Testing the efficacy of two methods designed to reduce the numbers of undersized whelks in the landings – Fisheries Challenge Fund (project FES293)

Andy Lawler, Dominic Bailey and Kathryn Nelson

Cefas, K&EIFCA and SxIFCA report for the Marine Management Organisation

Kent & Essex IFCA Inshore Fisheries and Conservation Authority

Sussex IFCA Inshore Fisheries and Conservation Authority

Cefas

Contents

Executive summary 2

1. Introduction 2

2. Objectives 4

3. Methods 4

   3.1 Selective traps – escape holes 4

   3.2 Riddle selection - performance of various riddle gaps 6

   3.3 Underwater imagery 7

4. Results 7

   4.1 Selective traps - escape holes 7

   4.2 Riddle selection 13

   4.3 Underwater imagery 16

5. Discussion 16

   5.1 Selective traps - escape holes 16

   5.2 Riddle selection 18

   5.3 Underwater imagery 19

6. Conclusions 20

7. References 21

8. Acknowledgements 21

Appendix 1. Invitation to Tender 23

Appendix 2. Comparison of experimental traps with commercial traps 35

Appendix 3. Selection ogives by riddle grid and survey area 37

Appendix 4. Summary outputs from the final glm model fitted 39

Appendix 5. Summary of data from pot selectivity experiment 41

Executive summary

This project successfully demonstrated that suitably sized escape holes in whelk pots can reduce the catch of undersized whelks. This benefit is offset by a loss of commercial catch. The magnitude of these effects is predominantly dependent on the size structure of the whelk population on the ground, the size of the escape holes and the size at which Minimum Landing Size (MLS) is set (i.e. the definition of undersized). Clearly, in a fishing area where undersized whelks are rare or absent there would be little or no benefit of using these selective gears but where the size structure of the population includes a significant proportion of undersized whelks the conservation benefits could be high. In fishing areas where there is a large number of small whelks just above the MLS then the use of selective gears could lead to a loss of yield especially if large escape hole sizes were employed.

Five sets of (10) whelk pots with escape holes sized from 20 to 28mm in 2mm increments were manufactured to provide direct comparison between catches for pots with each escape hole diameter. The fifty traps were deployed as five fleets of ten pots with two pots of each escape hole diameter on each fleet. Size distributions of the catch from traps for each hole size and on each fleet were measured. To determine whether the selective properties of the gear were similar between other survey areas and for alternative soak durations the experiment was repeated for four survey areas and soak time was controlled for. Four fishing vessels were chartered in the proximity of significant local whelk fisheries. The gear was hauled on five occasions in each of the four survey areas starting in September 2012 in the Thames estuary and ending in early January 2013 off the West Sussex coast.

In each survey area a sample of at least one fishing basket of whelks was passed over a series of grids (riddles) with gap sizes ranging from 20 to 28mm in 1mm increments and starting with the largest gap. Whelks that passed through each grid were sequentially passed over the next smallest grid.

Logistic regression techniques were used to describe the selection performance of each grid gap size in the form of a selection curve or ogive. These selection ogives were applied to a size distribution of catch assumed typical of one survey area to predict the proportions of both undersized and commercial sized whelks that would be retained for each riddle specification and under different hypothetical values of MLS.

Underwater cameras were used to provide insights into the behaviour of whelks in and around a baited commercial trap set in an aquarium. Time lapse photography proved most useful and showed both entrance and escape activity via the top of the trap.

1. Introduction

Whelk landings in England and Wales were worth over £8million at first sale in 2011, but there are concerns amongst scientists and fisheries managers over the sustainability of the fisheries. The only regulation in most areas is the EU Minimum Landing Size (MLS) of 45mm shell height and current management measures may not be adequate to conserve local whelk stocks, especially if fishing effort were to increase as a result of displacement from other more heavily regulated fisheries. A number of potential management changes are under consideration, including increasing the MLS, but also the requirement for better selectivity in both fishing gears and on-board sorting devices.

The primary objective of this research is therefore to determine the efficacy of two methods for reducing the numbers of undersized whelks in commercial landings. The first objective will look at the effectiveness of incorporating various sizes of escape holes in commercial traps and the second objective will determine the selectivity of various on-board sorting devices (riddles).

Recent Defra funded collaborative work between Cefas and Sussex IFCA (SxIFCA) has shown that in the Sussex fishery the size at which whelks mature is higher than the current MLS (45mm shell height), which therefore affords virtually no protection to the spawning stock. As the size at which whelks mature is known to vary regionally, this work has been extended, with further Defra funding, to determine the size at maturity in other English fisheries.

Whelks are an important fisheries resource throughout the South East, and concerns have been raised about their sustainable exploitation in both Sussex and Kent and Essex IFCAs districts. Both IFCAs have held stakeholder meetings where future management has been discussed (with Kent and Essex IFCA (KEIFCA) bringing in an emergency byelaw to limit the number of pots that can be used in their district). At these stakeholder meetings local fishermen suggested possible management options relating to the use of riddles and the use of escape holes in whelk pots. Both these suggestions received a lot of support, and would be relatively cheap and simple to legislate for and enforce.

This project aims to determine the efficacy of more selective traps for reducing the numbers of undersized whelks retained by the gear and the selection performance of various on-board sieving devices. The specification of those riddling devices which are consistent with current and potential future MLSs will be identified.

More selective gear, in the form of traps that retain less undersized whelks, could provide a useful conservation measure and escape gaps have been shown to be particularly useful in crustacean trap fisheries. Selective traps used in conjunction with appropriate on-board sorting devices may significantly reduce the numbers of undersized whelks in the landings and contribute to the sustainability of the fisheries.

Whelks are often landed in bulk making enforcement of the MLS difficult. On-board sieving devices are often deployed to separate the commercial component from the catch, with those whelks that pass through the riddle returned directly to the sea. These discards are thought to have high survival rates if carefully handled and returned quickly to the seabed in close proximity to the capture site, but poor practise will increase mortality. There is little consistency between fishers regarding the specification of riddles resulting in variable proportions of undersized whelks being incorporated into the landings.

2. Objectives

1) To determine whether the addition of escape holes of various diameters in standard commercial whelk traps reduces the proportion of undersized whelks in the catch (CEFAS - SxIFCA & KEIFCA)

2) To determine the selection properties of various riddle specifications which will inform fishery managers regarding the most appropriate devices consistent with MLS. (CEFAS - SxIFCA & KEIFCA)

3) To deploy underwater video cameras mounted on tripods and above commercial traps to determine trap entry and exit rates of foraging whelks. (CEFAS)

3. Methods

3.1 Selective traps – escape holes

With consideration of the numbers and sizes of holes already present in typical traps deployed throughout the Kent and Essex and Sussex IFCA regions the project partners decided on appropriate escape hole specifications. The partners decided on standard commercial traps modified with the addition of escape holes in five diameters (20 to 28mm dia. in 2mm increments. Figure 3.1). In June Kent and Essex IFCA commissioned a commercial whelk pot manufacturer to fabricate fifty traps, ten of each hole size. Each trap had 12 holes in the base and 18 (6 rows of 3) in the sides of the trap.

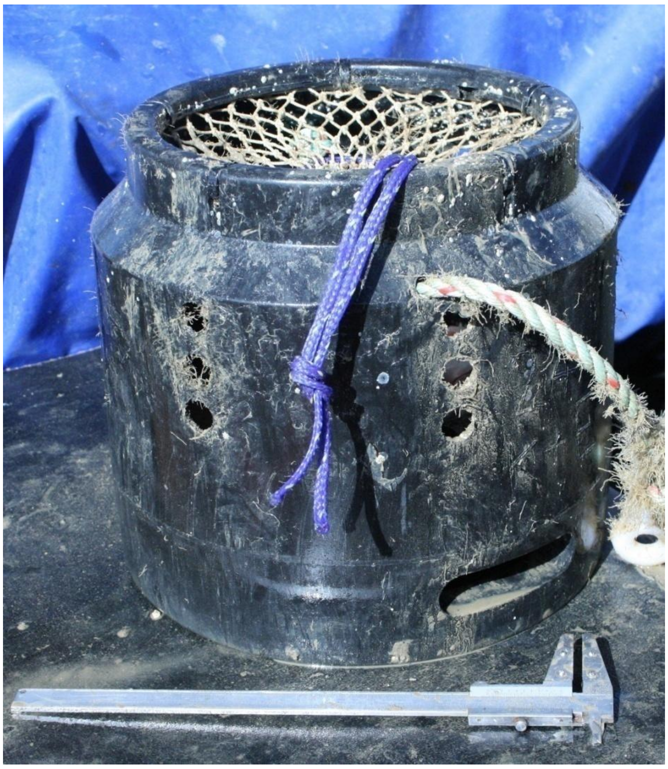

Figure 3.1. One of the experimental traps, with 18 x 24mm holes in the sides (12 x 24mm holes in base not shown)

The traps were delivered to KEIFCA in the summer who immediately deployed them locally to test and weather them as it was thought that new traps may not fish as well as older traps. It had been suggested that the smell of new plastic can deter entry of whelks so pre-trial weathering was deemed a necessary precaution.

Selective gear trials were carried out in two areas in each of the two IFCA regions (four survey areas) in an attempt to take into account expected spatial variation within this relatively large fishing area. Suitable vessels with experienced skippers and crews were commissioned to carry out the work following invitations to tender (ITT) being published on the Contract Finder website. The charter work for the Kent and Essex region was advertised on 27th July with a deadline 10th August (Appendix 1) and a similar ITT was also published 2nd October (deadline 19th October) for the Sussex region. Two vessels tendered for the work in each of the IFCA regions. In the Kent and Essex region vessels from Whitstable and Ramsgate and in the Sussex region vessels from Eastbourne and Selsey were contracted to carry out the survey work.

Experimental trials started in the Whitstable area in September when fifty pre-set traps deployed in five fleets of ten traps were hauled in the Thames Estuary close to the Isle of Sheppey. This configuration facilitated two traps of each experimental hole size to be included on each fleet. The distance between each trap on a fleet was kept to a minimum, but altered to accommodate the layout on each charter vessel. Replicate traps on each fleet were not placed adjacent to each other and the five fleets were fished close to each other to minimise spatial effects. Although we wished to investigate soak time effects, the priority was to determine the relative importance of the various escape hole sizes and to this effect the skipper of each fishing vessel was asked to locate a patch of whelks that contained a reasonable population of smaller undersized whelks.

Soak durations were varied in all survey areas in an attempt to determine if soak time influenced the selective performance of the gear. The exact combination of soak duration in each survey area was ultimately determined by weather constraints. Soak times ranging from 1 to 3 day periods were carried out in all four survey areas. In addition 5 and 8 day soak periods were utilised during fishing operations in the Selsey and Eastbourne areas, respectively (Table 4.1).

Table 4.1. Incidence of soak durations by survey area during the selective gear trials

Survey area	**Soak days**				
	1	**2**	**3**	**5**	**8**
Whitstable	3	1	1	-	-
Ramsgate	2	1	2	-	-
Eastbourne	2	1	1	-	1
Selsey	1	1	2	1	-

Bait was a combination of crab and fish. Whelk catches for each trap hole size on each fleet were combined providing twenty fives samples on each of five fishing days. The shell height of whelks was measured from each sample. If sub-sampling was required it was achieved by splitting the catch into equal portions using the centre mark on a fishing box as a guide. The procedure was repeated in the second sampling area on the 2nd charter vessel operating from Ramsgate.

The original plan was to look at the results from the first experimental area and decide whether changes to the traps would be required to investigate other design specifications. Clearly there are many potential combinations of hole size, numbers, placement that could be tested. The provisional results were circulated amongst project partners and it was agreed not to modify the gear further at this stage.

The experiment moved on to the Sussex region in November and the same experimental procedure was carried out by the chartered fishing vessel operating out of Eastbourne. In this survey area the skipper attached two of each of his own commercial traps to each of the five experimental strings for comparison with the experimental traps. Sampling in the fourth survey area off Selsey started in early December, but was delayed by bad weather and was not completed until early January 2013.

The relationships between the counts of captured whelks, escape hole size, soak duration in days and survey area were investigated using generalized linear modelling techniques and using R software (R Development Core Team, 2012). Whelk catch numbers were modelled as the dependent variable and catch component (commercial or undersized) and the other factors were the explanatory variables. A model specifying a negative binomial distribution provided an appropriate fit to these data and an analysis of deviance was used to test the significance of each factor.

3.2 Riddle selection - performance of various riddle gaps

Previous work on riddle performance carried out in the SxIFCA area suggested that grid gaps in excess of 20mm width were often used by the industry to remove most of the undersized whelks from the catch. KEIFCA commissioned a local engineer to manufacture a stainless steel riddle with nine separate grids with gaps of 20 to 28mm in 1mm increments.

Figure 3.2. The experimental riddle with the 20mm gap grid fitted

The selection performances of the nine grids were determined by passing a sample of whelks over each grid in turn. Starting with the largest grid (28mm gap) and passing whelks that passed through sequentially to the smallest grid. Care was taken during the riddling procedure to make sure each whelk had plenty of opportunity to pass through each grid if it were small enough to do so. We assumed there was no accidental or incidental retention. The performance of each grid was described by the relationship between a whelk's size (shell height) and the probability of it passing through the grid using logistic regression techniques and R software (R Development Core Team, 2012). The riddle experiment was carried out in all four areas to see if selection performance in relation to shell height was consistent.

To provide an indication of how the riddle grids with each gap size would perform when separating a typical catch of whelks an average selection ogive for each was computed by combining data for all survey areas and these were applied to a commercial catch size distribution (from the commercial fishing gear deployed alongside the experimental gear in the Eastbourne survey area). Predicted numbers of whelks retained and discarded by each riddle grid were converted to proportions by catch component (undersized or commercial size) for four hypothetical Minimum Landing Size scenarios (45, 50, 55 and 60mm).

3.3 Underwater imagery

To study the behaviour of foraging whelks around baited traps a video camera with lighting was mounted above a baited trap in a large circular tank. Sand was used as an artificial substrate within the tank which had a through flow of fresh filtered sea water and the bait used was crab and fish. After acclimatisation in net bags over a period of 24hrs 80 whelks were released into the tank and filmed over a period of 24 hours. Still photographs were taken at 2 minute intervals. The photographs were incorporated into a Microsoft PowerPoint presentation slideshow providing a time lapsed sequence of views.

4. Results

4.1 Selective traps - escape holes

Size distributions of the catches are poly-modal, typical of fish populations with seasonally defined life cycles, but at commercial sizes the modes are not distinct, typical of species exhibiting protracted hatching periods, variable individual growth rates and/or reduced growth after maturation. Size distributions of the catch for each survey area and escape hole size show a general and sequential reduction in the proportion of the catch that were undersized with increasing escape hole diameter (Figure 4.1.1). The modal sizes for the size distributions of whelks from Eastbourne are all between 50 and 60mm, whilst those for the Ramsgate and Whitstable areas in those pots with escape hole sizes of 20 or 22mm are below 45mm. The modal size of the catch in the Selsey area was above 60mm for all but the smallest escape hole diameter (20mm). There were fewer smaller whelks caught in the Selsey survey area and more in the Ramsgate area.

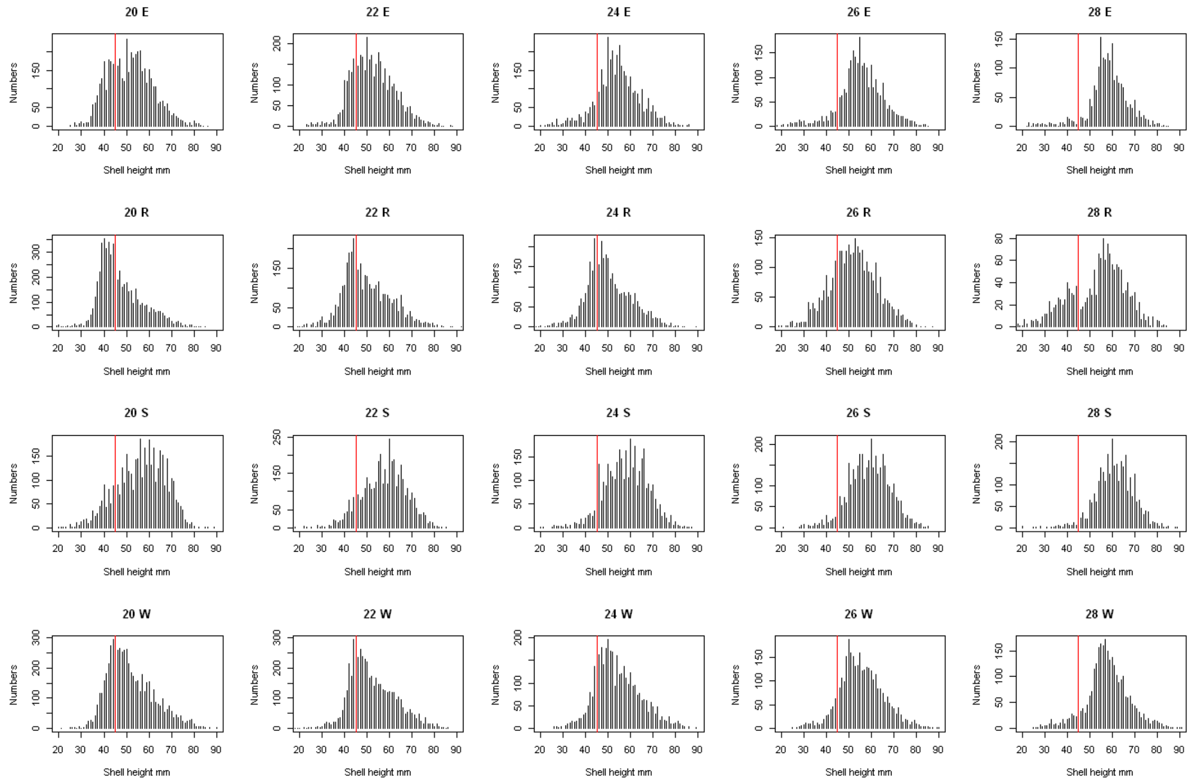

Figure 4.1.1. Size distributions of catches for each survey area (Eastbourne E, Ramsgate R, Selsey S and Whitstable W) and trap hole size (diameter in mm). The red vertical reference line is the MLS of 45mm

In the Whitstable and Eastbourne survey areas the overall numbers of whelks taken in the traps by each hole size showed a general decline in the numbers of both commercial and undersized whelks with increasing escape hole size (Figure 4.1.2), but with the under-sized component reducing by a much greater proportion. For the Ramsgate area catches of whelks of commercial size appear similar for all but the traps with the largest holes (28mm diameter) which showed significantly reduced catches. However, there was also a substantial decline in the number of undersized whelks taken with increasing hole size in the Ramsgate area. A similar lack of relationship between catch numbers of commercial whelks and escape hole size was apparent for the Selsey area, which showed a slight decline in commercial sized whelks for the largest hole size only. The proportion of undersized was generally lower in Selsey, but as in all other areas showed substantial reductions with increasing hole size.

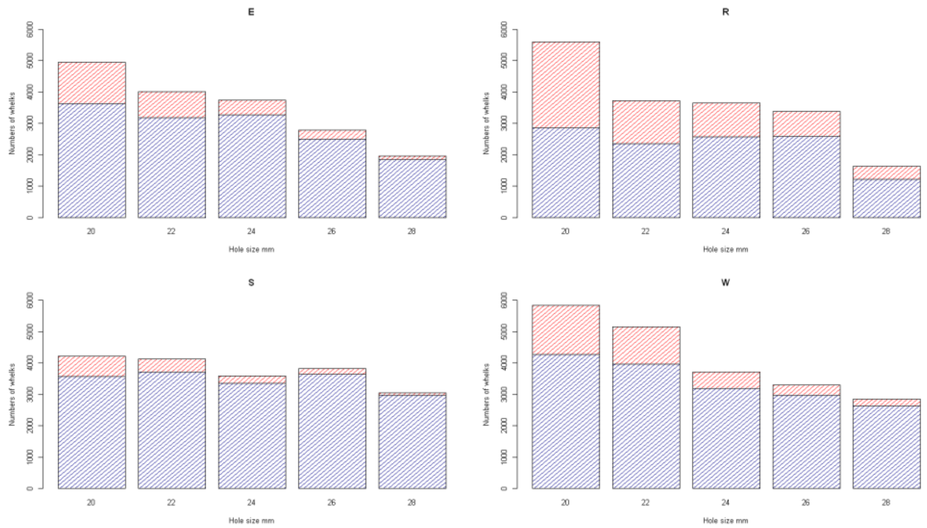

Figure 4.1.2. Summary of catches by catch component for each trap size and survey area. (Eastbourne E, Ramsgate R, Selsey S and Whitstable W). undersized component red, commercial sized whelks blue

Although the summary above of whelk catches by trap hole size and survey area is useful it does not convey the affect of soak duration. Because bad weather dictated the exact combination of soak durations used in each survey area during the experiment, different combinations of soak periods were used in each area. This is termed an unbalanced experimental design and needs to be taken into account if soak time is shown to affect catches. A matrix of plots of mean numbers of whelks in each catch component (>=MLS and <MLS) against hole size and by survey area and soak duration shows the influence of soak time of catches of both undersized and commercial sized whelks (Figure 4.1.3).

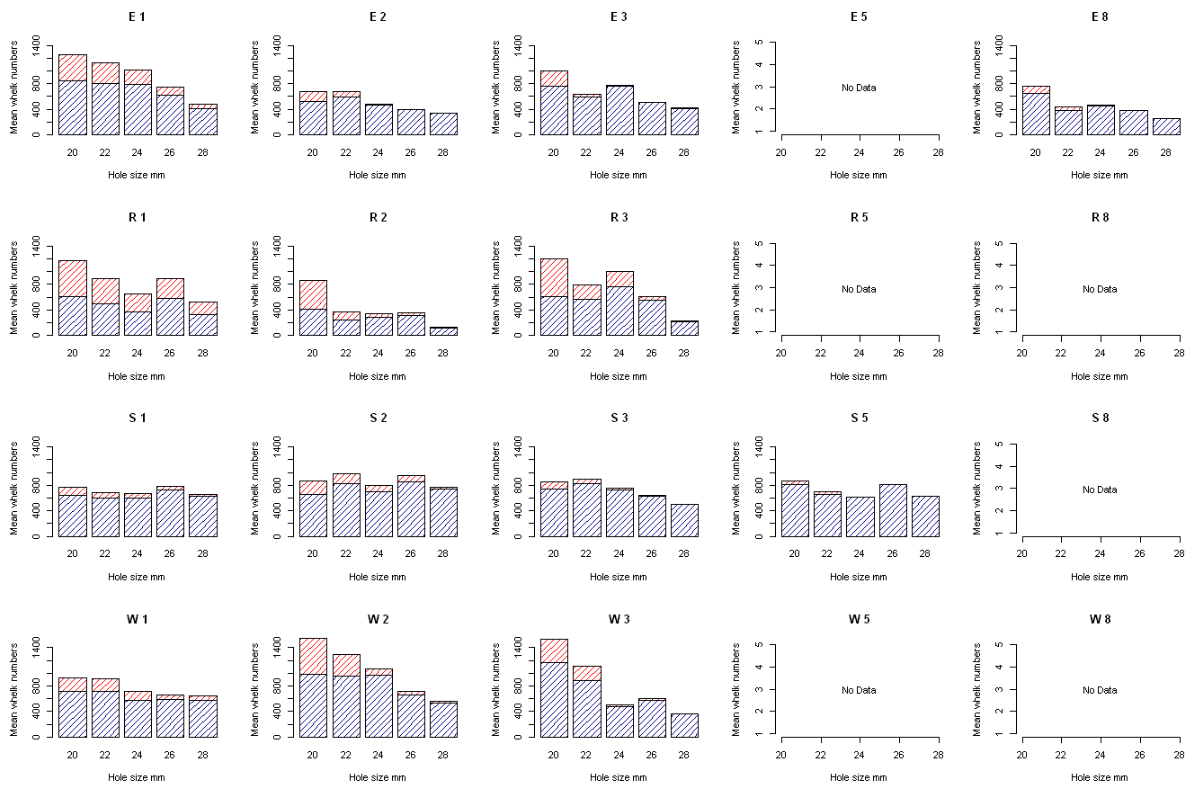

Figure 4.1.3. Mean numbers of whelks caught per hauling occasion by catch component (red<45mm, blue >=MLS), hole size, survey area (Eastbourne E, Ramsgate R, Selsey S and Whitstable W) and soak duration (1, 2, 3, 5 and 8 days)

In the Eastbourne area the mean catches of whelks were highest after a one day soak period followed by the three day soak period. The catches after a two day soak period were lower and were more comparable to those of an enforced 8 day soak. It is not clear why catches after a two day lay were lower than both the one and two day lays. There were no undersized whelks in the traps with 26 or 28mm escape holes after the 8 day soak.

In the Ramsgate area the size distribution of the catch contained a relatively high proportion of undersized whelks especially in the traps with the smaller escape hole sizes. The smallest average catches also occurred after a two day soak time. This area also showed some reduction in the proportion of undersized in the larger hole sizes with increased soak time.

In the Selsey area there was no obvious relationship between mean numbers of whelks caught in each catch component by trap hole size and soak duration. However, no undersized whelks were taken in the traps with the larger two escape hole sizes (26 and 28mm) after the extended and enforced soak duration of 5 days. The mean number of undersized whelks in the other traps was also lower when compared to catches for the shorter soak durations.

In the Whitstable area the mean numbers of undersized whelks caught in the traps with the two smallest hole sizes and after two and three day soak periods were higher compared to the one day soak period. For the three largest hole sizes the two and three day soak periods provided lower mean numbers of undersized whelks.

Overall there was no clear relationship between soak time and catch, with different areas showing different trends. However, there was a general tendency in all areas for pots with larger holes to have reduced proportions of undersized whelks after longer soak times.

Analysis of deviance confirmed that escape hole size, survey area and soak duration all affect catch numbers. Significant interactions between catch component and survey area, soak duration and escape hole size show that the proportion of undersized whelks in the catch is also dependent on these three factors. A further additional significant interaction between catch component, escape hole size and soak time combined shows that the relationship between the proportion of the catch which is undersized and the size of the escape holes varies for different soak durations. This makes interpretation more complex but substantiates the observation for Whitstable for example in figure 4.1.3 which for a two day soak time shows a higher proportion of undersized whelks for pots with smaller escape holes, but a lower proportion for pots with larger escape holes.

To aid interpretation of the affect of escape hole size on these results, predicted daily catches where soak duration was standardised to one day were presented for each survey area (figure 4.1.4). By standardising the soak time this figure better reflects the influence of escape hole size on the catches of both commercial sized and undersized whelks. The model is a good fit explaining 74% of the deviance and the predicted daily catches in this later figure show a similar but not identical pattern to figure 4.1.2.

After standardising for soak time, a gradual decline in the predicted catch number of commercial sized whelks with increasing escape hole size and a more sudden drop off at 28mm hole diameter was apparent (figure 4.5). Predicted numbers of undersized whelks declined at a higher rate with increasing hole size. This effect was more noticeable in the Ramsgate survey area because of the higher proportion of smaller whelks in this area.

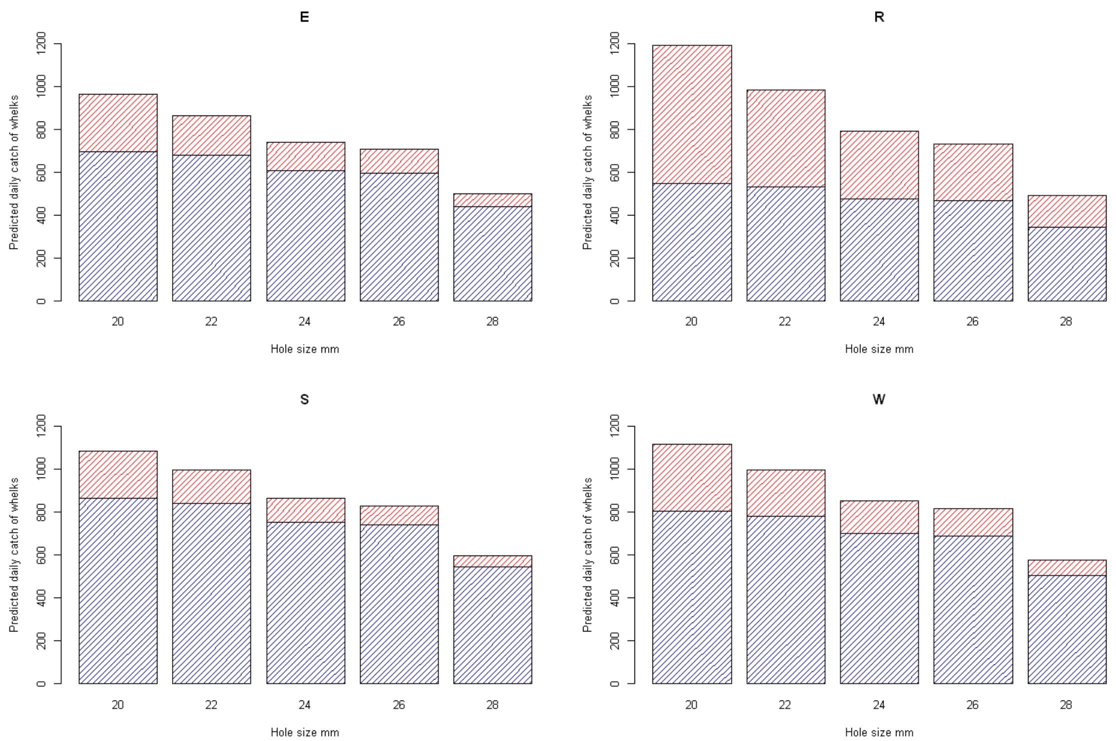

Figure 4.1.4. Predicted daily catches of commercial (blue) and undersized (red) whelks by escape hole size and survey area (Eastbourne E, Ramsgate R, Selsey S and Whitstable W) assuming a standard soak duration of one day.

To aid interpretation, proportions of undersized whelks in the predicted catches (soak time standardised to one day) have been plotted against escape hole size to show the relationship (figure 4.1.5 and table 4.1). The regression lines for all the survey areas except Ramsgate give similar slopes and intercepts, but the intercept for the Ramsgate regression line is larger. As an example, the slope of -0.0183 for Eastbourne shows that the proportion of undersized whelks in the catch is reduced by 0.0183 for each 1mm increase in hole diameter (or by 0.146 over the 8mm increment observed in the experimental gear). Clearly the largest impact of increasing escape hole size occurs in the areas with the highest proportion of small whelks in the catch. A more general interpretation is that within the range 20mm dia. to 28mm dia. holes sizes, each 1mm increase in hole size resulted in a reduction in the percentage of undersized whelks of between 1.5% and 3%, the greatest reduction occurring in Ramsgate where small whelks were more prevalent (Table 4.1).

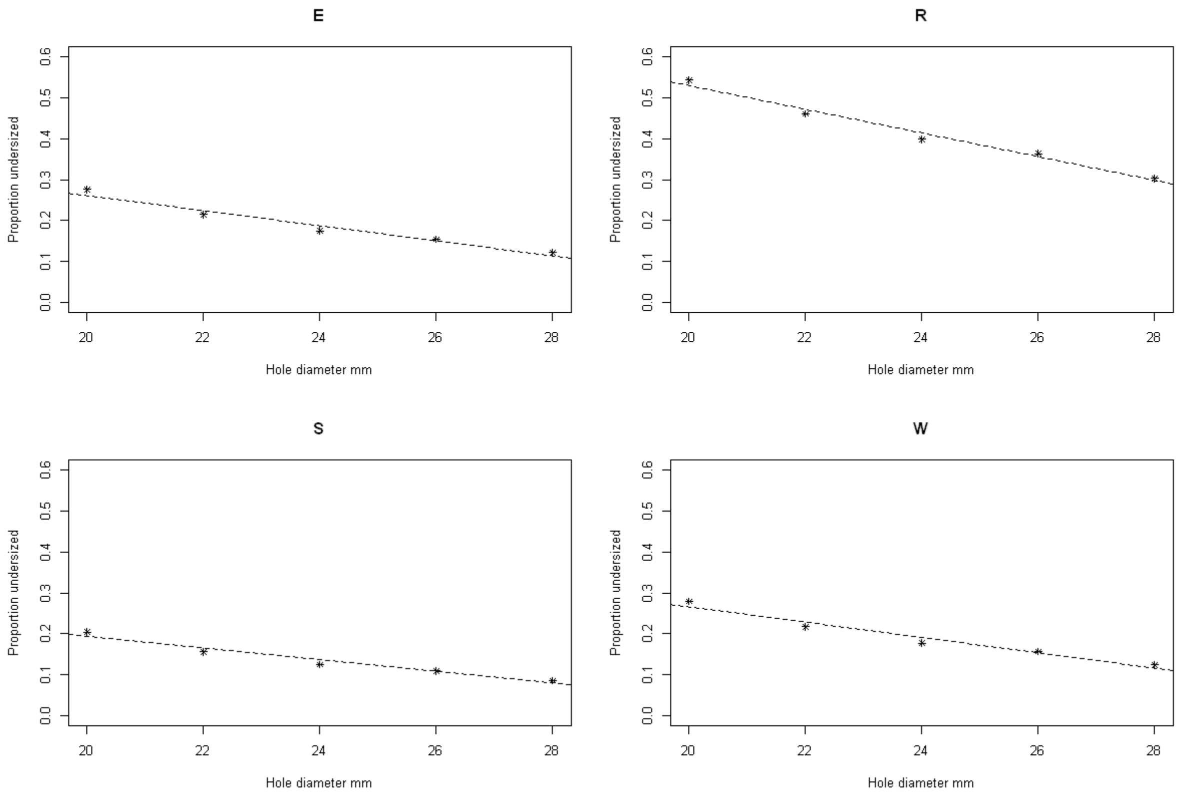

Figure 4.1.5. Plots of predicted proportional undersized catch against escape hole size with fitted regression line by survey area.

Table 4.1. Regression line coefficients for relationship between the proportion of undersized whelks in the catch and escape hole size by survey area

Survey area	Slope	Intercept	Percentage reduction of undersized whelks per mm increase in hole size
Eastbourne	-0.0183	0.6289	1.8
Ramsgate	-0.0288	1.1045	2.9
Selsey	-0.0141	0.4761	1.4
Whitstable	-0.0185	0.6358	1.9

4.2 Riddle selection

Minimum landing size legislation is based on shell height which is easily measured. Intuitively, it is likely that the minimum shell width is likely to restrict the passage of a whelk through a riddle grid. Because of the helical structure of the shell its width is less clearly defined and accurately measured in the field. The relationship between shell height and a measure of minimum shell width for whelks measured in the laboratory is known (figure 4.2.1). Shell width can be estimated by multiplying shell height by the slope of the line (0.429) and adding the intercept value (1.608).

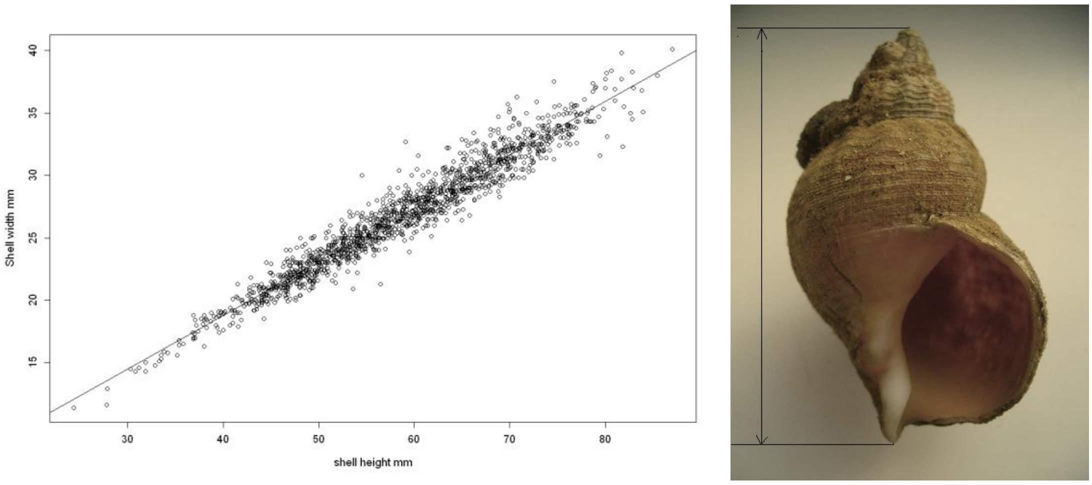

Figure 4.2.1. The linear relationship between shell width and shell height (LH panel). a=0.429, b=1.608. Shell height measurement (RH panel)

Logistic regression proved appropriate for modelling the riddle retention data explaining 98% of the deviance. Analysis of deviance showed that all of the explanatory factors (whelk shell height, riddle grid gap size and survey area) were important for describing the probability of a whelk passing through the riddle grid. The relationship between whelk size and the probability of a whelk being retained varied inconsistently depending on grid gap and survey area.

Using the logistic regression model, the predicted probability of a whelk of a certain size being retained by the grids was plotted to produce selection curves (ogives) for each grid and survey area (figure 4.2.3). The size of whelks where 50% were retained by each grid and survey area combination shows an increase in size with increasing grid gap as expected as well as some variation between areas (table 4.2). Generally the selection ogive for Selsey was to the left of the other areas on the horizontal axis suggesting that a whelk of a given size was more likely to be retained by the grid than for other areas (there are exceptions). Conversely the selection ogives for Ramsgate were often to the right of the ogives for the other areas suggesting that a whelk of given size was more likely to pass through the grid.

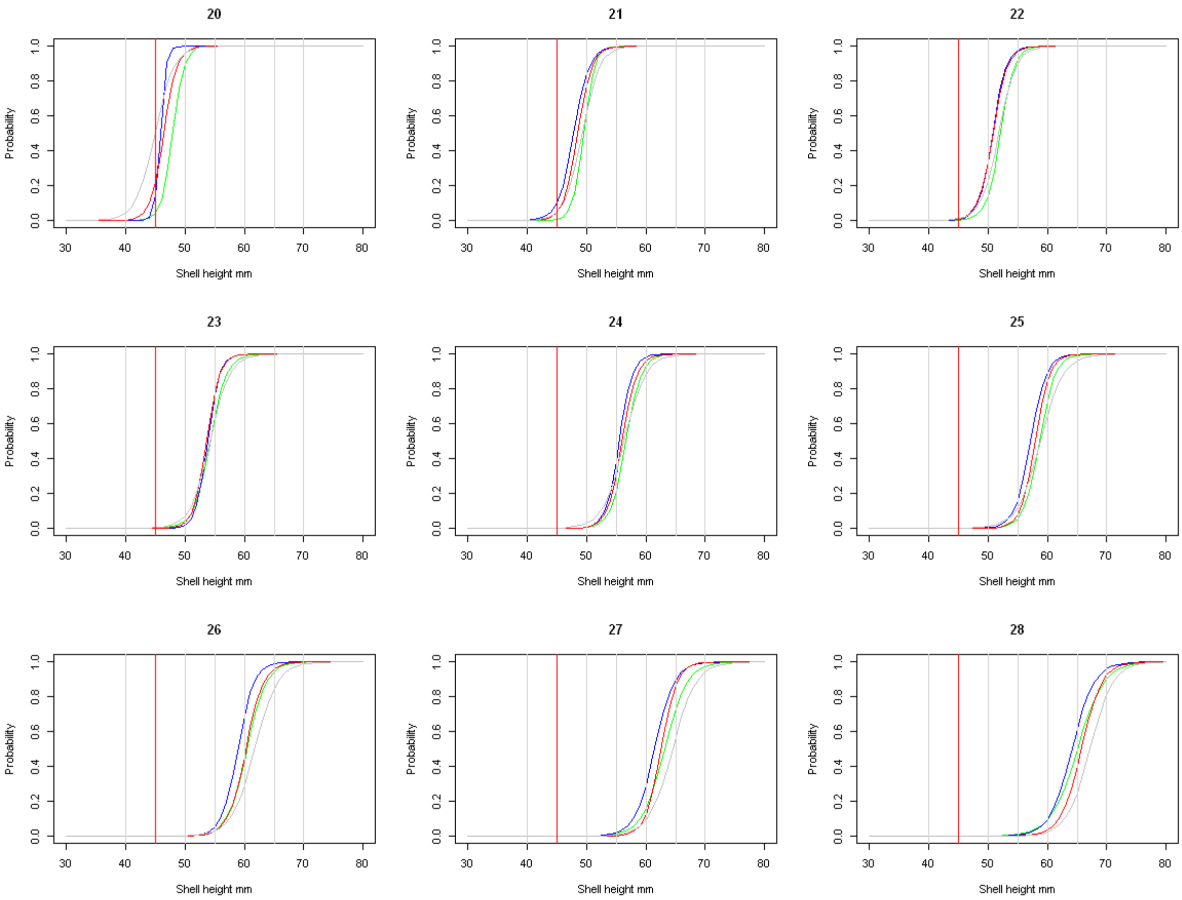

Figure 4.2.3. Selection performance of each riddle grid as probability of retention against whelk size (shell height in mm) by survey area. Selsey blue, Whitstable red, Ramsgate grey and Eastbourne green

Table 4.2. Size at which 50% of whelks are retained by grid gap and areas (including 95% confidence intervals).

Fishing area	Gap mm	Size at 50% retention	lower 95%	upper 95%
Eastbourne	20	47.94	47.46	48.42
	21	49.52	49.04	50.01
	22	52.11	51.58	52.64
	23	54.25	53.71	54.79
	24	56.67	56.16	57.19
	25	58.70	58.17	59.22
	26	60.45	59.89	61.01
	27	63.15	62.58	63.73
	28	65.06	64.44	65.68
Ramsgate	20	44.95	44.73	45.16
	21	49.28	49.13	49.44
	22	51.81	51.66	51.97

	23	54.21	54.04	54.39
	24	56.37	56.18	56.56
	25	58.83	58.62	59.05
	26	61.71	61.47	61.95
	27	64.49	64.20	64.77
	28	67.15	66.82	67.48
Selsey	20	45.89	45.04	46.74
	21	47.83	46.47	49.19
	22	50.77	50.06	51.48
	23	53.83	53.3	54.36
	24	55.53	54.97	56.09
	25	57.17	56.62	57.73
	26	58.93	58.42	59.43
	27	61.47	60.97	61.96
	28	64.13	63.63	64.64
Whitstable	20	46.42	46.18	46.66
	21	48.52	48.28	48.77
	22	50.82	50.57	51.08
	23	53.63	53.37	53.89
	24	56.03	55.72	56.33
	25	57.97	57.61	58.32
	26	60.26	59.77	60.75
	27	62.56	61.98	63.15
	28	65.71	64.64	66.78

Selection ogives for each of the nine riddle grids (all areas combined) were used with the size structure of a typical commercial catch to give the estimated numbers of whelks at size. A summary (percent by weight) shows the loss in commercial and undersized catch with increasing riddle grid gap size (figure 4.2.4) and for four hypothetical MLS. Assuming MLS is the current 45mm shell height there is a small loss of commercial whelk and low retention of undersized whelks at the smallest grid size. Increasing to a 21mm riddle grid gap would give a further loss of commercial catch but there would be virtually no retention of undersized whelks. If the MLS were assumed to be 50mm the 20mm grid would retain a significant proportion of undersized whelks for no loss of commercial catch, whilst a 22mm grid gap would mean the loss of a small amount of commercial catch but reduce retention of undersized whelks to a minimal level. If the MLS were as high as 60mm (close to the size at which whelks are believed to be sexually mature in this area) a 26 or 27mm grid gap might be more appropriate.

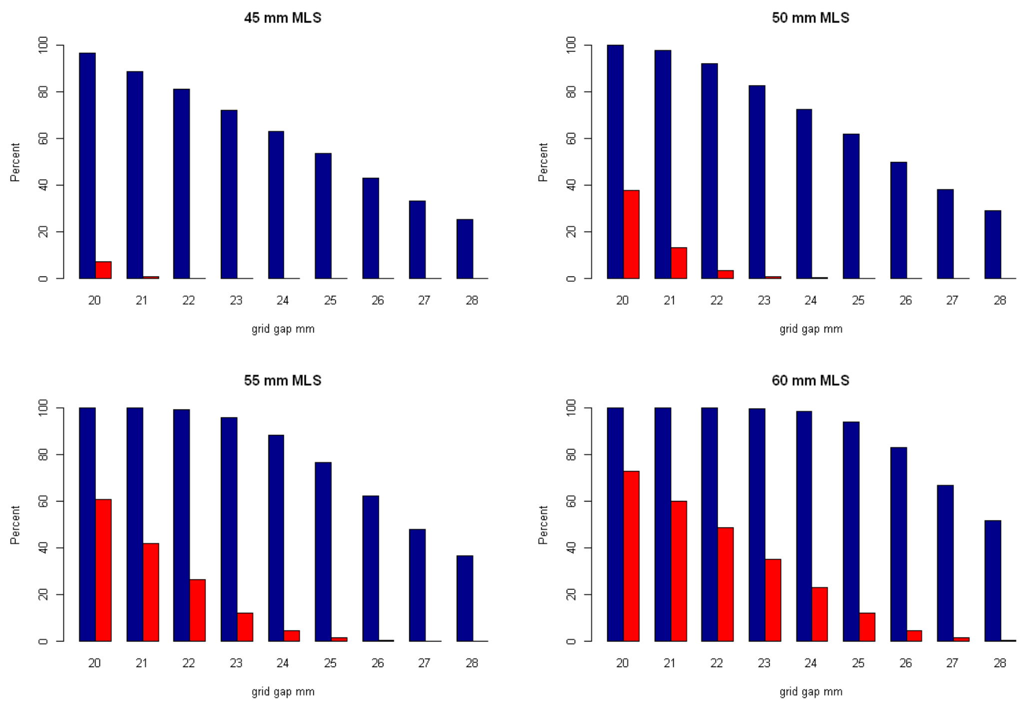

Figure 4.2.4. An example of catch retention by riddle grid gap of both commercial size (blue) and undersized (red) whelks for different assumed Minimum Landing Sizes. Estimated by applying an average selection ogive for each grid gap to a typical catch sample.

4.3 Underwater imagery

Underwater video in an aquarium environment showed that whelks did not necessarily take a direct route into the trap and were observed wandering around the netting on the top of the trap or the sides of the trap before sometimes moving off the trap and away.

Stills images show that whelks were able to move suspended under the netting at the top of the trap and this facilitated some escapes.

5. Discussion

5.1 Selective traps - escape holes

The effectiveness of escape gaps at releasing animals below commercial size in crustacean trap fisheries is well documented (Boutson *et al*, 2009, Jirapunpipat *et al*, 2008, Treble *et al*, 1998, Brown, 1982). Information on the usefulness of escape holes in gastropod trap fisheries is more limited but available for some gastropod fisheries (Grati *et al*, 2010, Park *et al*, 2007).

Limited information is available on survival of discarded whelks, but tagging studies suggest that after an initial recovery period released and marked whelks can be recovered in baited traps in reasonable quantities (Lawler and Vause, 2010, Hancock, 1963). This suggests that the capture process in baited traps is not detrimental to most individuals, but there remains the possibility damage by the sieving process. Intuitively we think that the heavily calcified shell will adequately protect whelks from mechanical damage during the riddling process, but survival trials for whelk sorting equipment are not known.

Whereas mortality of discarded whelks during fishing operations may not be high under typical conditions it is considered undesirable to bring unwanted animals onboard as poor handling and potential relocation to unsuitable habitat may have a detrimental affect on stocks. It is also undesirable from a fisher perspective as undersized whelks require separating from the landed component of the catch and large quantities will add unnecessary handling time to their procedure.

The selective properties of whelk traps are not well studied and many different design specifications are used by the fishing industry in the South East of England. Some fishers already incorporate holes that are large enough to allow passage of small whelks in their gear, for both conservation and ease of handling reasons. The majority of trap designs only have small holes whose purpose is to allow water drainage when hauling. Some fishers claim that addition of escape holes low down the sides of the pot enable commercial sized whelks to feed externally to the trap by allowing access to the bait via their long proboscis. Others claim that escape holes allow commercial sized whelks to escape when they have satiated themselves and that they allow netted dog whelk or other small gastropods to access and deplete the bait. Nonetheless some of these problems may be circumvented by further gear design and the conservation benefits of escape holes might prove worthwhile.

The project partners discussed various escape hole specifications and gear type candidates for the experimental traps for this study. The combination of 6 rows of 3 holes high up in the sides of the traps and 12 holes in the base of the trap with 5 hole diameters was deemed likely to provide useful results in consideration of current and other plausible Minimum Landing Size scenarios. For context, whelks of known shell height were passed through each of the five hole sizes during one of the surveys. It was found that a 39, 41, 45, 48 and 52mm whelk (shell height) would pass through the 20, 22, 24, 26 and 28mm diameter escape holes respectively with a tight fit and when gently pushed. We would expect that because of the extra mass of the foot of the whelk those individuals of those sizes would not be able to pass through those holes under their own locomotory efforts and as such are an overestimate of the size of whelks that could potentially pass through.

As there is no regulation standard pot design in the fishery and some designs in current use already have escape holes it was deemed unnecessary to include a control trap type with only small drain holes. The experiment was instead a direct comparison between the different escape hole diameters chosen for the experiment. However, the generous loan of commercial gear in the Eastbourne area did allow a direct comparison with the experimental gear in this area (Appendix 2).

The experiment was repeated in each of four survey areas partly because if local IFCAs were to consider obligatory use of escape holes in whelk traps as a future management measure the fishing industry would quite rightly want to refer to locally relevant evidence. Although the same experimental gear was fished in each survey areas we could foresee different results because of differences in local physical conditions like tide and substrate type. We suspect the degree and incidence of shell fouling by other organisms such as barnacles and sponges to vary regionally and this may affect results. There may also be slight differences in the shape of different populations of whelks in different regions and a “fat” whelk is less likely be able to pass through an escape hole of a given size than a “thin” whelk of the same shell height.

It was considered necessary to attempt to control for soak time in the experiment as best as weather would allow because it was thought likely that whelks capable of passing through the escape holes would not be inclined to do so until they were satiated or the bait depleted. As such we expected soak time to influence the numbers of small whelks in the catch. The results confirmed this with generally lower numbers of undersized whelks observed from catches with longer soak periods. The longest soak times of 5 and 8 days had the lowest numbers of undersized whelks overall with none in the traps with the 26 and 28mm escape holes. However, in the Whitstable and Selsey area higher numbers of undersized whelks were taken in the traps with smaller hole sizes after two days soak when compared to the one day soak period. Fishers in these survey areas were asked to try and move the gear after the first survey day in each area following concerns that the catches did not contain enough undersized whelks for a successful trial of the gear. They subsequently found an adjacent survey area with a higher proportion of small whelks in the catch. This will have confounded the effect of soak time with spatial variation in these areas and may explain the significant interactions between soak time and the other main effects in the generalized linear model.

The size distribution of the catch is a function of both the selective properties of the traps and the size structure of the whelk populations which are known to vary regionally. Commercial gear and our experimental designs will have unique selective properties and we assume that the size distributions of the catch from these traps will not be the same as that of the population. There were noticeably fewer smaller whelks in the Selsey survey area than at the other three sites and this corroborates evidence from an earlier study carried out in the Selsey and Eastbourne area in 2010.

Selective gear will have much more impact in terms of reduction of the undersized whelk catch in fishing areas where undersized whelks are more numerous and when soak time is extended beyond normal procedure.

5.2 Riddle selection

There is limited information in the literature on the selective performance of whelk sieving devices, but a selection of riddle grids in operation in the Sussex fishery were tested during a project carried out by Cefas and Sussex IFCA as part of a Fisheries Science Partnership project carried out in 2010 (Cefas, FSP report 2010). A number of designs and bar spacing (gap distance) are used and there is little consistency within the fishing industry. Sussex IFCA use a standard round bar grid with a 25mm gap for enforcement purposes. Grids are usually made from welded round bars or cut from thick solid sheets of stainless steel. These two fabrication methods provide a square or round profile to the gap. The profile will have an effect on the selection performance of the device and round bar and square cut grids with the same gap measurement will have different selection properties. Because of the complex helical structure of the shell and the profile of the grid, a round bar grid will allow a larger whelk to pass through than a corresponding square profile grid of the same overall gap size. Similarly, a square grid constructed from thin plate metal will allow a larger whelk through than a thick plate square grid. These differences are subtle and the gap size is the most important parameter to consider. For this project nine grid gaps were precision cut from 1.4mm sheet stainless steel in 20 to 28mm gap sizes in 1mm increments. Although not expected to give results identical to a thick gauge commercial riddle these were considered a good compromise for economic value and gap size choice.

The riddle trials were carried out in all four survey areas because variations in the level and occurrence of shell fouling and subtle regional differences in whelk shape could affect the results. Fundamentally the most important factor regarding the performance of a riddle is the diligence of the operator. Clearly if the whelks are not thoroughly moved around the surface of the grid, or the gaps become blinded or fouled by old bait, other whelks or debris then the selective performance of a riddle could be seriously impaired, resulting in the retention of more smaller whelks.

Proper use of an appropriate riddle grid with timely release of discards in to the sea, preferably over the fishing ground where they were caught, will likely contribute considerably to the sustainability of the stock, especially in areas where large numbers of undersized whelks are encountered. Proper use of such equipment may reduce or remove the requirement for selective traps with escape holes, but inconsistencies in riddling procedure and uncertainties over discard survival would suggest that both methods could prove beneficial and achieving as much of the selection process as possible prior to hauling may be beneficial from both whelk survival and conservation aspects as well as reducing the handling overheads of fishers.

The size distribution of the retained and discarded components of the catch is a function of the size distribution of the sample passed over the grid. The selective performance of the grid can be measured and can be used to predict the likelihood of a whelk of a given size passing through it. As such, the selection performance of a grid can be used to accurately predict the size distribution of the resulting catch components of any whelk sample. To give an indication of the likely results of using the various riddle gaps the selection ogives of each grid were applied to a commercial catch size distribution collected in the Eastbourne area. This size distribution is assumed typical for this area using this gear. The predicted outcome in terms of numbers at size in both the separated components of the catch and summarised in figure 4.2.4 above is a reasonable expectation of what would happen in a commercial environment providing the catch is well riddled. By providing hypothetical but plausible values for MLS we can see the relative proportions and losses of both undersized and commercial sized whelks from the landings.

Unfortunately, riddles are not ideal devices for separating whelk catches into landed and discarded components as the selection ogive is an “s shaped” curve and not “knife edged”. This means that even if a grid gap with a size appropriate for the current MLS is used, some undersized whelks are likely to end up in the landings and some commercial sized whelks will be discarded. A grid that allows all undersized whelks in a catch to pass through will undoubtedly release a significant proportion of commercial whelks regardless of how much care is used by the operator. Whelks are usually landed in large quantities, making manual measuring of each animal logistically difficult and as such there is likely to remain a requirement for this sort of automated grading equipment.

It is the choice of fishery managers to determine the right balance between conservation and loss of income to the fishing industry, although if a riddle which retains all commercial sized whelks is used, the retained component would require further sorting to comply with MLS legislation.

5.3 Underwater imagery

It had initially been envisaged that the underwater camera work would be done *in situ* on the sea bed, but the project partners thought that due to tidal and turbidity issues this would not yield useful results. We therefore decided to carry out filming in a large circular tank at the Cefas Lowestoft site which has circulating and filtered sea water facilities.

The stills photographs displayed in a time lapse slideshow were particularly useful and gave some useful insight into whelk behaviour around, on and in the baited trap. If we were to repeat this type of work we would recommend the time lapse approach and suggest that 30 second or 1 minute intervals would be appropriate.

Technical problems with video recording facilities prevented acquisition of as much video footage as we would have liked. Observations suggested that not all of the captive whelks appeared hungry as some moved over the trap without entering. With hindsight it may have been useful to use partially starved whelks rather than individuals which had recently been taken in baited traps and may have been satiated.

6. Conclusions

1. The number of both undersized and commercial sized whelks captured was reduced with increasing escape hole size.

2. The proportion of undersized whelks in the catch is reduced with increasing escape hole size (and therefore the proportion of commercial sized increased).

3. A suitable escape hole needs to balance the negative effect of loss of yield with improved conservation value and potentially reduced handling overheads.

4. The number and proportion of undersized whelks in the catches from the Ramsgate survey area was significantly higher than those from the other survey areas and therefore the effect of all escape hole sizes was greater.

5. The number and proportion of undersized whelks in the catches from the Selsey survey area was significantly lower than those from the other survey areas and therefore the effect of all escape hole sizes was smaller.

6. Increased soak duration generally reduced the numbers of undersized whelks in the catches, although weather disruption and gear relocation made the relationship between undersized whelk catches and increasing soak time difficult to interpret.

7. The potential benefits of appropriate escape holes would be more obvious in areas with high proportions of undersized whelks in the catch and when soak time is extended beyond typical practise.

8. The selective performance of nine riddle grids with gaps from 20 to 28 in 1mm increments was measured.

9. Selection ogives estimated for different riddle specifications can be applied to size distributions of total catches to predict a hypothetical size structure of both the discarded and retained component of the catch.

10. There were differences between the selection ogives for each grid between survey areas, but the differences were inconsistent between grid gap size suggesting some other (unknown) factor such as different levels of shell fouling may be responsible.

11. Time lapse stills photography in aquaria facilities is a useful method of observing whelk behaviour in proximity to baited traps.

7. References

Boutson, A., Mahasawasde, C., Mahasawasde, S., Tunkijjanukij, S. and Arimoto, T., 2009. Use of escape vents to improve size and species selectivity of collapsible pot for blue swimming crab *Portunus pelagicus* in Thailand. Fish. Sci. 75, 25-33.

Brown, C., 1982. The effect of escape gaps on trap selectivity in the United Kingdom crab (*Cancer pagurus* L.) and lobster (*Homarus gammarus* L.) fisheries. J. Cons. Int. Explor. Mer. 40, 127-134.

Jirapunpipat, K., Phomikong, P., Yokota, M. and Watanabe, S., 2008. The effect of escape vents in collapsible pots on catch and size of the mud crab *Scylla olivacea*. Fish. Res. 94, 73-78.

Grati, F., Polidori, P., Scarcella, G. and Fabi, G., 2010. Estimation of basket trap selectivity for changeable nassa (Nassarius mutabilis) in the Adriatic Sea. Fish. Res. 101, 100-107.

Hancock, D., 1963. Marking experiments with the commercial whelk (*Buccinum undatum*). Int. Comm. Nthw. Atlan. Fish. 4, 176-187.

Lawler, A. and Vause, B., 2010. Whelk Biology. Cefas Fisheries Science Partnership report. Cefas unpublished.

Park, H., Millar, R., Anc, H., Kim, H., 2007. Size selectivity of drum-net traps for whelk (*Buccinum opisoplectum dall*) in the Korean coastal waters of the East Sea. Fish. Res. 86, 113–119.

R Development Core Team (2012). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Treble, R., Millar, R. and Walker, T., 1998. Size-selectivity of lobster pots with escape-gaps: application of the SELECT method to the southern rock lobster (Jasus edwardsii) fishery in Victoria, Australia. Fish. Res. 34, 289-305.

8. Acknowledgements

This project was carried collaboratively between Cefas, Kent and Essex IFCA and Sussex IFCA . Funding was provided by Defra through the Fisheries Challenge Fund administered by the Marine

Management Organisation (MMO). We would like to take this opportunity to thank those who contributed to the success of the project, in particular the skippers and crews of the fishing vessels chartered, the staff of the IFCAs, MMO and colleagues at Cefas.

Appendix 1. Invitation to Tender

Testing the efficacy of two methods designed to reduce the numbers of undersized whelks in commercial landings: Research surveys designed to determine the effectiveness of escape holes in whelk traps (pots) and various specifications of onboard sorting devices (riddles).

INTRODUCTION

Cefas and Kent & Essex IFCA will be carrying out a research project in the whelk fisheries located off the Kent and Essex coasts with the aim of reducing the proportion of small whelks in the landings. This will involve determining the effectiveness of various sizes of escape holes in whelk traps and the selective performance or different riddle specifications.

These studies require one or two fishing industry collaborators with an interest in the sustainability of the stocks, local knowledge and experience of this fishery. The project is funded by the Marine Management Organisation (MMO) as part of the Fisheries Challenge Fund, and who are committed to promoting the long-term future of England's fishing industry and achieving Good Environmental Status under the Marine Strategy Framework Directive.

These aims will require taking up to two scientists to sea to determine the catches in modified whelk traps, **and you are invited to tender for the work to be undertaken this summer (before 30th September).** Further details are given below.

BACKGROUND TO THIS PROJECT

The two aims which require industry cooperation are:

Effectiveness of escape holes in whelk pots.
This objective plans to use a commercial fishing boat to fish for whelks using modified traps (to be supplied by K&EIFCA) and to measure the size distributions of whelks taken in each trap. These modified traps will be deployed in areas which are expected to provide reasonable catches of whelks and where whelk populations are characterised by a large size range (i.e. all size classes of whelk from small whelks below 40mm shell height to large whelks above 70mm shell height. These should be expected to occur in the catch in reasonable quantities). The traps will be serviced over a short period of time but flexibility is required to allow for testing the effect of short or long soak times (weather permitting). The fishing positions will be decided in consultation with the successful tenderer/s.

What would be required?

a) One or two experienced local skipper/s are required to assist scientists in creating a survey specification within the local whelk fishing grounds.
b) The vessel/s and skipper/s will be required for a minimum of 5 days and a maximum of 10 days. (The number of days required will be determined at tender evaluation stage dependent on location coverage provided in the tender submissions.)
c) The vessel/s and skipper/s will be required to deploy and service 5 strings of 10 pots (50 in total). These pots will be serviced over the course of the survey and until the end of September, but flexibility is required as scientists will want to vary soak time to note its affect on results.
d) The skipper is required to provide all bait, and this is to be standardised throughout the survey as much as possible.
e) A crew member would be expected to assist scientists with preparing the catch for sampling and recording results.

Testing riddle specification.
The aim is to determine the selection performance of riddles with various gap dimensions.

What would be required?

a) Catches that are expected to contain reasonable numbers of all size classes of whelks (including both small and large whelks).
b) The catch will be passed over a number of different riddle grids.
c) Both components of the catch (that retained on the grid and that passing through it) will be measured by scientists but a crew member will be expected to assist with recording results.

TECHNICAL REQUIREMENTS-

Cefas/K&EIFCA is seeking to commission a named and registered fishing vessel, including all management, crew, fuel, and other services necessary to fish in the manner defined below.

The vessel must be as specified in Appendix A.1.

Fishing gear and its operation must be as specified in Appendix A.2.

Fishing operations will be in the area specified in Appendix A.3.

Fishing operations must take place in accordance with the specification in Appendix A.4.

The Skipper must be named, must have experience of working the defined fishing gear in the defined area and must demonstrate that they have a track record of fishing for whelks in this particular fishery (with the defined fishing gear, in the defined area) as specified in Appendix A.5.

The vessel must satisfy accommodation and safety standards given in Appendix A.6

The Skipper is required to discuss with scientists and agree a Detailed Operational Plan as given in Appendix A.7 before work starts. This may be fulfilled by telephone conversation but may require attendance at a planning meeting with scientists. The tender price should include the cost of attending any meetings or telephone discussions.

OTHER CONSIDERATIONS

Cefas/K&EIFCA reserves the right to choose those individuals that it considers to be fit and proper persons for participation in the scheme. Cefas/K&EIFCA requires tenderers to provide any information they consider relevant to their decision. Examples of information that may be contained in such a statement are details as to whether or not the applicants have outstanding County Court judgements against them, or whether the applicants have been declared bankrupt within the past 12 months, or whether they have been shown not to have complied with fisheries legislation in the past 12 months. In making his decision as to whether tenderers are fit and proper persons for participation in the scheme, Cefas/K&EIFCA will consider all relevant information available.

If there are no such considerations to be taken into account please state so.

PRICE

In the tender please provide two quotations as follows:

1) An all-inclusive fixed price for the provision of all the services above, including attendance at meetings, the supply and repair of gear, crew, fuel, bait, and any additional insurance and accommodation for 5 days fishing. **The price must include a breakdown of VAT.**
2) An all-inclusive fixed price for the provision of all the services above, including attendance at meetings, the supply and repair of gear, crew, fuel, bait, and any additional insurance and accommodation for 10 days fishing. **The price must include a breakdown of VAT.**

SPECIAL PROVISIONS RELATING TO RETENTION OF UNDERSIZED WHELKS IN CONTRAVENTION OF EC REGULATION 850/98

A dispensation will be provided to allow retention on board or landing of undersized whelks to facilitate this work. Local authorities will be kept informed as to the project requirements and any additional dispensations or permissions required to achieve the scientific objectives will be provided as required.

SUBMISSION OF THE TENDER

Appendix B provides a template, which can be used to tender for the above work. It is not obligatory to use this template but all requirements of Appendix A must be covered in the tender submission, along with a statement of financial standing to support the "other considerations".

Failure to provide the requested information may result in disqualification of the tender.

Two copies of the tender must be submitted to:

Mrs Lisa Scott
Procurement Manager
The Centre for Environment, Fisheries & Aquaculture Science
Lowestoft Laboratory
Pakefield Road
Lowestoft,
Suffolk
NR33 0HT
UK

The tender should be returned in a stamped envelope. To ensure confidentiality of the tenders the envelope must not bear any details indicating the name of the sender but must show on the outside a project reference such as **whelk experiments – tender application.**

QUERIES ABOUT THE TENDER

Clarification of the tender requirements can be given. Please contact the Cefas Procurement Manager on 01502 521349 or lisa.scott@cefas.co.uk. Alternatively, please contact:

Andy Lawler at andy.lawler@cefas.co.uk or 01502 524405.

Please be aware that we will make clarification questions and answers available to all bidders.

TIMETABLE

Tenders must be delivered to Cefas by **17:00 Friday 10th August 2012**. Late submissions will only be considered if the tender envelope is post-marked before this date.

Tenderers will be informed of the results as soon as possible.

EVALUATION OF THE TENDER

All criteria of "What is Required" and Appendix A must be satisfied. The tender seeks to ensure delivery of the agreed science at an affordable price, so providing good value for money. All tenders will be evaluated and scored, and the highest scoring tenders, meeting all the criteria and offering best value for money, taking into account delivery and affordability will be selected, as funds allow.

Vessels will be subject to inspection prior to award of a contract.

Cefas reserves the right not to fund any project or award any contract.

CONTRACT AWARD

The preferred tenderer will be invited to contract for the specified services. A draft set of contract Terms and Conditions are enclosed for information.

If the preferred tenderer fails to agree the Contract within a reasonable period, then the next preferred tenderer may be approached or Cefas may decide not to continue with the project.

SPECIAL PROVISIONS RELATING TO THE SAFETY OF TAKING SCIENTISTS TO SEA

The tender evaluation and contract award procedure will seek to ensure that the vessel and crew can ensure the safety of Cefas/K&EIFCA staff, and, accordingly, a survey may be made prior to contract award and at any time thereafter. There may be a delay between contract award and the actual fishing survey, and scientific staff will be under instructions to ensure that all standard safety items and procedures are adequate before each sailing. It is a requirement of the MCA for the skipper to give an explanation to scientists of the vessel risk assessment and health and safety regime, including the stowage and use of life saving appliances, the procedures in an emergency and escape routes before embarking on the voyage, this requirement will be made clear when discussing the Detailed Operations Plan. Safety drills shall also be carried out prior to departure. If safety items and procedures are not as specified in the contract documents at the time of sailing, then the scientists will not sail and the Contractor will be deemed to be in breach of the Contract

All operations for this contract need to be compliant with the obligations set out in MCA guidance MSIS 27 Chapter 1 Annex 14 or 15.

APPENDIX A

DETAILED SPECIFICATIONS

A.1 VESSEL SPECIFICATION & ACCESS

The vessel must be a practicing commercial fishing vessel capable of deploying baited traps of similar specification to those typically used in this area.

The vessel must be capable of remaining at sea for a daily period.

The vessel must have a safe working deck area, well lit, with sufficient clear deck area to accommodate up to two scientists and their equipment.

The vessel will ideally have sufficient deck space to stack 50 standard whelk pots and associated chandlery.

Embarkation and disembarkation should be at a port giving appropriate access to the fishing grounds.

The tender must state the name, type and size of the vessel.

The tender must state the port, or ports, they would suggest for embarkation and disembarkation.

The tender must confirm that the vessel is capable of remaining at sea for a daily period.

The tender must confirm that the vessel and skipper will be available for a port visit by a Cefas/K&EIFCA scientist to assess the suitability of the vessel for the requirements of the survey.

A.2 FISHING GEAR

The fishing gear to be used will be:

- Modified standard whelk pots deployed in five fleets of ten traps (50 pots in total). These will be provided by K&EIFCA. Bait to be provided by tenderer.

The tender must confirm the vessel is suitably equipped to deploy and retrieve these pots.

The tender must confirm that the vessel is capable of providing suitable facilities to enable use of a number of sorting grids of similar external dimensions to that typically used by local industry (exact specification to be provided).

A.3 AREA OF OPERATION

Fishing operations will be carried out on the Kent and Essex whelk fishing grounds within the area of jurisdiction of K&EIFCA which are located in ICES areas IVc and VIId generally within 6nm of the coast and between the Stour and Rye Bay (drying sandbanks extend the offshore limits in the Essex area).

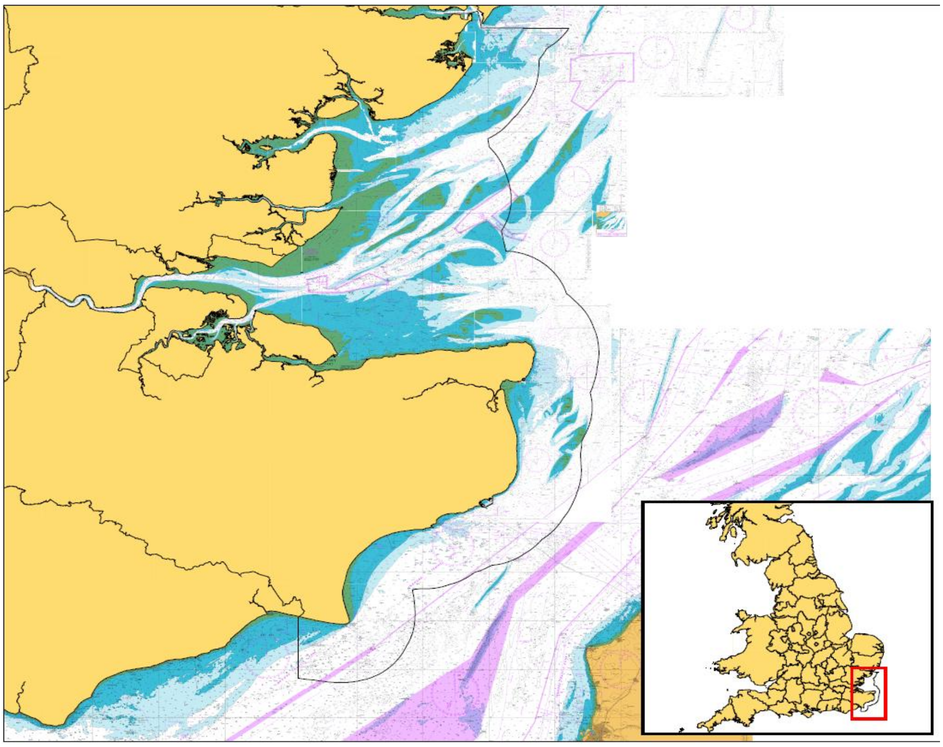

Figure 1. Location of operation within ICES subdivision IVc and VIId, showing Kent & Essex IFCA region.

A.4 FISHING OPERATIONS

Fishing operations must take place in accordance with the following:

A 4.1 Period of project: The potting survey shall start as soon as possible after 10th August and be completed by the end of September 2012. The exact timing and other details will be agreed in the Detailed Operations Plan of A.7.

A 4.2 Duration of project: The potting survey requires between 5 and 10 days fishing to be spread throughout the sampling period, but soak time will be varied from 24hr to 5 day soak (weather permitting). Additional sampling may be required in consultation with the successful tenderer.

Days at sea will be subject to weather conditions and vessel availability. In the event those days at sea are lost through adverse weather conditions or vessel availability, the lost day(s) must be re-scheduled for the earliest opportunity. Details will be agreed in the Detailed Operations Plan under A.7. The 5-10 days does not include an allowance for days lost to bad weather.

A4.3 Fishing Activities: Fishing activities will be required for approximately 5-10 days (depending on start date) with the specified gear deployed and fished as is typical for commercial practice. Note that scientists will require the gear servicing procedure to be slowed to enable enumeration of the catch and any necessary sampling procedures to be carried out (see A.4.4 below). Fishing practice may be altered during the survey period and will be agreed in the Detailed Operations Plan.

A 4.4 Sorting the Catch and recording: The crew will be required to assist in sorting and processing the catch and to assist in handling any whelks to facilitate biological sampling by the scientists where appropriate. A member of crew will be required to assist scientists by recording results with pen and paper.

A 4.5 Commercial Fishing: The scientific survey aims may be modified throughout the charter period. These aims must be fulfilled so it is currently unclear if there will be any spare time left each day for commercial fishing. Commercial fishing will be allowed in agreement with the scientists only if the survey aims have been completed successfully and the scientists onboard are allowed to sample the commercial catches. **We advise that in formulating a quote the tenderer assumes there will be no commercial fishing.**

The tender must confirm the number of days the vessel, Skipper and crew will be available for.

The tender must confirm that the required fishing will be undertaken throughout the specified area.

The tender must confirm that the crew will be willing and available to sort and process the catch and record data.

The tender must confirm that the fishing activities agreed in the Detailed Operations Plan will be undertaken.

A.5 EXPERIENCE

The Skipper must be named and have a track record of fishing for whelks in 2010 and/or 2011, using standard baited traps from the survey area defined in A.3. The Skippers' experience is crucial to the success of the project, and tenderers are encouraged to describe fully that experience. This will be a significant part of the tender evaluation.

The tender must detail the experience of the Skipper as required above.

The tender must include supporting evidence of the type of gear used for catching whelks.

A A.6 WORKING ENVIRONMENT AND SAFETY STANDARDS

A.6.1 Accommodation: The vessel shall provide a clean wheelhouse with sufficient space to accommodate up to two scientists and crew from adverse weather.

The vessel shall provide a safe working area, which will be well lit under all sea conditions, and large enough to accommodate the scientists and their equipment.

The tender must describe how the accommodation standards above are met, and give details of the size and character of the scientist's working area.

A.6.2 Safety Standards: (These are the normal standards required for fishing vessel operations)

The following is required for the vessel:

a) i) The vessel must have and supply a copy of a valid Marine & Coastguard Agency Fishing Vessel Decal certificate issued by an appointed MCA surveyor after inspection to ascertain the vessels general seaworthiness and compliance with The Small Fishing Vessels Code of Practice for Fishing Vessels under 15 metres LOA.

ii) If a mid-term inspection has been carried out by the MCA a copy of the report must be supplied.

iii) A copy of the declaration for annual self-certification under The Code of Safe Working Practice must be sent with the tender.

b) All vessels must have adequate marine insurance cover for the size of vessel and personnel on board.

The tender must supply a copy of the insurance cover for the vessel and personnel on board including scientific staff. (You may wish to detail your P&I and personnel insurance and financial limits on each)

c) All vessels must comply with the National levels of certification applicable to the area of operation and size of the vessel in respect of
Deck officers and engineers.

d) All vessels must comply with the applicable code on safety equipment such as: Liferafts. Lifejackets, Distress Rockets & flares, Radio Equipment and First Aid consumables.

The tender must confirm that the number of working liferafts are adequate to cover both the ship's personnel and Cefas personnel.

e) All crew on all vessels must have completed the Four x one day -
mandatory safety courses - Sea survival, First aid, Fire fighting & Safety awareness.

The tender must confirm that all crew will have these certificates and they will be produced at the first detailed meeting and prior to sailing.

f) All vessels must comply with the Marine & Coastguard Agency safe manning levels in accordance with size of vessel and area of operation.

g) The MCA advises that it is good practice for vessels to have a written risk assessment.

The tender must confirm whether or not they have a risk assessment and supply a copy of the risk assessment if they have one.

h) Prior to contract award an inspection of the vessels' lifesaving equipment will be carried out by a qualified surveyor.

The tender must confirm the vessel will be made available for an inspection on the vessel's lifesaving equipment.

In addition to the standards given above, Cefas also requires that:

i) The tender must confirm that there is a prohibition on the carriage of illegal drugs and alcohol.

Tendering vessels should ensure that they fully meet the requirements of the relevant code.

A.7 DETAILED OPERATIONS PLAN MEETING

The Skipper is required to be available for a meeting in early August 2012 for the development of a Detailed Operations Plan. This will involve scientists and the Skipper discussing the project objectives, and the joint development of details and structure of the Operations Plan. A further meeting may be needed to finalise a Detailed Operations Plan which will be required to be agreed no later than one week before the date of first sailing.

The tender must confirm the Skipper's availability for such meetings.

APPENDIX B: TEMPLATE (This is available as a separate word document by emailing lisa.scott@cefas.co.uk)

(PLEASE USE THIS TEMPLATE IF YOU WISH – IT IS NOT OBLIGATORY BUT YOU MUST PROVIDE SIMILAR MATERIAL IN YOUR SUBMISSION)

SUBMISSION OF TENDER

TITLE OF TENDER

Testing the efficacy of two methods designed to reduce the numbers of undersized whelks in commercial landings

NAME OF TENDERER (In capitals)

Name:

AUTHORITY TO SUBMIT THE TENDER

I confirm I have the authority to submit this tender.

ADDRESS & CONTACT DETAILS (in capitals)

Address for contacting over this tender:

Daytime phone numbers and mobile number:

Email address:

VESSEL NAME & SKIPPER

Vessel Name:

Vessel Registration Number:

Skipper:

I acknowledge that any change of Skipper has to be of one with qualifying experience of the fishery, and the name of any replacement and his experience notified immediately.

OTHER CONSIDERATIONS

It is up to you (the tenderer) to include any information, which you think is relevant under "Other Considerations" at the beginning of the Tender. In particular you should record details of any outstanding court judgements, whether or not you have been declared bankrupt within the last 12 months, compliance with fisheries legislation in the past 12 months and any factors relating to these matters.

AWARD CRITERIA – Testing the efficacy of two methods designed to reduce the numbers of undersized whelks in commercial landings

1. Vessel Specification

I confirm the vessel is a [ ] of [ ] metres LOA and [ ] HP engine power.

{If you have any other material about the vessel you wish to provide then please enclose them, it is often helpful}.

The suggested port for embarkation is [ ] and disembarkation is [ ].

I confirm that the vessel is capable of remaining at sea for a daily period.

2. Fishing Gear

I confirm that the fishing gear to be supplied and used will be [ ].

I enclose the specification and dimensions of the gear

3. Availability of the vessel

I confirm that the FV [ ] will be available for [ ] days between 10th August 2012 and 30th September 2012, as specified in A.4.1.

I confirm that the vessel is available from [ ] to [ ]

I confirm that the fishing activities agreed in the Detailed Operations Plan will be undertaken

I confirm that the skipper and crew will assist in sorting the catch and assist the onboard Cefas scientists with their duties.

4. Experience and Track Record of Fishing in the Area Defined

I enclose details of the Skipper and crew's experience of fishing for whelks in 2010 and/or 2011, using standard baited traps in the survey area defined in A.3.(N.B this may be a significant part of the evaluation of the tender).
I enclose supporting evidence of the type of gear used for catching whelks.

5. Suitability of the vessel for the survey application

I confirm the vessel and skipper will be available for a port visit by a Cefas scientist before a successful Contract Award, to assess the suitability of the vessel for the requirements of the survey.

6. Accommodation

I confirm that the accommodation requirements of A.6 will be met.
The vessel shall provide a clean wheelhouse with sufficient space to accommodate up to two scientists and crew from adverse weather.

The vessel shall provide a safe working area, which will be well lit under all sea conditions and large enough to accommodate the scientists and their sampling equipment.

7. Safety

a) i) I confirm that a current and valid Marine and Coastguard Agency Safety Certificate is held for the vessel FV[ ], a copy of which is enclosed for inspection.

ii) I confirm a mid-term inspection has/has not (delete as applicable) been carried out by the MCA. A copy of the report is/is not (delete as applicable) enclosed.

iii) I include a copy of the declaration of annual self-certification.

b) I enclose evidence of adequate insurance cover for the vessel and for personnel on board including Cefas staff. {You may wish to detail your P&I and personnel insurance and the limits of financial liability on each.}

c) I confirm the vessel complies with the national level of certification applicable to the area of operation and size of vessel in respect of deck officers and engineers.

d) I confirm the vessel complies with the applicable code on safety equipment such as: Liferafts, Lifejackets, Distress Rockets and Flares, Radio Equipment and first aid consumables. {Confirmation is required in writing that the liferafts and lifejackets are adequate to cover the number of ships personnel, including the Cefas scientist.}

e) I confirm that all crew have completed four 1-x sea survival, first aid, fire fighting and safety awareness safety courses and their certificates will be available for inspection as specified in Appendix A.6.2.

f) Explain how you comply with the MCA safe manning levels.

g) The vessel does/does not have a risk assessment. A copy of which is/is not enclosed for inspection, [delete as appropriate].

h) I confirm the vessel will be available for a safety inspection by a qualified surveyor.

i) <u>I confirm</u> there will be no carriage of illegal drugs or alcohol on the vessel. Please state how this will be enforced.

8. Pre-Cruise Planning, Workshop meetings & Reporting

<u>I can confirm</u> that the Skipper will be available for telephone discussions and meetings prior and during the exercise.

PRICE

I offer the above vessel and services at a fixed cost of:

Net Cost: £

VAT: £

Total price including VAT: £

Total price in words:

SIGNATURE: DATE:

Appendix 2. Comparison of experimental traps with commercial traps

In the Eastbourne survey area the chartered skipper was keen to compare his own commercial gear with the experimental traps. He generously loaned ten of his own traps, which were added to the five experimental fleets (two per fleet) where they were baited and fished in an identical manner to the experimental traps. Fishers often have their own preferred trap specifications which have often evolved after much fishing experience; as such there are a number of designs in operation throughout the South East. The design of this trap on first appearance was similar, but not identical, to the experimental traps, with the noticeable difference that they lacked escape holes. There were however numerous holes (15mm diameter) in the sides of the trap to aid dispersal of the attractant smell of the bait and more importantly to enable water to empty from the trap on hauling.

Comparison of the catches of whelks for all trap types including this commercial gear in the Eastbourne area indicated that catches of commercial sized whelks were higher in the commercial traps than those in the experimental traps (figure A.2.1). The catches of undersized whelks were also higher in the commercial traps.

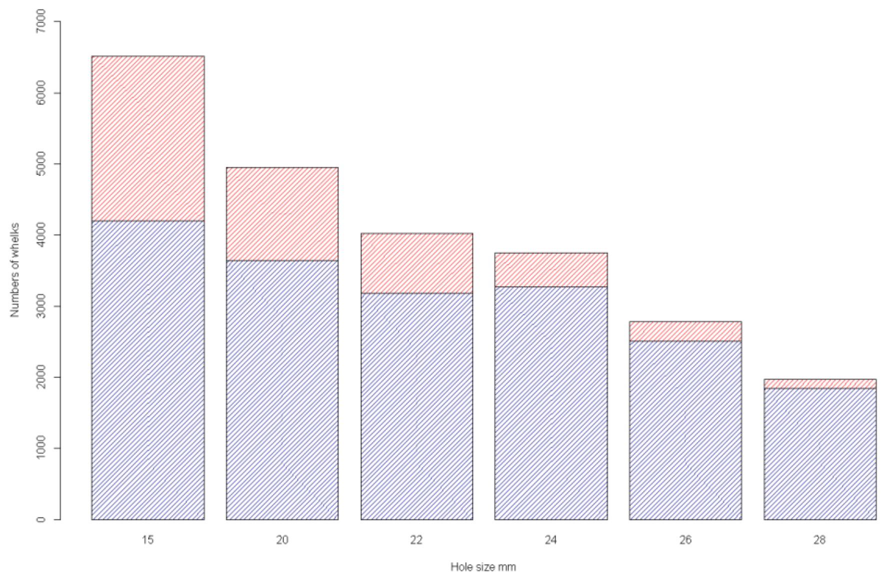

Figure A.2.1. Numbers of whelks caught in the Eastbourne area by catch component and trap hole size. Red undersized and blue commercial sized whelks.

The size distributions of whelks taken in the commercial gear showed a significant proportion of the catch was for whelk between 30 and 40mm shell height (figure A.2.2).

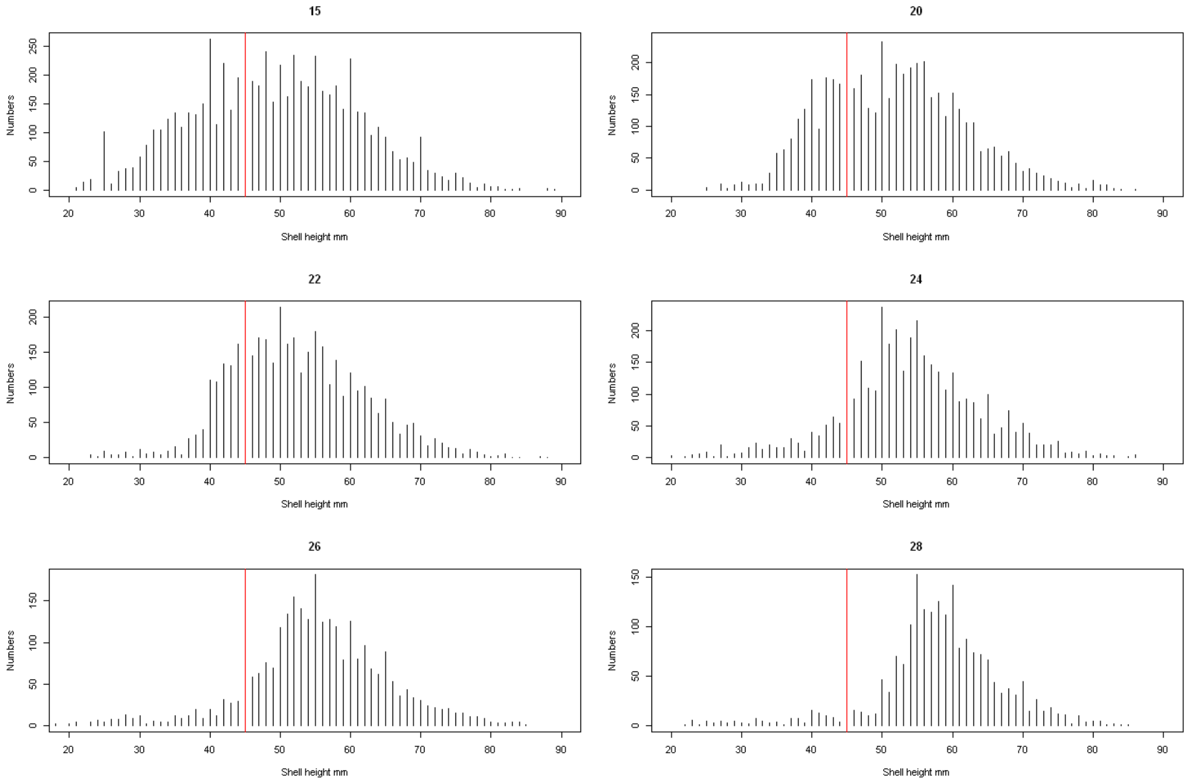

Figure A.2.2. Size distributions of whelks caught by all traps with all hole sizes. Red reference line is current MLS

Appendix 3. Selection ogives by riddle grid and survey area

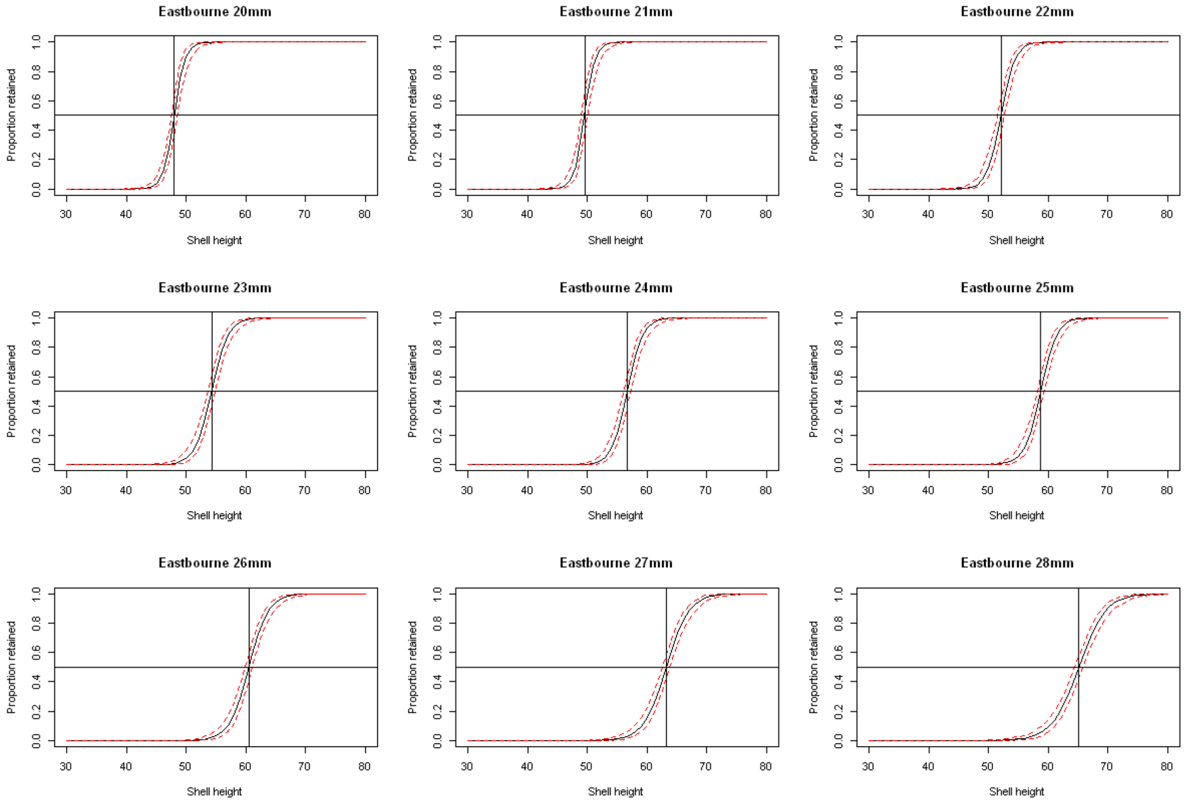

Figure A.3.1. Selection ogives by riddle grid gap in Eastbourne survey area. With 95% CIs

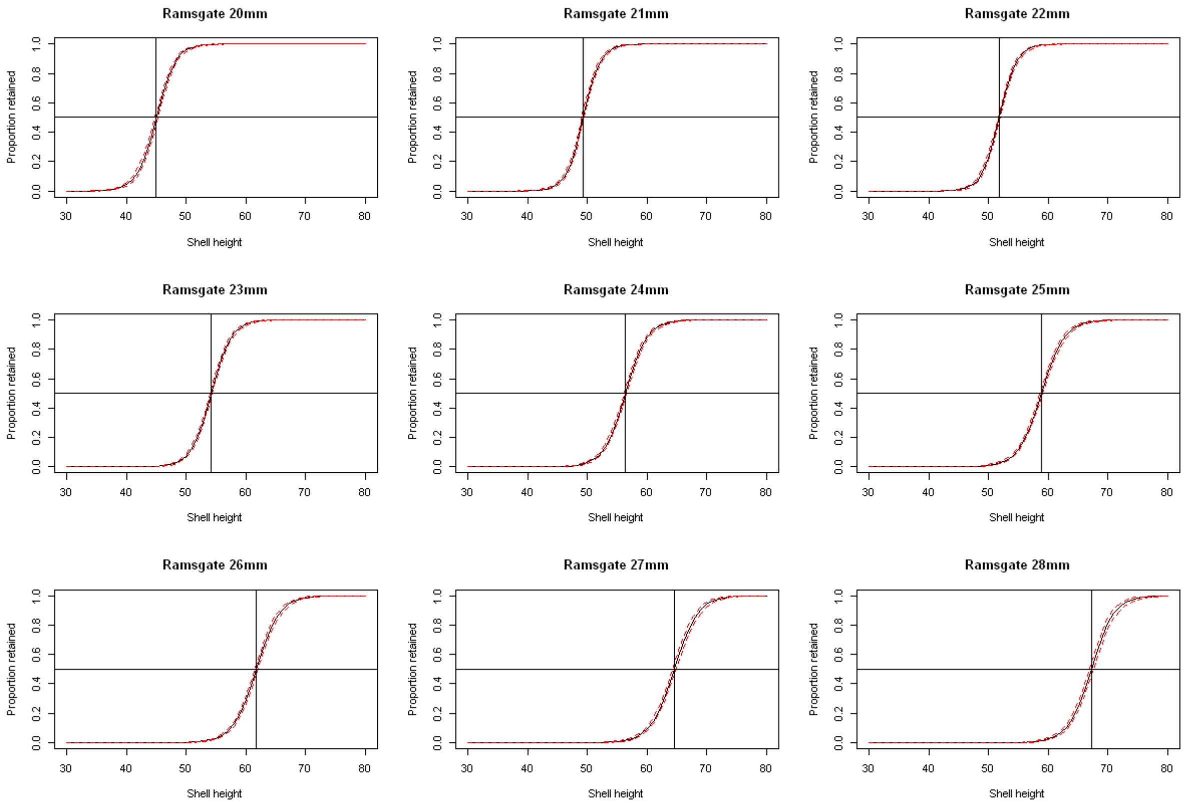

Figure A.3.2. Selection ogives by riddle grid gap in Ramsgate survey area. With 95% CIs

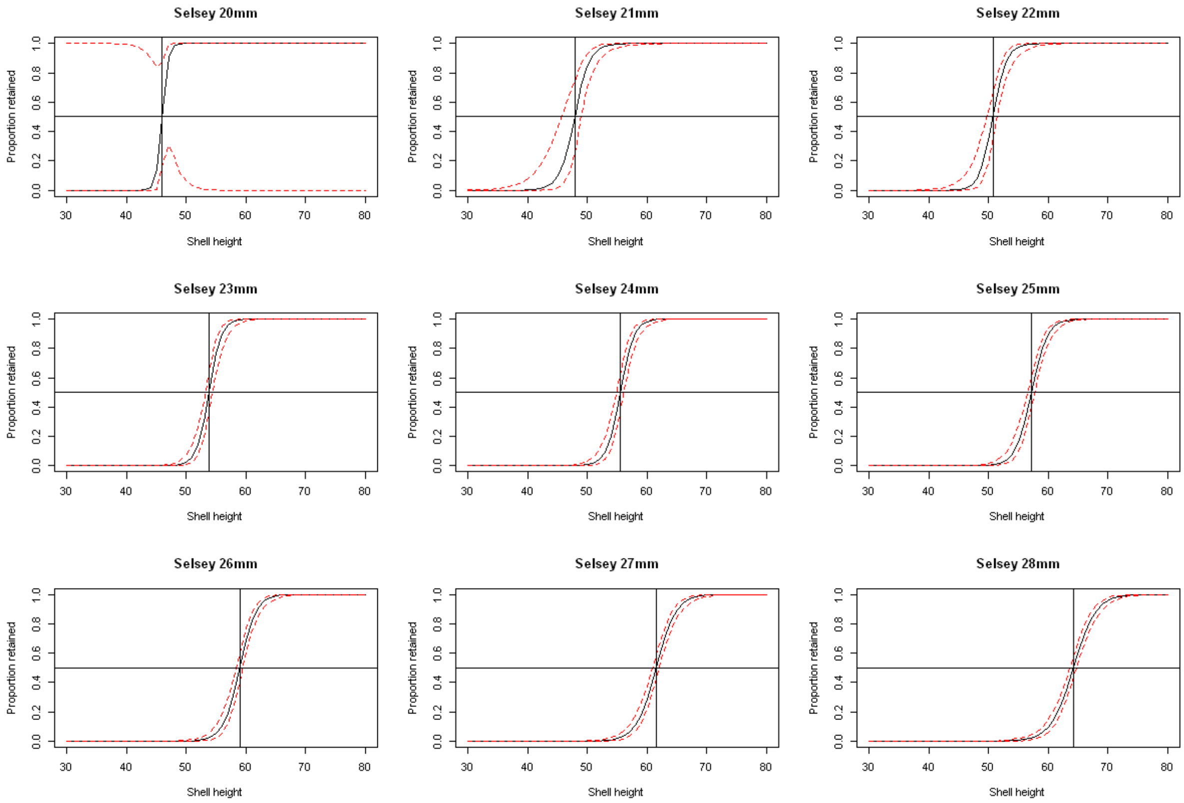

Figure A.3.3. Selection ogives by riddle grid gap in Selsey survey area. With 95% CIs

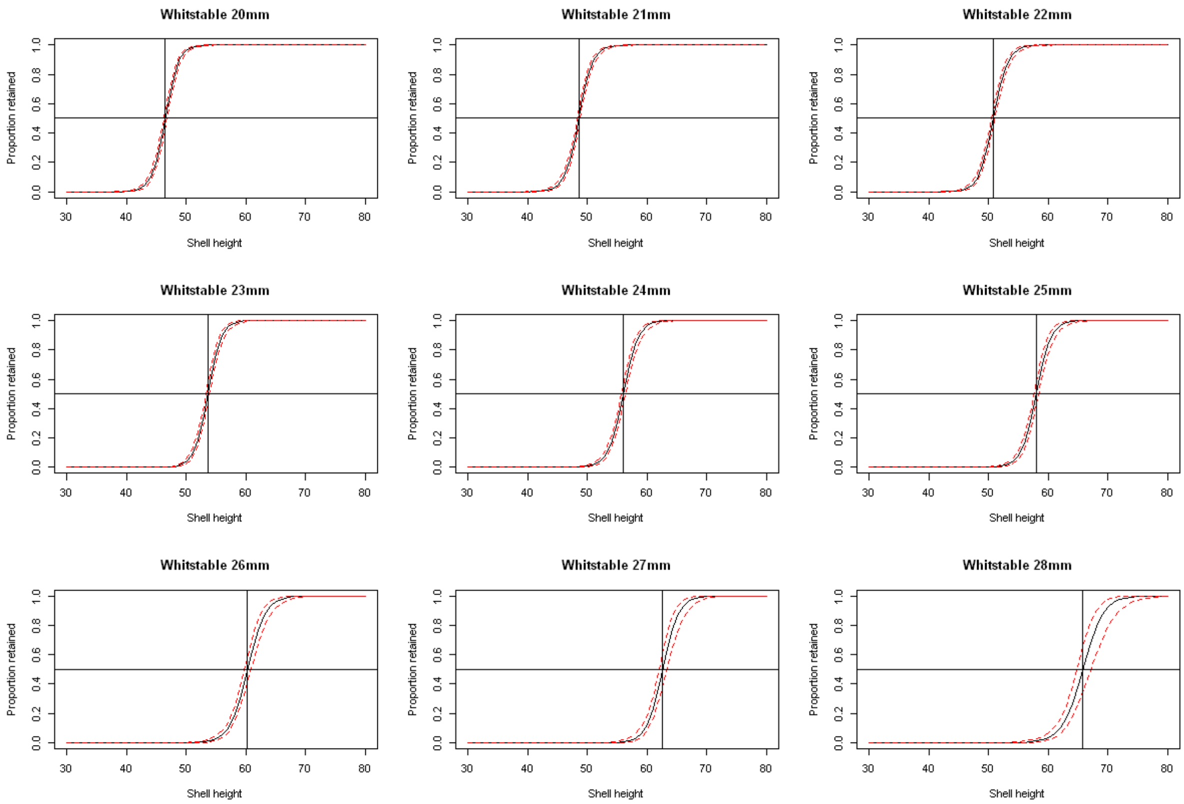

Figure A.3.4. Selection ogives by riddle grid gap in Whitstable survey area. With 95% CIs

Appendix 4. Summary outputs from the final glm model fitted

```
> summary(model4.nb)

Call:
glm.nb(formula = totnos ~ cat + sizeF + Area + Soak + cat:sizeF +
    cat:Area + cat:Soak + sizeF:Soak + cat:sizeF:Soak, data = ByEXpt3,
    init.theta = 2.761708079, link = log)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.3789  -0.6714  -0.1682   0.4008   2.8097

Coefficients:
                    Estimate Std. Error z value Pr(>|z|)
(Intercept)         6.549578   0.265677  24.652  < 2e-16 ***
catus              -0.838003   0.378495  -2.214   0.0268 *
sizeF22             0.022433   0.327696   0.068   0.9454
sizeF24            -0.130170   0.327699  -0.397   0.6912
sizeF26            -0.121213   0.327731  -0.370   0.7115
sizeF28            -0.399542   0.327912  -1.218   0.2231
AreaR              -0.245599   0.174884  -1.404   0.1602
AreaS               0.215340   0.170756   1.261   0.2073
AreaW               0.142629   0.178747   0.798   0.4249
Soak               -0.002870   0.081220  -0.035   0.9718
catus:sizeF22      -0.272475   0.465355  -0.586   0.5582
catus:sizeF24      -0.174269   0.474670  -0.367   0.7135
catus:sizeF26       0.083532   0.508643   0.164   0.8696
catus:sizeF28       0.263460   0.536939   0.491   0.6237
catus:AreaR         1.135198   0.252197   4.501 6.76e-06 ***
catus:AreaS        -0.392240   0.252812  -1.552   0.1208
catus:AreaW         0.016535   0.256758   0.064   0.9487
catus:Soak         -0.126306   0.115349  -1.095   0.2735
sizeF22:Soak       -0.050532   0.113420  -0.446   0.6559
sizeF24:Soak       -0.005159   0.113405  -0.045   0.9637
sizeF26:Soak       -0.035000   0.113428  -0.309   0.7577
sizeF28:Soak       -0.062432   0.113513  -0.550   0.5823
catus:sizeF22:Soak -0.059069   0.161689  -0.365   0.7149
catus:sizeF24:Soak -0.408779   0.169592  -2.410   0.0159 *
catus:sizeF26:Soak -0.816492   0.199598  -4.091 4.30e-05 ***
catus:sizeF28:Soak -1.266854   0.230970  -5.485 4.14e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Negative Binomial(2.7617) family taken to be 1)

    Null deviance: 840.01  on 199  degrees of freedom
Residual deviance: 215.23  on 174  degrees of freedom
AIC: 2510.1

Number of Fisher Scoring iterations: 1


              Theta:  2.762
          Std. Err.:  0.283

 2 x log-likelihood:  -2456.129


> anova(model4.nb)
Analysis of Deviance Table

Model: Negative Binomial(2.7617), link: log

Response: totnos

Terms added sequentially (first to last)
```

```
               Df Deviance Resid. Df Resid. Dev  Pr(>Chi)    
NULL                             199     840.01              
cat             1  251.642       198     588.37 < 2.2e-16 ***
sizeF           4   93.008       194     495.36 < 2.2e-16 ***
Area            3   18.224       191     477.14 0.0003955 ***
Soak            1   30.062       190     447.07 4.184e-08 ***
cat:sizeF       4   47.959       186     399.11 9.627e-10 ***
cat:Area        3   65.434       183     333.68 4.050e-14 ***
cat:Soak        1   43.783       182     289.90 3.669e-11 ***
sizeF:Soak      4   30.067       178     259.83 4.743e-06 ***
cat:sizeF:Soak  4   44.601       174     215.23 4.812e-09 ***
---
```

Appendix 5. Summary of data from pot selectivity experiment

Whelk numbers	Date	Area	Soak time	Catch component	Escape hole size
954	01/10/2012	R	3	comm	20
648	01/10/2012	R	3	comm	22
1232	01/10/2012	R	3	comm	24
760	01/10/2012	R	3	comm	26
209	01/10/2012	R	3	comm	28
837	01/10/2012	R	3	us	20
190	01/10/2012	R	3	us	22
403	01/10/2012	R	3	us	24
89	01/10/2012	R	3	us	26
3	01/10/2012	R	3	us	28
673	02/10/2012	R	1	comm	20
668	02/10/2012	R	1	comm	22
603	02/10/2012	R	1	comm	24
738	02/10/2012	R	1	comm	26
530	02/10/2012	R	1	comm	28
616	02/10/2012	R	1	us	20
603	02/10/2012	R	1	us	22
391	02/10/2012	R	1	us	24
280	02/10/2012	R	1	us	26
285	02/10/2012	R	1	us	28
641	05/12/2012	S	1	comm	20
599	05/12/2012	S	1	comm	22
595	05/12/2012	S	1	comm	24
726	05/12/2012	S	1	comm	26
622	05/12/2012	S	1	comm	28
126	05/12/2012	S	1	us	20
89	05/12/2012	S	1	us	22
80	05/12/2012	S	1	us	24
60	05/12/2012	S	1	us	26
27	05/12/2012	S	1	us	28
604	08/12/2012	S	3	comm	20
781	08/12/2012	S	3	comm	22
410	08/12/2012	S	3	comm	24
508	08/12/2012	S	3	comm	26
525	08/12/2012	S	3	comm	28
117	08/12/2012	S	3	us	20
66	08/12/2012	S	3	us	22
31	08/12/2012	S	3	us	24
19	08/12/2012	S	3	us	26
4	08/12/2012	S	3	us	28
656	10/12/2012	S	2	comm	20
823	10/12/2012	S	2	comm	22

Whelk numbers	Date	Area	Soak time	Catch component	Escape hole size
699	10/12/2012	S	2	comm	24
849	10/12/2012	S	2	comm	26
215	10/12/2012	S	2	us	20
150	10/12/2012	S	2	us	22
96	10/12/2012	S	2	us	24
96	10/12/2012	S	2	us	26
33	10/12/2012	S	2	us	28
805	11/01/2013	S	5	comm	20
649	11/01/2013	S	5	comm	22
611	11/01/2013	S	5	comm	24
816	11/01/2013	S	5	comm	26
624	11/01/2013	S	5	comm	28
61	11/01/2013	S	5	us	20
42	11/01/2013	S	5	us	22
7	11/01/2013	S	5	us	24
0	11/01/2013	S	5	us	26
0	11/01/2013	S	5	us	28
916	13/09/2012	W	1	comm	20
785	13/09/2012	W	1	comm	22
783	13/09/2012	W	1	comm	24
682	13/09/2012	W	1	comm	26
763	13/09/2012	W	1	comm	28
43	13/09/2012	W	1	us	20
34	13/09/2012	W	1	us	22
9	13/09/2012	W	1	us	24
5	13/09/2012	W	1	us	26
9	13/09/2012	W	1	us	28
867	14/01/2013	S	3	comm	20
873	14/01/2013	S	3	comm	22
1048	14/01/2013	S	3	comm	24
739	14/01/2013	S	3	comm	26
470	14/01/2013	S	3	comm	28
129	14/01/2013	S	3	us	20
67	14/01/2013	S	3	us	22
9	14/01/2013	S	3	us	24
8	14/01/2013	S	3	us	26
10	14/01/2013	S	3	us	28
605	14/09/2012	W	1	comm	20
758	14/09/2012	W	1	comm	22
474	14/09/2012	W	1	comm	24
602	14/09/2012	W	1	comm	26
655	14/09/2012	W	1	comm	28
75	14/09/2012	W	1	us	20

Whelk numbers	Date	Area	Soak time	Catch component	Escape hole size
76	14/09/2012	W	1	us	22
26	14/09/2012	W	1	us	24
23	14/09/2012	W	1	us	26
21	14/09/2012	W	1	us	28
889	17/09/2012	W	3	comm	22
481	17/09/2012	W	3	comm	24
576	17/09/2012	W	3	comm	26
358	17/09/2012	W	3	comm	28
372	17/09/2012	W	3	us	20
226	17/09/2012	W	3	us	22
28	17/09/2012	W	3	us	24
24	17/09/2012	W	3	us	26
1	17/09/2012	W	3	us	28
982	19/09/2012	W	2	comm	20
949	19/09/2012	W	2	comm	22
971	19/09/2012	W	2	comm	24
659	19/09/2012	W	2	comm	26
539	19/09/2012	W	2	comm	28
562	19/09/2012	W	2	us	20
337	19/09/2012	W	2	us	22
93	19/09/2012	W	2	us	24
52	19/09/2012	W	2	us	26
16	19/09/2012	W	2	us	28
609	20/09/2012	W	1	comm	20
595	20/09/2012	W	1	comm	22
488	20/09/2012	W	1	comm	24
466	20/09/2012	W	1	comm	26
316	20/09/2012	W	1	comm	28
516	20/09/2012	W	1	us	20
503	20/09/2012	W	1	us	22
368	20/09/2012	W	1	us	24
217	20/09/2012	W	1	us	26
173	20/09/2012	W	1	us	28
649	23/11/2012	E	8	comm	20
386	23/11/2012	E	8	comm	22
456	23/11/2012	E	8	comm	24
381	23/11/2012	E	8	comm	26
254	23/11/2012	E	8	comm	28
118	23/11/2012	E	8	us	20
51	23/11/2012	E	8	us	22
4	23/11/2012	E	8	us	24
0	23/11/2012	E	8	us	26
0	23/11/2012	E	8	us	28

Whelk numbers	Date	Area	Soak time	Catch component	Escape hole size
412	24/09/2012	R	2	comm	20
241	24/09/2012	R	2	comm	22
293	24/09/2012	R	2	comm	24
318	24/09/2012	R	2	comm	26
122	24/09/2012	R	2	comm	28
451	24/09/2012	R	2	us	20
52	24/09/2012	R	2	us	24
42	24/09/2012	R	2	us	26
11	24/09/2012	R	2	us	28
707	24/11/2012	E	1	comm	20
736	24/11/2012	E	1	comm	22
756	24/11/2012	E	1	comm	24
479	24/11/2012	E	1	comm	26
348	24/11/2012	E	1	comm	28
143	24/11/2012	E	1	us	20
112	24/11/2012	E	1	us	22
57	24/11/2012	E	1	us	24
44	24/11/2012	E	1	us	26
12	24/11/2012	E	1	us	28
528	26/11/2012	E	2	comm	20
598	26/11/2012	E	2	comm	22
465	26/11/2012	E	2	comm	24
396	26/11/2012	E	2	comm	26
342	26/11/2012	E	2	comm	28
148	26/11/2012	E	2	us	20
84	26/11/2012	E	2	us	22
11	26/11/2012	E	2	us	24
1	26/11/2012	E	2	us	26
1	26/11/2012	E	2	us	28
274	27/09/2012	R	3	comm	20
492	27/09/2012	R	3	comm	22
299	27/09/2012	R	3	comm	24
358	27/09/2012	R	3	comm	26
231	27/09/2012	R	3	comm	28
325	27/09/2012	R	3	us	20
252	27/09/2012	R	3	us	22
63	27/09/2012	R	3	us	24
26	27/09/2012	R	3	us	26
5	27/09/2012	R	3	us	28
551	28/09/2012	R	1	comm	20
315	28/09/2012	R	1	comm	22
147	28/09/2012	R	1	comm	24
423	28/09/2012	R	1	comm	26

Whelk numbers	Date	Area	Soak time	Catch component	Escape hole size
128	28/09/2012	R	1	comm	28
510	28/09/2012	R	1	us	20
193	28/09/2012	R	1	us	22
176	28/09/2012	R	1	us	24
342	28/09/2012	R	1	us	26
111	28/09/2012	R	1	us	28
766	29/11/2012	E	3	comm	20
596	29/11/2012	E	3	comm	22
505	29/11/2012	E	3	comm	26
416	29/11/2012	E	3	comm	28
234	29/11/2012	E	3	us	20
41	29/11/2012	E	3	us	22
19	29/11/2012	E	3	us	24
5	29/11/2012	E	3	us	26
2	29/11/2012	E	3	us	28
986	30/11/2012	E	1	comm	20
864	30/11/2012	E	1	comm	22
832	30/11/2012	E	1	comm	24
748	30/11/2012	E	1	comm	26
483	30/11/2012	E	1	comm	28
674	30/11/2012	E	1	us	20
554	30/11/2012	E	1	us	22
390	30/11/2012	E	1	us	24
223	30/11/2012	E	1	us	26
107	30/11/2012	E	1	us	28