Eastern IFCA
Inshore Fisheries and Conservation Authority

RESEARCH REPORT 2014

WFO COCKLE STOCK ASSESSMENT

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WFO COCKLE SURVEY

CONTENTS

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 were 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 2014 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 surveys were conducted between March 29th and April 29th. This is consistent with the majority of EIFCA's and ESFJC's previous spring cockle surveys. Although this timing is not ideal, as cockles can grow rapidly once the water begins to warm in spring, it is necessary in order to allow sufficient time for the data to be analysed and a Habitat Regulations Assessment to be conducted ready for a mid-June opening.

During the course of the surveys, 1,282 stations from a total of 21 sands were sampled. Figure 2 shows the coverage of these stations.

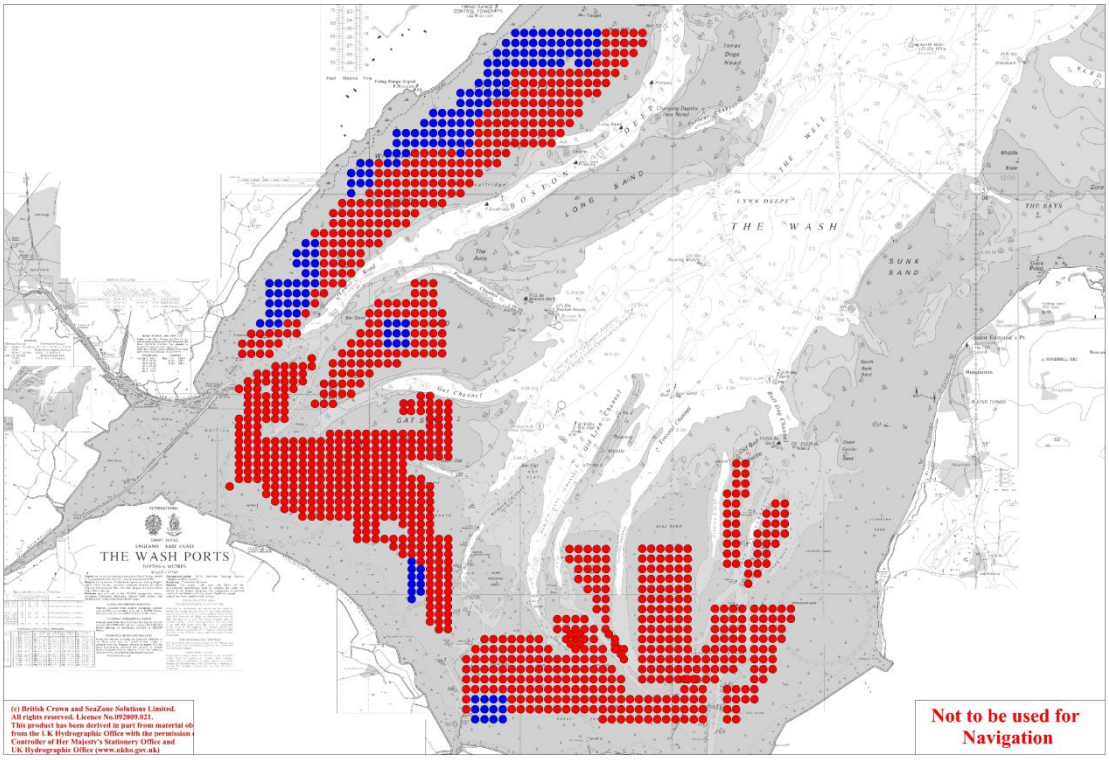


Figure 2 – Chart showing the positions of the stations sampled during the 2014 spring cockle survey (Red stations sampled using Day grab, blue stations sampled on foot with quadrat).

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 21 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

	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	126	41.33	2.06	260	119	68.75	0.55	65	325	80
Wrangle	235	12.73	1.04	243	123	13.08	0.12	14	257	95
Friskney	72	11.25	1.11	79	43	14.00	0.18	8	87	91
Butterwick Ext	162	27.27	1.12	182	217	92.94	0.60	131	313	58
Wrangle Ext	107	10.00	0.37	40	132	41.43	0.33	43	83	48
Friskney Ext	121	10.80	0.63	76	84	10.00	0.13	11	87	87
Boston Main Total	823			880	718			272	1152	76
Roger/Toft	208	40.53	2.98	621	84	978.57	3.26	275	896	69
Gat	73	35.00	1.79	130	36	30.00	0.76	27	157	83
Longsand									0	
Herring Hill	167	57.78	2.35	392	285	194.19	0.93	264	656	60
Black Buoy	163	81.17	3.34	546	168	406.47	4.24	712	1258	43
Mare Tail	309	104.41	4.60	1418	374	517.25	7.50	2801	4219	34
Holbeach	755	67.59	3.10	2341	435	136.79	2.12	922	3263	72
IWMK	300	91.67	4.03	1210	258	328.57	2.55	657	1867	65
Breast	730	63.49	2.90	2114	662	415.30	2.07	1368	3482	61
IWMK/Breast Total	1030			3324	920			2025	5349	62
Thief	9	20.00	2.40	22	0	0.00	0.00	0	22	100
Whiting Shoal	0	0.00	0.00	0	7	10.00	0.02	0	0	0
Daseley's	470	44.89	2.06	967	484	402.87	1.61	778	1745	55
Styleman's	0	0.00	0.00	0	0	0.00	0.00	0	0	0
Pandora	76	98.33	4.68	355	46	1703.00	4.62	212	567	63
Blackguard	0	0.00	0.00	0	0	0.00	0.00	0	0	0
Peter Black	149	23.08	1.09	13	117	23.00	0.19	22	35	37
TOTAL	**4232**			**11009**	**3674**			**8310**	**19319**	**57**
TAC @ 33.3% of Adult	**3670**									

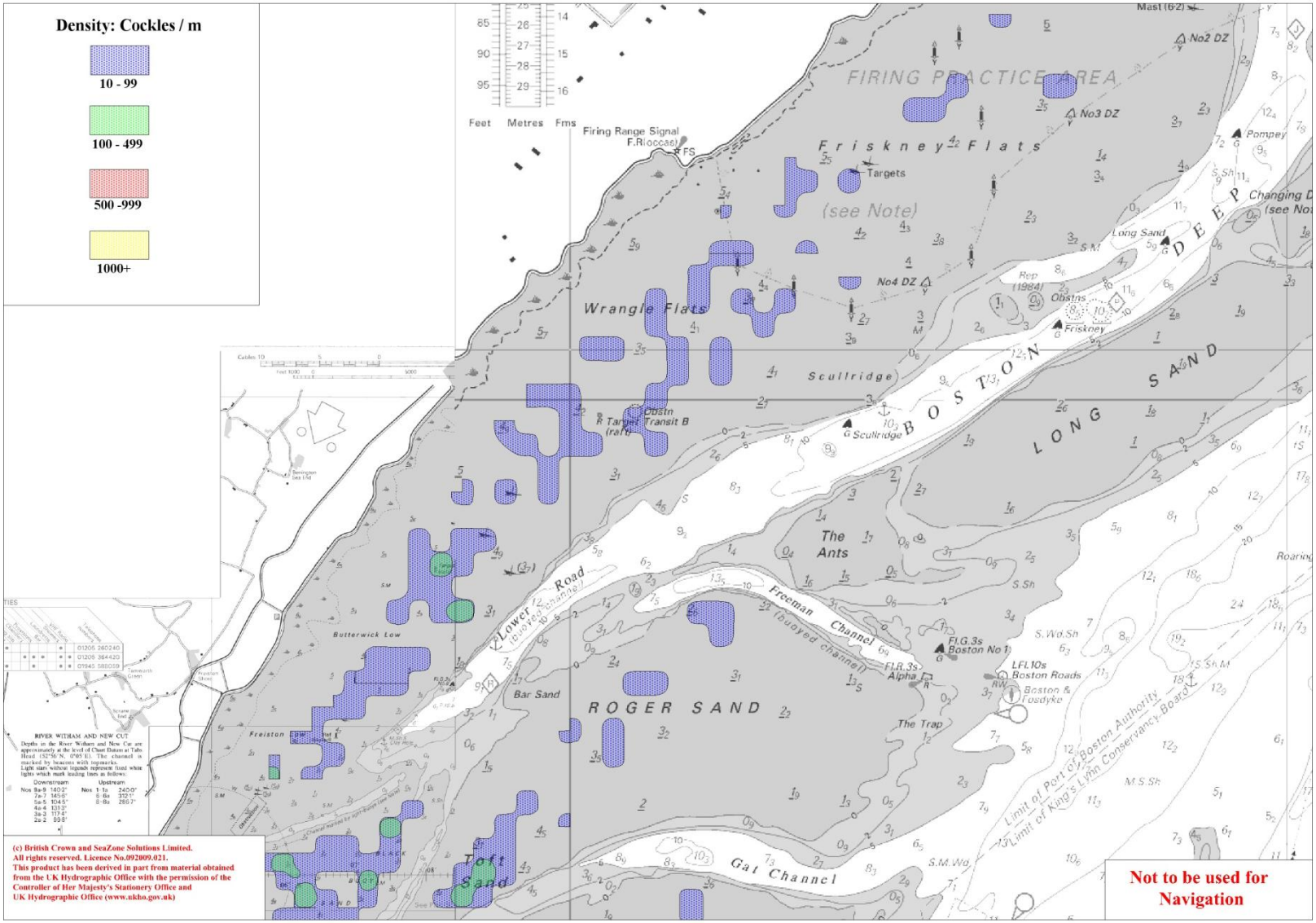


Figure 3 – Chart showing the stocks of cockles ≥14mm width on the Butterwick, Wrangle, Friskney and Roger/Toft sands

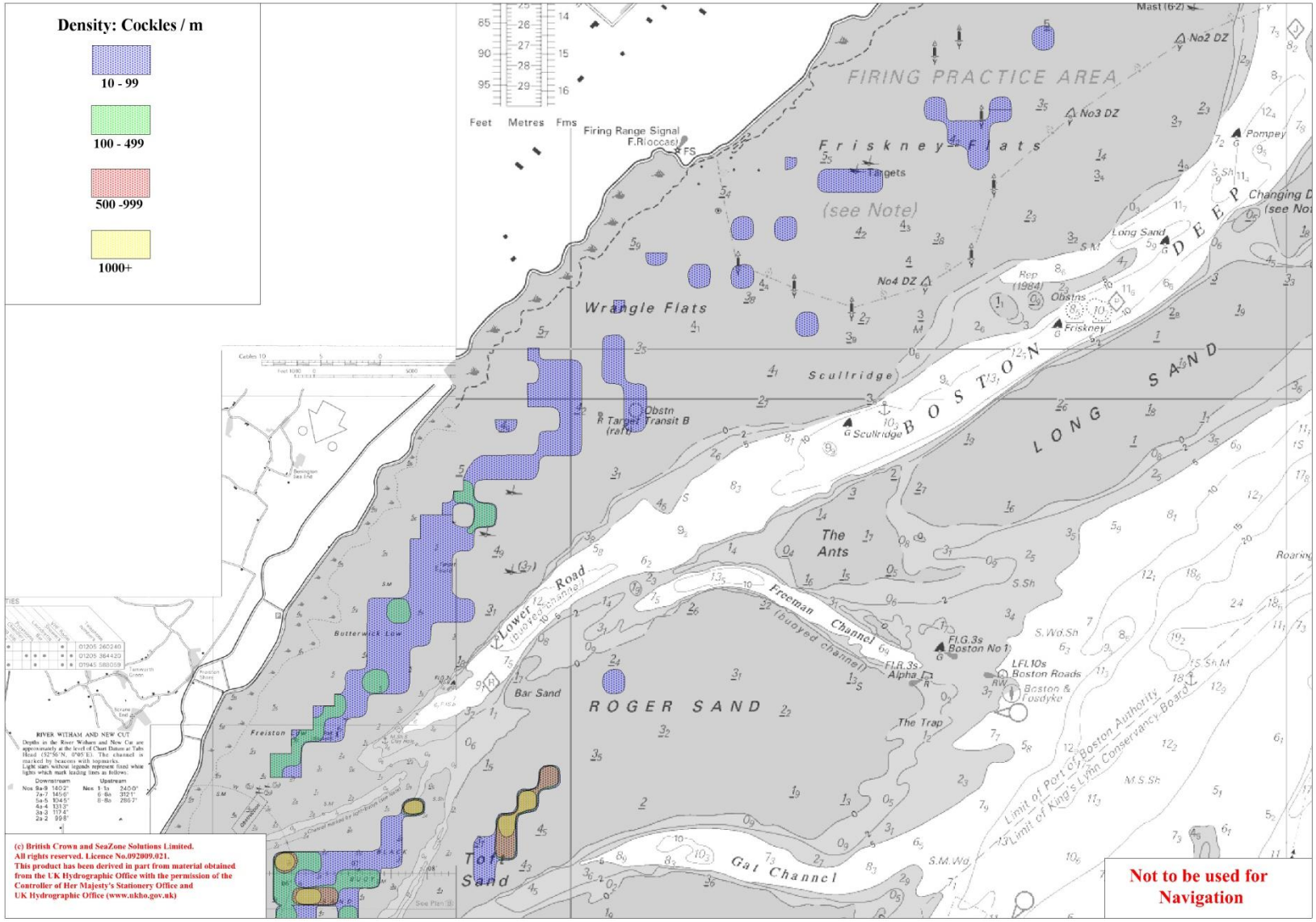


Figure 4 – Chart showing the stocks of cockles <14mm width on the Butterwick, Wrangle, Friskney and Roger/Toft sands

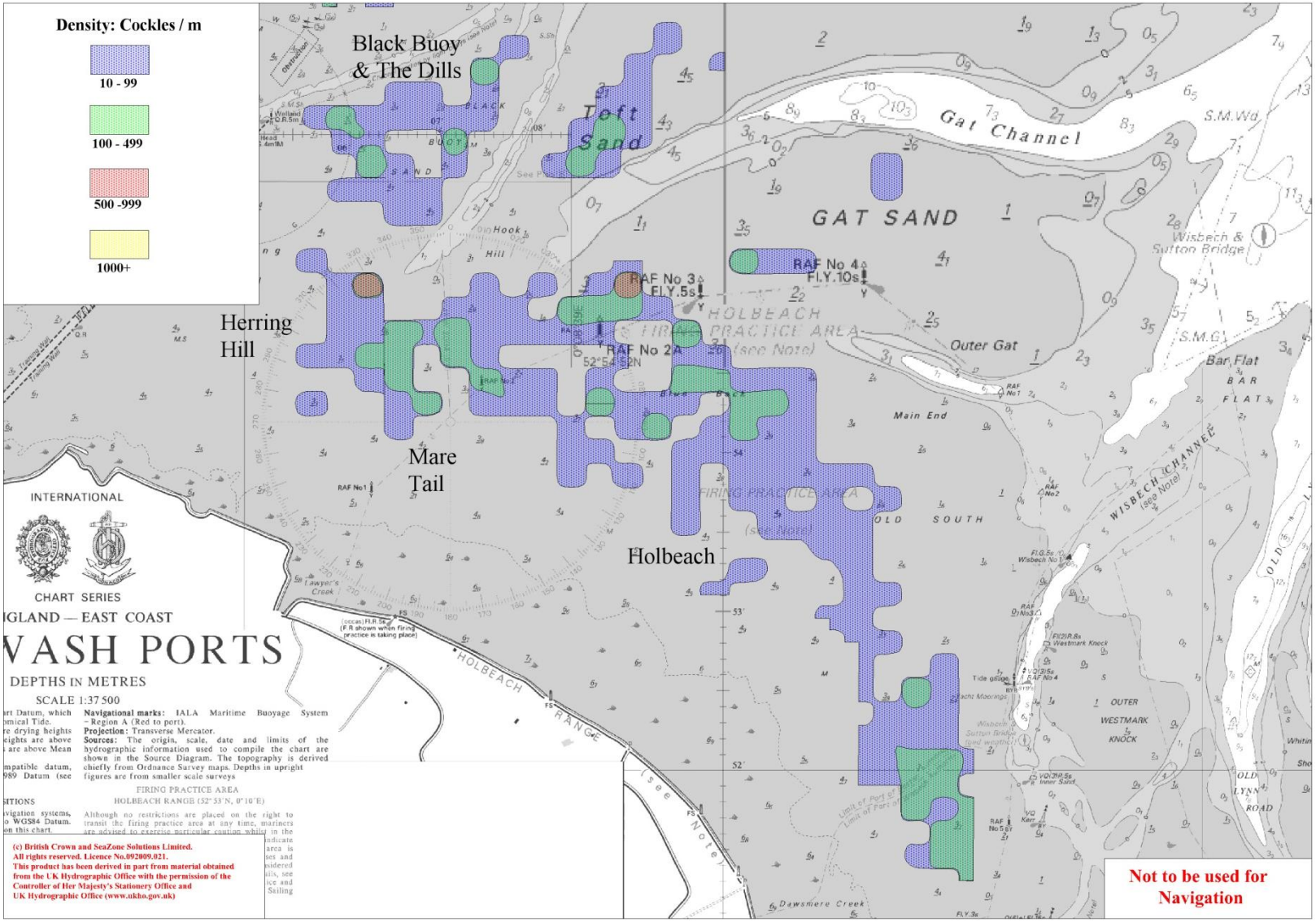


Figure 5 – Chart showing the stocks of cockles ≥14mm width on the Black Buoy, Dills, Herring Hill, Mare Tail, Gat and Holbeach sands

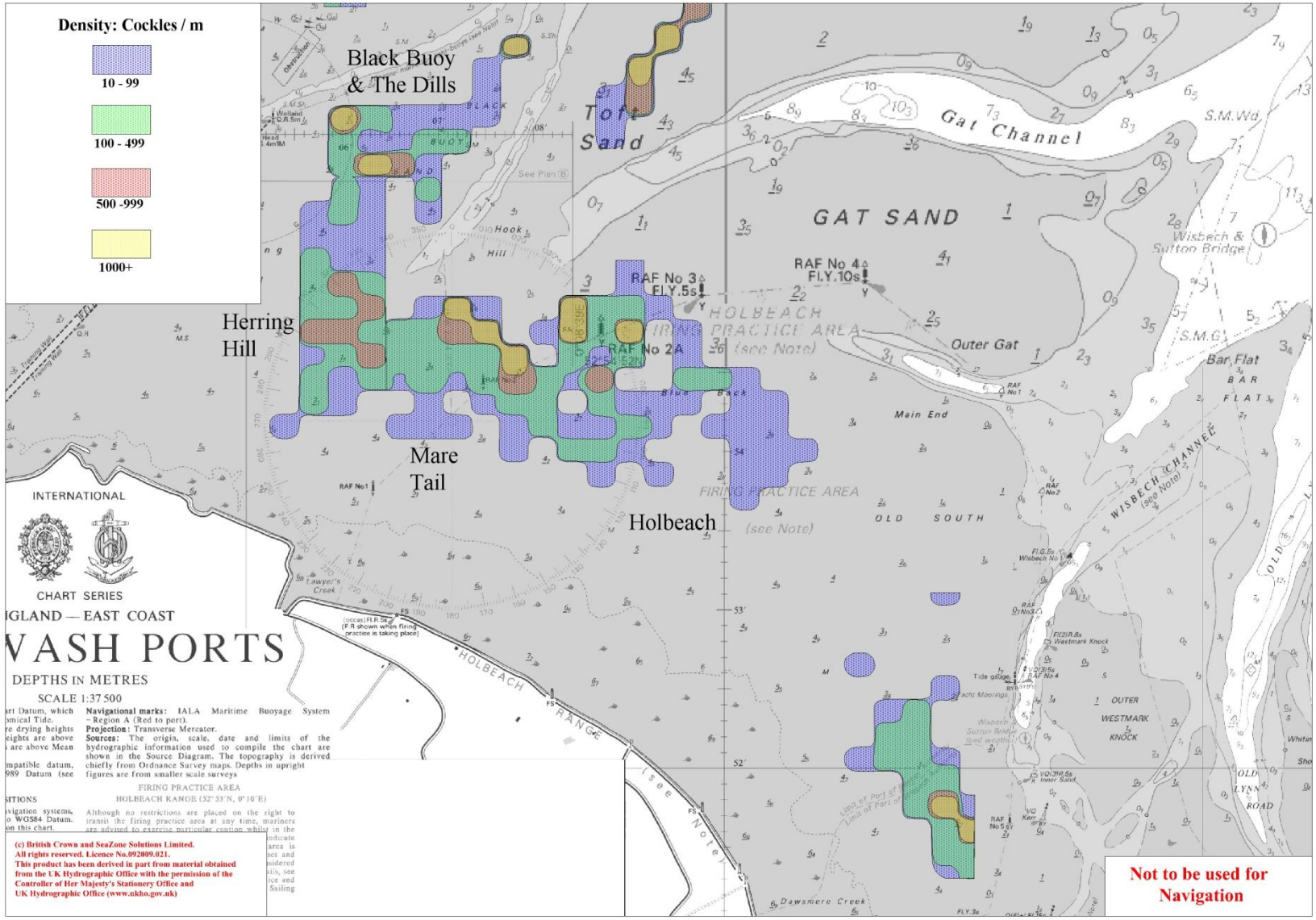


Figure 6 – Chart showing the Stocks of cockles <14mm width on the Black Buoy, Dills, Herring Hill, Mare Tail, Gat and Holbeach sands

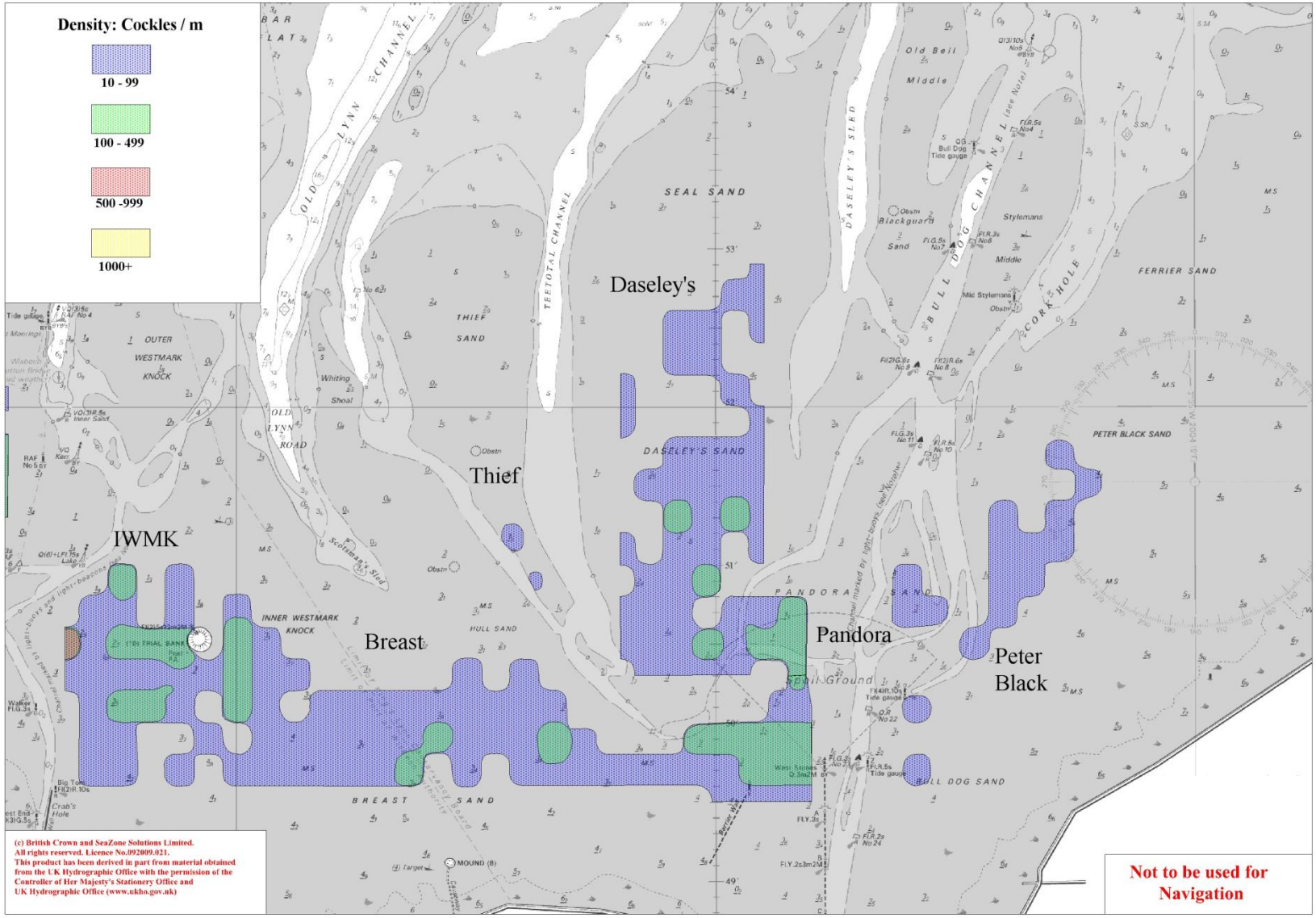


Figure 7 – Chart showing the stocks of cockles ≥14mm width on the IWMK, Breast, Thief, Daseley's, Pandora and Peter Black sands

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 2014

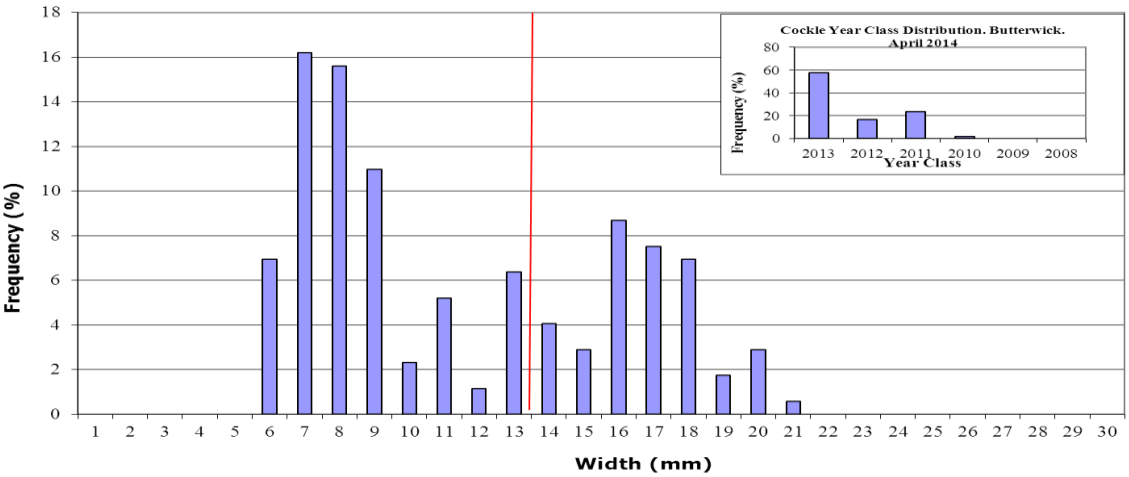


Figure 10 - Cockle Size Distribution. Wrangle. April 2014

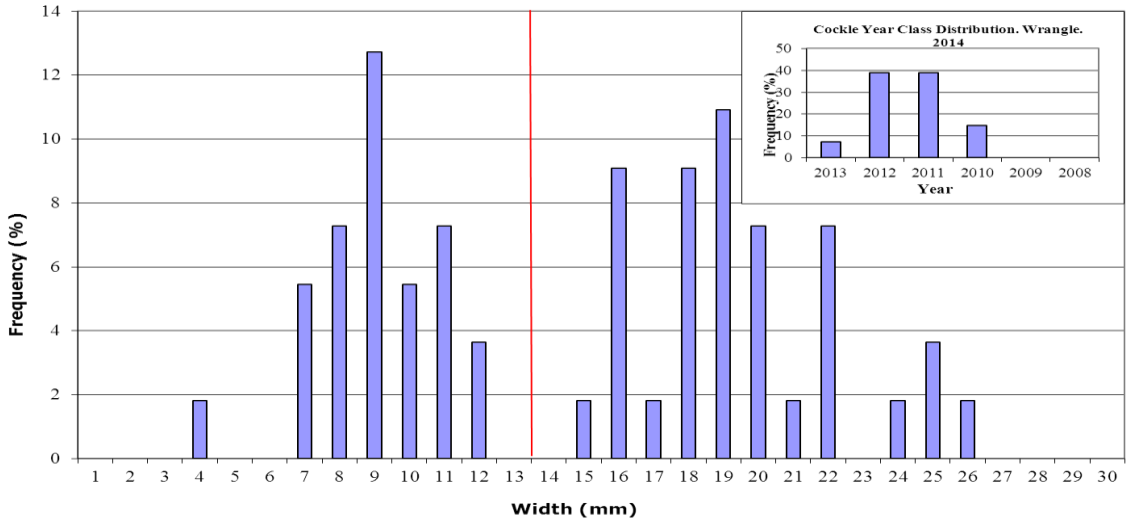


Figure 11 - Cockle Size Frequency. Friskney. April 2014

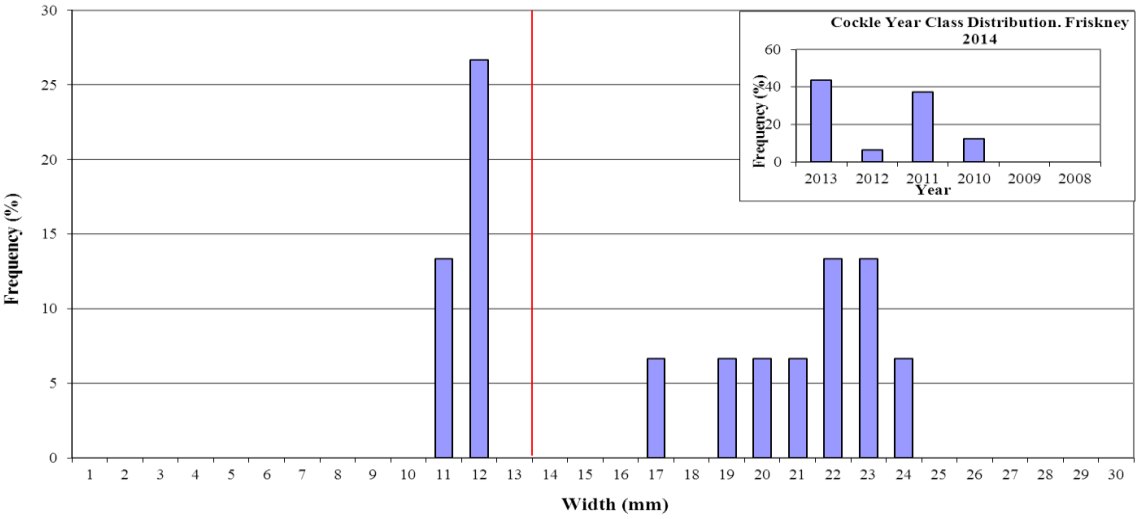


Figure 12 - Cockle Size Distribution. Roger/Toft. April 2014

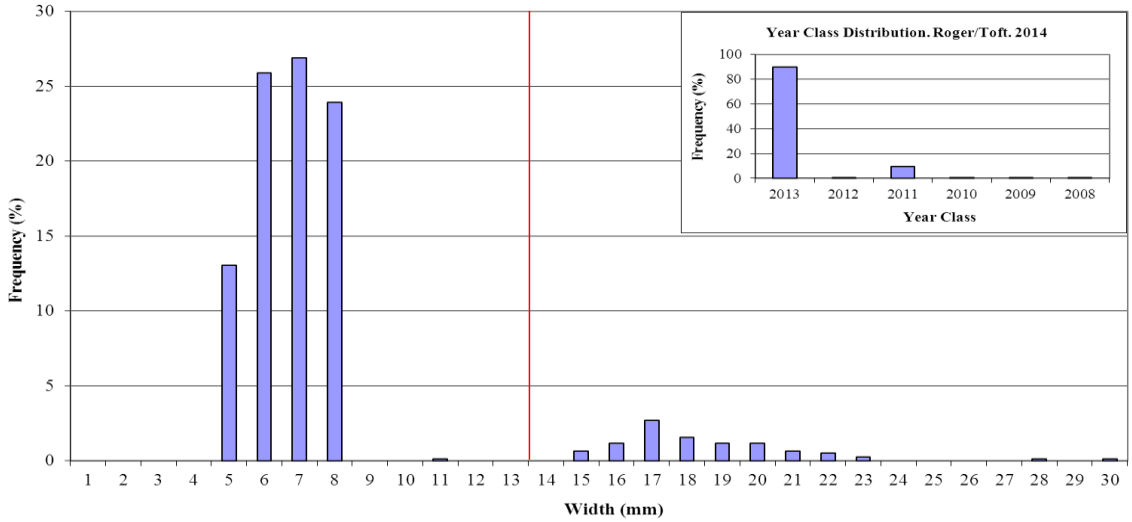


Figure 13 - Cockle Size Frequency. Gat Sand. April 2014

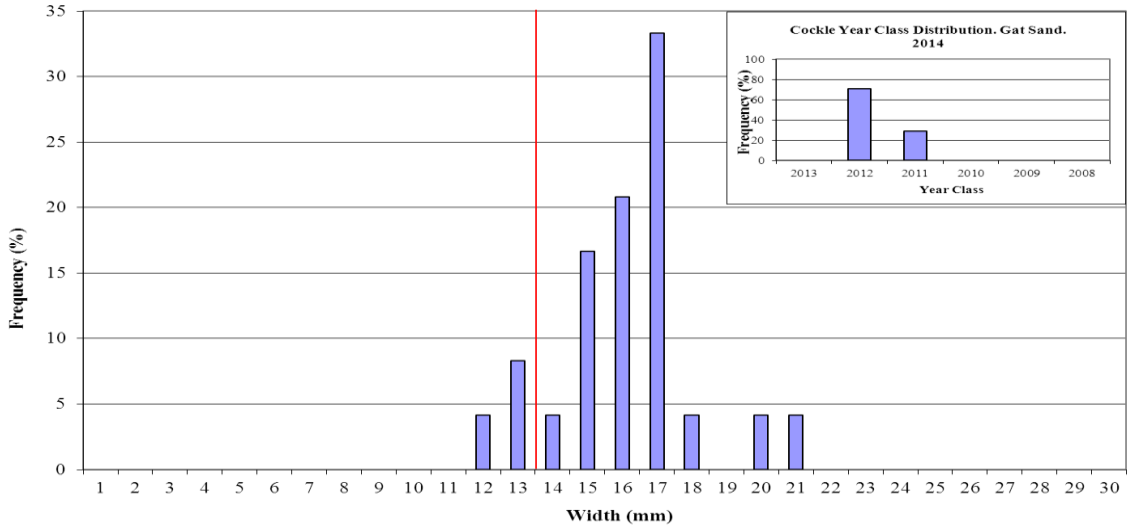


Figure 14 - Cockle Size Frequency. Black Buoy. April 2014

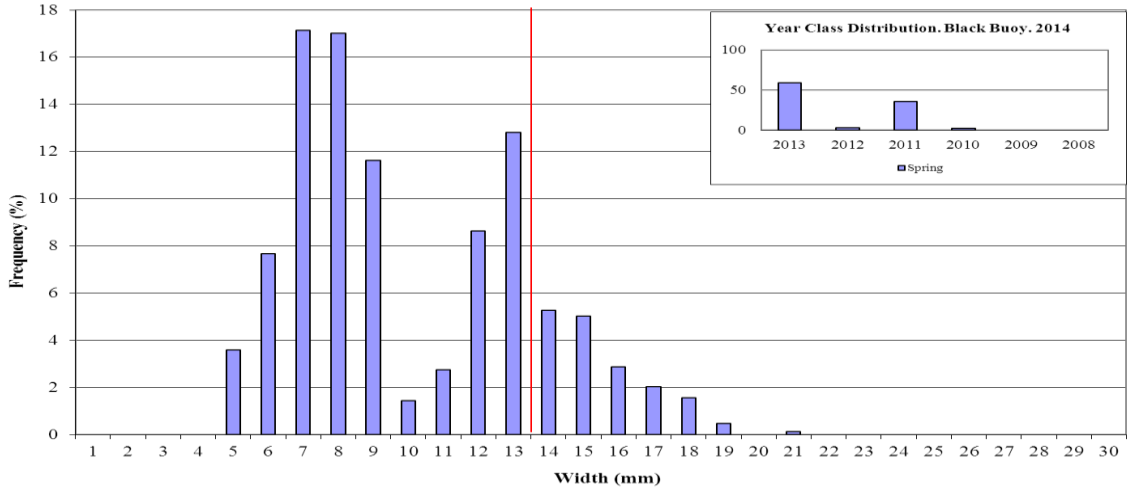


Figure 15 - Cockle Size Frequency. Herring Hill. April 2014

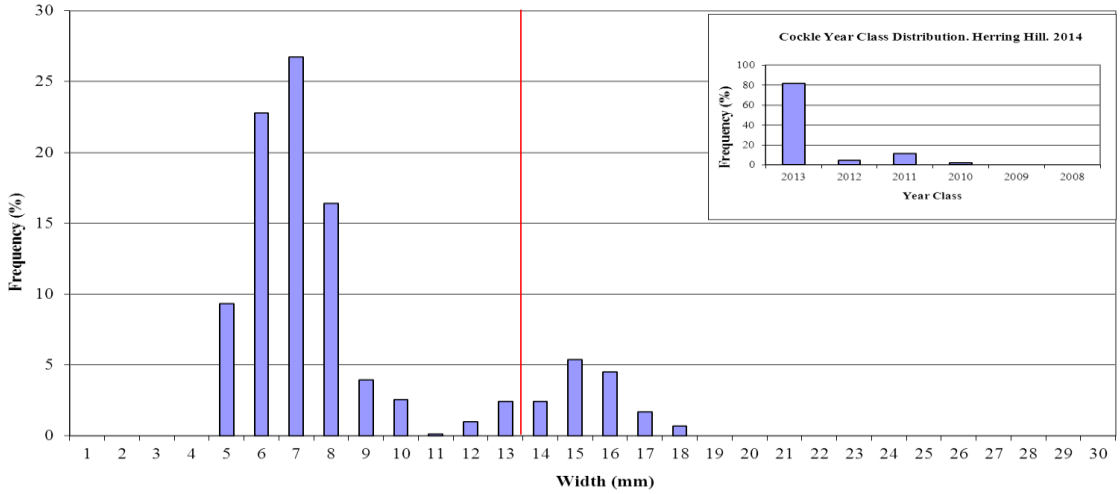


Figure 16 - Cockle Size Frequency. Mare Tail. April 2014

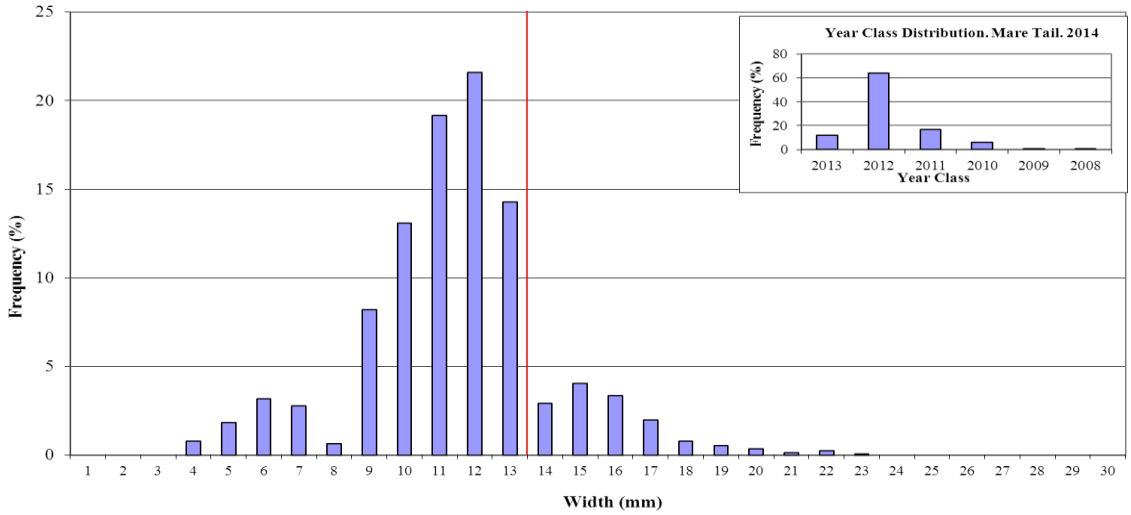


Figure 17 - Cockle Size Frequency. Holbeach. April 2014

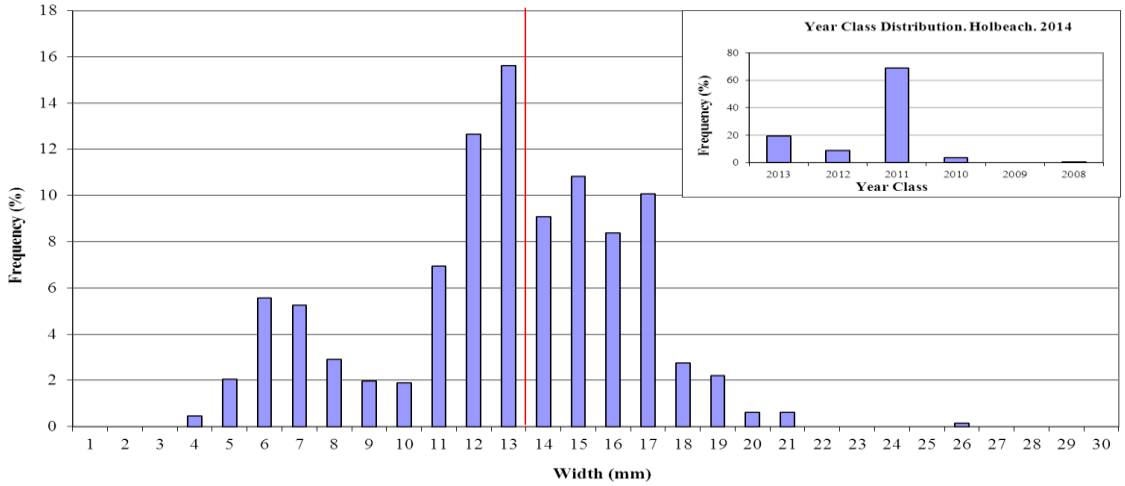


Figure 18 - Cockle Size Distribution. IWMK. April 2014

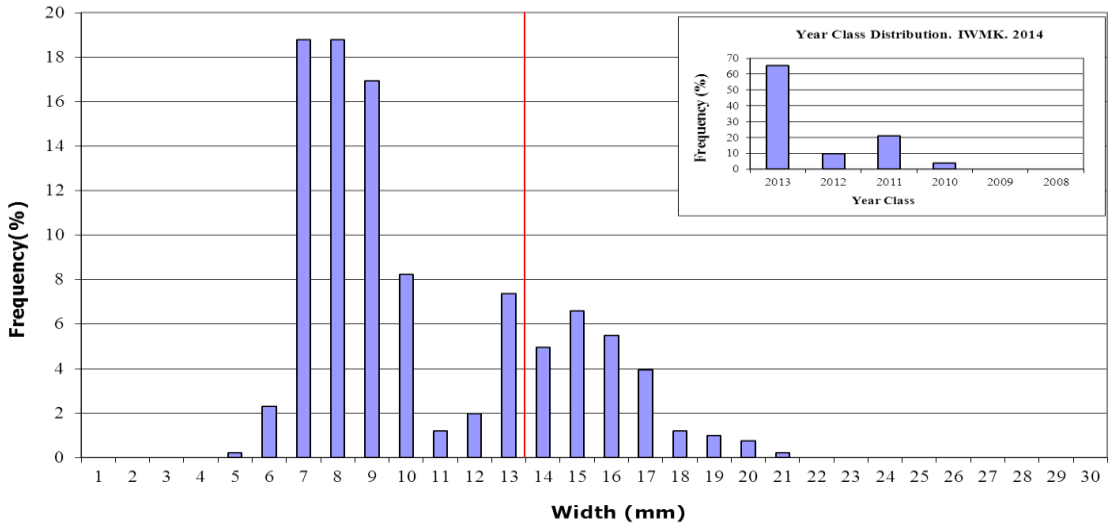


Figure 19 - Cockle Size Frequency. Breast Sand. April 2014

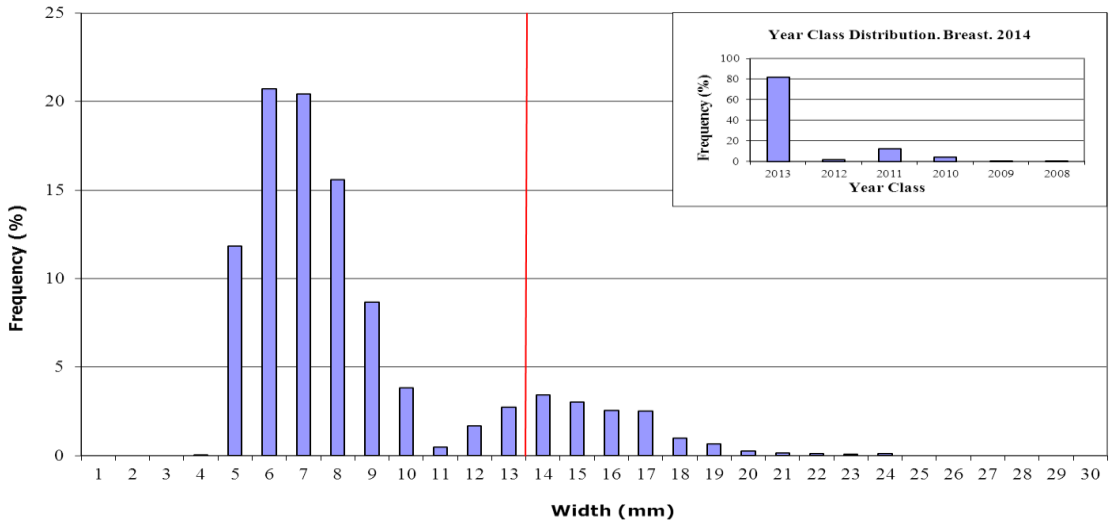


Figure 20 - Cockle Size Frequency. Daseley's. April 2014

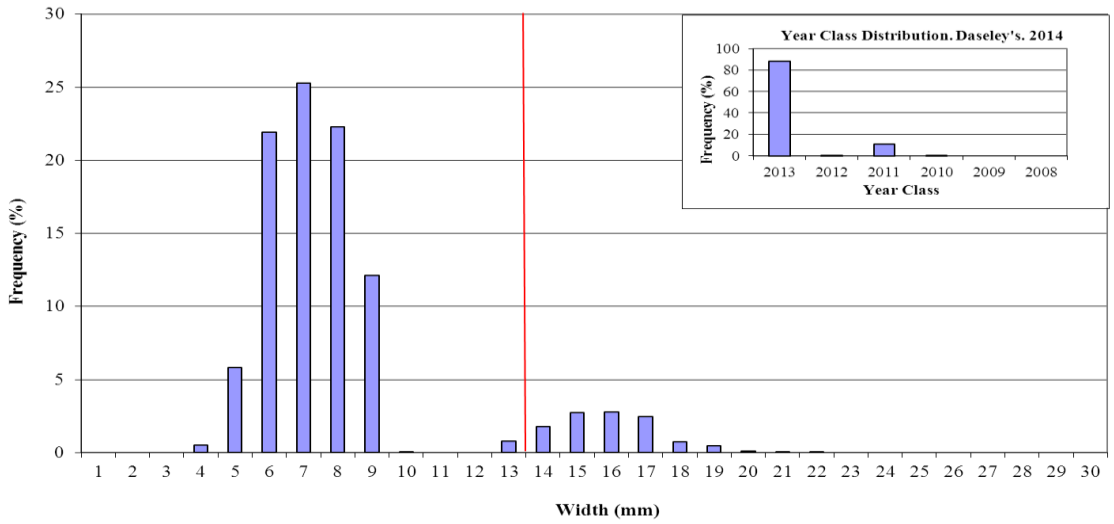
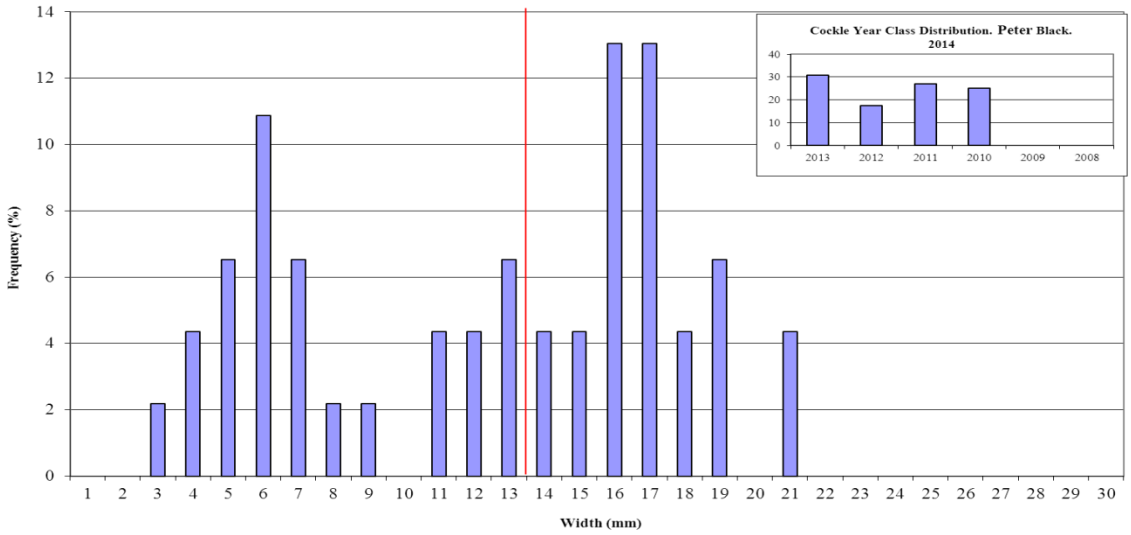


Figure 21 - Cockle Size Distribution. Peter Black. April 2014



Discussion

From table 1 the stocks at the time of the survey can be seen to be:

Total Adult Stock (≥14mm width)	**11,009 tonnes**
Total Juvenile Stock (<14mm width)	**8,310 tonnes**
Total Stock (all sizes)	**19,319 tonnes**

These figures show a decline from the total stock of 20,932 tonnes and adult stock of 11,159 tonnes present at the time of the previous year's survey. These declines had been predicted, however, and if anything were less severe than had been anticipated. In 2013 the stocks had supported a high proportion of adult (≥14mm width) cockles. Being more vulnerable to "atypical" mortality losses than smaller cockles, it was predicted that unless there was a significant spatfall over summer, the stocks would decline by 2014. Although a successful fishery had occurred in 2013, the stock biomass had been boosted by a good settlement in 2013 and a warm spring in 2014 that had encouraged cockle growth prior to the surveys.

Figure 22 shows the level of cockle stocks on the regulated beds compared to previous years. Although the stocks have suffered high annual mortalities since 2007, regular settlements have helped to maintain a degree of stability since 2012.

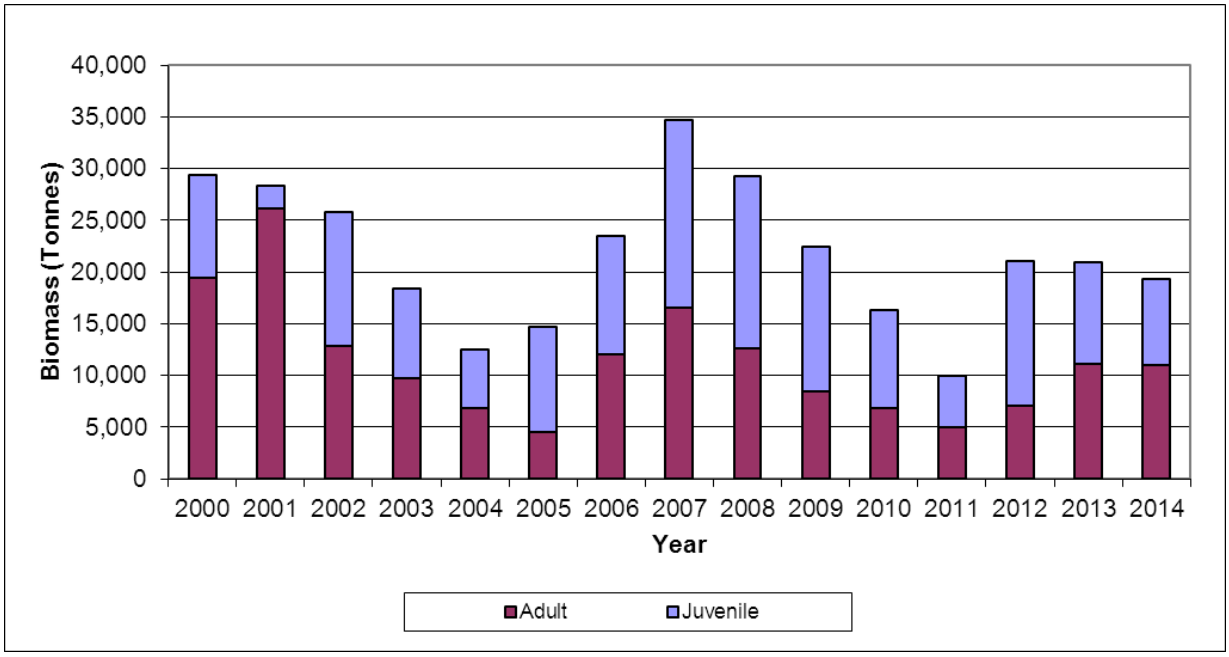


Figure 22 – Biomass of cockles on the WFO regulated beds between 2000 and 2014

Figures 23 and 24 show the numbers and weights of cockles from various year-classes that were measured during the 2013 and 2014 surveys. Comparison between them demonstrates changes that occurred to the stocks during that period.

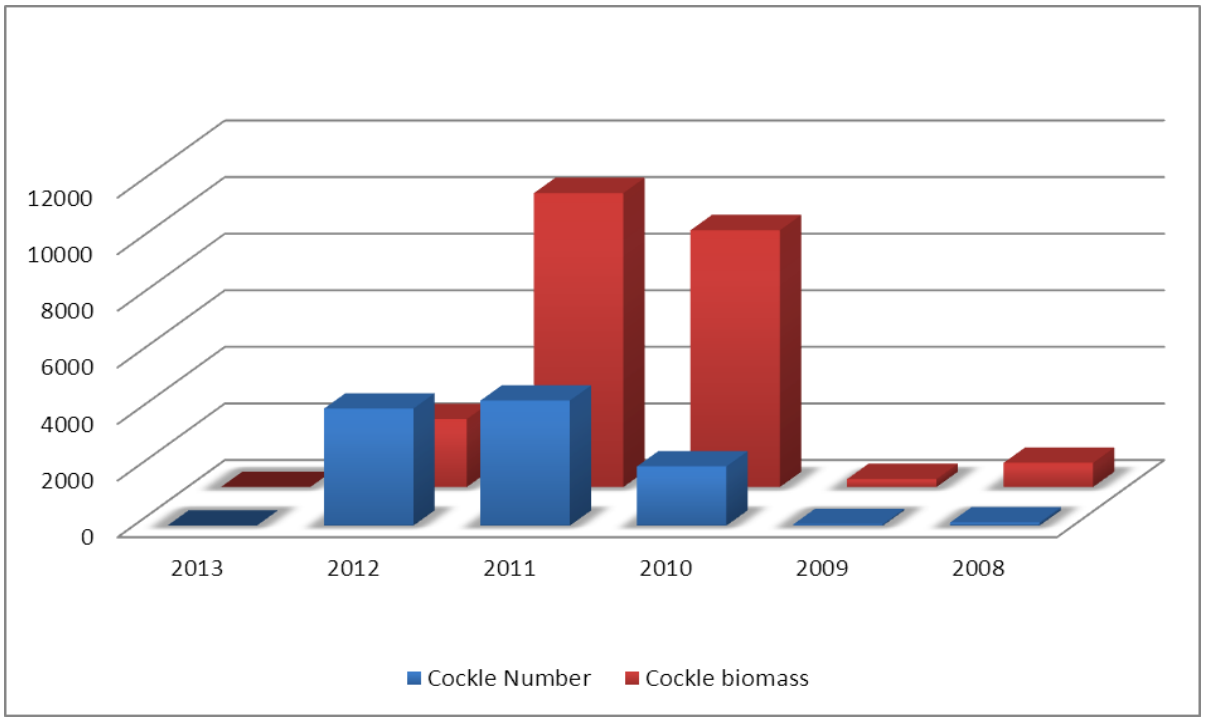


Figure 23 – Age composition of the cockles collected in the survey samples in 2013

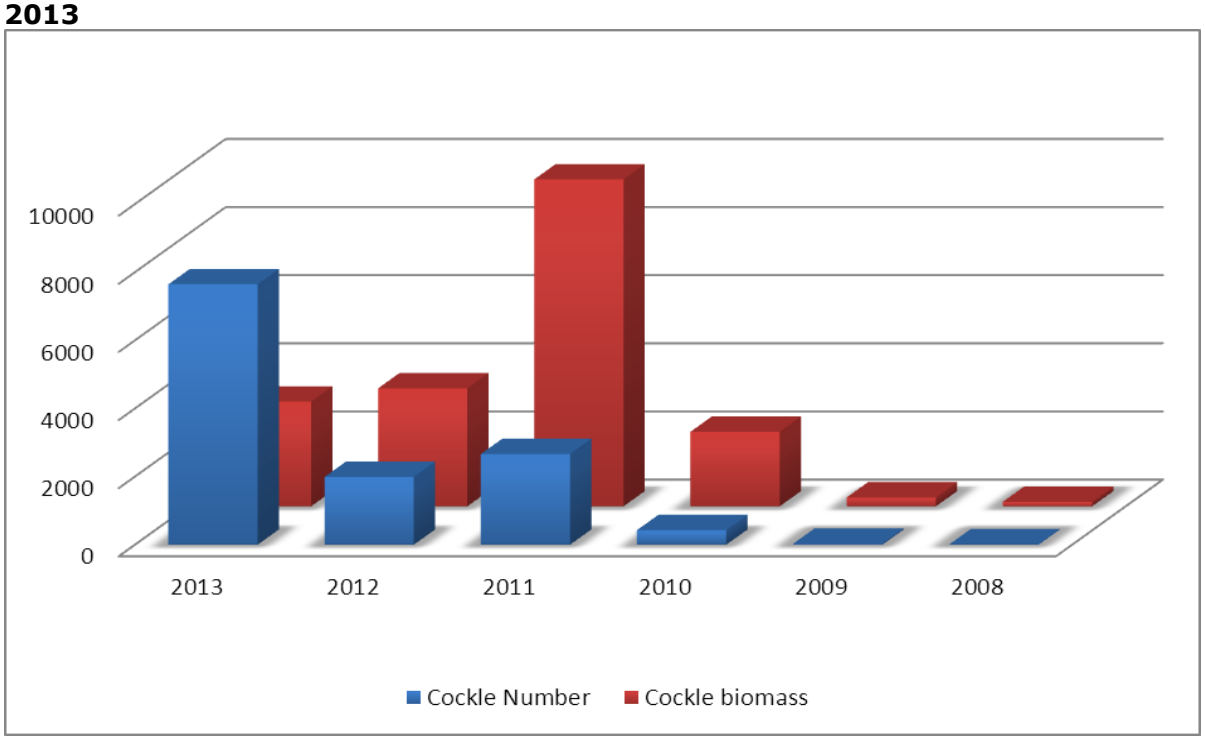


Figure 24 – Age composition of the cockles collected in the survey samples in 2014

Figure 23 shows that in terms of cockle numbers, the stocks were dominated in 2013 by cockles from the 2010, 2011 and 2012 year-class cohorts. In terms of biomass, though, it was the individually larger cockles from the 2010 and 2011 cohorts that were dominant, the small 2012 cockles contributing much less to the overall biomass.

Figure 24, which shows the same data taken from the 2014 survey, highlights there has been a successful settlement in 2013 but that a high proportion of the 2010 cohort present the previous year have gone. This loss of large cockles from the population would have left the stock with a large reduction in biomass had the good settlement in 2013 and the growth of the 2011 year-class cockles not partially compensated for this deficit.

Although the 2010 year-class cohort represented a significant proportion of the stock biomass at the time of the 2013 fishery, they were distributed only thinly over a widespread area. Because they were only present in low densities, they were not heavily exploited by the industry whose preference instead was to fish the dense patches of smaller 2011 year-class cockles that were present on the Dills and Daseley's sands at that time. Left virtually unfished, a high proportion of the 2010 year-class cockles succumbed to "atypical" mortality over the summer. Their vulnerability to "atypical" mortality had been anticipated by officers, who had encouraged their exploitation by recommending that the small cockles on the Dills and Daseley's sands remain closed for a month at the beginning of the season. Although this would have encouraged exploitation of a stock anticipated to die, and allowed another month's growth of the small cockles, the recommendation was strongly opposed by the industry. Because keeping these stocks closed carried its own risk of them "ridging out", the Authority ultimately favoured the industry's views and allowed the beds to be opened.

Data from the 2014 survey showed that beds that had been dominated by 2010 year-class cockles the previous year had declined in biomass. This included the Friskney, Wrangle, Butterwick, Herring Hill and Inner Westmark Knock beds. Most of the beds that had supported high proportions of 2011 year-class cockles in 2013 were found to have increased in biomass. These included the Roger/Toft, Mare Tail, Holbeach, Breast and Pandora beds, but not the Dills and Daseley's beds that had been heavily exploited by the 2013 fishery. The decline of these latter two beds posed a problem for the 2014 fishery. Usually stocks from these two beds would be fished in their third year (eg. 2014), not in their second year, as they had been. Their exploitation in 2013 meant there were few areas of high-density adult cockles left in 2014 for the fishery to target. Figures 3, 5 and 7 show the distribution of cockles that had attained a size of 14mm

width at the time of the 2014 surveys. While there were widespread patches of adult cockles across many of the beds in densities between 100 and 499 cockles/m^2, there were few areas that supported densities exceeding 500 cockles/m^2. Although this widespread distribution helped to produce a higher than expected adult biomass (and as a consequence, a higher TAC), it did not present obvious areas for fishery exploitation. Exasperating the problem were the numbers of juvenile cockles that were mixed among the adult stocks, as seen in figures 4, 6 and 8. These were comprised of a mixture of 2012 and 2013 year-class stocks. Fearing the industry would once again target the dense patches of juvenile cockles in preference to the lower density adults, the areas that supported stocks of 2013 year-class juveniles in densities exceeding 1000 cockles/m^2 remained closed to the 2014 fishery.

As the survey data had predicted, harvest rates were slower during the 2014 fishery than they had been the previous year. Although the beds were initially opened at weekends in order to encourage stocks to be exploited from the Holbeach bombing range, this measure was unpopular with a section of the industry. Instead, their preference again turned to harvesting small cockles, this time from the 2012 cohort.