Sustainable discard reduction in the Farne Deeps *Nephrops* fishery

Date: February 2008

Author: Mark Edmonds

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ISBN No. 978-1-906634-02-5

Seafish Research and Development

Author(s): Mark Edmonds

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Summary:
There is a recognised problem surrounding the issue of discarding whitefish in the Farne Deeps *Nephrops* fishery. Both local fishermen and DEFRA are aware of the need to make changes to current operations and are committed to reducing discards while encouraging the take up of technical conservation methods. This project explores the potential for reducing the fishing effort on cod, haddock and whiting by increasing the earning potential for the *Nephrops* catch component with a live (tubed) landing regime. Overall, this project was an industry lead responsible fishing initiative leading to a more sustainable fisher

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1. Introduction

There is currently a recognised problem surrounding the issue of discarding whitefish in the Farne Deeps *Nephrops* fishery. Many fishermen from the ports of North Shields, Blyth and Amble are aware of this and of the need to make changes to current operations. DEFRA have also identified the Farne Deeps area as having particularly high discard levels and under the strategic plan “Charting a New Course” are committed to reducing discards of round fish, in particular pressure cod stocks, in all *Nephrops* fisheries while encouraging the take up of technical conservation methods. This project explores the potential for reducing the fishing effort on cod, haddock and whiting by increasing the earning potential on non pressure stocks of *Nephrops*.

At the centre of this project lies the introduction of a live (tubed) *Nephrops* landing regime. The aim was to demonstrate an alternative fishery for the *Nephrops* sector in the area. The successful implementation of this would divert effort away from the whitefish by-catch component, and reduce reliance upon it by increasing the value of the prawn catch. Landing live ‘tubed’ prawns is now common in the creel sector on the NE coast and throughout the west coast of Scotland although is relatively less common amongst the trawling sector. This is largely due to limited survival rates following stress and physical damage sustained through contact with fishing gear. However, good reports have come from skippers in Eyemouth, Dunbar and Port Seton about the benefits of landing live prawns, with vessels regularly returning good survival rates from a trawled product. It was hoped that lessons learnt elsewhere could be successfully applied to the Farne Deeps fishery.

The first stage of the project involved following a FIFG funded program of instruction at the Fisheries Development Centre in Hull for four fishermen who agreed to voluntarily trial a combination of three gear related technical conservation methods (TCM) to reduce whitefish bycatch. The group of skippers received advise from Seafish on all matters including, gear technology, responsible fishing, economics, catch quality and marketing in order to provide the background to all areas of their fishing operations prior to embarking upon a change to live landings. In addition to training at the Fisheries Development Centre all skippers agreed to participate in the Seafish Responsible Fishing Scheme which focuses on the four key areas of improving catch quality, increasing earnings, reducing effort on and discards of the fish catch component.

Skippers received information on the expectations of the live market, which itself is relatively new and upcoming, before taking it upon themselves to establish a route to market for their live product. Interest was received from a number of sources although it was decided upon to go with D.R.Collin who has an extensive live holding facility in Eyemouth and an established market for live creel and trawl caught prawns. A day visit for the skippers involved in the trials to the shellfish grading facility acted to reinforce the requirements expected for a product entering into the live market with respect to quality and survival rates. They were also able to meet local skippers who gave guidance on onboard handling and storage. This visit was invaluable in providing the connection between the skippers and buyers and fostering relations between the two sectors.

2. Methods

Sea trials took place in December 2006, in order to make best use of the strong shellfish market in the weeks preceding Christmas.

Vessels involved in the trial:

MFV Sophie Louise II	SSS 678
MFV Bonaventure	BH 453
MFV Frem	SN361
MFV Trudie May	HL 1068

Prior to the start of the trials, a visit was made to the Eilidh Anne (GK2), based in Largs to discuss the importance of water quality in the onboard tanks on prawn survival. The Eilidh Anne lands live prawns all year and the skipper is familiar with practices to ensure good quality seawater is maintained to the tanks at all times.

It was expected that vessels steaming into the River Tyne would, at certain states of tide, encounter a freshwater plume extending a significant distance from the estuary mouth. Significant contact with freshwater or even low salinity seawater (i.e. below 28 parts per thousand (ppth)) is considered to be detrimental to prawn survival. As such it was essential that all skippers were aware of prevailing water conditions within and on approach to the harbour, and were issued with a swing needle hydrometer and log sheet to begin recording estuarine salinity at varying states of the tide. Readings were logged daily at three sites, 1 mile offshore, in the mouth of the estuary and lying alongside the quay for a period of one month prior to the start of the trials. Additional details included the number of hours before / after high water, recent weather in relation to rainfall and lastly whether any visible signs of freshwater are present (often a muddy brown plume of water). This exercise was invaluable in beginning to alter the mindset of the skippers into a new way of caring for the catch to ensure a top quality product was landed.

All skippers began trials using a Seafish designed coverless (cutaway) trawl (Arkley & Dunlin, 2002), manufactured by J & W Stuart Ltd in Eyemouth. These trial nets were consistent with all previous trial nets of this design, which are recognized to reduce whiting and haddock catches by up to 60% (Dunlin & Reece, 2003). Further technical conservation measures (TCM) included a 100 mm square mesh panel in place of the statutory 80 mm and 4.5 mm diameter single twine codends with a mesh size of 90 mm, in place of the minimum 80 mm (Appendix 1. Seafish Coverless Prawn Trawl Design and Construction Guidance Notes).

In conjunction with the introduction of the TCMs, the length of tow was reduced to ensure the best quality prawns. The skippers, who were used to 4 hour tows were required to have the codend aboard within 2 hours of the gear being shot away to minimize damage to the *Nephrops* whilst in the net.

Landing live, trawled *Nephrops* was a new leap of faith for the skippers involved who have previously relied upon a boxed fishery. Changes to catch handling were therefore of top priority. It was ensured that all vessels were suitably rigged for efficient handling of the catch once on deck. All trial vessels were fitted with reception hoppers and a good size sorting table. This has the advantage of firstly protecting the catch from the elements once emptied from the codend and secondly

reduces the manual handling of the catch. As the catch was sorted, all strong *Nephrops* in good condition were selected and placed into individual compartments within a tube matrix. Ideally this should be carried out in a single sorting operation to minimize the number of times the catch is handled.

Three sizes of tube were taken aboard at the start of the trial. These corresponded to three sizes of *Nephrops:*

Grade 1: 10-16 prawns per kg
Grade 2: 16-25 prawns per kg
Grade 3: 25-40 prawns per kg

Grade 1 prawns were placed in tube trays with 160 compartments, grade 2 with 104 and the large grade 3 with 77 compartments. For reference one basket of prawns equates roughly to 2.5 trays.

Once all compartments were full, each tray was secured and placed into aluminium holding tanks for the remaining time at sea (Appendix 2). The tanks fitted to the deck of the three smaller under 10 m vessels were made up of three compartments, with an overall length of 1.88 m, a height of 1 m and a width of 450 mm. With more deck space available, and stability concerns being less of a worry, the larger Sophie Louise II was fitted with a four compartment tank at an overall length of 2.5 m. The tanks were designed to hold between 3 – 5 trays (depending on the size of tube matrix) stacked on top of each other and held securely in each compartment. The deck hose was attached to an inlet valve at one end of the tank to supply a continual fresh seawater feed to the tubed prawns. Two outlets on the opposite end of the tank maintained the water level and removed debris and dirty water from the tanks. While at sea this open circulation system was maintained at all times. While steaming ashore, water salinity was continually monitored. On detection of a drop in salinity, the deck hose feed to the tanks was cut and the drain outlets plugged. Initial tests showed the dissolved oxygen content of the water fell within one hour from 9.4 mg/L (100% saturated at 8 ºC) to 6.6 mg/L (70%) saturation. While it is not clear what dissolved oxygen tolerances *Nephrops* can sustain, it can be assumed that survival and certainly recovery will have greater success at a level close to maximum saturation.

Initially a portable pump was used to provide water circulation within the tank although this was quickly found to compromise space for trays. To counter this, a small aeration pump was sourced from an ornamental fish supplier. Air stones were immersed in the bottom of the tank connected to the pump manifold and maintained effective water aeration even with the tank at maximum capacity. This system was maintained while the vessel was steaming into the Tyne and lying alongside the quay waiting for the daily pick up wagon from Eyemouth.

Upon landing all trays were transferred directly to a vivier lorry containing chilled and aerated tanks for transport to the wholesaler. *Nephrops* were left in the tanks overnight before being sorted the following day. The fishermen received daily feedback on the catch survival and a price per kg for each size of live and for their fresh boxed *Nephrops* as usual.

Overall, this regime was intended to increase fishermen's earnings and promote an industry lead responsible fishing initiative leading to a more sustainable fishery. In support of this initiative all trial vessels agreed to participate in the Seafish Responsible Fishing Scheme. All vessels were audited by Moody Marine during the early part of 2007 and are now fully accredited holders of the Responsible Fishing Scheme.

3. Results

Nephrops landings for each vessel for the trial period.

3.1. Sophie Louise II

Date	**Survival rate /%**		**Weight /kg**	**Price / £**	**Count /£**
04/12/06	87	Grade 1	0	10.00	0
		Grade 2	13	8.00	104.00
		Grade 3	40	5.00	200.00
		Dead	8	2.30	18.40
		Total	**61**		**322.40**
05/12/06	88	Grade 1	0	10.00	0
		Grade 2	15	8.00	120.00
		Grade 3	72	5.00	360.00
		Dead	11	2.30	25.30
		Total	**98**		**505.30**
06/12/06	79	Grade 1	0	10.00	0
		Grade 2	30.5	8.00	244.00
		Grade 3	78	5.00	390.00
		Dead	30	2.50	75.00
		Total	**138.5**		**709.00**
10/12/06	89	Grade 1	21	10.00	210.00
		Grade 2	56	8.00	448.00
		Grade 3	26	6.00	156.00
		Dead	13	3.00	39.00
		Total	**116**		**853.00**
11/12/06	93	Grade 1	16	10.00	160.00
		Grade 2	33.5	8.00	268.00
		Grade 3	37	6.00	222.00
		Dead	6.00	2.50	15.00
		Total	**92.5**		**665.00**
12/12/06	91	Grade 1	10.5	11.00	115.50
		Grade 2	25	9.00	225.00
		Grade 3	40	6.00	240.00
		Dead	7	3.00	21.00
		Total	**82.5**		**601.5**

13/12/06	77*	Grade 1	15	11.00	165.00
		Grade 2	24	9.00	216.00
		Grade 3	33	6.00	198.00
		Dead	22	3.00	66.00
		Total	**94**		**645.00**
14/12/06	92	Grade 1	11	11.00	121.00
		Grade 2	29	9.00	261.00
		Grade 3	44	6.00	264.00
		Dead	7.5	2.5	18.75
		Total	**91.5**		**664.75**

* Low survival experienced on 13/12/06 due to catch kept aboard overnight. Road closures due to poor weather prevented the transport lorry from picking up catch at usual time, the previous evening.

3.2. Trudie May

Date	**Survival rate /%**		**Weight /kg**	**Price / £**	**Count /£**
06/12/06	91	Grade 1	4.5	10.00	45.00
		Grade 2	20	8.00	160.00
		Grade 3	32	5.00	160.00
		Dead	5.5	2.50	13.75
		Total	**62**		**378.75**
07/12/06	96	Grade 1	3	10.00	30.00
		Grade 2	19	8.00	152.00
		Grade 3	36	5.00	180.00
		Dead	2	3.00	6.00
		Total	**60**		**368.00**

3.3. Bonaventure

Date	**Survival rate /%**		**Weight /kg**	**Price / £**	**Count /£**
06/12/06	92	Grade 1	2	10.00	20.00
		Grade 2	26.5	8.00	212.00
		Grade 3	48	5.00	240.00
		Dead	7	2.00	14.00
		Total	**83.5**		**486.00**
07/12/06	95	Grade 1	7	10.00	70.00
		Grade 2	33	8.00	264.00
		Grade 3	34	5.00	170.00
		Dead	2.5	2.00	5.00
		Total	**76.5**		**509.00**

3.4. Frem

Date	**Survival rate /%**		**Weight /kg**	**Price / £**	**Count /£**
06/12/06	92	Grade 1	6.5	10.00	65.00
		Grade 2	16	8.00	128.00
		Grade 3	47	5.00	235.00
		Dead	6	2.00	12.00
		Total	**75.5**		**440.00**

Only the Sophie Louise was able to work for the full week of the trial due to poor weather keeping the smaller vessels in harbour. However, for the first 2 days of the trial all skippers were aboard the Sophie Louise and so were able to observe first hand and participate in a full days fishing despite not being with their respective vessels. Following the week of trials, only the Sophie Louise was able to continue fishing – again due to poor weather for the remainder of the month. After Christmas the market for live prawns is severely reduced due to a drop in demand and so it was not anticipated that a further opportunity to land live prawns would present itself until the last few months of 2007. Tubing trawled prawns during the summer months often yields little success due to the soft nature of the animals at this time of year. Too much damage is often sustained in the net to ensure a worthwhile survival rate.

4. Catch comparison trials.

Discarding in the North Sea is a well documented issue, estimated to be around 0.9 million tonnes annually (Tasker et al., 2000) or about one third of total catches. The *Nephrops* fishery is regarded as one of the main fisheries responsible for this discarding. Historical results of the Farne deeps fishery held by CEFAS indicate that *Nephrops* trawlers discard typically between 69-79% of all finfish caught (by number) between 2001-2004 (Revill, Dunlin and Holst, 2006). It was hoped that this project would provide a means for reducing this discarding while providing a financial incentive for fishermen by increasing the value of the non-fish component of the catch.

Catch data was collected throughout the trial aboard all vessels while fishing with the coverless trawl. Selectivity parameters were then attained through comparison with historical data from similar vessels fishing with ‘ordinary’ trawls at a corresponding time of year. Due to the restricted time available only limited catch data was collected during the trial. No further opportunity was available following the initial trial due to very poor fishing in the Farne Deeps *Nephrops* fishery throughout 2007 and into the early part of 2008. As such for the purposes of this work, catch selectivity data has been obtained from previous CEFAS work in this fishery.

All gear selectivity trials referred to in this report were carried out in commercial fishing grounds in the Farne Deeps in ICES rectangle 39 E8, with hauls of 1-2 hours and water depth of between 38060m. This is representative of the fishing pattern used during the tubing trial. A full methodology of the catch comparison trial is given in Revill, Dunlin and Holst (2006).

Summary of CEFAS catch comparison results.

- Whiting was the predominant finfish bycatch observed during the trial. Highly significant reductions were observed with the coverless trawl, across the whole length range. This suggests that a proportion of whiting of all lengths were able to escape capture by rising out of the path of the trawl. Overall, whiting reductions were estimated at 53% (by number) with a 61% reduction for fish <MLS and a 41% reduction for fish >MLS (27cm).
- The catching power of the coverless trawl for whiting was approximately 50% of that of the 'ordinary' commercial trawl.
- No significant difference was detected between the two trawls for cod or lemon sole. Despite numbers for both species being very low, fewer small cod (<MLS) were caught with the cutaway trawl than with the 'ordinary' commercial trawl. Numbers of large cod (>MLS) were comparable suggesting a length dependent relationship for cod in response to the coverless trawl.
- The total value of fish sales as a proportion of the total catch showed no difference between the two trawl designs. This is largely due to whiting being a major component of landings in terms of weight but its value was significantly less. Due to the relatively low value of whiting, the difference in value of landings between the coverless and 'ordinary' trawls accounted for only 4% of the total landings.
- Whilst a reduction in whiting catches are well documented, unpublished work by Dunlin & Reece (2003) reported a reduction in haddock catches of 63% when the coverless trawl was first evaluated in the Farne deeps in 2002.
- The coverless trawl caught ~5% more *Nephrops* overall than the 'ordinary' trawl. This however was not expected to be the case for the gear used for the tubing trials. The coverless net, used during the tubing trials, incorporated further design modifications aimed to improve catch quality and ultimately survival numbers. This consisted of a 100 mm square mesh panel and a 90 mm, 4.5 mm diameter single twine codend. These modifications were in place to increase the size selectivity of the target *Nephrops* to ensure that only large animals, suitable for tubing were retained at point of capture.

5. Economic perspective

Nephrops are the most economically important catch component, worth around 85% of the total catch value when being landed in the traditional boxed form direct to the local market. Landing tubed to the live market was expected to increase this margin further due to a higher price being attained for the product in this form.

Vessel	Daily landings / kg	Value	£ / kg
Sophie Louise II	612	1296.75	2.12
Sophie Louise II	673	1648.6	2.45
Sophie Louise II	197	457.45	2.32
Sophie Louise II	131	506.3	3.86
Sophie Louise II	317	862.9	2.72
Sophie Louise II	342	1346.9	3.94
Sophie Louise II	302	1259.4	4.17
Sophie Louise II	126	597.35	4.74
Sophie Louise II	260	1229.25	4.73
Sophie Louise II	325	1508.9	4.64
Sophie Louise II	200	679.8	3.40
Sophie Louise II	366	1576.7	4.31
Sophie Louise II	143	436.7	3.05
Sophie Louise II	90	230.7	2.56
Sophie Louise II	74	197.6	2.67
Sophie Louise II	218	672.2	3.08
Sophie Louise II	130	496.25	3.82
Sophie Louise II	35	92.7	2.65
Trudie May	26	104	4.00
Trudie May	370	663.2	1.79
Trudie May	50	143.7	2.87
Trudie May	61	187.2	3.07
Trudie May	66	177	2.68
Trudie May	457	919.8	2.01
Trudie May	26	62.4	2.40
Trudie May	20	60	3.00
Average £ per kg			**£3.20**

Table showing price paid per kg for a sample of boxed (dead) prawns landed by the trial vessels during the same quarter as the tubing trial.

Vessel	Daily landings / kg	Value	£ / kg
Sophie Louise II	61	322.5	5.29
Sophie Louise II	98	505.3	5.16
Sophie Louise II	138.5	709	5.12
Sophie Louise II	267	861.3	3.23
Sophie Louise II	58	202.4	3.49
Sophie Louise II	91	664.75	7.30
Sophie Louise II	92	688.5	7.48
Trudie May	50	368	7.36
Trudie May	62	378.75	6.11
Average £ per kg			**£5.62**

Table showing price paid per kg for tubed prawns landed during the trial period

Despite a limited dataset it is possible to see great variation in price between live tubed prawns and the dead prawns landed iced in boxes in the traditional way. There is a significant difference between the value of live and dead prawns observed here (p=0.00161). This figure, while in line with expectations is only applicable to a very small sample, collected in the few days of the trial. It is recommended that a more reliable comparison would be attained from a dataset collected over a longer period.

6. Discussion

DEFRA have always been interested in incentives for fishermen to take up proven TCM's without the need for regulation. This project ensured that each participating vessel started the trials with as much knowledge, support and equipment needed to maximise their chances of success in order to act as a catalyst for change throughout the local *Nephrops* fleet. Experiences learnt through sea trials in the Farne deeps fishery will establish methods of best practice in line with onboard catch and handling operations. These will be transferable to similar fishing operations elsewhere in the UK and will be disseminated through training and media resources as appropriate.

There has always been a great deal of negative reaction from skippers off the back of the initial trials of the coverless trawl in 2002/3. This was largely due to the reduced catching ability for whiting across the whole length range would only reduce discards in proportion with landings for the species. As a result there was limited uptake of the coverless trawl. However the tubed landing regime in conjunction with the favourable prices paid for live product has shown real potential to incentivise fishermen to this novel technique. The coverless trawl can be considered a more environmentally friendly fishing method over and above other technical conservation measures used in other commercial fishing gear.

Further financial incentive for future uptake of the coverless trawl may come about with further increases in fuel price. This will force fishermen to maximize their return even further for each day at sea. The coverless trawl is constructed from less netting than a standard trawl of the same swept area due to the exclusion of a section of

headline panel. This converts to a reduction in construction cost and reduced towing costs. As yet however little difference has been realised between the cost of construction of standard and coverless trawls. This is largely down to development costs being included in the cost of manufacture. This will reduce as more nets are manufactured and as more netmakers become familiar with the design. Conversations with netmakers in early 2008 report an increase in interest in the coverless trawl. Despite fuel costs being at record levels (~43p/L) interest is predominantly motivated by bycatch reduction.

This project has shown that the coverless trawl, when combined with a live landing regime offers a real and financially viable opportunity for the *Nephrops* fleet in the Farne Deeps fishing grounds. During the trial, four vessels were given the tools and knowledge to pursue this new landing regime as and when favourable stock and market conditions prevail. The financial incentives demonstrated here may well prove essential if wider uptake is to be incorporated into legislation and management in the future.

7. References

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Appendices

Appendix 1

Evaluation of Technical Conservation Measures in UK *Nephrops* Fisheries – New Trawl Designs

Seafish Coverless Prawn Trawl

Design & Construction Guidance Notes

INTRODUCTION

Gear Technologists at the Seafish Fisheries Development Centre have been involved in a programme of work to develop bycatch reduction devices for *Nephrops* trawls. The work was initially directed at developing ways of reducing discarding by releasing the unwanted bycatch after capture e.g. using square mesh panels. More recently, effort has been concentrated on a slightly different approach, placing the emphasis on avoiding the capture of unwanted bycatch in the first place.

A trawl design has been developed with features that reduce the potential for catching certain finfish species, whilst at the same time maintaining *Nephrops* catching performance. In other words, making the gear design more species specific.
Seafish Report Nos. SR532
http://www.seafish.org/pdf.pl?file=seafish/Documents/SR532.pdf
and SR542
http://www.seafish.org/pdf.pl?file=seafish/Documents/SR542_Prawn%20Trawl.pdf
refer).

The objective of the work was to modify the design, construction and rigging of a conventional *Nephrops* trawl so as to exclude the unwanted roundfish bycatch prior to it entering the net. This had to be achieved in a commercially acceptable manner without any detrimental affect on the *Nephrops* catching capability of the gear.

The project relied on novel trawl design work coupled with modelling and testing at the Seafish Flume Tank in Hull.

The task of introducing such new net designs, especially ones originating from the R&D sector as opposed to from commercial gear manufacturers, is always a difficult one. For this reason, the work was conducted in collaboration with established trawl designers/manufacturers. The commercial credibility gained from this partnership is expected to increase the prospects of commercial uptake of any successful designs resulting from this work. The net manufacturers J&W Stuart Ltd, (Stuart Nets) from Eyemouth, Scotland have been actively involved in the work since its inception. All the full-scale versions of the new trawl designs used in commercial trials to date have been produced by Stuart Nets.

The resulting new trawl design is referred to as a ‘coverless’ trawl. As the name suggests, the cover which is in place to prevent fish herded into the mouth area of the net from rising upward and escaping over the headrope, was removed from a conventional prawn trawl design. This resulted in the net having a headrope equal to or slightly longer than the footrope. This is opposed to the conventional arrangement of the footrope being longer than the headrope. The inclusion of increased mesh sizes in the upper wings and upper netting panel immediately behind the headrope crown, coupled with reduced headline height, all serve to encourage the escape of fish species such as haddock and whiting in and around the mouth of the trawl.

Over a considerable period of time, the resulting coverless prawn trawl design has undergone extensive evaluations under commercial fishing conditions in a number of *Nephrops* fisheries around the UK. The results obtained have demonstrated the

conservation benefits of the new design by achieving bycatch reductions for haddock and whiting in excess of 60% without affecting the catches of prawns.

Seafish are actively encouraging commercial uptake of the coverless prawn trawl concept as another tool to assist fishermen in addressing the problems associated with unwanted bycatches in certain *Nephrops* fisheries.

The following information is designed to assist fishermen and net manufacturers interested in adopting the new design.

It is not possible to cover all the details for conversion of all the commercial prawn trawl designs available to fishermen in a document such as this. The aim is however, to give some general advice based on the principles used to make the net and practical guidance based on experiences gained from commercial usage.

DESIGN GUIDELINES

In order to alter a conventional prawn trawl to conform to the Seafish coverless design criteria, it is important to first define what is meant by the 'cover' or square panel as it is also commonly known.

The cover can be referred to as any netting panel spanning the width of the upper half of the net extending forward of the footrope. This can be checked by tracing the row of meshes attached to the footrope fishingline around the fishing circle, (mouth of the net). Any netting panel extending across the full width of the net, from selvedge to selvedge forward of this point is classed as cover.

The following describes the stages involved and the general procedures used in the re-design of a conventional prawn trawl to produce the Seafish trawl designs to date. Figures (1) & (2) show the relevant trawl sections referred to and viewed in conjunction with the text help to explain the process.

Two approaches have been used to achieve the elimination of cover. The aim is to use the minimum of alterations wherever possible.

For the conversion of an existing net in situations where the size of the net (fishing circle) is to be maintained, the simplest approach involves detaching the upper wings (1) and removing the square panel (4). The lower sections of the net (2, 3, 6) can remain unaltered. The only re-tailoring required is that of the upper wing (1). This has to be re-designed to produce a length, width and crown (C) to match those of the lower panels. The new upper wing is re-attached to the baitings (5) to complete the net.

The other approach involves more re-design of the original net plan and allows more scope for increasing the potential escape area within the mouth area of the net. Firstly, the upper (1) and lower wings (2 & 3) are detached and the square panel (4) is removed. The baitings (5) and belly (6) netting is extended to a point level with the position of the original cover using the same taper rates as in the existing belly/baitings panels. This effectively forms the new belly and baitings sections of the trawl. At this point, the overall length of the bellies/baitings has been increased by the length of the original square panel (4).

The upper (1) and lower wings (2 & 3) have to be re-tailored to achieve practical taper rates and the required dimensions i.e. width and length, before re-attachment to the new baitings and bellies sections respectively. For example, if the same overall length of net is to be retained, then the length of the original lower wings (2 & 3) will have to be shortened by an amount equal to the length of the square that has been removed. If the overall dimensions of the upper wing (1) remain unchanged, then the crown (C) length can remain the same. If however, the widths of the lower wing bunts (3) are kept the same, the result is an increased lower bosom length (B) due to the increase in the width of the new extended belly. Since the aim is to achieve a headrope and footrope of equal length, (or to have the headrope slightly longer), this re-tailoring enables the bosom length (B) to be matched with that of the crown (C).

Although the cover has effectively been removed, a narrow crown (C), coupled with a wide base to the upper wing (1) can create some additional overhang of netting in the 'shoulders' of the net. Increasing the length of the crown (C) and the headrope length relative to the footrope helps to reduce 'shoulder' cover. This can be beneficial in increasing the escape area in and around the mouth of the trawl.

The crown (C) and lower bosom (B) can be made the same in terms of equivalent mesh lengths, (number of meshes x mesh size) and still produce the required length difference between headrope and footrope by using different hanging rates, (e.g. crown 50% and bosom 35% of stretched mesh length).

Having removed cover from the net, an additional bycatch avoidance feature is incorporated in the form of a large mesh panel (9) immediately behind the headrope crown (C). This panel covers the width of the crown and stretches back over the full length of the baitings section (5). The mesh size of this panel must be large enough to allow free passage to any fish encountering it, therefore the larger the mesh, the better. However, practicalities should prevail. It is recommended that the mesh size should be at least twice the current minimum legal requirement but experience has shown that 200mm is more suitable.

To incorporate all of these factors it is inevitable that in some cases considerable re-designs and re-tailoring of the original net design will be required. In most cases however, the changes required can be made relatively simply and practically.

In summary, the key points and stages involved in producing a coverless trawl along the lines of the Seafish design are:

A. Removal of cover, i.e. ensuring no full width netting panels are in place forward of the fishing circle.

Stage 1: Starting with conventional trawl design;

Stage 2: Detach wings and take-out square panel;

Stage 3: Form new baitings and belly sections by extending existing netting panels using same taper rates. Re-shape wings as necessary to attain required dimensions

including an increased crown length and matched crown and bosom. Attach upper wings to new baitings and lower wings to new belly panels.

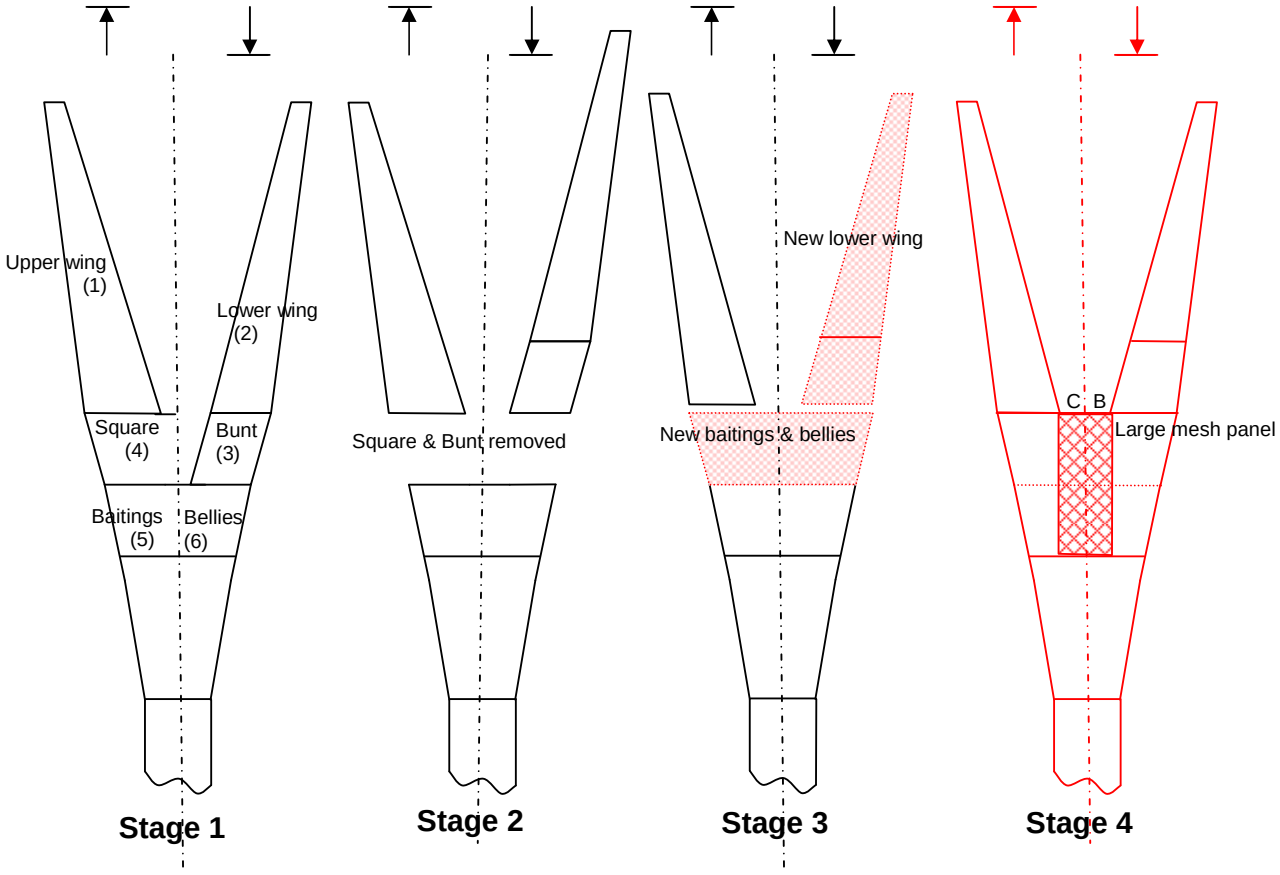
B. It is recommended that the number of meshes in the crown should be a minimum of 25% of the number, (equivalent mesh size) across baitings panel.

C. Headrope to be of equal length or slightly longer than footrope.

D. Hanging ratio for crown meshes to be ~50%.

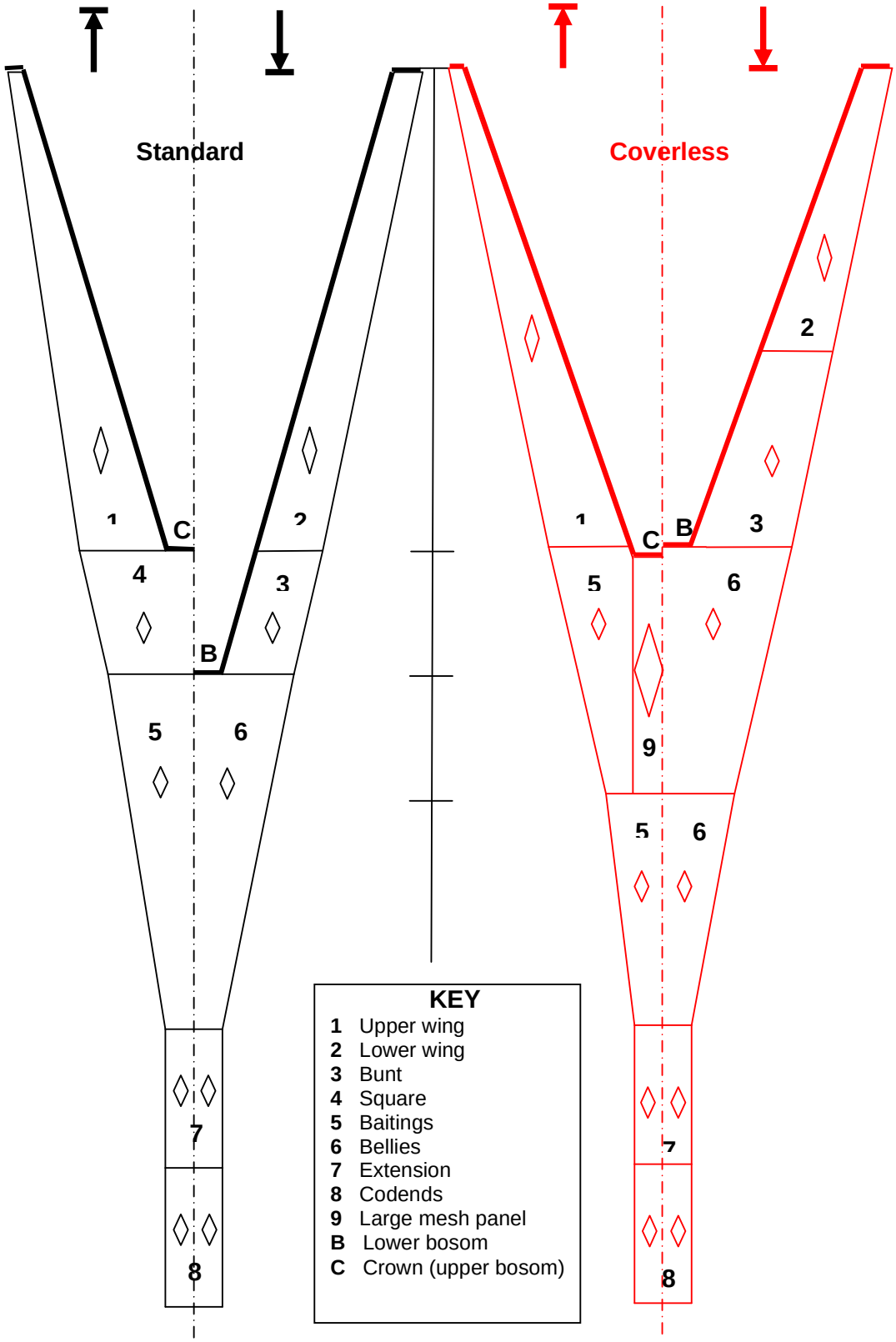
Stage 4: Incorporation of large mesh panel attached to and covering full width of crown and extending over full length of baitings section. (This panel could be fitted during the construction of the new baitings section at stage 3).

Figure 1: Summarising the main stages involved



It is expected that these guidelines should be sufficient for net makers and/or relatively experienced fishermen to undertake the necessary modifications to their existing net designs. Should further assistance be required, Seafish Gear Technologists and/or the net makers J&W Stuart (Stuart Nets) can be contacted directly for first hand advice or further information.

Figure 2: Schematic diagram showing comparison of standard prawn trawl with Seafish coverless trawl design



For more information please refer to:

Seafish report number SR532 - *Evaluation of Technical Conservation Measures in UK Nephrops Fisheries – New Trawl Designs*
http://www.seafish.org/pdf.pl?file=seafish/Documents/SR532.pdf

and

Seafish report number SR542 – *Improving the selectivity of towed fishing gears – New Prawn Trawl Designs to Avoid Capture of Unwanted Bycatch*
http://www.seafish.org/pdf.pl?file=seafish/Documents/SR542_Prawn%20Trawl.pdf

Or Contact:

Ken Arkley BSc
Senior Gear Technologist

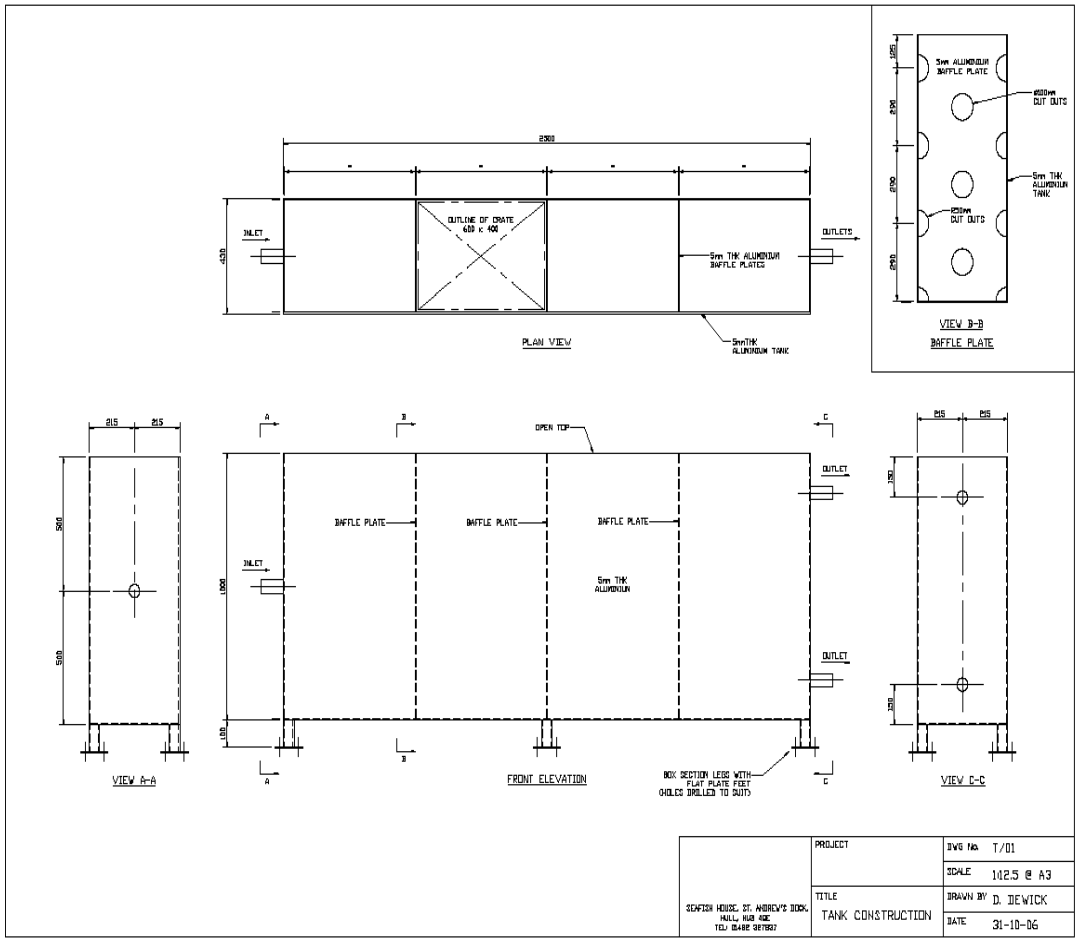
Sea Fish Industry Authority
Seafish Technology
Seafish House
St Andrew's Quay
HULL
HU3 4QE

Tel: +44(0)1482 327837
Fax: +44(0)1482 587013
Email: k_arkley@seafish.co.uk
Website: http://www.seafish.org.uk

Walter Hay

Stuart Nets
Eyemouth Industrial Estate
Eyemouth
Scotland
TD14 5AN

Tel: +44(0)1890 751684
Fax: +44(0)1890 751012
Email: Stuartnets@ukonline.co.uk


2300
OUTLINE OF CRATE
600 x 400
INLET
OUTLETS
5mm THK ALUMINIUM
BAFFLE PLATES
5mmTHK
ALUMINIUM TANK
PLAN VIEW
5mm ALUMINIUM
BAFFLE PLATE
ø100mm
CUT OUTS
5mm THK
ALUMINIUM
TANK
ø250mm
CUT OUTS
VIEW B-B
BAFFLE PLATE
215
215
500
500
VIEW A-A
A
B
OPEN TOP
C
OUTLET
BAFFLE PLATE
BAFFLE PLATE
BAFFLE PLATE
INLET
1000
5mm THK
ALUMINIUM
OUTLET
100
FRONT ELEVATION
BOX SECTION LEGS WITH
FLAT PLATE FEET
(HOLES DRILLED TO OUT)
215
215
350
350
VIEW C-C
SEAFISH HOUSE, ST. ANDREW'S DOCK,
HULL, HU3 4QE
TEL: 01482 327837
PROJECT
TITLE
TANK CONSTRUCTION
DWG No. T/01
SCALE 1:12.5 @ A3
DRAWN BY D. DEWICK
DATE 31-10-06

Appendix 2