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## Catch Comparison Trials with the Faithlie Cod Avoidance Panel (FCAP)

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### Summary

Catch comparison trials were conducted in the North Sea to evaluate the Faithlie Cod Avoidance Panel that has been developed by Willie Hepburn of Faithlie Trawls, Fraserburgh.

After modifying the original design by increasing the size of the fish outlet holes the results show a large and significant decrease in the number of the three main whitefish species retained. The reductions by weight of cod, haddock and whiting are 62, 74 and 66% respectively.

Due to the fact that there were very few *Nephrops* caught it is not possible to determine whether the Faithlie Cod Avoidance Panel has any effect on their capture

## Introduction

The Faithlie Cod Avoidance Panel (FCAP) was developed by Willie Hepburn of Faithlie Trawls, Fraserburgh, to reduce the bycatch of cod in *Nephrops* trawls. Initial trials by the Fishing Industry have suggested that a *Nephrops* trawl fitted with such a panel can reduce the capture of cod by 60% and hence fulfil the requirements as set out in the Scottish Fisheries Management and Conservation Group scheme rules to qualify as a ‘highly selective gear’. Here we report on trials carried out by Marine Scotland Science and the Scottish Fishermen’s Federation to evaluate this gear design in comparison to a standard gear used by the Scottish *Nephrops* fleet.

## The Faithlie Cod Avoidance Panel (FCAP) Design

The FCAP design incorporates an inclined panel in the tapered section of the gear where there are 200 open 80 mm meshes (or equivalent) in circumference. The panel is made of 300 mm netting which is intended to inhibit the passage of cod but permit that of *Nephrops*. It is expected that cod which do not go through the panel will escape through the two outlet holes that are cut out of the top sheet netting immediately ahead of the panel. There is also a hole at the bottom of the panel to allow the passage of benthos and ground fish species into the codend. A detailed definition of the positioning and design of the panel and fish outlet holes is provided in Appendix 1 and Figures 1-4.

## Materials and Methods

Trials were carried out during 28 July to 3 August 2012 on the *Victoria May*, PD267, a commercial twin rig *Nephrops* trawler. The gears used were the vessels own Faithlie “Letterbox” and Fidelis trawls. The Fidelis trawls are similar to a traditional Scottish *Nephrops* trawl and have a headline height of approximately 1.6 to 1.8 m. The Letterbox trawl is a coverless, low headline (approximately 0.6 m) *Nephrops* trawl which has been designed to reduce fish catches. The groundgear length for the Fidelis and Letterbox trawls were 54 m and 60 m respectively, consisting of 200 mm discs in the centre reducing to 150 mm discs out to the wingends. Both gears were fished using a three-warp system with 110 mm combination sweeps, 950 kg roller clump and 1.94 m<sup>2</sup> Thyborøn doors. The codends (test/control) were constructed from 80 mm (nominal) diamond mesh netting, 4 mm single PE twine, with 100 open meshes in circumference, 15 m in length and rigged with 160 mm lifting bags/covers constructed from 5 mm double PE twine. The square mesh panels were constructed from 4 mm single PE twine.

The comparative twin trawl haul method was used to assess the effect on cod catches of inserting the FCAP into each of these gears. Two sets of trials were initially planned:

- i. A comparison of the Fidelis trawl with and without an FCAP inserted, and
- ii. A comparison of a Letterbox trawl with and without an FCAP inserted. However, as the trials progressed, it was decided to make a third comparison, that of

- iii. The Fidelis trawl with and without a modified FCAP (FCAP2) inserted.

The gears compared were rigged as follows:

#### **Fidelis Trawl with and without an FCAP**

In the first set of trials the control gear was a Fidelis trawl with a 3 m long 110 mm SMP inserted at 15-18 m from the codline and an 80 mm diamond mesh codend. It was compared with a Fidelis trawl with an FCAP inserted and with a 3 m long 120 mm SMP inserted at 15-18 m from the codline and an 80 mm diamond mesh codend.

#### **Letterbox Trawl with and without an FCAP**

In the second set the control gear was a Letterbox trawl with a 3 m long 110 mm SMP inserted at 15-18 m from the codline and an 80 mm diamond mesh codend and it was compared with a Letterbox trawl with an FCAP inserted and with a 3 m long 130 mm SMP inserted at 15-18 m from the codline and an 80 mm diamond mesh codend.

#### **Fidelis Trawl with and without an FCAP2**

In the third set the control gear was the same as in the first, i.e. a Fidelis trawl with a 3 m long 110 mm SMP inserted at 15-18 m from the codline and an 80 mm diamond mesh codend. It was compared with a Fidelis trawl with a modified FCAP design, where the base of the two fish outlet holes was increased from 15 to 28 meshes and then cut forward on bar meshes, at each side, until there are 9 open meshes across (Figure 5). The test gear also had a 3 m long 120 mm SMP inserted at 15-18m from the codline and an 80 mm diamond mesh codend.

In addition, in order to assess their relative performance, the standard Fidelis trawl and the Letterbox trawl were towed alternately as the control gear for four pairs of hauls.

All cod, haddock and whiting, were sorted from the catch. All cod and subsamples of haddock and whiting were measured to the cm below. The live weights were estimated from the resulting length-frequency plots using the length-weight relationships of Coull *et al*, (1989). The mesh sizes of the codends and square mesh panels were measured, whilst the netting was wet, using the Omega Gauge with a 120N measuring force (Table 1) (Fonteyne *et al*. 2007).

#### **Data Analysis**

Cod, haddock and whiting catches from the test and control codends were analysed using the smoother based methodology of Fryer *et al*, (2003).

The analysis is in three stages: a smoother was used to model the log catch rate of the test gear relative to the control gear for each haul; the fitted smoothers were combined over hauls to estimate the mean log relative catch rate for each gear and bootstrap hypothesis tests using the statistic  $T_{\max}$  were used to assess whether the mean log relative catch rates depended on the gear fished and to compare the mean log relative catch rates to zero (or equivalently the mean relative catch rates to unity).

All p-values of pairwise comparisons have been adjusted for the number of comparisons, unless otherwise stated. The analysis was on the logistic scale, but the results have been back-transformed for presentation.

## Results

All hauls took place on the Fladden Grounds; the first haul was made at Skate Hole but then the vessel steamed over night to grounds between Tommy Raes and the Long Hole where hauls were made until the end of the trials. A total of 19 hauls were completed during the trials with good numbers of cod and haddock, but with limited numbers of whiting and monk fish. Very few *Nephrops* were encountered during the trials which was also the case for commercial *Nephrops* vessels fishing on northern North Sea grounds at the time. Fishing depths ranged from 110 m to 137 m and speed over the ground ranged from 2.8 kts to 3.0 kts which was the vessels usual towing speed.

### Fidelis Trawl with and without an FCAP

#### Cod

Eight hauls were made comparing the Fidelis trawl with and without an FCAP. The results were variable: in seven hauls the test gear gave a reduction of between 25 to 62% in the live weight of cod; and one haul gave an increase of 81%. Overall reduction in cod live weight was 35% and by number was 27% (Table 2).

A smoother analysis demonstrated that there was a pointwise difference between the standard Fidelis trawl and one fitted with the FCAP for cod > 49 cm (Figure 6).

#### Haddock and Whiting.

Fitting the FCAP in the Fidelis trawl led to significant reduction in the capture of haddock and whiting. The overall the reduction in live weight was 59% for haddock and 41% for whiting (Tables 6 and 7, Figures 7 and 8).

## **Letterbox Trawl with and without an FCAP**

Cod

Four hauls were made comparing the “Letterbox” trawl with and without the FCAP. The FCAP reduced the capture of cod by between 17 and 43% giving an overall reduction in cod live weight of 24% (and 18% by number) (Table 3).

The smoother analysis did not find a significant difference between the standard Letterbox trawl and one fitted with the FCAP, although, this is probably due to the low number of tows (Figure 6).

Haddock and Whiting.

There was no significant difference in the capture of these species between a Letterbox trawl fished with and without an FCAP (Figure 7 and 8). This is probably because the low headline, coverless Letterbox trawl already selects for haddock and whiting at the headline (Kynoch, *et al* 2011) and accordingly the resulting catches of these two species were low in both test and control Letterbox gears (Tables 6 and 7). This explanation is further supported by the four pairs of alternate hauls that compare the Fidelis and Letterbox trawls and which suggest there is no difference in the capture of cod but that the Letterbox trawl is very effective at reducing the capture of haddock and whiting (Table 5, Figures 9-11).

## **Fidelis Trawl with and without an FCAP2**

Owing to the fact that inserting the FCAP in either the Fidelis or Letterbox gears did not give rise to a 60% reduction in the live weight of cod it was decided to modify the FCAP design by increasing the size of the fish outlet holes ahead of the inclined panel. Both fish outlet holes were increased from 15 to 28 meshes and then cut forward along the bar meshes until there were 9 open meshes across (Figure 5). Seven hauls were made comparing the Fidelis trawl with and without this modified FCAP (FCAP2).

Cod

The FCAP2 reduced the capture of cod by between 49 and 74% leading to an overall reduction in live weight of 62% (and a 56% reduction by number) (Table 4).

The smoother analysis showed that the standard Fidelis trawl differed significantly from one fitted with the FCAP2 and that for cod > 57 cm more than 60% (by number) were released (Figure 6).



Haddock and whiting.

Fitting the FCAP2 in the Fidelis trawl led to significant reduction in the capture of haddock and whiting. The overall reduction in live weight was 74% for haddock and 66% for whiting (Tables 6 and 7, Figures 7 and 8).

## Discussion

Fitting an FCAP to the standard Fidelis trawl reduced the capture of cod, haddock and whiting by 35, 59 and 41% respectively, while fitting it to the Letterbox trawl led to corresponding reductions of 24, 24 and 50%.

By increasing the size of the fish outlet holes ahead of the inclined panel it was possible to further reduce the relative capture of cod to 62% and the relative capture of haddock and whiting to 74 and 66% respectively. Hence, the modified FCAP or FCAP2 design achieves the criterion of releasing 60% of cod by weight to qualify as a 'highly selective gear' under the FMAC scheme rules.

There is a length dependency for cod in each of the gears with fewer larger fish being retained in each case. For the FCAP2 gear, more than 60% (by number) of cod > 57 cm are released.

The four pairs of alternate hauls that compare the Fidelis and Letterbox trawls support the results of recent studies (Kynoch, *et al* 2011) which show that while low headline, coverless trawls can be very effective at reducing the capture of haddock and whiting, they do not reduce the capture of cod.

There were very few *Nephrops* caught and it is not possible to determine whether the FCAP or FCAP2 had any effect on their capture.

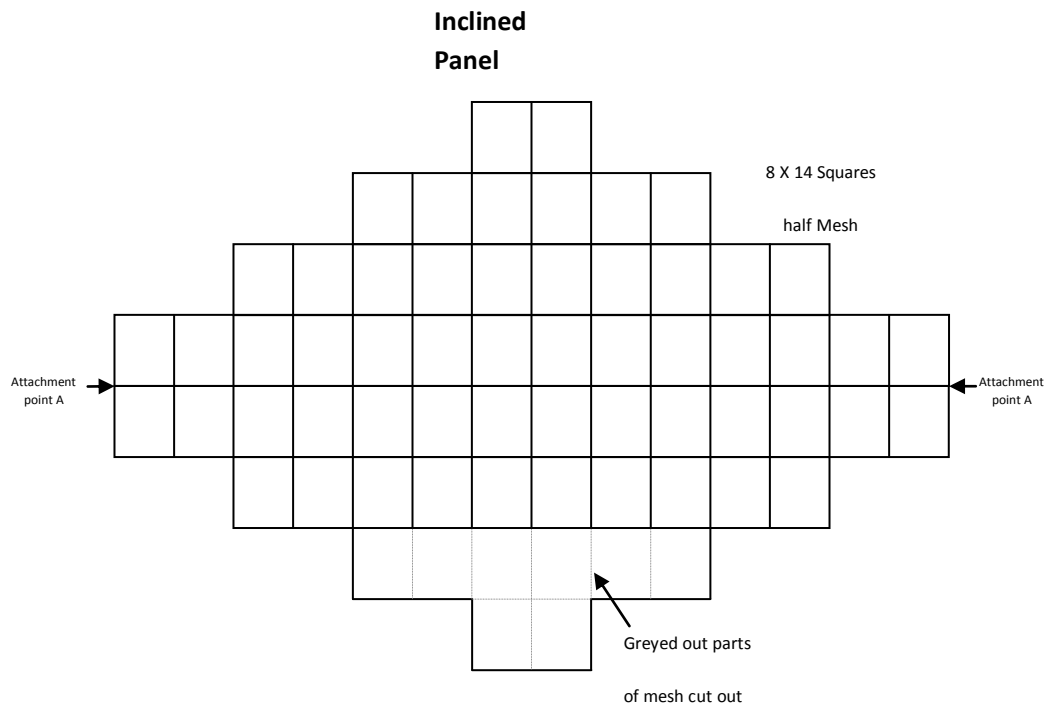
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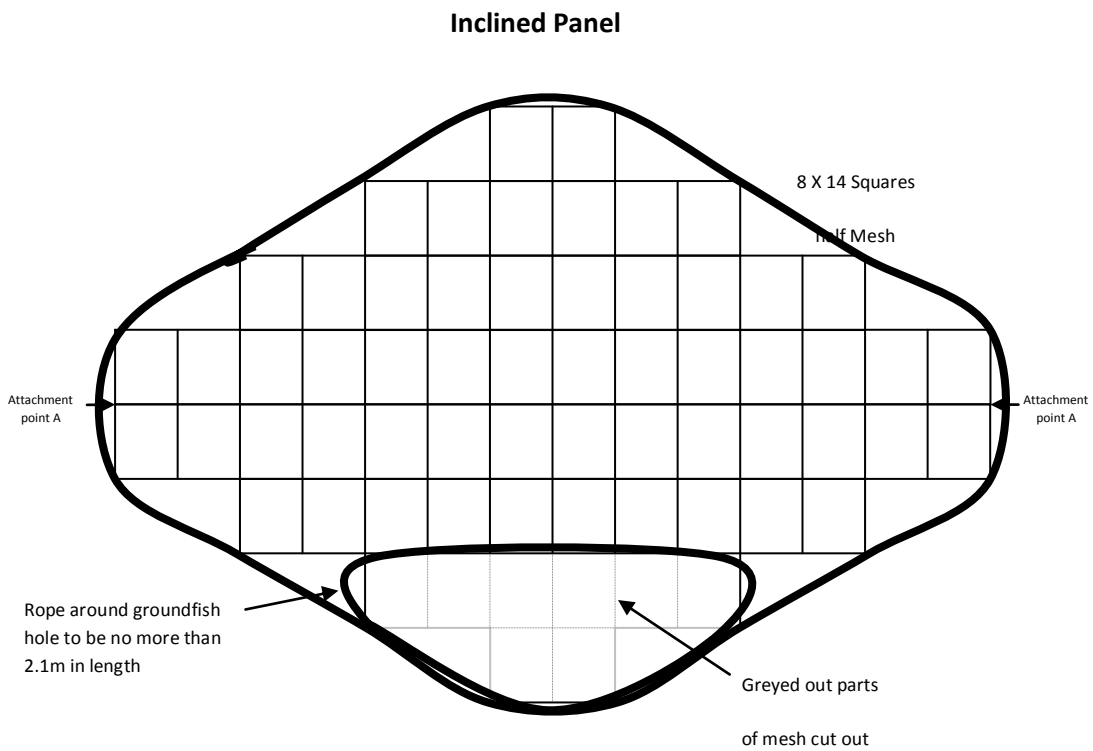
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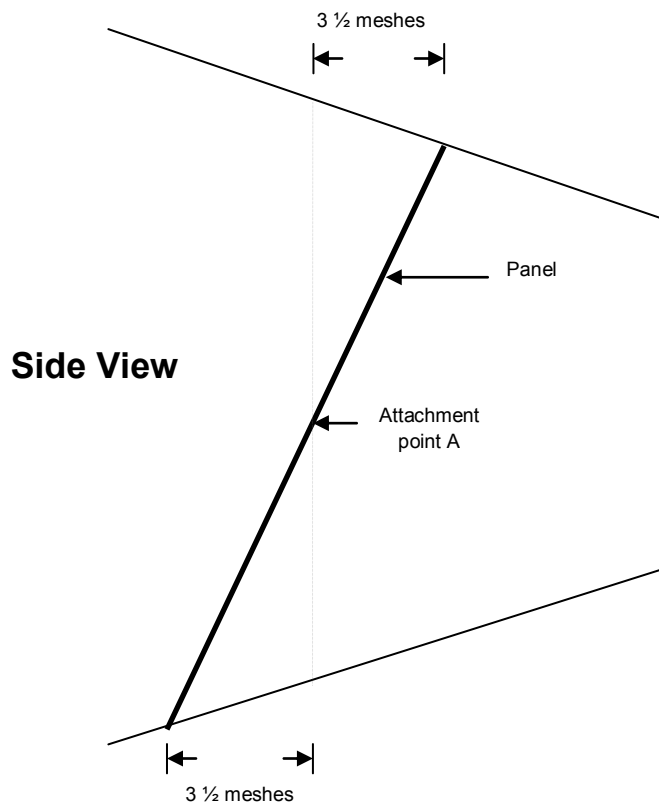
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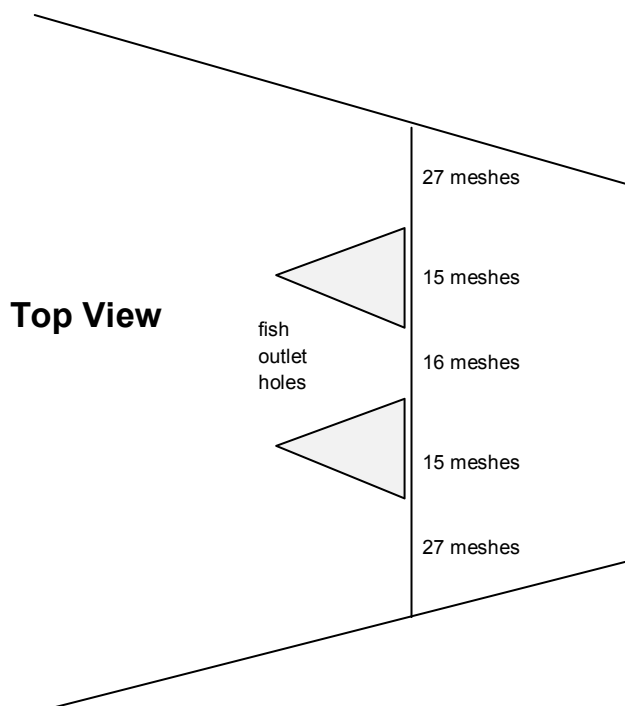
**Figure 1:** Design of inclined panel.



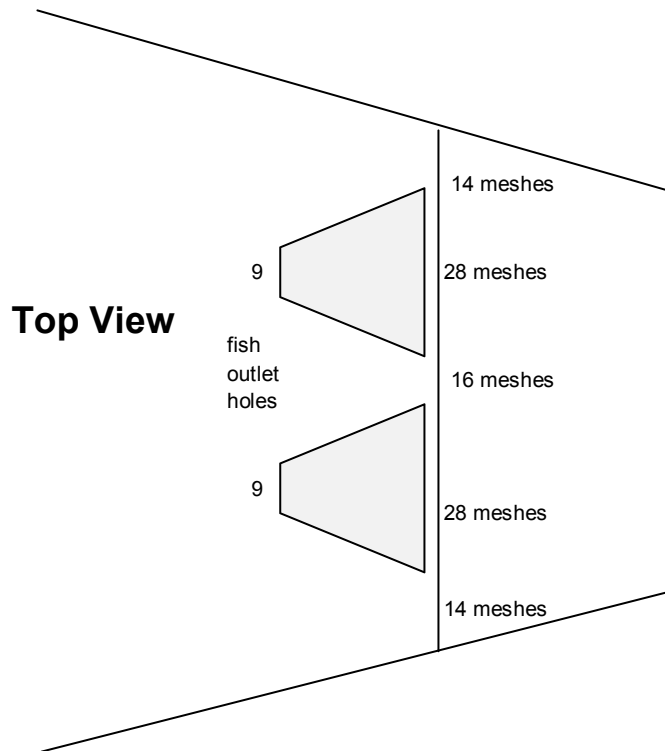
**Figure 2:** Roped inclined panel with roped ground-fish hole.



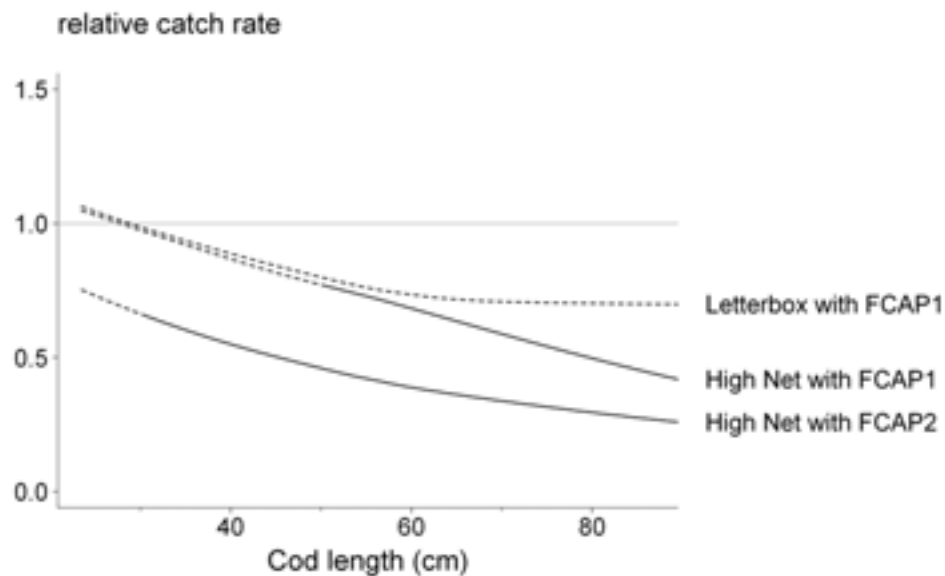
**Figure 3:** Side view of position of the Faithlie Cod Avoidance Panels (FCAP and FCAP2).



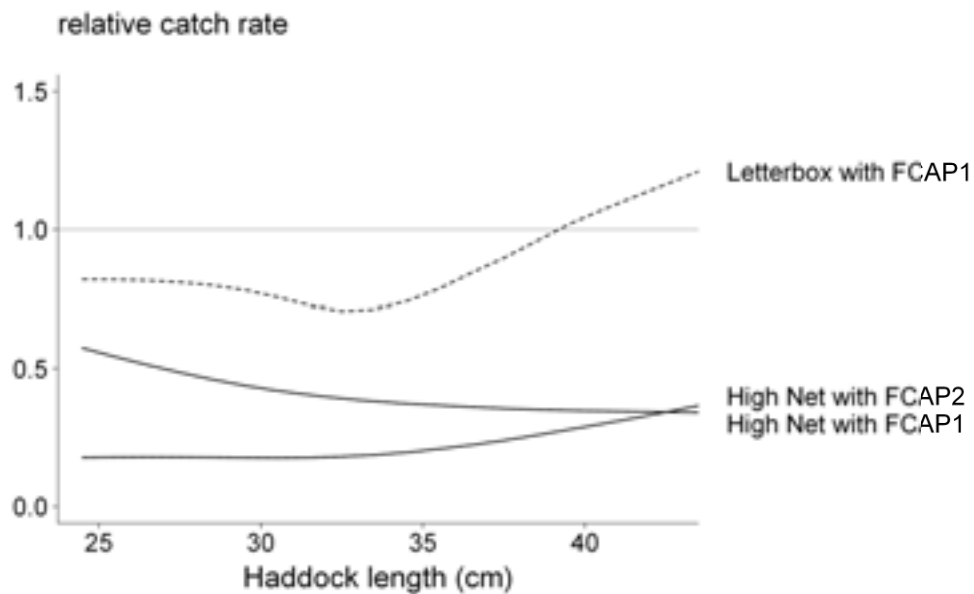
**Figure 4:** Top view of design and position of fish outlet holes of the original Faithlie Cod Avoidance Panel (FCAP).



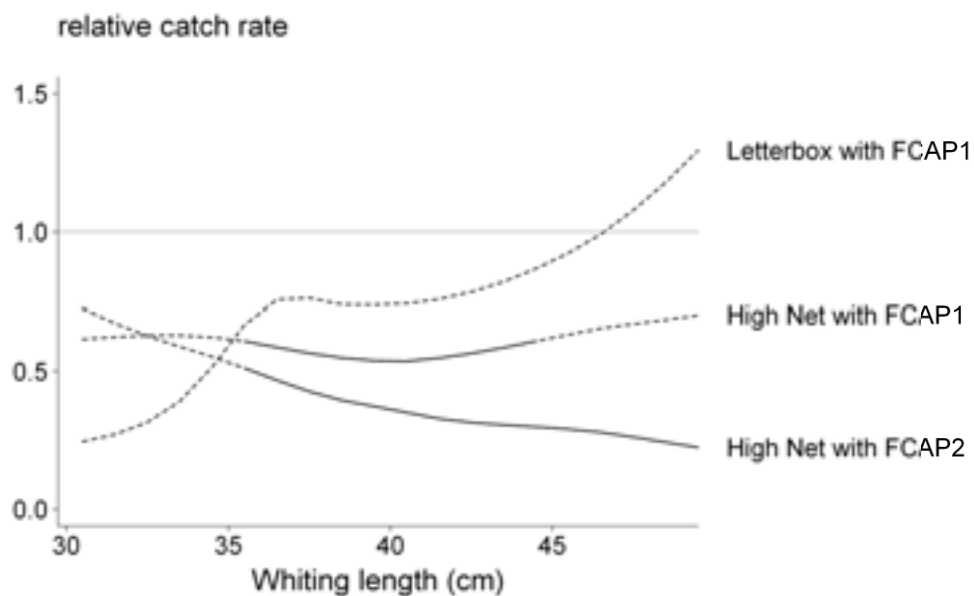
**Figure 5:** Top view of design and position of fish outlet holes of the modified Faithlie Cod Avoidance Panel (FCAP2).



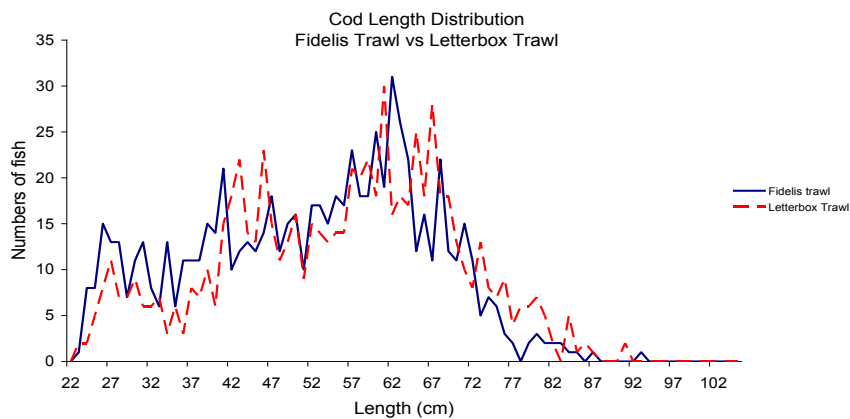
**Figure 6:** The selective performance of the Fidelis trawl with (i) the FCAP1 fitted; and (ii) the FCAP2 fitted, in relation to a standard Fidelis trawl; and the selective performance of the Letterbox trawl with the FCAP1 fitted in relation to a standard Letterbox trawl.



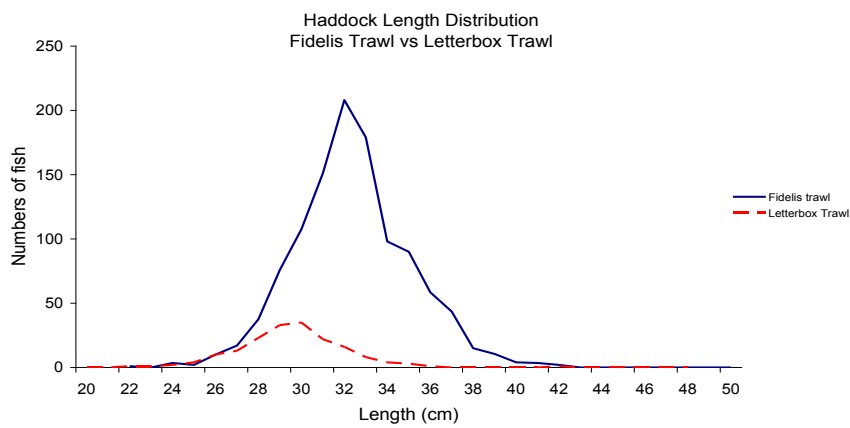
**Figure 7:** The selective performance of the Fidelis trawl with (i) the FCAP1 fitted; and (ii) the FCAP2 fitted, in relation to a standard Fidelis trawl; and the selective performance of the Letterbox trawl with the FCAP1 fitted in relation to a standard Letterbox trawl.



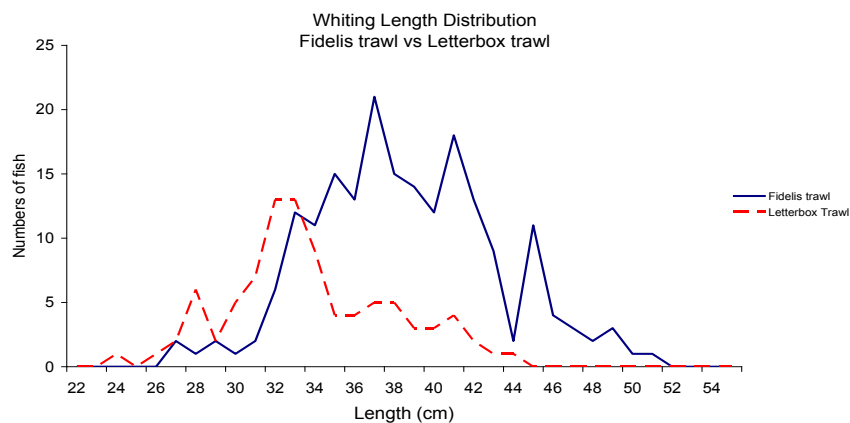
**Figure 8:** The selective performance of the Fidelis trawl with (i) the FCAP1 fitted; and (ii) the FCAP2 fitted, in relation to a standard Fidelis trawl; and the selective performance of the Letterbox trawl with the FCAP1 fitted in relation to a standard Letterbox trawl.



**Figure 9:** Cod length distribution for Fidelis and Letterbox trawls.



**Figure 10:** Haddock length distribution for Fidelis and Letterbox trawls.



**Figure 11:** Whiting length distribution for Fidelis and Letterbox trawls.

**Table 1**

Mesh measurements using the OMEGA gauge set to 125Nm measuring force.

Description	Codend (mm)	Square mesh panel (mm)
Control Fidelis	84.2	112.4
Test Fidelis	84.6	121.0
Control Letterbox	81.5	112.7
Test Letterbox	82.0	133.3

**Table 2**

Cod results comparing a standard Fidelis trawl (control) and a Fidelis trawl with an FCAP inserted (test).

Haul No	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Control	Test (FCAP)	Test/Control	Control	Test (FCAP)	Test/Control
1	26	21	-20	23	19	-17
2	465	184	-61	195	111	-43
3	657	250	-62	278	131	-53
4	270	490	81	122	196	60
5	208	147	-29	102	84	-18
6	318	240	-25	122	97	-20
7	358	203	-43	139	79	-43
8	543	304	-44	239	176	-26
Hauls combined	2845	1839	-35	1220	893	-27



**Table 3**

Cod results comparing a Letterbox trawl (control) and a Letterbox trawl with an FCAP inserted (test).

Haul No	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Control	Test (FCAP)	Test/Control	Control	Test (FCAP)	Test/Control
11	511	424	-17	232	227	-2
12	449	373	-17	196	173	-12
15	385	221	-43	181	98	-46
18	203	152	-25	121	97	-20
Hauls combined	1548	1170	-24	730	595	-18

**Table 4**

Cod results comparing a standard Fidelis trawl (control) and a Fidelis trawl with a modified FCAP (FCAP2) inserted (test).

Haul No	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Control	Test (FCAP2)	Test/Control	Control	Test (FCAP2)	Test/Control
9	240	123	-49	113	75	-34
10	437	112	-74	198	73	-63
13	554	209	-62	266	106	-60
14	232	93	-60	180	53	-71
16	435	172	-60	191	115	-40
17	463	184	-60	222	104	-53
19	137	46	-67	107	35	-67
Hauls combined	2498	939	-62	1277	561	-56

**Table 5**

Cod results for alternate hauls comparing Fidelis and "Letterbox" control trawls.

Haul Nos	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Fidelis	Letterbox	Letterbox/Fidelis	Fidelis	Letterbox	Letterbox/Fidelis
10 v 11	437	511	17	198	232	17
12 v 13	555	449	-26	266	196	-26
14 v 15	232	385	66	180	181	0
18 v 19	137	203	48	107	121	13
Hauls combined	1362	1548	14	751	730	-3

**Table 6**

Bulk haddock results comparing (i) a standard Fidelis trawl with and without an FCAP; (ii) a Letterbox trawl with and without an FCAP; and (iii) a Fidelis trawl with and without an FCAP2.

Gear	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Control	Test	Test/Control	Control	Test	Test/Control
FCAP in Fidelis	895	367	-59	2497	1063	-57
FCAP in Letterbox	58	44	-24	177	136	-23
FCAP2 in Fidelis	595	155	-74	1679	423	-75

**Table 7**

Bulk whiting results comparing (i) a standard Fidelis trawl with and without an FCAP; (ii) a Letterbox trawl with and without an FCAP; and (iii) a Fidelis trawl with and without an FCAP2.

Gear	Live weight (kg)		% difference in live weight	Number of fish		% difference in numbers
	Control	Test	Test/Control	Control	Test	Test/Control
FCAP in Fidelis	385	227	-41	896	532	-41
FCAP in Letterbox	31	15	-50	91	35	-62
FCAP2 in Fidelis	225	76	-66	429	156	-64

## **Appendix 1**

### **The Unmodified Faithlie Cod Avoidance Panel (FCAP) Design**

#### **Design of Inclined Panel**

- The Faithlie Cod Avoidance Panel is made from netting of mesh size of at most 300 mm.
- It is hung on the square and is 8 bars in height and 14 bars wide.
- It is cut out as shown in Figure 1.
- It can be roped around the perimeter in such a way so as not to distort the panel when laid flat (Figure 2).
- To allow the passage of benthos and ground fish species, it is permitted to create a hole at the bottom of the panel, by cutting out the mesh bars shown in Figure 1. For strength and integrity the perimeter of the hole must be roped with a rope whose length is no more than 2.1 m and whose diameter is no more than 12mm (Figure 2).

#### **Positioning of Panel**

- Attachment Points A are fitted to the selvages in the tapered section of the gear where there are 200 open 80 mm meshes (or equivalent) in circumference.
- Attachment Point B is fitted to the centre of the top sheet 3½ meshes aft of the cross section that is described by attachment Point A.
- Attachment Point C is fitted to the centre of the bottom sheet 3½ meshes forward of the cross section that is described by attachment Point A (Figure 3).
- The perimeter of panel is fitted to the trawl netting, length for length, between the attachment points.

#### **Fish Outlet Holes**

- Two unblocked fish outlet holes (with clean meshes all the way around) must be cut out of the trawls top sheet netting not more than two meshes ahead of the inclined panel at any point.
- They must be positioned 8 x 80 mm diamond meshes (or equivalent) meshes either side of the centre line.
- The opening width of the posterior side of these fish outlets should be no less than 15 x 80 mm diamond meshes (or equivalent) across and cut out to a tip in the forward direction along mesh bars (Figure 3).



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