A Pilot Study on Interactions Between Wading Birds and Mussel Gatherers at Heysham Flat

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Introduction

Morecambe Bay is an internationally important site for wading birds (Wilson, 1973). It is a large estuarine system providing a range of habitats including intertidal flats, mussel (*Mytilus edulis*) beds, shingle banks and saltmarsh (Liley *et al.,* 2015). It has been designated as a Site of Special Scientifica Interest (SSSI), a Ramsar site, a Special Protection Area (SPA) and a Special Area of Conservation (SAC). These designations as sites of significant biodiversity and scientific importance come from the European Community Directive on the Conservation of Wild Birds (79/409/EEC) which refers to the protection, management and control of all European wild bird species. Morecambe Bay sees a large number of passage, breeding and wintering birds which rely on the large areas of intertidal mud flat and adjacent mussel beds as a food source (Liley *et al.,* 2015). During the breeding season Morecambe Bay sees 11,000 pairs of herring gull (*Larus argentatus*), representing 1.2% of North West Europes breeding population, over winter the bay sees over 29,000 individuals of knot (*Calidris canutus*), representing 8.4% of the North East and West European population JNCC, 2016).

The mussel bed at Heysham Flat (also referred to as the skear) has been classed as ephemeral due to the unstable nature of the bed and the strong likelihood of the loose mussel being washed away during storms (Knott, 2015). The skear is made up of glacial boulder and cobble deposits which provide a hard substrate for the mussel to settle on. A hand-gathered seed mussel fishery has operated there every summer since 2005 (Knott, 2015). A Habitats Regulation Assessment (HRA) needs to be undertaken before the mussel fishery is opened because the site is designated as an SAC and there is a potential risk of damage being caused to the protected features. The ephemeral nature of the mussel bed means that the protected honeycomb worm (*Sabellaria alveolata*) reef (92/43/EEC), is only affected by mussel encroachment and burial for a few months of the year and is able to recover in the following spring (Egerton, 2014) and so a fishery can operate on the skear, working around the main historic reef area, this is a condition set within the authorisation document by NWIFCA. The fishery operates in the autumn usually between August and November. This results in a period of human and avian prey resource competition, specifically concerning mollusc eating birds such as knot and oystercatchers.

Oystercatchers and knot are Amber Status waders; this means they have unfavourable conservation status in Europe and meet the criteria set by RSPB (RSPB, 2015). They are found roosting and feeding on and around the mussel skear. Herring gulls are Red Status birds (RSPB, 2015) that can also be found on and around the skear. Due to their presence on the skear, these birds could be vulnerable to disturbance caused by the activities of hand-gatherers. Disturbance of birds on the skear can lead to interruptions of the birds from the most productive gathering and feeding areas, leading feeding to occur in less productive areas (Stillman *et al.,* 2001). This can also cause increased bird density and make competition for food more intense, decreasing the likelihood of survival (Stillman *et al.,* 2001).

Oystercatchers feed primarily on mussel and cockle (*Cerastoderma edule*) (WeBs, 2014). It has been reported that oystercatchers need to eat 111 mussels of 45mm (the upper size

limit for NWIFCA fisheries) per day, in order to meet energy requirements (Newton, 2013). This means that the mussel bed at Heysham Flat is a significant feeding site due to the large numbers of oystercatchers found in Morecambe Bay, in 2014 58,000 oystercatchers were recorded over wintering in Morecambe Bay (WeBs, 2014). Hand gathering of the mussels could cause the oystercatchers to avoid large areas of the skear, therefore reducing their feeding area. Knot feed on small mussel, cockles and intertidal worm species (RSPB, 2015). Herring gulls are omnivorous scavengers (RSPB, 2015) and their feeding habits may benefit from the hand-gathering industry, they are also known to feed on starfish attracted to large mussel beds.

Collapses in oystercatcher populations in the Wadden Sea and North Wales show the importance of proper management of shellfish stocks to ensure plentiful food for bird species (Goss-Custard *et al.,* 2004). The harvesting of mussels can result in a shift of the dominant invertebrate prey species from bivalve molluscs to intertidal worms (Atkinson *et al.,* 2010). Oystercatchers and knot have previously shown high levels of decline when the prey species changes, illustrating the need for a proportion of mussels to be left for these wading birds (Atkinson *et al.,* 2010). It is however difficult to ensure that the birds energy needs are met by the remainder of the shellfish (Goss-Custard *et al.,* 2004). Competition and bird behaviour mean that if enough prey was left to meet 100% of the birds' physiological energy requirements the population would still only be damaged by the harvest, even if they are able to consume other prey. It has been calculated that ecological food requirements are eight times the amount of the required shellfish to meet 100% of physiological energy needs. This is needed to prevent mussel harvest causing damage to the population (Goss-Custard *et al.,* 2004).

Due to the large human population in the Morecambe Bay area (Liley *et al.,* 2015) bird disturbance causing avoidance of a suitable habitats, stress, behavioural responses such as escape flight and also direct mortality is likely to occur (Liley *et al.,* 2015). There have been several studies on recreational bird disturbance in the area (Liley *et al.,* 2015) but no studies on interactions between wading birds and commercial activity in Morecambe Bay. This report will look at bird disturbance from commercial activity by recording the interaction between the hand gatherers and bird species of international importance (RSPB, 2015) on the mussel bed at Heysham Flat.

This pilot study observed the interactions between birds and hand-gatherers on the skear and explored changes that could be made to the survey methodology in order to better record the effects of the fishery on the density of bird at Heysham Flat.

Aims and objectives

- To examine the interactions between birds and mussel gatherers on Heysham Flat, particularly bivalve-dependant wading birds, and other birds that roost and feed on the skear.
- To develop a methodology to calculate the density of oystercatchers (*Haematopus ostralegus*), and to a lesser extent herring gull (*Larus argentatus*) and knot (*Calidris canutus*) observed on the seed mussel beds at Heysham Flat.
- To determine any differences in oystercatcher feeding behaviour when the seed mussel fishery is open and when it is closed.
- To analyse data and make recommendations for future studies.

Hypothesis

H_0 There will be no difference in bird density or behaviour between days where there is no hand-gathering activity and days where there is hand gathering activity on the skear

H_1 Bird density on survey days when there is hand gathering activity will be less due to an increase in disturbance factors.

H_2 Feeding behaviour of oystercatchers, knot and herring gulls will be different when the mussel bed is open to hand gatherers and when it is closed

Methodology

The Scientific Officers at North West Inshore Fisheries Conservation Authority (NWIFCA) confirmed the dates when the seed mussel fishery at Heysham Flat would be open to hand gatherers. Appropriate low tides for conducting the survey were chosen to ensure that enough of the skear was uncovered to allow fishing activity to occur, a tide height of 1.5 m or greater was recommended by the Senior Scientist, survey dates were then decided. The website 'tides 4 fishing' (http://www.tides4fishing.com/uk) was used to select two adjacent days, one when the fishery was closed and one when the fishery was open, in this pilot study a Sunday and Monday were used.

A risk assessment was carried out prior to the surveys being undertaken and relevant personal protective equipment (PPE) was worn this included a life jacket, waders, appropriate clothing for the weather and a mobile phone for emergencies. The survey was carried out by a minimum of two observers. An example risk assessment is attached to this document (Appendix 1).

Before carrying out the survey a method for estimating distance on Heysham Flat needed to be determined. Range finding binoculars were recommended, however these were not available for the survey and as such a range estimation stick was used instead. The range stick was made following the instructions found on the 'Ocean Science Consulting' website (http://www.osc.co.uk/tools/range-estimation-using-range-stick/).

During the pilot study six survey visits to Heysham Flat were carried out. Access to Heysham Flat was from Oakley Road (LA3 1NR), from here it was possible to walk down the slipway onto the survey site. On a closed survey the count was carried out at a distance not less than 500 m from where the birds were settled on Heysham Flat, this distance was estimated using the range stick. From this location (Figure 1) an hour long survey, split into three 20 minute observations were carried out.

During each 20 minute observation the skear was visually scanned using binoculars (8 x 36 magnification) and counts of oystercatcher, herring gull and knot were recorded. Their behaviour, for example feeding, was recorded as well as any changes in bird behaviour (WeBs, 2015). An estimated distance that the birds were seen in was also recorded. Weather, tides and wind were also recorded (Appendix 2). Human presence on Heysham Flat was recorded as was its proximity to the birds and the observed relationship between bird behaviour and human activity and distance, for example birds taking flight and where they resume their activities. When there was no human presence bird activity and any changes in activity were still recorded. When vehicles were present on Heysham Flat a description, their numbers and usage were recorded as was their distance from any settled birds and changes to bird behaviour when the vehicles were in use. The time when the mussel bed was exposed was also recorded. Birds flying overhead during the survey were not recorded, however birds that had taken flight due to disturbance events were recorded.. The three 20 minute observations that formed each survey followed consecutively to allow the tides on consecutive survey days to be comparable. Data collection forms (Appendix 2) were used during the survey to record data.

The closed fishery day surveys took place on 31st August 2015, 20th September 2015 and 25th October 2015. The open fishery day surveys took place on 1st September 2015, 21st September 2015 and 26th October 2015.

Figure 1. Shows the access point (red) and observer locations for survey one (green), survey two (blue) and survey three (orange) (Google Maps)

After the data had been collected it was typed up into a Microsoft Excel spreadsheet where the estimated density of the birds was calculated. The formula **Density = Bird Count / Estimated Area** was used. The data was then presented in graphical format to aid comparison of data collected when the fishery was closed, and when it was open. A T-test was chosen as there were two sets of data to analyse in order to compare bird densities when the skear was open and closed to hand gatherers.

Results

Data analysis was carried out on the data on bird density collected on the three repeat surveys. A t-test was run (Appendix 3) however because of the minimal repetitions the t-test was discounted from analysis in this pilot study. There was a low N value and large P values which mean that the relationship was not found to be statistically significant and that there was no relationship.

Table 1. Shows the key for bird species abbreviations in the following figures

Abbreviation	Species
HG	Herring gull
KN	Knot
OC	Oyster catcher

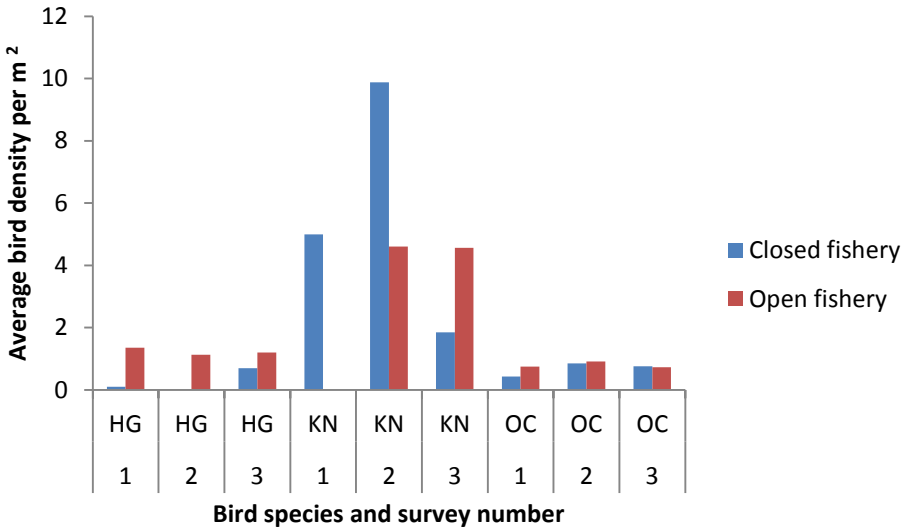

Figure 2. A graph to show the average bird density across the three survey dates when the mussel fishery was closed and open to hand-gatherers.

Density data for oystercatcher, knot and herring gull (fig. 2) shows observable differences (a different count shown in the graph) to when the mussel fishery was open to hand gatherers and when it was closed. However there was no trend of either the open or closed surveys having a greater density across the three repeated surveys. On the first and second surveys knot density was greater when the skear was closed to hand gatherers (fig.2). Oystercatcher had a greater density when the Heysham Flat mussel bed was open to hand gatherers in the first and second surveys (fig. 2).

Tide heights are shown on the following figures to aid comparison of bird density on different survey dates.

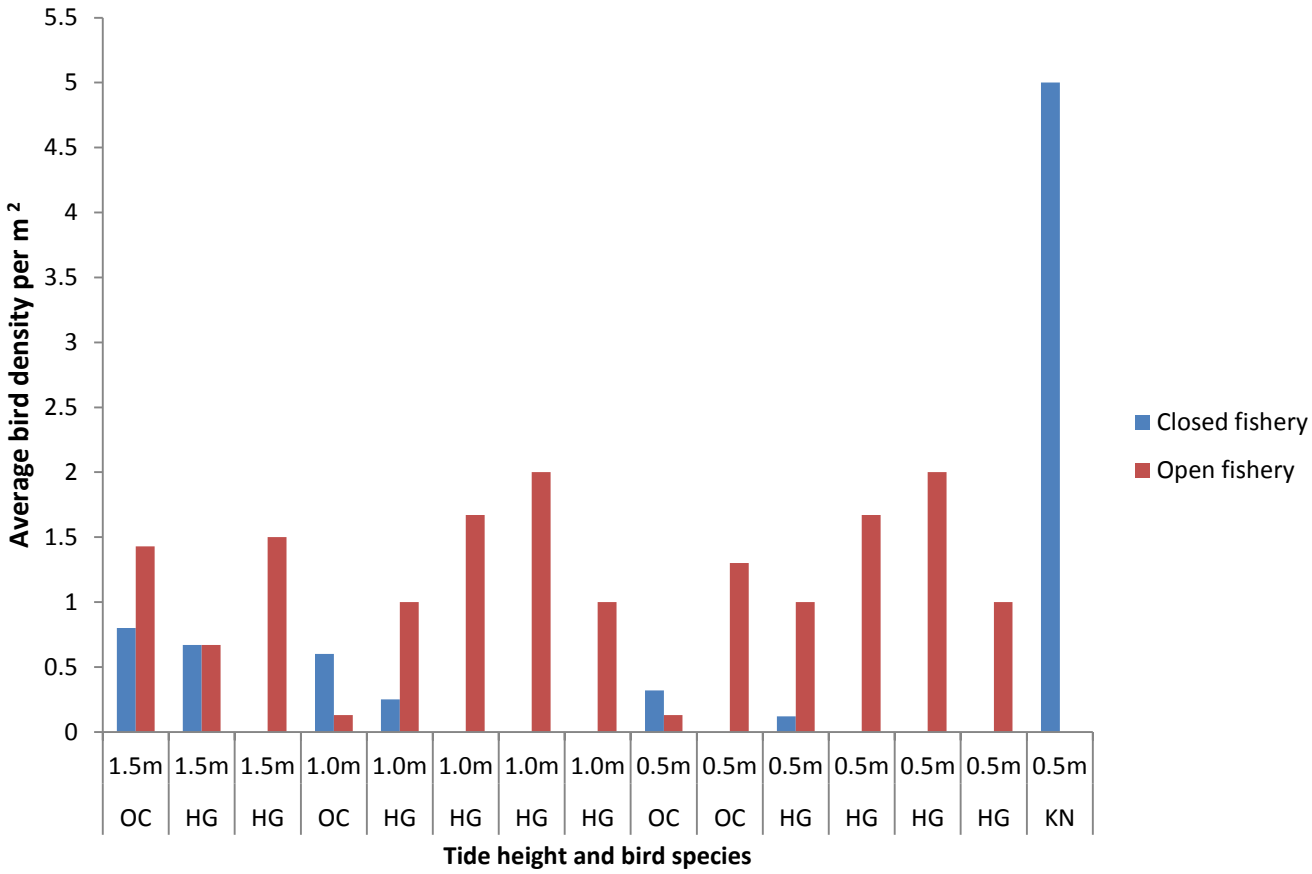

Figure 3. A graph to show the bird density (m^2) for the given species and tide heights during each 20 minute observation period for the three survey days when the hand-gathered mussel fishery was closed and open on the first survey.

During the first survey oystercatcher, herring gull and knot density was greater when the mussel bed was open to hand gatherers (fig. 3), with the exception of herring gull on the 1.5 m tide, oystercatchers on the 1 m tide and oystercatchers on the 0.5 m tide where the closed fishery was greater. On the 0.5 m tide knot were found in high density when the hand gathering fishery was closed but were not present at all when the skear was open.

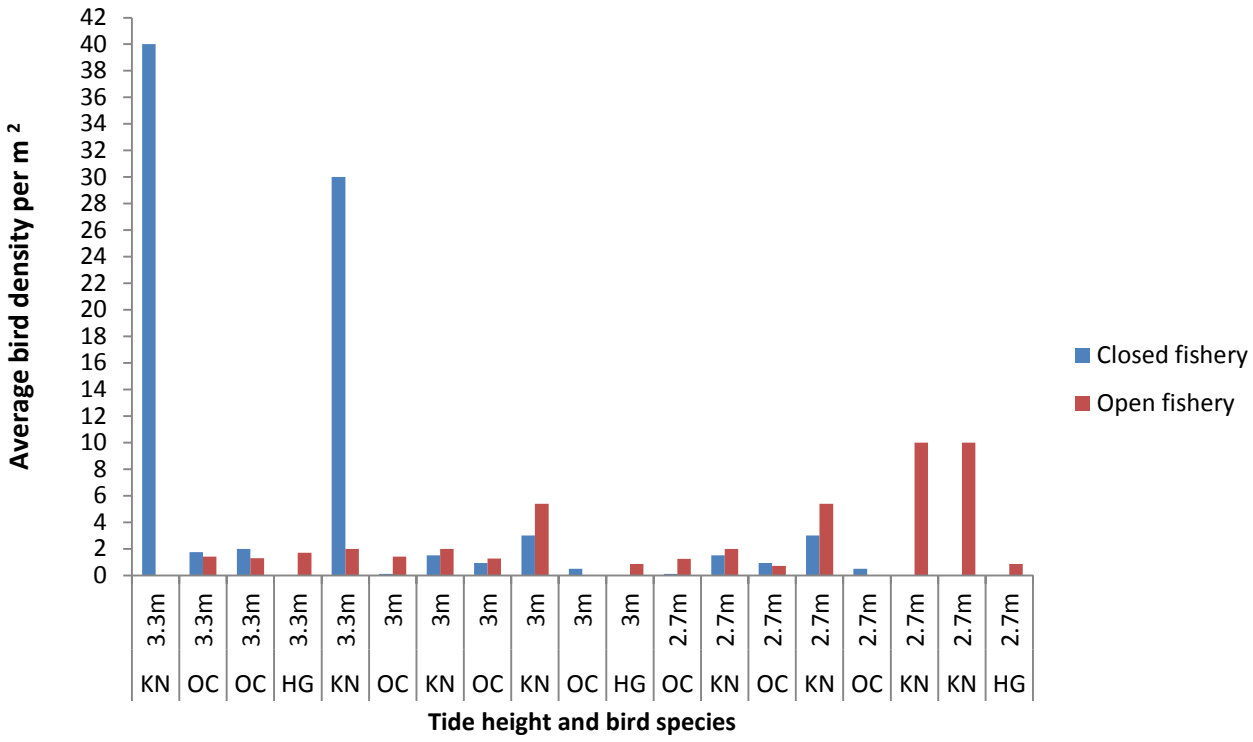

Figure 4. A graph to show the bird density (m^2) for the given species and tide heights during each 20 minute observation period for the three survey days when the hand-gathered mussel fishery was closed and open on the second survey.

During the second survey there was no difference of bird density in each of the three species at any tide height (fig. 4), with the exceptions of knot on the 3.3 m tide where there was a high density when the hand gathering fishery was closed and none present when the fishery was open.

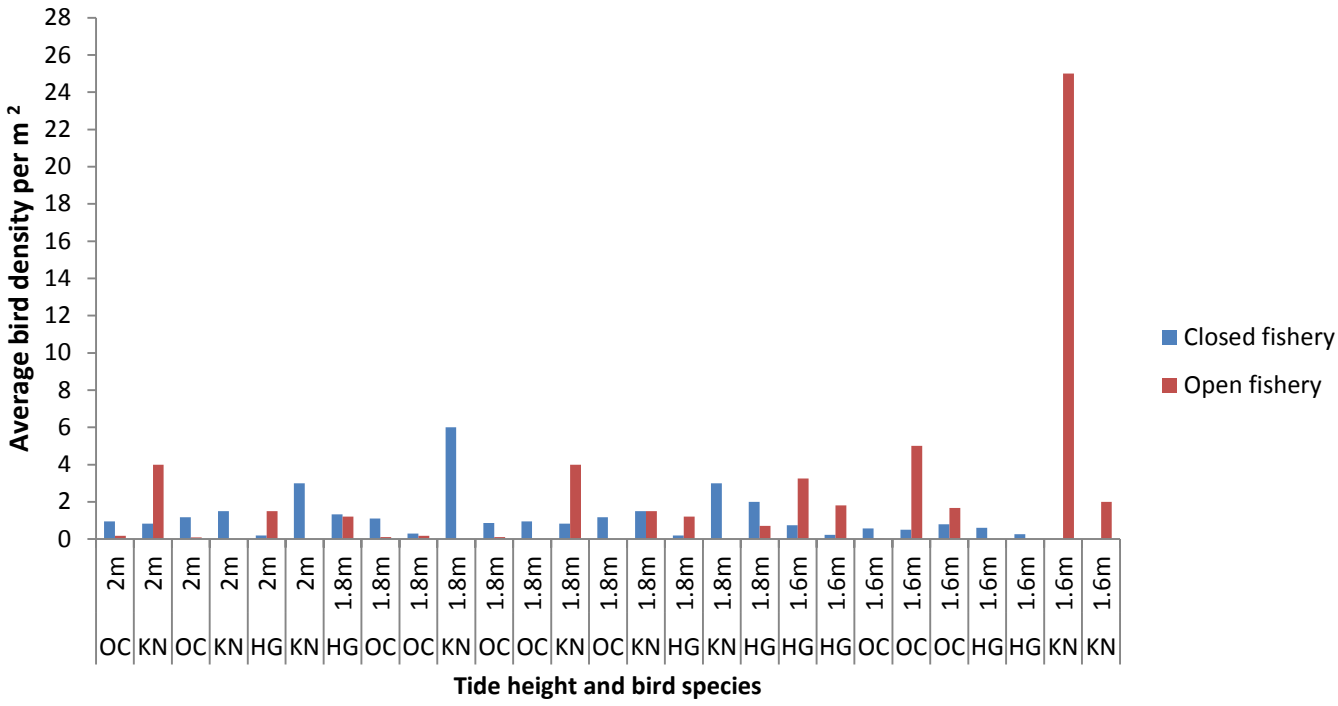

Figure 5. A graph to show the bird density (m^2) for the given species and tide heights during each 20 minute observation period for the three survey days when the hand-gathered mussel fishery was closed and open on the third survey.

Survey three showed few differences between bird densities on open and closed mussel fishery days (fig. 5). With the exceptions of knot on the 2 m tide where there was a greater density when the fishery was open to hand gatherers, this was the expected result in the hypothesis however on another area of the skear knot were found in greater density when the mussel fishery was open, suggesting that the hand gatherers have no effect on density.

Discussion

Previous studies of intertidal fisheries activity and bird interactions (Goss Custard *et al.* 2004, Atinson *et al.* 2010 and Stillman *et al.* 2007)) have suggested that that the interaction between birds and hand gatherers has a negative effect on bird density. An analysis of the data collected on this pilot study has been carried out to see if this could be the case at the Heysham Flat mussel bed.

Figure 2 shows herring gulls had a higher density on open days; this may be because they are known to scavenge their food (RSPB, 2015) however this higher density cannot classed as significant because no statistical analysis was carried out. Herring gulls were found in low densities across the three surveys, this may be due to herring gull behaviour (Catchpole *et al.* 2006). Herring gulls at Heysham are likely to have bred on local buildings and are habituated to disturbance. These gulls may not be showing naturalised behaviour in response to disturbance making it difficult to draw conclusions about their behaviour. The herring gulls at Heysham may have different disturbance reactions to naturalised gull colonies.

Greater knot density on closed fishery days (figure 2) was not an expected result as it has been previously shown that bird density is greater when there is human presence or disturbance factors are present (Stillman *et al.* 2007). This unexpected result in density could be due to the behavioural habits of knot (RSPB, 2015). When carrying out the surveys knot were observed taking flight and not returning to the skear when disturbed, this data was recorded as zero bird density in the results. This behaviour occurred on all survey days and could be due to the skittish nature of the birds. It is thought that the observers presence did not have any disturbance effect as they were at least 500m away from any bird aggregation on the skear.

Oystercatchers were shown to have a greater density on open fisheries survey day (figure 2), this result was expected as the hand gathering activity displaces them from parts of the skear and pushes them closer together (Stillman *et al.* 2001). However these results are not significant, in fact there are very similar densities on days when the mussel bed was closed and open to hand gatherers. On survey three there was a slightly greater density of oystercatcher when the fishery was closed. These results suggest that the hand gatherer industry on Heysham Flat has little effect on oystercatcher density.

Figure 3 shows no knot present during the open fisheries day survey, this suggests that the knot were so disturbed by the interactions with the hand gatherers that they avoided the skear altogether, or that some unknown factor was involved. Knot have a higher alert and disturbance distance than other waders (Smit and Visser, 1993). This higher disturbance distance may have caused knot to avoid the skear when there was hand gathering activity taking place. No other significant disturbance such as birds of prey or aircraft were recorded during the surveys.

The second survey (figure 4) show similar findings to the first survey and may also suggest that knot avoided the skear when the fishery was open. There was no change in species composition on the skear during the different low tides and all birds observed were feeding. However on the 2.7 m tide knot density was greater when the mussel fishery was open but none were found when the skear was closed to hand gatherers, it is possible that the knot

were not spotted by the observer or that the knot were not present on the skear due to unknown factors or even that the presence of hand gatherers has no significant effect on knot density. The size of mussel varies on different parts of the skear. Larger mussels are exposed further down the skear on the larger tides and smaller mussels are exposed higher up. These different mussel sizes could show a relationship to bird presence and prey preference.

On the 1.6 m tide no knot were found on the closed fishery day but there was a large density on the open mussel fishery day contradicting what was suggested in previous surveys, that Knot avoid the skear when the fishery is open, this further suggests that knot are not disturbed enough to effect density from interactions with the hand gatherers. On the 1.6 m tide herring gull had a greater density when the mussel fishery was open as did oystercatcher. The data is suggesting a negative correlation between oystercatcher density and hand gatherer activity. Further study will be required to provide significant results demonstrating the density of oystercatcher in relation to interactions with hand gatherers and to also show density patterns of knot and herring gulls.

These results show knot to have the most variation in density out of the three bird species looked at. This may be because of inconsistences when observing them, knot, herring gull and oystercatcher may have been miscounted due to them not being visible from the vantage point selected by the observer due to the undulating nature of the mussel mud topography, or simply because of human error when estimating distances in order to calculate densities. This variation in density could have occurred because of unknown factors including that the birds can chose to present or not present on the skear and the observer does not know if this was due to the interactions with the hand gatherers or different factors altogether.

Overall these results show the outcome of this pilot study to be inconclusive and the data also suggests the range of tide heights surveyed did not have an effect on density, though this could be because of similar tide heights being chosen for the project or because of bird prey preference for different sizes of mussel. Tides were selected to be similar to avoid oystercatchers, knot and herring gulls being too far away from the observer to be seen and so the tide was not out far enough so that the birds could be far enough away from the hand gathering activities to not have an interaction. The study also wanted to remove any effects on density from tide heights and to reduce the number of variables to consider. Further study is required to collect statistically significant results.

During the open mussel fishery surveys the majority of bird disturbance may have already occurred before the observer arrived and the survey began; when the hand gatherers began their shift on the skear. This time gap between when the hand gatherers arrive and when the survey begins may mean that many birds were disturbed and left the skear without being recorded. This could be a reason for the no observed difference between open and closed mussel fishery survey dates in the results. This time gap may also be enough time for the birds to become habituated to the hand gathering activities and so are observed to be less disturbed during the survey periods (Hill *et al.* 1997). Considering this time gap may create unobserved changes to the birds behaviour this pilot study suggests beginning future surveys before the hand gathering season begins and possibly use thermal imaging and night vision equipment to increase the reach of surveys beyond daylight limitations.

A limitation of the pilot study was that there were different sizes of the bird population present when the survey was carried out, fewer numbers of birds would still be able to have an effect on the bird density over the large area of the skear. Also the oystercatcher population on the skear was made up of several groups, each of which the density had to be taken individually to avoid taking an oystercatcher density across the entirety of Heysham Flat. This made creating comparisons between open and closed survey dates and repeat surveys difficult without working out an average as the oystercatcher population does not remain constant for a comparison. In future studies a GPS reading could overcome this issue.

When the mussel bed was closed to hand gatherers disturbance factors were still present although no observable disturbance was recorded, this could have had an effect on the oystercatcher and knot density. When birds take flight it is difficult to determine if they were disturbed, and if they were disturbed, what disturbed them (Natural England, 2012).

Recommendations for future studies

This pilot study on the interactions between mussel hand gatherers and oystercatcher, knot and herring gull at the Heysham Flat mussel bed has provided an opportunity to trial a methodology to assess differences in bird densities when the fishery is active and not active. The trial of this methodology has produced several areas that could be altered to produce a better methodology to provide more accurate results when the survey is carried out in following years. Recommendations for future studies are as follows:

Mussel growth on the skear at Heysham Flat produces mussel mud which contributes to the undulating topography of the site. This meant that when carrying out the survey it was difficult to locate birds as they could be hidden behind a mound or in a dip, this posed an even greater problem when escape flight distances of the birds were taken into account. Smit and Visser (1993) stated that in undisturbed sites oystercatcher escape flight distance was between 400 m and 500 m the greater figure of 500 m was used as buffer zone for the survey not get within this distance of birds on the skear. The undulating nature of the skear may reduce the alert distance of the birds in the study as hand gatherers may not become visible until they a very small distance away. In future studies it is recommended that observers can be stationed at a minimum of 300 m away from identified oystercatchers; this is the escape flight distance for walking people on tidal mudflats (Smit and Visser, 1993). Alternatively a drone could be used to observe avian interactions with hand gatherers and there is also the potential to have observers based on different sides of the skear and take an average of collected data to analyse.

Binoculars were used to aid observation of birds at Heysham Flat. In future surveys it is recommended that a combination of a telescope and binoculars should be used to aid location and identification of birds.

Use of a range finding stick was proved to be unreliable in the pilot study due to the relatively small size of the skear and its undulating nature. Sailing binoculars were then tested for use during the survey however due to the fast changing weather fog obscured the view of landmarks used for trigonometry purposes and so the range stick was still used to provide an estimate of the distance of the birds from the hand gatherers and to work out bird density. It is now know that Cumbria Wildlife Trust owns a laser range finder. It is suggested that this is used to estimate bird distances in future studies and also that a GPS should be used to identify the position of the observer, which may be able to provide some detail as to which area of the skear was uncovered and visible during the survey.

Due to time commitments of the Marine Team at Cumbria Wildlife Trust and restrictions posed to identifying suitable survey times by the tide and daylight hours it was not possible to carry out more than three surveys. Although this provided enough data and long enough to test the methodology developed for this study, it did not provide significant results or enough data to run a thorough statistical analysis. It is a recommendation of this pilot study to carry out more repetitions of surveys in future years. It is recommended that a minimum of ten repeat visits are carried out for this project (this would be 20 visits in total as one survey includes the closed fishery survey day and the open fishery survey day) in order to collect enough data to show robust results. The increased visits will also increase the variety of statistical tests that can be used in analysis. It is also recommended that surveys are carried

out by the marine team as a whole rather than one individual due to the large amount of time the surveys require, both on the day and inputting data.

As there was no change in the density of oystercatchers on the survey dates when the fishery was open and closed it is possible that the oystercatcher had habituated to the presence of hand gatherers on the skear. In future studies it is recommended that surveys begin before the hand gatherers begin work on the skear and end after the hand gatherers leave in order to observe the first instance of disturbance when the hand gatherers arrive to see if this has a significant effect on bird density. It is likely that night vision and low light emitting equipment would be needed for this purpose.

Surveying on days when the fishery was closed provided controlled data to compared disturbed densities to. In future studies it is recommended that this is taken one step further and that closed surveys begin before the skear opens to the seed mussel hand gatherers. Communication with NWIFCA is required to determine when this will occur. It is also worth noting for future studies that Heysahm Flat is fished for size mussel all year round with a very low effort level.

Continuing surveys after the fishery has closed for the season will provide data on how long it takes for oystercatcher density to return to similar numbers to before the fishery opened (if the density had changed over the hand gathering season). This would demonstrate whether the fishery had a long lasting effect on bird density on Heysham Flat.

Focusing on just one species will make it easier for the observers and potentially make the density calculations more accurate as there would be only one species to look for. Choosing one species will also refine the report and allow that species to be looked into in more depth in the discussion. This pilot study observed primarily oystercatchers and it is recommended that in future the survey only looks at oystercatchers. This may provide an opportunity to explore other aspects of oystercatcher behaviour such as prey preference and distance travelled from bird roost.

Perhaps the whole skear should be assessed in more detail and at regular intervals to determine the presence of other disturbance factors, other than the hand gatherers, which could have an effect on oystercatcher density.

It is recommended that a thorough analysis is carried out on the data collected in future surveys, including both statistical and descriptive analysis, with the hope of having scientifically significant findings.

Conclusion

This pilot study has tested a methodology for observing and recording the changes in oystercatcher, knot and herring gull density as a result of interactions between the bird population and the mussel hand gatherers on Heysham Flat. Results showed no difference between density on survey days when the fishery was open and survey days when the fishery was closed and so the evidence was not sufficient to support a hypothesis. Further study is needed to demonstrate whether trends illustrated in the data are due to chance or bird behaviour.

Several challenges were faced in this pilot study, such as not being able to locate birds, estimating distances and survey repetitions. This report has addressed these challenges and has made suggestions and recommendations on how to adapt the methodology in future studies to overcome these challenges in order to collect more data for a more robust report. Suggestions included use of a laser range finder, more survey repetitions and focusing on one bird species. The data collected in this study, although minimal, suggests little effect on bird density caused by disturbance and interactions with the hand gatherers. More data will need to be collected in subsequent years in order to assess this new hypothesis with accuracy.

References

Atkinson, P.W., Maclean, I. and Clark, N.A., 2010. Impacts of shellfisheries and nutrient inputs on waterbird communities in the Wash, England. *Journal of applied ecology*, *47*(1), pp.191-199.

Catchpole, T.L., Frid, C.L.J. and Gray, T.S., 2006. Importance of discards from the English Nephrops norvegicus fishery in the North Sea to marine scavengers. *Marine Ecology Progress Series*, *313*, pp.215-226.

Egerton, S. (2014) Distribution mapping and health assessment of honeycomb worm, Sabellaria alveolata, reefs on Heysham Flat, Lancashire, Unpublished report carried out by North Western Inshore Fisheries Conservation Authority, The Wildlife Trust of Lancashire, Manchester and North Merseyside and Cumbria Wildlife Trust

European Community Directive on the Conservation of Wild Birds (79/409/EEC)

European Community Directive Conservation of Natural Habitats and Wild Fauna and Flora (Habitats Directive) (92/43/EEC)

Goss-Custard, J.D., Stillman, R.A., West, A.D., Caldow, R.W.G., Triplet, P., dit Durell, S.L.V. and McGrorty, S., 2004. When enough is not enough: shorebirds and shellfishing. *Proceedings of the Royal Society of London B: Biological Sciences*, *271*(1536), pp.233-237.

JNCC.defra.gov.uk (2016). SPA Description, Morecambe Bay[Online] Available at: http://jncc.defra.gov.uk/default.aspx?page=1982 [Accessed 8th February 2016]

Knott, M. (2015) NWIFCA Technical, Science and Byelaw Sub-Committee, *Heysham Flat Mussels*. Unpublished recommendations.

Liley, D., Underhill-Day, J., Panter, C., Marsh, P. and Roberts, J. (2015) Morecambe Bay Bird Disturbance and Access Management Report. Unpublished report by FootprintEcology for the Morecambe Bay Partnership.

Morecambebay.org.uk. (2015). *Morecambe Bay's European Marine Site,* Morecambe Bay Partnership. [Online] Available at: http://www.morecambebay.org.uk/European-Marine-site [Accessed 4th December 2015]

Natural England (2012) A simple method for assessing the risk of disturbance to birds at coastal sites. Unpublished report by Natural England in partnership with Suffolk Coast and Heaths and Wildside Ecology

Newton, I (2013). Bird Populations, Collins New Naturalist Library, Book 124

RSPB, (2015). *Bird guide*. [online] Available at: https://www.rspb.org.uk/discoverandenjoynature/discoverandlearn/birdguide/ [Accessed 4 Dec. 2015].

Smit, C.J. and Visser, G.J.M., 1993. Effects of disturbance on shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area.*Wader Study Group Bulletin*, *68*(6).

Stillman, R. A., Goss-Custard, J. D., West, A. D., Durrel, S., McGrorty, S., Caldow, R., Norris, K. J., Johnstone, I. G., Ens, B. J., Van Der Mers, J. and Triplet, P. (2001) Predicting shorebird mortality and population size under different regimes of shellfishery management, *Journal of Applied Ecology* 38, 857-868.

Stillman, R.A., West, A.D., Caldow, R.W. and Durell, S.E.L.V., 2007. Predicting the effect of disturbance on coastal birds. *Ibis*, *149*(s1), pp.73-81

Wilson, J. (1973) Wader Populations of Morecambe Bay, Lancashire, Bird Study, 20:1, 9-23

Appendix 1

Table 1 **Example risk assessment**

RISK ASSESSMENT
Cumbria Wildlife Trust

Date:	31/08/2015 – 31/10/2015	**Area / Activity:**	Heysham flat/NWIFCA/RSPB Bird Disturbance Survey
Additional Information:	Survey of the mussel fishery at Heysham Flat		
General Assessment ☐ **Task Specific** ☒		**Supervisory Arrangements:**	
First Aid Arrangements:		Nearest Emergency Department:	Queen Victoria Hospital
Assessed By (Name & Position):		**Approved By (Name & Position):**	**Review Date:** 31/08/2016

Severity

Probability	**5**	**4**	**3**	**2**	**1**
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Severity Rating
5 = Fatality
4 = Serious Injury (hospitalisation)
3 = Moderate Injury
2 = Minor Injury
1 = Trivial Injury or minor cuts

Likelihood Rating
5 = Extremely Likely
4 = Probable
3 = Occasional
2 = Remote
1 = Very Remote

Under Risk Rating column S=Severity, L=Likelihood, RR=Risk Rating (SxL)

16 – 25 = Unacceptable, high level of risk, immediate controls required to reduce risk or stop wo ctivity.

10 – 15 = Undesirable, medium level of risk, further action required to reduce risk, if reasonably practicable.

3 – 9 = Low risk, risk should be managed appropriately and reduced where reasonably practicabl

1 – 2 = Extremely low risk, risk level to be maintained or reduced where reasonably practicable.

Hazard	**People/Items at Risk**	**Details**	**Risk Rating**			**Control Measures**	**Risk Rating**			**Long Term / Future Controls**	**Timescale/ Review**
			S	**L**	**RR**		**S**	**L**	**RR**		

Terrain	Staff/Public	Slips/trips/falls on pavement/track when walking to site.	4	3	**12**	Safety Briefing highlighting risks and dangerous areas. First aid kit and mobile phone will be brought. Appropriate footwear will be worn and caution exercised.	4	1	**4**	Risk Reduced as far as is reasonably practicable.	N/A
Open water	Staff/Public	Drowning by falling into water and being cut off by tide.	5	2	**10**	First aid kit and mobile phone will be brought and another member of staff informed. Appropriate footwear will be worn and extreme caution exercised. Survey participants will be made aware of tide times and will look out for incoming tide at all times. Appropriate PPE to be worn.	5	1	**5**	Risk Reduced as far as is reasonably practicable.	N/A
Litter	Staff/Public	Cuts, scrapes, infection and illness caused by contact with litter.	2	3	**6**	Briefing to include warning of litter present in area and its potential dangers. First aid kit and mobile phone to be carried. Hand sanitiser will be present. Advise public not to handle litter	2	2	**4**	Risk Reduced as reasonably practicable	N/A
Biological	Public/Staff	Dirt and bacteria from Heysham Flat and from coming in contact with mussels being on hands and then in contact with face/mouth. Could cause illness and infection.	2	2	**4**	Hand sanitiser will be available. Advise not to touch face/eat without first washing hands	1	2	**2**	Risk Reduced as reasonably practicable	N/A
Weather	Staff/Public	Hot weather could cause dehydration. Hot weather may cause health issues such as sunburn/ sunstroke. Wet or cold weather may cause health issues.	3	3	**9**	Regular breaks. Check weather forecast beforehand and bring water supplies, sunscreen, protective layers	3	1	**3**	Risk Reduced as reasonably practicable	N/A

Stinging animals	Staff/Public	Wasps and bees could cause stings. Weaver fish and jelly fish.	1	3	**3**	First Aiders will be on site. Mobile phone for calling emergency services if appropriate on hand at all times. Be careful where you are standing, do not touch fish or jellyfish, be aware of any biological matter.	1	3	**3**	Risk Reduced as reasonably practicable	N/A
Hazardous Materials	Staff/Public	Possibility of unexploded ordinance, buried items in sand, chemicals.	5	2	**10**	Safety briefing regarding what to do if these are found, i.e. to inform event leader who will contact emergency services.	5	1	**5**	Risk reduced as reasonably practicable.	N/A
Confrontation by members of public/fishermen/women	Staff	Possibility of verbal/physical confrontation with members of public who ar not aware of the survey taking place	3	4	**16**	In first instance explain conversationally what the survey is about. If problem persists, abandon survey.	3	3	**9**	Risk reduced as reasonably practicable.	N/A
ATV/tractor traffic	Staff	Risk of being hit and injured by moving vehicle either when walking on prom to Heysham Flat or whilst out surveying on the skear.	5	3	**15**	Remain vigilant of all traffic and vehicular noises at the survey site and surrounding area. Be aware of where the vehicles are going in relation to where you need to be to undertake the survey.	5	1	**5**	Risk reduced as reasonably practicable.	N/A
ADDITIONAL NOTES											

Tide times: Available on recording sheet for current survey dates.

Hospital Address
Queen Victoria Hospital
Thornton Road
Morecambe
Lancashire
LA4 5NN

Hospital Telephone Number
01524 518965

Police Station Address
394 Heysham Road
Heysham
LA3 2BJ
Lancashire

Police Station Telephone Number
+44 (0) 1524 63333

Assessors Signature:		**Approval Signature:**	

Appendix 2

Table 2 Survey results sheet for the closed mussel bed

Heysham Flat Bird and Mussel Gatherer Interaction Study 2015/16					
Closed bed/no seed mussel fishery					
Date	**Time**	**Tide height of 20 min survey**	**Weather**	**High water (time and height)**	**Low water (time and height)**
Observers			**Location/behaviour**		
Number of oyster catchers (and knot and herring gull) and estimate of area they are found in (used to work out density)					
At what time do oyster catchers move from their roosts and begin feeding? (and knot and herring gull)					
What time is the mussel bed exposed?					
What is the interaction between oystercatchers (and knot and herring gull) and any humans?					
If the birds are disturbed, at what distance does this occur? How do they behave? (see behaviours sheet)					
If birds take off due to human presence, where do they resettle and do they resume feeding?					
What do oyster catchers (knot and herring gull) do after the humans leave?					
When do birds stop feeding and return to roosts?					

Table 3 Survey results sheet for the open mussel bed

Heysham Flat Bird and Mussel Gatherer Interaction Study 2015/16					
Open bed/ seed mussel fishery					
Date	**Time**	**Tide height of 20 min survey**	**Weather**	**High water (time and height)**	**Low water (time and height)**
Observers			**Location/behaviour**		
Number of oyster catchers (and knot and herring gull) and estimate of area they are found in (used to work out density) and distance to gatherers					
At what time do oyster catchers move from their roosts and begin feeding? (and knot and herring gull)					
What time is the mussel bed exposed?					
Count number of gatherers and their proximity to the birds					
What is the interaction between oystercatchers (and knot and herring gull) and mussel gatherers as they move onto the bed?					
If the birds are disturbed, at what distance does this occur? How do they behave? (see behaviours sheet)					
If birds take off due to human presence, where do they resettle and do they resume feeding?					
What do oyster catchers (knot and herring gull) do after the humans leave?					
When do birds stop feeding and return to roosts?					
What time do gatherers return from the bed?					
Description and location (distance to birds) of quadbike usage					
Note if the disturbance of knot influence disturbance of oyster catchers					

Appendix 3

Table 1. Results of a T-test analysis of bird density comparing the closed and open hand-gathered mussel fishery on each of the three surveys.

Survey number	Species	Average difference	N	Degrees of freedom	T-value	P-value
1	HG	1.25	10	9	6.22	0.01
1	KN	-	-	-	-	-
1	OC	0.32	4	3	0.8	0.5
2	HG	1.28	2	1	3	0.21
2	KN	-5.26	8	7	0.81	0.44
2	OC	0.06	8	7	0.22	0.83
3	HG	0.51	8	7	1.13	0.3
3	KN	2.2	9	8	0.73	0.49
3	OC	-0.1	10	9	0.19	0.85