RESEARCH REPORT

2016

WFO COCKLE STOCK ASSESSMENT

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WFO COCKLE SURVEY

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Introduction

The intertidal cockle stocks in the Wash provide an important resource for the local fishing industry, particularly to the ports of Boston and King's Lynn. Since 2000 cockle landings into these two ports have been worth an average first-sale value of over £1 million, peaking at £2.7 million in 2006. Traditionally this was an artisanal hand-worked fishery but modernization of the fleet and expansion of the markets into Europe have greatly changed the fishery over the past forty years. Innovations during that time have included techniques to improve the efficiency of hand-working, such as "blowing out" (whereby an anchored vessel is manoeuvred in concentric circles during the ebbing tide in order to wash cockles out of the ground into easy to harvest piles) and "prop washing" (a similar practice, but in which the vessel is not anchored). Technological changes include the evolution of larger, more efficient vessels into the fleet and the introduction of hydraulic suction dredges in 1986. The greater efficiency that these methods and technology have brought, however, has on occasions been detrimental to the stocks. When management measures have not been sufficient to control their immediate impacts, over-fishing has occurred, resulting in declining stocks and "boom and bust" fisheries.

In 1993 the Fishery Order 1992 was introduced to strengthen the management of the shellfisheries in the Wash, but cockle stocks remained low through most of the 1990s. In 1998 an annual Total Allowable Catch (TAC) quota for the cockle fishery was introduced to limit exploitation to sustainable levels. This, together with the subsequent evolution of other management measures, has helped to stabilise the fishery and facilitate a stock recovery through the 2000s. This period has also seen a growing environmental awareness introduced into the management of the fisheries, whereby the fisheries are not just limited to ensure their sustainability, but to protect designated environmental features. This has resulted in the need to submit detailed Habitat Regulations Assessments to Natural England before fisheries can be consented. To facilitate this process, a suite of Management Policies was developed in 2007 to help manage the fisheries in a way that would not have a detrimental impact on the site's Conservation Objective targets. Irrespective of the management measures used, there is little that can be done to control natural events. In 2007 the Wash cockle stocks reached their second highest recorded level, appearing to validate the management measures that had brought about the recovery of the fishery. Since 2008, however, the stocks have suffered unusually high mortality rates, undoing much of the progress that the management measures

had helped to achieve and making it difficult to identify patches of adult cockles dense enough to fish. Such challenges place even more onus on having accurate survey information so that flexible contingency measures can be used to exploit the stocks without hazarding their sustainability.

This report provides details of the 2016 spring cockle surveys. Although there is no Minimum Landing Size (MLS) applied to cockles in the Wash, the results presented in this report divide the stocks into two size groups (cockles that are 14mm width and over and those that are under 14mm width). These groups are sometimes referred to in the report and management measures as "adult" and "juvenile" stocks, but these definitions are not strictly accurate, cockle size being influenced by a number of factors in addition to age. These size categories do, nevertheless, play an important role in the management of the fisheries, as to protect juvenile stocks, no cockles under 14mm width, irrespective of age, currently contribute towards the annual TAC.

Method

The intertidal cockle surveys are preferably conducted during spring tide periods (>6.5m). These allow best access to the beds either using a boat at high water or when walking the beds at low water. During neap tides some of the higher sites are inaccessible to the research boat at high water, while the lower sites may not drain adequately at low water to be accessible on foot. Timing of the high water periods during neap tides is also problematic, in that the night time high water period is usually between midnight and 03:00hrs, usually resulting in the loss of one of the two high water sampling periods.

Samples are collected at regular intervals on a predetermined conventional grid, from which the same sample stations are replicated each year. The majority of the stations on this grid are 370m x 340m apart, with a slightly higher resolution grid of 280m x 340m being used on the Herring Hill, Holbeach, Mare Tail and Gat sands.

Samples are collected either at high water using a $0.1m^2$ Day grab deployed from the research vessel, *Three Counties,* or a $0.1m^2$ quadrat during low water foot surveys. Once collected, the samples are washed over a 3mm mesh washing table (or using a 0.5mm sieve in the case of foot surveys), allowing any cockles present in the sample to be separated from the surrounding sediment. During the washing process the following data are recorded on the survey summary sheet (see figure 1):

Station – Record the station number of the sample

Sed – Record the sediment number using the following criteria:
1 – Sand (clean sand)
2 – Silty Sand (mainly sand, but contains some finer material)
3 – Sandy Silt (mainly fine silt but contains some coarser sand grains)
4 – Silt (Fine silty mud, generally fairly sloppy to walk on)
5 – Clay with a thin top veneer of Sand (The clay sediments are more compact and solid than silt).
6 – Clay with a thin top veneer of Silt (The clay sediments are more compact and solid than silt).
7 – Clay (The clay sediments are more compact and solid than silt).
Cockle – Record the approximate number of cockles present in each sample

A1, A2 and A3 – These columns are used to record the number of *Arenicola* casts found in each of three quadrats taken at each station during foot surveys. As casts are disturbed in a Day grab sample and cannot be identified, these three columns are not filled in during Day grab surveys.

Lan – During foot surveys record how many of the three quadrats contain *Lanice* tubes. As only one Day grab sample is taken at each station the presence or absence of *Lanice* tubes is recorded as Y/N.

Mac – Record the number of *Macoma* present in the sample.

SAND							
DATE							
STATION	SED	COCKLE	A1	A2	A3	LAN	MAC
1							
2							
3							
4							
5							
6							
7							
etc							

Figure 1 - Example of the survey summary sheets used to record additional environmental data collected during cockle surveys

Once cleaned any cockles present in the sample are retained in labelled bags for later analysis (one bag/station). Samples are stored in a cool place out of the sun.

At low water the cockles in the retained samples are individually measured to the nearest millimetre by length and width. These cockles are separated into three groups:

1. Those of width equal or greater than 16mm
2. Those of width 14 to 15mm
3. Those smaller than 14mm width.

The cockles within each group are then further separated into age classes using their annual growth rings to age them (taking care to identify whether outer ring

is the current or previous year's growth). The number of cockles in each age-size group is recorded and the total weight of cockles in each group measured to the nearest 0.01g. Due to the sensitivity of the scales used (200g/0.01g), the weighing of these samples can only take place ashore or once the vessel is aground.

The data acquired from these surveys are recorded in a bespoke Access database. These are later transferred to a MapInfo GIS database from which charts of the beds showing cockle densities can be interpolated. The minimum density used to determine the extent of the coverage on the bed is 10 cockles/m^2. The biomass of cockles on the bed is calculated by multiplying the mean weight of the samples to attain a weight per hectare, and applying this figure to the area of coverage. The biomass of fishable stock is determined by using the mean weight of those individuals having reached a width of 14mm or greater.

The additional environmental data collected during the surveys is also transferred to a MapInfo GIS database. This data is used to create models showing the distribution of *Lanice conchilega* and *Macoma balthica* using Vertical mapper software with a Nearest Neighbour interpolation methodology.

Results

The annual spring cockle surveys were conducted between March 21st and April 26th. During the course of the surveys, 1,297 stations from a total of 21 sands were sampled. Figure 2 shows the coverage of these stations.

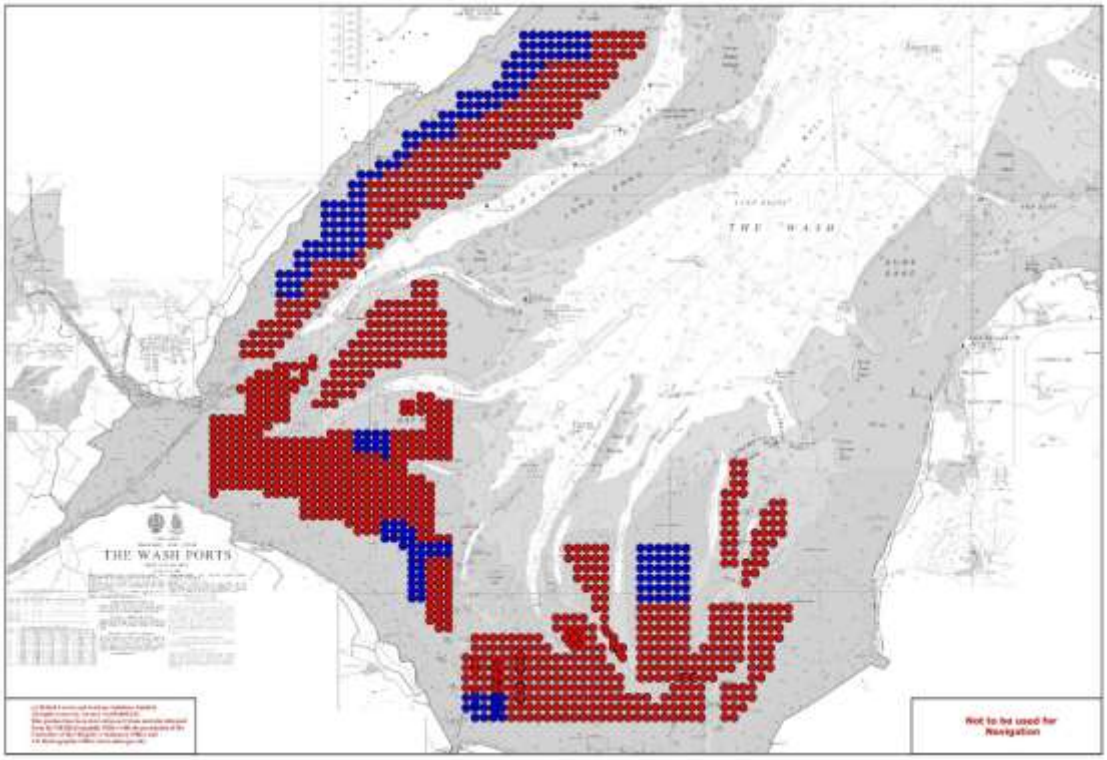


Figure 2 – Chart showing the positions of the stations sampled during the 2016 spring cockle survey (Red stations sampled using Day grab, blue stations sampled on foot with quadrat).

Table 1 provides a summary of the cockle stocks identified during the surveys, while figures 3 to 8 show the distributions of adult and juvenile stocks on the beds. Figures 9 to 23 show the cockle size frequencies and age frequencies of the cockles sampled from each bed.

Table 1 - Summary of cockle stocks on the Wash intertidal beds - April 2016

	ADULT				JUVENILES					
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**	**%Adult**
Butterwick	190	55.00	2.19	417	239	391.67	4.85	1156	1573.00	27
Wrangle	884	133.12	6.35	5616	256	44.48	1.00	257	5873.00	96
Friskney	637	101.17	6.68	4254	11	10.00	0.29	3	4257.00	100
Butterwick Ext	193	30.00	1.15	222	322	314.74	3.95	1268	1490.00	15
Wrangle Ext	237	13.00	0.59	140	144	31.67	0.48	68	208.00	67
Friskney Ext	487	31.32	1.84	895	11	10.00	0.32	4	899.00	100
Boston Main Total	2628			11544	981.6			2756	14300	81
Roger/Toft	519	136.74	6.67	3464	383	1062.00	19.53	7482	10946	32
Gat	75	345.00	15.75	1178	18	130.00	3.62	63	1241	95
Longsand									0	
Herring Hill	232	40.00	1.35	313	339	287.50	2.75	934	1247	25
Black Buoy	141	49.33	2.00	282	140	493.33	6.76	948	1230	23
Mare Tail	387	95.25	3.88	1502	338	602.94	7.85	2650	4152	36
Holbeach	608	49.84	1.95	1186	860	315.11	4.91	4220	5406	22
IWMK	182	40.77	1.60	292	320	550.42	6.37	2037	2329	13
Breast	802	49.30	1.91	1535	952	317.36	3.17	3016	4551	34
IWMK/Breast Total	984			1827	1271.6			5053	6880	27
Thief	210	392.11	15.80	3311	185	686.47	17.60	3247	6558	50
Whiting Shoal	11	20.00	1.21	13	0	0.00	0.00	0	13	100
Daseley's	539	48.20	2.02	1089	545	220.00	3.90	2126	3215	34
Styleman's	35	20.00	1.05	36	0	0.00	0.00	0	36	100
Pandora	75	14.00	0.57	43	82	15.00	0.12	10	53	81
Blackguard	0	0.00	0.00	0	0	0.00	0.00	0	0	
Peter Black	55	14.00	0.71	38	101	88.18	0.34	34	72	53
TOTAL	**6498**			**25826**	**5242**			**29523**	**55349**	47

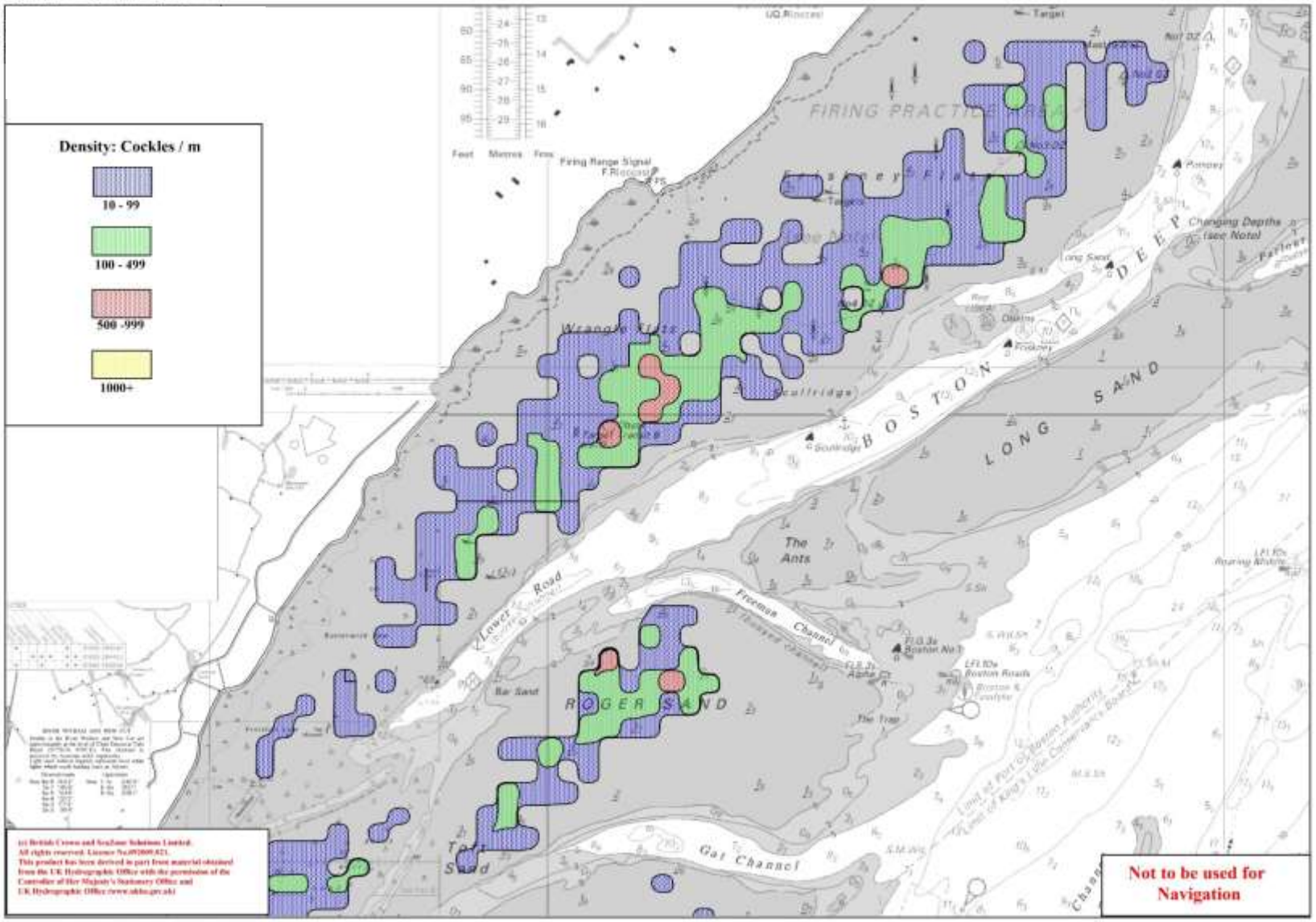


Figure 3 – Chart showing the stocks of cockles ≥14mm width on the Butterwick, Wrangle, Friskney and Roger/Toft sands

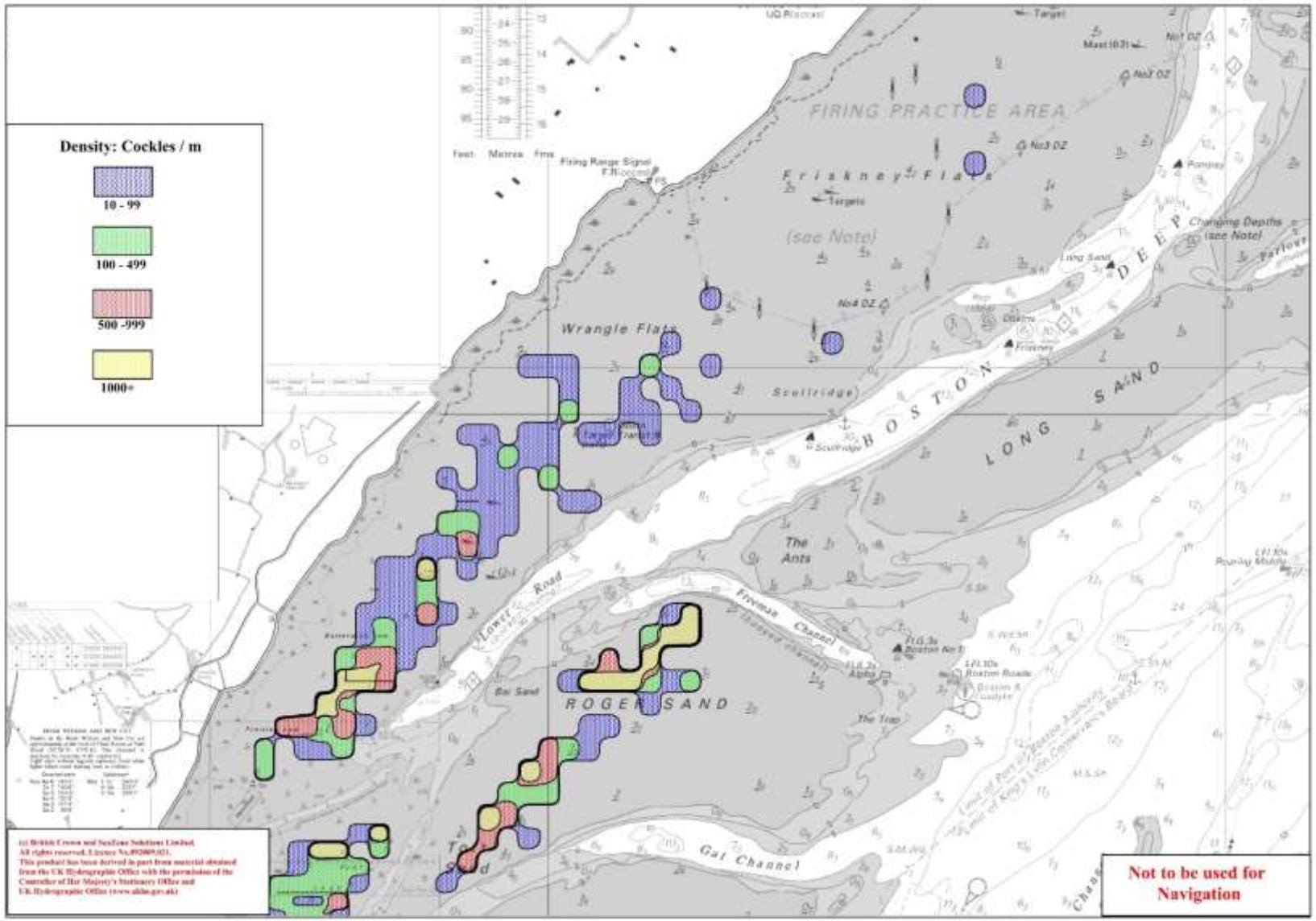


Figure 4 – Chart showing the stocks of cockles <14mm width on the Butterwick, Wrangle, Friskney and Roger/Toft sands

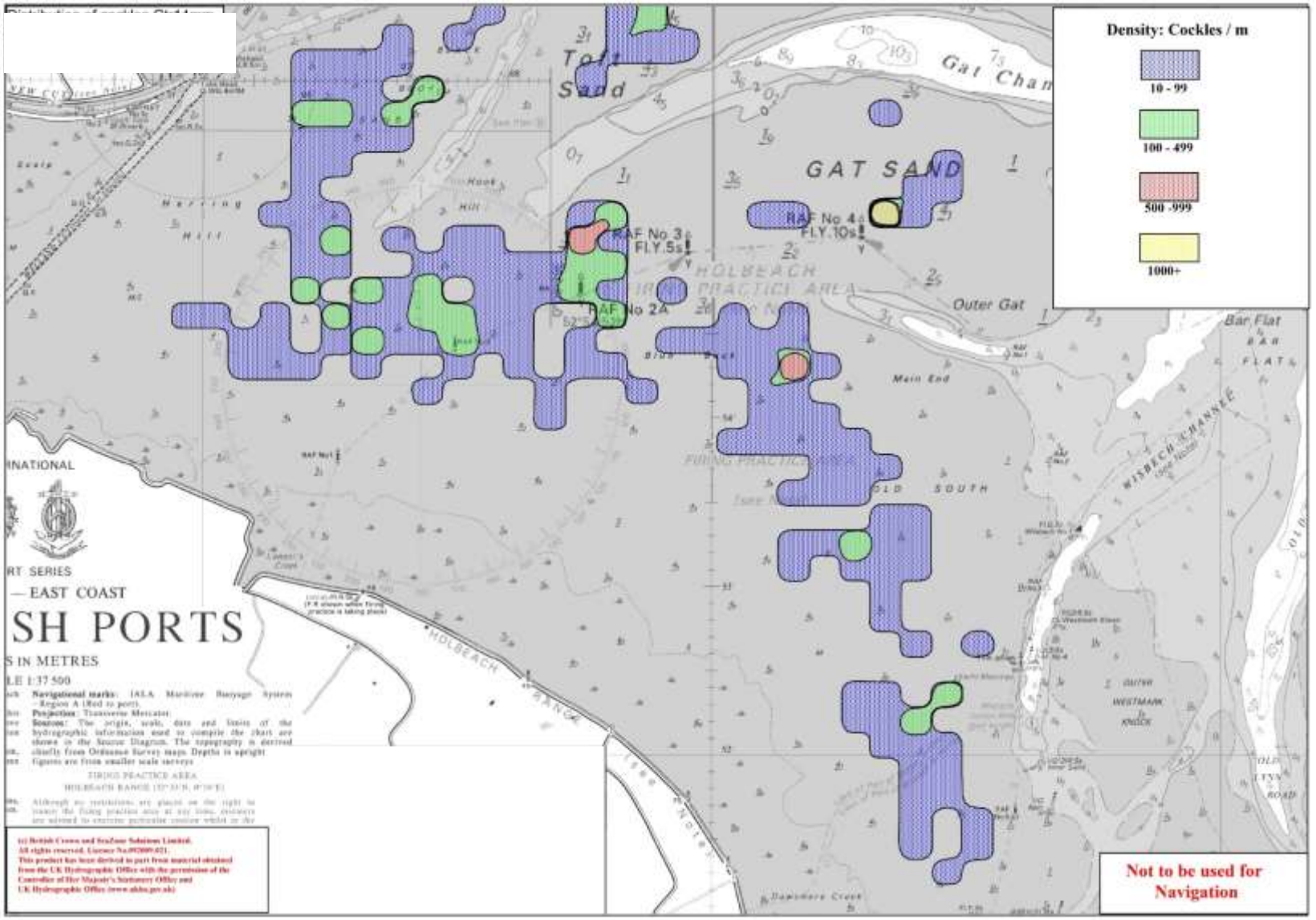


Figure 5 – Chart showing the stocks of cockles ≥14mm width on the Black Buoy, Dills, Herring Hill, Mare Tail, Gat and Holbeach sands

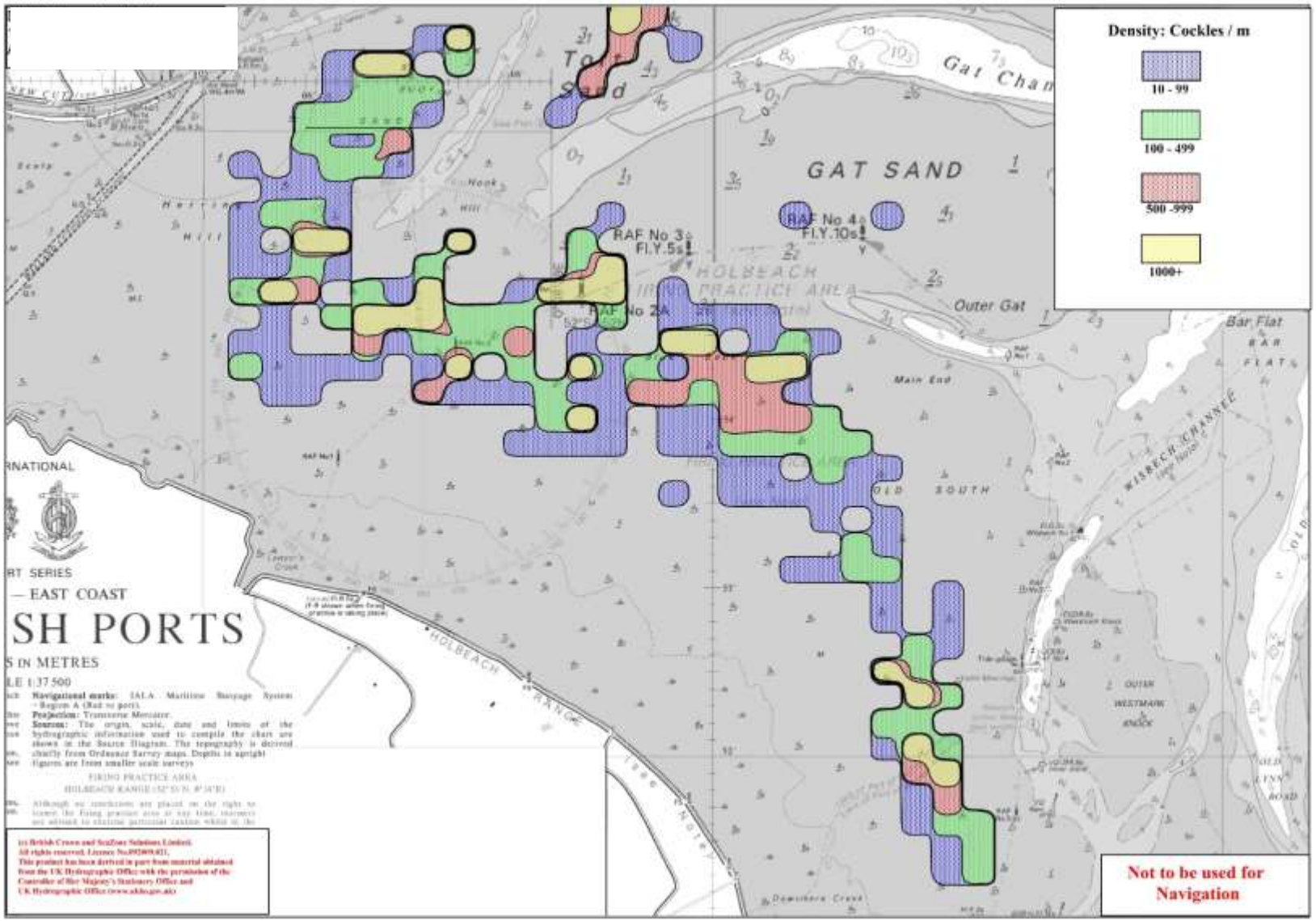


Figure 6 – Chart showing the Stocks of cockles <14mm width on the Black Buoy, Dills, Herring Hill, Mare Tail, Gat and Holbeach sands

Figure 7 – Chart showing the stocks of cockles ≥14mm width on the IWMK, Breast, Thief, Daseley's, Pandora and Peter Black sands

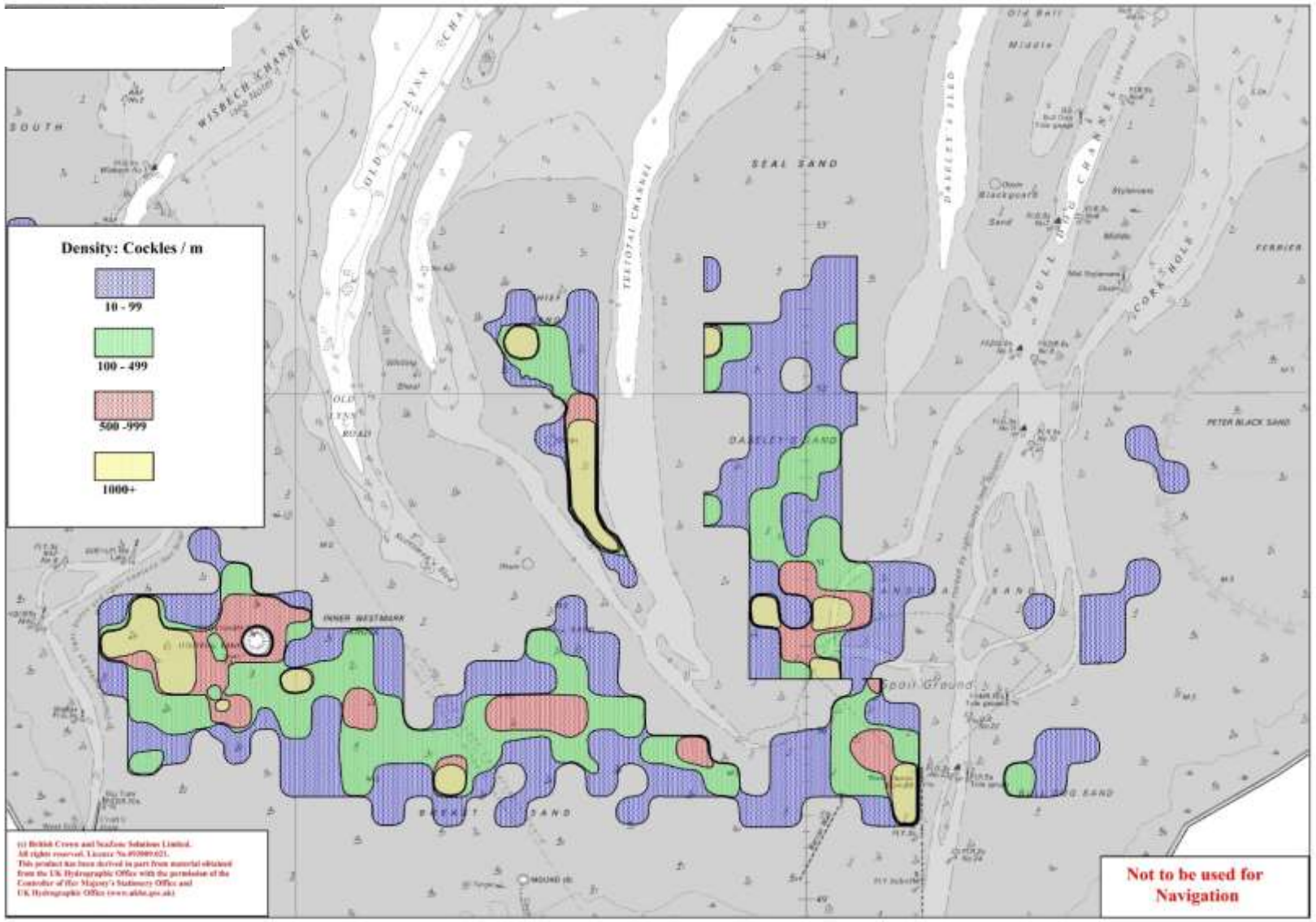


Figure 8 – Chart showing the stocks of cockles <14mm width on the IWMK, Breast, Thief, Daseley's, Pandora and Peter Black sands

Figure 9. Cockle Size Frequency. Butterwick. April 2016

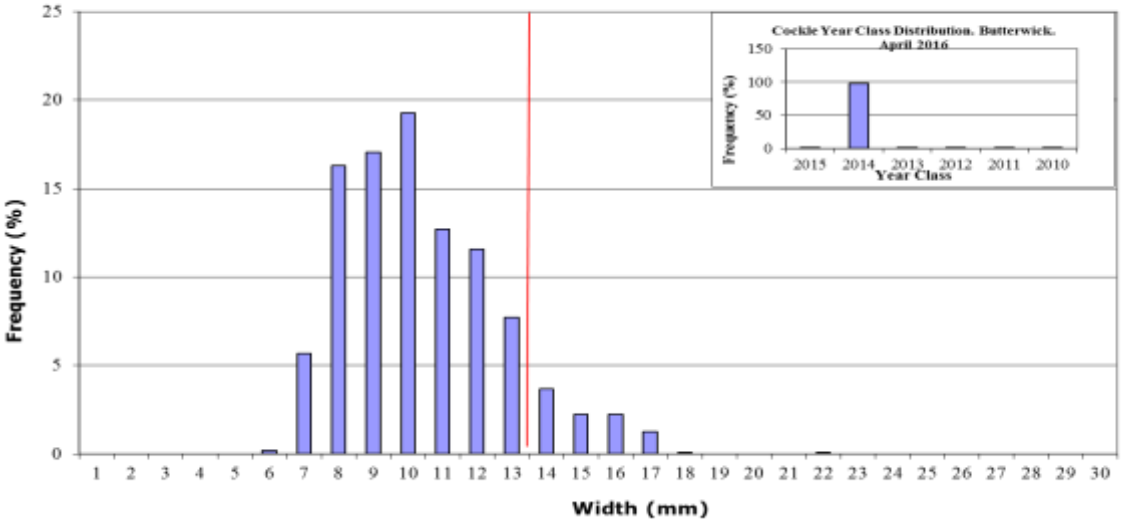


Figure 10. Cockle Size Distribution. Wrangle. April 2016

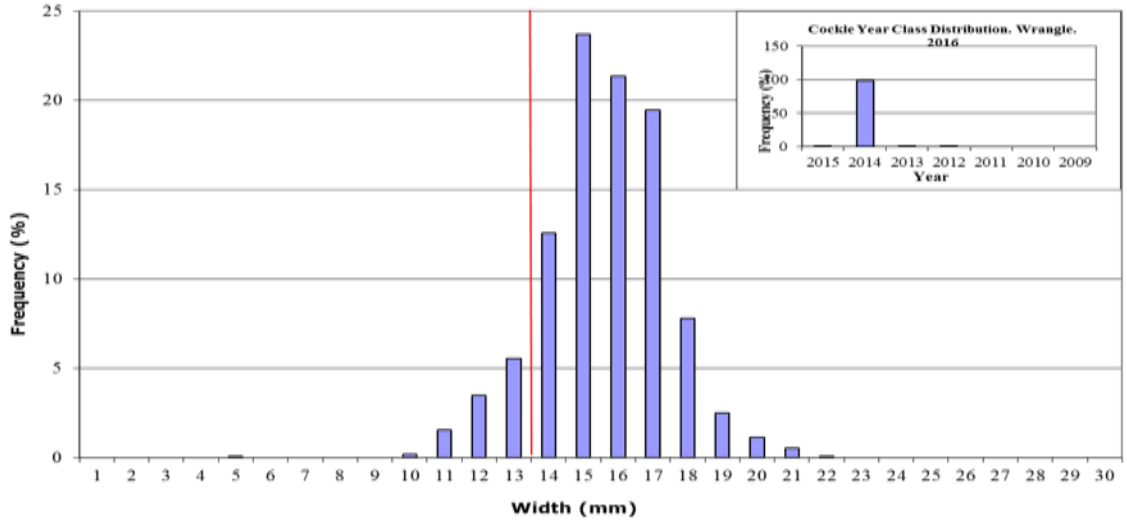


Figure 11. Cockle Size Frequency. Friskney. April 2016

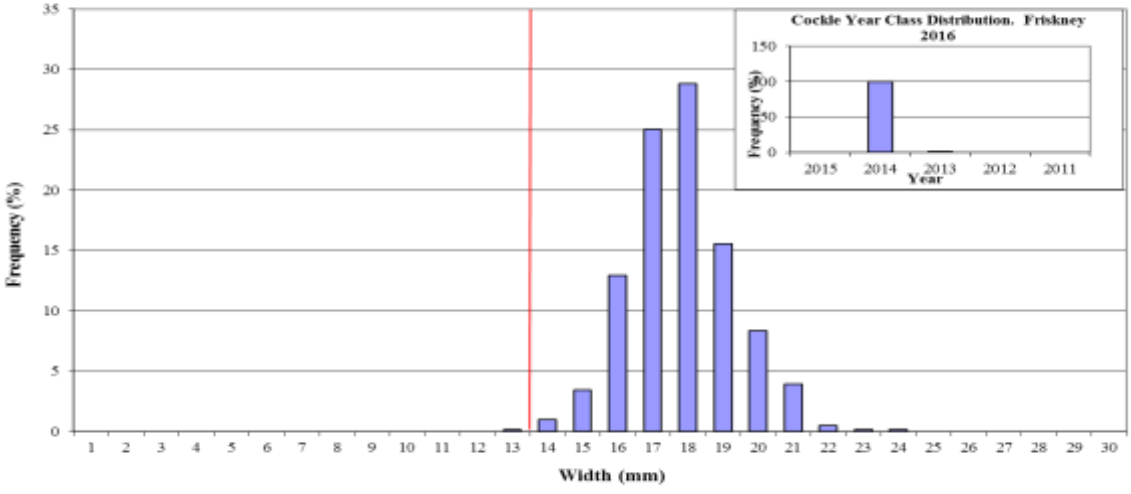


Figure 12. Cockle Size Distribution. Roger/Toft. April 2016

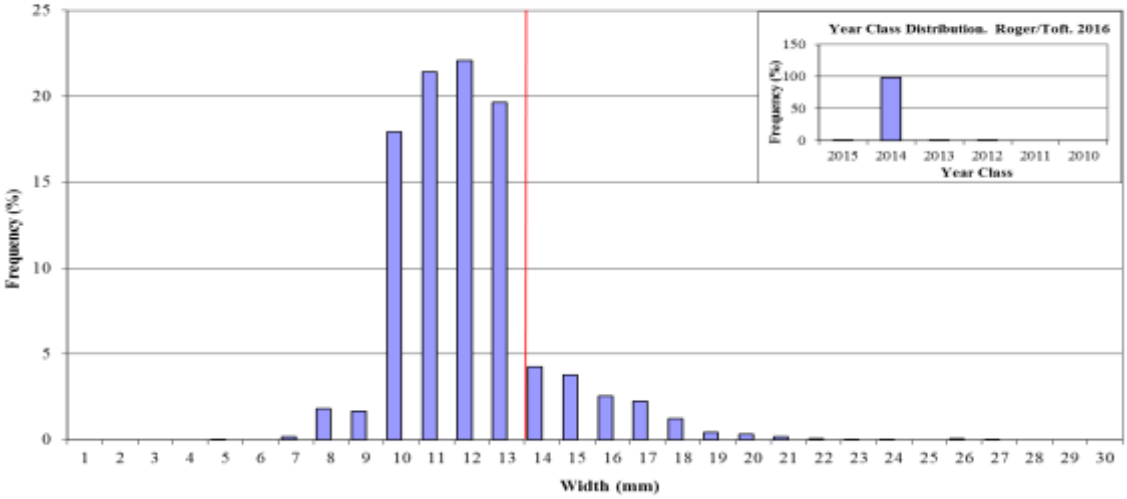


Figure 13. Cockle Size Frequency. Gat Sand. April 2016

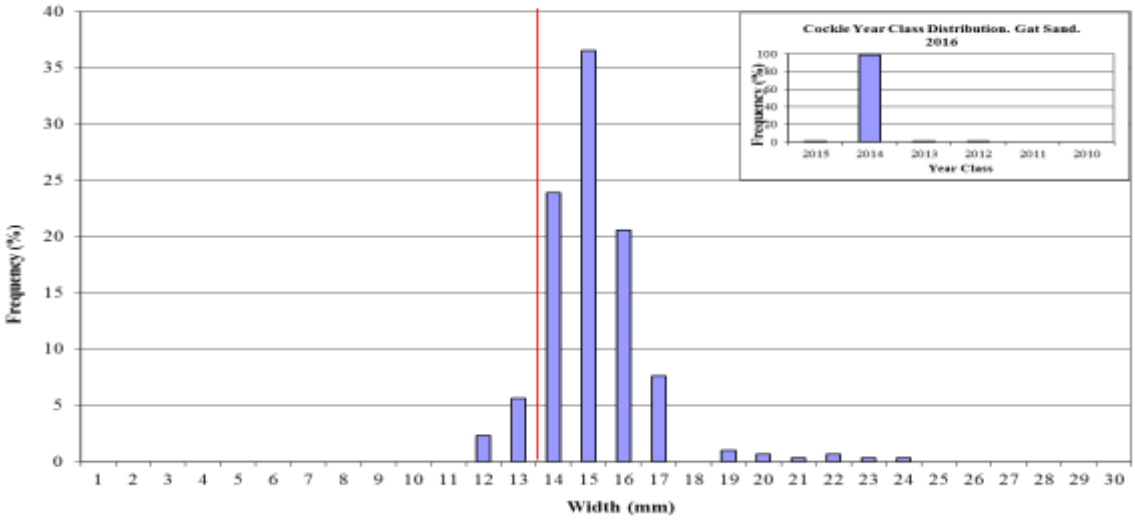


Figure 14. Cockle Size Frequency. Black Buoy. April 2016

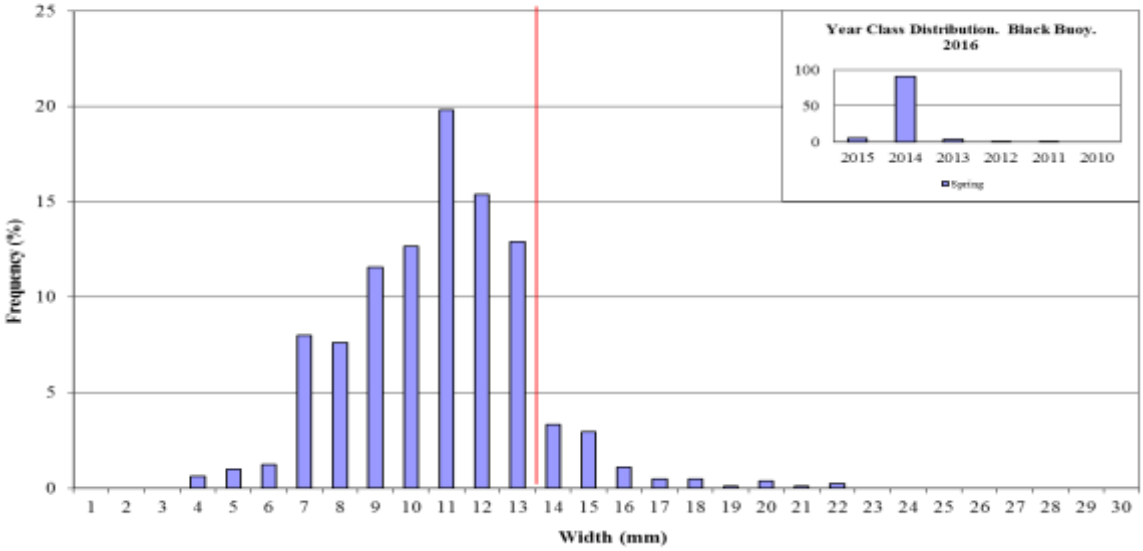


Figure 15. Cockle Size Frequency. Herring Hill. April 2016

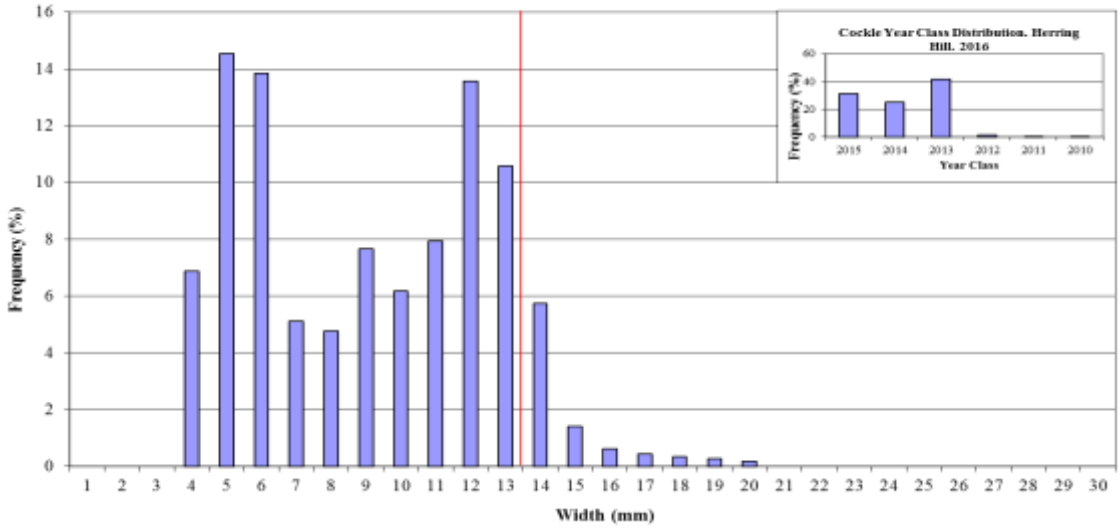


Figure 16. Cockle Size Frequency. Mare Tail. April 2016

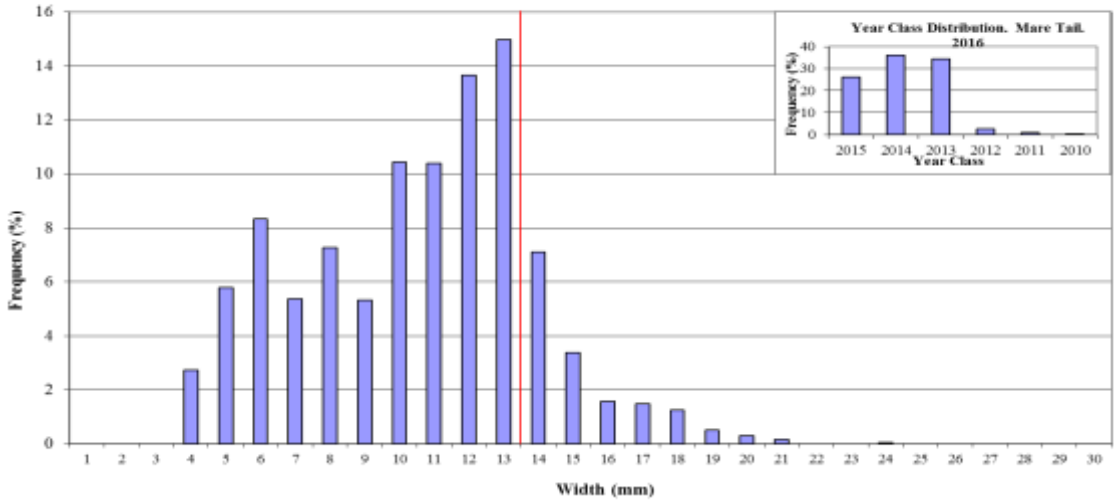


Figure 17. Cockle Size Frequency. Holbeach. April 2016

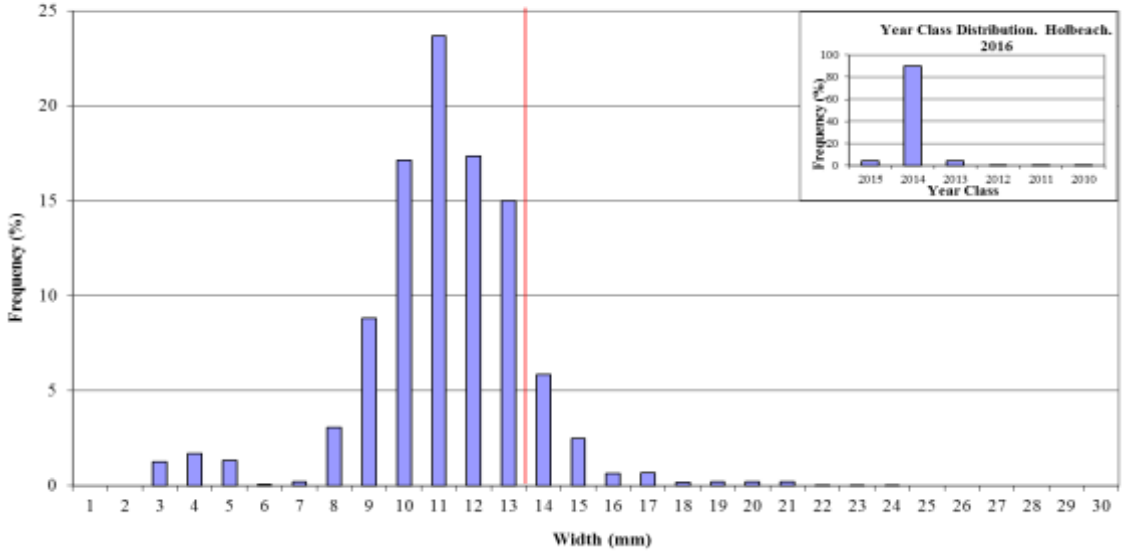


Figure 18. Cockle Size Frequency. Breast Sand. April 2016

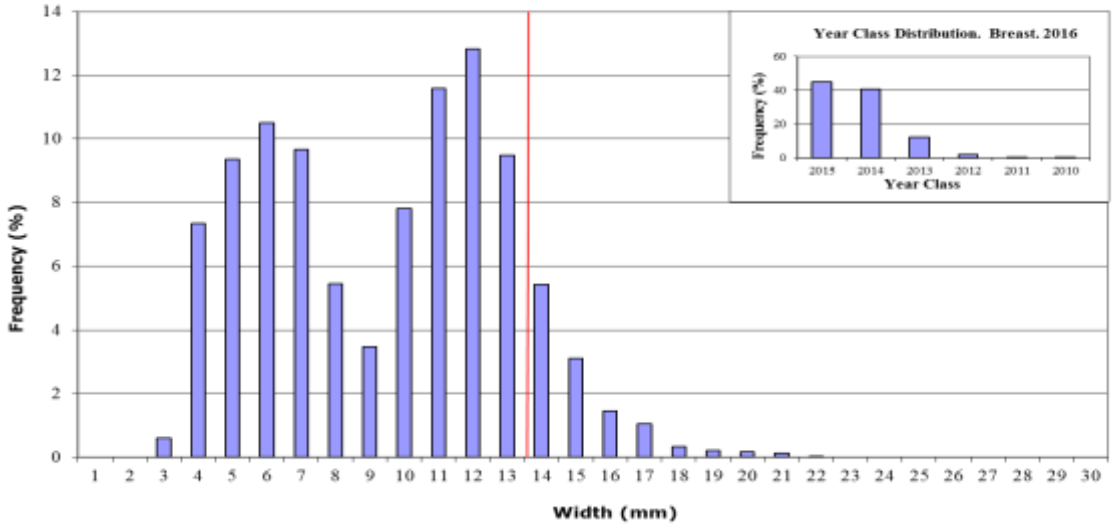


Figure 19. Cockle Size Frequency. IWMK. April 2016

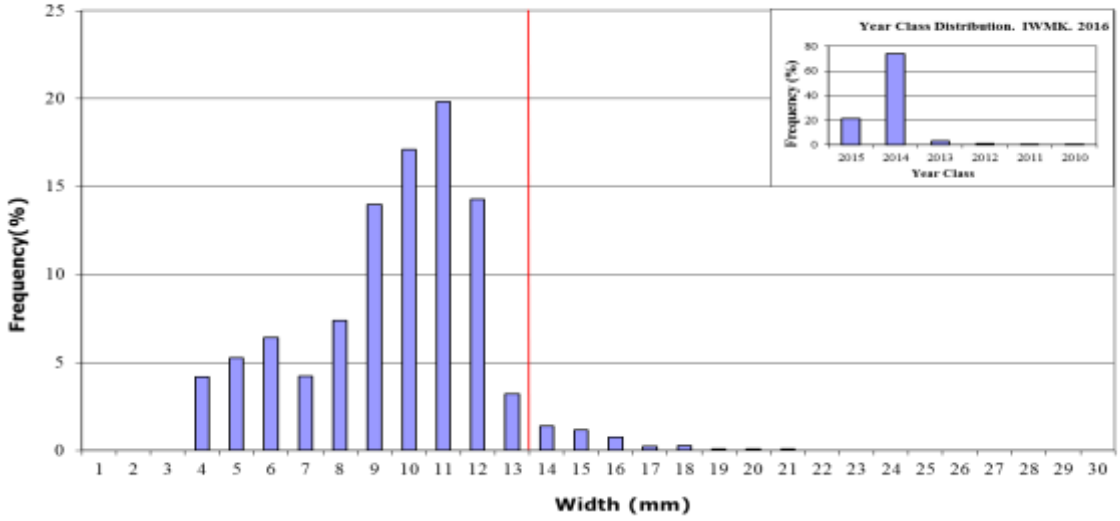


Figure 20. Cockle Size Frequency. Daseley's. April 2016

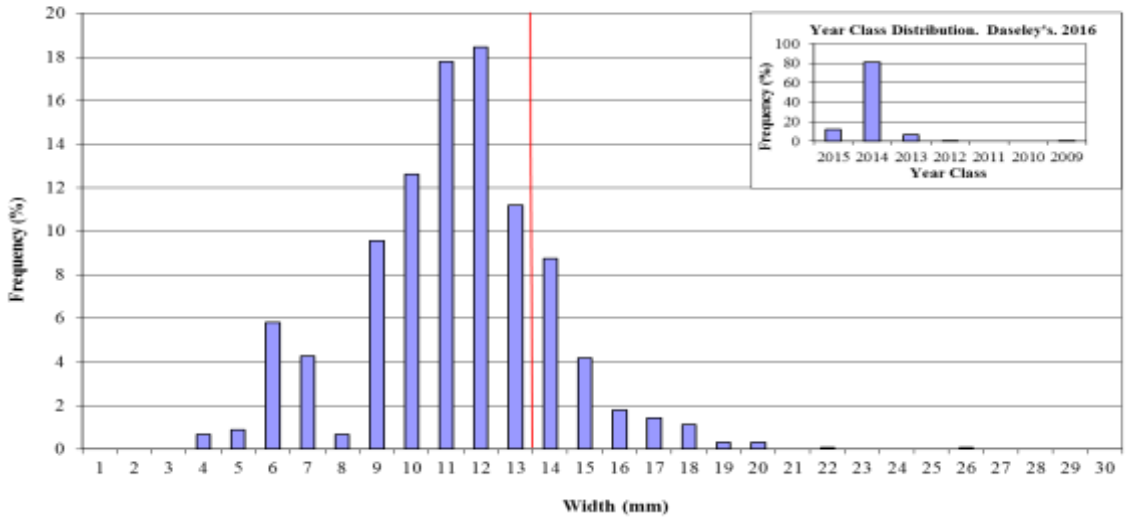


Figure 21. Cockle Size Frequency. Styleman's. April 2016

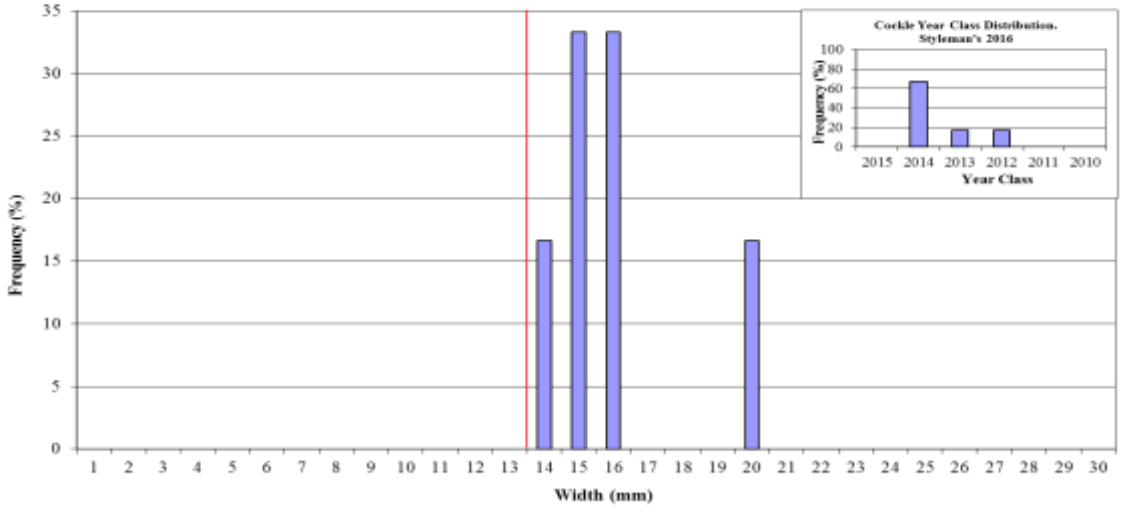


Figure 22. Cockle Size Distribution. Peter Black. April 2016

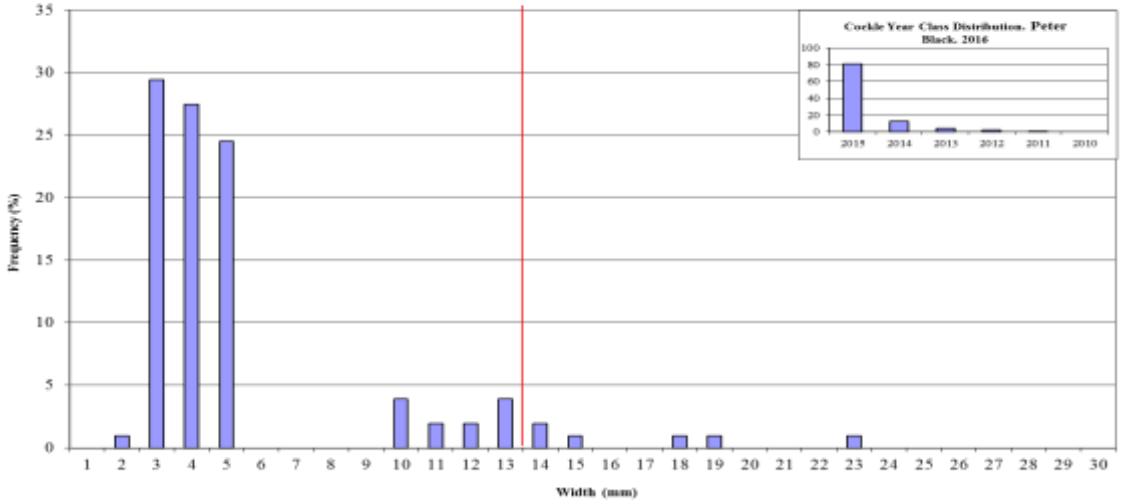
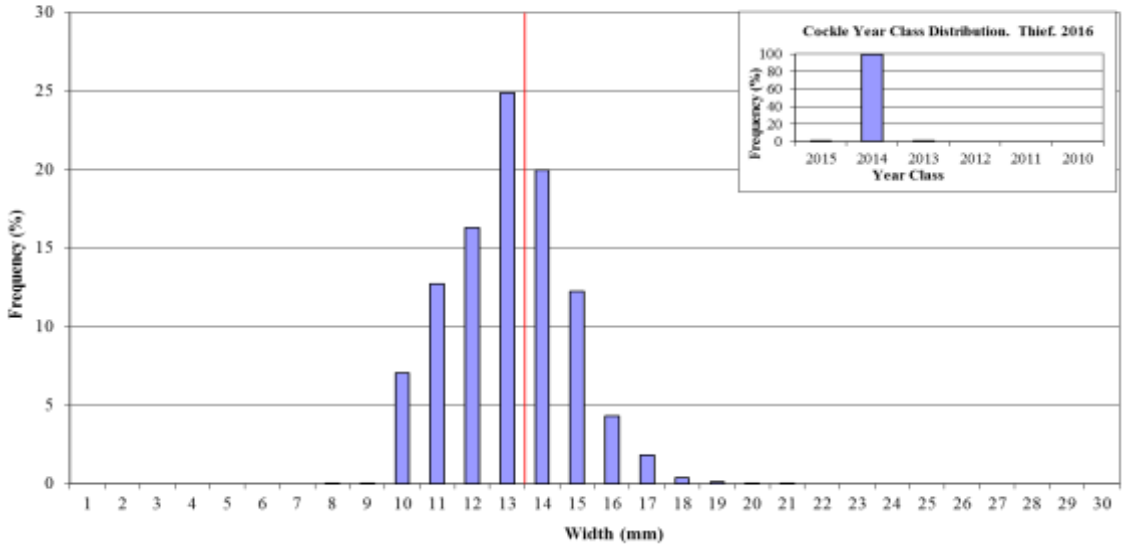


Figure 23. Cockle Size Frequency. Thief. April 2016



Discussion

The previous year's survey found there had been an exceptionally good settlement of cockle spat on the inter-tidal beds during 2014. The 2016 survey found this had survived and had grown well. Table 1 shows the cockle stocks at the time of the 2016 surveys:

Total Adult Stock (≥14mm width) 25,826 tonnes
Total Juvenile Stock (<14mm width) 29,523 tonnes
Total Stock (all sizes) 55, 349 tonnes

These figures are amongst the highest recorded for cockle stocks in the Wash. The total stock of 55,349 tonnes is second only to the estimated 60,000+ tonnes seen in 1967, and the adult stock of 25,826 tonnes is the highest since 2001. Anecdotally, stocks were also higher in the 1970s but surveys were not regularly conducted during that period. Figure 26 shows the stock levels present on the beds since 2000.

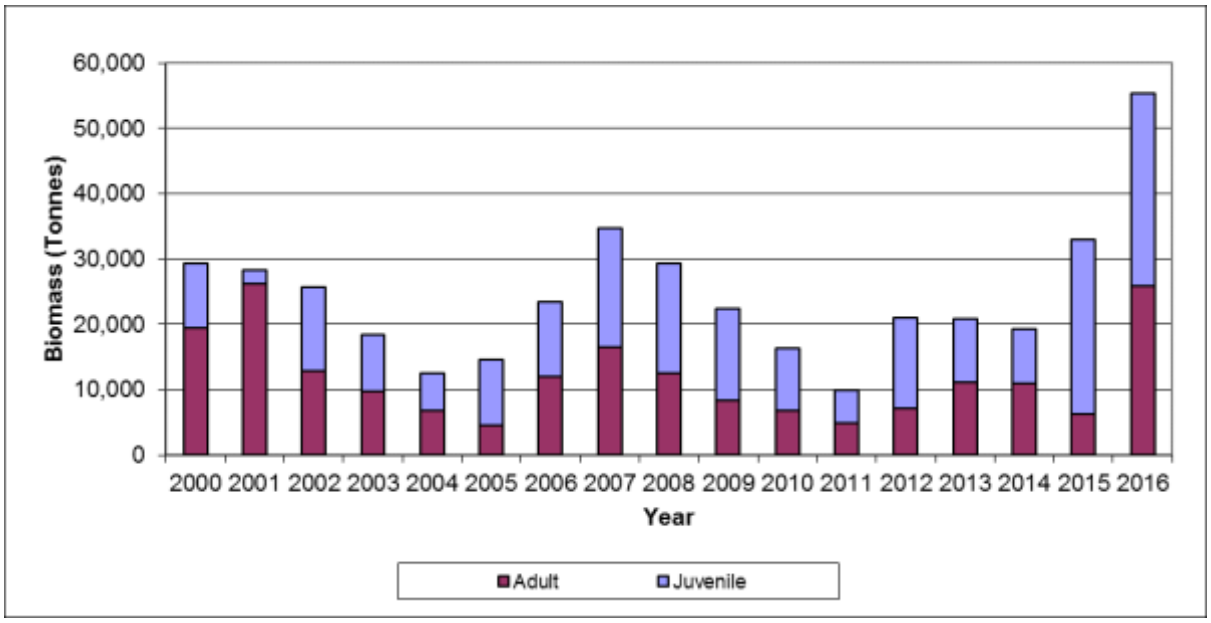


Figure 24 – Biomass of cockles on the WFO regulated beds between 2000 and 2016

Analysis of the data, in conjunction with figures 9 to 23 show, that barring a light settlement of spat of 800 tonnes and light densities of 2013 year-class and older cockles, the majority of the stock is from the 2014 year-class cohort. On the faster growing beds like Wrangle, Friskney, Roger, Gat and Thief a high proportion were found to have reached 14mm width and contributed towards the TAC. Between them, these five beds supported 18,858 tonnes (73%) of the "adult" stocks. On the slower growing beds, the majority of

the cockles had not reached 14mm width at the time of the survey but were expected to contribute towards the 2017 fishery.

The stocks found on the Roger/Toft sand were of particular interest. At the time of the 2015 survey this sand had supported an estimated 4,773 tonnes of mainly small cockles. These had experienced exceptional growth during the summer of 2015 and appeared vulnerable to "ridging out". Rather than lose them, this area was opened to the fishery and ring-fenced from the TAC, allowing a large fishery to take place during which approximately 4,000 tonnes were harvested. Growth was found to have more than compensated for these losses, though, resulting in a stock of 10,946 tonnes this year.

With an abundance of cockles to fish for and a high TAC of 8,609 tonnes, the prospects for the 2016 fishery were good. Analysis of the data and past trends, however, predicted some problems were likely to be encountered. On the Thief sand, where stocks exceeded an average of 33 tonnes per hectare, widespread "ridging out" was expected to occur as the cockles grew. Elsewhere, on sands were the cockles had grown faster and were already 14mm width, atypical mortality was anticipated to kill a high proportion of the stocks. Significant mortalities were expected to occur on the Wrangle, Friskney, Roger, Gat and Thief sands. As a lot of these mortalities were expected to occur over the summer, potentially before there had been an opportunity to harvest them, management measures were implemented that would minimise these losses. These were aimed at targeting the fishery onto the beds where the die-offs were anticipated to be the highest and increasing the daily vessel quota from 2 tonnes to 3 tonnes, to enable faster harvesting. Initially there was resistance from the industry, particularly regarding the increase in daily quota, but contrary to initial concerns, most vessels managed to achieve the higher quota throughout the season. This enabled the TAC to be achieved by the end of October, and prevented high levels of ridging-out from occurring on the Thief and Roger/Toft sands. One unfortunate consequence of increasing the daily quota, however, was that the majority of the vessels stopped fishing on the Wrangle and Friskney beds. Although the cockles were generally larger on these beds than elsewhere, their average densities were lower making it more difficult to achieve the higher daily quota. It will not be apparent until the 2017 surveys how many of these were lost to atypical mortality.