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Catch Comparison Trials of the Flip Flap netting Grid Trawl

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Summary

A pair of catch comparison trials was conducted in the North Sea to compare a standard *Nephrops* scraper trawl with the Flip Flap netting Grid (FFG) trawl which has been developed by Michael Watt of Gamrie Bay Trawls.

The results show a large and significant decrease in the number of the three main whitefish species retained by FFG gear. The reductions by weight of cod, haddock and whiting are 73, 67 and 82% respectively.

Nephrops catches were very similar for each gear and there is a weak suggestion that fewer monkfish and megrim were retained by the FFG gear.

Introduction

The Flip Flap netting Grid (FFG) trawl was developed by Michael Watt, owner of Gamrie Bay Trawls, to reduce fish bycatch in *Nephrops* trawls. He perfected the design during trials carried out during normal commercial operations and the results were considered encouraging enough that at a Conservation Credits meeting in January 2011, it was decided to send observers from the Scottish Fishermen's Federation (SFF) to assess the gear and subsequently for Marine Scotland Science (MSS) to carry out scientific catch comparison trials. Here we report on the two sets of trials carried out by MSS to evaluate this new gear design in comparison to a standard gear used by the Scottish *Nephrops* fleet in the North Sea.

The Flip Flap Netting Grid Design

The FFG design incorporates a number of specific features (Figure 1). These are (i) the 160 mm mesh size netting in the top wing and top sheet netting panels; (ii) the flip-flap netting grid and fish outlet hole and (iii) the 200 mm square mesh panel fitted forward of the fish outlet hole. (A detailed definition is supplied in Appendix 1)

The rationale of this design is that the 160 mm mesh size forward netting panels and the 200 mm mesh size SMP would select for small-medium gadoids. Those that are not selected by these panels, in particular larger cod, would be further encouraged by the vertical panel to leave through the fish outlet hole positioned directly above. Groundfish species such as monkfish (anglerfish) which are thought to move closer to the bottom panel would hopefully overcome the resistance presented by the weighted section and proceed to the codend. *Nephrops* were expected to pass directly through the large meshes of the vertical panel.

Diagram of the Flip-Flap 'netting' Grid trawl

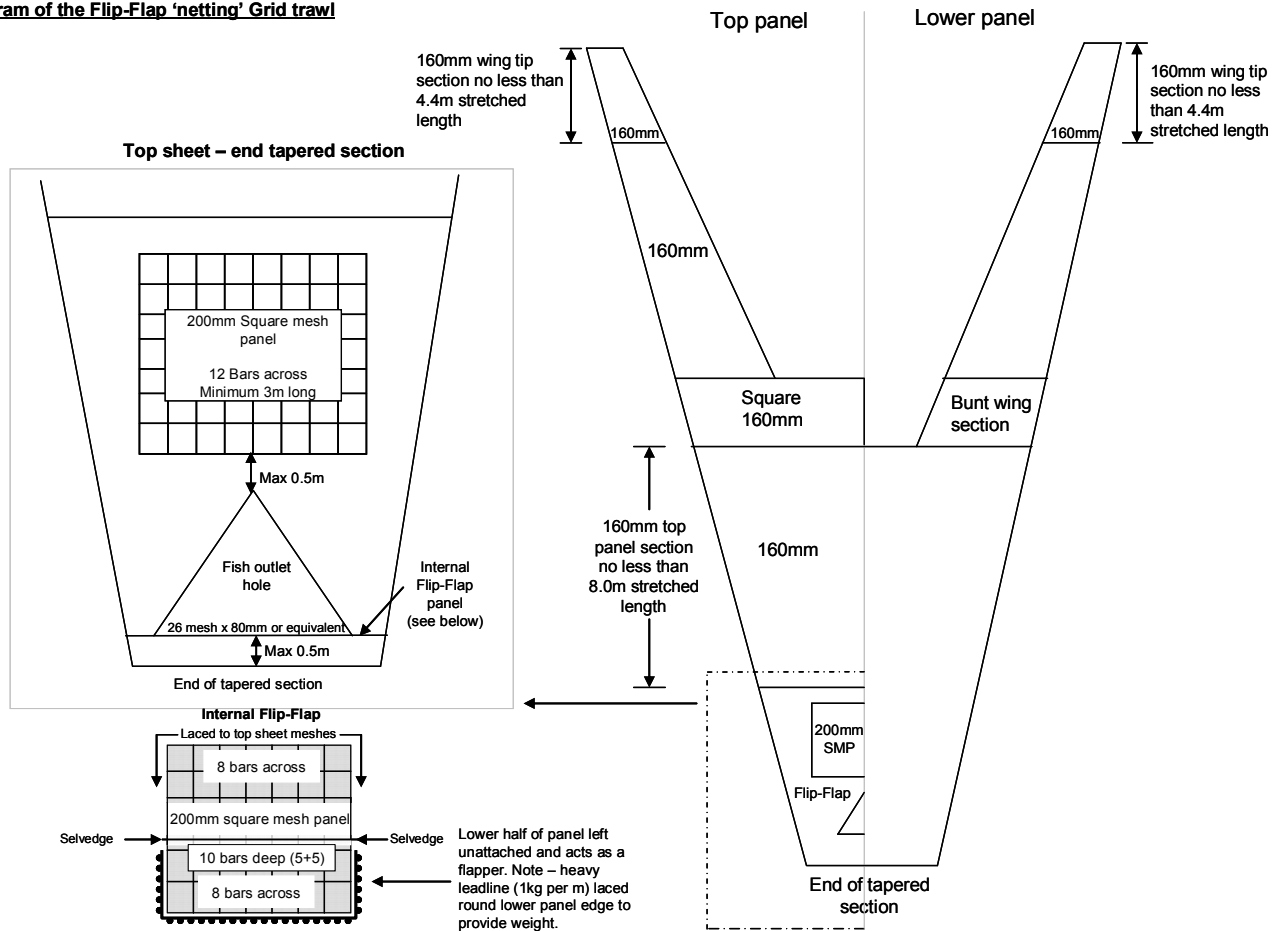


Figure 1: The FFG design.

Materials and Methods

The twin trawl method was used to perform catch comparison trials aboard the *Sardonyx II*, a 373 KW twin-rig *Nephrops* and whitefish trawler, during commercial fishing trips in July and November 2011.

For the trials a standard Gamrie Scraper net was fished alongside an identical gear that had been modified to incorporate the FFG design described above. These gears were the control and test nets respectively. They had a fishing circle of 560 x 80 mm (nominal) meshes and were constructed completely from high tenacity PE twine. The groundgears consisted of 49 m of disks: 200 mm disks for the central 8.5 m reducing to 150 mm out to the wing ends with 110 m sweeps constructed from 26 mm combination. The trawls were fished using a three-warp system utilising a 410 kg chain mat clump and spread using 7 feet/480 kg Dangreen doors. The diamond mesh codends had 100 open meshes in circumference, were 150 meshes in length and made from 4 mm single PE. The mesh size of the control measured 82 mm and that of the test 90 mm (using the Omega Gauge (Foyntene *et al*, 2007)). The standard gear had a 130 mm square mesh panel (SMP) positioned in the end

of the taper at 12-15 m from the codline and the codends of both gears were fitted with 160 mm diamond mesh lifting bags made from 5 mm double PE twine.

Trials were conducted over 24-28 July and 20-25 November 2011 during commercial trips on *Nephrops* tows around the H&I and the A&E Holes in the northern Fladens and in the Moray Firth. Door to Clump distances were measured using the vessels Notus system. Most hauls lasted between five and six hours, with the vessel towing at its normal fishing speed of 2.4 – 2.6 kts. To minimise tidal effects on the twin rig geometry, hauls were conducted, as far as possible, either with or against the tide. The positions of the test and control nets were swapped at intervals during the cruises to eliminate any possible port-starboard bias. All cod, haddock, and whiting, were sorted from the bulk catch and separated into landed and discarded categories. Discard class haddock would often require subsampling; this was done using a calibrated 50 kg Salter hanging balance or, during periods of poor weather, by volume after obtaining calibrated basket weights. There was no subsampling of cod and only one instance of whiting discards needing to be subsampled. Fish were measured to the cm below and after obtaining a full length frequency an estimated total weight was obtained using the length-weight relationships of Coull *et al*, (1989). Bulk weights were noted for nephrops, monkfish and megrim.

Data Analysis

For each species where there were sufficient data, the 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

A total of 22 hauls were undertaken during the two sets of trials of which 19 were considered valid. On the northern Fladen grounds there were very good catches of mixed whitefish and poor-fair catches of *Nephrops*, with relatively poor fishing for most species except haddock being found in the Moray Firth. Clump to port door distances averaged at 60.2 m and those to starboard door averaged 60.4 m.

The smoothed data for cod, haddock and whiting show that the catch rates of the test gear differed in each case from that of the control gear. There was a general decrease in retention with increasing length which levels out for whiting and haddock data but continues to decrease for cod. There were no significant differences in the relative catch rates of haddock and whiting between the three trial areas. For cod there was no difference in catch rates between the H&I area and the A&E area but some difference between these two and those of the Moray Firth. However, the cod catches from the Moray Firth are very low and a separate analysis is not applicable in this case. Results for the three species from the three areas combined are illustrated in Figures 2 - 4. The relative catch rate is shown as the proportion of fish retained at each length in the FFG gear in comparison to the standard net. A value of one indicates that the same number of fish was retained by both gears and a value of zero indicates all fish were released by the test gear. A dashed line indicates where the proportion of fish retained did not differ significantly from one, whereas a solid line indicates the difference is significant.

Cod

The catch rate of the test gear differed significantly from those of the control net ($p=0.003$). There was an approximately 30% reduction (by number) of small cod at 32 cm in length. Below this down to about 26cm, the smallest size analysed, there was no significant difference between test and control. At the minimum landing size (MLS) of 35cm there was a 33% reduction and by 87cm (maximum size analysed) there was a 76% reduction. The largest cod retained by the test net was 91cm with overall 28 fish retained at 80cm or larger; the control net retained 334 cod at 80cm or larger with the largest being 116cm. By weight, there was a 73% reduction in the catch of cod (Table 1).

Haddock

The catch rate of the test gear differed significantly from that of the control net ($p<0.001$). There was an approximately 51% reduction of small haddock at the smallest length analysed of 21 cm. At the minimum landing size (MLS) of 30cm the reduction was 67% and for a fish of 44cm it was 73%. The largest haddock retained by both test and control nets was 49cm with the test retaining 5 fish at 45cm or larger and the control retaining 11. By weight, there was a 67% reduction in the catch of haddock (Table 2).

Whiting

The catch rate of the test gear differed significantly from that of the control net ($p<0.001$). There was an approximately 62% reduction at 26cm the smallest size of whiting analysed. At the minimum landing size (MLS) of 27cm the reduction was 64% and for whiting larger than 48cm it was 84%. The largest whiting retained by the test net was 55 cm with a total of 17 retained of 45cm and larger. The largest whiting retained by the control net was 53cm and a total of 171 retained of 45cm and larger. By weight, there was an 82% reduction in the catch of whiting (Table 3).

***Nephrops*, Monkfish (Angler), Megrim**

Bulk weights were taken of *nephrops*, monkfish and megrim from each codend for comparison (Table 4). *Nephrops* catches were very similar for each gear, there is a weak suggestion that there was slightly less monk and megrim retained by test gear

Discussion

The results for the three main whitefish species show a large and significant decrease in the number retained by FFG gear (Table 3). The reductions by weight of cod, haddock and whiting are 73, 67 and 82% respectively. There is a length dependency for all three species and in each case fewer larger fish are retained. This is particularly the case for cod where at the minimum landing size (MLS) of 35cm there is a 33% reduction by number, and at 87cm (maximum size analysed) the reduction is 76% in comparison to the standard gear. For haddock, there is a 67% reduction at the MLS of 30 cm and 73% reduction at 44 cm and for whiting there is a 64% reduction at the MLS of 27 cm and 84% at 48 cm.

The design of the FFG gear is such that there are a number of areas where selection can take place. In comparison to the standard gear, additional escapes may occur through (i) the 160 mm mesh top wing and top sheet netting panels, (ii) at the flip-flap netting grid and fish outlet hole and (iii) through the 200 mm square mesh panel fitted forward of the fish outlet hole. It is not clear to what extent each of these features contribute to the overall selection process. It may vary between hauls, which may explain the between-haul variability of selection observed during the trials.

There was also a difference in the codend mesh size between the two gears; that of standard gear was 82 mm whereas that of the test gear was 90 mm. This difference, however, will have little bearing on the results as it is likely to only affect the selectivity of small juveniles < 30 cm.

There were no handling issues other than that on several occasions there were cod or hake backed up on the codend side of the vertical panel and these needed to be shaken down into the codend. Blocking of the vertical panel was infrequent. There were many instances where the codend catch contained brown crab, stone crab, and detritus etc but none of these was observed on the FFG panel indicating that they will not clog it.

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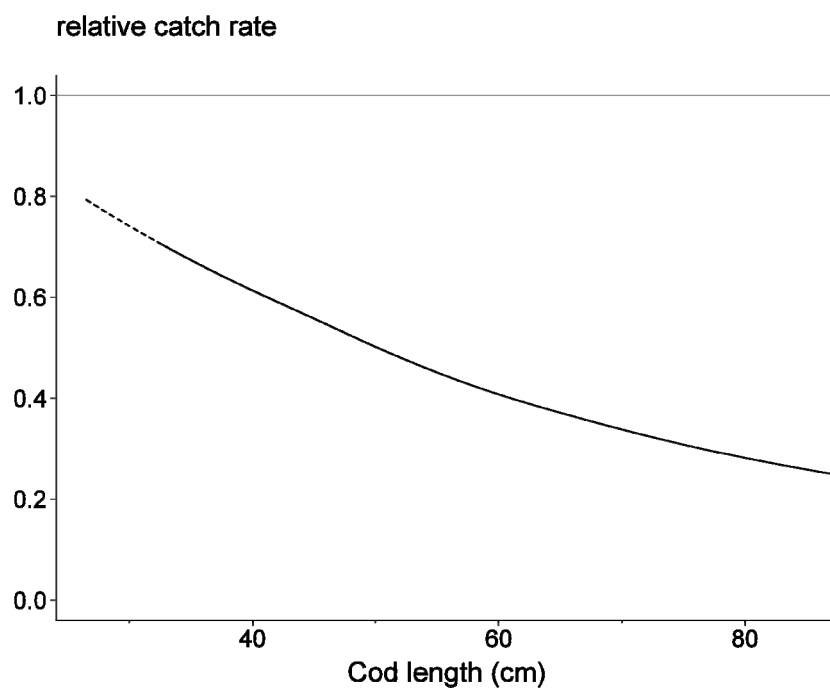


Figure 2: The relative catch rate of cod by FFG tested in comparison to standard Gamrie scraper net.

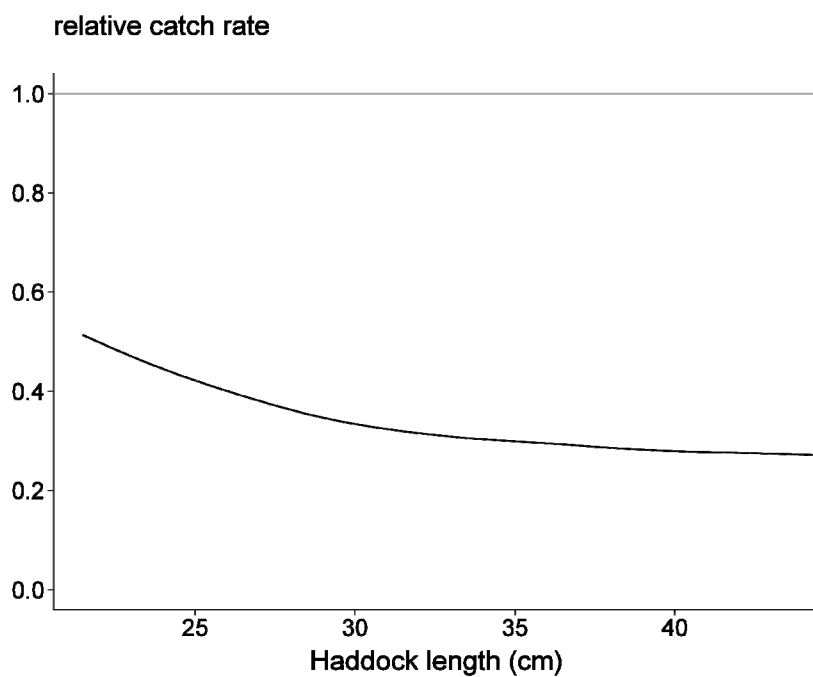


Figure 3: The relative catch rate of haddock by FFG tested in comparison to standard Gamrie scraper net.

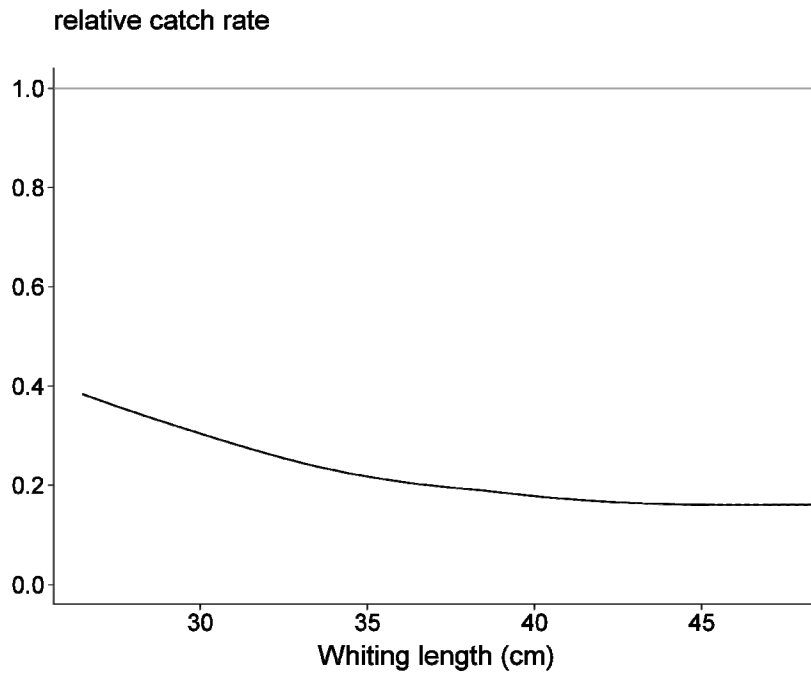


Figure 4: The relative catch rate of whiting by FFG tested in comparison to standard Gamrie scraper net.

Table 1

Number and estimated weight comparisons for cod using FFG as compared with the catch from the standard net. Missing haul numbers refer to foul hauls.

Cod results

Haul No.	Area	Test		Control		Cod number	Cod weight
		Cod No.	Cod Wt (kg)	Cod No.	Cod Wt (kg)	% reduction	% reduction
1	NE Holes	334	448	384	545	13	18
2	NE Holes	134	217	495	1730	73	87
3	NE Holes	117	141	199	281	41	50
4	NE Holes	67	99	702	2711	90	96
6	NE Holes	162	117	263	200	38	41
8	NE Holes	71	80	105	134	32	41
9	NE Holes	119	136	277	307	57	55
10	NE Holes	98	101	165	168	41	40
11	NE Holes	162	178	258	364	37	51
12	NE Holes	52	80	131	180	60	56
13	NE Holes	39	79	174	408	78	81
14	NE Holes	148	367	274	711	46	48
15	NE Holes	50	104	116	252	57	59
17	M. Firth	15	21	50	70	70	70
18	M. Firth	9	7	37	48	76	85
19	M. Firth	1	0.4	1	0.5	0	33
20	M. Firth	1	0.4	0	0	-	-
21	M. Firth	3	2	6	11	50	81
22	M. Firth	6	4	19	27	68	84
totals		1588	2183	3656	8147	57	73

Table 2

Number and estimated weight comparisons for haddock using FFG as compared with the catch from the standard net. Missing haul numbers refer to foul hauls.

Haddock results

Haul No.	Area	Test		Control		Haddock number	haddock weight
		haddock No	haddock Wt (kg)	haddock No	haddock Wt (kg)	% reduction	% reduction
1	NE Holes	395	91	1709	385	77	76
2	NE Holes	232	57	682	180	66	68
3	NE Holes	297	81	988	266	70	70
4	NE Holes	100	24	262	65	62	64
6	NE Holes	543	125	1665	383	67	67
8	NE Holes	188	45	144	35	-31	-27
9	NE Holes	315	68	1160	264	73	74
10	NE Holes	96	24	418	112	77	79
11	NE Holes	179	49	583	184	69	73
12	NE Holes	50	17	146	49	66	65
13	NE Holes	21	7	110	52	81	87
14	NE Holes	16	6	89	34	82	82
15	NE Holes	73	25	321	104	77	76
17	M. Firth	220	65	551	175	60	63
18	M. Firth	-	-	-	-	-	-
19	M. Firth	498	126	1015	260	51	52
20	M. Firth	578	137	1027	247	44	45
21	M. Firth	63	22	222	70	72	69
22	M. Firth	150	50	622	192	76	74
totals		4014	1018	11714	3057	66	67

Table 3

Number and estimated weight comparisons for whiting using FFG as compared with the catch from the standard net. Missing haul numbers refer to foul hauls.

Whiting results

Haul No.	Area	Test		Control		Haddock number	haddock weight
		Whi No	Whi Wt (kg)	Whi No	Whi Wt (kg)	% reduction	% reduction
1	NE Holes	9	4	126	59	93	93
2	NE Holes	41	20	256	125	84	84
3	NE Holes	56	27	447	230	87	88
4	NE Holes	10	4	34	16	71	74
6	NE Holes	54	23	256	106	79	78
8	NE Holes	7	3	15	7	53	57
9	NE Holes	22	8	81	39	73	79
10	NE Holes	35	10	112	32	69	69
11	NE Holes	83	34	323	150	74	77
12	NE Holes	32	16	106	56	70	71
13	NE Holes	10	5	135	67	93	93
14	NE Holes	9	2	81	27	89	93
15	NE Holes	19	6	107	34	82	82
17	M. Firth	-	-	-	-	-	-
18	M. Firth	5	1	15	3	67	63
19	M. Firth	56	5	67	7	16	32
20	M. Firth	86	7	141	12	39	42
21	M. Firth	0	0	2	0.2	100	100
22	M. Firth	3	0.1	18	4	83	97
totals		537	177	2322	974	77	82

Table 4

Total weights in kg (all hauls combined) of *nephrops*, monkfish, megrim retained by test and control net. The percentage illustrated is that retained by the test.

***Nephrops*, monkfish, megrim results**

	Test (kg)	Control (kg)	% reduction
<i>Nephrops</i>	292	304	96
Monkfish	380	435	87
Megrim	318	356	89

Appendix 1

Definition of the *Nephrops* Flip-Flap 'netting' Grid trawl.

A Flip-Flap 'netting' Grid trawl is defined to be a *Nephrops* trawl with the following features:

- all top wing netting to be made of diamond mesh netting of at least 160 mm mesh size;
- the top sheet netting panel must be made of diamond mesh netting of at least 160 mm mesh size. It must extend across the full width of the trawl and extend towards the rear of the net for at least 8.0 m (stretched length);
- the internal Flip-Flap 'netting' Grid (FFG) must be made from square mesh netting of at most 200 mm mesh size and must be positioned no more than 500 mm from the rearmost meshes of the end tapered section;
 - must be no less than 8 open mesh bars across by 10 open mesh bars deep;
 - the top 8 x 5 bar meshes to be attached to the top netting section between selvages length for length;
 - the lower 8 x 5 bar meshes can be left unattached across the trawls lower netting section but must have leadline (or similar) of weight no less than 1kg/m attached around the edges of its full length;
 - have an unblocked fish outlet cut out of the trawls top sheet netting immediate ahead of the FFG;
 - the opening width of the posterior side of the fish outlet should be no less than 26 x 80 mm diamond meshes (or equivalent) across and cut out to a tip in the forward direction along mesh bars.
- a top sheet square mesh panel (SMP) made from netting of at least 200 mm mesh size must be placed within the end tapered section;
 - the SMP must be no less than 3 m long;
 - the SMP must have no less than 12 open mesh bars across its width;
 - the rearmost meshes of the SMP must be no more than 0.5 m from the forward tip of the unblocked fish outlet.