Escape Gap Project

2016-17

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1. Introduction

The Northumberland potting fishery is a multi-species fishery targeting the European lobster (*Homarus gammarus*), Brown crab (*Cancer pagurus*), Velvet swimming crab (*Necora puber*) and prawns (*Nephrops norvegicus*) (Turner *et al.,* 2009). Shellfish stocks in Northumberland are being exploited beyond recommended levels, and are believed to be declining (Cefas 2011, 2015) despite existing EU (Minimum Conservation Reference Sizes[1] (MLS) of 87mm Carapace Length (CL) for lobster and 130mm Carapace Width (CW) for brown crab), National (Protection of V-notched lobsters and shellfish licensing) and local (NIFCA Byelaws) management measures.

Defra plan to review the shellfish management measures currently in place in the region and to consider options for future management. One potential measure is the implementation of voluntary or mandatory use of escape gaps in lobster pots within the NIFCA district.

Escape gaps are an opening in the pot of a size that allows undersized target species and non-target species to escape, yet still retain legal sized target species (Miller, 1990). Brown (1982) showed that the width of an escape gap should be determined by the CL of sized edible crab and the height of the gap should be determined by the CW of a sized lobster. Pantin *et al.* (2015) demonstrates the use of a linear regression model to estimate the CW of a sized (87mm) lobster and recommends escape gap height should be 1mm less than this mean width.

Escape gaps are deemed to have a number of benefits such as decreased injury or damage to catch, reduced sorting time and decreased potential for landing undersized organisms (Pantin *et al.,* 2015). Fishers in Northumberland have voiced concerns to NIFCA that escape gaps may also have negative effects on catch such as a decrease in sized lobsters and velvet crabs in catches (Pers. Comm. NIFCA).

In order to assess the positive and negative impacts of using escape gaps on pots fished within the NIFCA district, NIFCA conducted a 12-month experimental study looking at the effects of escape gaps on shellfish catches. NIFCA also offered 30 escape gaps free of charge to shellfish permit holders to enable them to test the effects for themselves.

2. Aims and Objectives

2.1 Experimental Study

Aim to assess the effectiveness of escape gaps as a conservation measure for lobster and brown crab. This study aimed to meet the following objectives:

1. To compare the sizes of lobster (and brown crab) caught in pots with and without escape gaps.
2. To determine if the number of landable lobsters (and Brown crab) is affected by the use of escape gaps.
3. To ascertain whether the use of escape gaps effects catchability of velvet crabs.
4. To determine if the use of escape gaps results in increased damage to catch.
5. To compare bycatch[2] caught in pots with and without escape gaps.

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[1] Formerly Minimum Landing Sizes (MLS)

[2] For the purpose of this report by-catch refers to all species caught excluding lobster, brown crab and velvet crab.

2.2 Questionnaires

Expert opinions and perceptions on the use of escape gaps from the industry was sought to complement and enhance analysis of NIFCA experimental data. The issuing of 30 escape gaps to all shellfish permit holders to voluntarily trial them formed the start of the study, which was repeated approximately one year later to assess for any changes. Questions focussed to inform the following objectives:

1. Assess how many fishermen were currently using escape gaps and if this changed with during the study period.
2. Evaluate fisherman's opinions of the positive and negative impacts of the use of escape gaps for ecological and socio-economic aspects.
3. Comparison of fishermen opinions and perceptions about the use of escape gaps to NIFCA's experimental survey data.

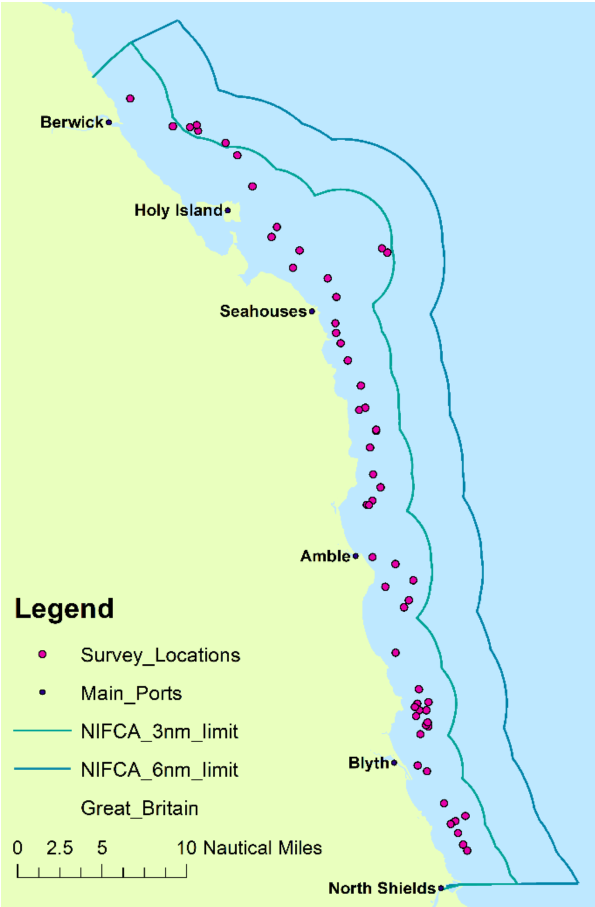
3. Methodology

3.1 Experimental Study

Starting in May 2016, NIFCA carried out a 12-month experimental study using PV St. Aidan, to assess the effects of escape gaps on shellfish catches. Advice from local fishermen was sought regarding the setup of pot fleets (particularly relating to the distance between pots and the length of end lines), guidance for hauling and shooting fishing gear, what bait to use and potting locations.

NIFCA set 2 fleets of 10 single eyed parlour pots fitted alternatively with escape gaps (diagram 1). The fleets were rigged up with surface marker buoys at both ends separated from a weight by a line of rope approximately two times the water depth. Each pot on the fleet was separated by approximately 10 fathoms of rope. The dimensions of the escape gaps used in this study were 46mm by 80mm (figure 2). All pots used for this study were single eyed parlour pots and the escape gaps were placed in the side of the parlours.

Potting location was different each time the pots were reset to ensure the experiment was conducted throughout the NIFCA district (Map 1). Pots were fished every other month and taken ashore when not in use. Time between hauls was weather dependant and ranged between two and nine days. Factors including species, abundance, carapace length (CL) and carapace width (CW) of lobsters, CW of brown crab and presence of escape gap were recorded for each pot.



Map 1. Escape gap survey locations.

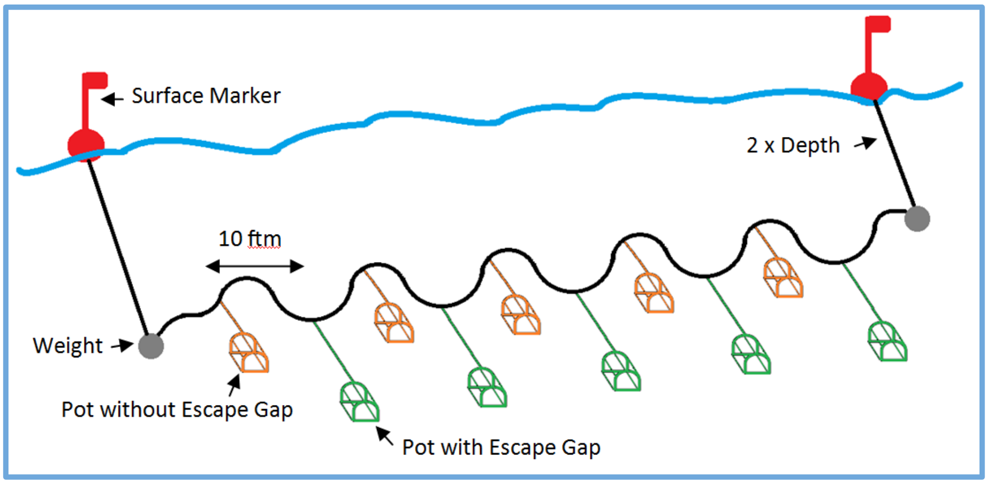


Figure 1. Diagram outlining the fleet set-up used during the NIFCA Escape Gap survey.

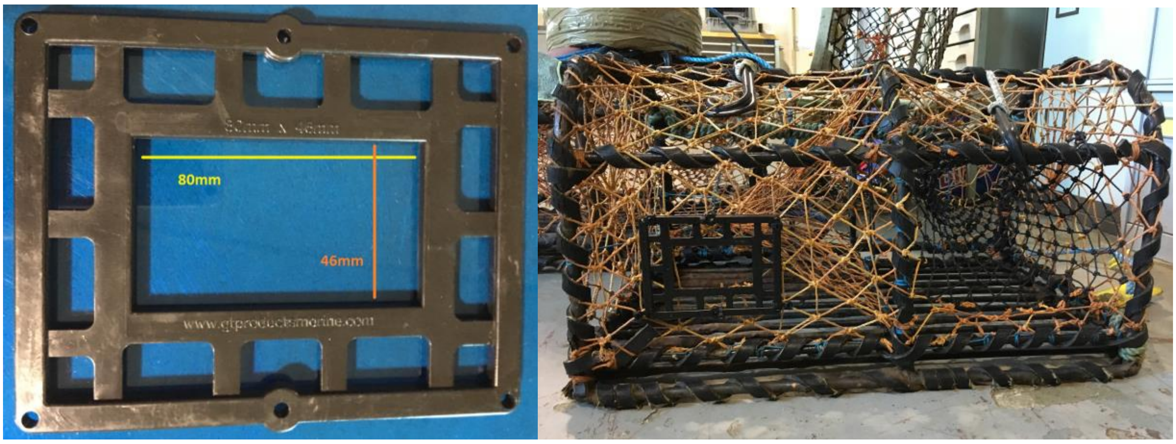


Figure 2. Dimensions of Escape gaps used in study (A) and Location of escape gap when fitted to a pot (B).

3.2 Questionnaires

Interviews were conducted by Marine Biology undergraduate students from Newcastle University for NIFCA, through a work placement module (MST2104 Marine Research & Employability Skills) which contributed academic credits to their overall Honours Degree. Daisy Leadbeater interviewed fishermen over three days from 15th to 17th March 2016 to co-inside with the beginning of the free trial of 30 escape gaps provided to all shellfish permit holders by NIFCA. Charlie Rhodes repeated the interviews approximately a year later over four days between the 3rd and 10th April 2017, having given fishermen time to trial the escape gaps.

The questionnaire was produced by Daisy in 2016 and updated by Charlie in 2017 (Annex I) under the supervision of NIFCA's environment team. The students accompanied NIFCOs on their shore patrol duties to conduct the interviews and interviewees were selected as to who was present at the time. NIFCO provided the initial introductions between fishermen and the student, after which they removed themselves from the vicinity to provide an unbiased forum.

4. Data Analysis

Statistical analysis was carried out using Microsoft Excel 2016 and "R" statistical software Version 3.4.3. All data were subject to tests for normality of distribution (Shapiro Wilk), both lobster carapace length and brown crab carapace width were not normally distributed.

The relative performance of pots with and without escape gaps were compared based on (a) size of individuals caught, (b) size frequency distribution, (c) proportion of individuals <MCRS and >MCRS and (d) Catch Per Unit Effort (number of individuals per trap haul) for each species.

A Mann Whitney U test was used to determine whether there was a difference between lobster carapace length for pots with and pots without escape gaps. A Mann Whitney U test was also used to determine whether there was a difference between brown crab carapace width for pots with and pots without escape gaps.

Catch per unit effort[3] was used to represent catch success and calculated using the following equations:

Catch per Unit Effort (CPUE) = Number of lobsters caught / Number pots hauled

Landings per unit effort (LPUE) = Number lobsters retained / Number pots hauled

Not retained per unit effort (NRPUE) = Number lobsters NOT retained / Number pots hauled

5. Results

5.1 Comparison of catchability

Of the 336 pots fished with escape gaps 53 pots were empty, 1 pot was lost, 270 pots contained lobsters or brown crab, 6 pots contained bycatch species only and 6 pots contained velvet crab/s only.

Of the 340 pots fished without escape gaps 23 pots were empty, 1 pot was lost, the door on 1 pot was open, 306 pots contained lobsters or brown crab, 3 pots contained by-catch species only and 6 pots contained velvet crab/s only.

5.3 Lobsters

Lobster CPUE and NRPUE were higher for pots without escape gaps than pots with escape gaps, however LPUE were higher for pots with escape gaps (Table 1).

Table 1. Lobster catch per unit effort, landings per unit effort and not retained per unit effort for all pots, pots with EG and pots without EG.

	All pots	Pots with EG	Pots without EG
Catch per Unit Effort	0.77	0.48	1.06
Landings per Unit Effort	0.28	0.31	0.25
Not Retained per Unit Effort	0.49	0.18	0.81

522 lobsters were caught during the study, of which 189 lobsters were sized. 162 lobsters were caught in pots with escape gaps, 103 (63.6%) of which were sized and 59 (36.4%) were undersized. 360 lobsters were caught in pots without escape gaps, 86 (23.8%) of which were sized and 274

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[3] CPUE calculations used in this study refer to number of lobsters per pot rather than weight.

(76.2%) were undersized. Figure 3 shows that the size frequency distribution for lobsters caught in pots with escape gaps peaks at a higher CL than the peak for lobsters caught in pots without escape gaps.

The mean CL of all lobster, lobsters caught in pots with EG and lobsters caught in pots without EG were 83.6mm, 88.2mm and 81.6mm respectively. There is a Significant difference between CL for pots with EG and pots without (Mann Whitney U test: W=42995, p=<0.001, n=523).

The mean CW of all lobster, lobsters caught in pots with EG and lobsters caught in pots without EG were 44.5mm, 47.1mm and 43.3mm respectively.

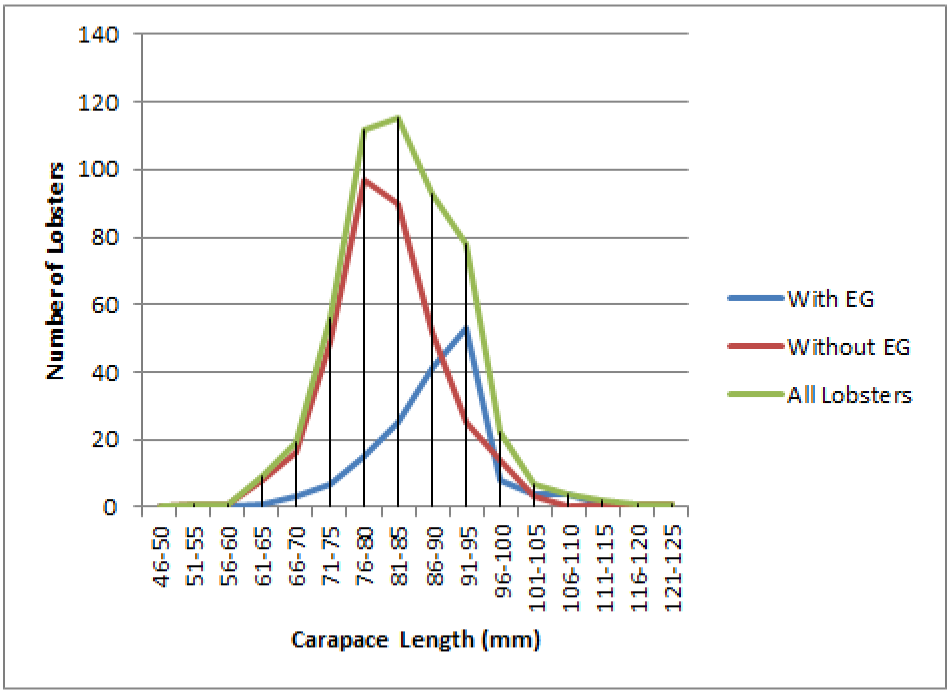

Figure 3. Size frequency distribution for lobsters caught in pots with escape gaps, without escape gaps and for all lobsters caught.

5.2 Damage to catch (lobster)

10 (6.17%) of the 162 lobsters caught in pots with escape gaps were damaged and 21 (5.83%) of the 360 lobsters caught in pots without escape gaps were damaged.

5.4 Brown Crab

Brown crab CPUE and NRPUE were higher for pots without escape gaps than pots with escape gaps, however LPUE were higher for pots with escape gaps (Table 2).

Table 2. Brown crab catch per unit effort, landings per unit effort and not retained per unit effort for all pots, pots with EG and pots without EG.

	All pots	Pots with EG	Pots without EG
Catch per Unit Effort	1.57	1.37	1.77
Landings per Unit Effort	0.92	1.01	0.83

Not Retained per Unit Effort	0.65	0.36	0.94

1061 brown crab were caught during the study, of which 620 were sized. 459 brown crabs were caught in pots with escape gaps, 338 (73.6%) of which were sized. 602 lobsters were caught in pots without escape gaps, 282 (46.8%) of which were sized. Figure 4 shows that the size frequency distribution for brown crab caught in pots with escape gaps peaks at a higher CL than the peak for lobsters caught in pots without escape gaps.

The mean CW of all brown crab, brown crab caught in pots with EG and brown crab caught in pots without EG were 133.7mm, 139.5mm and 129.4mm respectively. There is a significant difference between CW for pots with EG and pots without (Mann Whitney U test: W=174680, p=<0.001, n=1050).

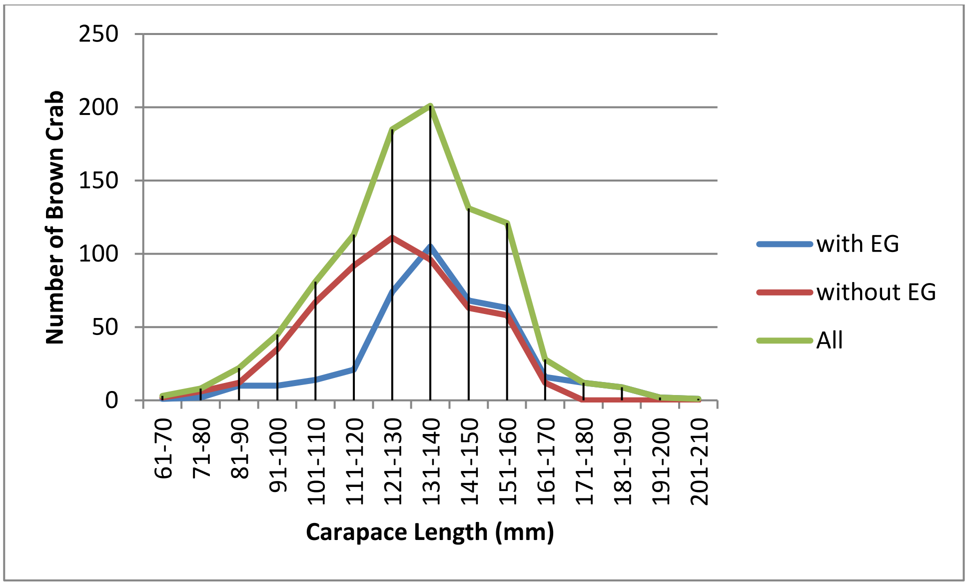

Figure 4. Size frequency distribution for brown crab caught in pots with escape gaps, without escape gaps and for all brown crab caught.

5.5 Velvet Crab

101 velvet crabs were caught during the study, of which 21 velvet crabs were caught in pots with escape gaps and 80 velvet crabs were caught in pots without escape gaps. 6 pots with escape gaps and 6 pots without escape gap contained velvet crabs only. CPUE was highest for pots without escape gaps than for pots with escape gaps (Table 3).

Table 3. Velvet crab catch per unit effort for all pots, pots with EG and pots without EG.

	All pots	Pots with EG	Pots without EG
Catch per Unit Effort	0.15	0.06	0.24

5.6 By-catch

90 individuals representing 10 species were caught during the study, of which 47 individuals of 5 species (hermit crab, whelk, urchin, common starfish and green crab) were caught in pots with

escape gaps and 43 individuals of 9 species (hermit crab, whelk, urchin, common starfish, squat lobster, sunstar, spider crab, cod and lemon sole) were caught in pots without escape gaps.

5.7. Fishermen's use of Escape Gaps

Overall 31 individuals were interviewed during the two surveys, 20 in 2016 and 19 in 2017 representative of 20% and 21% (retrospectively) of NIFCAs shellfish permit holders. Seven of the fishermen were interviewed in both years.

From the sample of fishermen interviewed over the study period the number of fishermen who responded that they were currently using escape gaps increased from five (25%) in 2016 and 11 (57%) in 2017. Further evidence supporting escape gaps increased use over the period of the study can be found by comparing the responses of the seven fishermen who were interviewed twice, only three out of the seven were using escape gaps when interviewed during 2016, and this increased to five in 2017.

5.8 Responses NOT to use Escape Gaps

Effects of the use of escape gaps on profitability were stated as the most negative impact among fishermen (Figure 5. Blue bars) for both 2016 and 2017. Responses assigned loss of smaller target species, for which their gear has a '*dual purpose*', targeting multiply species as the main cause for this loss in profit. Concerns of loss of velvet crabs was highest '*[I] target velvet crabs in the summer and only have one set of gear. If I had two [sets] then I could install them'* and to a lesser extent prawns, in addition to the loss of sized lobsters with the current gap size (80mm x 46mm, '*Sized lobsters escape. [Escape gap] needs to be smaller*'.

A few negative and negligible ecological impacts (Figure 5. Green bars) were also stated in respect to the releasing of undersized *'....providing fishermen abide the rules [there] is no reason to install [them] as [the] undersized are released'*, and fishermen carry out estimates for stock assessments '*.....can monitor lobster populations and fishing grounds' by the number of juveniles in catch'.*

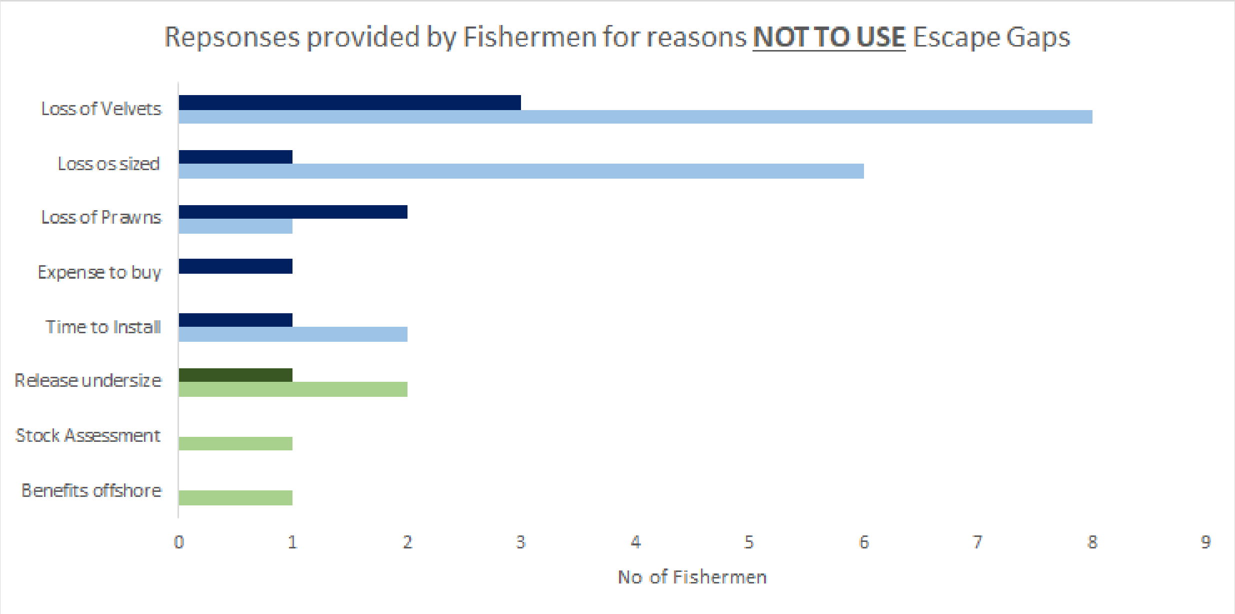

Figure 5. Concerns about using escape gaps provided by fishermen interviewed 2016 (PALE bars) and 2017 (**DARK** bars). Blue refers to a socio-economic reason and green an ecological reason.

5.9 Reasons FOR the use of Escape Gaps

Overall, ecological reasons provided by fishermen were the main reasons as to why they were using escape gaps; in total 13 responses (five in 2016, eight in 2017). The main motive given under ecological reasons was to *'let smalls out'*. However, the highest motive provided during the study amongst the fishermen interviewed was experimenting *'.... given a trial by NIFCA'*; seven in 2017 (Fig 6). Some of these fishermen had been trialling escape for a while and found that '*[their] pots were much better at fishing……. Only capture larger ones*'.

Although socio-economic reasons for the use of escape gaps were much lower over the study period (only five references; three in 2016 and two in 2017) these motives were incorporated with ecological positive responses, *'[I] used to work prawn pots and caught small lobsters. Installed [escape gaps] to allow them to escape and found out they fished better. [It] also saves time when working alone.'*

5.10 Fishermen's Opinions on the Impacts of Escape gaps

Opinions of the fishermen sampled for the impacts on various factors were much more positive in the 2017 survey than 2016 (Figure 7). This is further supported with the positive responses recorded for the 7 fishermen interviewed in both years, the number of positive responses were as follows for 2016, 2017 retrospectively; Sorting time- 3, 4; Sizable catch- 1, 4; Profitability- 1, 2; Incidence of damage- 2, 3.

Two full reports (2016 and 2017) have been completed by the Newcastle students and are available on NIFCA website.

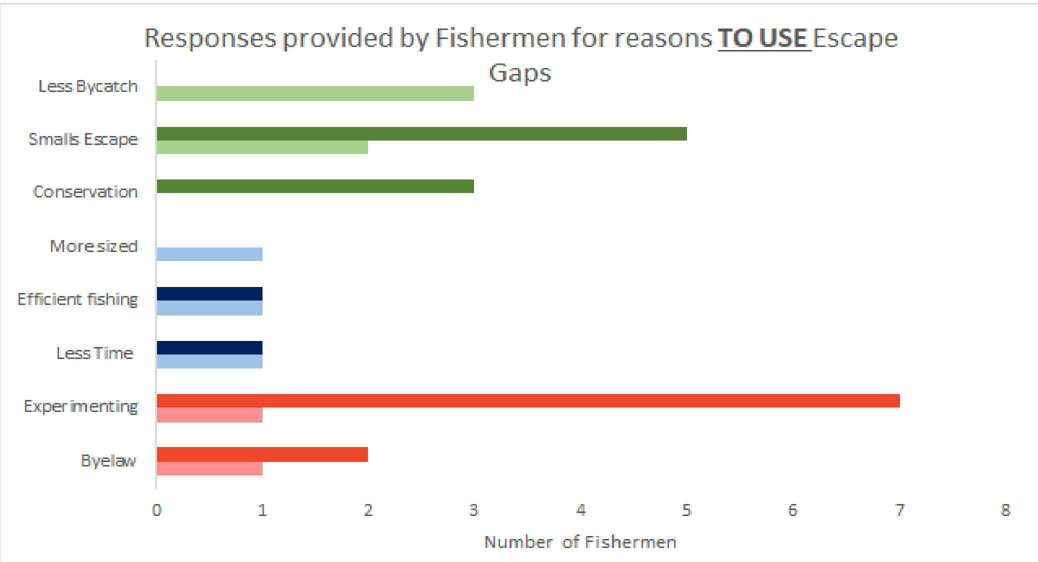

Figure 6. Positive reasons to use escape gaps provided by fishermen interviewed 2016 (PALE bars) and 2017 (**DARK** bars). Blue refers to a socio-economic reason, green an ecological and red other.

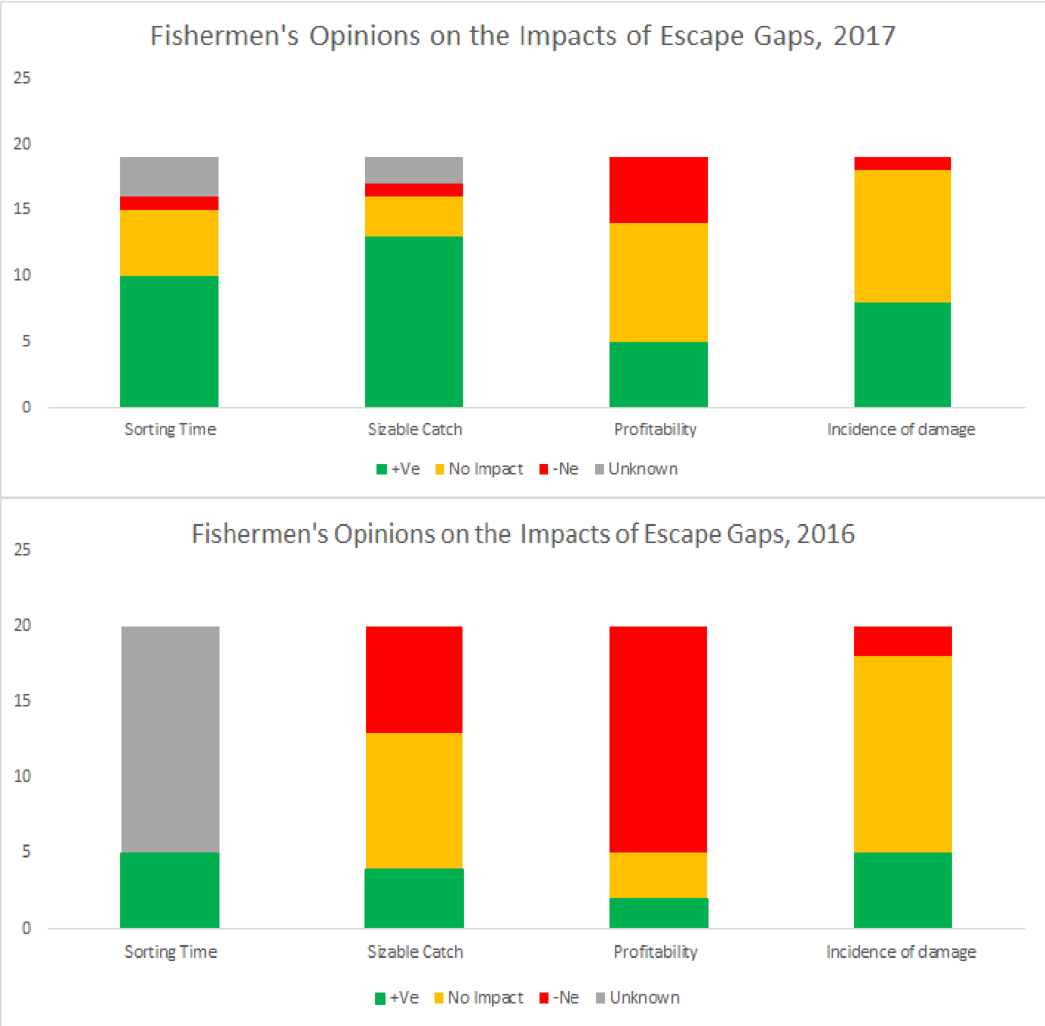

Figure 7. Responses of the fishermen interviewed, categorised into positive (green), no impact (amber), negative (red) and unknown (grey) for various factors for 2016 (a) and 2017 (b)

6. Discussion

6.1 Comparison of catchability

More pots with escape gaps (53 pots) were empty than pots without escape gaps (23 pots). This is deceiving and does not mean that pots with escape gaps are not efficient. On the contrary, it appears that pots with escape gaps are more efficient as 1] sorting time will be reduced as there is less undersized and unwanted catch and 2] overall more sized lobsters and brown crabs were caught in pots with escape gaps than without.

6.3 Lobsters

Although more lobsters were caught in pots without escape gaps (360 lobster) that pots with escape gaps (162 lobsters), significantly more sized lobsters were caught in pots with escape gaps than pots without representing 63.6% and 23.8% of lobsters caught respectively. These trends support the results of the CPUE and LPUE calculations. CPUE and NRPUE for lobster was higher for pots without escape gaps whereas LPUE was higher for pots with escape gaps, this is due to the high proportion of undersized lobsters caught in pots without escape gaps (which are included in the CPUE calculation but removed from the LPUE calculation and are then discarded for being undersized). When only landable (sized) lobsters are considered LPUE was highest for pots with escape gaps (Table 1) as the proportion of sized lobsters was greater in these pots. The increase in legal sized lobsters and corresponding LPUE may be explained by the theory of Shelmerdine and White (2011) who suggest that escape gaps allow undersized lobsters to escape making room for legal sized lobsters to enter the pot.

On average larger lobsters were caught in pots with EG then without EG. This can be seen in the size frequency distributions in figure 3, where the peak is at 91-95mm for pots with EG compared to 81-85mm for pots without EG. The mean CL of lobsters caught in pots with escape gaps was also significantly greater than lobsters caught in pots without escape gaps (Mann Whitney U test: W=42995, p=<0.001, n=523) with an increase of 6.6mm. This corresponds with the findings of several studies looking at the effect of escape gaps on lobster catches (Pantin *et al*., 2015; Clark, 2007; Murray *et al.,* 2009).

Several studies have examined the effectiveness of escape gaps in allowing smaller lobsters to escape (Brown, 1978, 1979, 1982; Conan, 1987; Maynard et al., 1987; Clark, 2007). Overall the use of escape gaps reduced number of undersized lobsters caught to 21.5% and increased catch of legal sized lobsters to 119.7%. On the one hand these results can be looked at in a positive light as the use of EG may not only have conservation benefits but may also provide socio-economic benefits for fisherman by increasing landable catch (table 5). On the other hand, there are also potential ecological and socioeconomic disadvantages to escape gaps (table 5). The main ecological concern is increase removal of sized lobsters from the fishery and what impacts this may have on the sustainability of the stock, it is possible however that this may be offset by increased survivability of juveniles and therefore an increase in the proportion of juveniles reaching legal size.

Table 5. Advantages and disadvantages of using escape gaps (Pantin *et al*. (2015), Brown and Caputi (1985)).

Advantages	Disadvantages
Ecological: - Decreased air exposure - Decreased risk of damage to eggs of berried females during handling and release. - Decreased injury or damage to undersized lobsters. - Reduction in number of undersized lobsters being predated on descent or when returned to unfamiliar territory without suitable shelter. - Reduction in ghost fishing. - Maintains growth rate as air exposure can affect this. - Potential reduction in fish by-catch. **Socio-economic**: - Potential economic benefits for fishermen (e.g. higher priced lobsters and increase in kandable catch). - Reduced sorting time for fishermen. - Decreased potential of illegal landings of undersized lobster. - Increased Free up space for legal sized lobsters to enter pots.	**Ecological:** - Increased targeting of legal sized lobsters. - Bias to sex ratio of escapees (larger CL males can escape through the gaps as they have narrower CW and Tail width). **Socio-economic**: - Reduction in catch of velvet crabs. - Initial economic impact of buying escape gaps. - indirect cost of installing escape gaps (time and fuel). - A small proportion of sized lobster may escape through the gap.

6.2 Damage to catch (lobster)

The proportion of lobsters damaged was similar for lobsters caught in pots with (6.17%) and pots without (5.83%) escape gaps. Although the proportion is slightly higher for pots with escape gaps we cannot determine if this is due to the presence of the escape gap as records of damage were very low. This finding is supported by the results of Pantin *et al.* (2015) who also found no association between damage and type of escape gap (no escape gap, small escape gap and large escape gap).

6.4 Brown Crab

More brown crab were caught in pots without escape gaps (459) than in pots with escape gaps (602), however more sized brown crab were caught in pots with escape gaps (338) than without (282). These trends support the results of the CPUE and LPUE calculations. CPUE and NRPUE for brown crab was higher for pots without escape gaps whereas LPUE was higher for pots with escape gaps, this is due to the high proportion of undersized brown crab caught in pots without escape gaps (which are included in the CPUE calculation but removed from the LPUE calculation and are then discarded for being undersized). When only landable (sized) brown crab are considered LPUE was highest for pots with escape gaps (Table 2) as the proportion of sized brown crab was greater in these pots.

On average larger brown crab were caught in pots with EG then without EG. This can be seen in the size frequency distributions in figure 4, where the peak is a 131-140mm for pots with EG and 121-130mm for pots without EG. The mean CW of brown crab caught was significantly greater in pots with escape gaps (139.5mm) than in pots without escape gaps (129.4mm) (Mann Whitney U test: W=174680, p=<0.001, n=1050) with an increase of 9.9mm. This suggest that larger brown crab are caught in pots with escape gaps.

Several studies have examined the effectiveness of escape gaps in allowing smaller brown crab to escape (Brown, 1978; Brown, 1979; Brown, 1982). Overall the use of escape gaps reduced number of undersized brown crab caught to 37.8% and increased catch of legal sized brown crab to 119.9%. Many of the Advantages and disadvantages in table 5 also apply when fishing for brown crab. This study has clearly demonstrated that the use of escape gaps has resulted in a decrease in undersized shellfish caught. However, some undersized shellfish will be retained in pots with escape gaps due to 1] the larger carapace width of females, 2] a blockage restricting exit and 3] the individual may not have had time to escape (reference). It is therefore important that all fishermen continue to measure shellfish to ensure compliance with MCRS restrictions.

6.5 Velvet Crab

Less velvet crabs were caught in pots with escape gaps (21) than pots without escape gaps (80) and CPUE for velvet crabs was higher in pots without escape gaps (Table 3, As velvet crabs were not measured as part of this study LPUE and NRPUE cannot be calculated). This outcome was expected as the width of the escape gap used in this study was greater than the mean carapace width (the largest dimension) of landable/sized velvet crabs (~73mm CW NIFCA 2017 wholesale survey data) and larger than the minimum conservation reference size for the species (65mm CW). Shelmerdine and White (2011) determined that an escape gap height of 20mm would be required to retain legally sized velvet crabs, however adopting a height this small is not practical for the NIFCA mixed fishery as this would retain undersized brown crab and lobster.

Not all fishers within the NIFCA district land velvet crab and for those who do the economic losses associated with the loss of velvet crabs will be outweighed by the increase in larger lobsters caught in pots with escape gaps (Pantin *et al*., 2015).

6.6 By-catch

The number of bycatch individuals caught in pots with escape gaps (47) and without escape gaps (43) were low and very similar. This agrees with the findings of Pantin *et al*. (2015) who state that escape gaps do not influence the total amount of bycatch caught in pots.

Fewer bycatch species were caught in pots with escape gaps (5) than without (9) and no fish species were caught in pots with escape gaps.

6.7. Questionnaire

The number of fishermen questioned using escape gaps increased between 2016 and 2017. When also considering the main reason for using escape gaps provided by fishermen in 2017 was "experimenting" it is a reasonable assumption to suggest that several fishermen have taken up NIFCA's offer of 30 free escape gaps to trial in their pots. Opinions on the impacts of using escape gaps were also more positive in 2017 than in 2016, this may be due to fishers trialling escape gaps and seeing the associated benefits for themselves.

The experimental and literature review sections of this study has allowed NIFCA to determine if the main reasons fisherman gave not to use escape gaps are justified. See responses in table 6 below:

Table 6. Reasons given by fishermen for NOT using Escape Gaps in the 2016 and 2017 surveys.

Reason NOT to use escape gaps	Is this reason justified?
Loss of Velvet Crabs	The number of velvet crabs caught in pots with EG was lower than in pots without EG. However, as the number of sized lobsters was greater in pots with EG it is possible that economic losses from velvet crabs will be made up for if not exceeded by increases in lobster landings. An economic study would be needed to determine this for sure.
Loss of sized lobsters	Before carrying out the experimental portion of this project a linear regression of lobster carapace length against carapace width showed that female lobsters of 82mm CL and males of 97mm in CL could potentially escape through a 46mm escape gap. So, the answer is yes, it is possible for a sized male lobster to escape from an EG. However, this is just an estimate based on average lobster size and does not mean all barely sized lobsters will escape. The results of the experimental study clearly show that more sized lobsters are caught in pots with escape gaps.
Loss of Prawns	No Prawns were caught during NIFCA's Escape gaps study therefore we are unable to provide comparisons. However, it is reasonable to assume that prawns can escape through the gap.
Expensive to buy	Escape gaps cost ~£0.31 each therefore for someone fishing 800 pots it would cost ~£248.00. the results of the experimental study suggest that lobster landings may increase with the use of EG. Therefore, it is down

	to the individual to determine if the cost of EG is worthwhile.
Time to install	Escape gaps will take time to install and it will likely be more difficult and time consuming at sea. Escape gaps can be installed in pots whilst carrying out routine maintenance and repair. Many studies also suggest that sorting time is reduced when using EG therefore the time lost installing EG could be made up at a later date.

7. Conclusion

During the experimental study, the use of escape gaps resulted in a decrease in undersized lobsters and brown crab caught. However, some undersized shellfish will be retained in pots with escape gaps and it is therefore important that both commercial and recreational fishermen continue to measure shellfish.

The results of this report suggest that the advantages of using escape gaps outweigh the disadvantages for fishermen. Fishermen questioned who are using/trialling escape gaps rate them positively and this study also saw an increase in landable catch with the use of escape gaps. On the other hand, the improved efficiency of pots with the addition of an escape gap was demonstrated by an increase in CPUE for both lobster and brown crab. It will be important to take this increased efficiency into account when conducting future stock assessments and many also need to be counteracted by other restrictions on effort.

Recreation pots tend to be fished less often than commercial pots, are more likely to be abandoned and resultantly ghost fish. Therefore, the compulsory use of escape gaps in recreational pots will be beneficial (Murray *et al.,* 2009) to shellfish stocks within the NIFCA district.

9. Acknowledgements

Thank you to the IFCOs, committee members and volunteers from Newcastle University, Natural England and others who participated in the surveys. NIFCA would also Like to thank North Eastern IFCA for donating the escape gaps and all fishermen who participated in the study.

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