Assessment of the value of spatial closures for protecting Year-0 cockles on Wrangle Sand

Introduction

The Wash cockle fishery exists within a heavily designated area including Special Areas of Conservation, Special Protection Areas, Sites of Special Scientific Interest and Ramsar sites. The Authority has overriding legal duties to protect these sites from the detrimental impacts of fisheries, while also trying to facilitate the sustainability of successful fisheries.

Before opening an annual cockle fishery, the Authority must submit a Habitats Regulations Assessment (HRA) to Natural England, to ensure the fishery will not prevent the condition of the site's conservation objectives from being achieved. The HRA is a lengthy, detailed document which Natural England can take up to 28 days to review. In 2008 a suite of polices were agreed between the Authority, the local fishing industry and Natural England to help speed up this review process. These policies were reviewed and updated in the 2018 Cockle Fishery Management Plan to account for significant changes in stock dynamics and fishing practices due to "atypical" mortality. Provided our management of a fishery follows these policies, Natural England are able to approve the HRA faster, preventing delayed starts to the fishery.

As is the case with most fisheries, the protection of juvenile stocks is an important component when considering the sustainability of the Wash cockle fishery. For many fisheries, this protection is achieved by implementing a Minimum Landing Size (MLS), tailored to enable individuals in the population an opportunity to breed at least once before being harvested. Because the cockle beds support mixed populations of adult and juvenile cockles, however, and cockles from different beds grow and mature at different rates, applying a MLS to this fishery would be problematic and not appropriate. Instead, spatial closures are used to protect high-density patches of juvenile cockles. These closures are described in the policies in the 2018 Cockle Fishery Management Plan as:

Areas supporting high densities (>1,000/m^2) of Year-0 juvenile cockles will remain closed to cockle fisheries unless EIFCA survey data shows it would be more beneficial to open them (e.g. widespread ridging-out is predicted). Opening such areas would be subject to Natural England approval.

These spatial closures are often unpopular with some members of the fishing industry, who feel the protected juvenile stocks are frequently lost despite being closed. As a result, they are unnecessarily denied access to fishable cockle stocks for no long-term benefit. During an Eastern-IFCA/industry workshop on May 19th 2026, fishermen were shown the Authority's proposals for the coming cockle fishery. These included, among other sites, three spatial closures on Wrangle Sand (sites A, B and C shown in figure 1). Several fishermen raised concerns that previous closures at Wrangle had all failed to protect the juvenile stocks, and that large numbers of cockles had been unnecessarily lost as a consequence. Industry members requested the Authority review what had happened to the cockle stocks during previous periods that Wrangle had been closed before committing to the proposed closures there this year.

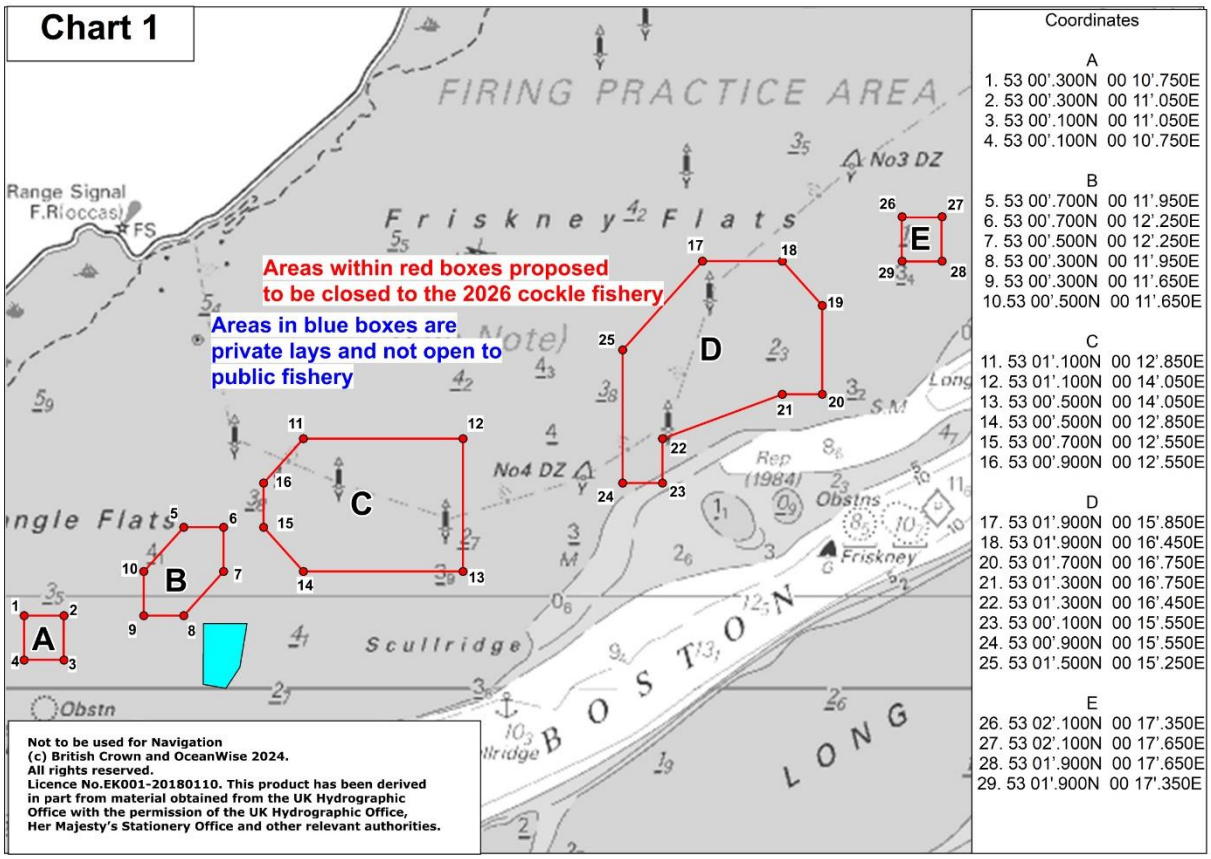

Figure 1 – Chart showing the proposed closures at Wrangle and Friskney for the 2026 cockle fishery

Assessment of previous closures at Wrangle

For this assessment, annual survey data have been used to compare cockle stocks at the time that various closures were implemented, with those same areas the following year. Data from 2008 onwards have been used for this study.

Table 1 shows the number of survey cells that have been closed at Wrangle each year to protect juvenile cockles.

Table 1 – Number of survey cells closed each year at Wrangle

Year	Stations closed	Year	Stations closed	Year	Stations closed	Year	Stations closed
2008	None	2013	None	2018	None	2023	3
2009	None	2014	None	2019	5	2024	None
2010	None	2015	97	2020	Covid	2025	4
2011	20	2016	None**	2021	None		
2012	97*/none	2017	97	2022	None		

*In 2012, officers proposed keeping the whole of Wrangle closed to protect Year-1 cockles. However, the Authority agreed to open the bed from the start of the cockle fishery.

**In 2016 the fishery was opened in three areas to target vulnerable stocks. One of these open areas was on Wrangle.

Since 2008, there have been 6 years when closures have been implemented on Wrangle. Twice, in 2015 and 2017, these involved closing the whole bed. There was a relatively large closure of 20 survey cells in 2011 and smaller closures of between 3 and 5 cells in 2019, 2023 and 2025. It has been possible to assess the success of each of these closures barring those in 2019, for which there is no comparative data from 2020 due to Covid-19 restrictions. This assessment, therefore, focuses on the 5 occasions for which there are comparative data.

2011 closure

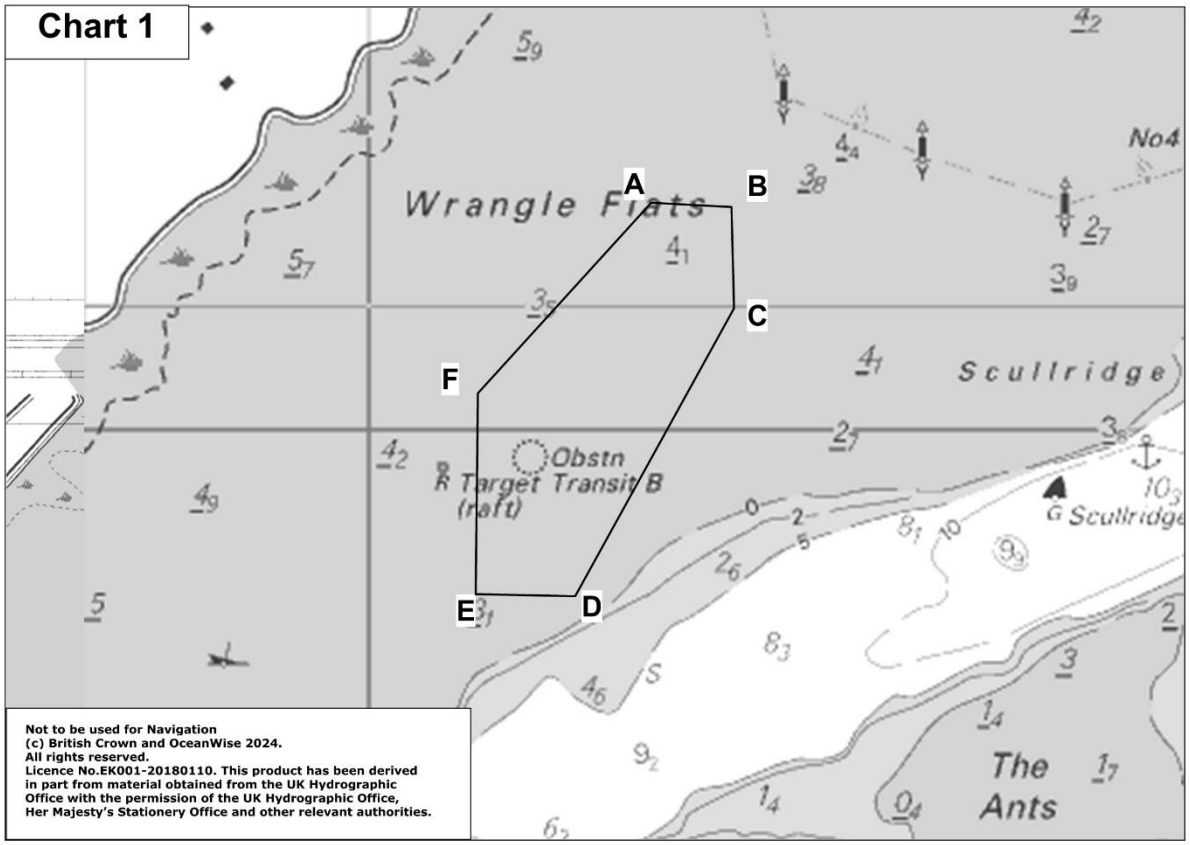

Figure 2 – Chart showing the area on Wrangle closed to the 2011 cockle fishery

The 2011 closed area on Wrangle shown in figure 2 covered an area of 20 survey cells, which is approximately 249 hectares. Table 2 shows the numbers and weights of cockles from each age-group cohort present in the samples collected from within the closed area during the 2011 and 2012 surveys.

Table 2 – Numbers and weights of each cockle cohort in 2011 and 2012

	Cockle numbers in cohort				Cockle weight in cohort			
Cohort	2010	2009	2008	2007	2010	2009	2008	2007
2011	13,690	50	50	0	367.7	9	38.2	0
2012	8,100	450	40	10	2145.5	256.5	34.9	8.3

The figures in table 2 show that in 2011, the samples taken from the 20 stations within the closed area contained 13,690 Year-0 cockles (the 2010 age-class cohort). These weighed 367.7g. By 2012, the number of cockles from this cohort had declined to 8,100 but their weight had increased over five-fold to 2,145.5g. There were low numbers of older cockles present within the closed area that also increased in overall biomass.

Officers initially proposed that these cockles should be closed during 2012 to allow further growth, but after consideration the Authority opened this bed at the start of the 2012 fishery. During that fishery, Wrangle was heavily fished. By 2013, the biomass of the 2010 year-class cohort had fallen to 437 tonnes.

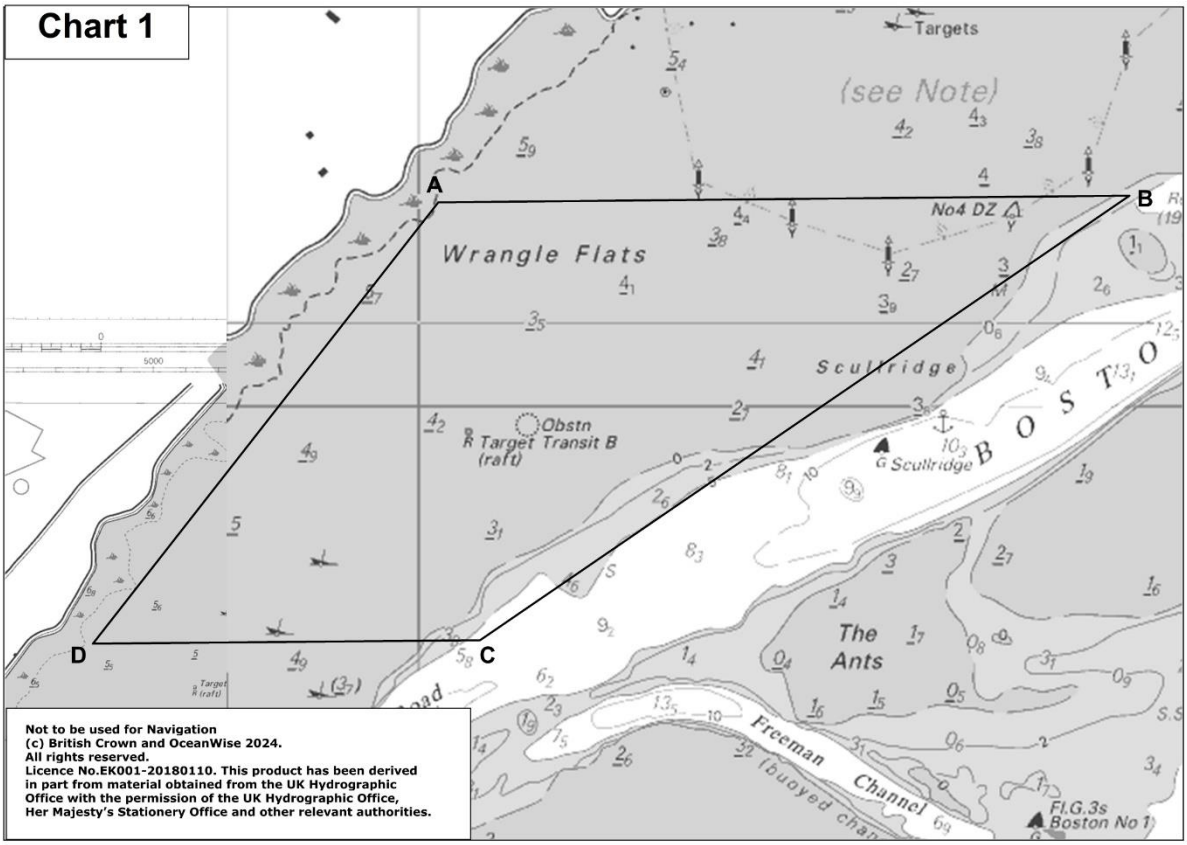

Figure 3 – Chart showing area on Wrangle that was initially proposed to be closed to the 2012 fishery, but was subsequently opened.

2015 closure

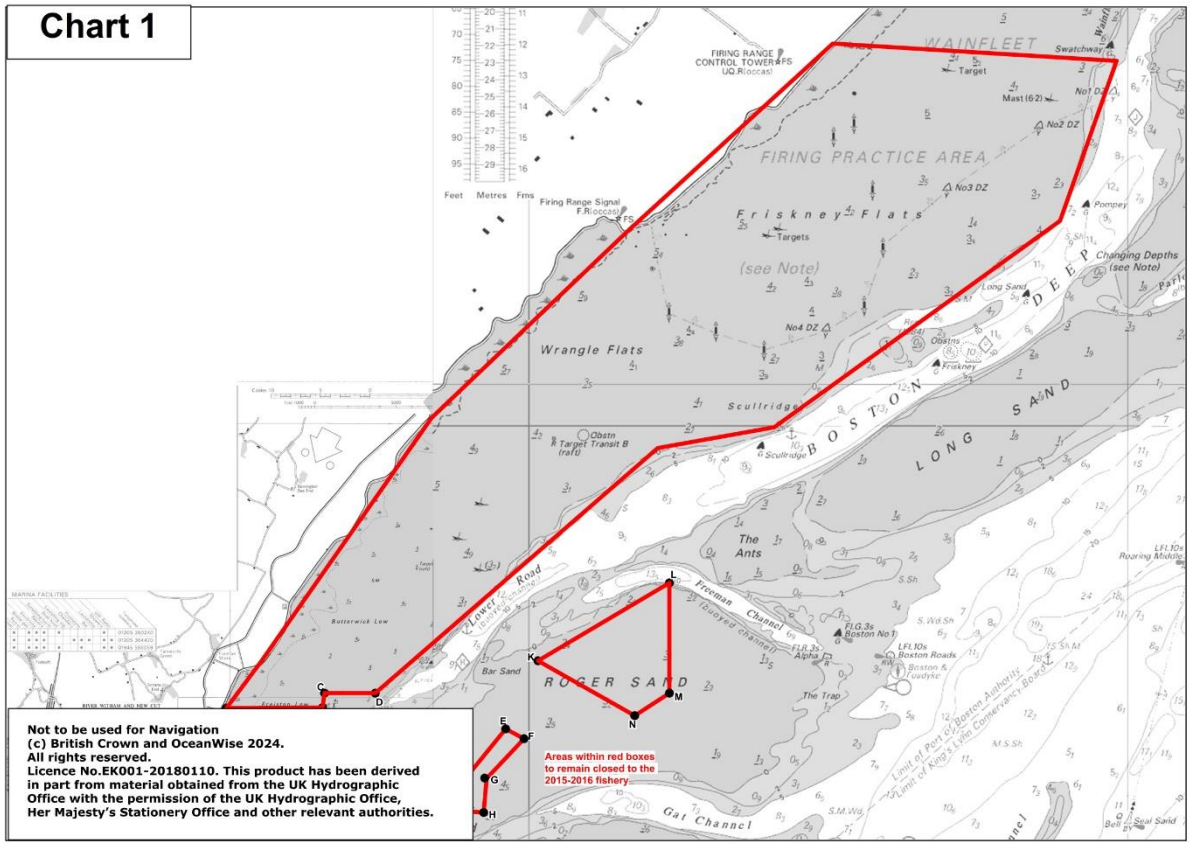

Figure 4 – Chart showing the extent of the area on Boston Main closed to the 2015 cockle fishery

Following an exceptional spatfall in 2014, the whole of Boston Main was closed to the cockle fishery in 2015. This included 97 survey cells at Wrangle covering approximately 1,207 hectares. Table 3 shows the numbers of weights of cockles from each cohort found in those samples in 2015 and 2016.

Table 3 – Numbers and weights of each cockle cohort in 2015 and 2016

	Cockle numbers in cohort				**Cockle weight in cohort**			
Cohort	2014	2013	2012	2011	2014	2013	2012	2011
2015	2,530	20	4	6	2,090.3	76.8	33.8	51.5
2016	1,141	7	1	0	5,107.5	58.6	9.0	0

The survey data shows that the Wrangle stations contained 2,530 Year-0 cockles from the 2014 year-class cohort in 2015. By 2016, this number had declined to 1,141, but their weight had more than doubled from 2,090.3g to 5,107.5g. There were also a low number of older cockles within the closure which declined over the course of the year.

In 2016, the fishery was concentrated into three areas, focusing on the faster-growing beds which were considered most vulnerable to die-off. Wrangle was one of the areas opened to this fishery, after which the 2014 cohort was reduced to 1,924 tonnes.

2017 closure

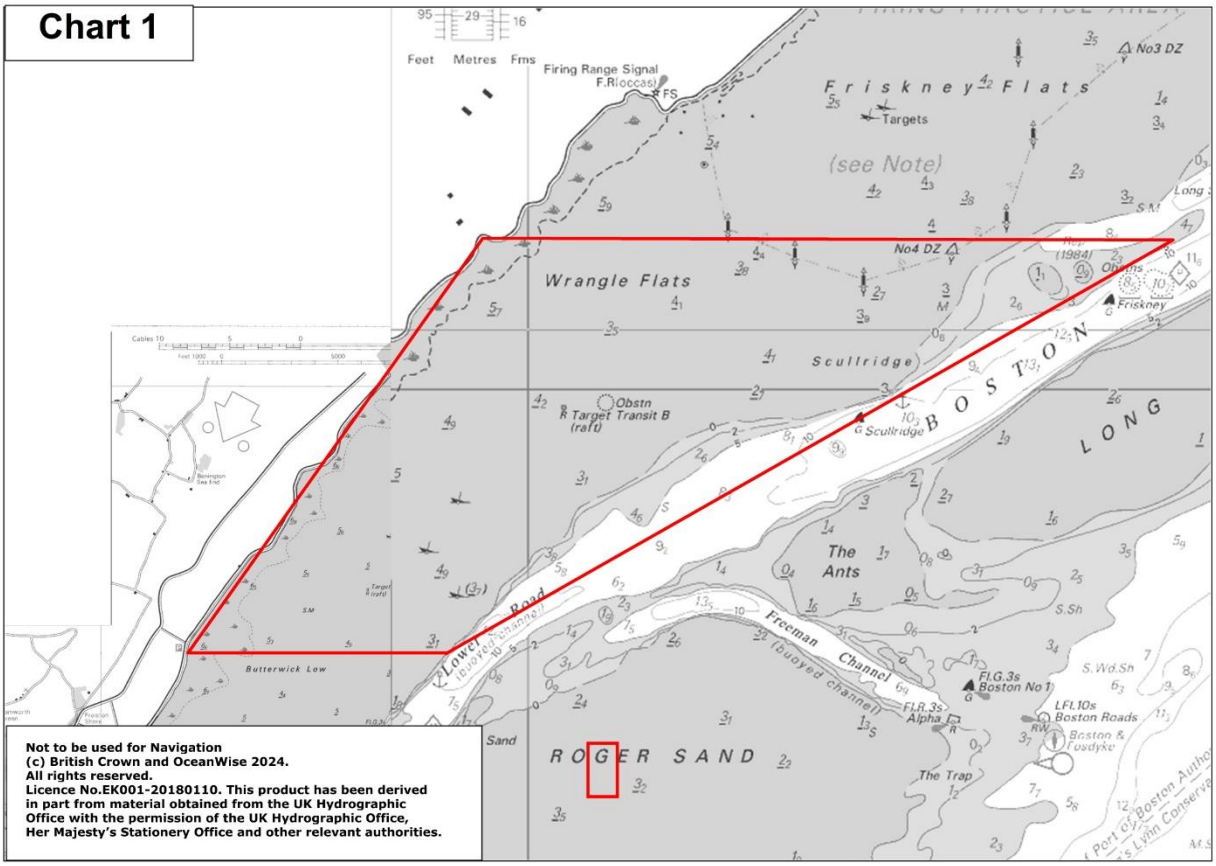

Figure 5 - Chart showing the extent of the area of Wrangle closed to the 2017 cockle fishery

Despite still supporting moderate densities of 2014 year-class cockles, the whole of Wrangle was closed in 2017 following another large spatfall in 2016. The figures in table 4 show the samples from the 2017 survey had 9,023 Year-0 cockles in them, weighing 1,726.5g. By 2018, their density had quartered to 2,189, but their weight had more than doubled to 3,957g. While the closure had successfully protected the Year-0 cockles, it had come at a cost to the Year-2 cohort which declined from 1,924.2g to 586.9g.

Table 4 – Numbers and weights of each cockle cohort in 2017 and 2018

	Cockle numbers in cohort				**Cockle weight in cohort**			
Cohort	2016	2015	2014	2013	2016	2015	2014	2013
2017	9,023	6	297	0	1,726.5	16.4	1,924.2	0
2018	2,189	24	69	1	3,957.1	95.5	586.9	8.6

When opened to the 2018 fishery, 2,070 tonnes of cockles were successfully harvested from Wrangle.

2019 closure

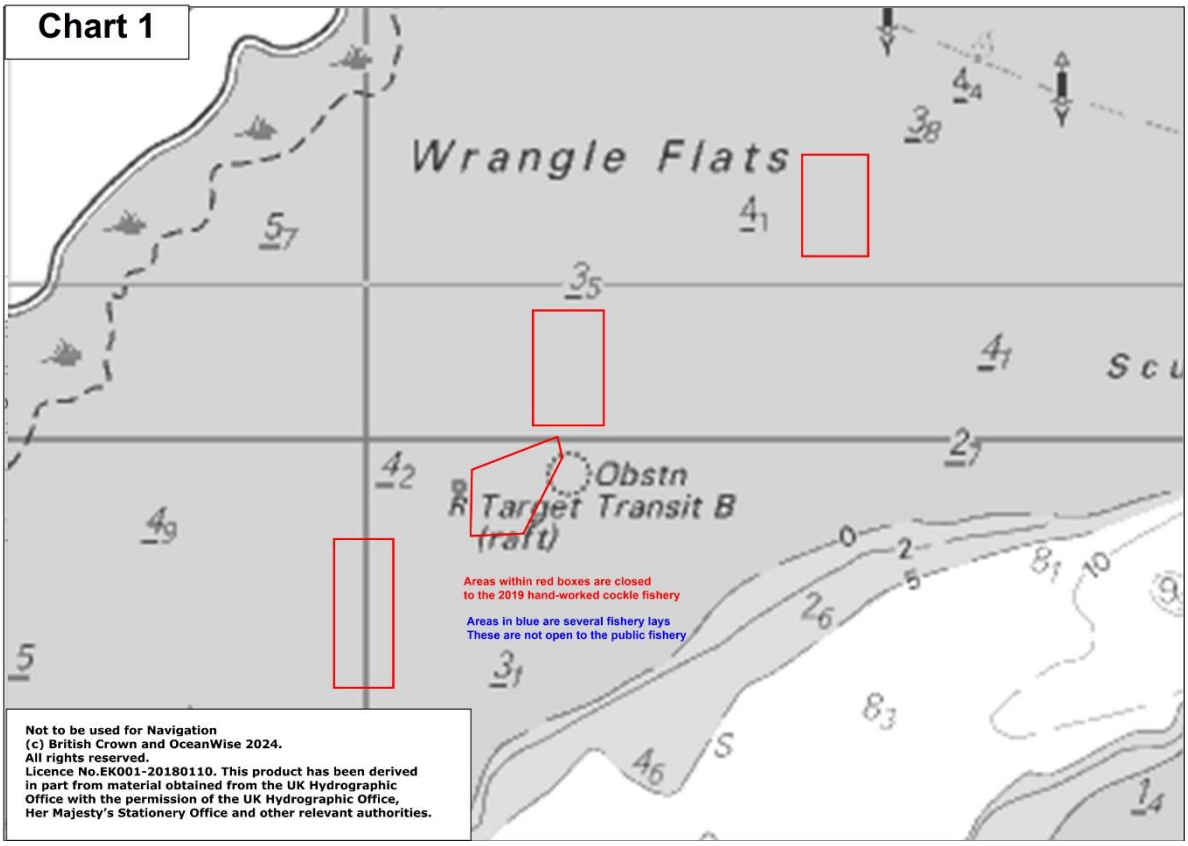

Figure 6 - Chart showing the extent of the area of Wrangle closed to the 2019 cockle fishery

In 2019, four areas containing 5 survey cells were closed to the cockle fishery. Unfortunately, due to Covid-19 restrictions in 2020, it was not possible to conduct the annual spring survey. As a result of this, there are no data to determine how successful these areas were at protecting the Year-0 stocks.

2023 closure

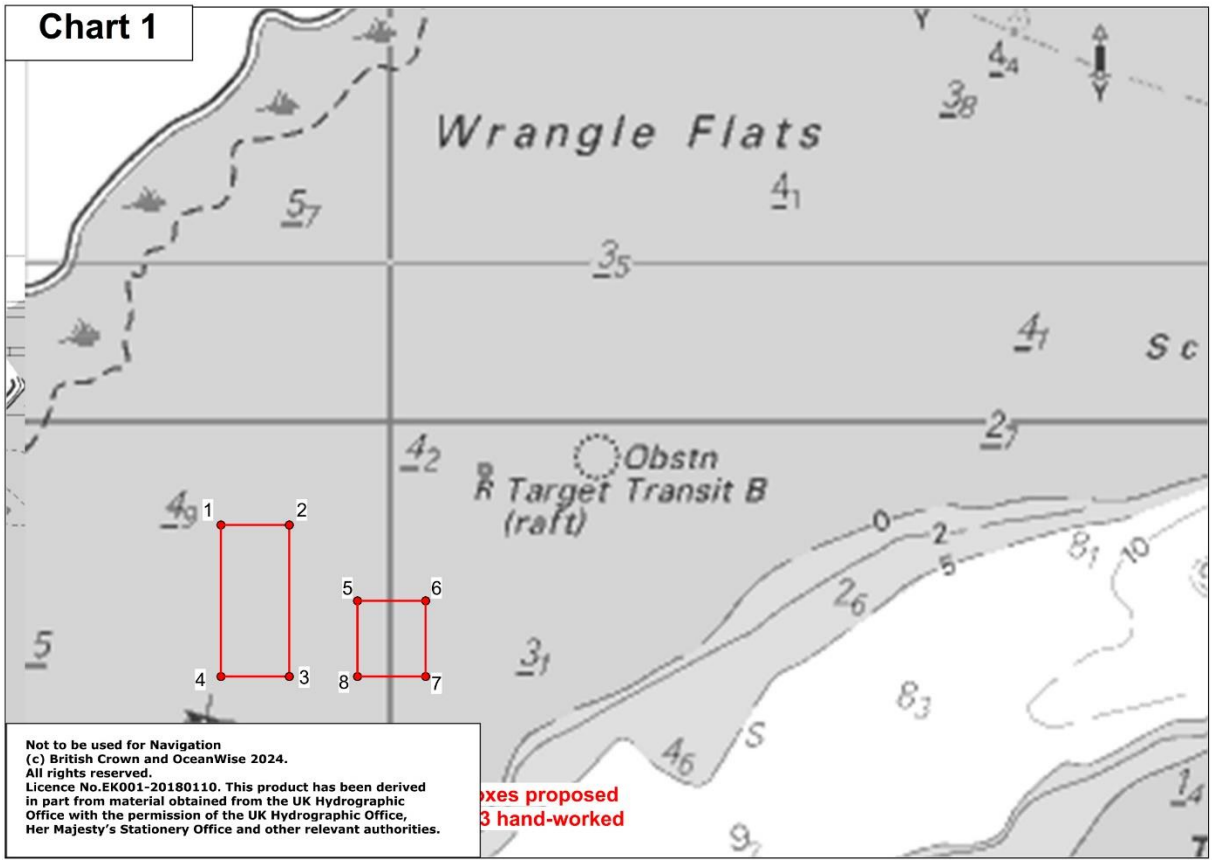

Figure 7 - Chart showing the extent of the area of Wrangle closed to the 2023 cockle fishery

In 2023, 2 small areas covering 3 survey cells (approximately 37 hectares) were closed to the cockle fishery. In 2023, these 3 samples contained 827 Year-0 cockles that weighed 298.6g. By the following year's survey, these had almost completely gone. The increase in biomass of lower densities of older cockles partially compensated for this loss.

Table 5 – Numbers and weights of each cockle cohort in 2023 and 2024

	Cockle numbers in cohort				**Cockle weight in cohort**			
Cohort	2022	2021	2020	2019	2022	2021	2020	2019
2023	827	5	0	0	298.6	9.2	0	0
2024	2	18	0	0	4.5	52.5	0	0

2025 closure

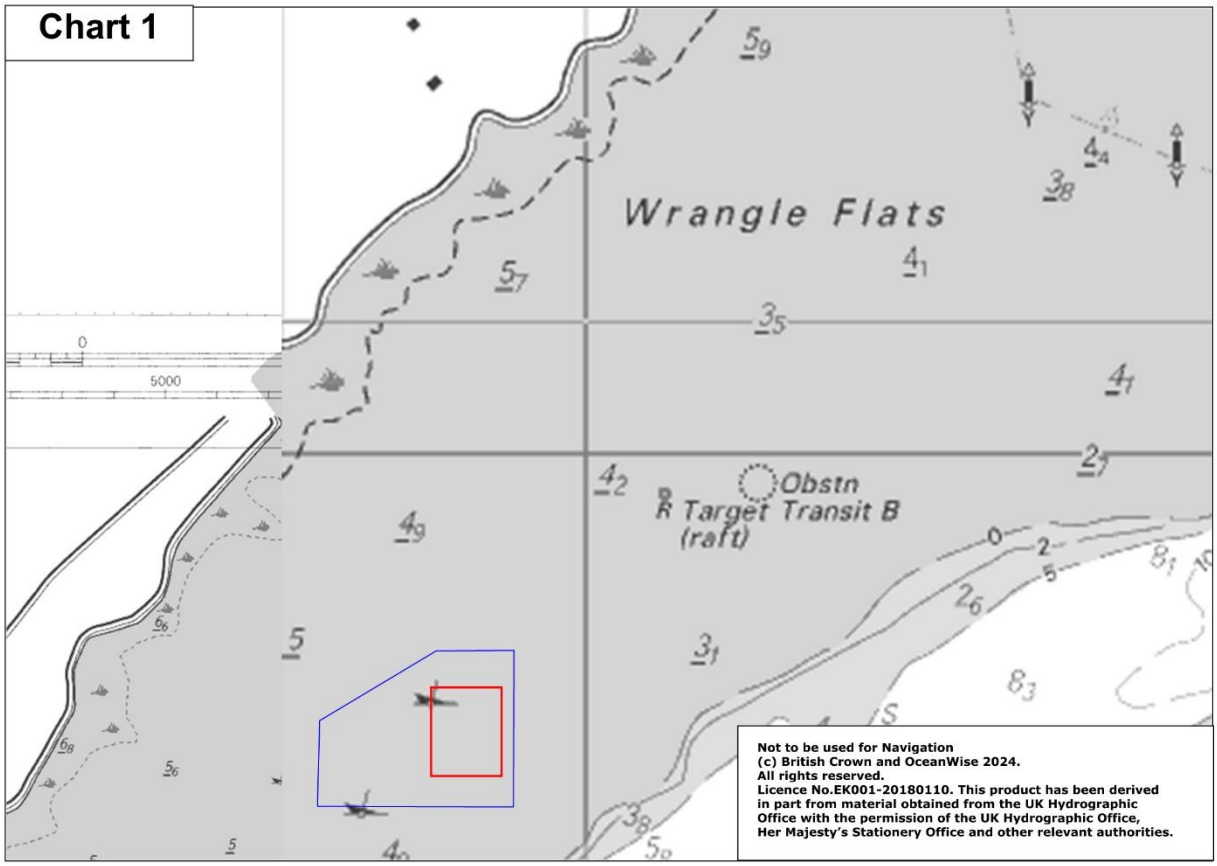

Figure 8 - Chart showing the extent of the area of Wrangle closed to the 2025 cockle fishery. Original closure (blue), revised closure (red)

In 2025, a single area of 91 hectares (marked blue in figure 8) was closed to the cockle fishery. At the time of the survey, the 4 sample stations within this area contained 1,757 Year-0 cockles, weighing 576.9g. There were also 44 Year-2 cockles weighing 206.4g.

A subsequent foot survey in June found the extent of the high-density Year-0 patch was smaller than had been estimated from the initial survey, being concentrated mainly to the eastern side of the closure. The area in the western side of the closure was found to be heavily undulated with hillocks and hollows and crossed by several creeks that had washed out cockles aggregated in them. From the cockle distribution found during the foot survey, it is thought that the grabs taken on that side of the closed area had landed where cockles had aggregated, so had over-estimated the cockle abundance for that area. Further, a low-way situated in the north-eastern part of the closure contained a large area of washed out cockles close to one of the survey stations (see figure 9). It is thought that the aggregations of cockles in these areas had resulted in the 2025 survey over-estimating the stocks within the closed area.

Following the foot survey, the closed area was realigned to cover where the high-density patch of Year-0 cockles were found to be situated (red box in figure 8).

Figure 9 – Washed out cockles in north-eastern part of Wrangle closure (13/06/2025)

Table 6 – Numbers and weights of each cockle cohort in 2025 and 2026

	Cockle numbers in cohort				**Cockle weight in cohort**			
Cohort	2023	2022	2021	2020	2023	2022	2021	2020
2025	1757	0	44	0	576.9	0	206.4	0
2026	161	3	3	0	242.9	10.8	15.2	0

The figures in Table 6 show the Year-0 cockles at the 4 stations within the original closure had declined from 576.9g to 242.9g. The biomass of Year-2 cockles had also declined from 206.4g to 15.2g. As explained above, however, a foot survey conducted 2 months after the first survey had found the original survey had over-estimated the extent of the Year-0 coverage. This will have made any cockle losses in this area appear larger than they were. Three further foot surveys were conducted within this closed area during 2025, all of which found the Year-0 patch was surviving.

Conclusion

Between 2008 and 2025, closures have been implemented at Wrangle on 6 occasions to protect high-density patches of Year-0 juvenile cockles These include twice when the entire bed was closed, one large closure and three small closures. Of these, it was not possible to assess the success of the small closures in 2019, due to the absence of data in 2020 caused by Covid-19 restrictions.

Contrary to fishermen's concerns that these closures on Wrangle had failed to protect the juvenile stocks, the survey data shows that the large closures implemented between 2011 and 2017 were all successful. Protected Year-0 stocks produced a five-fold increase in weight in 2011 and more than doubled in 2015 and 2017, resulting in good fisheries on subsequent years.

By contrast, the smaller closures in 2023 and 2025 were less successful, although foot surveys conducted after the survey in 2025 highlighted an over-estimation of the stock extent (and weight) in the original survey data. Further foot surveys during the summer within the realigned closed area found that the juveniles were surviving better than the data suggests.

The data shows that despite the losses seen in the small closure in 2023, the approach taken of protecting high-density patches of Year-0 cockles at Wrangle has been highly successful. When the data from these periods are pooled, the Year-0 cockles within the protected areas have more than doubled in weight, from 5,060g to 11,457g. When scaled up, these figures equate to an increase from 6,295 tonnes of cockles to 14,253 tonnes on the ground.

Challenges associated with spatial closures

While this assessment has demonstrated that the closures implemented in Wrangle have worked well, there are challenges associated with the approach that can lead to the perception that closures are not effective. This is mainly due to a combination of:

- The heterogeneous distribution of cockles, which often results in a mosaic of high-density aggregations being situated close to low density areas. This means that a grab sample taken from such an area could hit or miss an aggregation of cockles, producing very different results that significantly over or under estimate the abundance of cockles in the area they represent.
- The survey resolution, which at 400 yards between stations is quite low for placing closures accurately around stocks. It also means that a grab hitting a small aggregation of cockles will be scaled up to 12.44 hectares, significantly over-estimating the extent of such patches. Similarly, it is possible for significant patches of cockles to fall entirely between two stations and remain undetected.
- The approach used to assign closed areas, whereby stations found to support Year-0 densities exceeding 1,000m^2 are closed.

Because the full survey programme involves sampling over 1,000 stations, the issue of survey resolution and cockle heterogeny is not a major concern when calculating the total stock, from which the TAC is calculated. There are sufficient samples to smooth out any skewing caused by grabs hitting or missing aggregations of cockles.

For smaller areas involving fewer samples, however, this can have greater impact. Cockle distributions will not be exactly as they are mapped.

When used for assigning closed areas, these three conditions when combined can result in significant inaccuracy. The heterogeneous distribution of cockles means that samples could show cockle stocks as being much higher than they are in a particular area, or much lower. As samples containing high densities of Year-0 cockles will result in a closure, hitting an aggregation could result in a closure where none was needed. This can lead to the perception that stocks have been lost from a closed area, when in actual fact, there was probably only a small patch to begin with. By contrast, hitting a bare patch in a generally high-density area could result in no closure being placed in an area that would benefit from one. When these artefacts are scaled up from a $0.1m^2$ sample representing 12.44 hectares on the ground, this can result in significant areas being closed unnecessarily, or large areas going unprotected when needed. The 400 yard sampling resolution is also quite low when it comes to aligning the closed boxes with the juvenile patches. This frequently results in parts of a closed box not supporting juvenile patches, or the patches extending beyond the closed box. In the latter case, this often results in high levels of fishing effort around the edges of closed areas.

While these issues are known, finding solutions for them is not simple. Improving sampling resolution would seem an obvious option, but halving the distance between stations to 200 yards, would quadruple the number of samples needed to be collected. The Authority is already stretching its capacity to conduct the surveys at its current resolution. Stratified sampling could help, but this would mean large areas being surveyed at a much lower resolution in order to increase resolution elsewhere. At present, the Authority uses a dynamic approach, whereby closed areas are determined using the survey data, but then assessed in more detail during the summer. These foot surveys enable a more accurate alignment between closures and stocks, but are time-consuming to conduct, limiting how many can be undertaken. An added benefit, however, is that they can identify if high-density patches are vulnerable to ridging out.

Issues of assessment bias

When it comes to assessing the effectiveness of closures, such as this one, the conditions described above will have a tendency to make the results appear poorer than they might actually be. This is because by only closing areas that the survey data has found to support Year-0s in densities exceeding $1,000/m^2$, bias has been introduced into the baseline sample set. Due to the heterogeneous distribution of cockles on the ground, by only selecting the samples showing high densities, the sample set will tend to have a higher biomass than is actually average for the surrounding area that the sample is representing. This means that when resampled the following year, the law of averages mean that overall, those samples will appear to have declined in biomass. Care should, therefore, be taken when conducting assessments such as this one, particularly for small closures where skewing will be proportionally larger.