Thames Estuary
Cockle Survey Report
2023

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Executive Summary

This report gives an annual up-date on the assessment of all cockle stock surveys carried out by the Kent and Essex Inshore Fisheries & Conservation Authority (KEIFCA) during 2023. 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

Printed 12 May 2023

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1   INTRODUCTION

This report presents the findings from the 2023 annual surveys conducted in the Thames Estuary. These surveys provide essential data used to guide the sustainable management of the cockle (*Cerastoderma edule*) fishery.

The Thames Estuary is home to a significant cockle fishery, regulated by KEIFCA under the Thames Estuary Cockle Fishery Order, 1994 (TECFO) and relevant bylaws. Since 1988, the Authority has undertaken annual surveys of the cockle beds within the Thames Estuary to gather robust data essential for the sustainable management of the cockle fishery.

These annual surveys play a crucial role in providing information for the regulation of both the TECFO and Outside cockle fisheries, facilitating the establishment of their annual Total Allowable Catch (TAC) limits. This ensures the operation of a sustainable fishery. Additionally, sustainable management of cockle stocks offers vital insights for environmental management, including maintaining sufficient food sources for wading birds and marine species within the numerous Marine Protected Areas (MPAs) where the fishery operates. This management aims to control the exploitation of the cockle population, preventing any significant adverse impacts on the features of the Essex Estuaries SAC, the Mid Essex Coast, and Outer Thames Estuary SPA sites.

The cockle survey program is designed to assess annual and seasonal trends in cockle stocks within the major commercial harvesting areas of the Thames Estuary. These surveys are conducted on known cockle beds, divided into cockle management areas (see Figure 1), where stocks and fishing activity are evaluated annually.

The results of the stock assessment surveys enable examination of the distribution, density, and age structure of cockles in different areas, as well as the estimation of population size and biomass. These results, combined with data from preceding autumn surveys and subsequent spring surveys, are analysed within the context of long-term trends to inform the establishment of the total allowable catch (TAC) for the commercial fishing sector. The TAC is distributed among license holders (for areas within the TECFO) or permit holders (for areas outside the TECFO).
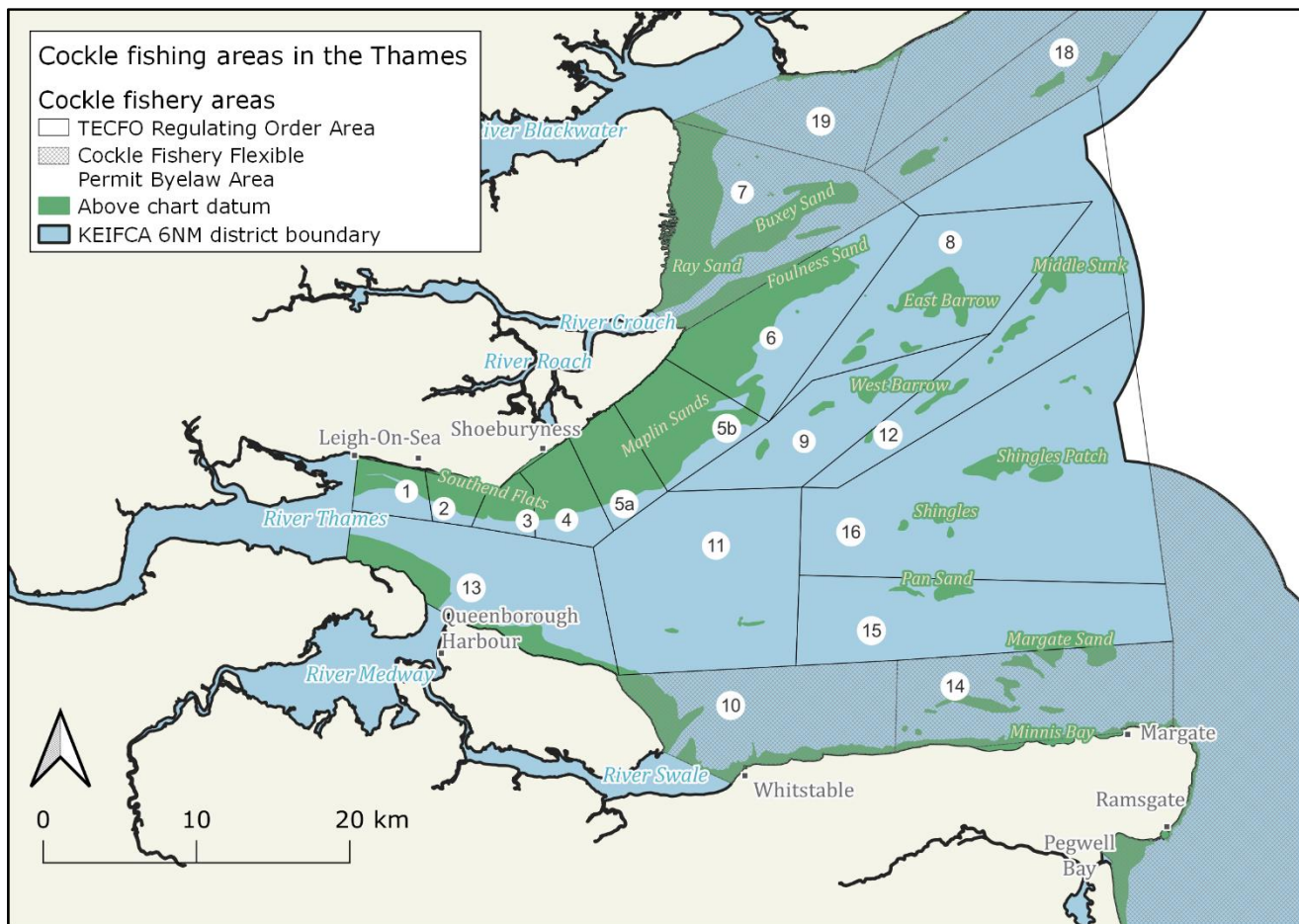
Figure 1: Cockle management areas in the Thames Estuary, showing two types of cockle fishery areas, as well as seabed above chart datum and sandbank names.

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 (main beds) were accessed using all-terrain vehicles (ATVs; Figure 2a). Sampling in the main beds was conducted during April 2023 around spring low tides, from 2-hours-before and 2-hours-after low water. The above sampling was carried out and repeated during September 2023 (autumn) for the subset of the main cockle harvesting areas; 4, 5a, 5b and 6 (Table 1). Samples were collected near the centre of each accessible (some sites become flooded and inaccessible over time) grid cell in the survey grid using an aluminium 0.1 m^2 quadrat (Figure 3). Sediment was removed from the upper 6 cm inside the 0.1 m^2 quadrat using a rake and sieved through a 5 mm square meshed sieve. Any cockles retained on the sieve with a 6×6 mm mesh size, 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 vessels, namely, 'FPV Tamesis' and 'FPV Nerissa', during April 2023 for all other cockle management areas (See Table 1). Samples were collected using a 0.1 m^2 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.

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

Annual sampling of all commercially harvested cockle beds in the Thames Estuary commenced on the 6th of April 2023 for the spring-survey, and the autumn-survey limited to the main cockle beds on the Maplin Sands were carried out over 3 days commencing on the 1 September 2023. 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, biomass and distribution of different age classes of cockles in the Thames Estuary to base the annual Total Allowable Catch (TAC) on. The main objectives of the autumn survey are to assess spat settlement and abundance, along with the distribution of the remaining cockles. The survey schedule is provided in Table 1. During the period from the 2nd of June to 6th October, the grounds were subject to controlled commercial fishing activity during 2023.

Table 1: Date and survey method, Thames Estuary, 2023

Survey Area	Survey Date	Survey Method	Platform
Area 1 – Marsh End	25/04/2023	Day grab	Tamesis FPV
Areas 2 & 3	09/04/2023, 24/04/2023	Quadrat, Day grab	All-terrain vehicles, Tamesis FPV
Areas 4, 5 & 6 (Spring)	06/04/2023 - 08/04/2023	Quadrat	All-terrain vehicles
Areas 4, 5 & 6 (Autumn)	01/09/2023 – 02/09/2023	Quadrat	All-terrain vehicles
Area 7 – (N. Foulness)	06/04/2023	Quadrat	All-terrain vehicles
Area 7 – Ray Sand	05/05/2023	Day grab	Tamesis FPV
Area 7 – Dengie	02/04/2023, 03/04/2023	Day grab	Tamesis FPV
Area 7 – Buxey	09/05/2023	Day grab	Tamesis FPV
Area 8 – East Barrow	04/04/2023	Day grab	Tamesis FPV
Area 8 – Maplin Spit	Not surveyed in 2023		
Area 9 – West Barrows	17/04/2023	Day grab	Tamesis FPV
Area 9/12 – Mouse/Knob	26/05/2023	Day grab	Tamesis FPV
Area 10 – Leysdown & Ham	05/04/2023	Day grab	Nerissa FPV
Area 13 - Scrapsgate	18/04/2023	Day grab	Nerissa FPV
Area 14 – Minnis Bay	09/05/2023	Day grab	Nerissa FPV
Area 14 – Margate Hook	09/05/2023	Day grab	Nerissa FPV
Area 14 – Margate Sands	21/04/2023, 24/04/2023	Day grab	Nerissa FPV
Area 15 – Margate Sands	17/04/2023	Day grab	Nerissa FPV
Area 15 – Margate Sands	18/07/2023	Day grab	Nerissa FPV
Area 17 – Pegwell Bay	25/04/2023	Day grab	Nerissa FPV

*(All samples in blue represents spring samples, and orange-yellow represents autumn samples)

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.
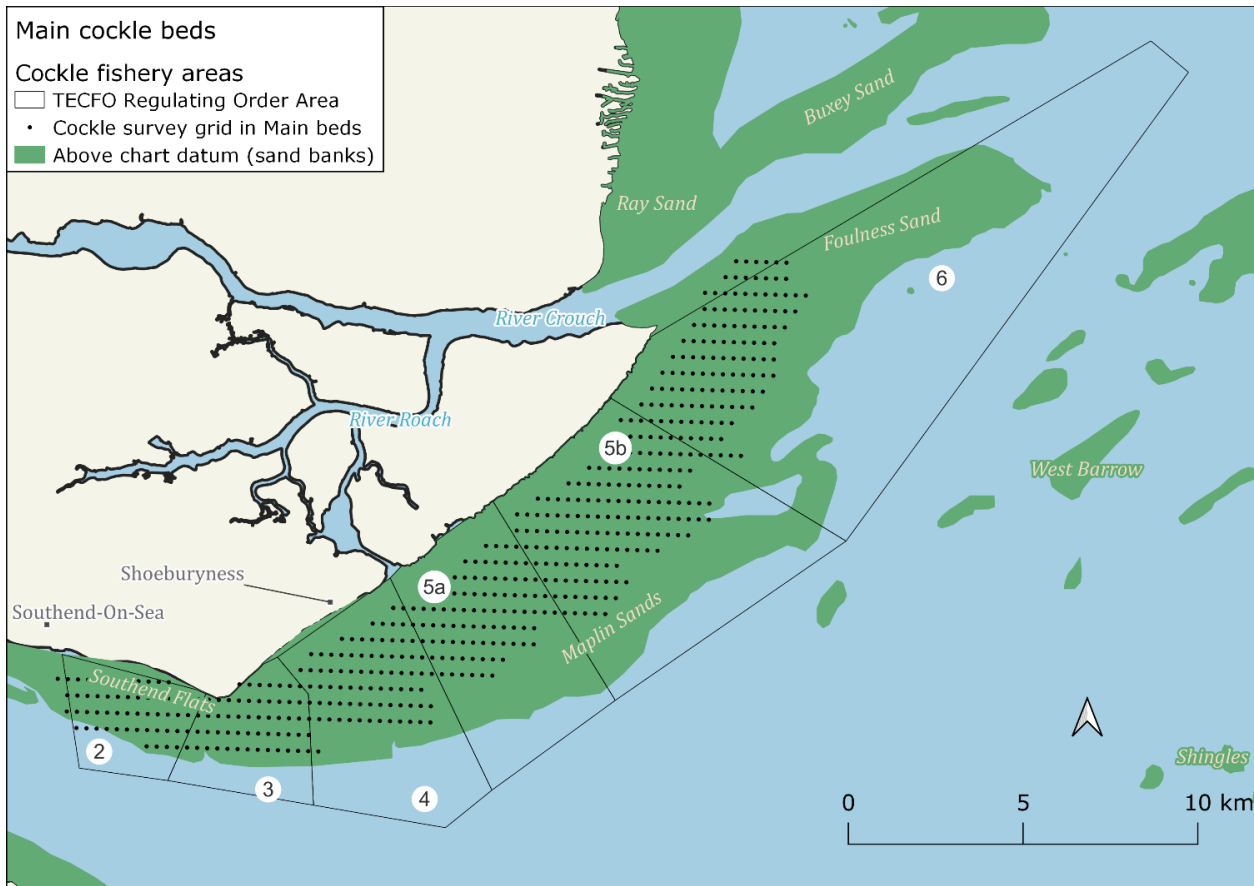
Figure 3. Kent and Essex IFCA's Thames Estuary cockle survey sampling positions in the main cockle harvesting Areas: 2, 3, 4, 5a, 5b and 6.

2.4 Area covered by survey

A total of 1231 samples were taken during the 2023 spring surveys, and a further 202 during autumn surveys. The spring and autumn surveys covered an area of 311.4 km² (Table 2).

Table 2: Number of samples taken and area of cockle beds surveyed in the Thames Estuary in 2023.

Area	Number of samples	Area surveyed (km²)
1 Marsh End (includes Chapman Sands)	30	2.8

2 East of pier	52	7.0
3 West of Shoebury boom	53	7.1
4 East of Shoebury boom	77	10.4
4 East of Shoebury boom (autumn)	40	10.4
5 Maplin Sands	230	30.9
5 Maplin Sands (autumn)	111	31.2
6 North Maplin and Foulness Sand	125	16.8
6 North Maplin (autumn)	52	14.9
7 Buxey	96	12.9
7 Dengie	51	7.0
7 Ray Sands	102	13.9
8 East Barrow	64	8.6
8 Maplin Spit	26	3.5
9-12 Mouse Knob	49	6.6
9 West Barrows	36	4.8
10 Leysdown	22	3.0
13 Scrapsgate	14	0.9
14 Minnis Bay	18	1.1
14 Margate Sands	65	8.7
14 Margate Hook	12	1.6
15 Margate Sands	67	9.0
15 Margate Sands	67	9.0
17 Pegwell Bay	42	5.7
Spring totals	**1231**	**223.0 km^2**
Autumn totals	**202**	**56.2 km^2**
Overall totals	**1433**	**291.2 km^2**

*(All samples in blue represents spring samples, and orange-yellow represents autumn samples)

2.5   Data analysis

The mean density of cockles in a given cockle management area, together with the size of the area (km^2) 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 in each area, above and below 16 mm.

2.6   Age class interpretation

We report on 4 age-class categories, namely 0-1 (spat), 1-2, 2-3 and 3+ (older than 3) years, whereafter cockles typically die. Cockles in the Thames Estuary spawn during the summer, such that small spat may be observed on the cockle beds over the course of summer and growing to 2-10 mm by the autumn. Consequently, a cockle's year class starts in the summer, such that during the autumn survey, the age class 0-1 (spat) represents the spat of the year during which the survey took place. E.g. In the autumn survey of 2023, we report on the spat that fell during summer 2023. Consequently, by the following spring, e.g. 2024, the spat that fell in the summer

of 2023 is still considered 0–1-year-old. Note this difference of year classes between the spring and autumn tables.

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 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. In Area 2, 11% of the biomass was over 16 mm cockles (similar to 13.6% in 2022), of which 79% was in the 3+ year age class. The relatively low density of 2020-year-class cockles suggests that the following year may have lower biomass in the area should average winter mortality levels be sustained this year.

Table 3: Area 2 stock parameters, spring 2023

	No. Samples	Area size	Year Class			
			2022	**2021**	**2020**	**2019**
Area 2	52	7.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			25.6	72.7	23.3	8.3
Stock (millions)			179.0	508.6	162.8	57.9
Mean Weight (g)			0.7	1.8	2.8	4.8
Biomass (tonnes)			119.8	904.9	452.1	278.0
Biomass below 16 mm			119.8	890.5	427.4	128.2
Biomass 16 mm and above			0.0	14.4	24.7	149.8

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 2022 year class   **179   million**
Total number of 2021 and older year class   **729.3 million**

Total stock biomass
Total stock (all cockles)   **1754.7 tonnes**
Total stock biomass   - cockles below 16mm   **1565.8 tonnes**
                           - cockles 16mm and above   **188.9 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 22 % of the biomass of cockles were made up from over 16 mm (width) cockles. The bulk (>90%) of the biomass coming from the 2019 (3+-year class), following 2022; this 2019-year class (then 2-year class) also formed the bulk of the over 16 mm cockles in 2022.

Table 4: Area 3 stock parameters, spring 2023

Area 3	No. Samples	area size	Year Class			
			2022	**2021**	**2020**	**2019**
	53	7.1	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			29.8	84.5	16.0	14.7
Stock (millions)			212.6	602.8	114.4	105.0
Mean Weight (g)			1.1	1.7	2.9	5.4
Biomass (tonnes)			226.1	1016.6	331.1	571.3
Biomass below 16 mm			226.1	1016.6	295.0	124.9
Biomass 16 mm and above			0.0	0.0	36.1	446.4

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 2022 year class   **212.6 million**
Total number of 2021 and older year class   **822.2 million**

Total stock biomass
Total stock (all cockles)   **2145 tonnes**
Total stock biomass   - cockles below 16mm   **1662.5 tonnes**
                                        - cockles 16mm and above   **482.5 tonnes**

AREA 4

3.3 Area 4 assessment of stock (spring survey)

A total of 77 sites were sampled covering a total area of 10.4 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 (also see Figure 11 for long term trend). The geographical distribution of each year class is presented in Figure 4 – 8. Approximately 27 % of the biomass in Area 4 was comprised of over 16 mm cockles (shell width).

Table 5: Area 4 stock parameters, spring 2023

Area 4	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	77	10.4	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			81.0	68.7	22.6	20.3
Stock (millions)			839.7	711.8	234.1	209.9
Mean Weight (g)			0.9	2.0	3.6	5.1
Biomass (tonnes)			785.8	1455.9	834.1	1073.8
Biomass below 16 mm			785.8	1442.4	604.0	173.6
Biomass 16 mm and above			0.0	13.4	230.1	900.2

Summary of stock assessment for Area 4 (spring survey)

The final stock estimation, based on the survey area of **10.4 km²** are as follows:

Total number of cockles:
Total number of 2022 year class   **839.7 million**
Total number of 2021 and older year class   **1555.9 million**

Total stock biomass
Total stock (all cockles)   **4149.6 tonnes**
Total stock biomass   - cockles below 16mm   **3005.8 tonnes**
                           - cockles 16mm and above   **1143.8 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 2023 survey are presented in Table 6 and a summary of the stock assessment is presented below (also see Figure 11 for long term trend).   The density and geographical distribution of spat is presented in Figures 4 – 8. Approximately 28 % of cockle biomass was made up of over 16 mm individuals by the autumn 2023, remaining relatively constant between spring and autumn.

Table 6: Area 4 stock parameters, autumn 2023

Area 4	No. Samples	Area km²	Year Class			
			2023	2022	2021	2020
	40	10.4	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			223.3	109.5	41.5	17.8
Stock (millions)			2313.1	1134.5	430.0	183.9
Mean Weight (g)			0.4	2.5	4.0	6.6
Biomass (tonnes)			888.5	2812.2	1719.9	1216.4
Biomass below 16 mm			888.5	2761.1	1105.7	0.0
Biomass 16 mm and above			0.0	51.1	614.3	1216.4

Summary of stock assessment for Area 4 (autumn survey)

The final stock estimation, based on the survey area of **10.4 km²** are as follows:

Total number of cockles
Total number of 2023 year class   **2313.1 million**
Total number of 2022 and older year class   **1748.4 million**

Total stock biomass
Total stock (all cockles)   **6637.0 tonnes**
Total stock biomass   - cockles below 16mm   **4755.2 tonnes**
                                          - cockles 16mm and above   **1881.8 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 (also see Figure 12 for long term trend). The distribution of each year class is presented in Figures 4 – 8. Area 5 comprises the largest management area in the main beds, and explains why the area contains the highest biomass, derived from the lower stock densities relative to Area 4. Approximately 27% of the cockle biomass recorded in Area 5 was comprised of over 16 mm (shell width) and was consistent with Area 4.

Table 7: Area 5 stock parameters, spring 2023

Area 5	No. samples	area km²	2022	2021	2020	2019
					Year Class	
	230	30.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			23.9	63.9	27.0	10.4
Stock (millions)			738.7	1978.0	835.6	322.9
Mean Weight (g)			0.8	1.9	3.6	5.8
Biomass (tonnes)			578.6	3712.9	3000.0	1857.6
Biomass below 16 mm			578.6	3712.9	2183.6	211.2
Biomass 16 mm and above			0.0	0.0	816.4	1646.5

Summary of stock assessment for Area 5 (spring survey)

The final stock estimation, based on the survey area of **30.9 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **738.7 million**
Total number of 2021 and older year class   **3136.6 million**

Total stock biomass
Total stock (all cockles)   **9149.7 tonnes**
Total stock biomass   - cockles below 16mm   **6686.2 tonnes**
                                          - cockles 16mm and above   **2462.9 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. High levels of growth were recorded in Area 5, such that biomass of over 16 mm cockles (shell width) increased from 2463 tonnes to 5063 tonnes between spring and autumn. The proportion of cockle stock over 16 mm also increased between spring and autumn from 27 to 32 %.

Table 8: Area 5 stock parameters, autumn survey 2023

Area 5	No. samples	Area km²	Year Class			
			2023	2022	2021	2020
	110	30.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			201.6	46.6	53.2	12.0
Stock (millions)			6240.4	1443.3	1645.9	371.4
Mean Weight (g)			0.4	2.7	4.1	6.5
Biomass (tonnes)			2478.7	3839.6	6757.8	2412.0
Biomass below 16 mm			2478.7	3742.1	4104.6	99.8
Biomass 16 mm and above			0.0	97.5	2653.2	2312.2

Summary of stock assessment for Area 5 (autumn survey)

The final stock estimation, based on the survey area of **30.9 km²** are as follows:

Total number of cockles
Total number of 2023 year class   **6240.4 million**
Total number of 2022 and older year class   **3460.6 million**

Total stock biomass
Total stock (all cockles)   **15488.2 tonnes**
Total stock biomass   - cockles below 16mm   **10425.3 tonnes**
                                           - cockles 16mm and above   **5062.9 tonnes**

AREA 6

3.7 Area 6 assessment of stock (spring survey)

A total of 111 sample sites 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 in Table 9 and a summary of the stock assessment is presented below (also see Figure 13 for long term trend). The distribution of each year class is presented in Figures 4 – 8. Area 6 had a relatively low level of stock, of which only 18 % was over 16 mm (shell width).

Table 9: Area 6 stock parameters, spring 2023

Area 6	No. samples	Area km²	Year Class			
			2022	2021	2020	2019
	111	14.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			36.3	40.2	14.6	2.4
Stock (millions)			542.3	600.1	218.0	36.3
Mean Weight (g)			0.4	1.4	3.0	5.0
Biomass (tonnes)			231.4	834.3	648.9	180.4
Biomass below 16 mm			231.4	834.3	467.5	16.9
Biomass 16 mm and above			0.0	0.0	181.4	163.5

Summary of stock assessment for Area 6, spring survey

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

Total number of cockles
Total number of 2022 year class   **542.0 million**
Total number of 2021 and older year class   **854.5 million**

Total stock biomass
Total stock (all cockles)   **1895.0 tonnes**
Total stock biomass   - cockles below 16mm   **1550.1 tonnes**
                                             - cockles 16mm and above   **344.9 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 form the 2023 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 4 – 8. Area 6 also showed lower levels of growth than recorded in Area 5, with over 16 mm biomass increasing from 344 to 413.6 tonnes.

Table 10: Area 6 stock parameters, autumn 2023

Area 6	No. samples	Area km²	Year Class			
			2023	2022	2021	2020
	52	14.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			25.0	70.6	32.9	2.1
Stock (millions)			373.4	1054.1	491.2	31.6
Mean Weight (g)			0.3	1.8	3.2	6.1
Biomass (tonnes)			94.9	1913.0	1576.9	192.4
Biomass below 16 mm			94.9	1913.0	1355.7	0.0
Biomass 16 mm and above			0.0	0.0	221.2	192.4

Summary of stock assessment for Area 6 (autumn survey)

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

Total number of cockles
Total number of 2023 year class   **373.4 million**
Total number of 2022 and older year class   **1576.9 million**

Total stock biomass
Total stock (all cockles)   **3777.2 tonnes**
Total stock biomass   - cockles below 16mm   **3363.6 tonnes**
                              - cockles 16mm and above   **413.6 tonnes**

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

The spatial distribution of cockles in the main beds showed highest densities on the more southern beds, for all year classes, from spat to 3+. There was also a strong spatial correlation of areas with highest densities of 3+ year old cockles in the spring and spat in the autumn. Area 6 had the lowest densities of the main beds, and relatively high densities of Manila clams (not reported on here).
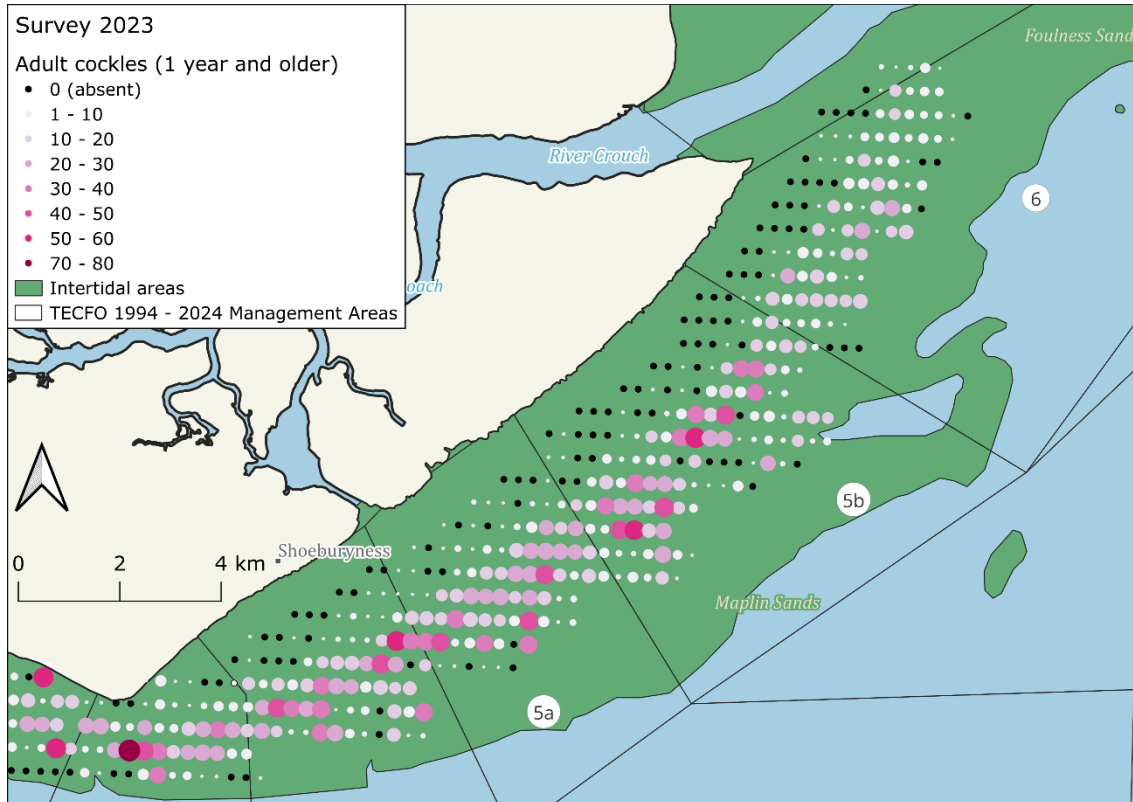
Figure 4: Distribution of adult cockles (1 year and older (2019, 2020, 2021-year classes)) in a subset of the main beds (focussing on areas 4, 5 & 6), Thames Estuary, spring 2023.
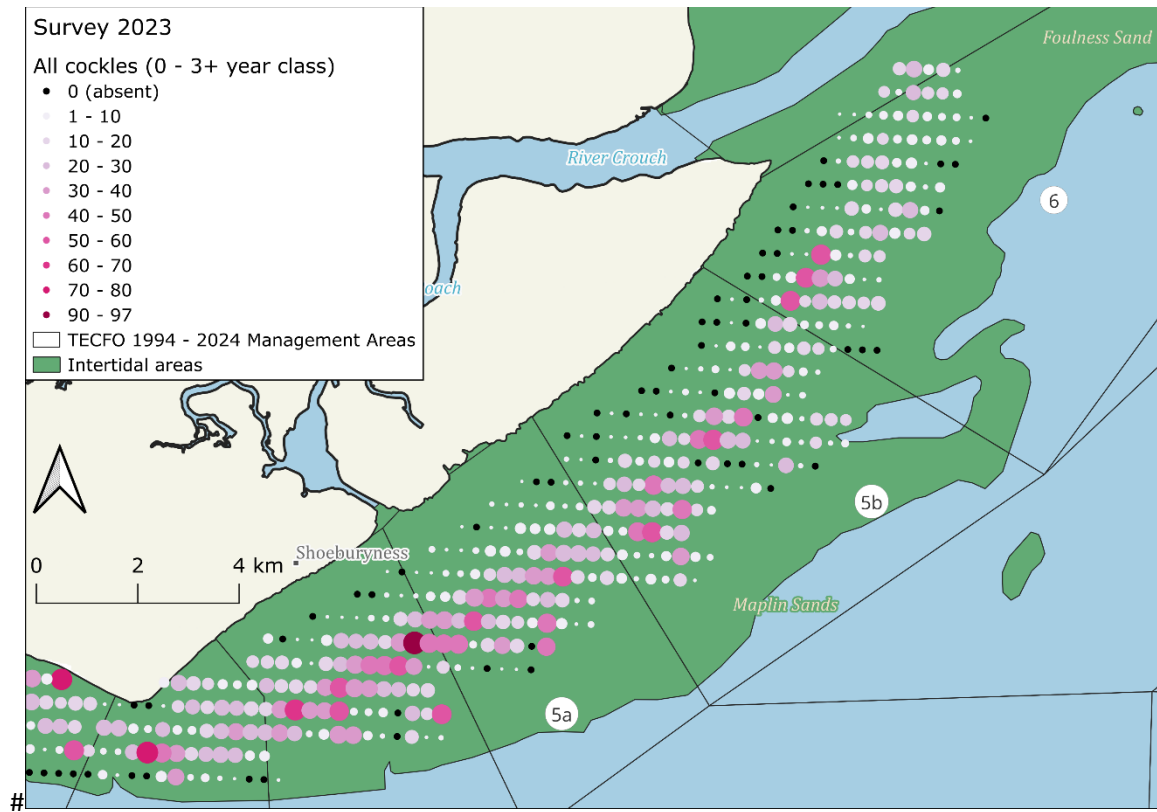
Figure 5: Distribution of all cockles (0 to 3+ year classes, where 3+ is the 2019-year class) in areas 4, 5 & 6 of the Thames Estuary, spring 2023.
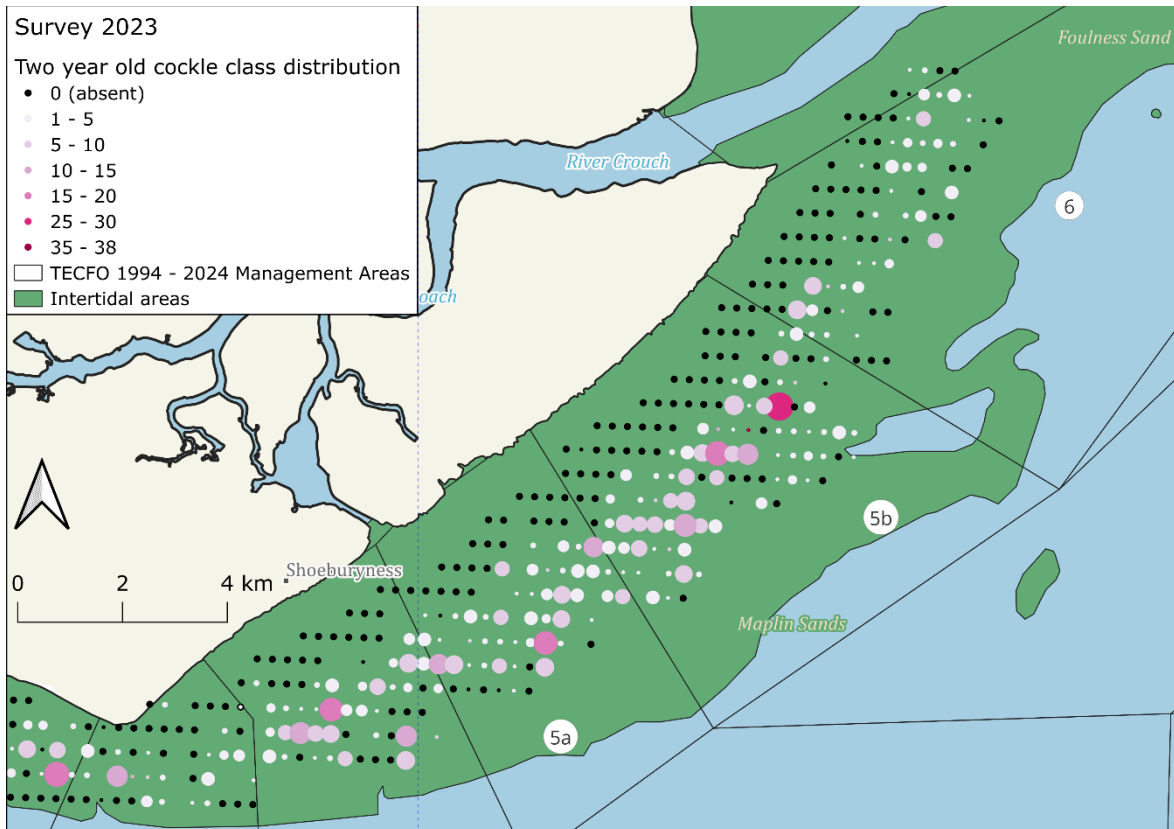
Figure 6: Distribution of 2-year-old class (2020) year class cockles in areas 4, 5 & 6 of the Thames Estuary, spring 2023.
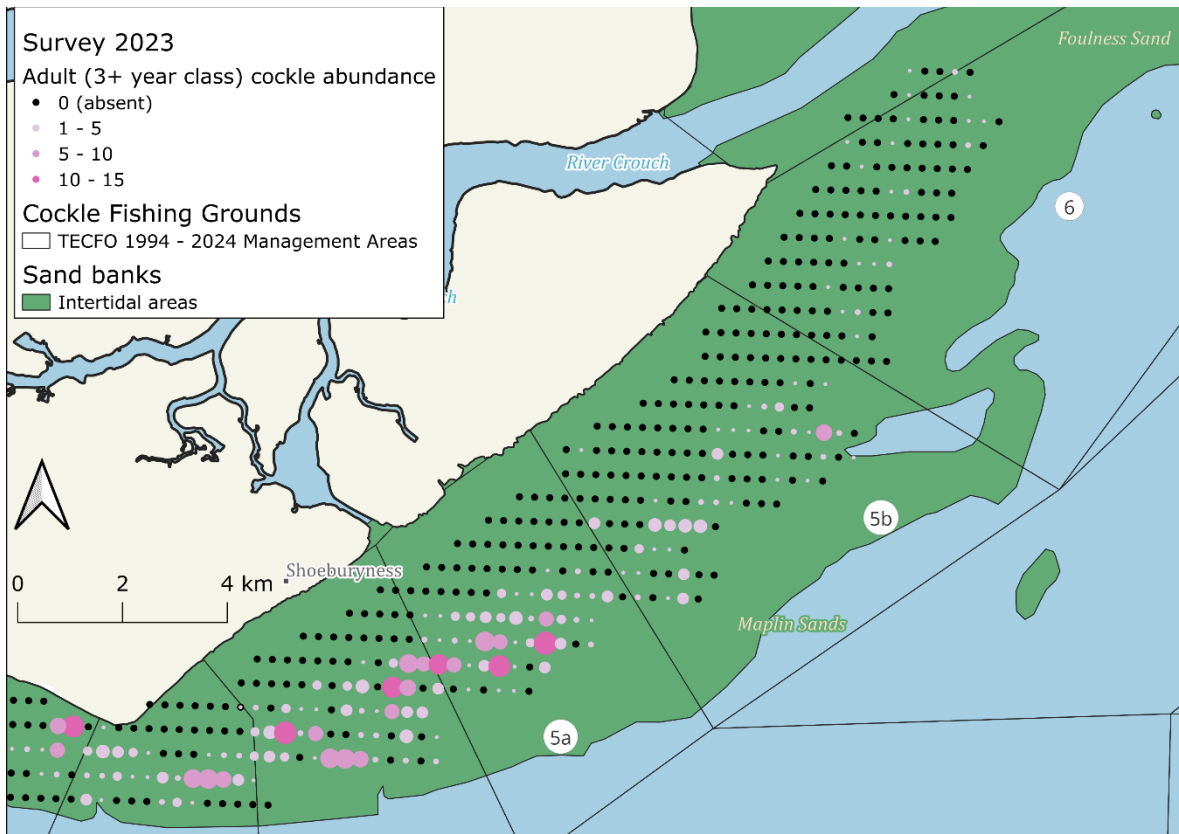
Figure 7: Distribution of 3-year-and-older year class (2019 and earlier) cockles in areas 4, 5 & 6 of the Thames Estuary, spring 2023.
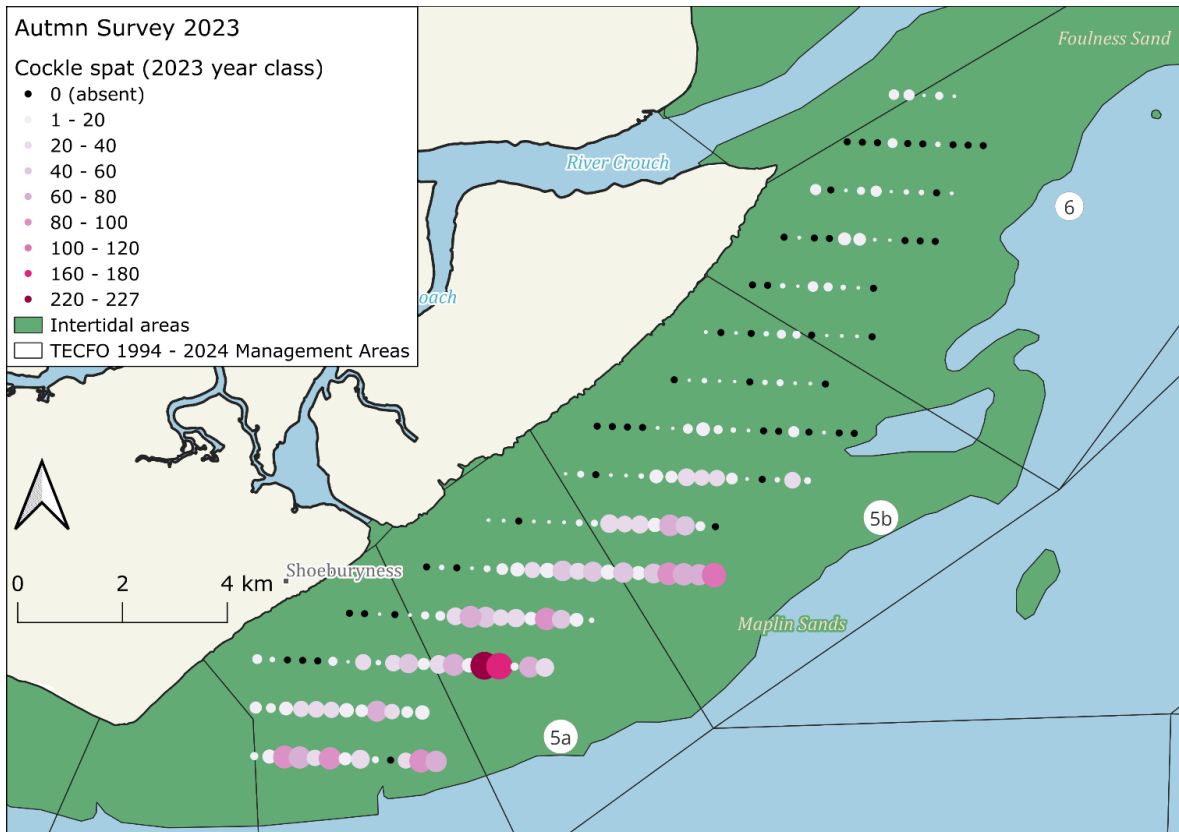
*Figure 8. Distribution of cockle spat (0-year-class, i.e. 2023-year class) in areas 4, 5 & 6 of the Thames Estuary, autumn 2023. ***

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 km^2. 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 that. Area 1 only supports a very small contribution to the overall biomass of over 16 mm (shell width) cockles, with 98 % arising from the 1- 2 years class.

Table 11: Marsh End stock parameters

			Year Class			
Area 1	**No. Samples**	**Area km^2**	**2022**	**2021**	**2020**	**2019**
	41	2.8	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			4.6	77.6	2.4	8.8
Stock (millions)			12.8	214.0	6.7	24.2
Mean Weight (g)			0.6	13.1	1.5	4.2
Biomass (tonnes)			8.1	2794.7	10.1	102.6
Biomass below 16 mm			8.1	2794.7	10.1	51.6
Biomass 16 mm and above			0.0	0.0	0.0	51.0

Summary of stock assessment for Area 1 – Marsh End

The final stock estimation, based on the survey area of **2.8 km^2** are as follows:

Total number of cockles:

Total number of 2022 year class	**12.8 million**
Total number of 2021 and older year class	**244.9 million**

Total stock biomass

Total stock (all cockles)	**2915.5 tonnes**
Total stock biomass - cockles below 16mm	**2864.5 tonnes**
- cockles 16mm and above	**51.0 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 km^2. 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 that (also see Figure 18 for long term trend). The majority of the total stock biomass was comprised by the under 16 mm. The Ray Sands had a relatively high (~92/m^2) density of 0–1-year-old cockles in the spring of 2023.

Table 12: Ray Sands stock parameters

Area 7 - Ray	No. Samples	Area km^2	Year Class			
			2022	2021	2020	2019
	105	14.0	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 **13.9 km^2** are as follows:

Total number of cockles:

Total number of 2022 year class	**63.2 million**
Total number of 2021 and older year class	**1750.6 million**

Total stock biomass
Total stock (all cockles)	**2087.3 tonnes**
Total stock biomass - cockles below 16 mm	**1885.1 tonnes**
- cockles 16 mm and above	**202.1 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 that (also see Figure 16 for long term trend). Only 15 tonnes of the total biomass of 327 tonnes were above 16 mm (shell width) by spring.

Table 13: Dengie Flats stock parameters

Area 7 - Dengie	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	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 2022 year class   **31.6 million**
Total number of 2021 and older year class   **241.5 million**

Total stock biomass
Total stock (all cockles)   **327.0 tonnes**
Total stock biomass   - cockles below 16mm   **311.9 tonnes**
                           - cockles 16mm and above   **15.1 tonnes**

AREA 7

3.13 Area 7 – Buxey Sands assessment of stocks

A total of 96 sampling stations were surveyed covering an area of 12.9 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 (also see Figure 17 for long term trend). The Buxey had the lowest level of stock since 1998, with only limited 26.8 tonnes above 16 mm in the spring, and very low levels of stock of younger year classes.

Table 14: Buxey Sands stock parameters

Area 7 – Buxey Sands	No. Samples	Area km²	2022	2021	2020	2019
	96	12.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	0.1	0.5	31.8
Stock (millions)			0.0	1.3	6.7	410.4
Mean Weight (g)			0.0	1.0	1.6	0.4
Biomass (tonnes)			0.0	1.3	10.8	157.4
Biomass below 16 mm			0.0	1.3	10.8	130.6
Biomass 16 mm and above			0.0	0.0	0.0	26.8

Summary of stock assessment for Area 7 – Buxey Sands

The final stock assessment, based on the survey area of **12.9 km²** is as follows:

Total number of cockles:

Total number of 2022 year class   **0**
Total number of 2021 and older year class   **418.5 million**

Total stock biomass   **169.5 tonnes**
Total stock biomass - cockles below 16mm   **142.7 tonnes**
  - cockles 16mm and above   **26.8 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 East Barrows is a subtidal sandbank that can produce high levels of mean weight per cockle potentially because of fast growth over the summer supported in the subtidal beds. Over 309 tonnes of the 345.8 tonnes on the East Barrows were over 16 mm by the spring survey in 2023.

Table 15: East Barrow stock parameters

Area 8	No. Samples	Area km²	Year Class			
			2022	**2021**	**2020**	**2019**
	64	8.6	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.2	3.4	1.1	0.3
Stock (millions)			1.3	29.6	9.4	2.7
Mean Weight (g)			1.0	7.6	7.7	17.5
Biomass (tonnes)			1.3	224.7	72.7	47.1
Biomass below 16 mm			1.3	31.2	0.0	0.0
Biomass 16 mm and above			0.0	189.7	72.7	47.1

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 2022 year class   **1.3 million**
Total number of 2021 and older year class   **41.7 million**

Total stock biomass
Total stock (all cockles)   **345.8 tonnes**
Total stock biomass   - cockles below 16mm   **32.5 tonnes**
                           - cockles 16mm and above   **309.5 tonnes**

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. The annual biomass increased from 51 tonnes to 126 tonnes from spring 2022 to spring 2023. The over 16 mm cockle stock comprises 75% of the biomass on the cockle bed and consists of large 1–2-year-old cockles and 2–3-year-old cockles.

Table 16. East Barrow stock parameters

			Year Class			
Area 8	No. Samples	Area km²	**2022**	**2021**	**2020**	**2019**
	26	3.5	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	6.2	1.9	0.0
Stock (millions)			0.0	21.5	6.7	0.0
Mean Weight (g)			0.0	6.0	6.2	0.0
Biomass (tonnes)			0.0	129.2	41.7	0.0
Biomass below 16 mm			0.0	40.4	4.0	0.0
Biomass 16 mm and above			0.0	88.8	37.7	0.0

Summary of stock assessment for Area 8 – Maplin Spit

The final stock estimation, based on the survey area of **3.5 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **0**
Total number of 2021 and older year class   **28.3 million**

Total stock biomass
Total stock (all cockles)   **170.9 tonnes**
Total stock biomass   - cockles below 16mm   **44.4 tonnes**
                          - cockles 16mm and above   **126.5 tonnes**

3.16   Area 9 – West Barrows assessment of stock

A total of 36 sampling stations were surveyed in the West Barrows area covering a surface area of 4.8 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 cockles on the West Barrows were smaller with an average weight of 3.1 g for 1-2 year old cockles, compared to that on the Maplin Spit (6.0 g). The proportion of the commercially harvestable cockle biomass increased significantly from 1% above 16 mm in 2022 to 29% in 2023.

Table 17: West Barrows stock parameters

Area 9/12	No. Samples	Area km²	Year Class			
			2022	**2021**	**2020**	**2019**
	36	4.8	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	54.9	2.7	0.0
Stock (millions)			0.0	265.8	13.1	0.0
Mean Weight (g)			0.0	3.1	5.2	0.0
Biomass (tonnes)			0.0	826.2	68.1	0.0
Biomass below 16 mm			0.0	514.2	14.4	0.0
Biomass 16 mm and above			0.0	203.8	53.7	0.0

Summary of stock assessment for Area 9 – West Barrows

The final stock estimation, based on the survey area of **4.8 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **0.0 million**
Total number of 2021 and older year class   **278.9 million**

Total stock biomass
Total stock (all cockles)   **894.3 tonnes**
Total stock biomass   - cockles below 16mm   **528.6 tonnes**
                                         - cockles 16mm and above   **257.5 tonnes**

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

A total of 49 sampling stations were surveyed in the Mouse knob area covering a surface area of 6.6 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 over the Mouse-Knob was again very low in 2023, falling further from 57.9 to 34.5 tonnes, mostly (82%) above 16 mm.

Table 18: Mouse/Knob stock parameters

Area 9/12	No. Samples	Area km²	Year Class			
			2022	**2021**	**2020**	**2019**
	49	6.6	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.00	0.82	0.00	0.00
Stock (millions)			0.00	5.38	0.00	0.00
Mean Weight (g)			0.00	6.50	0.00	0.00
Biomass (tonnes)			0.00	34.99	0.00	0.00
Biomass below 16 mm			0.00	6.73	0.00	0.00
Biomass 16 mm and above			0.00	28.26	0.00	0.00

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

The final stock estimation, based on the survey area of **6.6 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **0 million**
Total number of 2021 and older year class   **5.4 million**

Total stock biomass
Total stock (all cockles)   **34.5 tonnes**
Total stock biomass   - cockles below 16mm   **6.7 tonnes**
                          - cockles 16mm and above   **28.3 tonnes**

3.18   Area 10 - Leysdown assessment of stock

A total of 22 sampling stations were surveyed in Leysdown covering an area of 3.0 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 on the Leysdown beds also remained low, falling from 60.6 to 53.3 tonnes between 2022 and 2023, with most (38%) of the stock below 16 mm.

Table 19: Leysdown stock parameters

Area 10	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	22	3.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	3.2	5.0	0.0
Stock (millions)			0.0	9.4	14.8	0.0
Mean Weight (g)			0.0	1.3	2.8	7.0
Biomass (tonnes)			0.0	12.1	41.2	0.0
Biomass below 16 mm			0.0	12.1	21.0	0.0
Biomass 16 mm and above			0.0	0.0	20.2	0.0

Summary of stock assessment for Area 10 - Leysdown

The final stock estimation, based on the survey area of **3.0 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **0 million**
Total number of 2021 and older year class   **24.2 million**

Total stock biomass
Total stock (all cockles)   **53.3 tonnes**
Total stock biomass   - cockles below 16mm   **33.1 tonnes**
                                              - cockles 16mm and above   **20.2 tonnes**

AREA 13

3.19   Area 13 - Scrapsgate assessment of stock

A total of 14 sampling stations were surveyed in Scrapsgate covering an area of 0.9 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 declined from 424.3 tonnes in 2022, to 271.3 tonnes in 2023, of which only 38.3 tonnes were above 16 mm.

Table 20: Scrapsgate stock parameters

Area 13	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	14	0.9	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			2.1	10.7	69.3	17.9
Stock (millions)			2.0	10.1	65.3	16.8
Mean Weight (g)			0.5	1.4	2.9	3.9
Biomass (tonnes)			1.0	13.9	191.1	65.3
Biomass below 16 mm			1.0	13.9	175.6	49.6
Biomass 16 mm and above			0.0	0.0	15.5	22.9

Summary of stock assessment for Area 13 - Scrapsgate

The final stock estimation, based on the survey area of **0.9 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **2 million**
Total number of 2021 and older year class   **92.2 million**

Total stock biomass
Total stock (all cockles)   **271.3 tonnes**
Total stock biomass   - cockles below 16mm   **240.1 tonnes**
                          - cockles 16mm and above   **38.3 tonnes**

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 cockle biomass in Minnis Bay declined from 526.6 tonnes in 2022 to 462.5 in 2023, of which 712% were above 16 mm.

Table 21: Minnis Bay stock parameters

Area 14	No. Samples	Area km2	Year Class			
			2022	2021	2020	2019
	20	1.1	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	31.7	51.7	21.7
Stock (millions)			0.0	34.0	55.4	23.2
Mean Weight (g)			0.0	1.3	3.8	7.4
Biomass (tonnes)			0.0	42.6	212.8	171.1
Biomass below 16 mm			0.0	42.6	74.5	5.4
Biomass 16 mm and above			0.0	0.0	138.3	165.7

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 2022 year class   **0**
Total number of 2021 and older year class   **127.5 million**

Total stock biomass
Total stock (all cockles)   **426.5 tonnes**
Total stock biomass   - cockles below 16mm   **122.5 tonnes**
                           - cockles 16mm and above   **304 tonnes**

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 decreased from 387 tonnes (of which 283 tonnes were over 16 mm) in 2022 to 87 tonnes (of which 40.5 tonnes were over 16 mm) by spring 2023.

Table 22: Margate Long Sands stock parameters

Area 14 - Margate Long Sands	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	65	8.7	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.1	0.9	0.3	0.3
Stock (millions)			0.9	7.9	2.6	2.6
Mean Weight (g)			0.0	5.9	4.4	11.0
Biomass (tonnes)			0.0	46.5	11.6	28.9
Biomass below 16 mm			0.0	3.0	0.0	0.0
Biomass 16 mm and above			0.0	43.6	11.6	28.9

Summary of stock assessment for Area 14 - Margate Long Sands

The final stock estimation, based on the survey area of **8.7 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **0.9 million**
Total number of 2021 and older year class   **13.1 million**

Total stock biomass
Total stock (all cockles)   **87 tonnes**
Total stock biomass   - cockles below 16mm   **3.0 tonnes**
                                          - cockles 16mm and above   **84.1 tonnes**

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

A total of 67 sampling stations were surveyed in Margate Long Sands covering an area of 9.0 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. Conversely to Area 14, the cockle biomass in Margate Sands in Area 15 remained relatively stable between 2022 and 2023, increasing slightly from 1023 tonnes to 1127 tonnes, of which 908.6 tonnes were over 16 mm by spring.

Table 23: Margate Long Sands (Area 15) stock parameters

Area 15 - Margate Long Sands	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	67	9.0	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.0	28.5	2.7	1.2
Stock (millions)			0.0	257.0	24.2	10.8
Mean Weight (g)			0.0	3.5	3.6	12.3
Biomass (tonnes)			0.0	909.1	86.0	131.9
Biomass below 16 mm			0.0	194.1	24.2	0.0
Biomass 16 mm and above			0.0	715.0	61.8	131.9

Summary of stock assessment for Area 15 - Margate Long Sands

The final stock estimation, based on the survey area of **9.0 km²** are as follows:

Total number of cockles
Total number of 2021 year class   **0**
Total number of 2020 and older year class   **292 million**

Total stock biomass
Total stock (all cockles)   **1127.0 tonnes**
Total stock biomass   - cockles below 16mm   **218.3 tonnes**
            - cockles 16mm and above   **908.6 tonnes**

AREA 17

3.23   Area 17 – Pegwell Bay assessment of stock

A total of 42 sampling stations were surveyed in Pegwell Bay covering an area of 5.7 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 that. The biomass in Area 17 remained relatively high and stable, falling slightly from 1089.9 to 933.4 tonnes, of which 45 % were over 16 mm.

Table 24: Pegwell Bay stock parameters

Area 17 – Pegwell Bay	No. Samples	Area km²	Year Class			
			2022	2021	2020	2019
	42	5.7	0-1 year	1-2 year	2-3 year	3+ years
Mean Density			0.7	59.1	2.8	6.3
Stock (millions)			4.0	333.8	15.8	35.5
Mean Weight (g)			0.7	1.5	4.8	10.3
Biomass (tonnes)			2.7	488.9	76.2	365.5
Biomass below 16 mm			2.7	488.9	18.4	5.4
Biomass 16 mm and above			0.0	0.0	57.8	360.1

Summary of stock assessment for Area 17 – Pegwell Bay

The final stock estimation, based on the survey area of **5.7 km²** are as follows:

Total number of cockles
Total number of 2022 year class   **4.0 million**
Total number of 2021 and older year class   **385.1 million**

Total stock biomass
Total stock (all cockles)   **933.4 tonnes**
Total stock biomass   - cockles below 16mm   **515.4 tonnes**
                                          - cockles 16mm and above   **417.9 tonnes**

3.24 Combined data for all surveys

In total, 1410 sites were sampled during Spring and Autumn 2023, thereby providing stock estimates for 311.4 km² of cockle beds in the Thames estuary as shown in Table 25. Within a subset of the main harvesting areas (areas 4, 5 & 6) a calculated total of 5146.9 million adult cockles were present during the Spring survey, and a calculated 6786 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 3951.6 tonnes during the spring and 7358.3 tonnes by the autumn.

Table 25: Survey area and cockle biomass in the Thames Estuary, 2023 Definition: Year Class: YC

Area	Area surveyed (km²)	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	30		2907.4		51.0		244.9	
2 Southend	7.0	52		1635.0		188.9		729.3	
3 Southend	7.1	53		1918.9		482.5		822.2	
4 Maplin Sands	10.4	77	40	3363.8	5748.5	1143.8	1881.8	1155.9	1748.4
5 Maplin Sands	30.9	230	110	8570.5	13009.5	2462.9	5062.9	3136.6	3460.6
6 Maplin Sands	14.9	111	52	1663.6	3682.3	344.9	413.6	854.5	1576.9
7 Ray Sands	13.9	102		2073.8		202.1		1750.6	
7 Dengie	7.0	51		320.1		15.1		241.5	
7 Buxey	12.9	96		169.5		26.8		418.5	
7 Foulness N	1.9	14		86.8		47.4		24.2	
8 East Barrow	8.6	64		344.5		309.5		41.7	
8 West Barrows	4.8	36		894.3		257.5		278.9	
8 Maplin Spit	26.0	3.5		170.9		126.5		28.3	
9/12 Mouse Knob	6.6	49		35.0		28.3		5.4	
10 Leysdown	3.0	22		53.3		20.2		24.2	
13 Scrapsgate	0.9	14		270.2		38.3		92.2	
14 Minnis Bay	1.1	18		426.5		304.0		112.7	
14 Margate Hook	1.6	12		0.0		0.0		8.1	
14 Margate Long Sands	8.7	65		40.5		84.1		13.1	
15 Margate Long Sands	9.0	67		1127.0		908.6		292	
17 Pegwell Bay	5.7	42		930.7		417.9		385.1	
Total	**255.2**	**1208**	**202.0**	**27002.2**	**22440.3**	**6523.5**	**7358.3**	**10062.2**	**6786.0**

Survival of cockles in areas 4, 5 & 6

Comparison of the mean cockle density calculated from the 2023 spring survey and the autumn survey results in 2022, indicate that the survival over the 2022/23 winter period was within the normal range, with relatively high survival (> 80%) rates of 0 – 2 year old cockles (Table 26).

Table 26. Mean density and winter survival rates of cockles from 2022 to 2023 by year class in areas 4, 5 & 6.

	2022 Autumn Survey			2023 Spring Survey		
	mean density			mean density		
year class:	2022	2021	2020+	2022	2021	2020+
AREA 6 (57 rectangles)	21.9	46.8	46.7	36.3	40.2	17.0
AREA 5 (110 rectangles)	31.4	66.9	60.2	23.9	63.9	37.4
AREA 4 (36 rectangles)	69.8	71.7	72.4	81.0	68.7	42.9
Cockle stock remaining (Area 6)				52.0%	56.0%	23.5%
Cockle stock remaining (Area 5)				76.1%	95.5%	62.2%
Cockle stock remaining (Area 4)				116.2%	95.8%	59.2%
			Mean	81.5%	82.4%	48.3%

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 & 2023.

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
2023				7358.3				7358.3

Table 28: Stocks of all cockles (millions), excluding spat, in main areas outside of those covered by the TECFO between 1997 & 2023.

YEAR	Area 7 Dengie	Area 7 Buxey	Area 7 Ray	Area 10	Area 14* Minnis Bay	TOTAL
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
2023	241.5	418.5	1750.6	24.2	112.7	2547.5

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 9) after 2019. 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.**). The spatfall values in 2023 were higher than recent years, and above the long-term mean, however, winter survivorship of spat is critical for informing subsequent stock size and will be determined by the spring 2024 survey.

Adult stock before and after winter
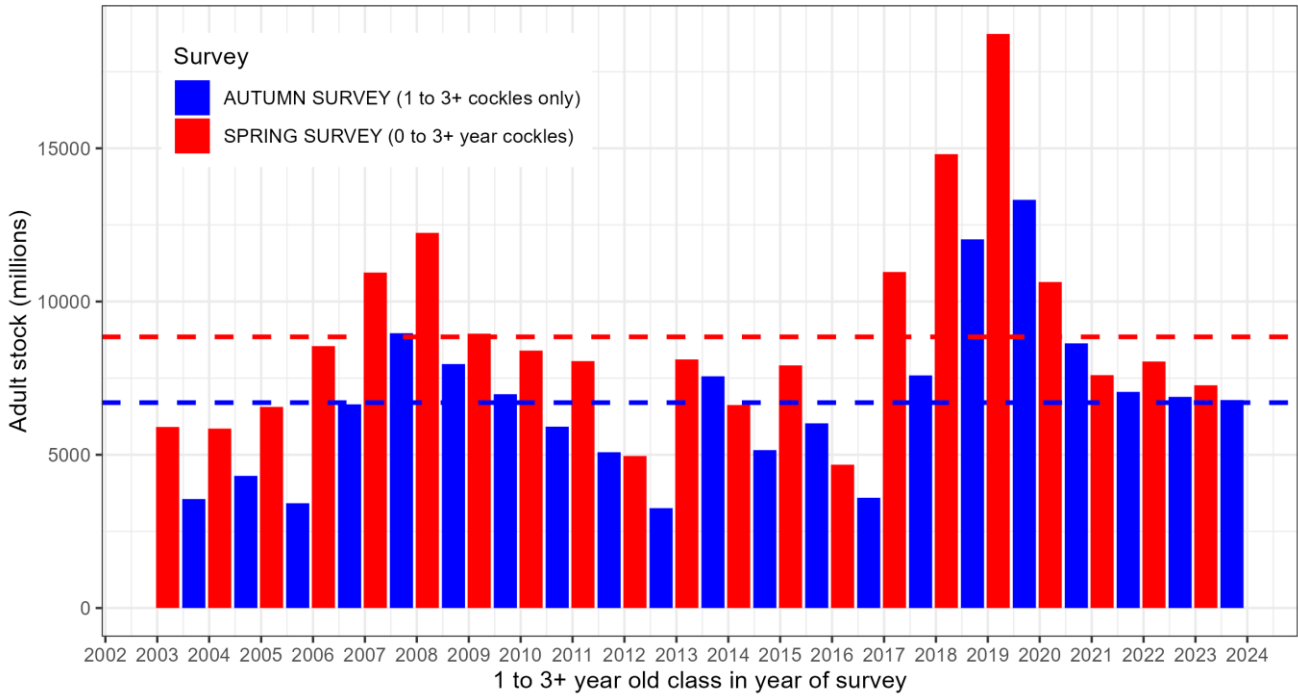
Figure 9: Seasonal adult cockle stocks (1 to 3+ year class in year of survey) on areas 4, 5 and 6 from 2003 to 2023, with mean values indicated by dashed lines for spring and autumn respectively.

Stock size of spat before and after first winter
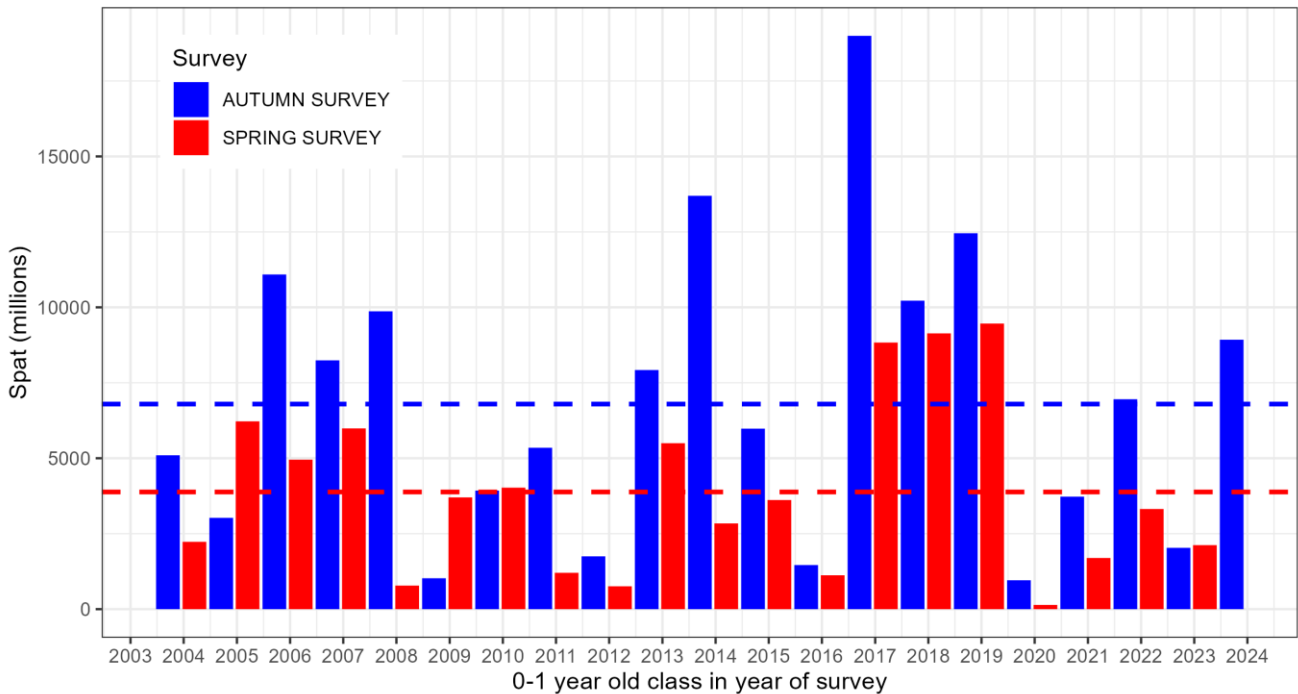
Figure 10: Seasonal number of cockle-spat before and after the first winter on areas 4, 5 and 6 from autumn 2003-2023, with mean values indicated by dashed lines for spring and autumn respectively.

3.27 Comparison of long-term trends for Area 4

Cockle density for area: 4
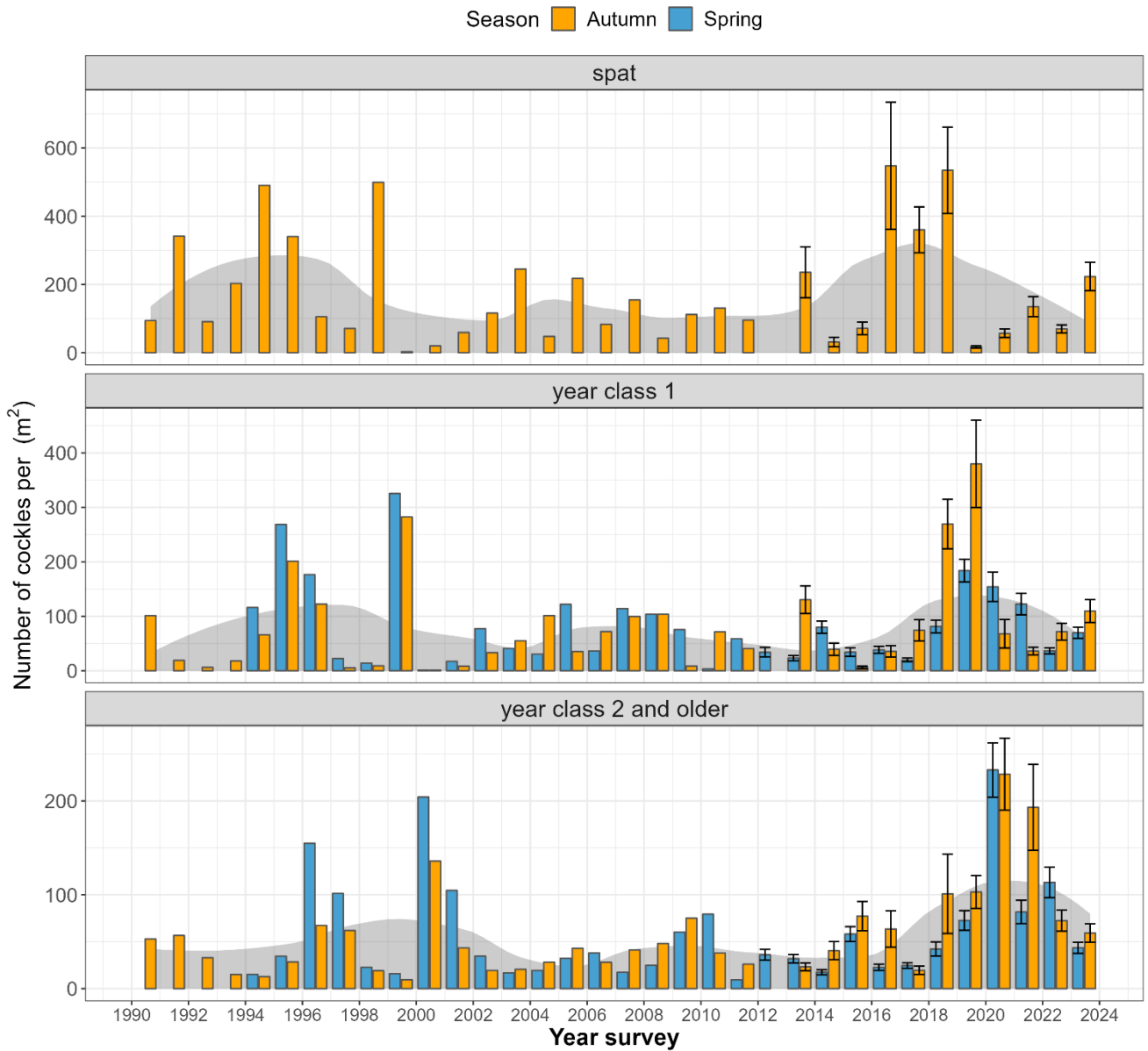
Cockle biomass for area: 4
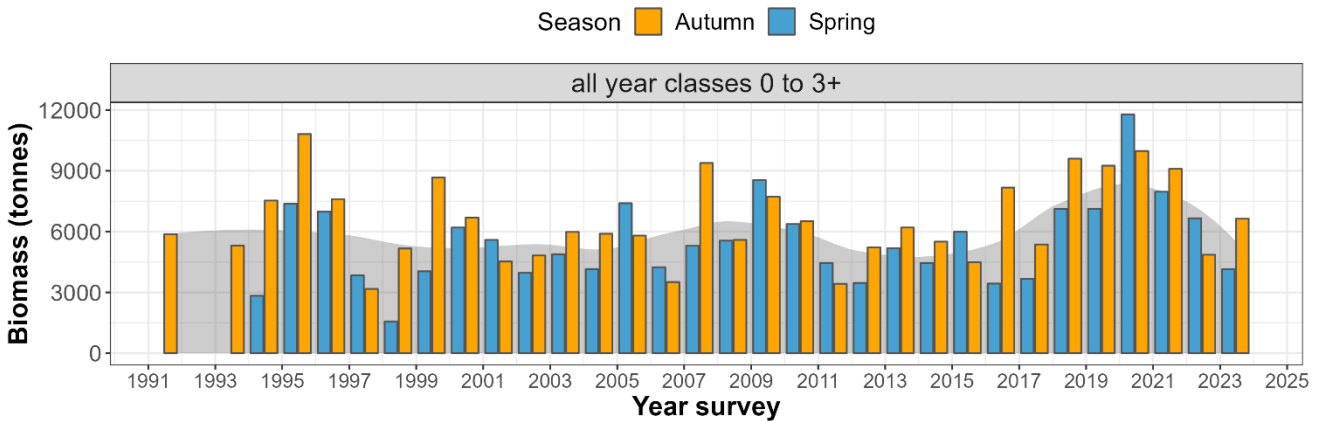
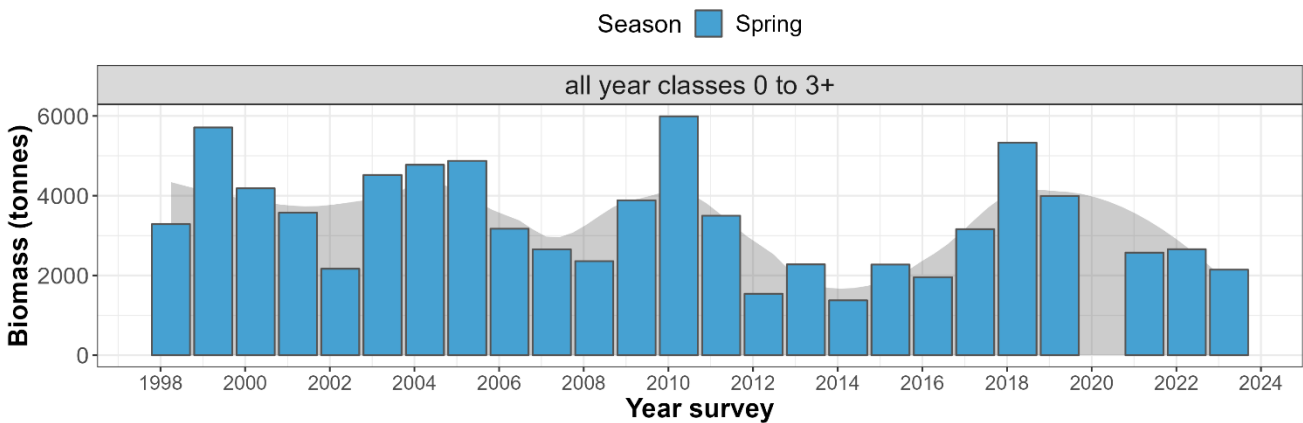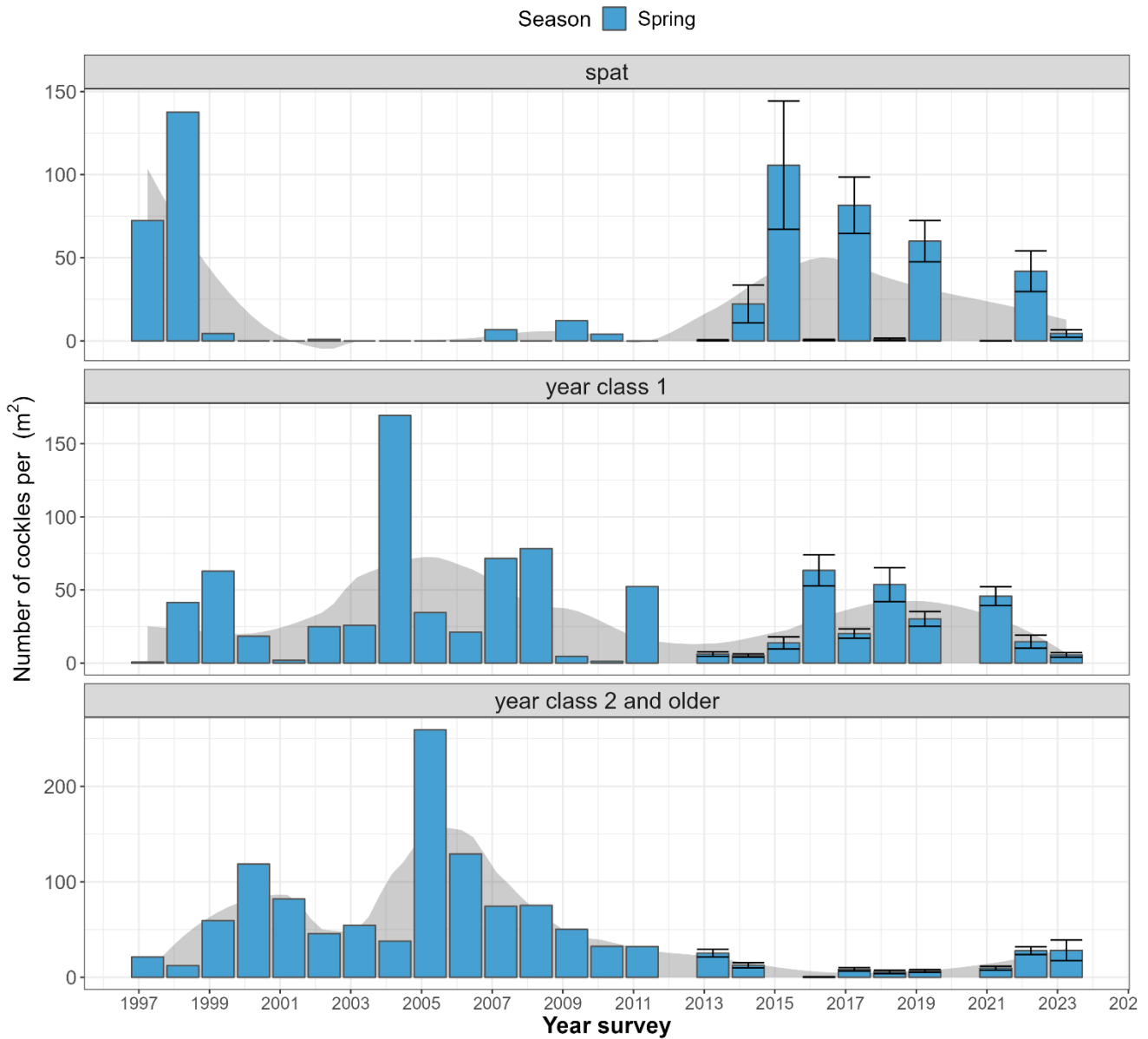*Figure 11: Mean cockle densities & total stock biomass in Area 4, 1991 - 2023*

3.28   Comparison of long-term trends for area 5

Cockle density for area: 5
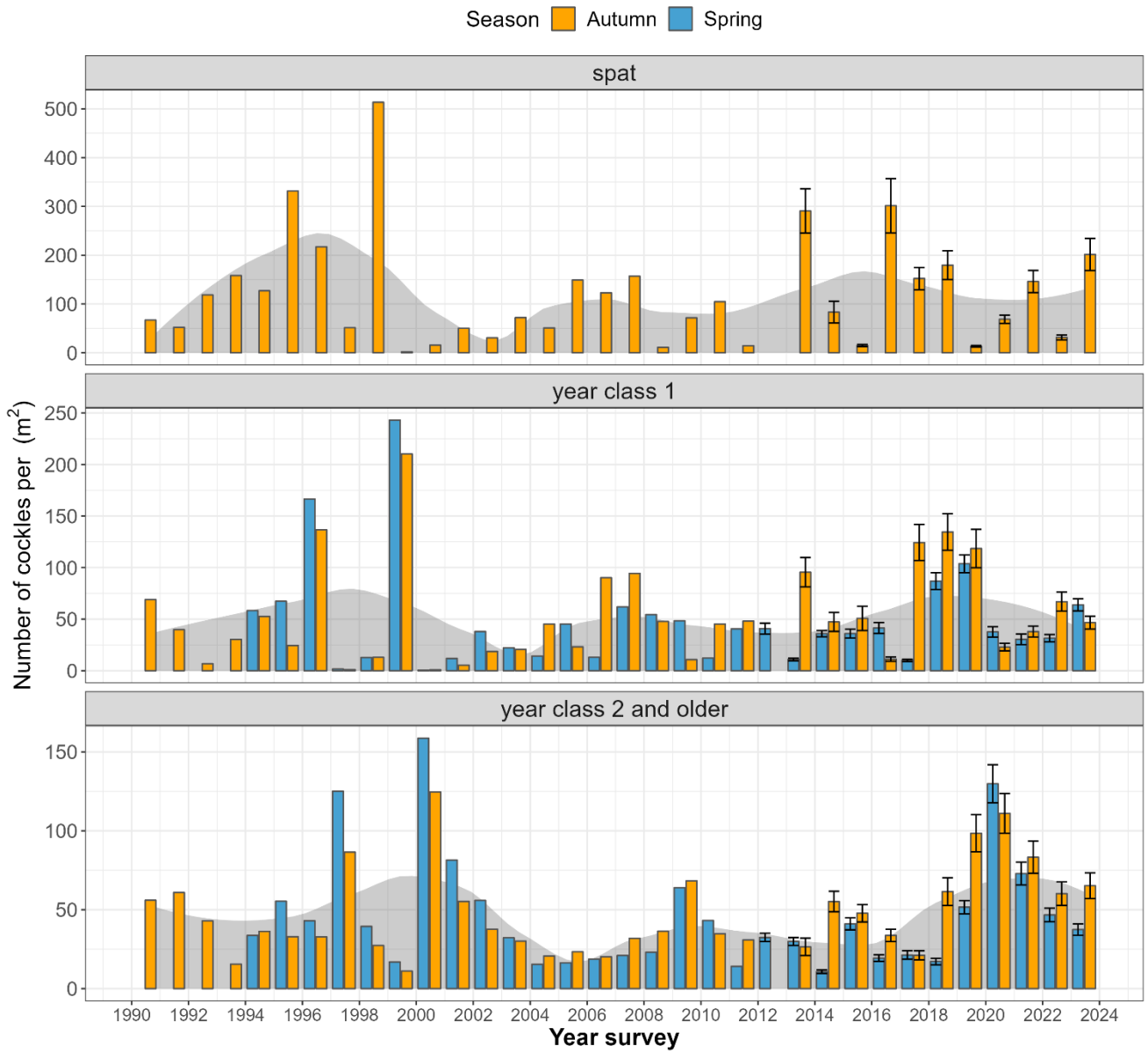
Cockle biomass for area: 5
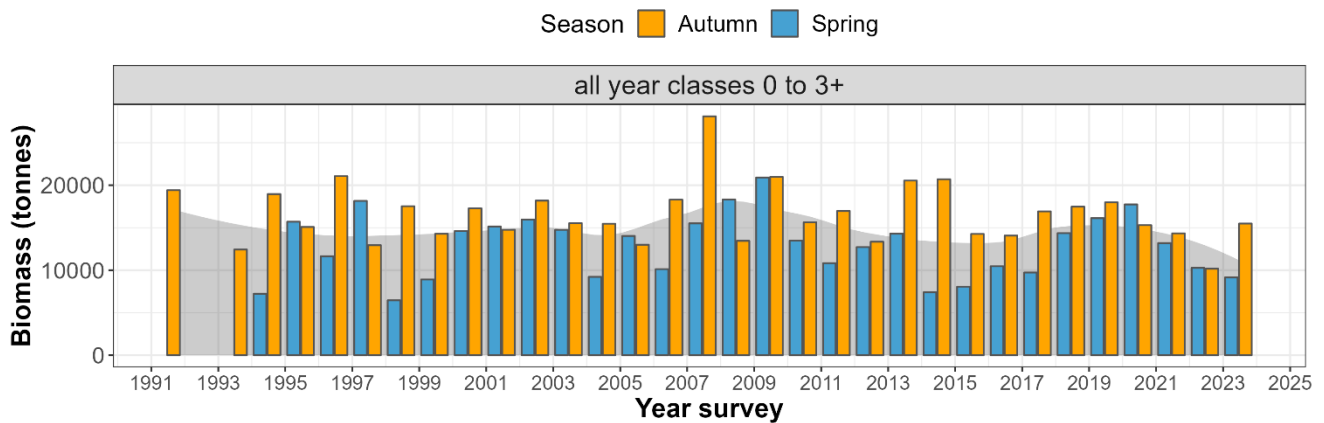
Figure 12: Mean cockle densities & total stock biomass in area 5, 1991-2023.

3.29   Comparison of long-term trends for area 6

Cockle density for area: 6
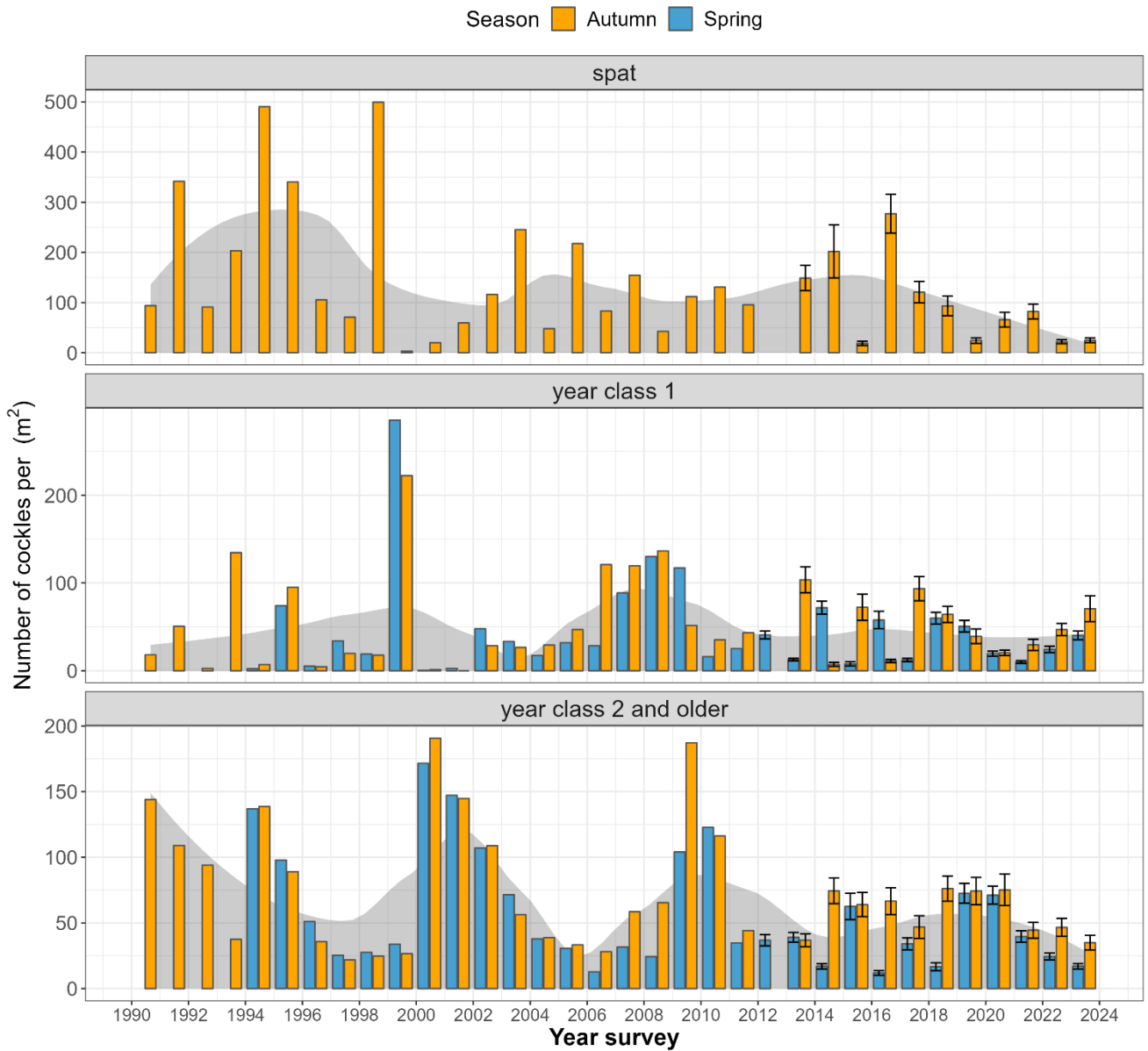
Cockle biomass for area: 6
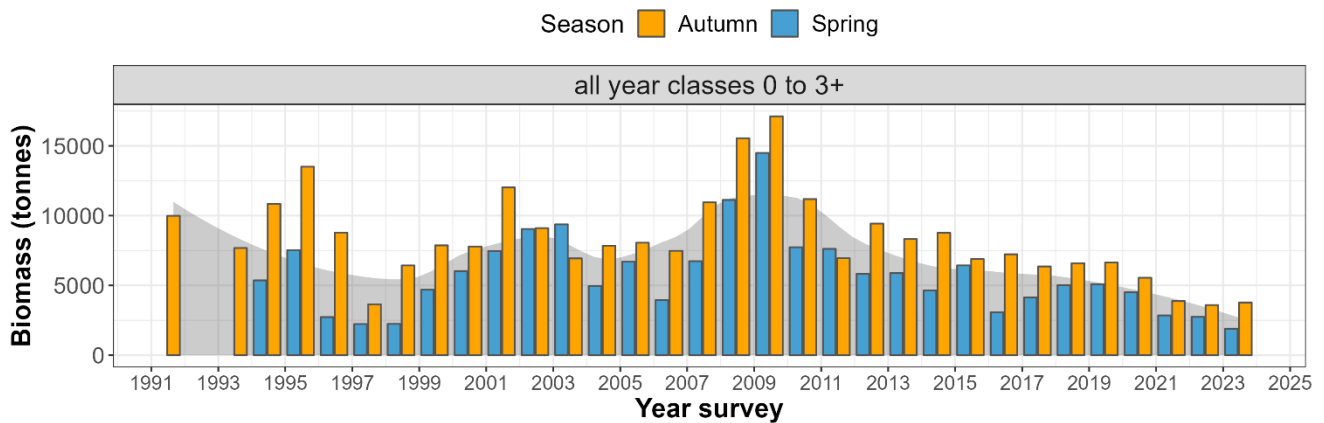
Figure 13: Mean cockle densities & total stock biomass in area 6, 1991-2023.

3.30   Comparison of long-term trends for area 2

Cockle density for area: 2
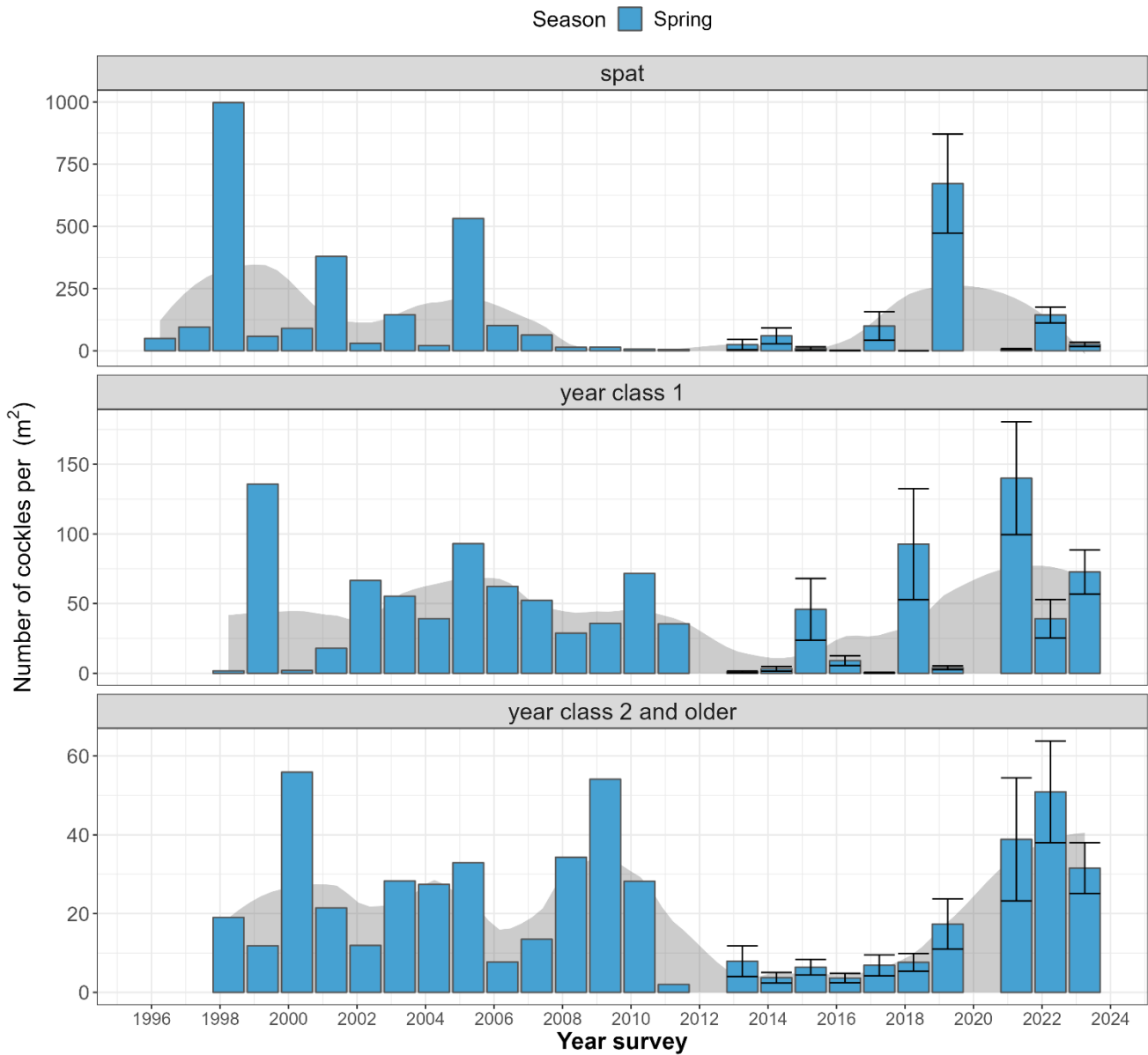
Cockle biomass for area: 2
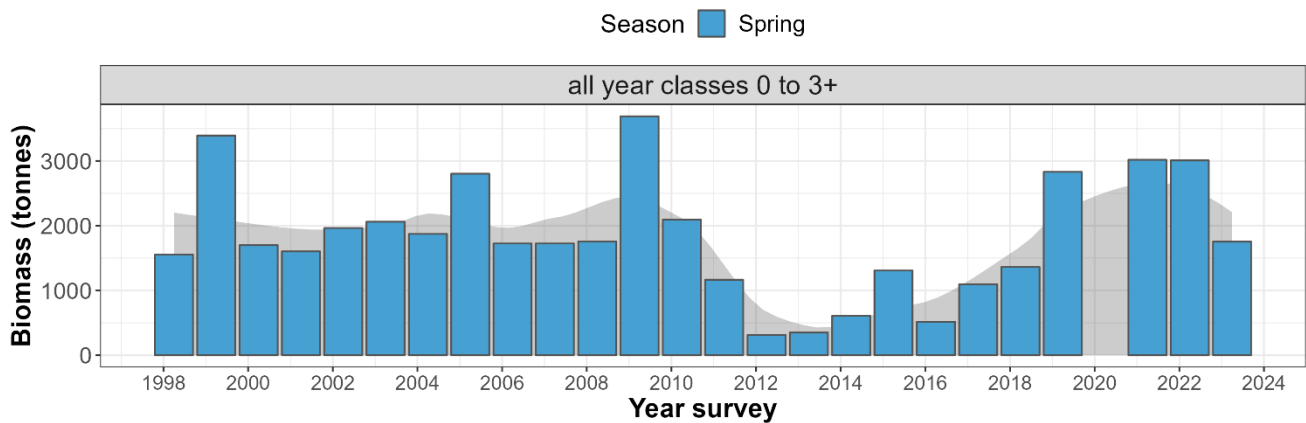
Figure 14: Mean cockle densities & total stock biomass in area 2, 1998-2023.

3.31 Comparison of long-term trends for area 3

Cockle density for area: 3
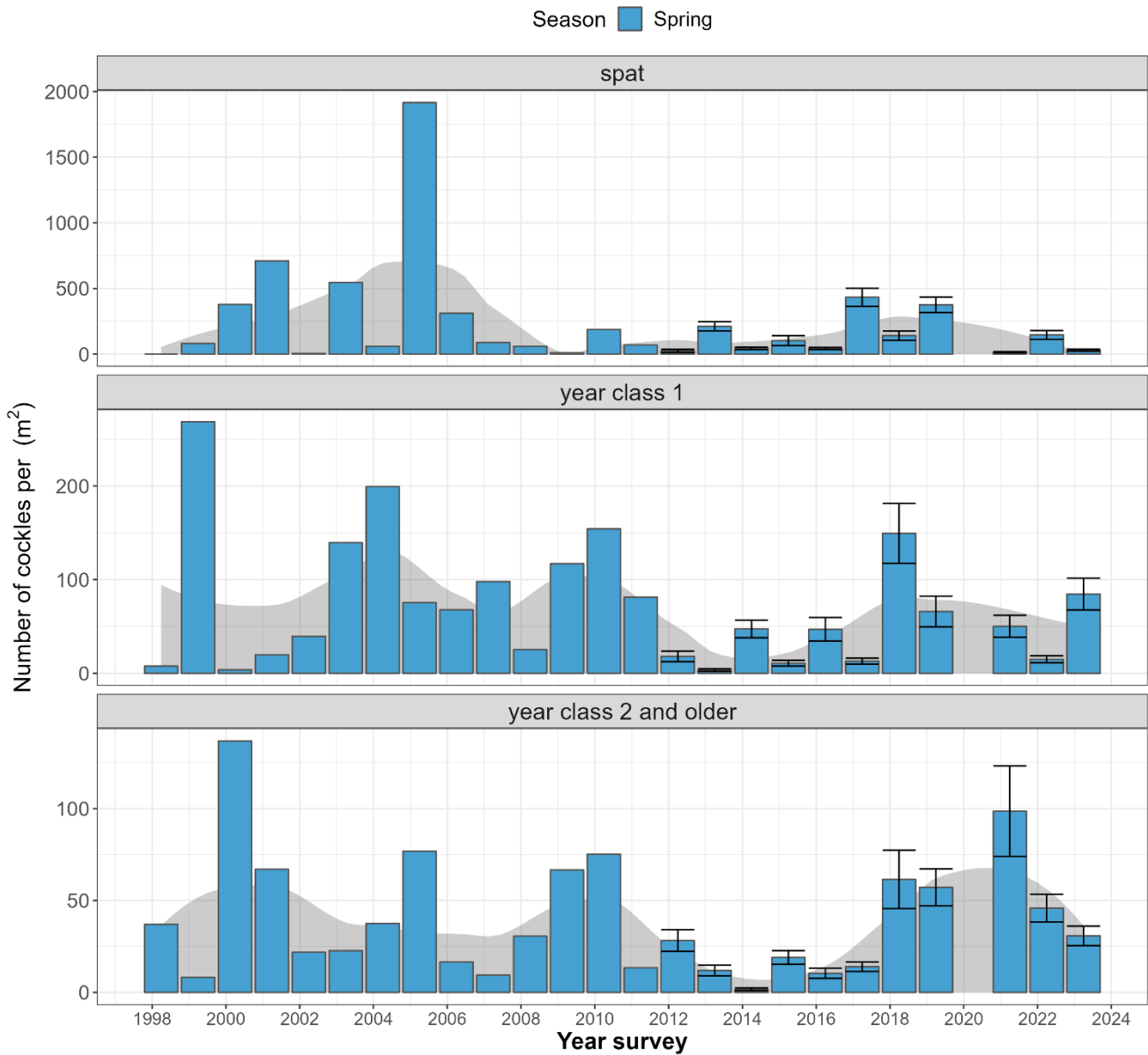
Cockle biomass for area: 3

Figure 15: Mean cockle densities & total stock biomass in area 3, 1998-2023.

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

Cockle density for area: 7 Dengie

Cockle biomass for area: 7 Dengie
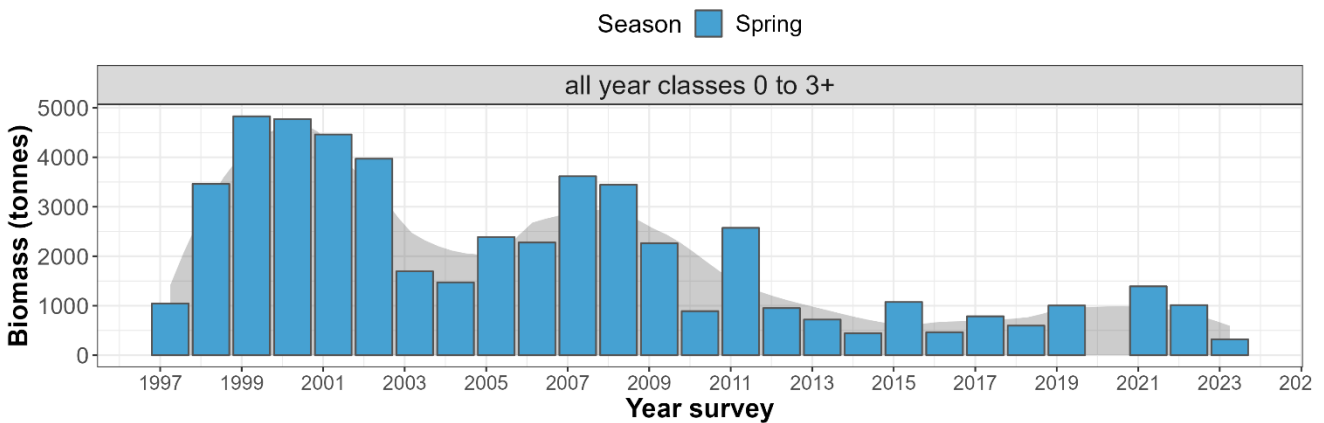
Figure 16: Mean cockle densities & total stock biomass in area 7 - Dengie Flats, 1997-2023

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

Cockle density for area: 7 Buxey
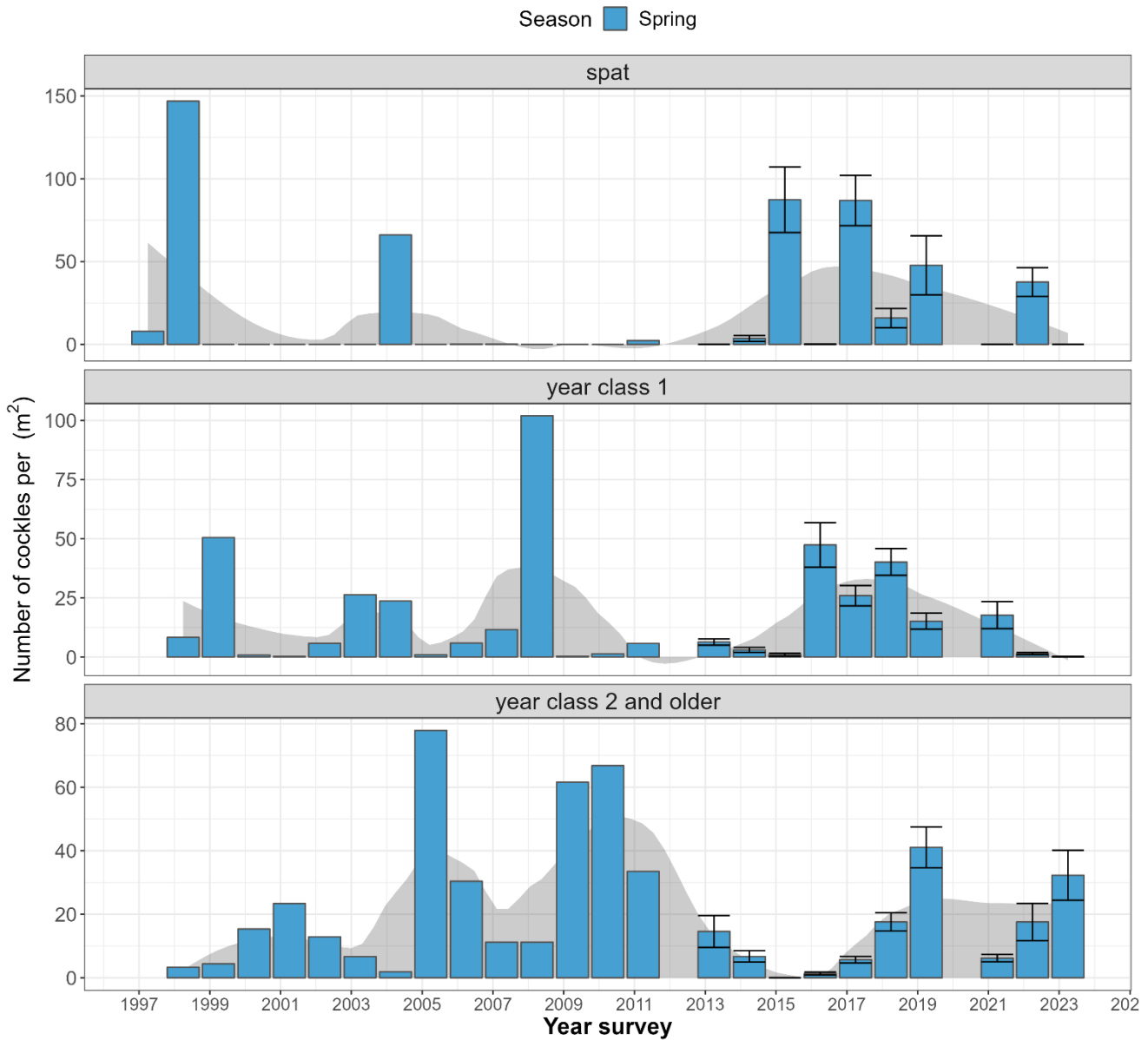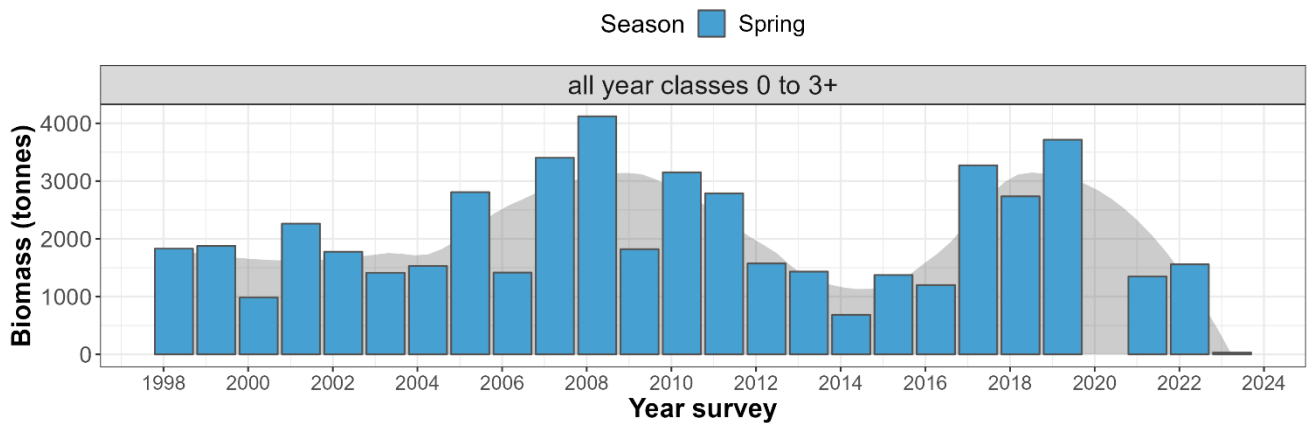

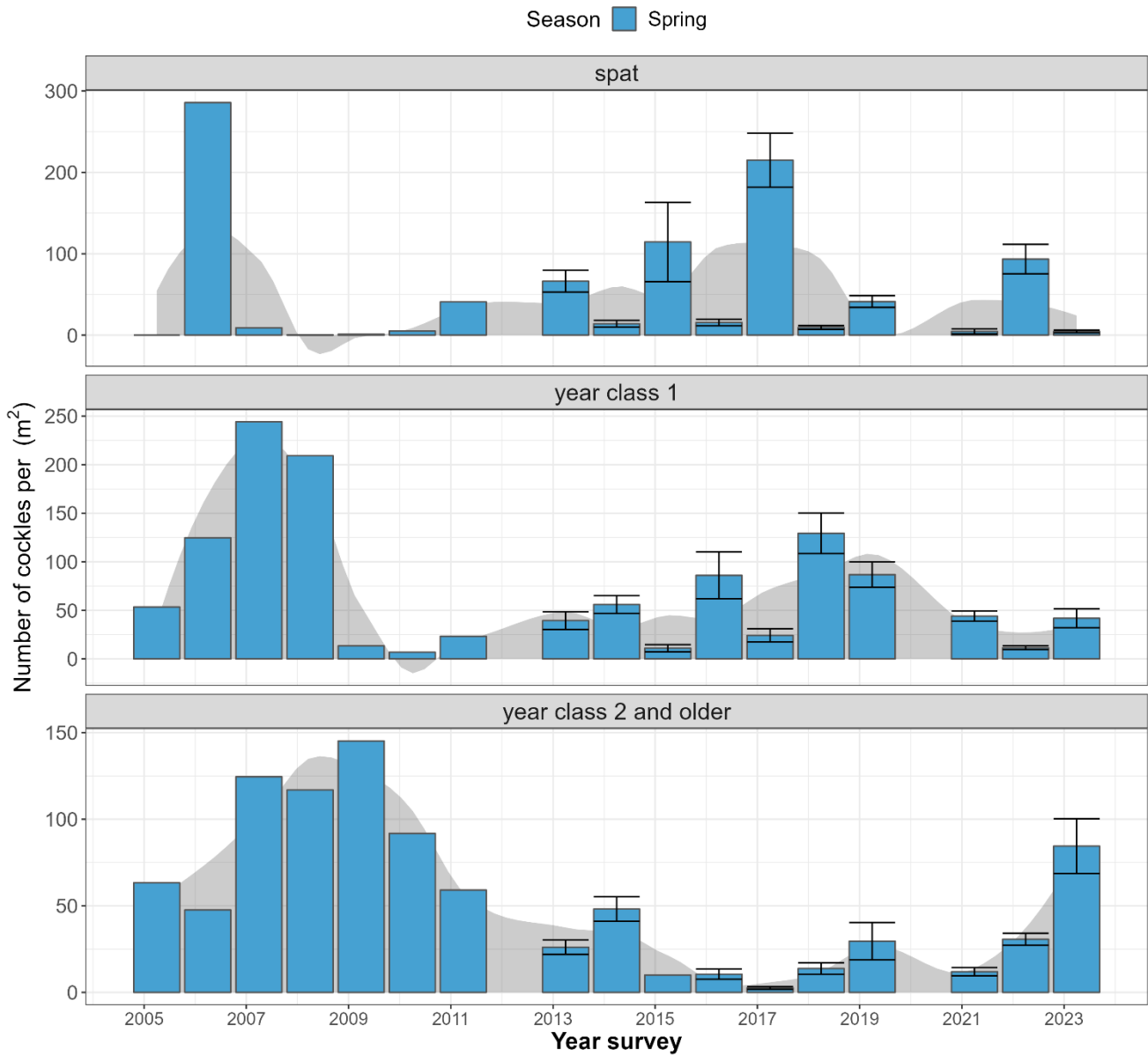### Cockle biomass for area: 7 Buxey

Figure 17: 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

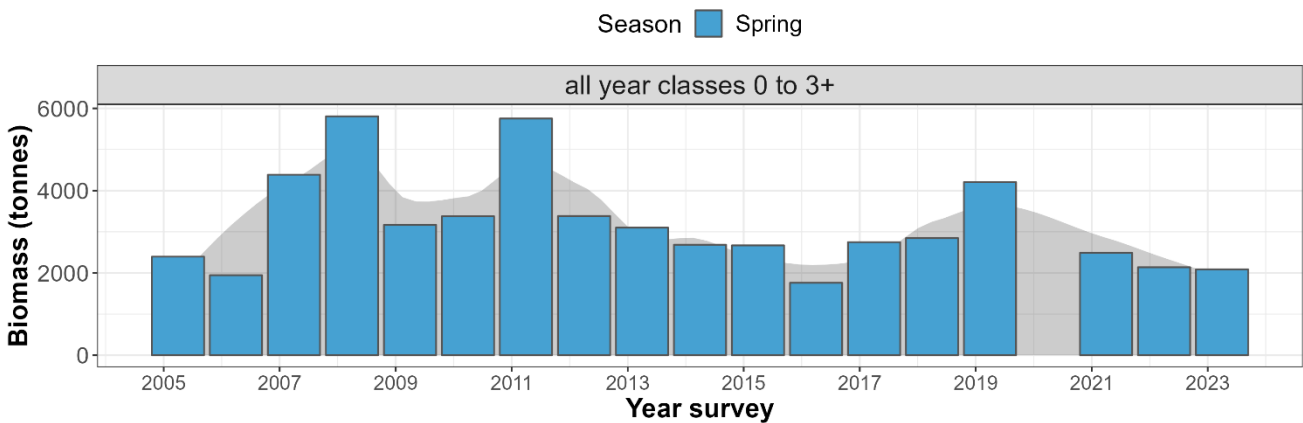### Cockle biomass for area: 7 Ray

Figure 18: Mean cockle densities & total stock biomass in area 7 - Ray Sand, 2005-2022

4 CONCLUSION

4.1   Summary of results

A total area of 255.2 km² was surveyed during spring and 56.2 km² in autumn of 2023, with a total of 1410 samples collected. On the Maplin and Foulness Sands (Areas 4, 5 & 6), constituting the main commercial harvesting areas, a total of 620 samples were taken, comprising 418 from the Spring survey and 202 from the autumn survey. This survey effort is comparable to previous years.

In Areas 4-6 (subsample of main beds), we estimate 5146.9 million cockles in spring 2023 and 6786.0 million by autumn, indicating approximately a 31% increase. This follows 2022, where there was a recorded increase of 46%, and in 2021, when a 19% increase was observed from a spring stock size of 5903 million cockles to 7052 million by autumn in the same area. This contrasts with 2020, when there was an 18% decline, transitioning from 10497 million cockles during spring to 8635.3 million by autumn. In 2023, cockle populations showed signs of stabilizing and indicated growth in numbers and biomass, allaying concerns arising from the decline observed in 2022, when biomass of cockles above 16 mm in the core subset of the main harvesting areas was 8879.1 tonnes during spring but decreased to 6233.0 tonnes by autumn, suggesting a die-off. This decline was unusual and concerning, given the expectation of biomass increase over the summer period; for instance, in 2021, the total biomass in the core subset of the main harvesting areas was 8884.4 tonnes during spring and increased to 12285.2 tonnes by autumn. Adult stock and biomass increase from spring to autumn, which is a result of growth over the summer, with the 0–1-year class of cockles from spring growing to reach adult size by autumn of the same year, before winter mortality, as well as biomass accrued over the summer. Conversely, declines are likely due to mortality of adult stock, attributed to environmental and fishing pressures. As indicated by data for individual areas, in 2022, lower than average growth occurred, possibly coupled with mortality of larger cockles in older year classes. We recorded a coincident mass whelk mortality event in 2022 on the Kent North coast, following an extended marine heatwave. It remains uncertain the role of this heat wave in cockle survival.

Cockle spat numbers in 2023 was relatively high (8926 million), above the long-term average (3882 million ± 2803 (s.d.)), and in contrast to 2022 when we estimated only 2031.5 million spat, making 2023 more similar to autumn of 2021 when we estimated 6954 million individuals. Spatfall can be highly irregular between years, as shown in Figure 10. 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 low levels of spat in 2022, poor summer survivorship, but high winter survivorship meant that the cockle population remained relatively stable in 2023. The high levels of spatfall and growth in 2023 suggest improved conditions. The concerns surrounding the lack of growth and poor survivorship of 2022 have not materialized in lasting long-term damage to the stock in 2023; however, more attention needs to be given to the relationship between hot warm summer temperatures and growth and survivorship of cockles.

4.2   Implications for future management of the fishery

Data from the 2023 cockle survey contribute to a long-term dataset 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.

The cockle stock trends recorded in 2022 and 2023 surveys show a stabilization of adult stock size following two years of sharp declines (2020 and 2021), which in turn followed three exceptionally high-stock-level years (2017–2019). Analysis of the cockle population since surveys commenced in 1998 indicates periodic fluctuations, with typical peaks and troughs. The adult population size on the core subset of the main cockle beds is therefore within the normal range and is considered relatively stable, supporting previous assessments (2021, 2022) suggesting that the population was starting to stabilize after the sharp drop from 2019.

It is worth noting that the timing of the surveys may need to be reviewed and adjusted to earlier in the year. With warming seas, cockles begin to grow earlier in the year; hence, the winter ring and new growth are already visible in April, making cockles appear older than they are by the April spring survey and complicating stock assessment, where aging of cockles plays a vital role. We recommend that spring surveys be conducted during March of each year to align the survey with the warming waters of the Thames Estuary.