

Thames Estuary Cockle Survey Report 2022



Inshore Fisheries and
Conservation Authority

Philip Haupt

www.kentandessex-ifca.gov.uk

Executive Summary

This report gives an annual up-date assessment of all cockle stock surveys carried out by the Kent and Essex Inshore Fisheries & Conservation Authority (KEIFCA) during 2022. The data from these surveys are added to the previous annual surveys to provide current information which is used to assess the management strategy of the district's commercial cockle stocks.

NOT TO BE QUOTED WITHOUT PRIOR REFERENCE TO KEIFCA

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1 INTRODUCTION

This report presents the results of the 2022 annual surveys in Thames Estuary to provide data used to inform sustainable management of the cockle (*Cerastoderma edule*) fishery.

The Thames Estuary supports an important cockle fishery, and the commercial harvesting of the cockles is regulated by KEIFCA under the Thames Estuary Cockle Fishery Order, 1994 (TECFO) and relevant byelaws. The Authority has conducted annual surveys of the cockle beds within the Thames Estuary since 1988 to provide robust data to inform sustainable management of the cockle fishery.

The annual cockle surveys are critical in providing information to open the TECFO and Outside cockle fisheries, and to set their annual Total Allowable Catch (TAC) limits. That allows for a sustainable fishery to operate. The sustainable management of the cockle stocks also provides important information for environmental management, such as continued adequate food for wading birds and marine species, within the numerous Marine Protected Areas (MPAs) within which the fishery operates. The management controls the exploitation of the cockle population to ensure that there is not any significant adverse impact upon the features of the Essex Estuaries SAC along with the Mid Essex Coast and Outer Thames Estuary SPA sites.

The cockle survey programme was designed to allow for assessing annual and seasonal trends in cockle stocks within the major commercial harvesting areas of the Thames Estuary. The annual surveys take place on known cockle beds in the Thames Estuary, which were divided into cockle management areas (Figure 1) within which stocks and fishing activity are assessed annually.

The results of the stock assessment surveys were used to examine the distribution, density and age structure of cockles in the different areas, and to produce estimated values of population size and biomass. The results from the preceding autumn survey, together with the results from the following spring survey are analysed and evaluated within the context of the long-term trend to inform setting the total allowable catch (TAC) for the commercial fishing sector. The TAC for the fishery which was divided between licence holders (for areas inside the TECFO area) or permit holders (for areas outside the TECFO area).

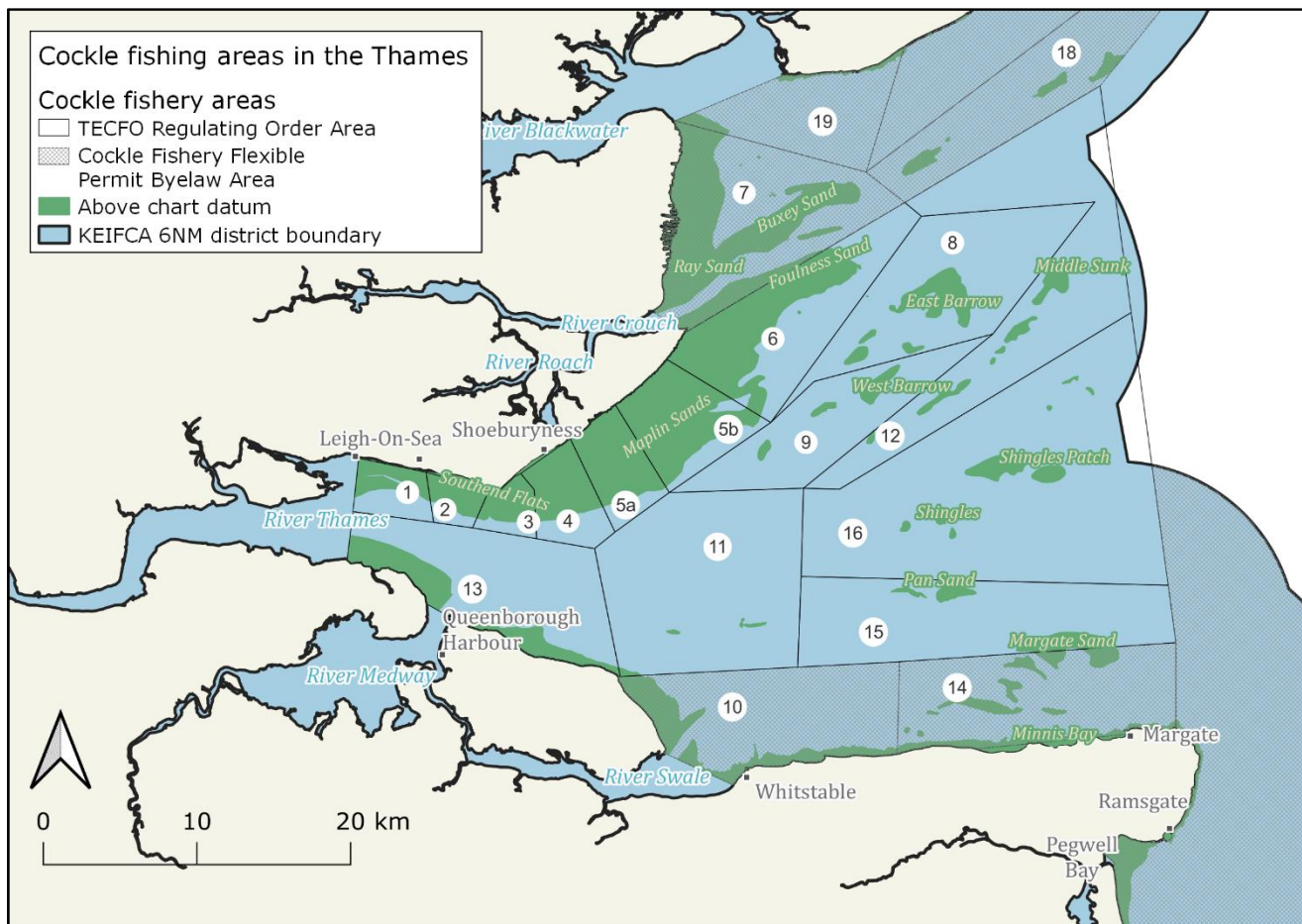


Figure 1: Cockle management areas in the Thames Estuary, showing two types of cockle fishery areas, as well as seabed above chart datum and sandbank names.

Chart area key:

Grounds within the area covered by the Thames Estuary Cockle Fishery Order 1994

1. Marsh End & Chapman Sands
2. East of pier
3. West of Shoebury boom
4. East of Shoebury boom
- 5a. South Maplin
- 5b. Mid Maplin
6. North Maplin & Foulness Sands
8. East Barrow & Maplin Spit
9. West Barrow
11. East Cant, Middle & Red Sand
12. Sunk Sand
13. West Cant & Scrapsgate
15. North Margate Sand & Pan Sand
16. Shingles & Long Sand

Grounds outside the area covered by the Thames Estuary Cockle Fishery Order 1994

- 1a. Inner Estuary
7. Buxey, Ray & Dengie Sands
10. Leysdown & Ham.
14. South Margate Sands
17. South Kent Coast to Dungeness
18. Gunfleet Sand
19. Blackwater Estuary
20. Wallet & North Essex Coast

2 METHODS

2.1 Survey methodology

2.1.1 Sample collection from shore (quadrats)

Intertidal sandflats, accessible from shore in areas 2, 3, 4, 5a, 5b and 6 were accessed using all-terrain vehicles (ATVs; Figure 2a) within 2 hours of low water. Sampling of these areas was conducted during spring low tides in April 2022 and repeated for the subset of main cockle harvesting areas; 4, 5a, 5b and 6, in September 2022 (Table 1). Samples were collected at each sample point in the survey grid (Figure 3) using a 0.1 m² quadrat. Sediment was removed from the upper 6 cm inside the 0.1 m² quadrat using a rake and sieved through a 5 mm square meshed sieve. Any cockles retained on the sieve were collected for further analyses.

2.1.2 Sample collection at sea (Day grab)

Surveys of intertidal cockle beds not accessible from shore were carried out from KEIFCA's vessel 'FPV Tamesis' during periods of high tide in April 2022 for all other areas (See Table 1). Samples were collected using a 0.1 m² Day grab which was lowered from the vessel via a hydraulic winch (Figure 2b). The contents of the day grab were emptied and sieved through a 5 mm square meshed sieve. Any cockles retained on the sieve were collected for further analyses.

The subtidal and some of intertidal Margate Sands sand bank was surveyed again in 2022, following the discovery of very high-quality cockles from the area during the 2020 fishing season.



Figure 2: Sample collection methods; (a) ATV, quadrat, rake and sieve; and (b) Day grab deployed from vessel.

2.1.3 Biomass and stock size measurements

Cockles from each sample point were separated into year classes, identified by the number of growth rings visible on the outside of the shell. The cockles were tallied and cockles from each sample point in each year class were combined for each cockle management area. Cockles from each age class in each area were sorted into 3 size classes (<14 mm, 14 – 16 mm and >16 mm) using 14 mm and 16 mm sorting riddles. The minimum landing size for cockles within the KEIFCA district is 16 mm which relates to the smallest dimension of the cockle. The total weight and number of cockles in each year and size class for each cockle management area were measured and used to estimate the total stock size and biomass of each age and size class of cockles.

2.2 .Survey schedule

Sampling of the cockle beds commenced on the 1st of April 2022, with the final cockle survey completed on the 7 October September 2022. All surveys, areas and sampling methods are shown in Table 1.

Spring surveys tend to take place during April while autumn surveys are carried out for a subset of the sampling grid during September. The main objectives of the spring surveys are to estimate the population size and biomass and distribution of different age classes to base the TAC on. The main objectives of the autumn survey being to assess spat settlement and abundance, along with the distribution of the remaining cockles. We also carried out summer checks on specific areas, such as Margate Sands in area 15 and the Buxey to monitor growth over the summer period. The survey schedule is provided in Table 1. During the period from the 20th of June to 7 October, the grounds were subject to controlled commercial fishing activity during 2022.

Table 1: Date and survey method, Thames Estuary, 2022

Survey Area	Survey Date	Survey Method	Platform
Area 1 – Marsh End		Day grab	Tamesis FPV
Areas 2 & 3	4,29 April	Quadrat, Day grab	All-terrain vehicles, Tamesis FPV
Areas 4, 5 & 6 (Spring)	1 – 5 April	Quadrat	All-terrain vehicles
Areas 4, 5 & 6 (Autumn)	8 – 12 September	Quadrat	All-terrain vehicles
Area 7 – (N. Foulness)	1 April	Quadrat	All-terrain vehicles
Area 7 – Ray Sand	26, 27 April	Day grab	Tamesis FPV
Area 7 – Dengie	13 April	Day grab	Tamesis FPV
Area 7 – Buxey	14, 19 April	Day grab	Tamesis FPV
Area 7 – Buxey	22, 23 September	Day grab	Tamesis FPV
Area 8 – East Barrow	17 May	Day grab	Tamesis FPV
Area 8 – Maplin Spit	18 May	Day	Tamesis FPV
Area 9 – West Barrows	4 May	Day grab	Tamesis FPV
Area 9/12 – Mouse/Knob	5 May	Day grab	Tamesis FPV
Area 10 – Leysdown & Ham	27 April	Day grab	Nerissa FPV
Area 13 - Scrapsgate	4 May	Day grab	Nerissa FPV
Area 14 – Minnis Bay	3 May	Day grab	Nerissa FPV
Area 14 – Margate Hook	Not surveyed	Day grab	Nerissa FPV
Area 14 – Margate Sands	20, 26 April, 3 May	Day grab	Nerissa FPV
Area 15 – Margate Sands	19 April	Day grab	Nerissa FPV
Area 15 – Margate Sands	26, 31 July, 1 August and again surveyed – 29 September	Day grab	Nerissa FPV
Area 17 – Pegwell Bay	9, 16, 17 May 2022	Day grab	Nerissa FPV

2.3 Survey Array

Cockle sampling was carried out over a predetermined systematic sampling grid, for which their geographical localities are kept consistent over time to allow comparing the same areas over time. The sampling grid consisted of a series of parallel transect lines which were evenly spaced across the cockle beds. Samples were

taken at predetermined points along each transect line. All samples were taken at positions recorded by GPS to be within 10 m of the target transect position, unless otherwise recorded.

The majority of the surveys utilised a sample grid consisting of one quarter of a minute latitude by one quarter of a minute longitude (464 m by 290 m) apart. Autumn surveys of the Maplin sands (areas 4, 5 & 6) use a sample grid of one-half minute latitude by one quarter of a minute longitude, covering the same total area.

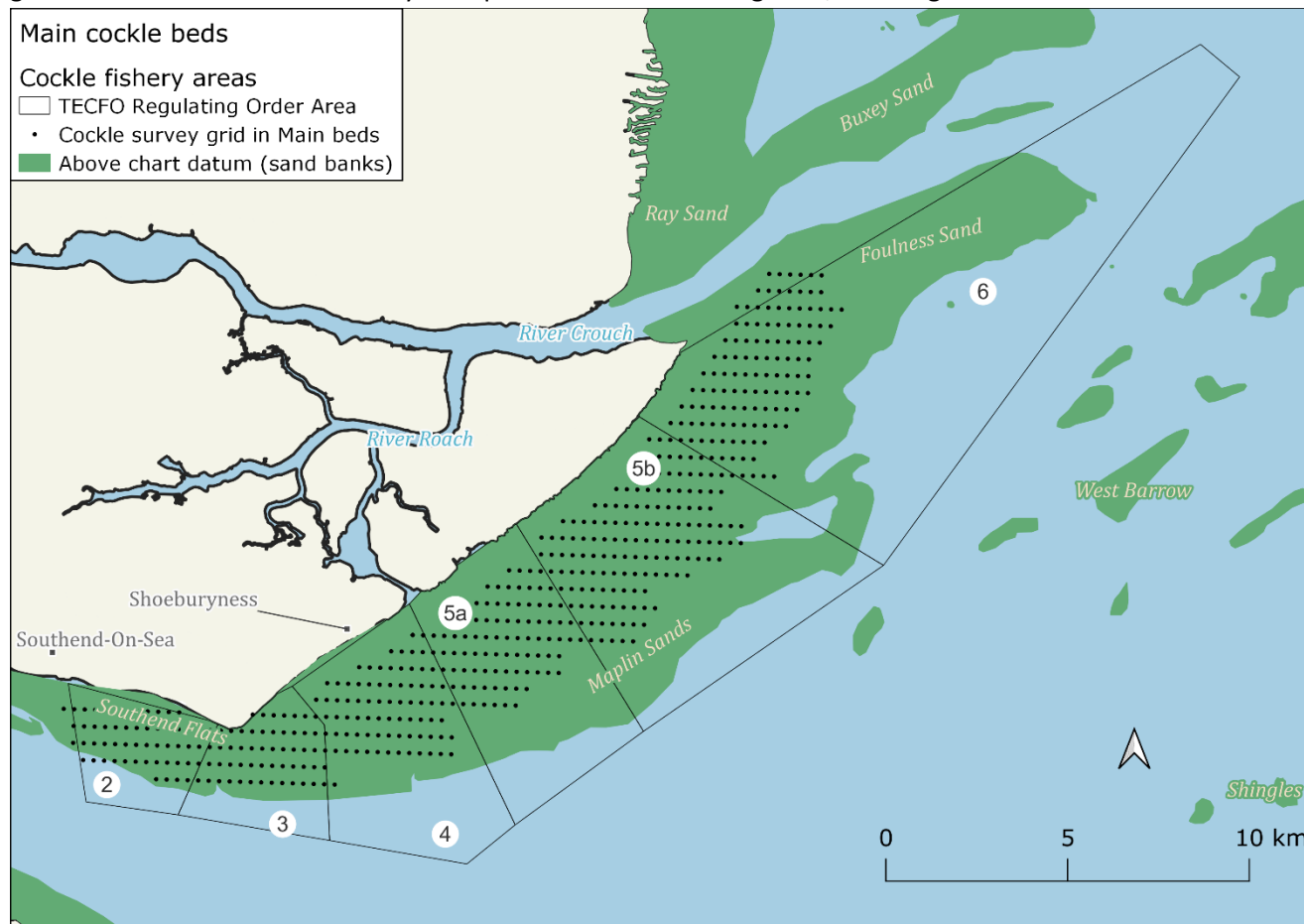


Figure 3: Cockle survey sampling positions in the main cockle harvesting areas: 2, 3, 4, 5a, 5b and 6.

2.4 Area covered by survey

A total of 1383 samples were taken during the 2022 spring surveys, and a further 462 during summer and autumn surveys. The surveys covered an area of 261.8 km² (including spring, autumn on the Maplin Sands and July and again October surveys on the Margate Long Sands, and September surveys on the Buxey) (Table 2)

Table 2: Number of samples taken and area of cockle beds surveyed in the Thames Estuary in 2022.

Area	Number of samples	Area surveyed (km ²)
1 Marsh End (includes Chapman Sands)	41	2.8
2 East of pier	55	7.4
3 West of Shoebury boom	53	7.1
4 East of Shoebury boom	76	10.2
4 East of Shoebury boom (autumn)	41	10.2
5 Maplin Sands	232	31.2

5 Maplin Sands (autumn)	111	31.2
6 North Maplin and Foulness Sand	129	17.4
6 North Maplin (autumn)	57	15.5
7 Buxey	111	14.9
7 Buxey	111	14.9
7 Dengie	52	7.0
7 Ray Sands	104	14
8 East Barrow and Maplin Spit	90	12.1
9-12 Mouse Knob	50	6.7
9 West Barrows	53	7.1
10 Leysdown	41	5.5
13 Scrapsgate	15	1.0
14 Margate Sand	100	13.5
14 Minnis Bay	21	1.1
15 Margate Sand	69	9.3
15 Margate Sand	91	6.1
15 Margate Sand	51	3.4
17 Pegwell Bay	91	12.2
Spring totals	1383	180.5 km²
Autumn totals	462	81.3 km²
Overall totals	1845	261.8 km²

*(All samples in spring unless otherwise stated, blue represents spring samples, and orange-yellow represents autumn and summer samples)

2.5 Data analysis

The mean density of cockles in a given cockle management area, together with the size of the area (km²) was used to calculate the number of each year class of cockles in that area. The number of cockles and the mean weight of cockles in each age class were used to calculate the biomass of each year and size class of cockles within each cockle management area. The proportions of cockles above and below 16 mm were used to calculate the biomass of each year class cockles in that area above and below 16 mm.

3 RESULTS

- MAIN BEDS -

AREA 2

3.1 Area 2 stock assessment (spring survey)

A total of 52 sites were sampled covering a total area of 7.0 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 3 and a summary of the stock assessment is presented below. Only 13.6% of the total stock biomass was comprised of cockles over 16 mm (width). It was difficult to cockles especially the age 0 – 1-year year because there was no clear 1st year winter ring, and because of the small average size of the cockles observed during this survey.

Table 3: Area 2 stock parameters, spring 2022

	No. Samples	Area size	Year Class			
			2021	2020	2019	2018
Area 2	52	7.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			143.5	39.1	45.1	5.8
Stock (millions)			1061.7	289.3	333.7	43.1
Mean Weight (g)			0.8	2.6	3.6	5.3
Biomass (tonnes)			827.5	746.0	1206.6	228.2
Biomass below 16 mm			827.5	746.0	939.1	84.7
Biomass 16 mm and above			0.0	0.0	267.5	143.5

Summary of stock assessment for Area 2 (spring survey)

The final stock estimation, based on the survey area of **7.0 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	1061.7 million
Total number of 2020 and older year class	666.1 million
Total stock biomass	
Total stock (all cockles)	3008.4 tonnes
Total stock biomass - cockles below 16mm	2597.3 tonnes
- cockles 16mm and above	411.0 tonnes

AREA 3

3.2 Area 3 assessment of stock (spring survey)

A total of 53 sites were sampled covering a total area of 7.1 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 4 and a summary of the stock assessment is presented below. Approximately 36 % of the biomass of cockles were made up from over 16 mm (width) cockles. The bulk of the biomass coming from the 2 – 3-year class.

Table 4: Area 3 stock parameters, spring 2022

Area 3	No. Samples	area size	Year Class			
			2021	2020	2019	2018
	53	7.1	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			146.0	14.9	43.4	2.5
Stock (millions)			1041.5	106.3	309.5	17.5
Mean Weight (g)			0.7	2.7	4.9	8.0
Biomass (tonnes)			720.8	289.7	1508.1	139.9
Biomass below 16 mm			720.8	289.7	692.3	0.0
Biomass 16 mm and above			0.0	0.0	815.8	139.9

Summary of stock assessment for Area 3 (spring survey):

The final stock estimation, based on the survey area of **7.1 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	1041.5 million
Total number of 2020 and older year class	433.3 million
Total stock biomass	
Total stock (all cockles)	2658.5 tonnes
Total stock biomass - cockles below 16mm	1702.8 tonnes
- cockles 16mm and above	955.7 tonnes

AREA 4

3.3 Area 4 assessment of stock (spring survey)

A total of 76 sites were sampled covering a total area of 10.2 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 5 and a summary of the stock assessment is presented below. The geographical distribution of each year class is presented in Figures 3 – 7. Figure 3 shows that area 4 had the highest concentration of high-density adults. However, with a mean weight of 3.7 – 4.7 g per cockle (for cockles older than 2 or 3 years respectively), the biomass of cockles here were largely (66 %) comprised of cockles below 16 mm. Therefore, despite having a high density of adult and 3+ year old cockles, they were smaller than cockles of the same age from area 5.

Table 5: Area 4 stock parameters, spring 2022

Area 4	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	76	10.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			147.9	36.4	46.2	67.0
Stock (millions)			1512.5	372.7	472.3	684.9
Mean Weight (g)			0.5	2.6	3.7	4.7
Biomass (tonnes)			750.9	961.8	1731.4	3213.3
Biomass below 16 mm			750.9	961.8	1327.6	1363.1
Biomass 16 mm and above			0.0	0.0	403.7	1850.2

Summary of stock assessment for Area 4 (spring survey)

The final stock estimation, based on the survey area of **10.2 km²** are as follows:

Total number of cockles:

Total number of 2021 year class

1512.5million

Total number of 2020 and older year class

1529.9 million

Total stock biomass

Total stock (all cockles)

6657.3 tonnes

Total stock biomass - cockles below 16mm

4403.4 tonnes

- cockles 16mm and above

2253.9 tonnes

AREA 4

3.4 Area 4 assessment of stock (autumn survey)

The mean density, total stock, mean weight and biomass of each year class of cockles from the autumn 2022 survey are presented in Table 6 and a summary of the stock assessment is presented below. The density and geographical distribution of spat is presented in Figures 3 – 7. The proportion of cockles that were above 16 mm, was close to 35 %, therefore many of these adult cockles were below 16 mm. Area 4 and five tend to receive higher spatfall than area 6. First indications that numbers of cockle-spats were lower than 2021 are alluded to in the data presented here, because the density of 0–1-year cockles was similar to that of 1 – 2 (2021) year class cockles (which have had to survive a year of fishing, predation and winter).

Table 6: Area 4 stock parameters, autumn 2022

Area 4	No. Samples	Area km ²	Year Class			
			2022	2021	2020	2019
	41	10.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			69.8	71.7	28.0	44.4
Stock (millions)			713.4	733.3	286.8	454.0
Mean Weight (g)			0.6	1.9	3.0	4.9
Biomass (tonnes)			394.1	1387.0	865.5	2211.7
Biomass below 16 mm			394.1	1387.0	766.6	567.4
Biomass 16 mm and above			0.0	0.0	98.9	1644.3

Summary of stock assessment for Area 4 (autumn survey)

The final stock estimation, based on the survey area of **10.2 km²** are as follows:

Total number of cockles	
Total number of 2022 year class	713.4 million
Total number of 2021 and older year class	1474.1 million
Total stock biomass	
Total stock (all cockles)	4858.3 tonnes
Total stock biomass - cockles below 16mm	3115.1 tonnes
- cockles 16mm and above	1743.2 tonnes

AREA 5

3.5 Area 5 assessment of stock (spring survey)

A total of 232 sites were sampled covering a total area of 31.2 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 7 and a summary of the stock assessment is presented below. The distribution of each year class is presented in Figures 3 – 7. Area 5 contained the bulk of the cockle biomass in the TECFO fished area, and here about 51% of cockles were above 16 mm.

Table 7: Area 5 stock parameters, spring 2022

Area 5	No. samples	area km ²	Year Class			
			2021	2020	2019	2018
	232	31.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			51.0	31.5	29.4	17.3
Stock (millions)			1591.8	983.6	917.7	539.6
Mean Weight (g)			0.4	2.6	4.3	5.8
Biomass (tonnes)			682.2	2519.3	3946.4	3124.9
Biomass below 16 mm			682.2	2459.8	1743.1	144.6
Biomass 16 mm and above			0.0	59.5	2203.3	2980.2

Summary of stock assessment for Area 5 (spring survey)

The final stock estimation, based on the survey area of **31.2 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	1591.8 million
Total number of 2020 and older year class	2440.9 million
Total stock biomass	
Total stock (all cockles)	10272.7tonnes
Total stock biomass - cockles below 16mm	5029.7 tonnes
- cockles 16mm and above	5243.0 tonnes

3.6 Area 5 assessment of stock (autumn survey)

The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 8 and a summary of the stock assessment is presented below. The density and distribution of spat is presented in Figures 3 -7. The increments of annual growth rate in area 5 appeared to be relatively low, with 2 – 3 year old cockles only gaining 0.6 g per cockle on average, suggesting that the bulk of the stock may be experiencing a year of low growth rates (compare average weight of 2019 cockle in Table 7 to 2019 cockle in Table 8). A small increase in 0 – 1 year class suggests a spatfall over the summer months, however not substantial, given that the 2021 year class was of higher density.

Table 8: Area 5 stock parameters, autumn survey 2022

Area 5	No. samples	Area km ²	Year Class			
			2022	2021	2020	2019
	111	31.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			69.8	71.7	28.0	44.4
Stock (millions)			713.4	733.3	286.8	454.0
Mean Weight (g)			0.6	1.9	3.0	4.9
Biomass (tonnes)			394.1	1387.0	865.5	2211.7
Biomass below 16 mm			394.1	1387.0	766.6	567.4
Biomass 16 mm and above			0.0	0.0	98.9	1644.3

Summary of stock assessment for Area 5 (autumn survey)

The final stock estimation, based on the survey area of **31.2 km²** are as follows:

Total number of cockles	
Total number of 2022 year class	713.4 million
Total number of 2021 and older year class	1474.1 million
Total stock biomass	
Total stock (all cockles)	4858.3 tonnes
Total stock biomass - cockles below 16mm	3115.1 tonnes
- cockles 16mm and above	1743.2 tonnes

AREA 6

3.7 Area 6 assessment of stock (spring survey)

A total of 115 sample sites were surveyed covering an area of 15.5 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 9 and a summary of the stock assessment is presented below. The distribution of each year class is presented in Figures 3 – 7. The average weight per cockle in area 6 was relatively higher compared to that in areas 2 – 5 for two- to three-year-old cockles.

Table 9: Area 6 stock parameters, spring 2021

Area 6	No. samples	Area km ²	Year Class			
			2021	2020	2019	2018
	115	15.5	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			13.8	24.3	18.6	5.8
Stock (millions)			214.0	375.4	288.0	90.2
Mean Weight (g)			0.3	2.2	4.5	6.2
Biomass (tonnes)			55.8	831.6	1294.5	562.5
Biomass below 16 mm			55.8	795.2	459.9	51.1
Biomass 16 mm and above			0.0	36.3	834.5	511.3

Summary of stock assessment for Area 6, spring survey

The final stock estimation, based on the survey area of 15.5 km² are as follows:

Total number of cockles	
Total number of 2021 year class	214.0 million
Total number of 2020 and older year class	753.5 million
 Total stock biomass	
Total stock (all cockles)	2744.3 tonnes
Total stock biomass - cockles below 16mm	1362.1 tonnes
- cockles 16mm and above	1382.2 tonnes

3.8 Area 6 assessment of stock (autumn survey)

The mean density, total stock, mean weight and biomass of each year class of cockles from the 2022 autumn survey are presented in Table 10 and a summary of the stock assessment is presented below. The density and distribution of spat is presented in Figures 3 – 7. There was a decline in the average weight of 3-year-old cockles by autumn, suggesting low growth rates or mortality of larger cockles. Spat density was low at 22 individuals per meter square.

Table 10: Area 6 stock parameters, autumn 2022

Area 6	No. samples	Area km ²	Year Class			
			2022	2021	2020	2019
	57	15.5	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			21.9	46.8	40.2	6.5
Stock (millions)			339.4	724.9	621.7	100.4
Mean Weight (g)			0.3	1.2	3.3	5.3
Biomass (tonnes)			108.6	895.9	2062.6	530.1
Biomass below 16 mm			108.6	895.9	1423.5	39.1
Biomass 16 mm and above			0.0	0.0	639.1	491.1

Summary of stock assessment for Area 6 (autumn survey)

The final stock estimation, based on the survey area of **15.5 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	339.4 million
Total number of 2020 and older year class	1447.0 million
Total stock biomass	
Total stock (all cockles)	3597.2 tonnes
Total stock biomass - cockles below 16mm	2467.0 tonnes
- cockles 16mm and above	1130.2 tonnes

3.9 Distribution of cockles in the main beds (areas 4, 5 & 6)

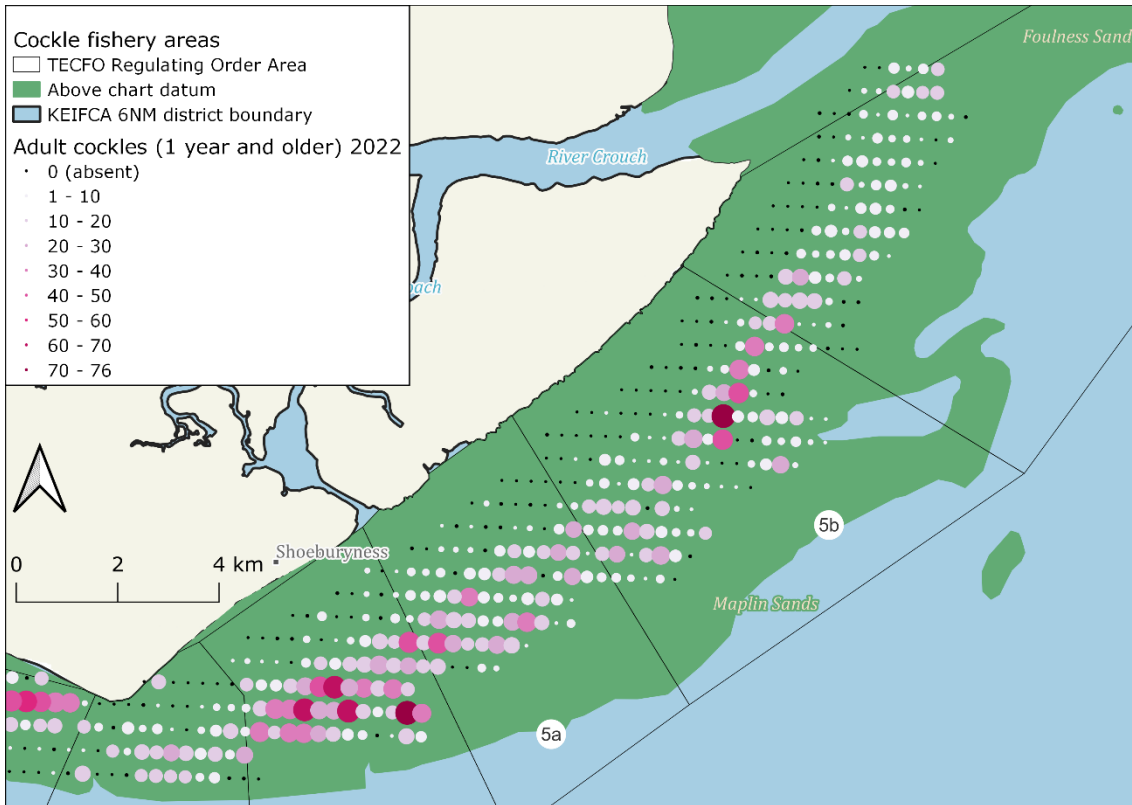


Figure 3: Distribution of adult cockles (1 year and older (2019, 2020, 2021-year classes)) in a subset of the main beds (focussing on areas 4, 5 & 6), Thames Estuary, spring 2022.

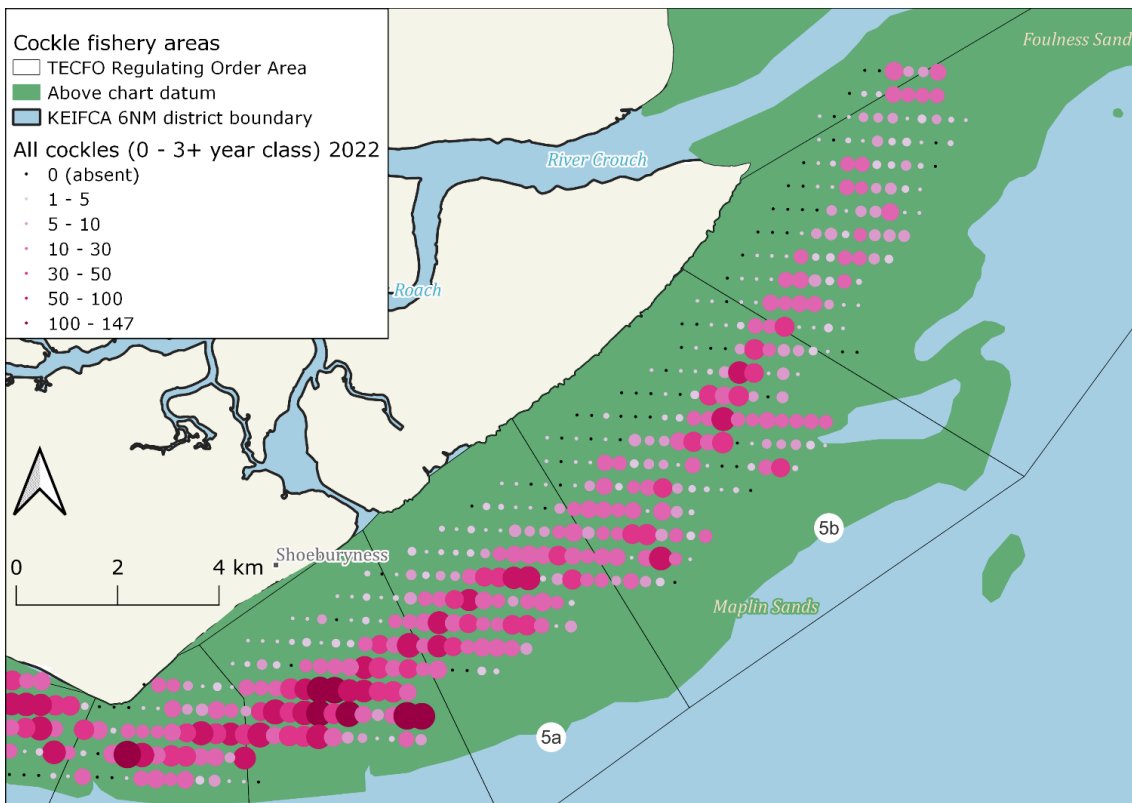


Figure 4: Distribution of all cockles (0 to 3+ year classes, where 3+ is the 2018-year class) in areas 4, 5 & 6 of the Thames Estuary, spring 2022.

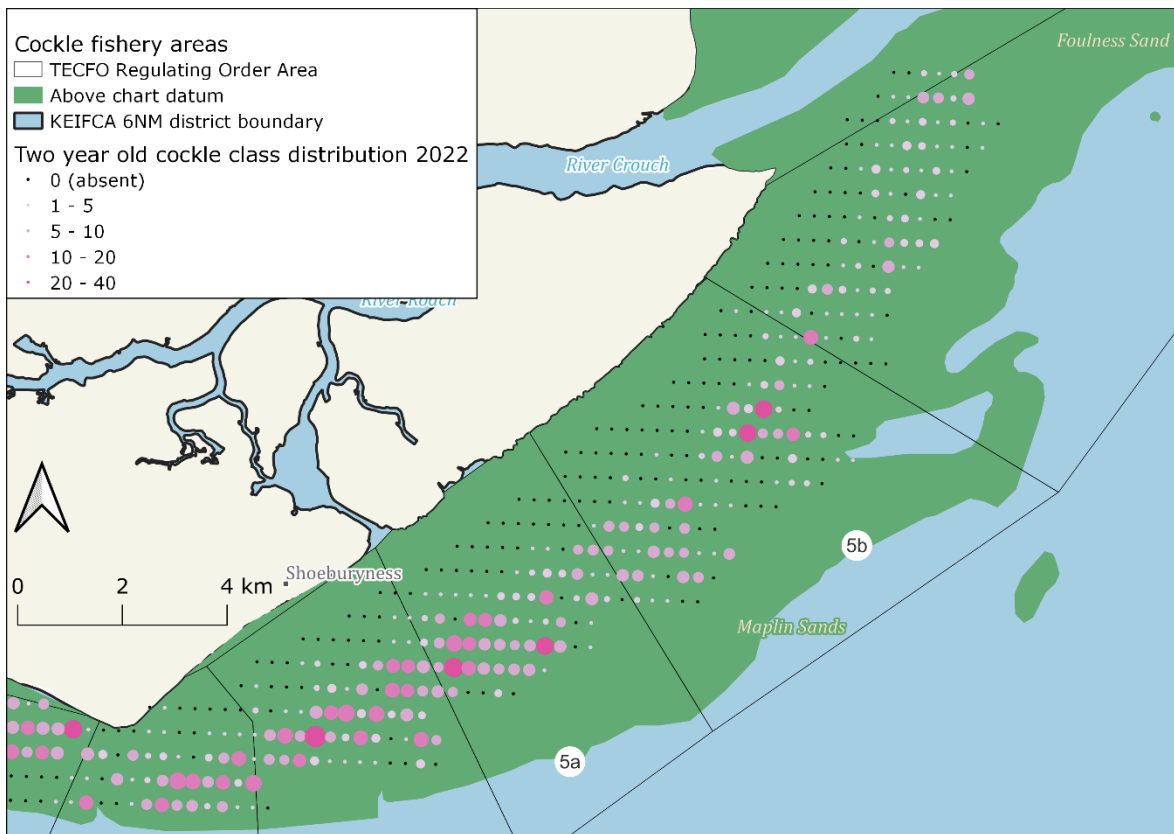


Figure 5: Distribution of 2-year-old class (2020) year class cockles in areas 4, 5 & 6 of the Thames Estuary, spring 2022.

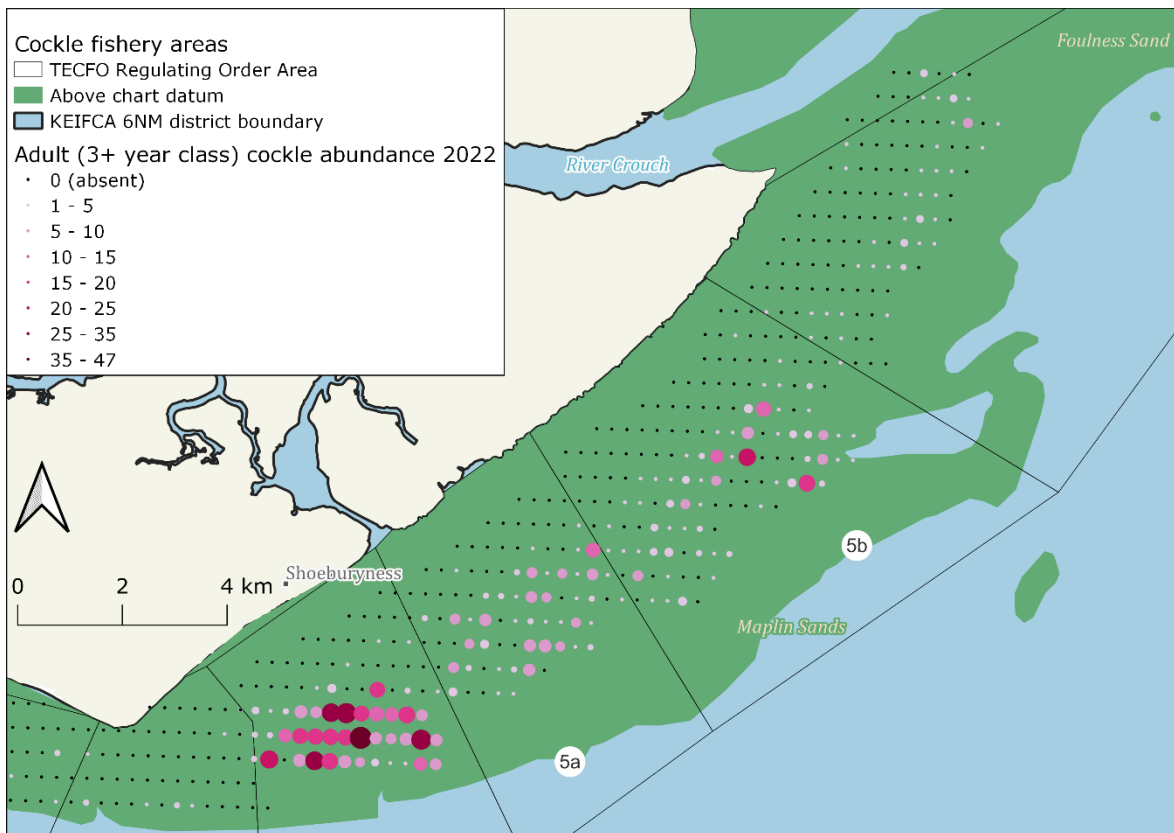


Figure 6: Distribution of 3-year-and-older year class (2019 and earlier) cockles in areas 4, 5 & 6 of the Thames Estuary, spring 2022.

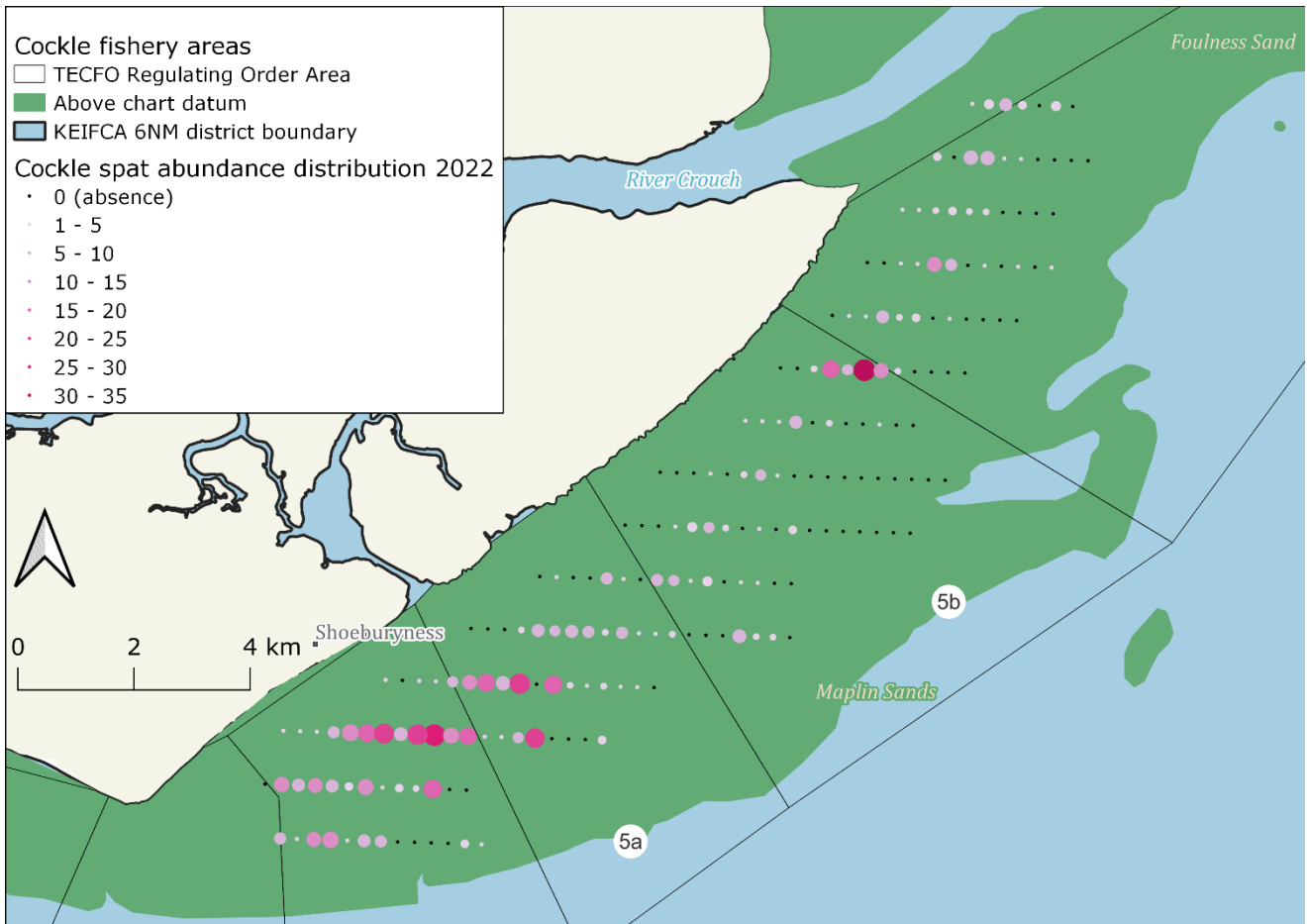


Figure 7. Distribution of cockle spat (0-year-class) in areas 4, 5 & 6 of the Thames Estuary, autumn 2022.

AREA 1

3.10 Area 1 – Marsh End assessment of stocks

A total of 41 sampling stations were surveyed in Marsh End covering an area of 2.8 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented below in Table 11, and a summary of the stock assessment is presented below. Marsh End's 1- 2 years class had a density over 100 one-to-two-year-old cockles, and 90 three-year-old cockles per square meter; comparatively high densities to the rest of the main beds. However, here also the cockles were of relatively low average weight per year class, and smaller compared to area 5.

Table 11: Marsh End stock parameters

Area 1	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	41	2.8	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			10.2	107.1	3.4	90.0
Stock (millions)			28.3	295.4	9.4	248.3
Mean Weight (g)			0.3	0.9	2.5	4.1
Biomass (tonnes)			8.1	255.0	23.5	1007.9
Biomass below 16 mm			8.1	255.0	23.5	513.4
Biomass 16 mm and above			0.0	0.0	0.0	494.5

Summary of stock assessment for Area 1 – Marsh End

The final stock estimation, based on the survey area of **2.8 km²** are as follows:

Total number of cockles:

Total number of 2021 year class	28.3 million
Total number of 2020 and older year class	553.0 million

Total stock biomass	
Total stock (all cockles)	1294.5 tonnes
Total stock biomass - cockles below 16mm	800.0 tonnes
- cockles 16mm and above	494.5 tonnes

AREA 7

3.11 Area 7 – Ray Sands assessment of stocks

A total of 105 sampling stations were surveyed covering an area of 14 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented below in Table 12, and a summary of the stock assessment is presented below. The majority of the total stock biomass was comprised by the under 16 mm, relatively high density, 2 - 3-year-old age class cockles. The Ray Sands had low densities of stocks, other than 0 – 1 year old cockles.

Table 12: Ray Sands stock parameters

Area 7 - Ray	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	105	14	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			91.7	11.2	23.3	6.8
Stock (millions)			1295.8	158.8	329.7	95.5
Mean Weight (g)			0.3	1.8	3.3	3.8
Biomass (tonnes)			387.9	286.1	1098.5	365.2
Biomass below 16 mm			387.9	286.1	997.1	120.2
Biomass 16 mm and above			0.0	0.0	101.3	245.0

Summary of stock assessment for Area 7 – Ray Sands

The final stock estimation, based on the survey area of **14 km²** are as follows:

Total number of cockles:

Total number of 2021 year class	1295.8 million
Total number of 2020 and older year class	584.0 million

Total stock biomass	
Total stock (all cockles)	1774.6 tonnes
Total stock biomass - cockles below 16 mm	1671.8 tonnes
- cockles 16 mm and above	102.7 tonnes

AREA 7

3.12 Area 7 – Dengie Flats assessment of stock

A total of 52 sampling stations were surveyed covering an area of 7.0 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented below in Table 13, and a summary of the stock assessment is presented below.

Table 13: Dengie Flats stock parameters

Area 7 - Dengie	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	52	7.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			42.7	14.9	26.3	2.2
Stock (millions)			299.1	104.3	183.8	15.1
Mean Weight (g)			0.3	2.4	3.4	4.8
Biomass (tonnes)			85.8	253.0	622.2	71.7
Biomass below 16 mm			85.8	253.0	517.4	7.5
Biomass 16 mm and above			0.0	0.0	104.7	64.1

Summary of stock assessment for Area 7 – Dengie Flats

The final stock assessment, based on the survey area of **7.0 km²** is as follows:

Total number of cockles:

Total number of 2021 year class	299.1 million
Total number of 2020 and older year class	303.2 million

Total stock biomass	
Total stock (all cockles)	1032.7 tonnes
Total stock biomass - cockles below 16mm	863.9 tonnes
- cockles 16mm and above	168.8 tonnes

AREA 7

3.13 Area 7 – Buxey Sands assessment of stocks

A total of 111 sampling stations were surveyed covering an area of 14.9 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented below in Table 14, and a summary of the stock assessment is presented below. Whilst numbers on the Buxey were relatively low, the average size of the adult stock was high, with 72 % of cockles being over 16 mm width.

Table 14: Buxey Sands stock parameters

Area 7 – Buxey Sands	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	111	14.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			37.7	1.4	15.8	1.8
Stock (millions)			562.5	21.5	235.5	26.9
Mean Weight (g)			0.2	2.5	5.0	7.2
Biomass (tonnes)			135.3	54.5	1174.7	193.5
Biomass below 16 mm			135.3	54.5	244.9	0.0
Biomass 16 mm and above			0.0	0.0	929.8	193.5

Summary of stock assessment for Area 7 – Buxey Sands

The final stock assessment, based on the survey area of **14.9 km²** is as follows:

Total number of cockles:

Total number of 2021 year class	562.5 million
Total number of 2020 and older year class	283.9 million

Total stock biomass	
Total stock (all cockles)	1558.0 tonnes
Total stock biomass - cockles below 16mm	434.6 tonnes
- cockles 16mm and above	1123.3 tonnes

AREA 8

3.14 Area 8 – East Barrow assessment of stock

A total of 64 sampling stations were surveyed covering an area of 8.6 km² in the East Barrows. The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 15 and a summary of the stock assessment is presented below. The harvestable biomass on the East Barrows in 2022 was entirely underpinned by the 2 - 3-year class.

Table 15: East Barrow stock parameters

Area 8	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	64	8.6	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.2	40.8	8.4	0.0
Stock (millions)			1.3	351.2	72.7	0.0
Mean Weight (g)			1.0	1.9	10.6	0.0
Biomass (tonnes)			1.3	667.4	771.0	0.0
Biomass below 16 mm			1.3	479.0	16.1	0.0
Biomass 16 mm and above			0.0	5.6	753.5	0.0

Summary of stock assessment for Area 8 – East Barrow

The final stock estimation, based on the survey area of **8.6 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	1.3 million
Total number of 2020 and older year class	423.9 million
Total stock biomass	
Total stock (all cockles)	1439.8 tonnes
Total stock biomass - cockles below 16mm	496.4 tonnes
- cockles 16mm and above	759.1 tonnes

AREA 8

3.15 Area 8 – Maplin Spit assessment of stock

A total of 26 sampling stations were surveyed covering an area of 3.5 km² in the Maplin Spit. The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 16 and a summary of the stock assessment is presented below. No individuals were recorded in the 0 – 1 year class during the spring 2022 survey. Only 51 tonnes of cockles were above 16 mm in (width) size, and consequently represents a very minor contribution to the fishery.

Table 16. East Barrow stock parameters

Area 8	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	26	3.5	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	135.4	0.8	0.4
Stock (millions)			0.0	473.7	2.7	1.3
Mean Weight (g)			0.0	1.6	10.5	17.0
Biomass (tonnes)			0.0	740.1	28.3	22.9
Biomass below 16 mm			0.0	740.1	0.0	0.0
Biomass 16 mm and above			0.0	0.0	28.3	22.9

Summary of stock assessment for Area 8 – East Barrow

The final stock estimation, based on the survey area of **3.9 km²** are as follows:

Total number of cockles

Total number of 2021 year class

0

Total number of 2020 and older year class

477.7 million

Total stock biomass

Total stock (all cockles)

791.2 tonnes

Total stock biomass - cockles below 16mm

740.1 tonnes

- cockles 16mm and above

51.1 tonnes

AREA 9

3.16 Area 9 – West Barrows assessment of stock

A total of 53 sampling stations were surveyed in the West Barrows area covering a surface area of 7.1 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 17 and a summary of the stock assessment is presented below. The biomass for the area was almost entirely comprised (< 1 %) of cockles below 16 mm.

Table 17: West Barrows stock parameters

Area 9/12	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	53	7.1	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			64.1	13.5	0.2	0.0
Stock (millions)			457.0	96.4	1.3	0.0
Mean Weight (g)			0.7	1.2	3.0	0.0
Biomass (tonnes)			318.3	115.7	4.0	0.0
Biomass below 16 mm			318.3	90.0	0.0	0.0
Biomass 16 mm and above			0.0	0.0	4.0	0.0

Summary of stock assessment for Area 9 – West Barrows

The final stock estimation, based on the survey area of **7.1 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	457.0 million
Total number of 2020 and older year class	97.7 million
Total stock biomass	
Total stock (all cockles)	437.9 tonnes
Total stock biomass - cockles below 16mm	408.3 tonnes
- cockles 16mm and above	4.0 tonnes

AREA 9/12

3.17 Area 9/12 – Mouse/Knob assessment of stock

A total of 50 sampling stations were surveyed in the Mouse knob area covering a surface area of 6.7 km². The mean density, total stock, mean weight and biomass of each year class of cockles are presented in Table 18 and a summary of the stock assessment is presented below. The biomass for the area was extremely low, estimated at 57.9 tonnes with very low or zero densities for all age classes, and no cockles above 16 mm.

Table 18: Mouse/Knob stock parameters

Area 9/12	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	50	6.7	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.40	5.60	0.00	0.00
Stock (millions)			2.69	37.68	0.00	0.00
Mean Weight (g)			1.00	1.46	0.00	0.00
Biomass (tonnes)			2.69	55.17	0.00	0.00
Biomass below 16 mm			2.69	55.17	0.00	0.00
Biomass 16 mm and above			0.00	0.00	0.00	0.00

Summary of stock assessment for Area 9/12 – Mouse/Knob

The final stock estimation, based on the survey area of **6.7 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	2.7 million
Total number of 2020 and older year class	37.7 million
Total stock biomass	
Total stock (all cockles)	57.9 tonnes
Total stock biomass - cockles below 16mm	57.9 tonnes
- cockles 16mm and above	0 tonnes

AREA 10

3.18 Area 10 - Leysdown assessment of stock

A total of 41 sampling stations were surveyed in Leysdown covering an area of 5.5 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 19 and a summary of the stock assessment is presented below. The total biomass for Leysdown was relatively low (60.6 tonnes) compared to other areas, and the bulk of the biomass was comprised of two-to-three and three-plus year age class cockles of which about two-thirds were over 16 mm.

Table 19: Leysdown stock parameters

Area 10	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	41	5.5	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			5.1	2.2	1.2	0.5
Stock (millions)			28.3	12.1	6.7	2.7
Mean Weight (g)			0.3	1.3	2.6	6.5
Biomass (tonnes)			9.4	16.1	17.5	17.5
Biomass below 16 mm			9.4	10.8	2.7	0.0
Biomass 16 mm and above			0.0	5.4	14.8	17.5

Summary of stock assessment for Area 10 - Leysdown

The final stock estimation, based on the survey area of **5.5 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	28.3 million
Total number of 2020 and older year class	21.5 million
Total stock biomass	
Total stock (all cockles)	60.6 tonnes
Total stock biomass - cockles below 16mm	22.9 tonnes
- cockles 16mm and above	37.7 tonnes

AREA 13

3.19 Area 13 - Scrapsgate assessment of stock

A total of 15 sampling stations were surveyed in Scrapsgate covering an area of 1.0 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 20 and a summary of the stock assessment is presented below. The biomass for Scrapsgate increased from 2021 totalling 424.3 tonnes in 2022, and the bulk of the biomass was comprised of 3+ year age class cockles, of which more than half was over 16 mm in width. The area holds promise for strong 3+ year class for the following year if survival and growth is favourable, given that it has a relatively high density of 2 – 3-year-old cockles.

Table 20: Scrapsgate stock parameters

Area 13	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	15	1.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0	3.3	116.0	38.7
Stock (millions)			0	3.4	117.1	39.0
Mean Weight (g)			0	1.0	1.4	6.6
Biomass (tonnes)			0	3.4	161.5	259.5
Biomass below 16 mm			0	1.7	146.0	13.0
Biomass 16 mm and above			0	1.7	15.5	246.5

Summary of stock assessment for Area 13 - Scrapsgate

The final stock estimation, based on the survey area of **1.0 km²** are as follows:

Total number of cockles

Total number of 2021 year class

0

Total number of 2020 and older year class

159.5 million

Total stock biomass

Total stock (all cockles)

424.3 tonnes

Total stock biomass - cockles below 16mm

160.7 tonnes

- cockles 16mm and above

263.6 tonnes

AREA 14

3.20 Area 14 – Minnis Bay assessment of stock

A total of 20 sampling stations were surveyed in Minnis Bay covering an area of 1.1 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 21 and a summary of the stock assessment is presented below. The biomass for Minnis Bay was (526.6 tonnes) and the bulk of the biomass was comprised of 1 – 2 and 3+ year age class cockles, of which the majority was over 16 mm in width.

Table 21: Minnis Bay stock parameters

Area 14	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	20	1.1	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			1.4	53.8	3.3	31.9
Stock (millions)			1.5	57.7	3.6	34.2
Mean Weight (g)			0.7	3.6	4.8	8.8
Biomass (tonnes)			1.0	208.8	17.0	299.8
Biomass below 16 mm			1.0	67.8	4.9	0
Biomass 16 mm and above			0	141.0	12.1	299.8

Summary of stock assessment for Area 14 - Minnis Bay

The final stock estimation, based on the survey area of **1.1 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	1.5 million
Total number of 2020 and older year class	95.5 million
Total stock biomass	
Total stock (all cockles)	526.6 tonnes
Total stock biomass - cockles below 16mm	73.7 tonnes
- cockles 16mm and above	452.9 tonnes

AREA 14

3.21 Area 14 – Margate Long Sands (south) assessment of stock

A total of 68 sampling stations were surveyed in Margate Long Sands covering an area of 9.2 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 22 and a summary of the stock assessment is presented below. The biomass for Margate Long Sands was down from 2021 to a tonnage of 263.6 in 2022 of which the bulk of the biomass was comprised of 3+ year age class cockles, and of which the majority was over 16 mm in width.

Table 22: Margate Long Sands stock parameters

Area 14 - Margate Long Sands	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	68	9.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			6.3	3.0	0	1.8
Stock (millions)			57.6	27.5	0	16.5
Mean Weight (g)			0.7	1.2	0	11.7
Biomass (tonnes)			38.8	32.0	0	192.8
Biomass below 16 mm			38.8	32.0	0	0
Biomass 16 mm and above			0	0	0	192.8

Summary of stock assessment for Area 14 - Margate Long Sands

The final stock estimation, based on the survey area of **9.2 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	57.6 million
Total number of 2020 and older year class	43.9 million
Total stock biomass	
Total stock (all cockles)	263.6 tonnes
Total stock biomass - cockles below 16mm	70.8 tonnes
- cockles 16mm and above	192.8 tonnes

AREA 15

3.22 Area 15 – Margate Long Sands (north) assessment of stock

A total of 69 sampling stations were surveyed in Margate Long Sands covering an area of 9.3 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 23 and a summary of the stock assessment is presented below. The biomass for Margate Long Sands in Area 15 was 1021.3 tonnes and the majority of the biomass was comprised of 3+ year age class cockles, of which all were over 16 mm in width. The area has shown three consistent years of larger than average weight and size of cockles relative to its year class when compared to areas.

Table 23: Margate Long Sands stock parameters

Area 15 - Margate Long Sands	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	69	9.3	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			24.8	23.0	0.1	5.4
Stock (millions)			230.1	214.0	1.3	49.8
Mean Weight (g)			0.6	1.3	7.0	12.2
Biomass (tonnes)			130.5	274.5	9.4	606.9
Biomass below 16 mm			130.5	274.5	0	0
Biomass 16 mm and above			0	0	9.4	606.9

Summary of stock assessment for Area 15 - Margate Long Sands

The final stock estimation, based on the survey area of **9.3 km²** are as follows:

Total number of cockles

Total number of 2021 year class

230.1 million

Total number of 2020 and older year class

265.1 million

Total stock biomass

Total stock (all cockles)

1021.3 tonnes

Total stock biomass - cockles below 16mm

405.0 tonnes

- cockles 16mm and above

616.3 tonnes

AREA 17

3.23 Area 17 – Pegwell Bay assessment of stock

A total of 91 sampling stations were surveyed in Pegwell Bay covering an area of 12.2 km². The mean density, total stock, mean weight and biomass of each year class of cockles' age presented in Table 23 and a summary of the stock assessment is presented below. The majority of the stock were 3+ year age class, over 16 mm. The area had a biomass estimate at 1089.9 tonnes, of which 95 % were over 16 mm.

Table 24: Pegwell Bay stock parameters

Area 17 – Pegwell Bay	No. Samples	Area km ²	Year Class			
			2021	2020	2019	2018
	91	12.2	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0	3.4	1.9	9.1
Stock (millions)			0	41.7	22.9	111.7
Mean Weight (g)			0	0.6	0.9	9.3
Biomass (tonnes)			0	25.6	21.5	1042.8
Biomass below 16 mm			0	25.6	21.5	4.0
Biomass 16 mm and above			0	0	0	1038.8

Summary of stock assessment for Area 17 – Pegwell Bay

The final stock estimation, based on the survey area of **12.2 km²** are as follows:

Total number of cockles	
Total number of 2021 year class	0
Total number of 2020 and older year class	176.3 million
Total stock biomass	
Total stock (all cockles)	1089.9 tonnes
Total stock biomass - cockles below 16mm	51.1 tonnes
- cockles 16mm and above	1038.8 tonnes

3.24 Combined data for all surveys

In total, 261.8 km² of cockle beds were surveyed within the Thames estuary, with 1845 sites sampled during Spring and Autumn 2022, as shown in Table 25. Within a subset of the main harvesting areas (areas 4, 5 & 6) a calculated total of 8457 million adult cockles were present during the Spring survey, and a calculated 6889 million adult cockles upon completion of the Autumn survey. The total biomass of cockles above 16 mm in the main harvesting areas (area 4 – 6) was 8879.1 tonnes during the spring and 17711.9 tonnes by the autumn.

Table 25: Survey area and cockle biomass in the Thames Estuary, 2022

Area	Area surveyed (km ²)	Total number of samples		Total biomass of 1-3 yc (tonnes)		Total biomass above 16mm (tonnes)		Total no. of 1-3 yc cockles (million)	
		Spring	Other	Spring	Other	Spring	Other	Spring	Other
1 Marsh End	2.8	41		1286.4		494.5		553.0	
2 Southend*	7.4	55		2180.8		411.0		666.1	
3 Southend*	7.1	53		1937.7		955.7		433.3	
4 Maplin Sands	10.2	76	41	5906.4	4464.2	2253.9	1743.2	1529.9	1474.1
5 Maplin Sands*	31.2	232	111	9590.5	9759.1	5243.0	3359.6	2440.9	3968.3
6 Maplin Sands*	15.5	115	57	2688.5	3488.6	1382.2	1130.2	753.5	1447.0
7 Ray Sands	14.0	104		1749.7		346.3		584.0	
7 Dengie	7.0	52		928.7		165.6		297.4	
7 Buxey*	14.9	111	111	1422.7		1123.3		283.9	
7 Foulness N	1.9	14		156.9		118.6		33.6	
8 East Barrow	8.6	64		1438.5		759.1		423.9	
8 Maplin Spit	3.5	26.0							
9 West Barrows	7.1	53		119.7		4.0			
9/12 Mouse Knob	6.7	50.0		55.2					
10 Leysdown	5.5	41		51.1		37.7		21.5	
13 Scrapsgate	1.0	15		424.3		263.6		159.5	
14 Minnis Bay	1.1	21		551.8		475.5		100.3	
14 Margate Hook	0.0	0.0		no data		0.0			
14 Margate Long Sands	13.5	100.0		330.6		283.5			
15 Margate Long Sands**	18.8	69.0	142	890.8					
17 Pegwell Bay	12.2	91		1089.9		1038.8		176.3	
Total	261.8	1383.0	462.0	32800.3	17712.0	15356.6	6233.0	8457.2	6889.4

*Same surface area sampled twice, i.e., times 2 in total area calculation; **9.3 km² in spring, 6.1 in summer, and 3.4 in autumn.

Survival of cockles in areas 4, 5 & 6

Comparison of the mean cockle density calculated from the 2022 spring survey and the autumn survey results in 2021 indicate that the survival over the 2021/22 winter period was within the normal range, with higher survival rates of the 2020 year class than younger or older cockles (Table 26).

Table 26. Mean density and winter survival rates of cockles from 2021 to 2022 by year class in areas 4, 5 & 6.

year class:	2021 Autumn Survey			2022 Spring Survey		
	mean density			mean density		
	2021	2020	2019+	2021	2020	2019+
AREA 6 (57 rectangles)	82.2	29.4	22.2	13.8	24.3	12.2
AREA 5 (110 rectangles)	146.1	38.0	41.6	51.0	31.5	23.3
AREA 4 (36 rectangles)	135.1	35.9	96.6	147.9	36.4	56.6
Cockle stock remaining (Area 6)				10.2%	67.7%	12.6%
Cockle stock remaining (Area 5)				34.9%	82.9%	56.0%
Cockle stock remaining (Area 4)				109.5%	101.7%	58.6%
	Mean			51.5%	84.1%	42.4%

3.25 Long term trends in cockle populations within areas covered by the TECFO

Table 27: Autumn cockle stocks (millions) excluding spat within areas covered by the TECFO between 1993 & 2022.

YEAR	AREA							
	1	2	3	4, 5 & 6	8 East Barrows	11	13	TOTAL
1993				4371	237			4608
1994			162	5721	287			6107
1995		1276	2783	6789	26			10874
1996		857	1064	4641	358			6920
1997		166	1053	3963	78			5260
1998		112	361	2154	77			2704
1999	246	1004	2087	13412	68			16817
2000		397	941	8117	18		655	10128
2001		256	582	4588	<1			5426
2002		395	445	3907	3	3228		7978
2003		529	1156	8104	0		420	5639
2004		448	1495	4312				6255
2005		797	1086	3420			90	5393
2006		405	545	6646	9	1278		11484
2007		755	1286	8966	8	4158		15173
2008	535	433	385	7960	8			9321
2009		618	1260	6976				8854
2010		1234	1126	5916	20		172	8468
2011		275	663	5084	11		61	6094
2012		198	480	3259			94	4031
2013	159	65	109	7561			85	7979
2014		30	127	5152				5309
2015				6026				6026
2016				3597				3597
2017				7589				7589
2018				12030				12030
2019				13318				13318
2020				8635.4				8635.4
2021				7052.1				7052.1
2022				6889.4				6889.4

Table 28: Stocks of all cockles (millions), excluding spat, in main areas outside of those covered by the TECFO between 1997 & 2022.

YEAR	Area 7	Area 7	Area 7	Area 10	Area 14*	TOTAL
	Dengie	Buxey	Ray		Minnis Bay	
1997	138	84				232
1998	926	232			10	1168
1999	2173	1130				3702
2000	1992	296				2288
2001	1220	486				1506
2002	1031	340				1371
2003	507	561	1193			2161
2004	245	405	272	69	9	1000
2005	1640	1418	540	3		3601
2006	891	445	1090		327	2753
2007	1120	2041	2430		100	5691
2008	1105	2211	2106		359	5781
2009	391	475	875	73	62	1876
2010	231	522	955	117	19	1844
2011	878	632	1330	63	33	2936
2012	319	299	1005	367	9	1999
2013	225	312	811	176	3	1527
2014	120	131	981	44	67	1343
2015	231	101	560	16	47	954
2016	429	655	1000	18	21	2123
2017	192	472	389	192	90	1335
2018	424	863	1978	86	129	3480
2019	263	839	1559	Not surveyed	Not surveyed	2661
2020	Not surveyed	Not surveyed	Not surveyed	Not surveyed	Not surveyed	Not surveyed
2021	395	354	776	149	77	1751
2022	297	284	584	22	100	65

3.26 Comparison of long-term trends for areas 4, 5 & 6

Surveys of the Areas 4, 5 & 6 within the TECFO have now been carried out for almost two decades.

Adult cockle stocks appear to have stabilised after the sharp short-term declining trend (Figure 8) in the previous two years. The population estimates are close to the long-term mean values. The substantial variation observed in the stock size over time appears to be driven by recruitment success and over winter survivorship (Table 26**Error! Reference source not found.**), however there appears to be have been a relatively low over-summer survivorship compared to the year before. The relatively low spatfall values in 2020 and 2021 suggests that the adult cockle population size for 2022's may be smaller than the preceding two years. Spatfall was down from 2021, and well below the long-term mean recorded for autumn.

Adult stock before and after winter

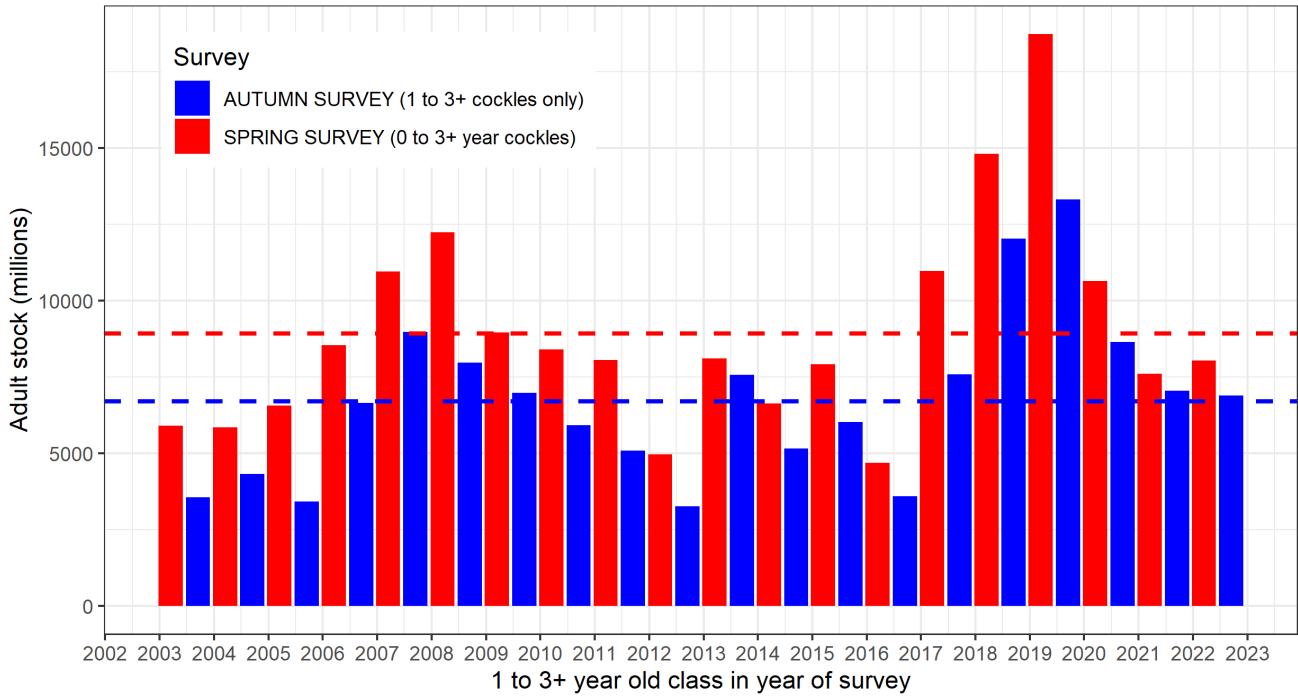


Figure 8: Seasonal adult cockle stocks (1 to 3+ year class in year of survey) on areas 4, 5 and 6 from 2003 to 2022, with mean values indicated by dashed lines for spring and autumn respectively.

Stock size of spat before and after first winter

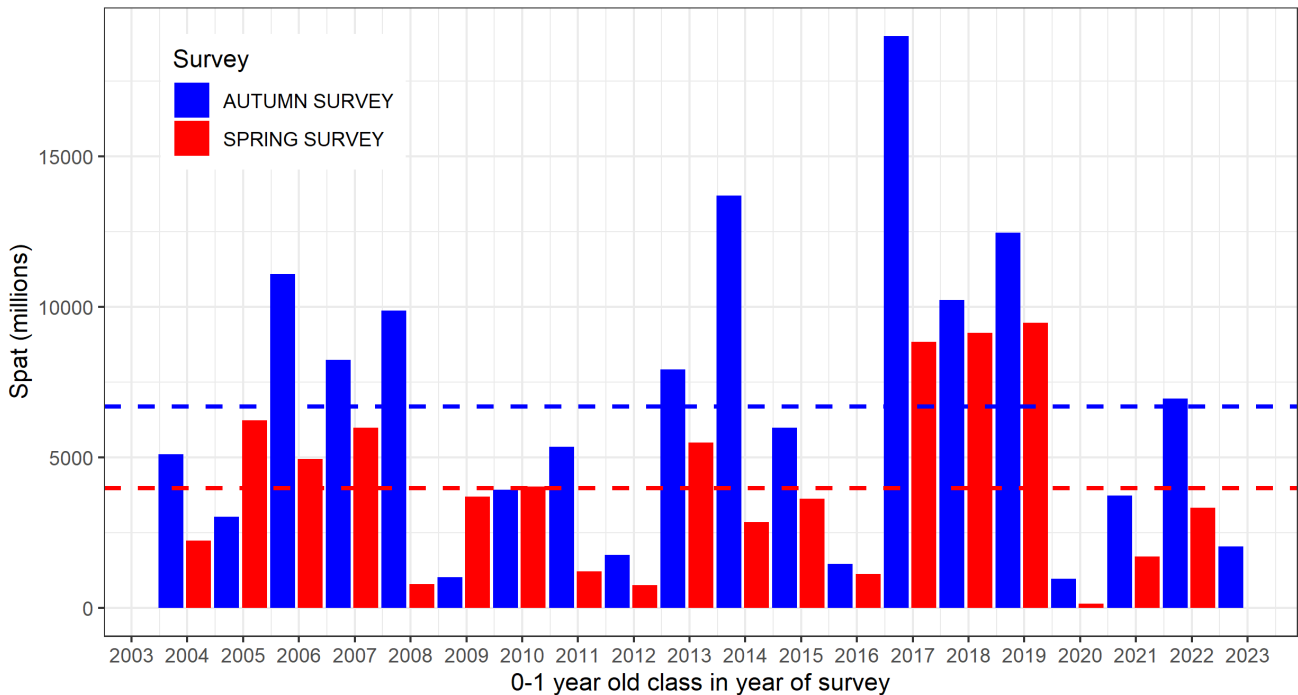
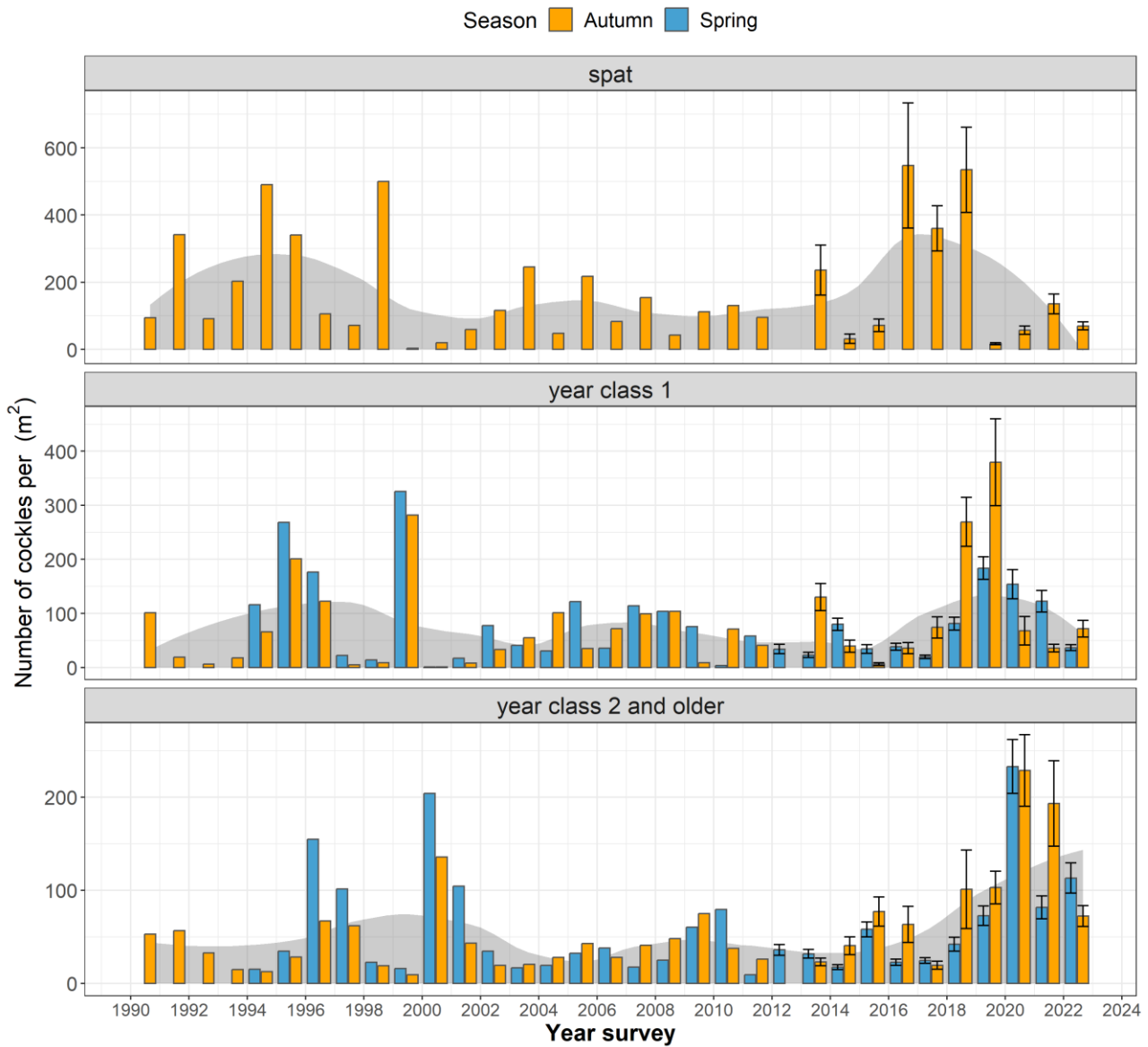


Figure 9: Seasonal number of cockle-spat before and after the first winter on areas 4, 5 and 6 from autumn 2003-2022, with mean values indicated by dashed lines for spring and autumn respectively.

3.27 Comparison of long-term trends for Area 4

Cockle density for area: 4



Cockle biomass for area: 4

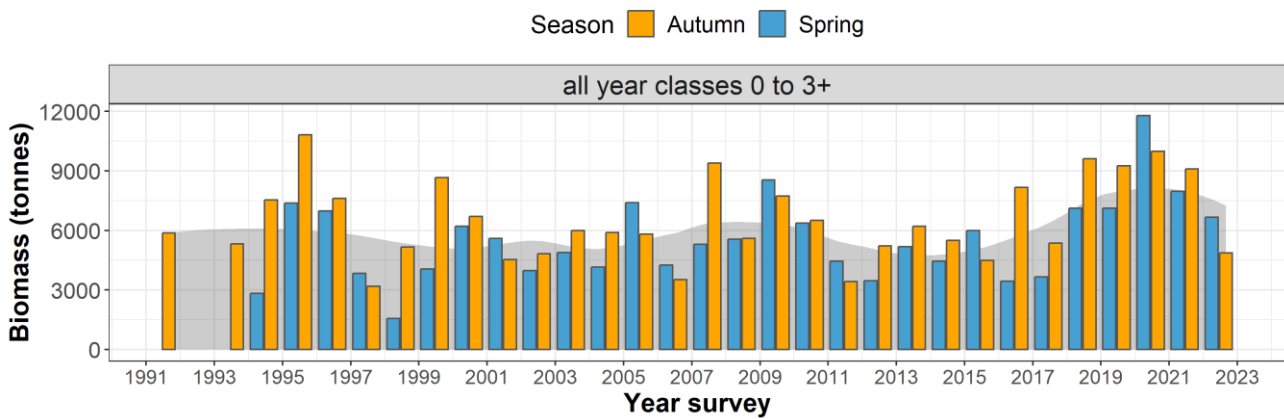


Figure 10: Mean cockle densities & total stock biomass in Area 4, 1991 - 2022

3.28 Comparison of long-term trends for area 5

Cockle density for area: 5



Cockle biomass for area: 5

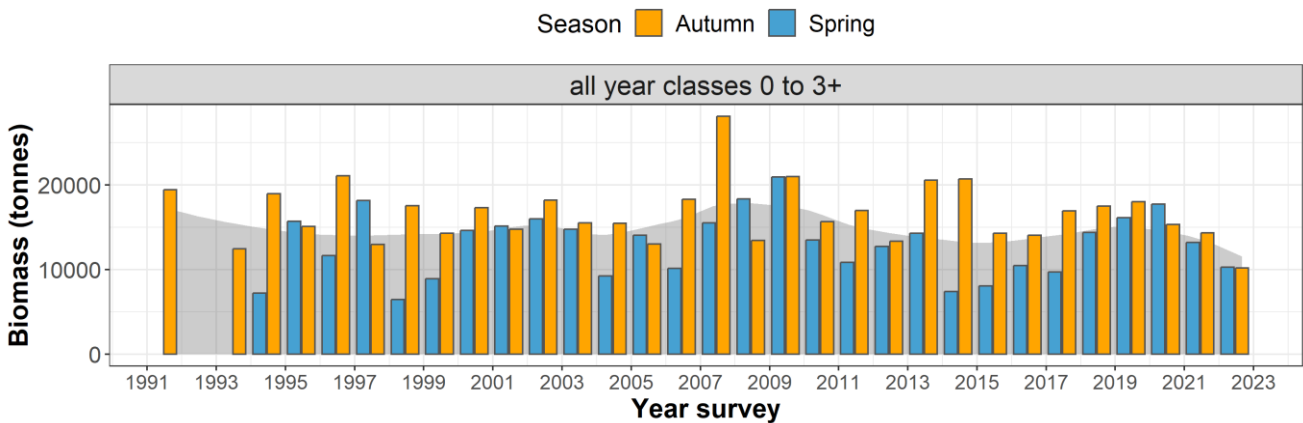


Figure 11: Mean cockle densities & total stock biomass in area 5, 1991-2022

3.29 Comparison of long-term trends for area 6

Cockle density for area: 6



Cockle biomass for area: 6

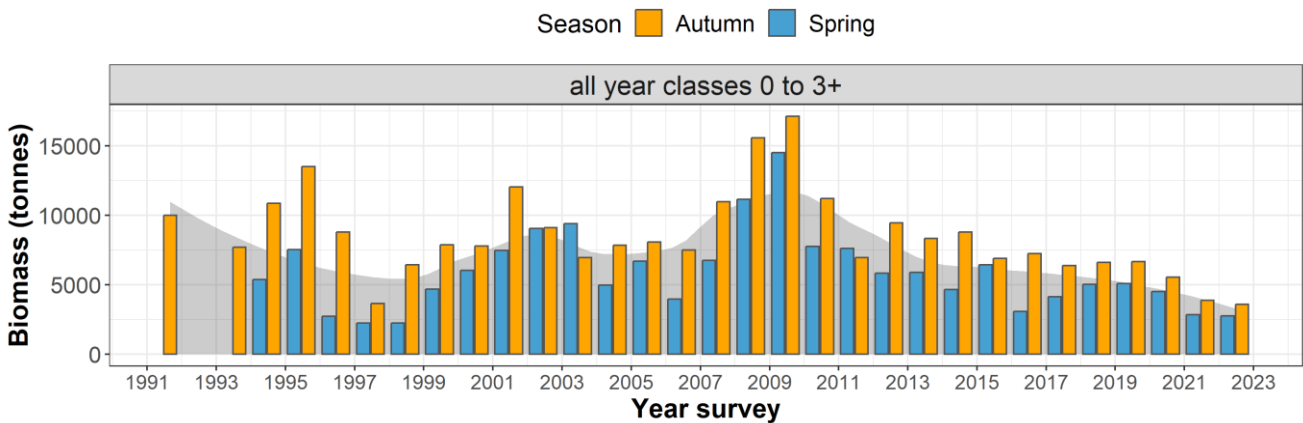
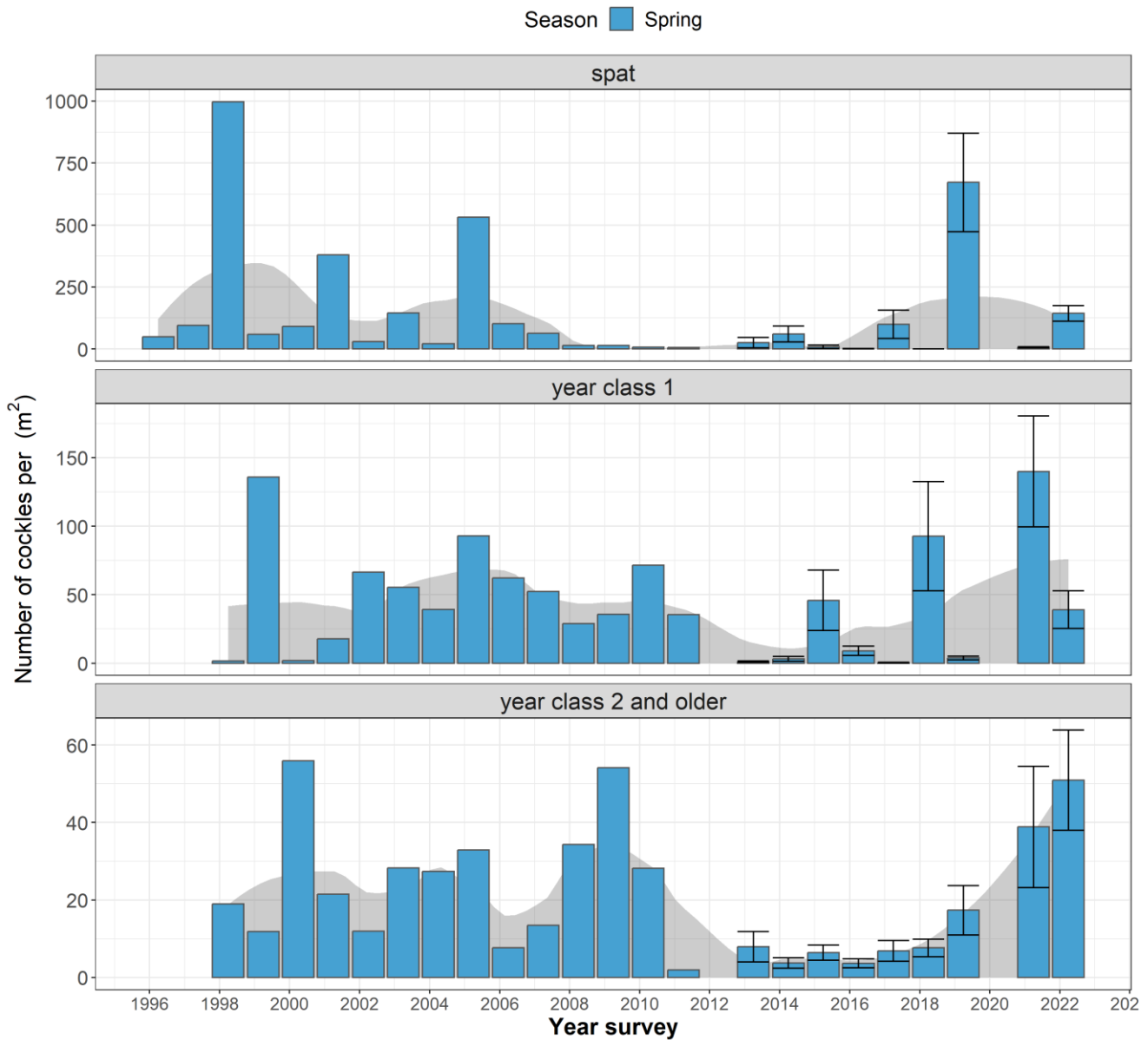


Figure 12: Mean cockle densities & total stock biomass in area 6, 1991-2022

3.30 Comparison of long-term trends for area 2

Cockle density for area: 2



Cockle biomass for area: 2

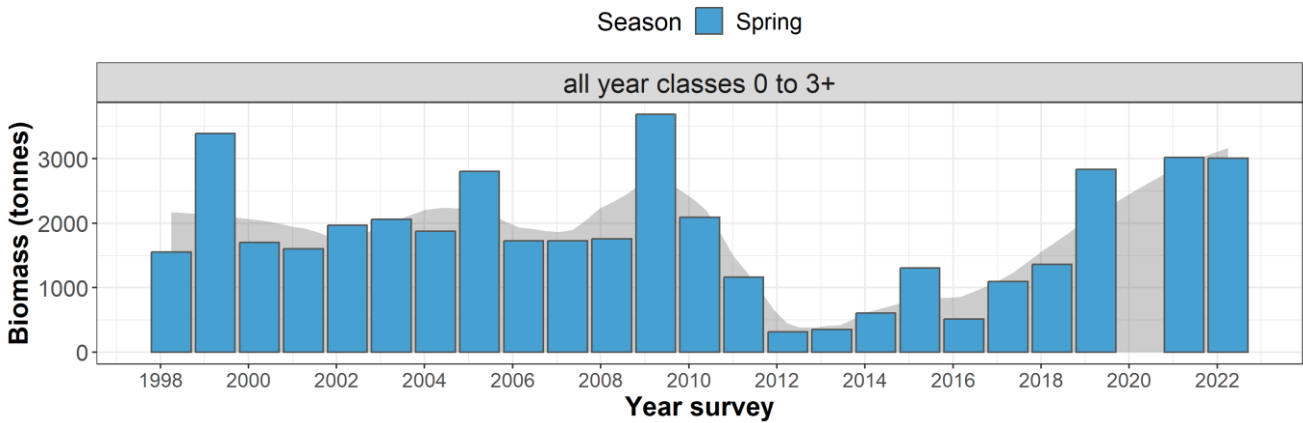
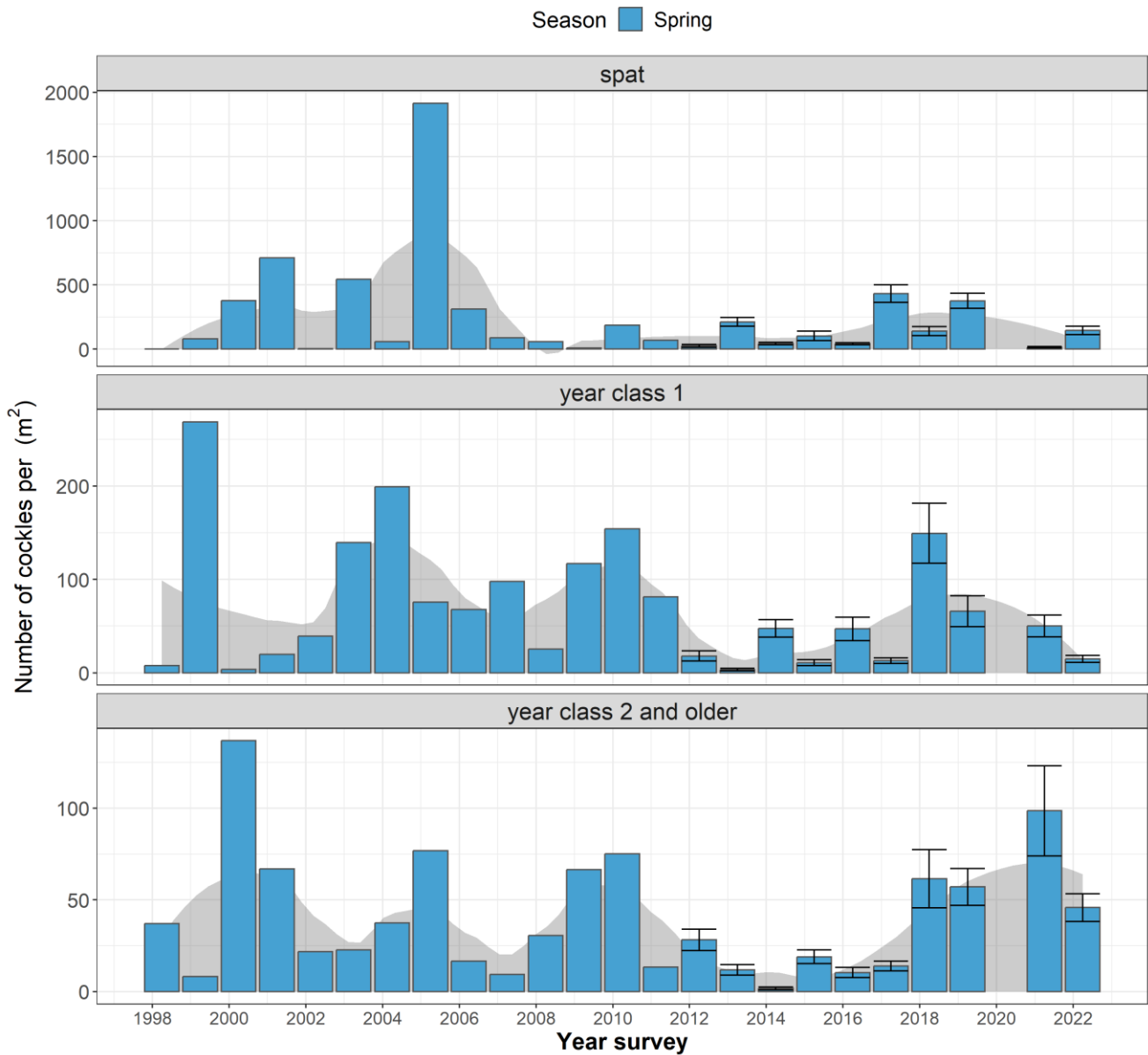


Figure 13: Mean cockle densities & total stock biomass in area 2, 1998-2022

3.31 Comparison of long-term trends for area 3

Cockle density for area: 3



Cockle biomass for area: 3

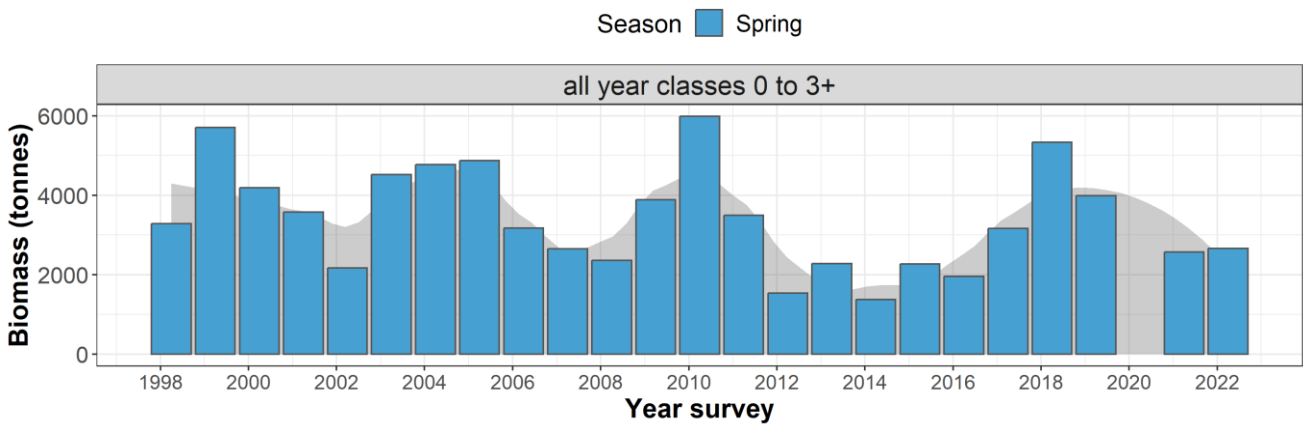
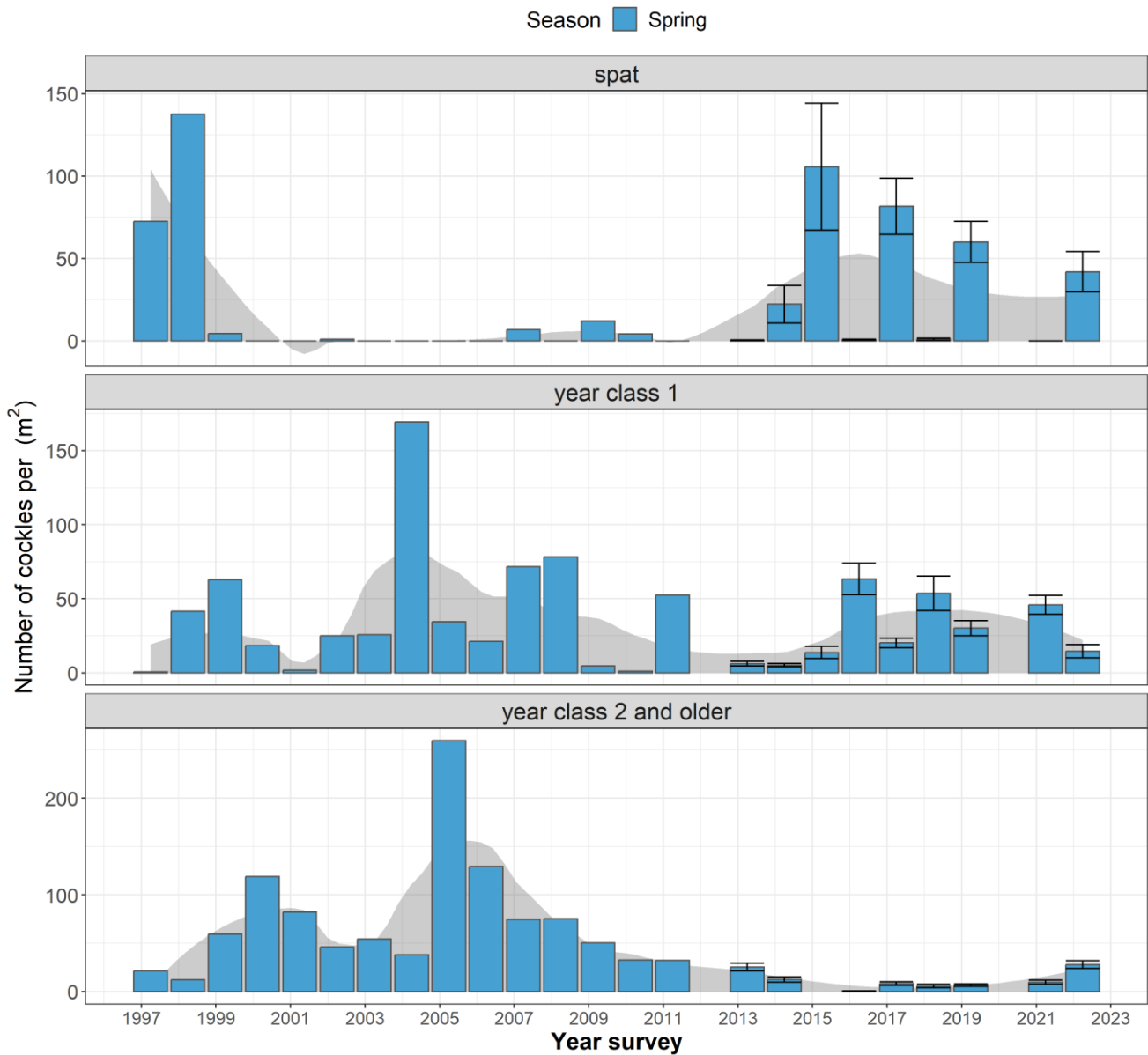


Figure 14: Mean cockle densities & total stock biomass in area 3, 1998-2022

3.32 Comparison of long-term trends for area 7 – Dengie Flats

Cockle density for area: 7 Dengie



Cockle biomass for area: 7 Dengie

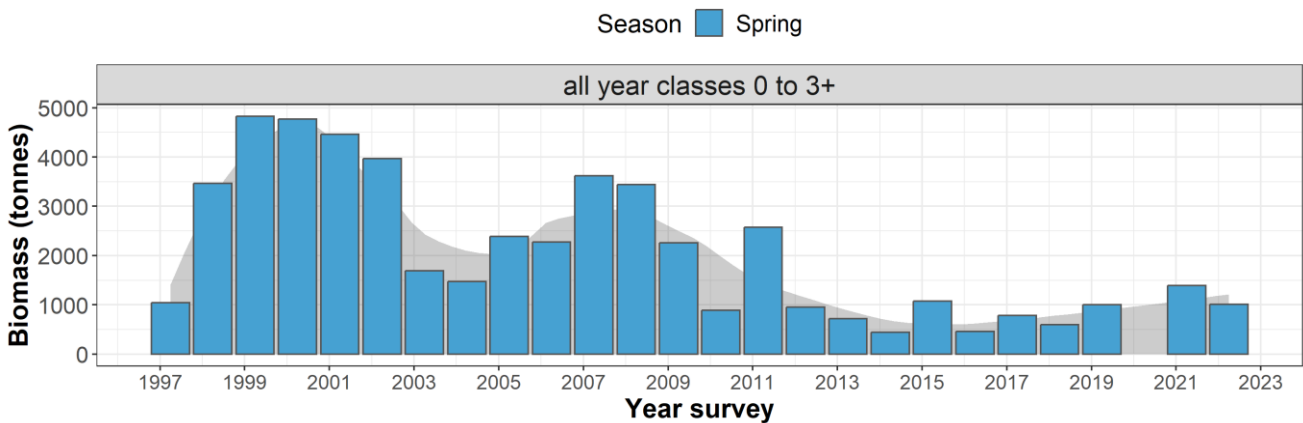
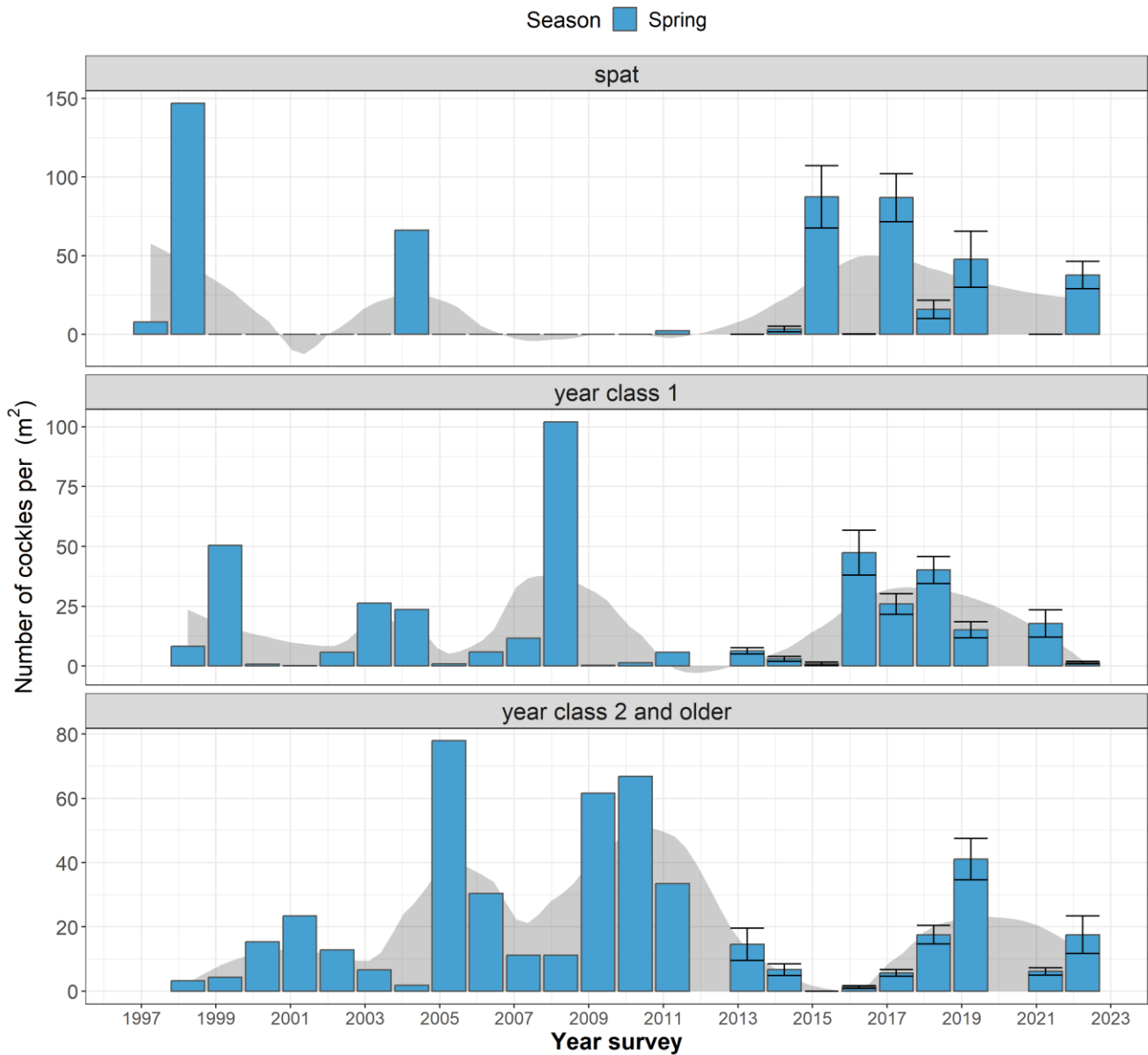


Figure 15: Mean cockle densities & total stock biomass in area 7 - Dengie Flats, 1997-2022

3.33 Comparison of long-term trends for area 7 – Buxey Sands

Cockle density for area: 7 Buxey



Cockle biomass for area: 7 Buxey

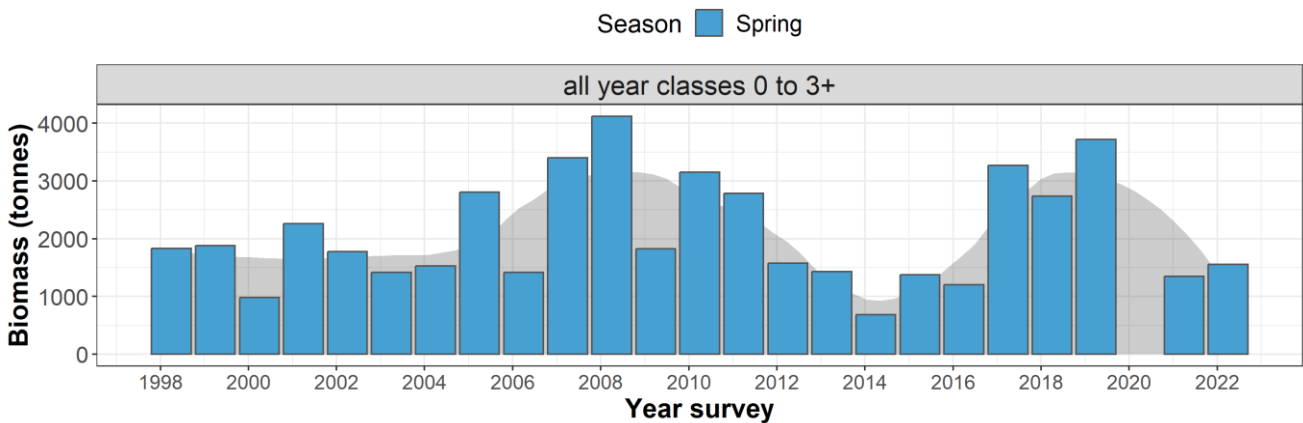
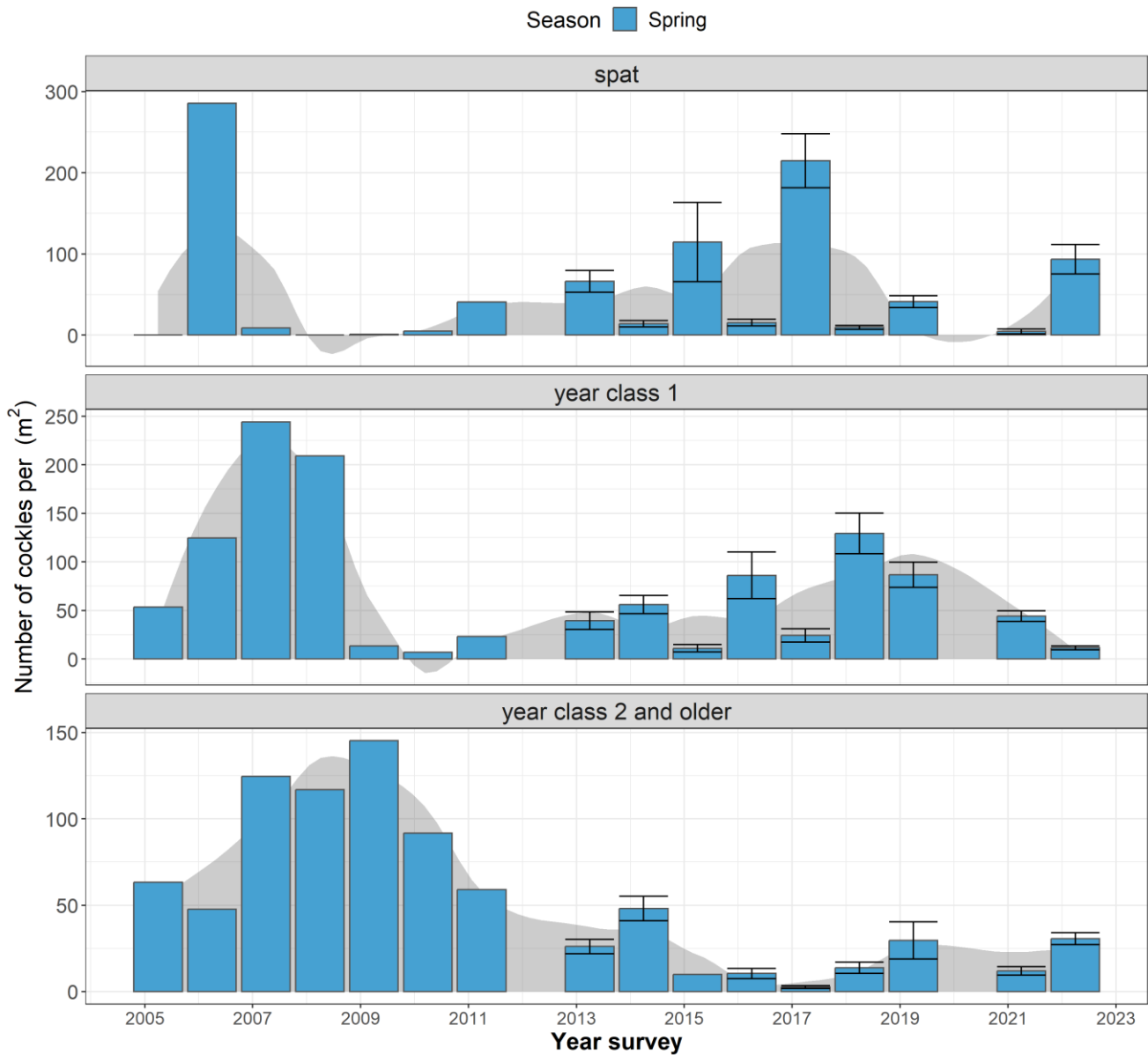


Figure 16: Mean cockle densities & total stock biomass in area 7 - Buxey Sand, 1998-2022

3.34 Comparison of long-term trends for area 7 – Ray Sands

Cockle density for area: 7 Ray



Cockle biomass for area: 7 Ray

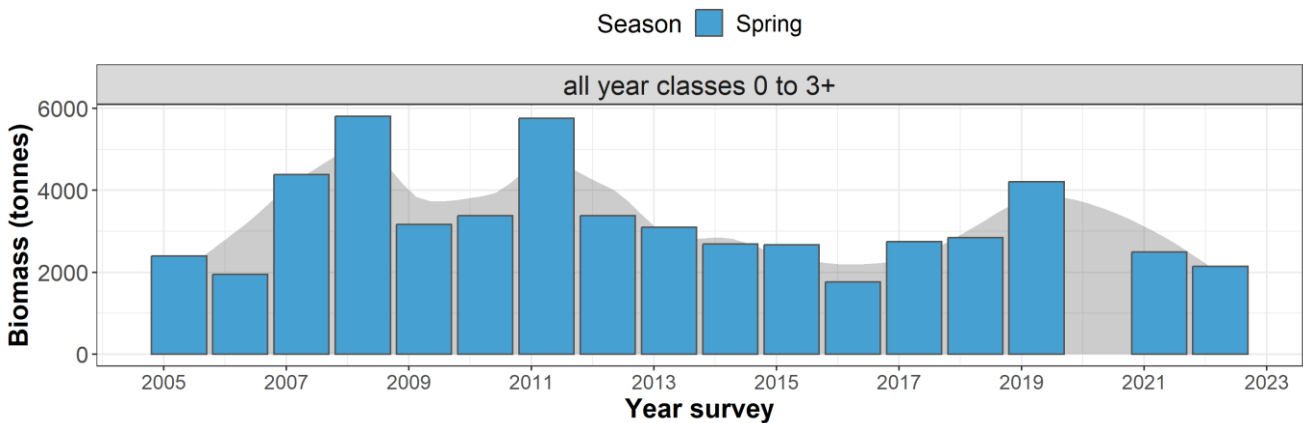


Figure 17: Mean cockle densities & total stock biomass in area 7 - Ray Sand, 2005-2022

4 CONCLUSION

4.1 Summary of results

A total area of 261.6 km² was surveyed during 2021, with a total of 1854 samples collected. On the Maplin and Foulness Sands (Areas 4, 5 & 6), which constitute the main commercial harvesting areas, a total of 632 samples were taken, of which 423 were collected during the Spring survey and 209 during the autumn survey. Overall, this represents a slight increase and comparable to the number of samples collected in 2022 and prior to 2020, suggesting that the survey effort was relatively high.

The total number of adult cockles (excluding any spat) on the Maplin and Foulness Sands (core subset of the main beds) was estimated at 4724.4 million cockles in the spring and 6889.4 million by the autumn (representing approximately 46 % increase). This follows 2021 when a 19 % increase was observed from a spring stock size of 5903 million cockles to 7052 million by the autumn for the same area. This was in contrast to 2020, when a 18 % decline was observed with a change from 10497 million cockles during spring to 8635.3 million by the autumn. Despite cockle populations stabilising and showing indications of growth, biomass declined. The 2022 total biomass of cockles above 16 mm in the core subset of the main harvesting areas was 8879.1 tonnes during the spring and decreased to 6233.0 tonnes by the autumn. This is a concerning drop in biomass, when compared to 2021, when the total biomass in the core subset of the main harvesting areas was 8884.4 tonnes during the spring and increased to 12285.2 tonnes by the autumn. Adult stock and biomass ought to increase from spring to autumn are a result of growth over the summer, when the 0–1-year class of cockles from the spring grows to reach adult size by the autumn of the same year, prior to winter mortality, as well as growth accrued over the summer in terms of biomass. Conversely, declines are likely to be caused by mortality of adult stock. Mortality of can be attributed to environmental and fishing pressures. As the data for the individual areas have shown, it appears that in 2022 lower than average growth occurred, and possibly coupled with mortality of larger cockles in the older year classes.

Cockle spat in 2022 was below average estimated at 2031.5 million individuals, down from autumn of 2021 estimated at was 6954 million individuals and lower than 2020 (3727 million). Spatfall can be highly irregular between years, as shown in Figure 9. The high variations in spatfall between years appears to be driven by environmental conditions and has gone through about 5 cycles of sinusoidal increases and decreases over the past 18 years.

The combination of a stable but below average size of adult cockle stock, coupled with a very low spatfall suggests that the conditions were sub-optimal for growth and reproduction, and may therefore have a low capacity to replenish stocks for the 2023 fishery. The spring survey of 2023 will be very important to assess the seriousness of the lack in growth and spat on the population of cockles in the Thames.

4.2 Implications for future management of the fishery

Data from the 2022 cockle survey contributes to a long-term data set of cockle stocks used to inform long term stock management strategies, and adjust year to year management measures, such as the Total Allowable Catch (TAC) limits from year to year.

The stocks recorded in 2022 represents a stabilization of the adult stock size at normal levels, after it had come down in 2020 and 2021 from three exceptionally high years (2017 – 2019). This peak in the Thames cockle stock-size followed three years (2016 – 2018) of exceptionally high levels of spatfall relative to that recorded over the last two decades. Analysis of the cockle population since surveys commenced in 1998 indicate periodic fluctuations, with typical peaks and troughs. The adult population size on the core subset of the main cockle beds therefore is within the normal range and is considered relatively stable and supports our previous assessment in 2021 which suggested that the population was stabilising after the sharp drop from 2019.

While the population has stabilised in terms of number of adult cockles, both spatfall, size and biomass of cockles are down from 2021 and below the long-term average. The substantial reduction of the adult cockle population size and biomass could affect the TAC, and fishing quotas by 2023. Furthermore, a low spatfall, suggests limited capacity to replenish the population size in 2023. Winter survivorship, which will be recorded in the 2023 spring survey will be of great importance to determine the TAC for the fishery. If there were a low survivorship of adult cockles on the back of the poor growth observed in the summer of 2022, the biomass available to the 2023 fishery for cockles over 16 mm will be reduced and it is then forecast to result in a declined number of fishing trips for 2023.