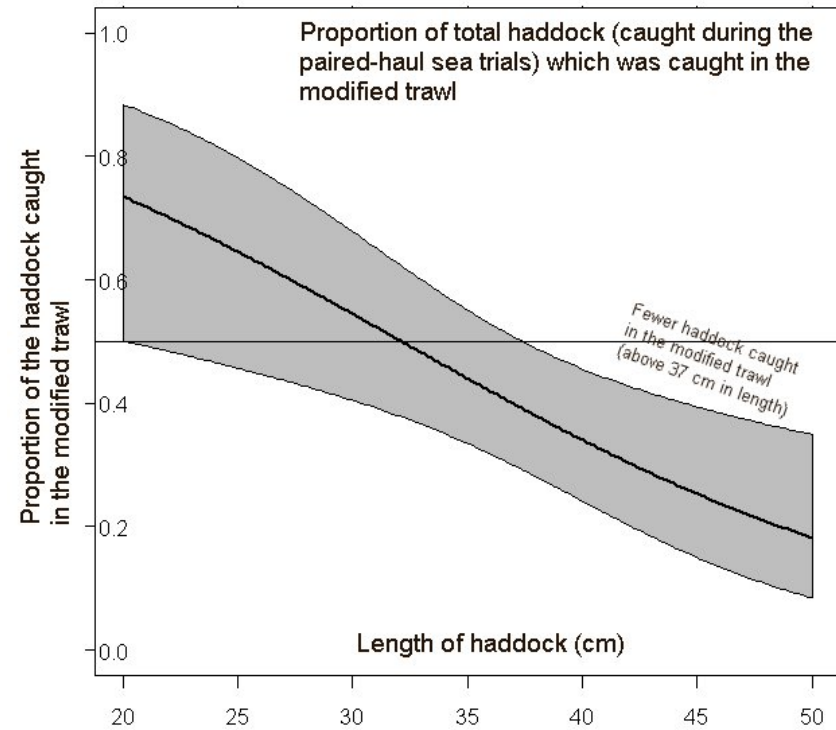


Haddock (*Melanogrammus aeglefinus*)

Basic catch data for haddock (pooled data)



Statistical analysis of the haddock data (GLMM analysis)*



*Generalised linear mixed model

See Holst R., Reville A.

A simple statistical method for catch comparison studies. Fisheries Research 95 (2009) 254–259

RESULTS

Haddock catches during the sea trials

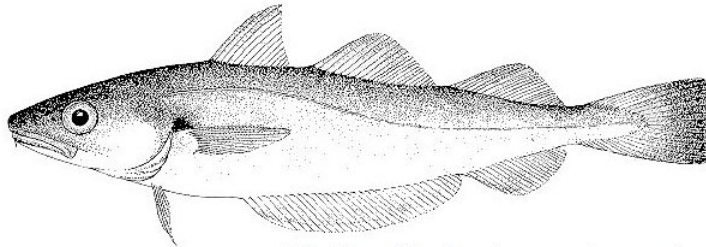
Species: HADDOCK		
Number of fish caught		
Haul code	Modified trawl	Standard trawl
4	0	1
6	4	20
7	2	14
10	562	401
15	124	179
16	71	226
53	1	0
54	3	11
55	273	972
56	410	400
57	48	4
58	15	66
59	702	1,076
65	46	30
66	260	338
67	312	294
68	106	69
Total	2,939	4,101
<i>p-value (by Wilcoxon rank test) = 0.82</i>		

Results: Haddock catches - points of note

- (a) During the sea trials, haddock was caught in 17 paired hauls
- (b) The modified trawl caught fewer haddock (in total) than the standard trawl in 10 of the 17 paired hauls (i.e. 59 % of cases)
- (c) The Wilcoxon analysis indicated a high statistical probability ($p=0.82$) that the difference in total haddock catches *was* likely due to chance (however – see comment below)
- (d) The GLMM analysis of the haddock catches indicated that the modified trawl caught fewer haddock above 37 cm in length

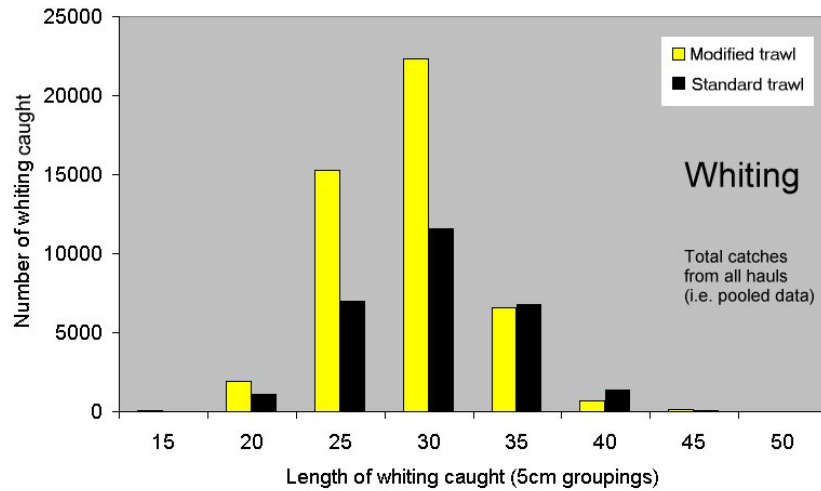
RESULTS

Results: Whiting - How whiting catches were affected by the trawl modification

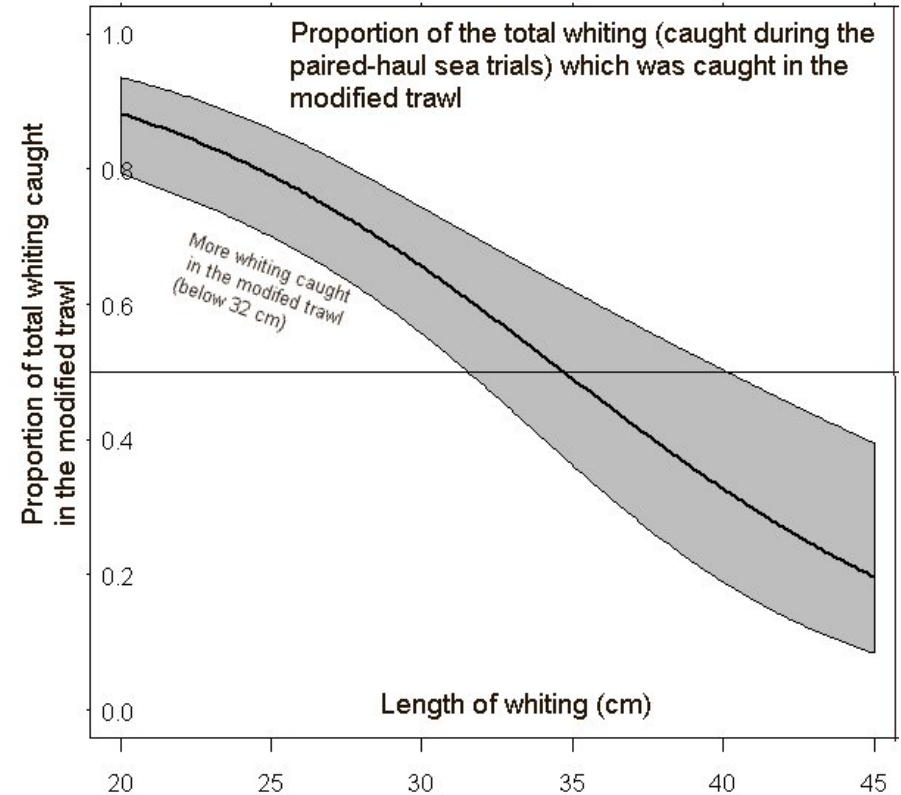


Whiting (*Melangius merlangus*)

Basic catch data for whiting (pooled data)



Statistical analysis of the whiting data (GLMM analysis)*



*Generalised linear mixed model

See Holst R., Revill A.

A simple statistical method for catch comparison studies. Fisheries Research 95 (2009) 254–259

RESULTS

Whiting catches during the sea trials

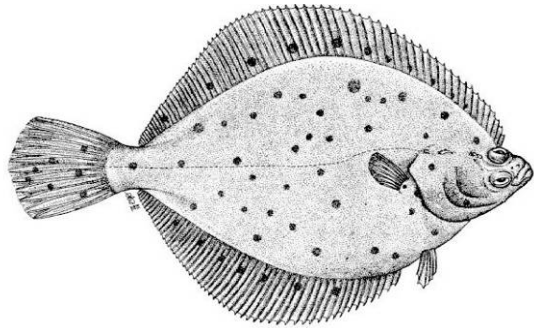
Species: WHITING		
Number of fish caught		
Haul code	Modified trawl	Standard trawl
1	7,996	5,758
2	51	24
3	122	51
4	473	877
6	220	258
7	520	405
8	72	2,150
9	357	4
10	186	20
15	1,464	286
16	1,180	576
17	1,046	184
18	2,407	726
51	958	2,091
52	1,496	1,504
53	3,943	129
54	1,405	845
55	9,593	4,473
56	6,480	3,420
57	992	292
58	465	1,048
59	115	133
65	538	408
66	1,652	637
67	2,650	998
68	533	582
Total	46,915	27,877
<i>p-value (by Wilcoxon rank test) = 0.59</i>		

Results: Whiting catches - points of note

- (a) During the sea trials, whiting was caught in 26 paired hauls
- (b) The modified trawl caught more whiting (in total) than the standard trawl in 18 of the 26 paired hauls (i.e. 69 % of cases)
- (c) The Wilcoxon analysis indicated a high statistical probability ($p=0.59$) that the difference in total whiting catches *was* likely due to chance (however - see comments below)
- (d) The standard trawl around 28,000 whiting in total during the trials, while the modified trawl caught around 47,000 (168 % by comparison)
- (e) The GLMM analysis of the whiting catches indicated that the modified trawl was more effective in catching whiting of lengths 32 cm and below, and less effective for larger whiting in excess of 40cm.

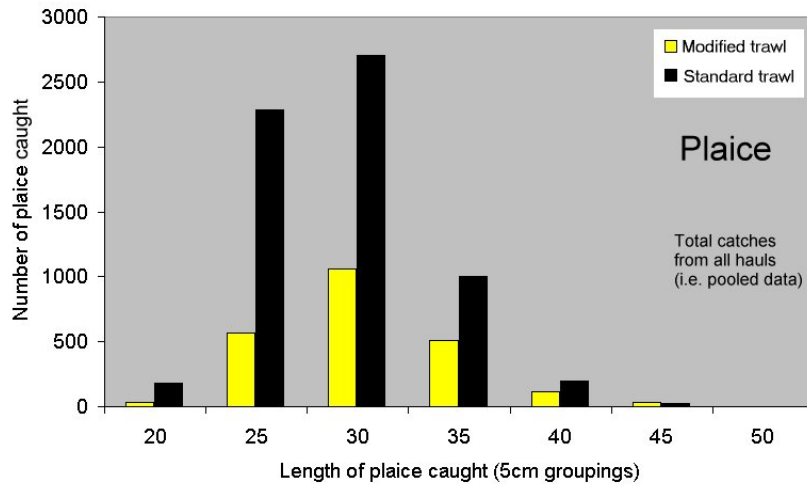
RESULTS

Results: Plaice - How plaice catches were affected by the trawl modification

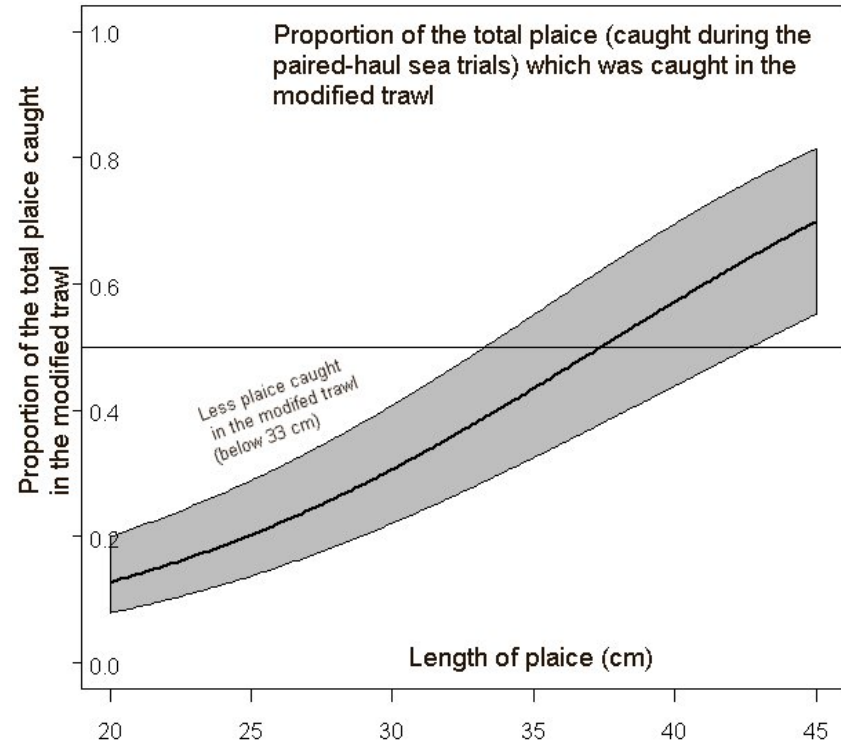


Plaice (*Pleuronectes platessa*)

Basic catch data for plaice (pooled data)



Statistical analysis of the plaice data (GLMM analysis)*



*Generalised linear mixed model

See Holst R., Reville A.

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RESULTS

Plaice catches during the sea trials

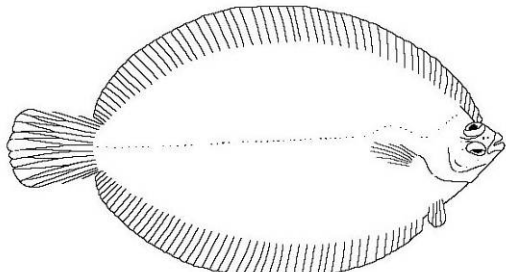
Species: PLAICE		
Number of fish caught		
Haul code	Modified trawl	Standard trawl
1	2	1
2	193	309
3	25	425
4	23	1,152
6	3	57
7	10	16
8	948	856
9	199	1,590
10	34	130
15	32	78
16	13	16
17	3	1
18	2	3
51	4	5
52	0	1
53	184	211
54	41	192
55	27	67
56	55	61
57	21	56
58	201	461
59	70	194
65	7	39
66	109	201
67	96	213
68	10	65
Total	2,312	6,399
<i>p-value (by Wilcoxon rank test) = 0.00</i>		

Results: Plaice catches - points of note

- (a) During the sea trials, plaice was caught in 26 paired hauls
- (b) The modified trawl caught less plaice (in total) than the standard trawl in 24 of the 26 paired hauls (i.e. 92 % of cases)
- (c) The Wilcoxon analysis indicated a high statistical probability ($p=0.00$) that the difference in plaice catches *was not* due to chance
- (d) The standard trawl caught 6,399 plaice in total during the trials, while the modified trawl caught significantly fewer individuals (2,312) (36 % by comparison)
- (e) The GLMM analysis of the plaice catches indicated that the modified trawl was less effective in catching plaice, particularly below 33 cm

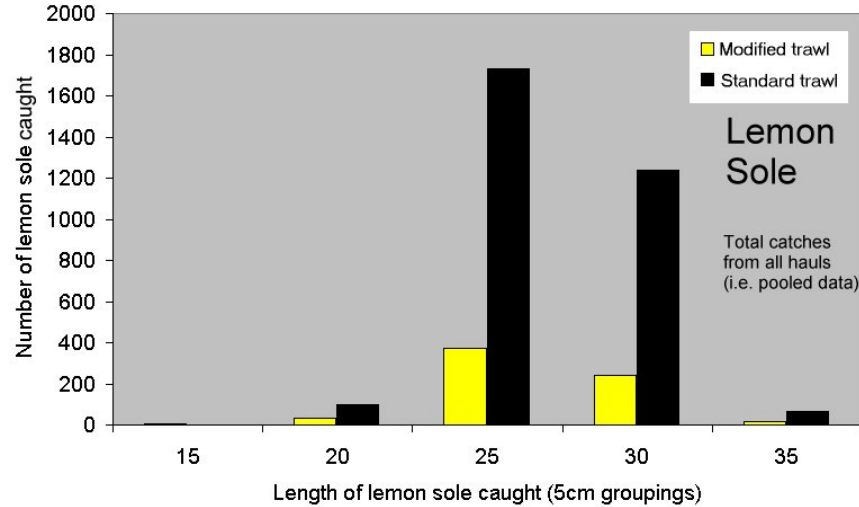
RESULTS

Results: Lemon sole - How lemon sole catches were affected by the trawl modification

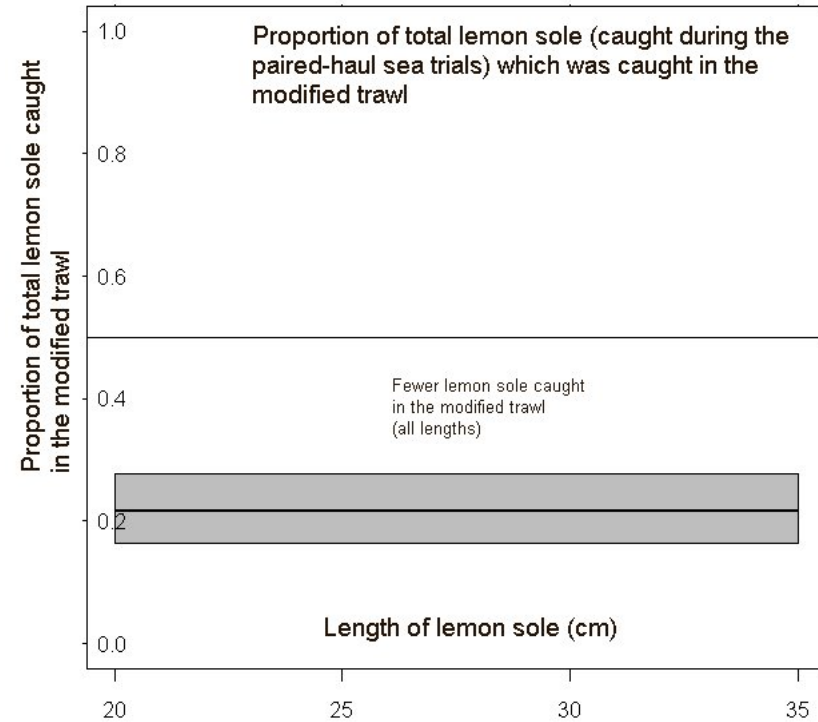


Lemon sole (*Microstomus kitt*)

Basic catch data for lemon sole (pooled data)



Statistical analysis of the lemon sole data (GLMM analysis)*



*Generalised linear mixed model

See Holst R., Reville A.

A simple statistical method for catch comparison studies. Fisheries Research 95 (2009) 254-259

RESULTS

Lemon sole catches during the sea trials

Species: LEM' SOLE		
Number of fish caught		
Haul code	Modified trawl	Standard trawl
1	18	35
2	24	54
3	0	26
4	9	8
6	33	198
7	32	429
8	8	55
9	4	51
10	46	201
15	58	132
16	29	94
17	8	31
18	6	33
51	9	32
52	0	28
53	36	27
54	33	78
55	40	67
56	17	48
57	10	32
58	52	114
59	19	208
65	29	64
66	71	465
67	67	560
68	8	63
Total	666	3,132
<i>p-value (by Wilcoxon rank test) = 0.00</i>		

Results: Lemon sole catches - points of note

- (a) During the sea trials, lemon sole was caught in 26 paired hauls
- (b) The modified trawl caught less lemon sole (in total) than the standard trawl in 24 of the 26 paired hauls (i.e. 92 % of cases)
- (c) The Wilcoxon analysis indicated a high statistical probability ($p=0.00$) that the difference in lemon sole catches *was not* due to chance
- (d) The standard trawl caught 3,132 lemon sole in total during the trials, while the modified trawl caught significantly fewer individuals (666) (21 % by comparison)
- (e) The GLMM analysis of the lemon sole catches indicated that the modified trawl caught fewer lemon sole across the full length range

Conclusions: Main findings from this study

General

- ❖ During the two weeks of sea trials, a total of 26 paired hauls were successfully obtained
- ❖ The paired hauls facilitated the direct comparison of catches from two identical industry standard trawls, one of which had been modified to reduce catches of cod (referred to as the modified trawl)
- ❖ Any potential bias due to ‘vessel effects’ was negated as the trawls were swapped over between vessels during the sea trials

Cod

- ❖ The modified trawl caught fewer cod in 22 of the 26 paired hauls (i.e. in 85% of cases)
- ❖ The statistical analyses, using the Wilcoxon test and also the GLMM (generalised linear mixed model) , both indicated that the reduced catches of cod in the modified trawl were not due to chance alone
- ❖ The standard trawl caught 4,943 cod in total during the trials, while the modified trawl caught significantly fewer individuals (2,116) (43 % by comparison)

Other species

- ❖ Catches of haddock, whiting, lemon sole and plaice were also different in the modified trawl when compared to those caught in the standard trawl
- ❖ Lemon sole, plaice (<33cm) and haddock (>37 cm) were all reduced in number in the modified trawl, whereas catches of whiting (<32 cm) were increased

The trawl modification

- ❖ The simple trawl modification described in this work appears to offer a basic technique to reduce cod catches in a North Sea demersal whitefish mixed fishery
- ❖ The skippers reported that the modified trawl appeared to be the most effective at releasing cod when the trawl was towed down the tide

APPENDICES

Appendix: Personnel engaged in the study



Graham Hall
Skipper
Jubilee Quest



John Hingley
Scientist
Cefas



Arnold Locker
Director
Locker Trawlers Ltd



James Locker
Skipper
Our Lass II



Frank Armstrong
Scientist
Cefas



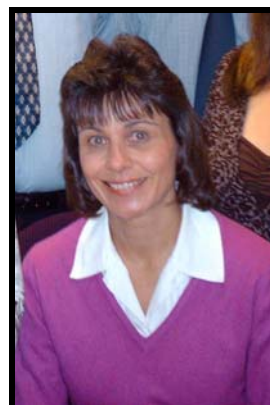
Andrew Allard
Managing Director
Jubilee Fishing Co Ltd



Shaun Doran
Scientist
Cefas



Andy Reville
Scientist
Cefas



Jane Medler
Cefas admin support

The contributions of Andrew Payne and Peter Randall (Cefas), the MFA and Fisheries Science Partnership team are also acknowledged for their important contributions to the success of this work.

APPENDICES

Appendix: The operational plan agreed before the paired gear sea trials began

This document describes a detailed operational plan based upon the understandings and agreements reached by all parties below at a planning meeting held in Grimsby on 04 June 2009 and through subsequent discussions.

- ❖ *Andy Revall and Shaun Doran (Cefas, Lowestoft)*
- ❖ *Arnold Locker (Locker Trawlers, Whitby)*
- ❖ *Andrew Allard and Dave Johnson (Jubilee Fishing, Grimsby)*

What are we doing?

- ❖ The primary purpose of the trials is to evaluate how specific demersal trawl modification(s) may affect the catches of cod in the catch

Why are we doing this?

- ❖ There is a need to investigate if such trawl modifications can significantly reduce cod catches while retaining a substantive proportion of other demersal fish species.
- ❖ This type of information could be very useful for industry and managers alike in finding trawl designs which allow industry to continue to catch demersal species while affording some protection to cod stocks in the North Sea.

Who will be doing the work?

- ❖ Two vessels (Jubilee Quest GY900 and Our Lass II WY 261) along with a full compliment of skippers and crews for each vessel will be chartered for the work. These vessels will be skippered by Graham Hall and James Locker respectively, both of whom are experienced skippers.
- ❖ Two Cefas scientists (one per vessel) will also be onboard for the entire duration of the trials. Shaun Doran (from Fleetwood) and John Hingley (from Brixham) are both qualified as Cefas scientists, but also have extensive sea going experience as fishing skippers.
- ❖ In addition to undertaking their normal seagoing duties, a crew member on each vessel will be required to assist the Cefas scientists to help measure the catch (under the direction of the Cefas scientist). The skippers on each vessel need to ensure that crew members are nominated for this task.
- ❖ Andy Revall (Cefas) will have overall management responsibility for this FSP work project (from the Cefas perspective), but will be in the USA during the sea trials. Shaun Doran will therefore deputise for Andy Revall during the sea trials phase of this work. Andy Revall will be responsible for the data analysis and production of final report.
- ❖ Andrew Allard (Jubilee Fishing, Grimsby) will act as primary shore-based contact for all matters relating to the Jubilee Quest and her crew.
- ❖ Arnold Locker (Locker Trawlers, Whitby) will act as primary shore-based contact for all matters relating to the Our Lass II and her crew

Where will the work be undertaken?

- ❖ Sea trials to be undertaken in North Sea (within British limits) in IVb and IVc on commercial fishing grounds chosen and agreed by the two skippers

APPENDICES

- ❖ No trials to be undertaken outside of British waters due to time constraints in getting permissions from foreign governments (requires 6 months) – (confirmed by Joe Horwood 05 June 2009)
- ❖ Access has been requested by Andy Revill (Cefas) from the MFA to enter the closed cod boxes in IVb and IVc during the trials as part of the general derogation. MFA will confirm their decision on this in due course. Delivery of derogation expected 10th July 2009
- ❖ The Jubilee Quest will sail from and return to Grimsby
- ❖ The Our Lass will sail from and return to Whitby

When will the work be done?

- ❖ Starting date of trials 19th June 2009 (subject to weather etc)
- ❖ End date of trials 2nd August 2009 (subject to weather etc)
- ❖ Total of 15 days of charter available
- ❖ One day of charter to be used for rigging and de-rigging of gear ashore
- ❖ Fourteen days of charter to be used for sea trials
- ❖ Fourteen days of sea trials to be split into two blocks of 7 days each (or thereabouts)

How will the work be done?

- ❖ Both ‘teams’ (i.e. Jubilee Quest and Our Lass II) will work together, each repeatedly towing their designated trawls along parallel tracks keeping around 0.25 nm apart from each other
- ❖ Both trawls must necessarily be shot and hauled together and have the same tow times and towing speeds in order to provide the basis for a useful comparison of the catches
- ❖ All hauls should ideally be of commercial length (i.e. typically 3-5 hours) but can be shortened if it is necessary to obtain more repeat hauls
- ❖ Both vessels will be issued with a dispensation (by the MFA) which will exempt the vessels from days at sea and quota restrictions for the duration of the sea trials

What trawl modifications will be tested?

- ❖ The most important trawl modification to test is the one suggested by skipper Graham Hall and involves inserting a section of 300mm mesh in to the trawl. This large mesh section will hopefully allow some cod to escape from the trawl, but allow other demersal fish to pass along to the cod end
- ❖ Before the trials commence, the ‘Jubilee Quest’ team will have made modifications to a standard demersal trawl by inserting a section of 300mm diamond mesh in the lower aft section of the trawl belly (before the extension).
- ❖ This modified trawl will be towed alongside and compared to an identical same trawl (which has not been modified) deployed from the Our Lass II.
- ❖ Both trawls must be identical in all respects (i.e. same make and model) with only the one exception – i.e. the modified trawl has the section of 300 mm mesh inserted. The rigging and attachment of the ground gear, sweeps and cod end construction must all be comparable between the two trawls.
- ❖ A spare section of 300 mm mesh will be carried onboard the Jubilee Quest to use if needed

Why we will probably need to make any other comparisons between different trawl types?

APPENDICES

- ❖ Assuming the trials with the modified trawl versus un-modified trawl are showing some promise (i.e. reducing cod catches) it would be useful to then compare the Eliminator trawl directly to the same un-modified trawl.
- ❖ This experiment would allow us to evaluate how the cod reductions obtained with the modified trawl compare to reductions obtained with the Eliminator trawl.
- ❖ In this case, the cod end construction need to be identical between the two trawls but sweep length and ground gear do not have to be exactly the same as they are both very different trawls by design.

Why we don't want to compare the modified trawl directly to the Eliminator trawl?

- ❖ If we do this and we don't catch many cod in either trawl – this will cause us a problem. We won't be sure if both trawls are both releasing a lot of cod or if there simply aren't many cod on the fishing grounds. This particular arrangement of trawl comparison is likely to be the least useful for getting useful information.

Why we need to ideally repeat the experiments on both vessels?

- ❖ All successful experiments (i.e. trawl comparisons) that have been completed during the first trip should ideally be repeated during the second trip with the trawls swapped over to the other vessel. This should eliminate any potential bias in the results (if any) due to vessel effects.

Experimental plan (for guidance only)

TRIP No	Experiment No	Jubilee Quest	Our Lass II	Target No of hauls
1	A	Modified demersal trawl	Unmodified trawl	6-10
1	B	Unmodified trawl	Eliminator trawl	6-10
2	A	Unmodified trawl	Modified demersal trawl	6-10
2	B	Eliminator trawl	Unmodified trawl	6-10

How many hauls might reasonably be expected during the sea trials?

- ❖ We might expect to be able to obtain 40 hauls in total during the sea trials. This assumes that four days are lost due to steaming, and that we obtain 4 hauls in any 24 hour period during the remaining 10 days.

I (and those I represent) agree in full with the content of this detailed operational plan and am willing to participate in these trials on these terms

Andy Revall (for Cefas)

Arnold Locker (for Locker Trawlers)

Andrew Allard (for Jubilee Fisheries)