Wash intertidal cockle survey report (2022)

The 2022 Wash intertidal cockle surveys were conducted between March 17th and April 30th, consistent with previous surveys. During the course of the surveys 1,043 stations were sampled from a total of 23 survey areas. Figure 1 shows the extent of the stations surveyed.

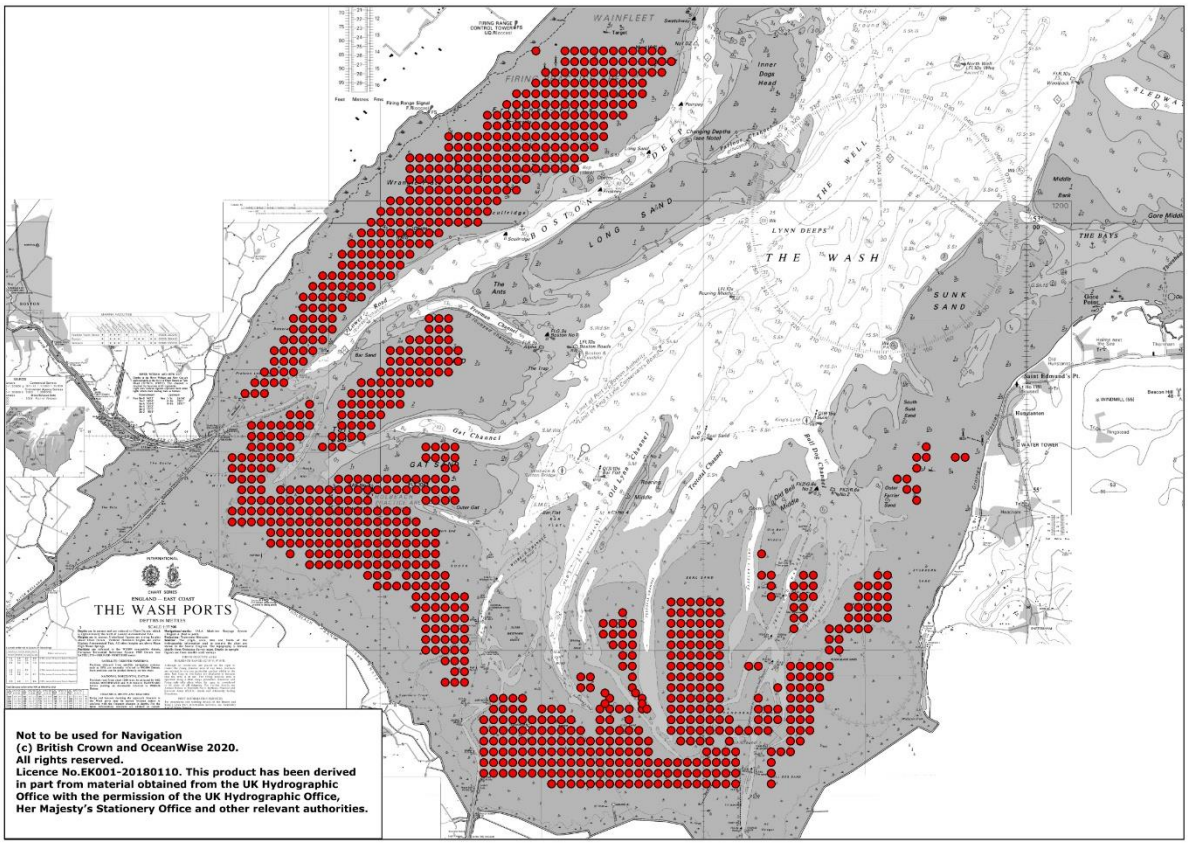


Figure 1 – Chart showing stations sampled during the 2022 Wash cockle surveys

The stock composition at the time of the 2021 survey had indicated cockle stocks were declining and would likely result in poor stock levels in 2022. Anecdotal reports from fishermen struggling to achieve daily quotas during the 2021 fishery supported the survey evidence that apart from a few small patches at the start of the season, cockle densities were low. The results from the 2022 surveys, below, confirm there has been a continued decline in stocks from the 15,848 tonnes of adult cockles and 20,153 tonnes total stock calculated to be present in 2021.

Summary of 2022 cockle stocks

Total Adult Stock (≥14mm width)	8,226 tonnes
Total Juvenile Stock (<14mm width)	5,485 tonnes
Total Stock (all sizes)	13,711 tonnes

Table 1 provides details about the stocks found on each bed, while figures 2 and 3 show the distribution of the adult stocks (cockles ≥14mm width) and juvenile stocks (cockles <14mm width). Further charts in figures 4-7 show the distributions of the cockles from the Year-0, Year-1, Year-2 and Year 3 age cohorts.

Table 1 - Summary of cockle stocks on the Wash intertidal beds – April 2022

	Adult (≥14mm)				Juvenile (<14mm)					
SAND	**Area (ha)**	**Mean Density (no/m2)**	**Mean Weight (t/ha)**	**Biomass (t)**	**Area (ha)**	**Mean Density (no/m2)**	**Mean Weight (t/ha)**	**Biomass (t)**	**Total Biomass (t)**	**% Adult**
Black Buoy	124	80.00	37.32	464	199	843.75	27.17	541	1005	46
Blackguard	0	0.00	0.00	0	0	0.00	0.00	0	0	0!
Breast	672	33.30	15.77	1059	858	218.99	14.66	1258	2317	46
Butterwick	211	22.94	14.36	304	249	335.00	9.70	241	545	56
Butterwick EXT	124	33.00	15.34	191	162	350.00	10.91	176	367	52
Daseley's	286	18.70	10.47	300	572	103.26	3.88	222	522	57
Friskney	311	17.60	15.17	472	187	24.00	2.46	46	518	91
Friskney EXT	124	14.00	10.53	131	124	17.00	1.58	20	151	87
Gat	174	46.42	33.48	583	62	72.00	10.57	66	649	90
Herring Hill	124	14.00	4.45	55	199	88.13	8.56	170	225	24
Holbeach	622	33.00	18.72	1165	878	118.89	7.62	664	1829	64
IWMK	299	77.50	31.48	940	286	287.39	20.22	578	1518	62
Mare Tail	249	62.50	29.74	740	411	399.39	18.17	746	1486	50
Outer Ferrier	25	15.00	18.69	46	25	75.00	1.56	4	50	92
Pandora	37	13.33	5.83	22	25	10.00	1.47	4	26	85
Peter Black	50	10.00	4.10	20	37	10.00	2.03	8	28	71
Roger	336	23.70	17.06	573	187	121.33	10.35	193	766	75
South Ferrier	112	22.22	12.67	142	199	63.13	2.52	50	192	74
Styleman's	25	15.00	8.78	22	25	20.00	1.66	4	26	85
Thief	112	20.00	14.83	166	137	184.55	21.29	291	457	36
Whiting Shoal	12	20.00	25.53	32	37	23.33	3.99	15	47	68
Wrangle	448	23.33	17.30	775	398	70.31	4.50	179	954	81
Wrangle EXT	37	10.00	6.36	24	5	15.00	1.85	9	33	73
Total	**4,514**			**8,226**	**5,262**			**5,485**	**13,711**	**60**

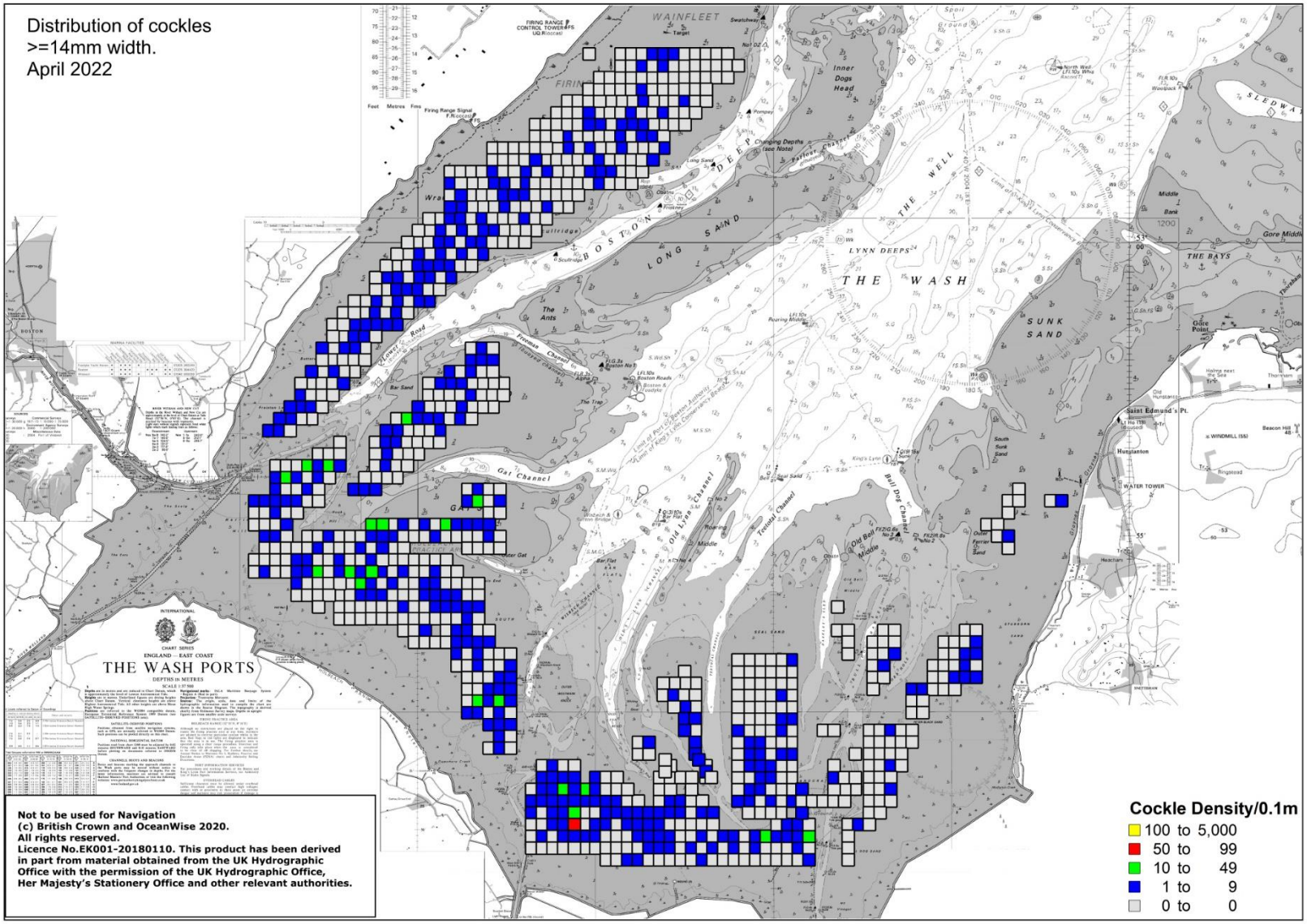


Figure 2 – Chart showing the distribution of adult cockles (≥14mm width) at the time of the 2022 spring surveys

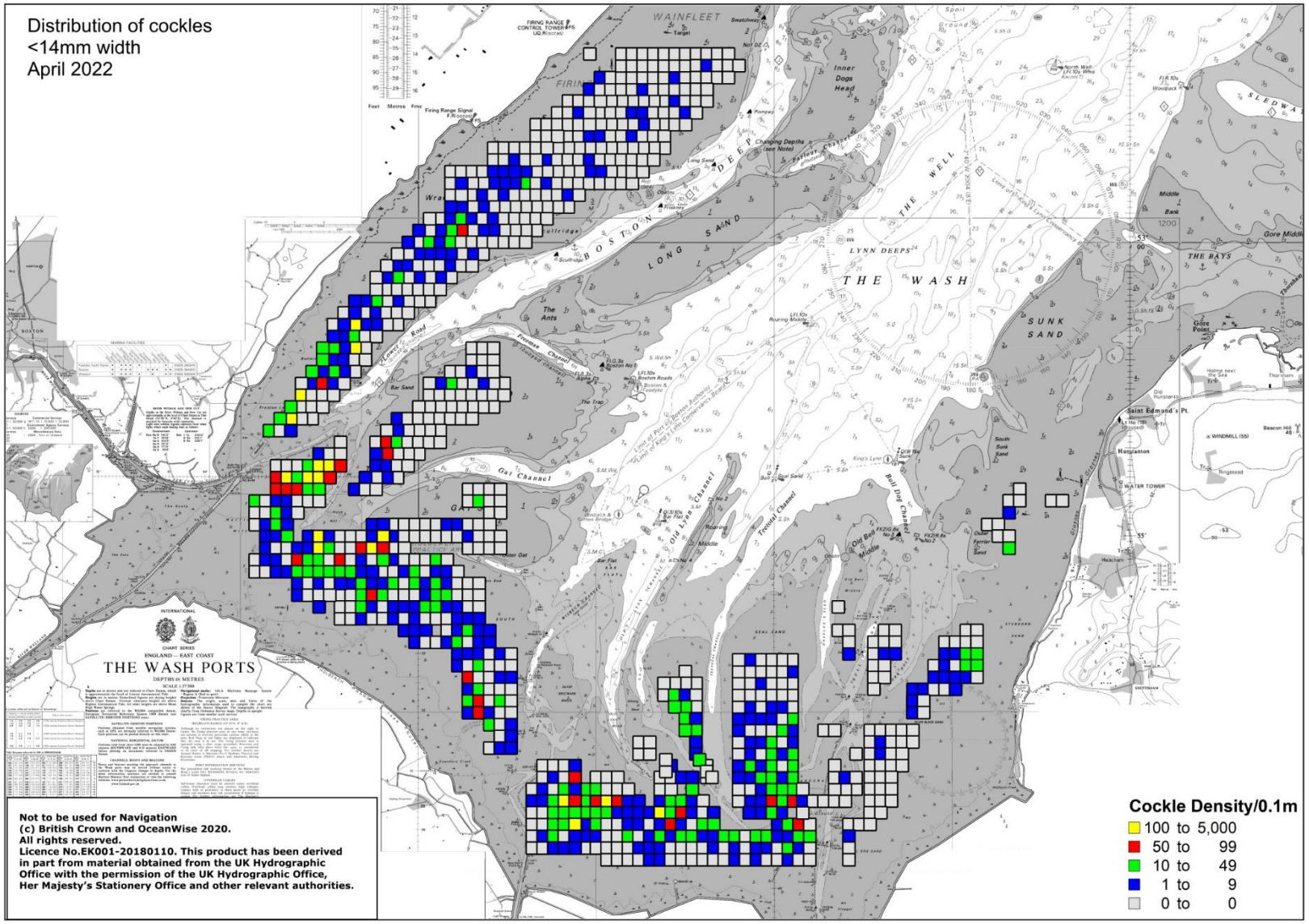


Figure 3 – Chart showing the distribution of juvenile cockles (<14mm width) at the time of the 2022 spring surveys

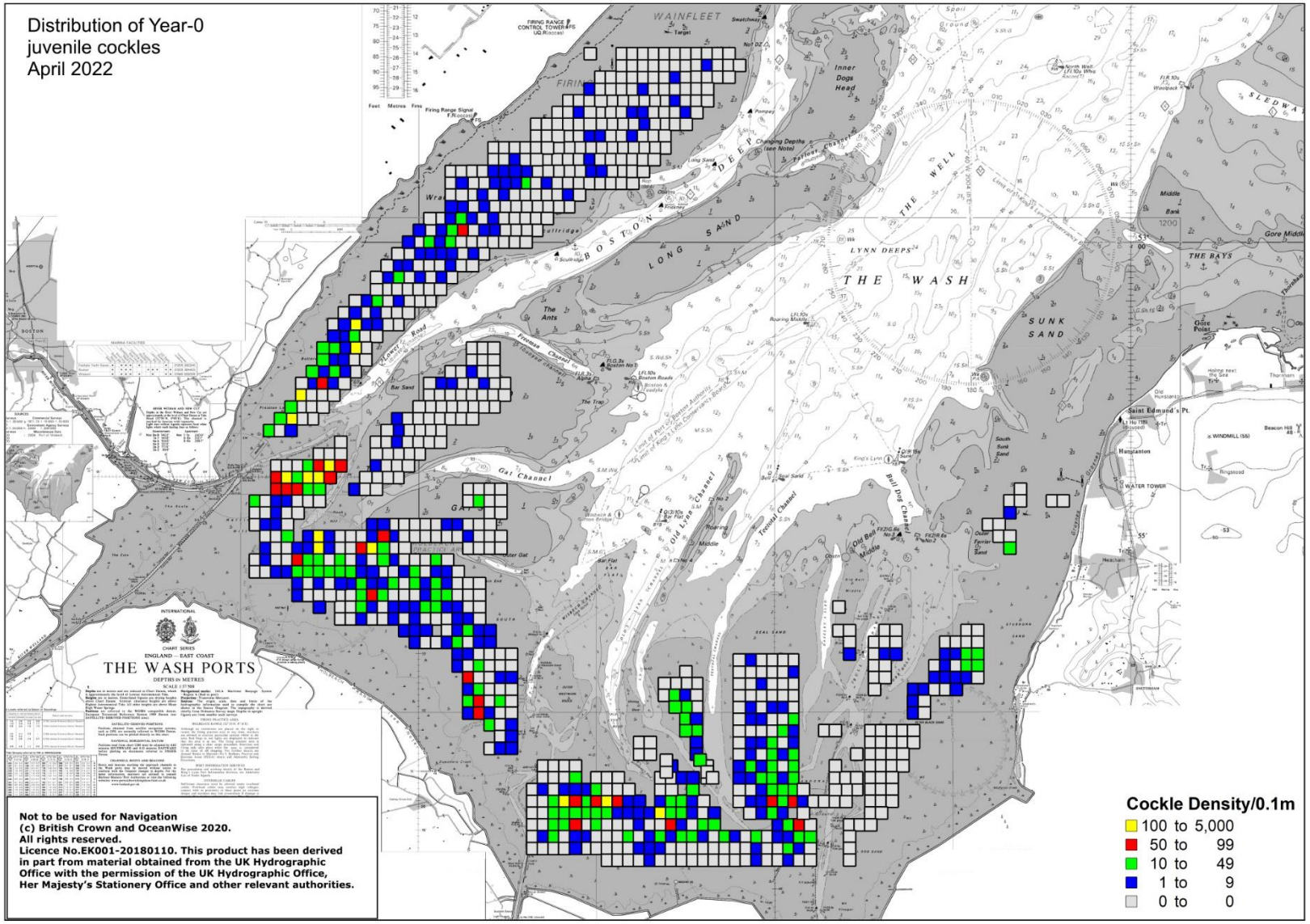


Figure 4 – Chart showing the distribution of Year-0 (2021 year-class) cockles at the time of the 2021 spring surveys

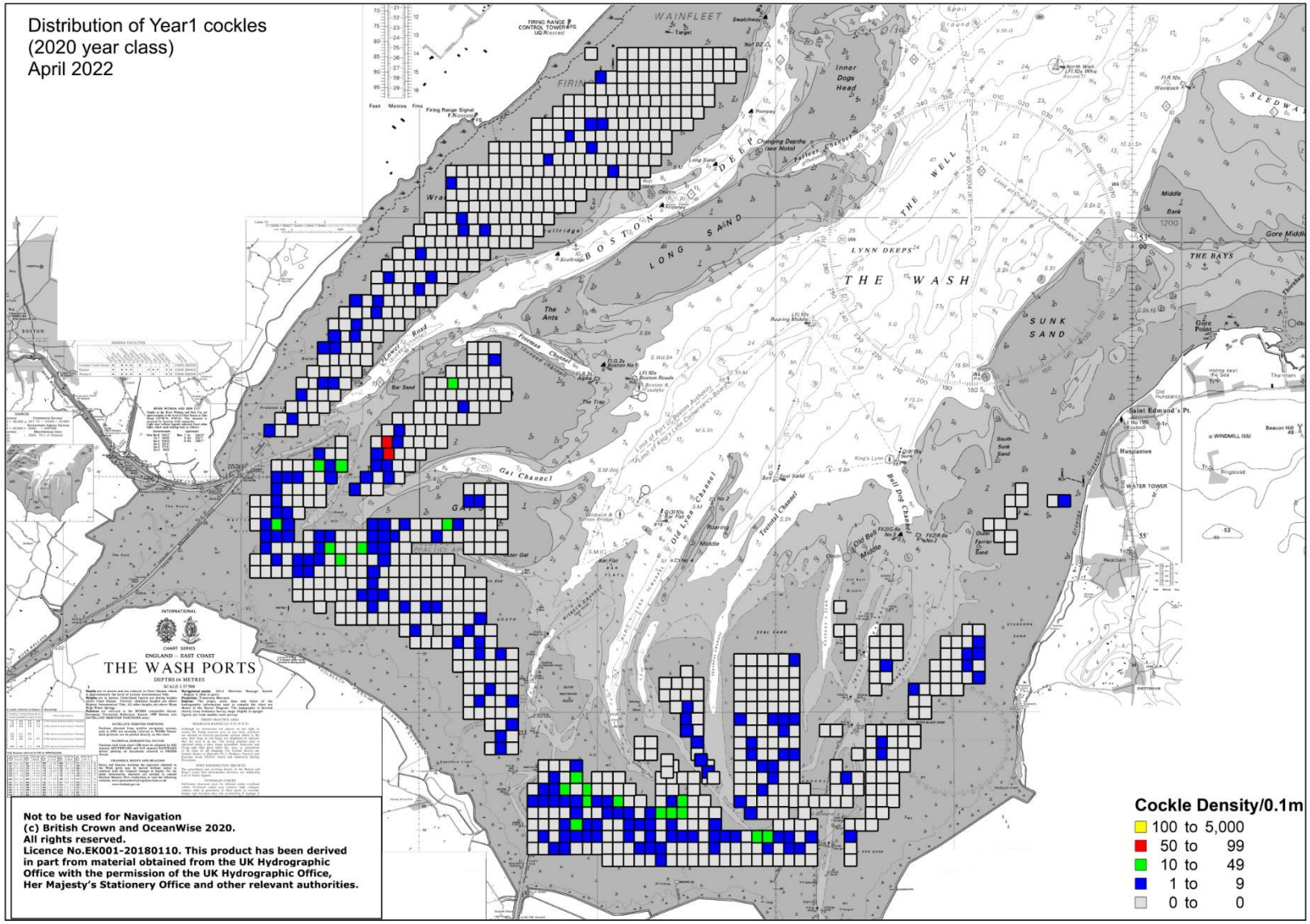


Figure 5 – Chart showing the distribution of Year-1 (2020 year-class) cockles at the time of the 2021 spring surveys

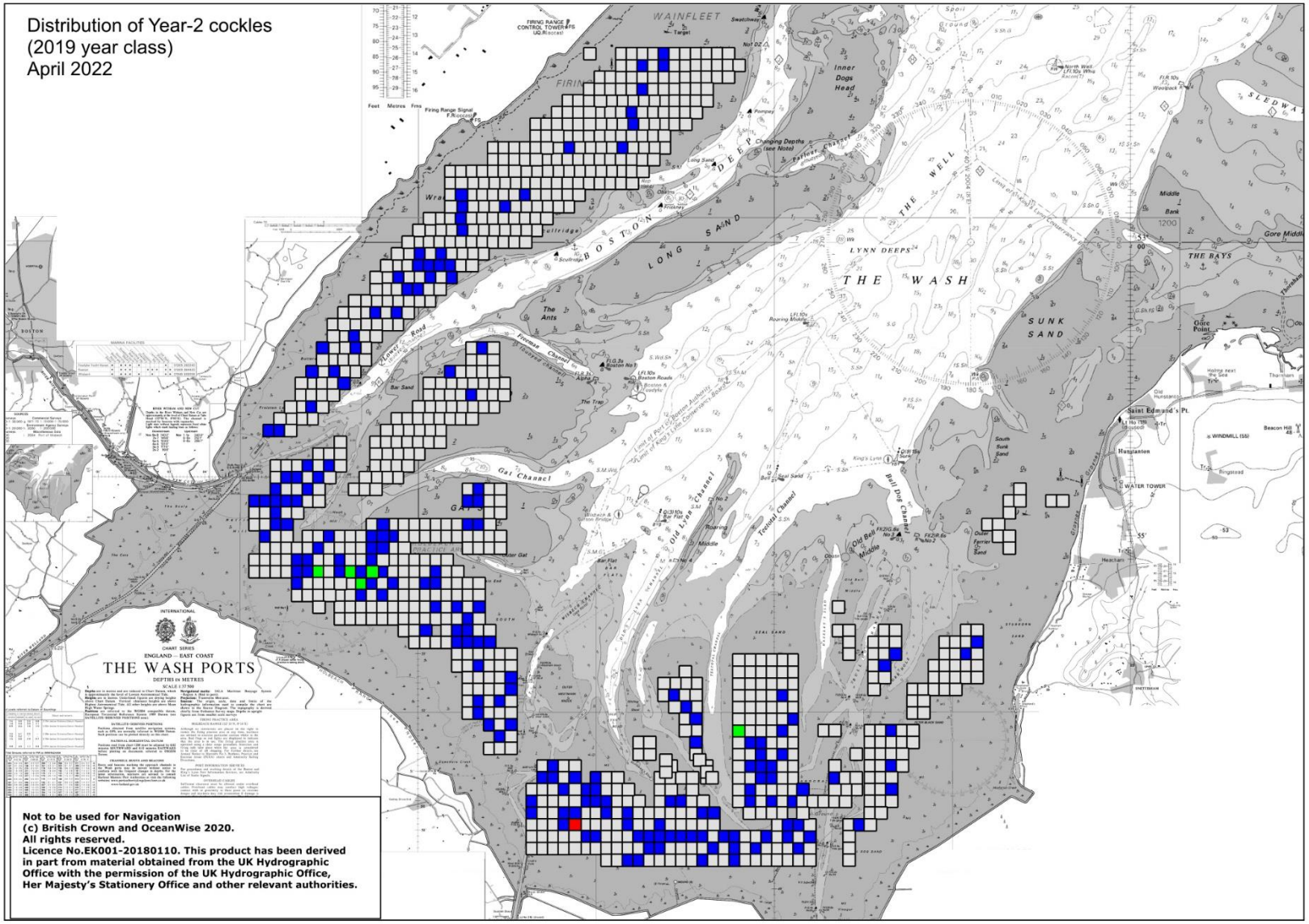


Figure 6 – Chart showing the distribution of Year-2 (2019 year-class) cockles at the time of the 2021 spring surveys

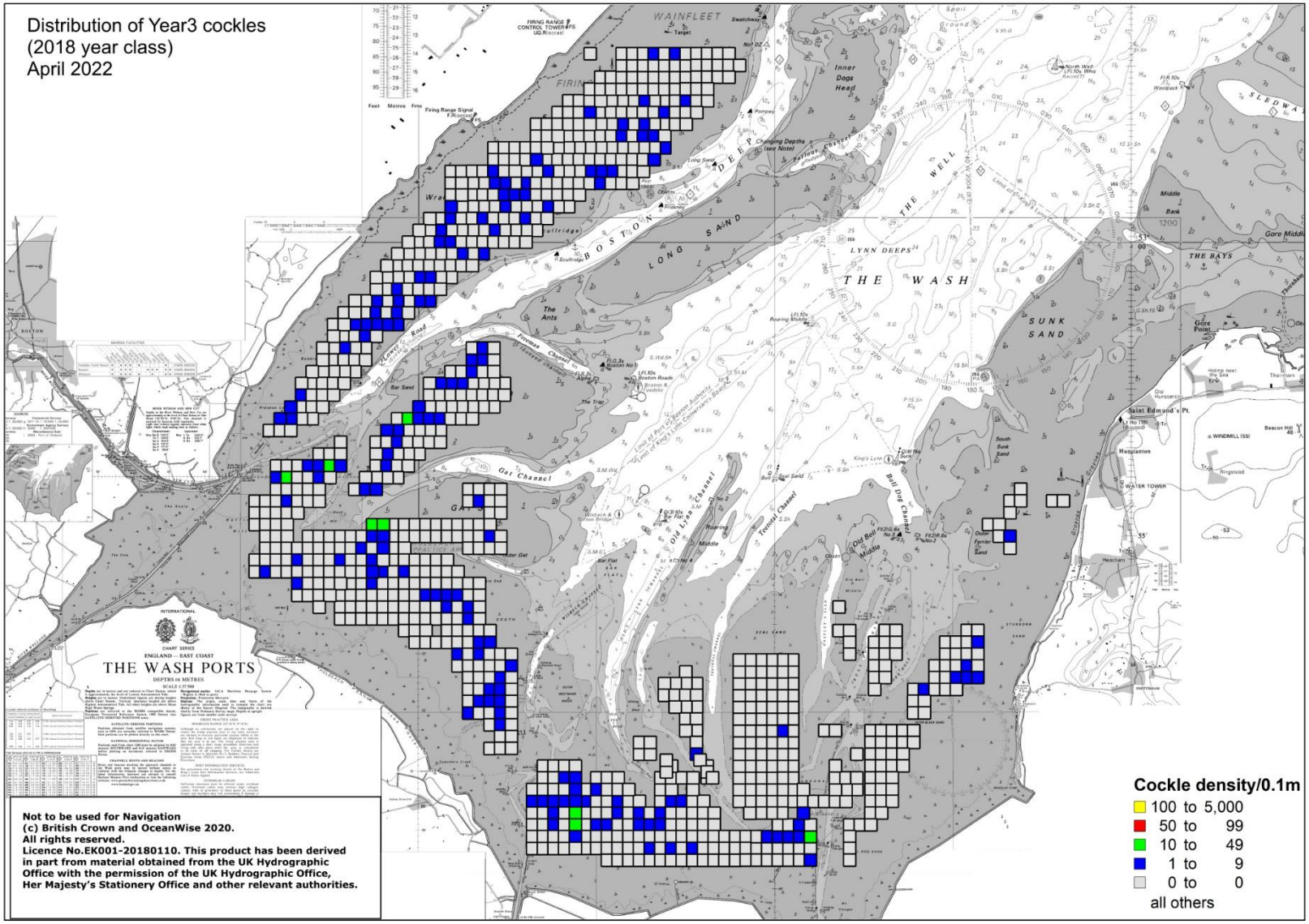


Figure 7 – Chart showing the distribution of Year-3 (2018 year-class) cockles at the time of the 2021 spring surveys

Cockle distribution

Compared to most years, the cockle densities shown in the charts above are low. In figure 2, which shows the distribution of adult (≥14mm width) cockles, there is only one station where their densities exceed 500/m^2 (coloured red on the charts). As this tends to be the minimum density for a hand-worked fishery to achieve a 2-tonne daily quota, opportunities for a fishery based on this size-range of cockles is limited.

In recent years, due to “atypical” mortality killing disproportionate numbers of larger cockles, there has been a tendency for the fishery to target smaller cockles before they die, particularly if the targeted patches also contain some large cockles. Figure 3 shows there are several high-density patches of <14mm width juvenile cockles present on the beds. However, the similarity between figure 3 and figure 4, which shows the distribution of Year-0 cockles, highlights that numerically, the population of <14mm width cockles shown in figure 3 is dominated by Year-0 cockles. Having only settled last summer, the Year-0 cohort are currently only 5-9 mm in width and won’t spawn until 2023 at the earliest. Where their densities exceed 1,000/m^2 (areas coloured yellow in figure 4) it is policy in the Wash Cockle Fishery Management Plan to protect them with spatial closures, but even outside of these areas, Year-0 cockles should not be targeted by the fishery (see section below, “Natural Mortality and Recruitment).

Figures 5 and 6 show the distributions of Year-1 and Year-2 cockles. Individuals from these two cohorts could be of a fishable size this year, particularly the Year-2 stocks. However, having originated from poor settlements in 2019 and 2020, their densities are sparse, particularly as some were targeted during the 2021 fishery. There is a patch of Year-1 cockles on the Tofts that exceed 500/m^2, but they are not present in a fast-growing area and are currently only 7-10 mm in size. The only place where the surveys found Year-2 stocks exceed densities of 500/m^2 is a small patch on the Inner Westmark Knock. Here, they have reached a size of 13-15 mm width and their densities are boosted with additional Year-1 and Year-3 cockles (plus Year-0 spat). However, while the cockle density in this area does appear fishable, and the survey sample indicated the area could support up to 400 tonnes of cockles, in reality it is likely to support fewer because a foot survey found the patch does not cover the full 12.44 hectares represented by the sample station and the cockle distribution in the area was found to be patchy.

Figure 7 shows the distribution of Year-3 cockles that are the survivors from the last large settlement in 2018. This cohort supported a late summer fishery on Friskney and the Gat in 2019, and were the main cohort targeted during the 2020 and 2021 fisheries. They have also been vulnerable to atypical mortality during those years, but while significant losses have been seen, the survey data and mid-season bed inspections have found mortality rates to be lower than seen in previous cohorts. While this cohort is now sparsely distributed, due to the individual cockle sizes, they are still the largest of the cohorts in terms of biomass, contributing 3,922 tonnes towards the overall stock biomass (see figure 8).

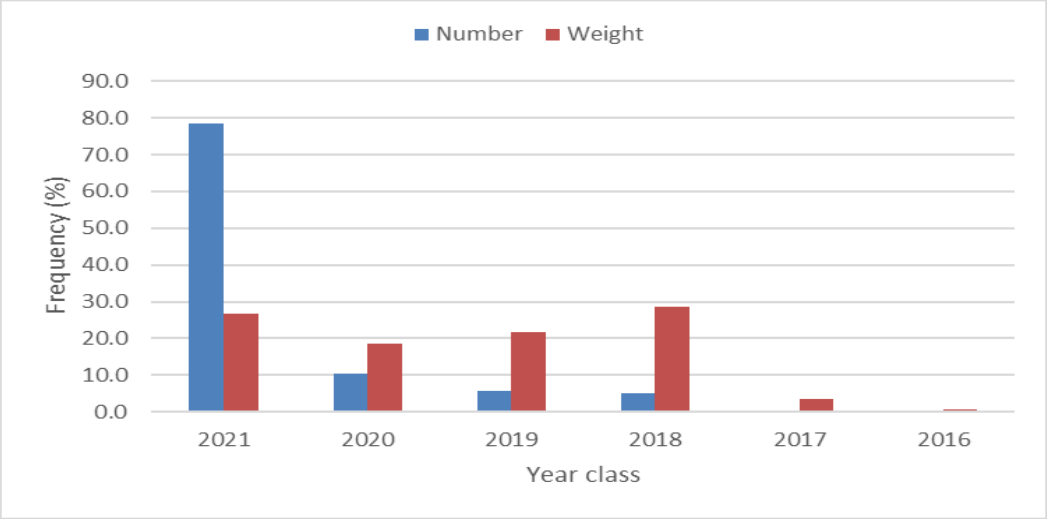


Figure 8 – Graph showing the proportionate sizes of each year-class cohort in terms of numbers (blue) and weight (red)

The stock summary table and charts above show the cockle stocks to be low this year. For comparison, figure 9 shows the biomass of adult and juvenile cockles present during the annual surveys from 2000 onwards. From this graph it can be seen that during this period, the stocks have only been lower in 2004 and 2011.

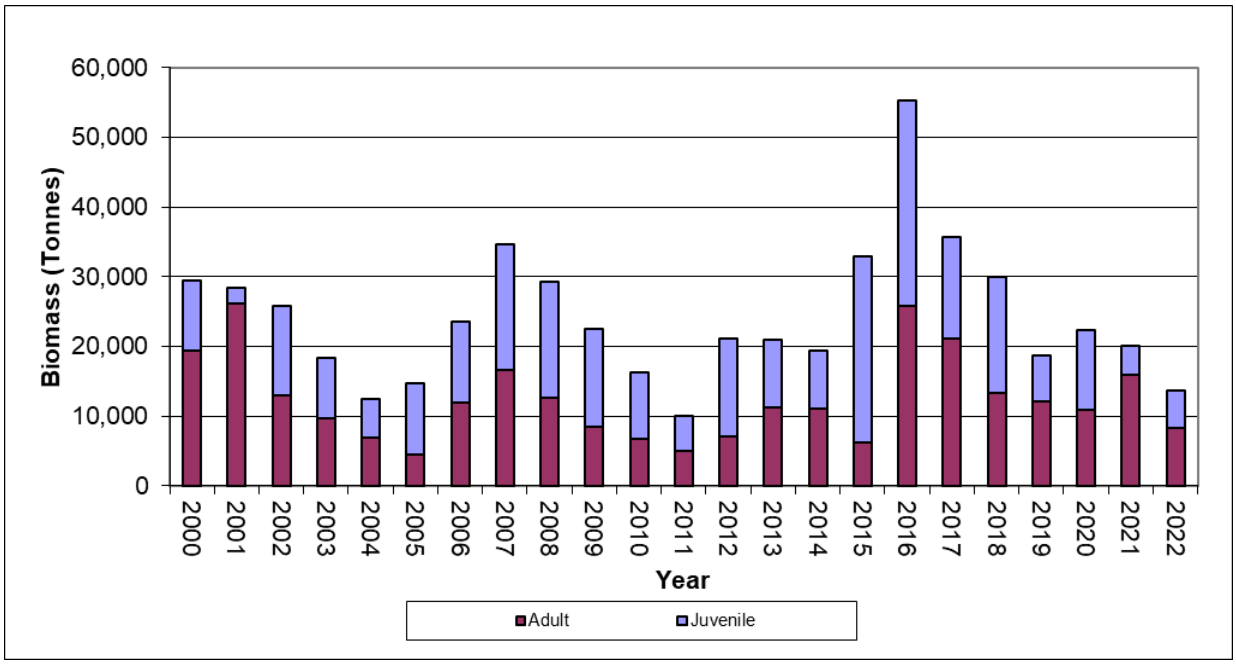


Figure 9 - Adult and juvenile cockle stock levels between 2000 and 2022 on the regulated beds

Due to the tendency for cockle numbers to be biased in favour of younger/smaller individuals, density charts showing cockle numbers (as seen in figures 2-7) do not always reflect the better fishing opportunities. Usually, cockle densities showing biomass are better indicators of where the best fishing opportunities are situated. Figures 10 and 11 show the cockle distributions in 2021 and 2022 in terms of biomass of total stock (excluding Year-0's).

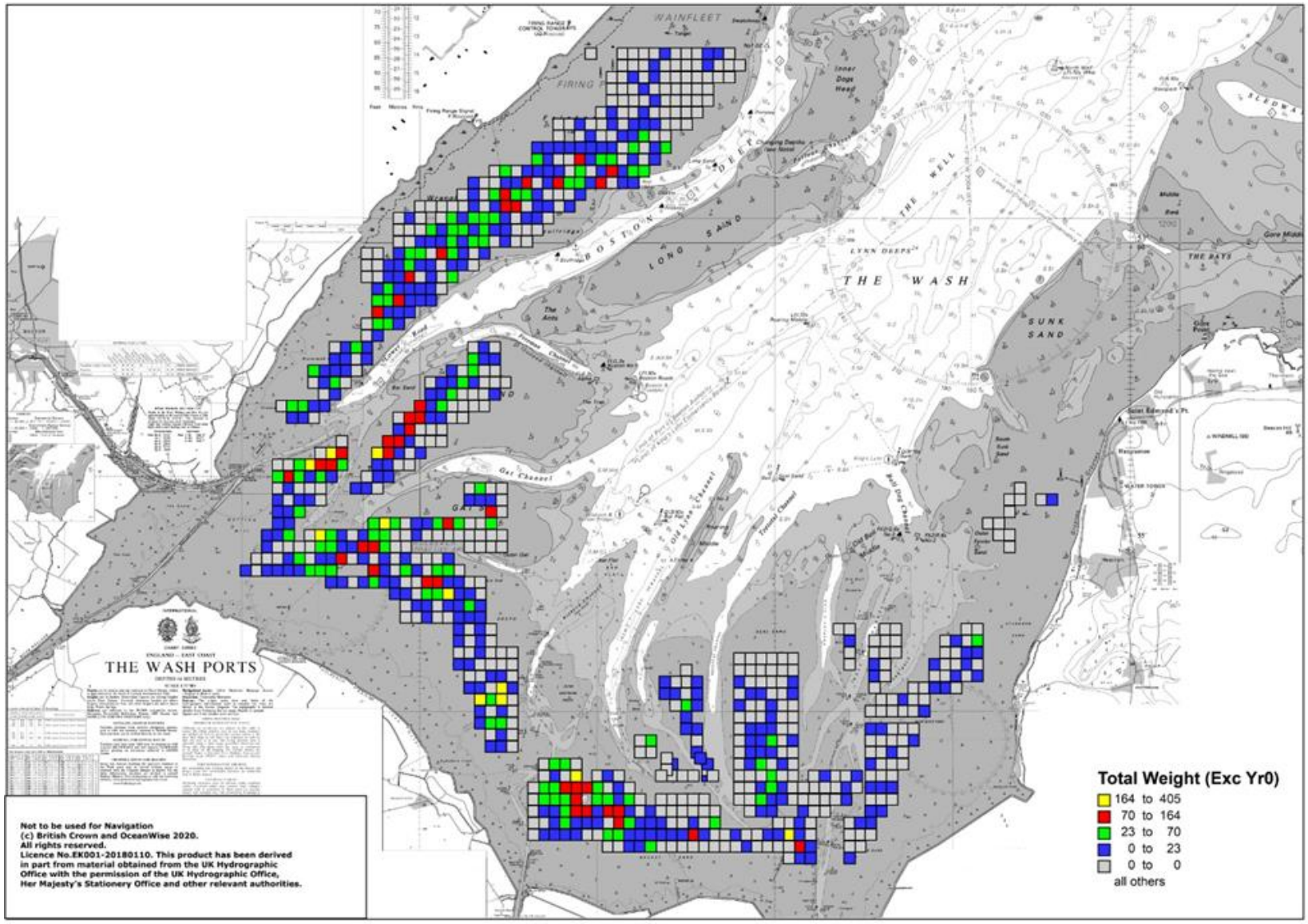


Figure 10 – Chart showing the total weight (g/0.1m2) of cockles at each station at the time of the 2021 spring surveys

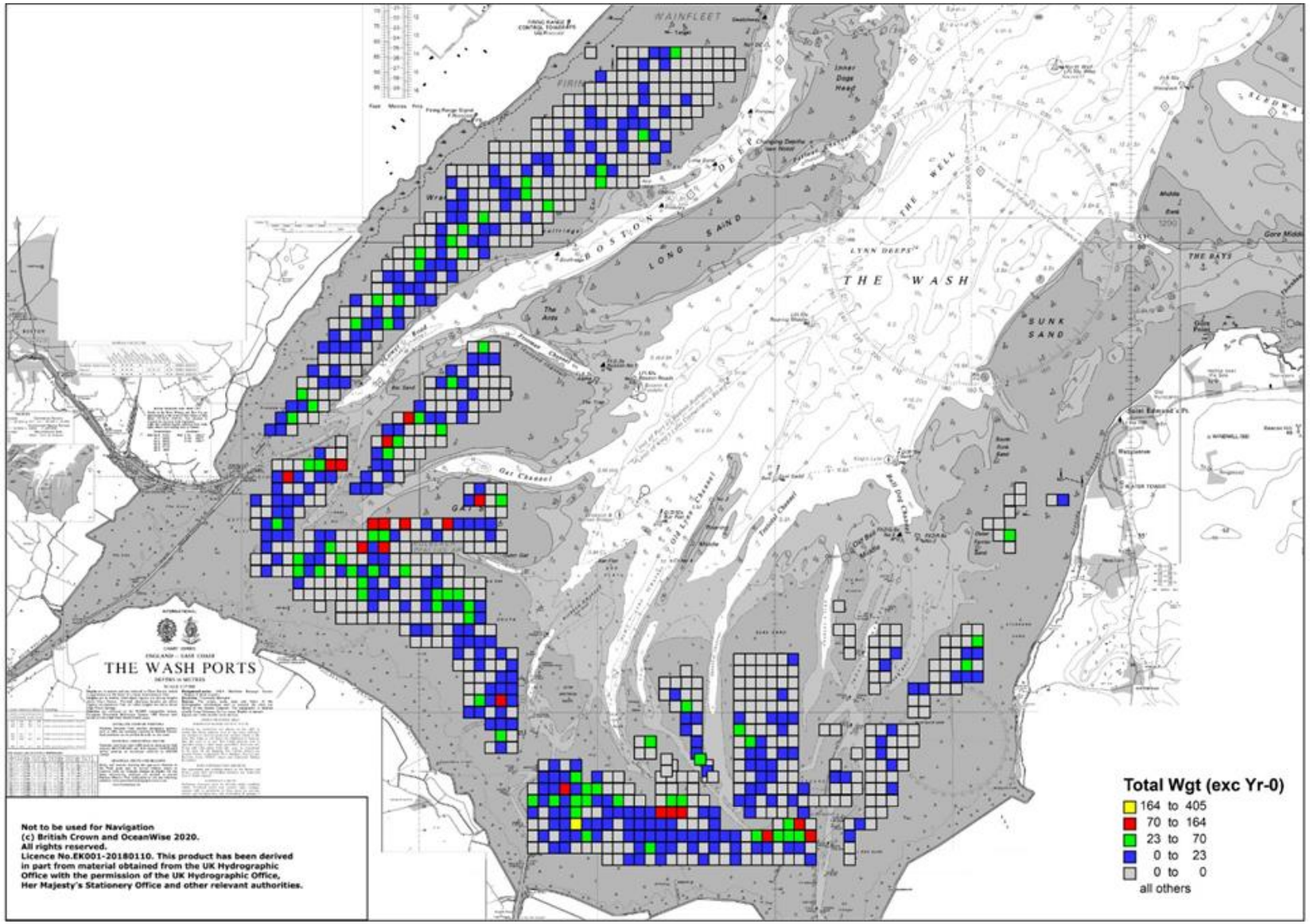


Figure 11 – Chart showing the total weight (g/0.1m2) of cockles at each station at the time of the 2022 spring surveys

By comparing the above two charts, it can be seen that the overall cockle densities this year are poorer than last year. In particular, the areas of higher density cockles on the Dills, Tofts, Hook Hill and Inner Westmark Knock in figure 10, that supported the majority of the 2021 fishery have been thinned out. Only small patches of cockles now remain in fishable densities and are unlikely to support anything more than a very small-scale fishery.

Natural Mortality and Recruitment

Since 2008, high proportions of cockles have died annually from what has been termed “atypical mortality”. These mortalities tend to occur during the summer months and primarily affect cockles that have reached a size of about 13-14mm width. On the majority of beds, the peak mortality occurs two years after the cockles have settled, but on the beds where cockle growth is slower, mortalities tend to be spread out over the second and third years. On the faster-growing areas, mortality rates among the vulnerable sized cockles have been seen to exceed 90% of their biomass some years and in most cases exceeds 50%.

Faced with such high natural losses, the fishery can only remain viable if there are regular settlements of new recruits. Fortunately, since 2004 widespread settlements have occurred more regularly in The Wash than during the previous decades, when recruitment tended to be erratic. Figure 12, which plots the numbers of Year-0 cockles found in the survey samples since 2003, shows a fairly regular pattern of good spatfalls occurring every second or third year. These regular settlements have helped to offset natural and fishery losses, producing the recoveries seen in figure 9 and have even resulted in one of the largest cockle stocks on record in 2016. However, because the cockles are particularly vulnerable to “atypical” mortality from their second year, such recoveries are inevitably short-lived, requiring further settlements to maintain sustainability. When these do not occur, or are too small to replace the losses, the stocks quickly decline.

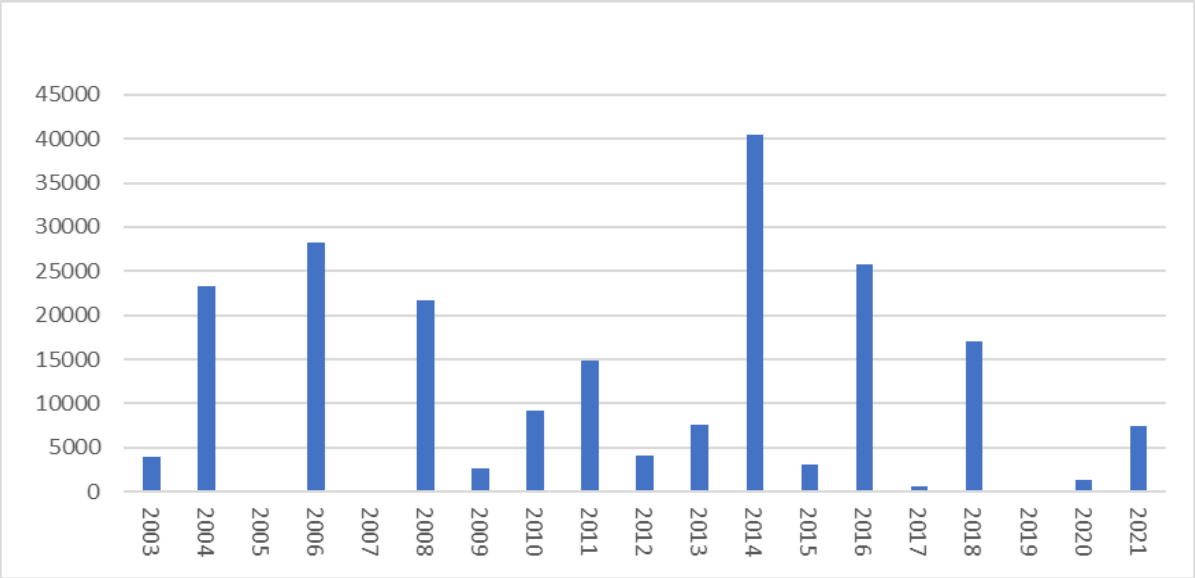


Figure 12 – Graph showing the relative size of annual spatfalls on the regulated beds since 2003

Two years of poor settlements in 2019 and 2020 have been insufficient to replace losses that have occurred during that period, resulting in the stocks rapidly declining to the current low levels. The 2022 survey found there had been a moderate settlement in 2021, but as can be seen in figure 12, it is small compared to some of the peak settlements seen between 2004-2008 and 2014-2018. Further, rather than having a widespread coverage across the intertidal beds, the settlement distribution seen in figure 4 shows the higher density patches are limited to areas of the Butterwick, Dills, Mare Tail and Inner Westmark Knock sands.

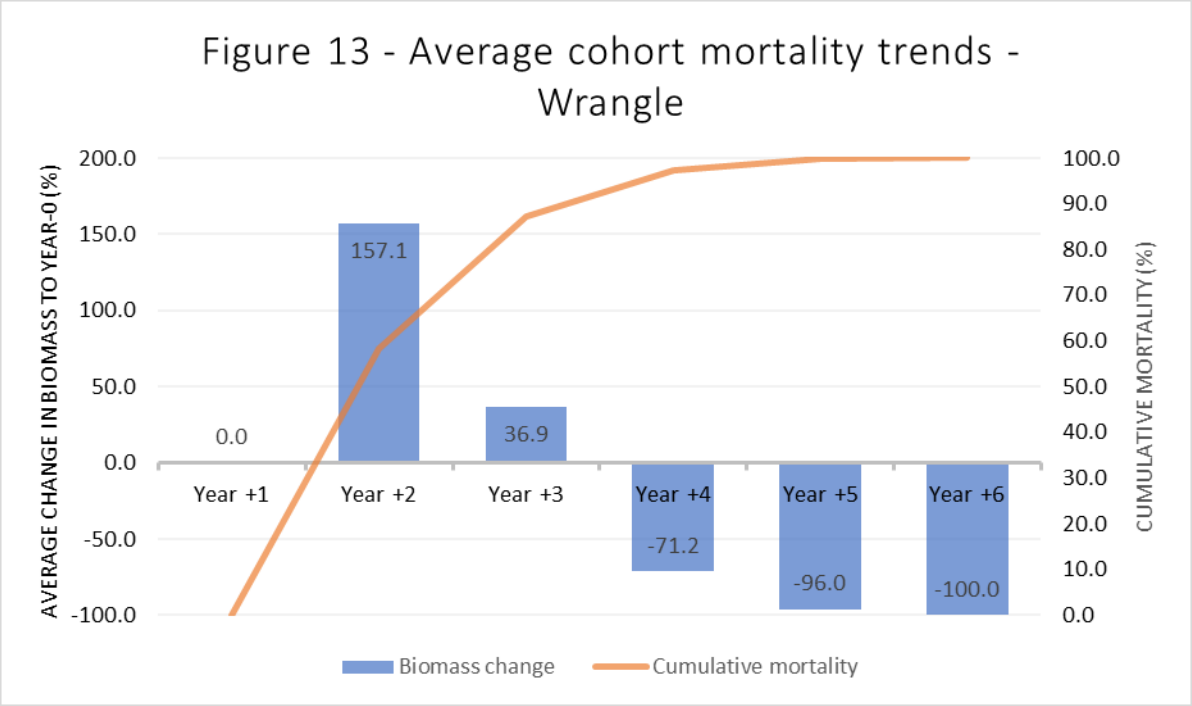
On occasions in previous years, when there has been good settlement on fast-growing beds situated in vulnerable areas, where the risk of loss is high, cockles from the previous year's settlement have been opened to the fishery in late summer as they become Year-1's and they have reached a size of approximately 12-13 mm width. In recent years, such fisheries have been opened at Friskney and the Gat, in areas vulnerable to winter storms, and on the Roger where a dense area of juvenile cockles were vulnerable to ridging out. Such fisheries are only considered, however, when there are high densities of juveniles elsewhere to safeguard the sustainability of the fishery. Unfortunately, for fishermen hoping for such an opportunity this year, these faster-growing sands have not benefitted from an appreciable settlement. Further, while last summer's recruitment settled in good densities on several of the beds, its distribution is not considered widespread, nor as seen in figure 12, particularly large. Considering the usual growth rates in the areas it has settled, it will be at least 2023 or possibly 2024 before the majority of this cohort is of fishable size. Due to the current low levels of stock on the intertidal beds, it is important that in the interim, this cohort is protected.

Consequences of fishing "down the age groups"

Prior to the high mortalities associated with "atypical" mortality that began in The Wash in 2008, fishermen tended to target cockles that had reached 14mm width and many had a preference for cockles that had attained 16mm width. Because "atypical" mortality tends to predominantly affect larger cockles, stocks of younger cockles have been targeted in recent years before they die. Initially, this meant fishermen changed from targeting predominantly 3-year old cockles to 2-year olds. Over the course of a few years, however, the thinning of 2-year old stocks has led to some fishermen starting to target even smaller 1-year old stocks. Originally, the absence of market demand for small cockles limited this behaviour but recently markets for small cockles have developed, providing a financial incentive for landing juvenile stocks. Although it has been recognised that cockle stocks have previously recovered from some very low stock levels, fishing juvenile stocks presents issues. Firstly, fishing cockles before they have spawned reduces the spawning potential of the population, potentially reducing the size of future settlements. Secondly, by thinning the stocks at increasingly younger ages/sizes, reduces the densities they would otherwise achieve the following year. This practice then creates a vicious cycle in which faced with reduced stock densities resulting from previous fisheries, fishermen resort to targeting even younger stocks. This situation has now reached the stage where some fishermen have questioned the potential for a late-summer fishery this year targeting last summer's settlement. As mentioned above, such

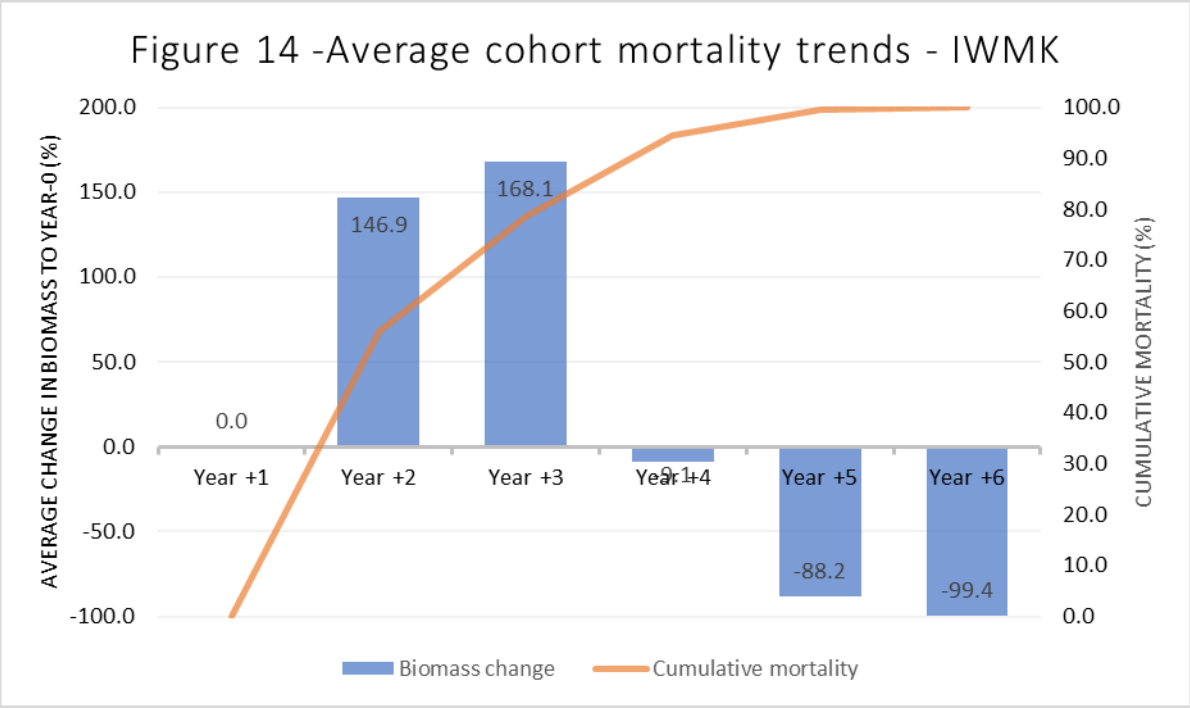
fisheries have occasionally been opened in the past, but only on beds considered vulnerable to imminent loss, and even then, only if there are significant densities of juveniles elsewhere to ensure sustainability. Fishing those juveniles this year would have a detrimental impact on the recovery of the fishery, reducing the potential densities of next year's Year-1 stocks and placing an even greater reliance on targeting Year-0 stocks in the future. Having a fishery dependant on targeting Year-0 juveniles would inevitably result in more fishery closures, either because there hadn't been a settlement, or because the overall biomass of the stock was no longer able to reach Conservation Objective targets. The reduced spawning stock could also result in smaller, more erratic settlements in the future. While the size of the stock biomass is heavily influenced by natural recruitment and mortality, the potential impacts on future recruitment from fishing juvenile stocks should not be underestimated.

Analysis was conducted of the survey data from 2003 onwards to look specifically at annual survival rates of each year-class cohort. In the graphs below, the orange lines show mortalities in terms of cockle numbers. These lines are invariably steep, reflecting the very high mortality rates encountered among small cockles. Unlike cockle numbers, however, which will always be highest before any losses are incurred, data plotting stock biomass follow a different pattern because individual cockles gain weight as they grow. In these graphs the blue columns show cockle biomass relative to their biomass at the time of their first survey following settlement. As such, any data above the 0.0 line means there is greater biomass than at the time of the first survey and anything below that line means the biomass is lower than that first survey. These graphs have been developed for each bed and several show a similar pattern to the one in figure 13, depicting the situation at Wrangle, in which the peak biomass for any particular cohort is distinctly 2 years after the settlement.

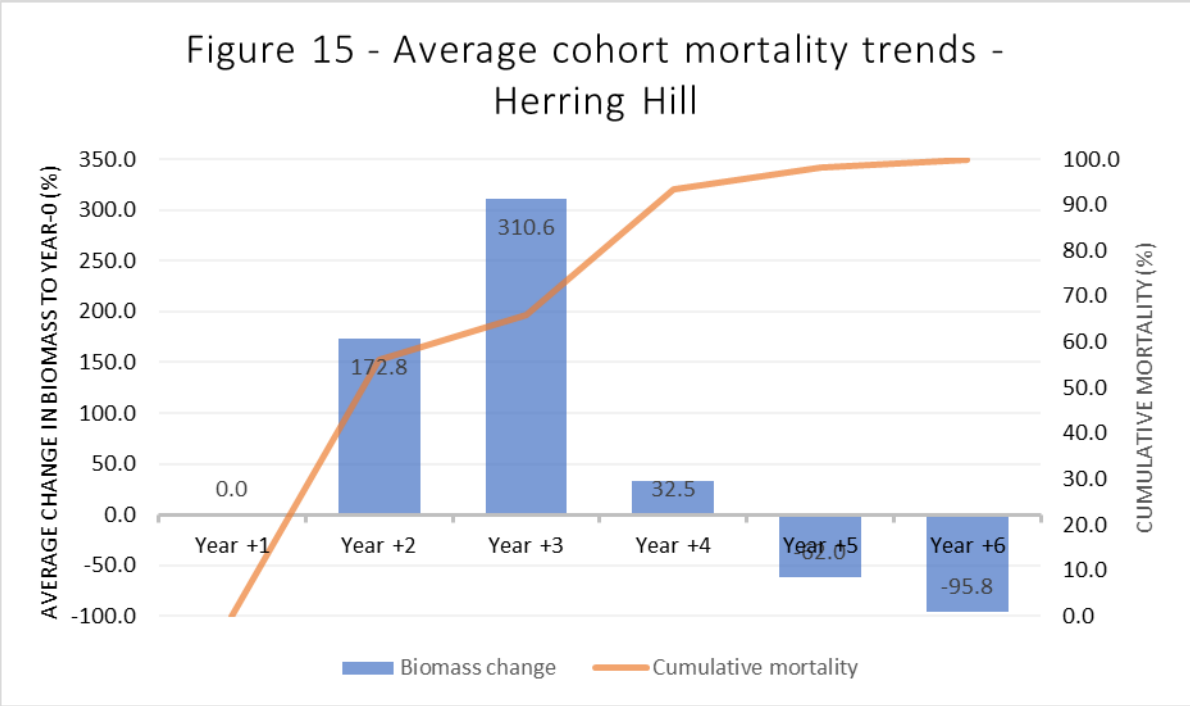


Other beds, including the Roger/Toft, the Gat and Holbeach have patterns similar to the graph for IWMK in figure 14, where the peak biomass is spread over the second

and third years. (Note - In the case of the Gat and Roger/Toft, this is likely to be due to those beds supporting discrete patches of faster growing and slower growing areas within the same bed).



On some of the higher elevated beds, such as Herring Hill, where cockle growth is slow, the peak biomass is distinctly in the third year as seen in figure 15.



What these graphs highlight is that by now fishing Year-1 cockles, those doing so are not only targeting cockles that could survive for another year, but they are also fishing them at a suboptimal biomass; effectively reducing the size and value of the

fishery. These data show that, ideally, the 2021 juveniles should not be targeted until 2023 on the faster-growing areas or until 2024 on the slower-growing areas.

Cockle stock sustainability targets

Since its introduction in 1998, the Total Allowable Catch (TAC) for the fishery has been calculated as a third of the adult cockle stock (cockles ≥14mm width). Based on the 8,226 tonnes of adult cockles present this year, this would produce a maximum TAC of 2,742 tonnes. However, the cockle fishery management plan details a number of minimum thresholds that the stocks must exceed before a fishery can be opened. These include maintaining a total cockle stock biomass above 11,000 tonnes and a minimum spawning stock biomass (cockles ≥14mm width) above 3,000 tonnes. As the current total stock is only 13,711 tonnes, a TAC of 2,742 tonnes would take the total stock below the 11,000 tonnes minimum threshold. Based on these figures, therefore, the TAC would need to be limited to 2,711 tonnes.

Conservation Objective targets

The Wash is an important site for over-wintering bird populations. When determining the TAC for the Wash cockle fishery, therefore, consideration must also be given to maintaining shellfish stocks above a minimum SSSI Conservation Objective target threshold required to support those overwintering populations. This is done using a "Bird Food Model" that was developed specifically for The Wash in 2004 and was reviewed last year. Because the overwintering birds prey on both cockles and mussels, the model considers both of these stocks in its calculations and uses the oystercatcher population as an indicator for the wider bird population. In its calculations, the model uses the following values:

- **Target number of oystercatchers overwintering in the site**.

Natural England provides advice on the target number of overwintering oystercatchers each year following bird surveys. The current advice is:

Restore the size of the non-breeding population at a level which is above 24,000 individuals, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.

This advice means the target is to support a minimum of 24,000 oystercatchers, but if their population exceeds that number, the target is to avoid deterioration from the current level. Based on a five-year mean, the current number of oystercatchers is 26,586, so that is the number used in the current calculations.

- **Shellfish stocks**.

The most current survey data from the regulated beds are used to inform the model of cockle and mussel stocks. In this case these are the 2021 autumn mussel surveys and the 2022 spring cockle surveys. Because oystercatchers only prey on shellfish above a certain size, the figures that are used from these surveys are:

  - Total biomass of cockles excluding Year-0 stocks = 10,027 tonnes

- Total biomass of mussels ≥25mm length =12,137 tonnes (after 80 tonne hand-worked relaying fishery)

- **Ash Free Dry Mass (AFDM)**

The model uses Ash Free Dry Mass for determining the food requirements of the birds.

- Bird mortality studies conducted by the British Trust for Ornithology (BTO) calculate the shellfish requirement of individual oystercatchers is 40kg AFDM.
- 1kg of live mussels = 0.058kg AFDM
- 1kg of live cockles = 0.030kg AFDM

2022 Bird Food Model Calculations

- Bird food AFDM requirement = 26,586 oystercatchers x 40kg = 1,063 tonnes AFDM
- Mussel AFDM contribution = 12,137 tonnes x 0.058 = 704 tonnes AFDM
- Cockle AFDM contribution = 10,027 tonnes x 0.030 = 301 tonnes AFDM
- Total shellfish AFDM = 704 tonnes + 301 tonnes = 1,005 tonnes AFDM

The above figures used by the model indicate the regulated cockle and mussel beds in The Wash do not support the number of birds estimated to be present in the site. Based on the number of oystercatchers and the biomass of mussels currently present, the cockles would need to contribute a minimum of 359 tonnes AFDM to meet the minimum threshold. This is equivalent to 11,967 tonnes live weight of cockles (excluding Year-0's). There is, therefore, currently a shortfall of 1,940 tonnes of cockles. As the current stocks do not meet the minimum Conservation Objective targets, a Habitats Regulations Assessment for a proposed fishery would have to conclude that the fishery was likely to cause a significant adverse effect to the site features. As such, **opening a cockle fishery this year would not be approved**. It should be noted, the stocks would have failed to achieve the target threshold, irrespective of whether the 80 tonnes hand-worked mussel fishery was opened or not.

Considering cockles in Le Strange Estate and/or the Several fishery for inclusion within the Bird Food Model

The Wash SSSI covers the whole of The Wash, not just the regulated cockle and mussel beds. Usually there are sufficient stocks within the regulated beds to operate the cockle and mussel fisheries without even needing to consider the additional stocks within the several fishery and the Le Strange Estate. As the birds do not recognise these anthropogenic boundaries when feeding, however, officers have raised the question with Natural England as to whether these stocks can be included in the bird food model when stocks within the regulated fishery alone are insufficient to meet the required targets.

There are a number of challenges with doing so. Foremost, officers are currently uncertain whether stocks from the several or Le Strange Estate fisheries were incorporated into informing the bird food model. If they weren't, and only regulated stocks were used to derive the 40kg AFDM food requirement, adding these additional stocks to the calculations now would artificially inflate the stock figures in the calculations. This would lead to an underestimation of what the birds actually require, for their food requirement would be 40kg AFDM plus whatever they usually derive from outside of the regulated beds. This question has been raised with the developer of the bird food model.

There are then additional concerns regarding the management of these additional stocks. To be effective in preventing large-scale bird mortalities, the management regime needs to ensure there are sufficient stocks remaining at the end of the fisheries to ensure there is sufficient food available over winter for the over-wintering bird populations. The regulations in place on the regulated beds are sufficient to manage those stocks within the bounds of natural fluctuations. The situation is different for the several fishery and Le Strange Estate fishery, however. As the stocks within those areas are privately owned, legally, there is nothing stopping the owners totally fishing them out. As such, there is a danger that if their stocks were used in the bird food model calculations to facilitate a fishery within the regulated fishery, subsequent removal of those stocks from the private fisheries could lead to high bird mortalities. This is something that needs to be avoided at all costs. The Wash is already a heavily designated site that comes under close scrutiny from conservation NGOs. Should the management of the regulated fishery result in high bird mortalities, as were seen in the late 1990s, the consequences for future fisheries could be severe.